Determining the Impact of a New Farm Credit Branch in East Central Oklahoma

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Selected Paper Prepared for presentation at the Southern Agricultural Economics Association's 2015 Annual Meeting, Atlanta, Georgia, January 31-February 3, 2015.

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Abstract

As a major provider of credit to agricultural producers, continuity of business is an important concern for Farm Credit. This study seeks to estimate the change in annual new loan volume that a new Farm Credit branch would generate using county market and spatial characteristics. Annual new loan volume data from Farm Credit of East Central Oklahoma for each of the 51 counties in the region from 1993 to 2012 are regressed against each county's proximity to an office, total cash receipts for crops and livestock, acres rented, and value of agricultural real estate. Results confirm that annual new loan volume is significantly impacted by distance from potential borrowers in the county to the nearest lending office, acres of agricultural land rented, and value of agricultural real estate. Loan volume predictions are used to simulate the impact of additional Farm Credit offices, including offices recently opened. The methodology utilized here allows Farm Credit to predict the financial consequences of opening a new branch, allowing for more profitable branch placement decisions. The existing literature focuses on the effect of credit availability on agricultural production and lacks specificity and a managerial perspective of the effect of producers' characteristics on the success of the Farm Credit System. In contrast, this research offers detailed insight into the profitability of additional offices in East Central Oklahoma.

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INTRODUCTION

The availability of capital is a substantial concern for all farm operators, but for small family farms the issue is paramount. In 2007, 84.7% of farms in Oklahoma were family-owned and operated sole proprietorships (USDA NASS, 2014). Family farms are typically financed through owner equity as opposed to corporate shareholders or stock investors. To supplement owner equity, producers may also hold debt in order to finance operating costs and equipment purchases. Often, the debt of a family farm is secured by real estate that includes the family's home. The foreclosure of this real estate would mean much more than simply the loss of business assets. Thus, it is important for these types of borrowers to have access to affordable, reliable credit to finance their operations. There are several options for financing farms including commercial banks, credit unions, and personal lending. However, not all lending institutions offer products that are specifically designed for a seasonal payoff structure. Additionally, many retail lending institutions perceive some aspects of agricultural production as higher in risk than other small businesses. Operational lines of credit for a farm can be secured by the actual livestock or crops during the production process. The idea of loans secured by living collateral may be perceived as more risky to a lending institution that does not typically lend for agricultural purposes. With small farms especially, credit may be offered but at a higher rate than would be offered to a non-farm business (Bard et al., 2000). The Farm Credit System provides an agriculturally specialized, nationally covered, borrower-owned financial solution specifically tailored to farmers' needs.

The Farm Credit System is a vital source of credit for farmers and producers in America. Since its formation in 1916 as a network of a dozen Federal Land Banks, Farm Credit has evolved from a much-needed solution to an industry threatening credit shortage to a rapidly growing cooperative of 78 local associations and four Farm Credit banks (Farm Credit Network, 2014). Today, nearly one third of rural American's financing needs are met by the Farm Credit System (Farm Credit of East Central Oklahoma, 2014). Providing reliable credit at competitive rates is part of Farm Credit's mission of serving American agriculture. Assessing the optimal locations of the branches that make up this system is the foundation of this research.

The location and availability of credit suppliers are important to the profitability of agricultural producers in the surrounding areas (Ciaian and Falkowski, 2012). According to Briggeman et al. (2009), an increase in capital availability could increase agricultural production and profit. Conversely, market demographics in an area are important to the profitability and success of the Farm Credit System. Operation characteristics may dictate the credit needs of a particular region. The relative location of Farm Credit branches to a specific location can be indicative of the credit availability to the region. This leads to questions regarding how agricultural market dynamics and proximity to a Farm Credit lender affect new loan volume of the Farm Credit system. Further, as a major provider of credit to farmers and operators, continuity of business is an extremely important concern for Farm Credit. Farm Credit of East Central Oklahoma has added two branches in the last 20 years. The decision of new branch location was based on the success of field offices currently in those locations and gaps in market coverage (Sutterfield and Burk, 2014). There is no procedure in place to determine the optimal location of a new branch in a new location. The addition of a new branch could potentially benefit producers in the area by decreasing transportation cost and making Farm Credit a more

convenient source of credit. However, if the additional loan volume the branch would generate does not exceed the cost of building and operating the branch, it is economically inefficient and will result in profit loss.

The subject of this research is Farm Credit of East Central Oklahoma (FCECO). The objective of this study is to estimate the change in annual new loan volume that a new lending office (branch or field office) would generate. Specifically, this study models steady-state annual new loan volume of the area affected by the new office and determines the impact on the entire East Central Farm Credit region. Results are used to simulate the impact of adding new Farm Credit offices, including offices recently opened. The methodology utilized here allows Farm Credit to predict the financial consequences of opening a new office, allowing for more profitable branch placement decisions.

Literature Review

The economic impact and financial role of Farm Credit Service has been the subject of much scrutiny since the farm debt crisis in the mid-1980s. Changes in the regulatory environment and subsequent restructuring of Farm Credit prompted research regarding the impact of bank structure and its effect on agricultural banking. Farm Credit's pivotal role in the financing of American production agriculture calls for consideration of credit supply and demand and the factors that determine them. This paper's focus on individual branch loan volume brings to light the importance of borrower-lender relationships in agricultural lending and their possible role in the profitability of both the farmer and lender. The literature reviewed for this study includes relevant research on the Farm Credit System's structure and importance, credit supply and demand and their determinants, and lending relationships. In addition, overviews of the

methodologies used in relevant studies are presented to ascertain the most appropriate model for this project.

