Explaining Differences in Farm Lending among Banks

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Do small, rural banks lend to farmers because they are small, or because they are rural? This paper combines a new measure of the extent of agricultural activity in banking markets with an appropriate statistical framework to examine causes of interbank variation in agricultural production loans. The results show that a bank's size and head office location both matter to some extent, but that the size of a bank's branches in agricultural areas is the single most important factor determining agricultural loan levels. Other variables, such as ownership structure and charter type, have no significant effects. While far from definitive, the results suggest that industry consolidation and mergers may have little effect on agricultural credit, as long as they do not lead to the outright closure of branches in rural areas.

Banks differ substantially in their agricultural lending. Most banks do none. Banks that *are* agricultural lenders vary in their degree of emphasis, with most doing little but some devoting 50 percent or more of their assets to farm loans. One possible explanation for such variation in the composition of bank loan portfolios is that location matters, especially in farm lending. As an industry, agriculture is notably tied to particular, typically rural, locations. Banks located in such areas might specialize in farm loans, while banks in urban areas might not.[1]

This explanation, while simply stated, is not so simply tested. When is a bank "located" in a farm area? When it has its head office in a farm area, or when it has branches in farm areas? If the latter, *how many* branches must it have in farm areas? And what exactly is meant by a "farm" area? Even given answers to these questions, other complications arise. For example, it is part of banking folklore that small banks are more likely to lend to farmers, all else equal, and rural banks tend to be smaller. Could differences in farm lending by location actually be a size effect? Or could apparent size effects simply be due to differences in bank location?

Answering these questions requires, as a first step, a measure of how "agricultural" a bank's market area is. For banking, a sensible measure of the degree to which a market is "agricultural" is the quantity of farm loans demanded within that area. This paper begins by constructing a proxy for agricultural loan demand within the area served by a bank, based on the geographic distribution and relative size of its branches. As a second step, this paper develops a model of bank agricultural loan decisions consistent with the observation that most banks do no farm lending, and in which

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1. The idea that bank loan portfolios vary by location to reflect the industrial composition of the local market area assumes that proximity matters in lending, that banks have a greater tendency to lend to nearby potential borrowers than to those farther away. Such a tendency might reflect the importance of information for credit analysis and monitoring on the bank's side or convenience-related effects on the borrower's side. However, while these considerations seem reasonable, their empirical importance in bank lending is an open question. A finding that loan portfolios reflect the nature of the local market would provide evidence that these things have an observable effect.

location, size, and other bank characteristics play a role in determining two facets of lending behavior: whether or not a bank becomes involved in agricultural lending at all, and the quantity of farm loans if it does get involved. Appropriate statistical techniques are applied to account for the apparent "censoring" of the data (that is, the fact that most banks hold no farm loans).

The model is applied to banks in four important western agricultural states: California, Idaho, Oregon, and Washington. The results allow an assessment of factors that might determine differences in farm lending by commercial banks, including differences in the nature of markets and differences in bank characteristics, such as size and ownership structure. In addition, the results have implications for other issues. For example, concerns have been raised over the effects of structural changes in the banking industry, such as merger waves or interstate banking. Suppose that large banks, or those owned by out-of-state holding companies, tend to do less agricultural lending than otherwise similar banks not owned by such companies. In that case, an industry trend toward bigger banks, or toward acquisition of independent banks in agricultural states by out-of-state banking firms, might tend to reduce the amount of credit flowing to agriculture. The loan mix of acquired banks would change to match the acquiring companies' profiles. However, branch *locations* usually change little following mergers or other structural changes.[2] If the results show that location and market composition are what matter for farm lending, then structural change in banking at the industry level might have little effect on lending, because it would not change the composition of markets. Any institution acquiring a particular branch in an agricultural area likely would continue to lend to farmers.

The next two sections provide background, summarizing relevant aspects of existing research and presenting information on agricultural lending in the sample states. Four following sections describe the measure of local market demand for agricultural loans, the model of loan decisions, the econometric framework, and the data used in the study. Section VII discusses the results, Section VIII assesses the implications for the relative importance of bank and market characteristics, and a final section concludes.

2. Some branches may be closed outright following a merger or acquisition. However, most often the acquirer consolidates unwanted branches with other branches in the same market; in that case, the combined presence within the market is unchanged. Occasionally, unwanted branches are sold to other banking firms rather than closed or consolidated, which similarly maintains the same lending capacity in the market. Frequently, the same employees remain at a branch as it changes hands.

I. Previous Research

Three previous papers dealt with various aspects of the issues raised here. Gilbert and Belongia (GB 1988) examined the effects of bank size and holding company affiliation on agricultural lending. They attempted to eliminate the effects of location through sample design, using only banks in counties that were not part of any Metropolitan Statistical Area (MSA), that had high ratios of agricultural loans to total loans, and that were in one of nine states with restricted branching in 1985. GB found that agricultural loans comprised a significantly smaller share of assets for banks owned by bank holding companies than for other banks, and the holding company effect was greater the larger the parent company.

Laderman, Schmidt, and Zimmerman (LSZ 1991) looked at the effects of location on agricultural lending by banks. LSZ found that banks headquartered in MSAs had significantly lower ratios of agricultural loans to total loans. The sample consisted of banks surveyed each quarter from 1981 through 1986 by the Federal Reserve as part of the Survey of Terms of Bank Lending to Agriculture; this group of banks, varying in number from 168 to 188 depending on the date, has been deemed to be representative of farm lenders. The only bank-specific variables in the LSZ model were total assets and the ratio of deposits to loans; no measures of ownership structure were included, so it is not clear to what extent the results were driven by structural differences rather than location. LSZ found that size had a negative but insignificant effect on farm lending.

A paper by Whalen (1995) covered small agricultural loans as part of a more general analysis of small-business lending by banks. Whalen's sample consisted of 1,377 banks in the states of Illinois, Kentucky, and Montana (all of which had restricted branching as of his June 1993 sample date). Whalen looked specifically at the effects of bank size, holding company ownership, and out-of-state ownership; he found some evidence that small banks not owned by bank holding companies have higher ratios of agricultural loans to total assets than do other banks. However, Whalen acknowledged that the difference might reflect location rather than structure, since he found no significant size- or affiliation-related differences in mean agricultural loan ratios among banks in non-MSA areas.

II. Agricultural Lending by Banks

Banks provide two broad types of agricultural credit: loans secured by agricultural real estate and other agricultural loans. Agricultural producers generally use loans secured by real estate to acquire physical capital, including land, equipment, and livestock. Nonbank lenders, especially insurance companies, are active competitors for this type of lending. Prices and quantities of loans secured by farm real estate depend heavily on land values and only indirectly on agricultural prices and output.

This paper considers the second category, loans not secured by real estate; banks are the dominant supplier of such loans. These loans are referred to as agricultural production loans, generally financing variable production costs such as seed, fertilizer, and labor. Demand for production loans is driven primarily by agricultural output. The loans tend to be shorter term and have a strong seasonal element, with a clear trough in the first quarter of each year.

The four states covered in this study—California, Idaho, Oregon, and Washington—account for about 90 percent of agricultural production lending by banks in the Twelfth Federal Reserve District. They comprised about 16 percent of agricultural output for the United States in 1992 as measured by the market value of sales (see Table 1) and similar percentages of total U.S. farm debt and bank agricultural production loans outstanding. California is the largest of the four in terms of market value of agricultural sales.

The importance of banks as agricultural lenders varies somewhat across the states, with banks supplying about 54 percent of production credit in Oregon, but nearly 70 percent in the state of Washington; except for Oregon, all four are above the national average. Oregon has a higher proportion of farm debt secured by real estate. Viewing production loans as an input to the agricultural production process, California and Oregon have the highest output per dollar of bank loans, with Idaho below the national average. Taken as a group, banks in these four states have a higher than average share of production lending, production loans are a slightly smaller share of total farm debt, and the value of output is higher relative to total production loans, but the differences from the rest of the country are not remarkable.

One aspect of agricultural production in these states that may limit the generality of the results is that a relatively high proportion of production is concentrated in larger farms. For example, production units with annual sales exceeding $500,000 accounted for 80 percent of the total market value of sales in California in the 1992 Census of Agriculture, compared to 47 percent for the United States as a whole. The difference stems in part from an emphasis on production of higher value crops, but also reflects an above average number of large agricultural enterprises. Large farms in Idaho, Oregon, and Washington had somewhat smaller shares of state output—61, 54, and 60 percent, respectively—but all are above the national average. On the other hand, these states are not so far from the norm that they are completely unrepresentative; for example, Florida is comparable to California in the dominance of large farms, and traditional farming states like Kansas and Colorado have higher percentages than the Pacific

TABLE 1

Agriculture and Bank Lending

	California	Idaho	Oregon	Washington	Four states	U.S.
Market value of agricultural sales	17,052	2,964	2,293	3,821	26,130	162,608
Market value of sales as % of US total	10.5	1.8	1.4	2.4	16.1	100.0
Bank share of ag production loans, in %	55.1	62.9	53.7	69.4	58.4	54.5
Ag production loans as % of total farm debt	41.9	48.6	33.0	49.7	42.8	45.8
Ratio of sales to ag production loans	3.1	2.4	3.0	2.7	2.9	2.6

Notes: Market value of sales in millions of dollars, from 1992 Census of Agriculture.
Total ag production loans and total farm debt from 1992 USDA Farm Balance Sheets by State.
Bank ag production loans from December 1992 Call Reports.