The wide range of financing options available to farmers today sets the stage for a competitive market across which cost in terms of interest rate and degree of agricultural specialization can be compared (Barry, 1980). The Farm Credit System in particular offers competitive rates by benefiting from government sponsorship and a cooperative structure. Some have called into question the viability of continuing government sponsorship, since this status is accompanied by greater lending restrictions than Farm Credit would face as a private enterprise (Riemenschneider and Freshwater, 1995). However, Farm Credit's large size and national organization allows it to capture the benefits of scale economies and the ability to specialize in agricultural and rural development lending (Barry, 1980).

A study of the effect of commercial bank structure and borrower characteristics on lending decisions by Bard et al. (2000) utilized a survey to analyze actual responses from agricultural lenders to three case loan applications. Results imply that credit terms are affected more by demand factors such as farm size and structure than by supply-side characteristics such as cost of funds.

To examine the demand-side factors affecting credit terms, Farley and Ellinger (2007) evaluated the effects of borrowers preferences for lenders on borrowers credit decisions. Farley and Ellinger postulated that the profitability of producers could be affected by borrower-lender relationships through cost and customer service benefits. Like Bard et al. (2000), Farley and Ellinger utilized a survey method to ascertain attitude measures such as price sensitivity and borrower loyalty. Results show that Farm Credit Services customers are generally highly price sensitive and less loyal to a particular lender.

Brewer et al. (2014) analyzed borrowers' use of single versus multiple lenders. Farm-level data were obtained from the Kansas Farm Management Association and used to determine how farm characteristics affect the number of lending relationships held. A Poisson regression model was developed with number of lending relationships as a function of the year which the data represents, current ratio, debt-to-asset ratio, age of farm operator, and return on assets for a farm. Results indicated that farmers develop multiple lending relationships as a result of increasing leverage and financial risk.

The availability of credit is crucial to the profitability of agricultural producers and to the productivity of the agricultural sector as a whole. The extent to which credit constraints impact the agricultural industry can be determined by quantifying the effect of such constraints on production. Briggeman et al. (2009) employed a propensity score-matching estimator to determine how credit constraints affect production in both farm and non-farm sole proprietorships. The results of their study suggest that the production of credit constrained sole proprietorships can be significantly lower than those that are not credit constrained. Specifically, credit constrained farm sole proprietorships can face decreases in value of production of approximately $39,000. A similar study by Ciaian and Falkowski (2012) utilized a matching estimator to analyze how farm production, as well as input use, is related to credit availability in the Central and Eastern Europe transition countries. The results of this study indicate that production increases up to 1.9 percent per 1,000 EUR of additional credit. Variable input and capital investments are also increased by additional credit: 2.3 and 29 percent, respectively.

Ahrendsen et al. (1994) determined factors affecting agricultural credit supply in Arkansas commercial banks and identified characteristics that were important to lenders' portfolio decisions, loan funds availability, and loan market size. Risk of farm business income

(the creditors' risk aversion), growth in number of farms relative to total population growth, number of banks in the county, and metropolitan status all had a significant impact on agricultural loan-to-deposit ratios at the 0.05 level. Loan market size analysis reveals that the value of farmland and property values had a positive significant impact at the 0.01 level. The implication of this result is that higher land values increase the agricultural loans outstanding. This is somewhat intuitive, since farmland is very commonly used as collateral, creating the opportunity for higher value loans.

Katchova (2005) analyzed factors affecting agricultural loan demand. Katchova determined that farm size, government payments, crop insurance, diversification, land ownership, farm structure, and operator age all impact credit use. Degree of indebtedness is impacted by fewer factors; most importantly, gross farm income and operator age. Degree of consolidation is impacted by gross farm income, crop insurance, and interest rate. The study concludes that higher gross farm income, operator age, and operators risk aversion (indicated by crop insurance use) all affect indebtedness. The relevant implication here is that farmers who own a higher proportion of their farmland are more likely to carry debt than those that rent land for farm use.

A model of bank branch placement similar to the model in this study was used by Scaletta and Stokes (2003). To determine the optimum number, size, and location of branch locations from a managerial perspective, Scaletta and Stokes assessed three Pennsylvania Agricultural Credit Associations that had recently merged into a single system, AgChoice Farm Credit (ACA). A model was developed using the ACA's loan volume data prior to the merger to serve both motives of an Ag Credit system: profit-maximization and service-maximization. Solutions from the model identified the optimal configuration of the AgChoice Farm Credit

system in terms of location and number of branches, personnel at each branch, and loan volume of each branch as well as the entire system. The total loan volume estimated by the model, $505.6 million, was very comparable to actual total loan volume of AgChoice in 1999, $528.5 million.

The spatial modelling techniques used in this study are similar to those used by Roe, Irwin, and Sharp (2002) in their model of the spatial structure of hog production. Changes in the swine industry, including a movement to large-scale, specialized production units and increased vertical coordination, caused a spatial reorganization of hog production in the U.S. Roe, Irwin, and Sharp look at the effects of spatial concentration, urban encroachment and population characteristics, input availability, firm productivity and specialization, local economic conditions, market access and regulatory stringency variables on hog production location. The effects of these variables are considered on three different aspects of hog population: per county hog inventory in 1997, the change in per county hog inventory from 1992 to 1997, and hog inventory per farm in 1997. These three models account for production, change in production, and production intensity, respectively. The results of the study vary by region and model, but in general, industry infrastructure (as indicated by a spatial lag) positively and significantly increases the likelihood of hog production activity. The authors conclude that counties may hold some power in determining future levels of hog production through policies that affect tax rate and environmental regulations in the western counties, and human population levels and building activity in the eastern counties.