Northwest states. Nevertheless, readers should be cautious in using results from this sample to draw inferences for the rest of the county.[3]

III. HOW AGRICULTURAL IS THE MARKET?

Gauging the importance of location requires a measure of the degree to which banks' markets are agricultural. Previous papers (such as GB, LSZ, and Whalen) used the location of banks' head offices, typically comparing banks headquartered in MSAs with those headquartered outside of MSAs. The reasoning is that non-MSA areas are more rural, and hence probably more agricultural.

This distinction based on MSA/non-MSA headquarters is sensible if the location of the head office adequately portrays the location of the bank's business, and if MSA areas are in fact less agricultural than non-MSA areas. However, both conditions frequently are violated. In the western states, and increasingly in recent years in the rest of the country, banks can and do branch statewide; the result is that the head-office location of the bank is not a good indication of the location of its branches. The characterization of MSAs as less agricultural than non-MSA areas also is not necessarily accurate in the western states. The top agricultural counties as measured by total agricultural production in California, Oregon, and Washington are all MSA counties; in California, nine of the top ten counties in agricultural production are within MSAs. (MSA definitions are based on boundaries of single counties or groups of contiguous counties.)

A better measure of the nature of any bank's market area can be based on the actual geographic distribution of its branches and the amount of agricultural activity in the branch locations. From a bank's perspective, a market is more agricultural if more of the loans in that market are used to finance agricultural production. Assume that agricultural loan demand in a county c at any point in time is proportional to farm output as measured by the total value of sales reported by farms in that county:

$$LD_c = \gamma \cdot Q_c \,, \tag{1}$$

where LD is loan demand, Q is farm output, and γ is a proportionality factor that may vary over time depending on bank interest rates, the price of substitute forms of credit, and other factors, but is constant at any point in time over the counties in which the bank operates. (In the empirical work to follow, the factor γ is allowed to vary by state, to reflect state differences in agricultural production functions and credit market conditions. It is held constant within any given state to allow estimation.) Assume that the share of this loan demand faced by bank i is equal to the bank's share of the deposit market in a county:

$$LD_{ci} = \gamma \cdot Q_c \cdot \left(\frac{D_{ci}}{D_c} \right), \tag{2}$$

where D represents deposits. Summing across counties for bank i yields a measure of the agricultural loan demand facing the bank, based on the extent of agricultural production in the counties in which the bank actually operates:

$$LD_i = \gamma \cdot \sum_{c=1}^{N} Q_c \cdot \left(\frac{D_{ci}}{D_c} \right) = \gamma \cdot MARKET_i \,, \tag{3}$$

where $MARKET_i$ is a weighted average of agricultural production in all of the counties in which the bank has branches.

IV. LENDING DECISIONS

Banks can and do invest in many different kinds of assets, including various types of loans. However, most do not invest in every type of asset available to them; they go through management decision processes that result in positive amounts of some assets and zero of others. In the case of agricultural lending, some banks invest in farm loans and others do not, despite the fact that the market areas of almost all banks include at least some agricultural production.

One way to explain such a pattern is to posit a decision process in which bank management takes prices (or interest rates) as given by the market, and then sets threshold levels for investments in various types of assets, including farm loans. Thresholds might arise because different types of loans require different approaches to marketing, credit evaluation, and monitoring; as a result, a particular type of lending can require specific investment in systems and staff, leading to quasi-fixed costs that must be incurred regardless of the quantity of lending done. Unless the quantity of any given category of lending is high enough, the costs cannot be covered and that type of loan is unprofitable for the bank. After setting a threshold, a bank then calculates a profit-maximizing quantity of each asset type; if this quantity exceeds the threshold, the bank invests (making loans, in the case of lending), and otherwise it does not.

More formally, a bank sets (on some basis not explicitly modeled here, but possibly depending on characteristics of the bank) a threshold T for agricultural lending. Independently of the threshold, the bank determines a profit-maximizing quantity of farm loans L^*, based partly on the

3. Zimmerman (1989) discusses differences between the West and the rest of the country in agricultural lending.

demand for such loans. The bank then compares L^* to T; if L^* is at least as large as T, the bank holds farm loans in the amount L^*; otherwise, the bank holds no farm loans, thereby avoiding the costs of gearing up to manage such a specialized type of asset. Both T and L^* may depend partly on characteristics of the bank and partly on factors that are common to all banks in a particular market or region. However, while L^* depends on the demand for agricultural loans in the market, T does not; in essence, the bank sets a threshold, then looks around its markets to see if the quantity of lending it can actually do would meet or exceed that threshold.