Theoretical Model

The addition of a new Farm Credit branch or field office in East Central Oklahoma is expected to increase the annual new loan volume of FCECO by increasing convenience to

borrowers through lower transportation costs and opportunity costs. It is hypothesized that annual new loan volume of FCECO in a particular county is a function of the county's proximity to an office, total cash receipts for crops, total cash receipts for livestock, acres rented, and value of agricultural real estate. The estimated effects of each variable are discussed below.

Behavioral Model

It is assumed that producers minimize costs of obtaining financing. Financing costs inherent to producers' financing decisions include interest rates, transportation costs, creditor fees, and search costs, among several others. The objective function for minimizing cost of borrowing can be expressed as

$$\min_{B_i \epsilon B} COB = COB(rate(B), dist(B), fees(B), Other(B)) \quad (2)$$

where *COB* is the cost to a producer of borrowing capital; *rate(B)* are interest rates available at various banks; *dist(B)* are the distances from the borrower to various banks, *fees(B)* are the fees that a borrower would pay at the various banks; and *Other(B)* are other factors (e.g., search costs) affecting borrow costs. By solving (2) for the optimal B_i individual borrowers' demand for loans for each bank in set *B* can be derived. The sum of all borrowers' derived demand within a county will equal the county derived demand for borrowing at bank *i*.

Suppose a farmer in a particular county currently has to drive over an hour to the nearest Farm Credit office. This would presumably discourage the farmer from using Farm Credit for their financing needs by increasing both transportation and search costs. Now suppose a new office is placed within 10 minutes of the farmer. If the farmer was not using Farm Credit because of the inconvenience, expense of the traveling distance and visibility, he/she is now more likely to use Farm Credit for future credit needs. It is expected that the distance between offices and potential borrowers plays a significant role in the loan volume of a branch. The distance from the

centroid of a county to the nearest branch or field office is used as a proxy for the average distance from farmers in the county to a lending office. Distance between the centroid of a county and a lending office is expected to be negatively related to loan volume for that county. That is, the shorter the distance, the greater the predicted loan volume. This hypothesis is supported by Farley and Ellinger (2007) who found that farmers who obtain credit from Farm Credit Services tend to be highly price sensitive. It is reasonable to assume Farm Credit borrowers would also be sensitive to other costs related to borrowing, including the cost of transportation and search for credit providers to a distant branch.

Although distance is the variable of interest in this paper, other factors may also affect the loan volume of FCECO. In order to more accurately estimate loan volume, this study also considers market and demographic variables that affect the credit needs of producers in each county. These factors include cash receipts for crops and livestock, acres rented, and value of agricultural real estate. Each is discussed below.

Cash Receipts for Crops and Livestock

Because farming requires significant cash investment with delayed income, operating lines of credit are often taken by farmers to pay for costs such as planting and harvesting for a crop farm, and purchasing and feeding, for a livestock operation. Operating notes are then paid by the income from operations. Cash receipts are used to measure the income of a farm. As a firm receives additional income, their need for credit to finance operations may decrease. However, larger farms may have higher financing requirements. So, in net, the impact cannot be signed *a priori*.

Acres Rented

In Katchova (2005) analysis of factors affected credit use, it was found that if rural resident farmers own a higher proportion of their farmland, they are more likely to carry farm debt. Conversely, if farmers rent land rather than own it, they have no need for real-estate loans, which are typically larger than operating and machinery loans. So, acres rented is expected to be negatively related to predicted loan volume.

Value of Agricultural Real Estate

The greatest credit requirement of farmers is the purchase of land, which is often also the most valuable asset a farmer owns. Ahrendsen et al. (1994) found that as farmland and property values increase, agricultural loans outstanding for Arkansas commercial banks also increase. Higher property values allow for higher collateral values, increasing security for lenders and loan amounts for borrowers. This concept is considered through the incorporation of the total value of agricultural real estate (including buildings) in each county. The value of real estate in a county is expected to be positively related to predicted loan volume for that county.

Data

Loan volume data were provided by Farm Credit Services of East Central Oklahoma. The sample included observations (loans) in 51 counties in Oklahoma[1]. Annual new loan amounts for each of the 51 counties in the region from 1993 to 2012 were computed by summing across individual loans. FCECO currently has ten branch offices and 26 field offices. A branch office is defined as an established location with three to five loan officers working full time. A field office is often a single office rented from a local business with one loan officer working on a part-time basis. The market boundary of the East Central Region as well as the locations of the existing

[1] Cleveland County is in the East Central region, but the data did not include any loan volume for this county. It is assumed there was no loan activity in Cleveland County. Alfalfa County loans were included in the original data but there were only two loans in the data and Alfalfa County is not in the East Central (FCECO) territory. So, observations from Alfalfa County were deleted.

branch and field offices including those added in 2012 are represented in Figure 1. All branches excepting the Ardmore and Poteau branches have been open for the entire study time range (Poindexter, 2014). There have been some changes in field office locations during the 20-year time period of this study. In 2004, a field office was opened in Ardmore, OK, in Carter County. In 2010, a field office was opened in Poteau, OK in LeFlore County. In 2011, the field office that was in Tonkawa, OK, (Kay County) was closed and a new office opened in Blackwell, OK, (also in Kay County). The Ardmore and Poteau field offices were open through 2012 until the opening of the new branches in these locations in 2013, which is outside the time range of this study. All changes in location through time are reflected in the distance variables. County-level market characteristics used to predict loan volume are represented by the total annual cash receipts for crops and livestock, acres of agricultural land rented from others, value of agricultural real estate per acre, and operator age. Acres rented and value of agricultural real estate were obtained from USDA's National Agricultural Statistics Service, and cash receipts for crops and livestock were obtained directly from the Bureau of Economic Analysis regional data on farm income and expenses. The change in value of money over time is accounted for by adjusting all dollar variables to 2012 dollars using the unadjusted annual Producer Price Index for farm products (Bureau of Labor Statistics, 2014).

Distance measures were obtained through ArcMap10.1 (ESRI, 2012) by determining the distance in miles from the centroid of each county in the region to the nearest existing branch or field office.[2] Explanatory variables also included farm income and land value and tenure measures for each county, which are hypothesized to be important factors in predicting loan

[2] Addresses were geocoded for use in ArcMap10 and most were successfully identified. However, the addresses of the Vinita and Kingfisher branches did not exactly match any address recognized by ArcMap10. For these branches, the centroid of the town was used.

volume. The data provided by FCECO were at the individual loan level. The specific data used for this study included the date the loan was opened, the original amount, and the county in which the borrowers address resides. Annual new loan volume is calculated as the sum of new loans across borrowers by year and county. Loan volume is predicted as a function of distances, cash receipts from crops and livestock, acres rented, and value of agricultural real estate.

Table 1 presents descriptive statistics of each variable. Total new loan volumes by county range from zero to over $22 million, with a county annual average of $1.8 million. On average, the closest branch is 30.5 miles from the centroid of a county, and is within a range of two to nearly 80 miles. The larger number of field offices implies that they are generally more available to borrowers, confirmed by an average distance of 16 miles and a range from less than one to 42 miles. The sample mean of cash receipts for crops and livestock is $77.7 million and is within a range of $11 million to nearly $320 million. The average acres rented and value of agricultural real estate are 103,541 acres and $576 million, respectively. Because of the very large size of the market demographic variables relative to the distance variables, all variables are scaled appropriately, as described in the variable descriptions below.

Empirical Model

The equation used to estimate the effects of branch location, producer cash flows, land ownership, and real estate values on loan volume has the following functional form:

$$(1) \qquad LV_{it} = \beta_0 + \beta_1 D1_i + \beta_2 D2_i + \beta_3 LV1_{it-1} + \beta_4 CASH_{it} + \beta_5 RENT_{it} + \beta_6 VAL_{it} + \sum_{j=0}^{18} \beta_{7+j} Yr_j + e_{it}$$

where $i \in \{1,.., 51\}$ denotes county; $t \in \{1993,\ldots, 2012\}$ denotes year; LV_{it} denotes total new loan volume (2012 $10M) for county i in year t; $D1_i$ denotes distance from center of county i to the nearest branch (natural log of miles); $D2_i$ denotes distance from center of county i to the nearest

field office (natural log of miles); $LV1_{it-1}$ denotes the total new loan volume (2012 $10M) for county *i* in year *t-1*; $CASH_{it}$ denotes the sum of total cash receipts for crops and total cash receipts for livestock (natural log of 2012 dollars) in county *i* in year *t*; $RENT_{it}$ denotes agricultural land rented from others (millions of acres in county *i* in year *t*; VAL_{it} denotes value of agricultural real estate including buildings (2012 $Billions) in county *i* in year *t*; $YR_t \in \{0,1\}$ is a binary variable indicating the year of each observation $t \in \{1994,\ldots,2011\}$; and e_{it} is an error term.

A Linear-Log functional form allows for the relationship of loan volume to distance to decrease at a decreasing rate[3]. Binary variables are included for each year to capture any variability due to time.

The wide range and uneven distribution of observed values of loan volume is likely a source of heteroscedasticity. Because real estate loans can be high in relation to operational loans, a county may have few loans but a relatively high loan volume if they are real estate loans. A plot of the residuals against predicted values reveals that residuals increase as predicted loan volume increases. In addition, the Breush-Pagan test revealed heteroscedasticity is caused by the market variables: *CASH*, *RENT*, and *VAL*. By estimating variance as a function of the variables known to cause the heterescedasticity, homoscedasticity can be obtained (Greene, 1997). Thus, the model for variance is estimated as follows:

$$(2) \qquad \hat{S}^2 = V_0 + V_1\beta_3 + V_2\beta_4 + V_3\beta_5 + V_4\beta_6$$

where β_3 is the relationship between $LV_{it-1}$and estimated loan volume; β_4 is the relationship between $CASH_{it}$ and estimated loan volume; β_5 is the relationship between $RENT_{it}$ and estimated

[3] Linear and quadratic models produced very similar regression estimates.

loan volume; and β_6 is the relationship between VAL_{it} and estimated loan volume. Using $\hat{S}^2$ as a measure of the true variance allows for homoscedasticity in the empirical model.

The model for predicting loan volume was estimated using the PROC NLMIXED procedure in SAS (SAS Institute Inc., 2012), which is a non-linear maximum likelihood estimation method. Variance Inflation Factors are determined for each variable to test for multicollinearity. A VIF greater than five indicates a multicollinearity problem with a variable (Neter et al., 1989). Since all variables had VIF values less than five and the correlation matrix did not reveal any covariance greater than 0.8, no further action was taken to correct for multicollinearity.