V. ESTIMATION FRAMEWORK

For empirical work, both L^* and T are modeled as linear random functions of observable variables. Factors that affect all banks or markets within a state equally (such as interest rates) are captured through binary dummy variables for each state. To allow for idiosyncratic variation at the firm level, a disturbance term is added to each equation:

$$(4) \quad L_i^* = \beta_0 + \beta_1 X_i + \beta_2 STATE_i + \beta_3 MARKET_i + u_{Li} ,$$

$$(5) \quad T_i = \alpha_0 + \alpha_1 X_i + \alpha_2 STATE_i + u_{Ti} ,$$

$$(6) \quad \begin{aligned} L_i &= L_i^* \quad \text{if} \quad L_i^* \geq T_i \\ L_i &= 0 \quad \text{if} \quad L_i^* < T_i \quad , \end{aligned}$$

where X is a vector of bank-specific characteristics that might influence loan decisions, u_T and u_L are bank-specific disturbances assumed to be jointly normal with means of zero, standard deviations σ_T and σ_L respectively, and covariance σ_{LT}, and $STATE$ is a vector of state dummies (with one state, California, omitted and picked up in the intercept instead). The coefficient β_3 captures two effects, the impact of loan demand LD_i on L^*, and the influence of agricultural output on loan demand, as measured by γ above; γ implicitly is incorporated into β_3.

The threshold T cannot be observed; thus, this is a model in which the data are censored, and the censoring variable is endogenous, stochastic, and unobserved. As with any censored regression model, estimation using only the banks with nonzero values of L would give biased estimates, because the errors would not have zero mean.[4] However, following Heckman (1976), it is possible to estimate a well-behaved probit model, from which the conditional mean of the residuals can be computed and used as an adjustment in an ordinary least squares regression to explain variations in loan quantity.

Specifically, let I be an indicator variable that takes the value $I_i = 1$ if $L_i^* \geq T_i$, and zero otherwise:

$$(7) \quad \begin{aligned} I_i = 1 \text{ if } & (\beta_0 - \alpha_0) + (\beta_1 - \alpha_1) X_i \\ & + (\beta_2 - \alpha_2) STATE_i + \beta_3 MARKET_i \\ & + (u_{Li} - u_{Ti}) \geq 0 , \\ I_i = 0 \text{ } & \text{otherwise.} \end{aligned}$$

The disturbance term $u_L - u_T$ is normal with zero mean and variance $\sigma^2 = \sigma_L^2 + \sigma_T^2 - 2\sigma_{LT}$. Probit estimation of this "selection" equation yields consistent estimates of β_3 and of the differences in all of the other coefficients. Most importantly, it can be used to compute estimates of the inverse Mills ratio, which is related to the probability that each observation is censored; this ratio can be used as a regressor in an ordinary least squares "quantity" regression based on the observations with positive farm lending:

$$(8) \quad \begin{aligned} L_i = & \beta_0 + \beta_1 X_i + \beta_2 STATE_i \\ & + \beta_3 MARKET_i + \beta_4 IMR_i + \varepsilon_{Li} , \end{aligned}$$

where IMR is the inverse Mills ratio computed from the probit results. The coefficient estimates measure the impact of each variable on the optimal quantity of agricultural loans in the bank's portfolio, conditional on the bank engaging in such lending. The adjustment for censoring introduces an element of heteroskedasticity which must be corrected, but the corrections are relatively straightforward (see Maddala 1983). With consistent estimates of the β coefficients from the quantity regression, estimates of the α coefficients can be recovered from the probit coefficients in the selection equation (7), thereby providing information about determinants of agricultural loan thresholds.

The Heckman censored regression framework used here is similar to a Tobit regression. The major differences are that with a Tobit, the factors determining the lending threshold must be the same as those determining the optimal level of lending, and the coefficients on the variables in the selection and quantity equations must be constrained to be identical (that is, the coefficients in the threshold equation must be constrained to zero). The two-step Heckman procedure is preferable because it relaxes those unnecessary constraints.[5]

4. LSZ explicitly assumed this problem away, while GB do not appear to have dealt with the issue at all.

5. Gunther and Siems (1995) applied a related approach to an analysis of banks' exposure to derivative financial instruments; I am grateful to them for pointing me in this direction.