Regression Results

Parameter estimates are presented in Table 2. Standard errors, p-values, and test statistics are also reported. All variables except the year dummies, the intercept, and CASH are significantly different from zero at $p \leq 0.05$, with distance to the nearest branch, lagged loan volume, and value of agricultural real estate significant at $p \leq 0.01$. Results of the variance estimation equation are presented in Table 3, as well as the standard errors, p-values, and test statistics for these coefficients.

The regression coefficients for the distance from the centroid of county *i* to both the nearest branch (*D1*) and nearest field office (*D2*) are negative and statistically significant. This implies that as the travel distance for customers in county *i* increases, new loan volume for county *i* decreases. These results confirm the hypothesis that adding a new office will increase the new loan volume of the surrounding counties as well as for the entire FCECO region.

The regression coefficient for cash receipts for crops (*CASH*) is not statistically significant. The insignificance of this seemingly important variable is possibly due to the

offsetting effects of the variable. High cash receipts could indicate higher sales prices reducing credit needs, but also higher replacement cost of breeding livestock. Additionally, larger farms may receive high crop income and may not need operating notes, but have high financing requirements for equipment and land.

The regression coefficient for acres rented (*RENT*) is negative and significant, confirming the hypothesis that if more acres in county *i* are rented, there will be fewer real estate loans, decreasing loan volume for county *i*. Conversely, if more acres in a county are owned, FCECO is likely to capture more loan volume through land purchases. These results are similar to those in Katchova (2005).

The regression coefficient for value of agricultural real estate (*VAL*) is positive and significant, indicating that a county with high real estate values will also have high new loan volume. This confirms the hypothesis that higher real estate values increase new loan volume through higher collateral values and increased security for FCECO.

The regression coefficient for lagged loan volume (*LV1*) is positive and significant. This implies that a county that had high new loan volume in the previous year will also have high new loan volume in the current year.

The binary annual dummy variables are included in the model to account for any variability due to time. However, by adjusting all dollar variables to real 2012 dollars, much of the variability is eliminated. The dummy variables serve, then, to capture any other variability that may be due to the entrance and exit of competitors in the market or other changes in the market environment across time. The general insignificance of the annual dummies indicates that little variability is captured through their inclusion.

All variables that were expected to cause heteroscedasticity within the model were significant to the variance estimation model at $p \leq 0.01$ and positively related to estimated variance.

Marginal Effects

The actual coefficients produced from the regression are difficult to interpret other than in sign due to scaling. Significant parameters are interpreted into actual marginal effects of a one unit (acre or dollar) change in the market variable on loan volume. Results for the linear variables are reported in Table 4. As an example, for every acre rented in a county, loan volume in that county decreases by $3.10. For every dollar of farm real estate assets, loan volume increases by $0.0018 or $1.80 per $1,000 of real estate value. The interpretation of the variables that were in natural log form (the distance variables) is more complex. The derivative of estimated loan volume with respect to the variable x is the parameter β divided by the variable x at a specific point. Table 5 illustrates this change in marginal effect at several levels of distance for both *D1* and *D2*. Because of the natural logarithm formulation, the impact of distance variables decreases at a decreasing rate. For example, if a new branch office were added one mile from the county centroid, new loan volume is expected to increase by $310,000 but if it is 10 miles away, the new volume is expected to increase by $31,000.

Predictions

To determine the change in the new loan volume of FCECO that is caused by an additional lending office, predictions are estimated for 19 counterfactual offices. Counterfactual offices are placed in the town centroid of the county seat of each county that did not already have a branch or a field office as of 2012. In addition, counterfactual branches are placed in Ardmore and Poteau, to compare FCECO's decisions to the results of this model. The Ardmore and

Poteau counterfactual locations were treated only as branch offices, but all other locations were treated once as a branch and once as a field office. Each of the 21 counterfactual branches and 19 counterfactual field offices are added individually to determine the isolated impact of each office. All predictions are made as in 2012 dollars, assuming the existing office locations and demographic information in that year. Since the predictions are made at a single point in time, the only variables that change given the addition of a branch are the distance variables. Further, the addition of a branch office in a particular county will only affect the distance variables in that county and some of the surrounding counties. Predictions are made for each county affected by the new branch. The change in loan volume before and after the new branch for each affected county is summed to determine the total marginal impact of the new branch on FCECO. The same procedure is applied assuming the counterfactuals are field offices rather than branches.

The counterfactual predictions producing the top five highest marginal impacts, for branch offices and field offices respectively, are presented in Tables 6 and 7. The initial estimate prior to the addition of the counterfactual branch is reported for each county affected as well as the total estimates for the entire FCECO region. The new estimates for the entire region after the addition of the new branch are reported for each counterfactual branch. The change in loan volume is calculated for both the counties affected and the entire region. Additionally, confidence intervals around the marginal impacts are reported. These confidence intervals are calculated using the coefficient and standard errors of the D1 and D2 variables for the branch and field office counterfactuals respectively. To determine if the region-wide estimates of annual new loan volume were realistic, model estimates are compared to the Association's 2014 New Loan Volume Target (Farm Credit of East Central Oklahoma, 2014). The Association's new loan goal for 2014 is $105 Million. This target includes the Ardmore and Poteau branches and is two

years after the data used to here to simulate new loan volume. Given this, our estimate of annual new loan volume of $93 Million seems reasonable.

CONCLUSIONS

The results of this study suggest that FCECO can utilize market and spatial datasets to increase loan volume by selective branch placement. Although Ardmore and Poteau were not one of the top five impacting counterfactual offices, the branch placement decisions recently made by FCECO align with the results of the distance and lagged loan volume variables. The Ardmore branch was built because the existing field office was highly productive (Sutterfield and Burk, 2014). It was assumed that the high loan volume of the field office was indicative of high loan volume in the following years. This is confirmed by the positive coefficient for lagged loan volume. The Poteau branch was added because there was a gap in the market coverage in that area that was being encroached upon by competitors (Sutterfield and Burk, 2014). By placing a new branch in Poteau, the transportation costs to borrowers in that area is reduced, and loan volume for Le Flore, Haskell, and Sequoyah counties is predicted to increase. This decision is supported by the results of the distance variables.

The branches added in 2012 may not be one of the top five impacting branches because there were already field offices in these locations for some or all of the relevant time period. The marginal impact on loan volume of adding a branch in these locations is not as great as a location without any Farm Credit presence. The loan volume in Carter and Le Flore counties was already being captured by the existing field offices, so replacing the field offices with branches did not produce the full marginal impact that it would have if the branch were added in a location with no existing offices. The implications of this study suggest that FCECO could maximize the marginal impact of an added branch or field office by placing new offices in areas with high crop

and livestock income, low acres of land rented (or high land ownership), high value of agricultural real estate, and areas that are long distances from existing offices.

Note that the change in total loan volume for the top 5 branches is over $1.1M in all cases, and is over $240K for the top 5 field offices. These values can be used for comparison purposes when evaluating the cost of setting up and operating a new Farm Credit location. If the costs are expected to exceed the profits associated with the change in loan volume, opening a new branch or office in that area does not make economic sense.

REFERENCES

Ahrendsen, B.L., Dixon, B.L. and Priyanti, A. (1994), "Growth in agricultural loan market share for Arkansas commercial banks." *Journal of Agricultural and Applied Economics* 26:430-430.

ESRI (2012), ARCMap 10.1, Redlands, CA.

Bard, S.K., Barry, P.J., and Ellinger, P.N. (2000), "Effects of commercial bank structure and other characteristics on agricultural lending." *Agricultural Finance Review* 60:17-31.

Barry, P.J. (1980), "Prospective trends in farm credit and fund availability: implications for agricultural banking." In proceedings of the Future Sources of Loanable Funds for Agricultural Banks, a symposium sponsored by Federal Reserve Bank of Kansas City 1980, pp. 13-59.

Brewer, B.E., Wilson, C.A. Featherstone, A.M., and Langemeier, M.R. (2014), "Multiple vs single lending relationships in the agricultural sector." *Agricultural Finance Review* 74:55-68.

Briggeman, B.C., Towe, C.A., and Morehart, M.J. (2009), "Credit constraints: their existence, determinants, and implications for US farm and nonfarm sole proprietorships." *American Journal of Agricultural Economics* 91:275-289.

Ciaian, P., and Falkowski, J. (2012), "Access to credit, factor allocation and farm productivity: Evidence from the CEE transition economies." *Agricultural Finance Review* 72:22-47.

ESRI (Environmental Systems Resource Institute) (2012), ArcMap 10.1. ESRI, Redlands, California.

Farley, T.A. and Ellinger, P.N., (2007), "Factors influencing borrowers' preferences for lenders." *Agricultural Finance Review* 67:211-223.

Farm Credit of East Central Oklahoma (2014), Available at http://www.farmcreditecok.com/index.cfm?id=2 (Accessed 09 September 2014).

Farm Credit of East Central Oklahoma. Annual Business Plan. 2014. Broken Arrow, Oklahoma.

Farm Credit Network (2014), Available at http://www.farmcreditnetwork.com/about (Accessed 09 September 2014).

Greene, W.H. (1997), Econometric Analysis, Third Edition, Prentice Hall, Upper Saddle River, New Jersey.

Katchova, A.L. (2005), "Factors affecting farm credit use." *Agricultural Finance Review* 65:17-29.

Neter, J., Wasserman, W., and Kutner, M.H. (1989), "Applied linear regression models," Columbus, OH: McGraw-Hill/Irwin, pp. 408-410.

Poindexter, J. (2014), Personal Communication, 10 June 2014.

Riemenschneider, C.H. and Freshwater, M.H. (1995), "Is a revised mandate for the US farm credit system needed?" *Agribusiness* 11:291-296.

Roe, B., Sharp, E.G., and Sharp, J.S. (2002), "Pigs in space: Modeling the spatial structure of hog production in traditional and nontraditional production areas." *American Journal of Agricultural Economics* 84(2): 259-278.

SAS Institute Inc (2012), SAS Enterprise Guide 5.1., SAS Institute Inc., Cary, North Carolina.

Scaletta, T.M. and Stokes, J.R. (2003), "Optimal Agricultural Credit Association Branch Office Locations." *Journal of Agricultural and Applied Economics* 35.

Sutterfield, J. and Burk, J. (2014), Personal Communication, 03 October 2014.

US Department of Commerce Bureau of Labor Statistics (2014), Producer Price Index Commodity Data. Retrieved on July 25, 2014 Available at http://data.bls.gov/cgi-bin/dsrv (Accessed 25 July 2014)

US Department of Agriculture National Agricultural Statistics Service (2014), Available at http://quickstats.nass.usda.gov/ (Accessed 30 January 2014).