VI. DATA

The sample of banks includes all 527 commercial banks with branches in any of the four states of the sample as of June 1994.[6] Of these, 229 reported having farm loans on their books. Data on agricultural production loans at the banks come from the Reports of Condition (Call Reports) filed by banks, Schedule RC-C Line 3, "Loans to finance agricultural production." Use of the June reporting date avoids the seasonal trough in farm production lending.

Several variables are used to describe bank characteristics that may be related to either the loan threshold or the profit-maximizing loan quantity or both:

BHC = 1 if the bank is owned by a bank holding company, 0 otherwise

FOREIGN = 1 if the bank is owned by a foreign entity, 0 otherwise

OSBHC = 1 if the bank is owned by a holding company from a state other than the state in which the bank is headquartered (but not a foreign entity), 0 otherwise

MSAHQ = 1 if the head office of the bank is in a Metropolitan Statistical Area, 0 otherwise

NATIONAL = 1 if the bank has a national charter, 0 if state-chartered (reflecting possible differences in supervision)

MC = 1 if the bank has branches in multiple counties, 0 otherwise

BRANCHES = Number of branches of the bank, including the head office

SIZE = Natural log of total assets (in thousands of dollars) of the bank

The first five items come from Federal Reserve bank structure data. *MC* and *BRANCHES* are constructed from data in the FDIC Summary of Deposits. The asset figures come from the Call Reports. Regardless of the source, all data are reported as of June 30, 1994.

Figures for the market value of agricultural sales in each county are used as a proxy for agricultural production from the 1992 Census of Agriculture. The other elements needed to construct the *MARKET* variable for each bank are the deposits at each branch of the bank and the locations of the branches. Such branch-level data are available from the FDIC Summary of Deposits for June 1994.

6. Five banks were excluded from the sample because they reported having no loans or no deposits or both.

The composition of the sample of banks is summarized in Table 2; the first column shows the number of banks in each group, and the second column shows the percentage of those banks that report holding agricultural production loans. Only a few banks in the sample are either foreign-owned or owned by an out-of-state BHC. A large number have branches in only one county. Most of the banks are in California, and most are headquartered in MSAs. A notably larger proportion of non-MSA banks engage in agricultural lending compared to MSA-headquartered banks. A smaller percentage of banks located in California hold farm loans in their portfolios, and banks owned by foreign entities also are less likely to be agricultural lenders.

VII. ESTIMATION RESULTS

Initial estimates using the two-step model revealed substantial size-related heteroskedasticity, a common problem in banking research: Larger banks in the sample may have loan levels that are many times greater than the total assets of the smaller banks, and hence tend to have much larger regression residuals. Experimentation with various

TABLE 2

COMPOSITION OF SAMPLE

		Number of Banks	Percentage with Agricultural Loans
Total		527	43
Owned by BHC		209	49
Not owned by BHC		318	40
Owned by foreign entity		20	20
Not owned by foreign entity		507	44
Owned by out-of-state BHC		44	52
Not owned by out-of-state BHC		483	43
Headquartered in MSA		444	36
Not headquartered in MSA		83	86
National charter		165	38
State charter		362	46
Branches in more than one county		195	56
Branches in only one county		332	36
Headquartered in:	California	375	31
	Idaho	20	85
	Oregon	45	78
	Washington	87	69

size variables and specifications revealed that the residuals were most strongly related to the natural log of total assets. Dividing by the log of assets to rescale all variables is a simple correction for this source of heteroskedasticity and is applied throughout the rest of this paper. Thus, the estimation framework in Section V should be understood as applying to the rescaled data.[7]

Estimated coefficients for each variable are presented in Table 3; standard errors are in parentheses immediately below each coefficient, with asterisks denoting various levels of significance for a test of the hypothesis that the coefficient is zero. The first column shows estimates for the first-stage probit selection equation, using all 527 observations. (In the notation of equation (7), the reported coefficients are actually $(\beta - \alpha)/\sigma$, as is standard in probit estimation.) The results can be interpreted as identifying factors that affect the probability that a bank will engage in agricultural lending.

The variable that measures the degree to which banks' markets are agricultural, *MARKET,* has a positive and strongly significant effect. The larger a bank's presence in highly agricultural areas according to this measure, the more likely that the bank does at least some farm lending. This result directly supports the hypothesis that a bank's decision to engage in a particular type of lending reflects the composition of its local markets. Equally important, with this variable included in the model, the effects of various bank-specific factors on the probability of engaging in farm lending can be evaluated separately from the confounding correlation between those characteristics and location.[8]

The significant negative coefficient on *SIZE* shows that larger banks are less likely to engage in agricultural lending than are smaller banks. This is a true size effect, since other factors such as location and ownership structure that may be related to the size of the bank have been separately controlled.