Table 1. Descriptive Statistics for Dependent and Independent Variables

Variable	Mean	Std. Dev.	Minimum	Maximum
LV ($M)*	$1.8	$2.2	0	$22.0
DB (miles)	30.5	15.3	2.0	78.1
DFO (miles)	15.5	10.8	0.1	41.6
CASH ($M)	77.7	59.8	10.7	319.9
RENT (1,000 acres)	104	60	24	396
VAL ($100M)	$5.8	$2.3	$1.5	$18.0
LV1 ($M)	$1.7	$2.2	0	$22.0

* LV is annual new loan volume for county *i*; *DB* is the distance from the centroid of county *i* to the nearest branch; *DFO* is the distance from the centroid of county *i* to the nearest field office; *CASH* is the sum of total cash receipts for crops and total cash receipts for livestock in county i; *RENT* is the total acres rented in county *i*; *VAL* is the total value of agricultural real estate in county *i*; and *LV1* is annual new loan volume for county *i* in year *t-1*.

Table 2. Regression Results for Loan Volume Estimation Equation

Variable	Coefficient	Standard Error	Test Statistic	Pr > |t|
Intercept	0.23	0.20	1.13	0.26
D1	-0.31***	0.10	-3.08	<0.01
D2	-0.14**	0.06	-2.42	0.02
LV1	0.22***	0.03	6.94	<0.01
CASH	-0.01	0.12	-0.06	0.95
RENT	-0.31**	0.15	-2.1	0.04
VAL	0.18***	0.05	3.21	<0.01
Y94	-0.01	0.04	-0.27	0.79
Y95	-0.04	0.04	-0.92	0.36
Y96	0.03	0.04	0.66	0.51
Y97	-0.05	0.04	-1.22	0.22
Y98	0.00	0.04	0.08	0.94
Y99	-0.05	0.04	-1.2	0.23
Y00	-0.06	0.04	-1.4	0.16
Y01	0.04	0.04	1.05	0.29
Y02	0.04	0.04	0.92	0.36
Y03	0.03	0.04	0.73	0.46
Y04	-0.04	0.04	-0.94	0.35
Y05	0.01	0.04	0.15	0.88
Y06	-0.05	0.04	-1.17	0.24
Y07	0.03	0.04	0.84	0.40
Y08	0.06	0.04	1.56	0.12
Y09	-0.01	0.04	-0.31	0.76
Y10	-0.04	0.04	-0.9	0.37
Y11	-0.02	0.04	-0.51	0.61

*Significant at $p \leq 0.10$. **Significant at $p \leq 0.05$. ***Significant at $p \leq 0.01$.

Note: *D1* is the natural log of the distance from the centroid of county *i* to the nearest branch; *D2* is the natural log of the distance from the centroid of county *i* to the nearest field office; *CASH* is the natural log of the sum of total cash receipts for crops and total cash receipts for livestock in county *i*.; *RENT* is the total acres rented in county *i*.; *VAL* is the total value of agricultural real estate in county *i*.; *LV1* is annual new loan volume for county *i* in year *t-1*; and Y_t is a binary variable indicating the year of the observation $t \in \{1994, \ldots, 2011\}$.

Table 3. Regression Results for Variance Estimation Equation

Variable	Coefficient	SE	Test Statistic	Pr > |t|
Intercept	0.00	0.09	-0.04	0.96
LV1	0.75***	0.02	37.36	<0.01
CASH	0.62***	0.00	654.50	<0.01
RENT	0.59***	0.03	20.91	<0.01
VAL	0.38***	0.02	23.79	<0.01

***Significant at $p \leq 0.01$;

Note: *CASHC* is total cash receipts for crops in county *i*; *RENT* is the total acres rented in county *i*; *VAL* is the total value of agricultural real estate in county *i*; and *LV1* is annual new loan volume for county *i* in year *t-1*.

Table 4. Marginal Effects of Significant Linear Market Variables

Variable	Marginal Effect	Pr > |t|
RENT	-3.10	0.04
VAL	0.0018	<0.01
LV1	0.22	<0.01

Table 5. Marginal Effects of Distance Variables

Miles	Marginal Effect ($)	
	D1	*D2*
1	310,000	140,000
2	155,000	70,000
…		
10	31,000	14,000
20	15,500	7,000
…		
90	3,444	1,556
100	3,100	1,400

Table 6. Prediction Results for Top Five Impacting Branch Counterfactuals

New Branch	Counties Affected	Initial Estimate	New Estimate	Confidence Intervals α=.05 Lower Bound	Confidence Intervals α=.05 Upper Bound	Change LV
Bartlesville (Washington Co.)						
	Nowata	$ 1,408,822	$ 1,534,002	$ 45,560	$ 204,798	$ 125,180
	Osage	$ 1,738,066	$ 1,955,527	$ 79,147	$ 355,774	$ 217,461
	Washington	$ 1,289,272	$ 2,145,267	$ 311,549	$ 1,400,442	$ 855,995
	Total	$ 92,854,071	$ 94,052,707	$ 436,257	$ 1,961,014	$ 1,198,636
Hugo (Choctaw Co.)						
	Choctaw	$ 1,492,260	$ 2,423,328	$ 338,873	$ 1,523,263	$ 931,068
	McCurtain	$ 1,173,151	$ 1,361,283	$ 68,473	$ 307,791	$ 188,132
	Pushmataha	$ 918,890	$ 1,018,764	$ 36,350	$ 163,399	$ 99,874
	Total	$ 92,854,071	$ 94,073,146	$ 443,696	$ 1,994,453	$ 1,219,074
Sallisaw (Sequoyah Co.)						
	Adair	$ 1,584,765	$ 1,687,684	$ 37,459	$ 168,380	$ 102,919
	Haskell	$ 1,498,432	$ 1,666,872	$ 61,306	$ 275,574	$ 168,440
	LeFlore	$ 2,022,475	$ 2,155,152	$ 48,289	$ 217,065	$ 132,677
	Sequoyah	$ 1,669,693	$ 2,423,724	$ 274,438	$ 1,233,624	$ 754,031
	Total	$ 92,854,071	$ 94,012,140	$ 421,492	$ 1,894,645	$ 1,158,067
Tahlequah (Cherokee Co.)						
	Adair	$ 1,584,765	$ 1,853,854	$ 97,938	$ 440,241	$ 269,089
	Cherokee	$ 1,700,174	$ 2,606,829	$ 329,987	$ 1,483,321	$ 906,655
	Sequoyah	$ 1,669,693	$ 1,750,934	$ 29,569	$ 132,914	$ 81,241
	Total	$ 92,854,071	$ 94,111,056	$ 457,494	$ 2,056,476	$ 1,256,985
Wewoka (Seminole Co.)						
	Hughes	$ 1,665,710	$ 1,870,203	$ 74,428	$ 334,559	$ 204,493
	Okfuskee	$ 1,587,790	$ 1,817,663	$ 83,665	$ 376,081	$ 229,873
	Pottawatomie	$ 1,551,661	$ 1,655,954	$ 37,958	$ 170,627	$ 104,293
	Seminole	$ 1,435,171	$ 2,028,216	$ 215,845	$ 970,245	$ 593,045
	Total	$ 92,854,071	$ 93,985,775	$ 411,896	$ 1,851,511	$ 1,131,704

Note: LV is annual new loan volume for county *i;* the total of the initial estimates and new estimates are for the entire region before and after the addition of the new branch; and the total change is the estimated impact of the new branch on the entire region and is equal to the sum of the estimated changes on each affected county.

Table 7. Prediction Results for Top Five Impacting Field Office Counterfactuals

				Confidence Intervals α=.05		
New Office	Counties Affected	Initial Estimate	New Estimate	Lower Bound	Upper Bound	Change LV
Bartlesville (Washington Co.)						
	Nowata	$ 1,408,822	$ 1,500,271	$ 17,189	$ 165,708	$ 91,449
	Washington	$ 1,289,272	$ 1,586,165	$ 55,805	$ 537,980	$ 296,893
	Total	$92,854,071	$ 93,242,413	$ 72,994	$ 703,688	$ 388,342
Hugo (Choctaw Co.)						
	Choctaw	$ 1,492,260	$ 1,873,716	$ 71,700	$ 691,211	$ 381,456
	Pushmataha	$ 918,890	$ 925,818	$ 1,302	$ 12,555	$ 6,928
	Total	$92,854,071	$ 93,242,455	$ 73,002	$ 703,766	$ 388,384
Nowata (Nowata Co.)						
	Nowata	$ 1,408,822	$ 1,633,790	$ 42,286	$ 407,650	$ 224,968
	Washington	$ 1,289,272	$ 1,355,899	$ 12,523	$ 120,730	$ 66,627
	Total	$92,854,071	$ 93,145,666	$ 54,809	$ 528,380	$ 291,595
Sallisaw (Sequoyah Co.)						
	Sequoyah	$ 1,669,693	$ 1,914,624	$ 46,038	$ 443,824	$ 244,931
	Total	$92,854,071	$ 93,099,003	$ 46,038	$ 443,824	$ 244,931
Tahlequah (Cherokee Co.)						
	Cherokee	$ 1,700,174	$ 2,079,625	$ 71,323	$ 687,579	$ 379,451
	Total	$92,854,071	$ 93,233,522	$ 71,323	$ 687,579	$ 379,451

Note: LV is annual new loan volume for county *i;* the total of the initial estimates and new estimates are for the entire region before and after the addition of the new field office; and the total change is the estimated impact of the new field office on the entire region and is equal to the sum of the estimated changes on each affected county.

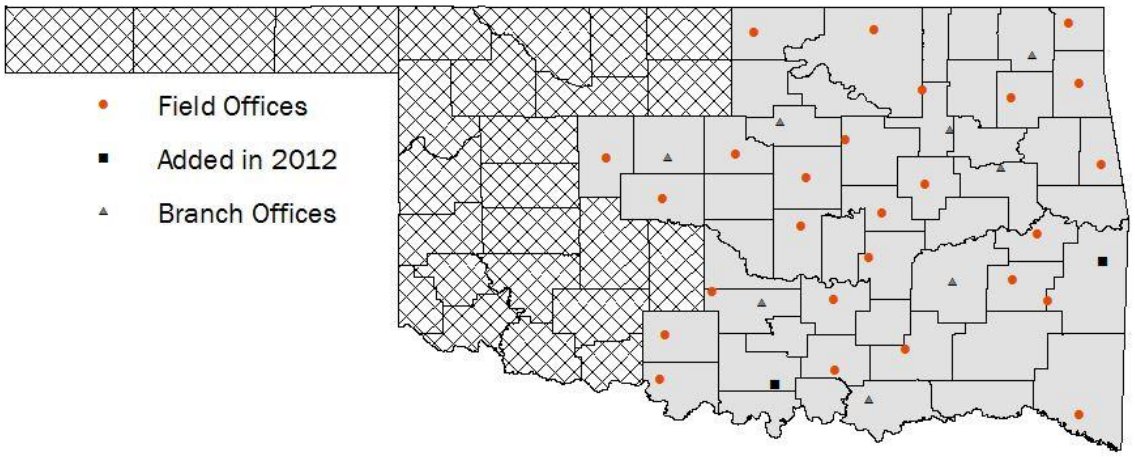

Figure 1. East Central Region and Existing Offices