Of the structural variables, head office location has a significant effect: Banks headquartered in MSA counties are significantly less likely to lend to farmers than those headquartered in non-MSA areas. This is *not* because

TABLE 3

Estimation Results

	PROBIT	*L**	*T*
MARKET	0.0004*** (0.0001)	0.2751*** (0.0208)	—
SIZE	–2.49** (1.02)	1454 (1775)	3083
BHC	–1.14 (1.70)	–1849 (3524)	–1101
FOREIGN	–17.64 (16.17)	77836*** (18194)	89380
OSBHC	–5.59 (5.59)	14889* (8036)	18548
MSAHQ	–10.47*** (2.41)	–1939 (4405)	4912
NATIONAL	2.01 (1.69)	2156 (3655)	838
MC	2.76 (1.95)	3938 (3594)	2132
BRANCHES	0.71** (0.33)	–251** (101)	–715
INTERCEPT	24.01** (11.04)	–27174 (20665)	–42882
IDAHO	11.16** (5.14)	11036 (7192)	3731
OREGON	10.62*** (2.90)	7741 (5234)	792
WASHINGTON	9.31*** (2.09)	11664*** (4432)	5572
Number of banks	527	229	—
Log likelihood	–229.82	—	—
R^2	—	0.901	—

Notes:
*** Significantly different from zero at 1% level
** Significantly different from zero at 5% level
* Significantly different from zero at 10% level

7. The precise form of this correction turns out to have little practical effect on the results; use of other scaling variables changes none of the conclusions regarding the effects of any explanatory variables. Other studies have used a similar (but usually implicit) scaling, generally based on total assets.

8. Of course, this assumes that the location of branches does not depend on these other characteristics. While unlikely to be strictly true, such an assumption is a reasonable working approximation in the absence of a fully developed theory of bank branch location.

banks with rural head offices tend to be smaller or in more heavily agricultural markets, since the *SIZE* and *MARKET* variables have captured the influence of size and market composition. The coefficient on number of branches is significantly positive: Having more branches raises the probability that a bank will do at least some farm lending. Thus, if two banks of identical size and ownership structure have the same market share in the same array of counties, the one with more branches is more likely to be holding farm loans in its portfolio. This may reflect enhanced monitoring capability for the lender or possible convenience-related effects on loan demand.

Notably, ownership structure—whether by an in-state or out-of-state BHC or a foreign entity—has no statistically significant effect on whether a bank is a farm lender; independent banks are neither significantly more nor significantly less likely to have agricultural production loans in their portfolios. As for the state dummies, banks in Idaho, Oregon, and Washington are all more likely to hold agricultural loans than are California banks, even with other factors held constant.

The second column shows the estimated coefficients for the loan quantity equation; recall that L^* is the profit-maximizing, or desired, quantity of farm loans the bank would hold if there were no threshold. These coefficients come directly from the second stage least squares regression using the 229 banks with $L > 0$, incorporating the *IMR* variable as an estimate of the degree of censoring of each observation. (The coefficient on *IMR* was 831.2, with a standard error of 431.5.) Coefficients from the probit selection equation can be multiplied by the standard deviation of the residuals (654.3) and combined with coefficients from the quantity regression to derive implied coefficients for a loan threshold equation; these implied values are presented in the last column of the table.

The significantly positive coefficient on *MARKET* shows that banks with a greater presence in agricultural counties do more lending to farmers, all else equal. The desired L^* also increases with asset size—larger banks aim for higher loan quantities—but the coefficient is not significantly different from zero. The coefficient on *SIZE* in the threshold equation implies that T rises with size faster than L^* does; larger banks run larger agricultural loan portfolios if they have farm loans, but require still higher levels of activity if they are to engage in farm lending in the first place. The net effect is that larger banks are significantly less likely to engage in lending at all, as the probit coefficient indicates.

Foreign ownership has a significant and positive effect on the quantity of agricultural loans in the portfolio, implying that foreign-owned banks engaging in farm lending do more of it, for any given combination of market composition, size, and other bank characteristics. However, this turns out to be an anomaly due to a single large foreign-owned bank, Sanwa Bank of California. Sanwa reported \$360 million in agricultural production loans, accounting for 64 percent of the total farm loans of foreign-owned banks in the sample. If Sanwa is deleted from the sample, the coefficient on *FOREIGN* drops to 2347 and becomes insignificant, with little change in the other coefficients.

Having a head office in an MSA lowers the desired quantity of agricultural loans, as the negative coefficient on *MSAHQ* shows. An MSA head office also raises the lending threshold substantially. These two effects reinforce each other, thereby significantly reducing the probability that an MSA-headquartered bank will engage in farm lending. Once again, this is *not* because MSA-headquartered banks necessarily operate in markets with less agricultural loan demand. These effects on the threshold and desired loan quantity are related specifically to the location of the head office as opposed to the branches, perhaps indicating that the physical location of key decisionmakers has an important influence on the type of lending a bank will do.

The effect of the number of branches is significantly negative, a surprising conclusion in view of the probit result that additional branches significantly raise the probability of being a farm lender. The explanation lies with the coefficient on *BRANCHES* in the threshold equation; additional branches lower T by more than they lower L^*. Banks with more branches are willing to engage in agricultural lending in much smaller amounts than otherwise similar banks with fewer branches. Each additional branch reduces a bank's desired quantity of agricultural production loans by \$251,000 on average.

Out-of-state ownership is positive and mildly significant, indicating that out-of-state banks have higher desired loan levels; however, their thresholds are also higher, so they are less likely to actually lend to farmers (the probit point estimate is negative, although insignificant). Neither BHC ownership nor charter type has a significant effect on agricultural loan quantity decisions. Banks in the state of Washington hold significantly more farm loans than do banks in other states, a finding that is consistent with Washington banks' large share of the total agricultural production loan market in that state (see Table 1). At the risk of being repetitious, this is *not* because markets in Washington are more agricultural than in other states, since that characteristic is separately controlled in the estimation.

Gilbert and Belongia (1988) found that the size of the parent BHC had a significant impact on agricultural lending for banks that were owned by holding companies. To test for such an effect in these data, the two-step model was reestimated with *BHC* replaced by three separate binary variables, each taking the value of one for banks owned by holding companies if the parent's consolidated total assets were under \$150 million, between \$150 million and \$1 billion, or over \$1 billion, respectively. The results (Table 4) show no significant effect of parent size on either the quantity of agricultural loans or the probability of engaging in farm lending. The impact of other variables is largely unaffected by the change in specification, except that the influence of out-of-state BHC affiliation on loan quantity diminishes to insignificance.

VIII. RELATIVE IMPORTANCE OF LOCATION AND BANK CHARACTERISTICS

The preceding section focused on the statistical significance of coefficients. However, statistical significance does not directly address the quantitative impact of interbank differences in these variables on farm lending. As noted above, effects flow through two channels: the decision to engage (or not engage) in farm lending, and the decision regarding quantity of agricultural loans for banks that choose to hold such loans. Since the directions of these two effects may be opposing (as, for example, in the cases of *BRANCHES* or *MSAHQ*), it is important to have a summary measure of the impact of each variable, combining the two channels.

One possible summary measure is the effect of each variable on the conditional expectation of farm lending at a representative bank. The conditional expectation is equal to the *unconditional* expected value of farm loans multiplied by the probability of being above the threshold level. If Z is the matrix of all variables included in the model, β is the vector of *OLS* coefficients, and γ is the vector of probit coefficients, then expected farm lending is:

$$E(L) = E(L^*(Z\beta)) \cdot N(Z\gamma)\,, \tag{9}$$

where $E(L^*)$ is the expected profit-maximizing quantity of farm loans (the unconditional expectation) and $N(\cdot)$ is the cumulative normal density function.

The effects of each variable z_i included in Z can be evaluated through the elasticity:

$$\frac{\partial E(L)}{\partial z_i} \cdot \frac{z_i}{E(L)}\,, \tag{10}$$

which can be interpreted as the approximate percentage change in expected farm loans for a 1 percent change in z_i. The elasticity must be calculated for a representative bank; in this case, consider an "average" bank, for which all variables are equal to their sample means.

Following McDonald and Moffitt (1980), $\partial E(L)/\partial z_i$ can be decomposed into a "quantity effect" due to the impact on the quantity of farm loans for banks above the threshold, and a "selection effect," the change in the expected

TABLE 4

ESTIMATION RESULTS, WITH BHC PARENT SIZE DUMMIES

	PROBIT	L^*	T
MARKET	0.0004*** (0.0001)	0.2760*** (0.0208)	—
SIZE	–2.36** (1.06)	1116 (1857)	2672
BHC < \$150 mil	–0.05 (0.18)	–4 (375)	28
BHC \$150 mil–\$1 bil	–0.25 (0.24)	–319 (456)	–151
BHC > \$1 bil	–0.15 (0.32)	551 (613)	649
FOREIGN	–18.76 (17.09)	84911*** (19007)	97262
OSBHC	–5.28 (5.80)	8806 (9728)	12286
MSAHQ	–10.38*** (2.41)	–1920 (4401)	4911
NATIONAL	1.93 (1.71)	1690 (3705)	419
MC	2.74 (1.98)	3813 (3604)	2012
BRANCHES	0.76** (0.35)	–267** (102)	–767
INTERCEPT	22.52** (11.32)	–23209 (21455)	–38030
IDAHO	11.06** (5.15)	9684 (7228)	2401
OREGON	10.54*** (2.91)	7487 (5255)	548
WASHINGTON	9.20*** (2.11)	11051** (4456)	4994
Number of banks	527	229	—
Log likelihood	–229.44	—	—
R^2	—	0.901	—

Notes:
*** Significantly different from zero at 1% level
** Significantly different from zero at 5% level
* Significantly different from zero at 10% level

value of farm loans due to the change in the probability of being above the threshold and therefore engaging in farm lending. McDonald and Moffitt develop this decomposition for a Tobit, but extension to the current case is fairly straightforward.

The results are in Table 5. The figures can be interpreted as percentage changes in expected agricultural loans for the average bank. With the exception of *MSAHQ*, the quantity effects are larger in absolute value than the selection effects, implying that the major impact of differences in each variable come through their effect on the size of the loan portfolio held by banks that are in the farm loan business, not through the impact on the probability of being farm lenders. Based on either the selection elasticity or the quantity elasticity or the two combined (the total elasticity), market composition has a relatively large impact on cross-sectional differences in expected agricultural loans. A 1 percent increase or decrease in agricultural loan demand leads to a corresponding 1.7 percent increase or decrease in the expected value of farm production loans, with about 0.3 percentage points of that arising from the increase in the probability that desired lending will exceed the bank's threshold.

TABLE 5

IMPACT OF VARIABLES ON EXPECTED VALUE OF BANK AGRICULTURAL LOANS

VARIABLE	SELECTION ELASTICITY	QUANTITY ELASTICITY	TOTAL ELASTICITY
MARKET	0.294	1.427	1.721
SIZE	–0.458	3.583	3.125
BHC	–0.007	–0.102	–0.109
FOREIGN	–0.011	0.484	0.474
OSBHC	–0.008	0.220	0.212
MSAHQ	–0.141	0.023	–0.118
NATIONAL	0.010	0.087	0.097
MC	0.016	0.199	0.215
BRANCHES	0.141	–0.779	–0.638
IDAHO	0.007	0.053	0.059
OREGON	0.014	0.076	0.090
WASHINGTON	0.025	0.258	0.283

Note: "Selection Elasticity" reflects the change in expected loans due to changes in the probability of engaging in farm lending. "Quantity Elasticity" reflects the change in expected loans due to changes in the expected value of the unconditional profit-maximizing loan quantity. "Total Elasticity" is the sum of the two. All are expressed as elasticities, the approximate percentage change in expected loans for a percentage change in the explanatory variable.

Bank size has a large negative selection effect, but the total elasticity is positive and relatively large, due to the quantity effect. However, these size results are hard to interpret for two reasons. First, the quantity elasticity depends heavily on the size coefficient in the *OLS* equation, which (from Table 3) has a large standard error. A shortcoming of the elasticity-based analysis as developed by McDonald and Moffitt is that it does not reflect the standard errors of the estimated parameters and therefore does not explicitly recognize that some coefficient estimates are noisier than others.[9] Second, the *SIZE* variable in the regression is the log of assets; a 1 percent change in *SIZE* corresponds to a much larger percentage change in actual bank assets.[10] The elasticity of $E(L)$ with respect to the average bank's *total assets* rather than log of assets is only 0.195, based on the estimates in Table 3. For these reasons, the large calculated elasticity with respect to *SIZE* should be viewed with some skepticism.

The negative effect of the number of branches on loan quantity overwhelms the positive effect on selection, while the opposite is true for *MSAHQ*. Despite the strong statistical significance of *MSAHQ*, the net quantitative impact on farm lending is relatively small. The net impact of out-of-state ownership is large and puzzling, and may be driven by a small number of large multistate organizations in the sample. Foreign ownership has a substantial measured effect, but as noted above this reflects the influence of a single bank, Sanwa.

IX. CONCLUSION

This paper has considered determinants of cross-sectional differences in agricultural production lending by banks in four western states, distinguishing between the influence of

9. In principle, each quantity and selection elasticity could be treated as a statistical estimate, and more precisely estimated elasticities could be given additional weight. An extension along these lines is left for possible future work.

10. Put differently, a 1 percent change in the log of assets is very large relative to its cross-sectional sample variation. A 1 percent change corresponds to a change of 0.085 standard deviations in SIZE, whereas a 1 percent change in MARKET corresponds to only 0.0016 standard deviations for that variable.

structural characteristics of banks and attributes of the markets in which the banks operate. A new measure of the importance of agriculture in each bank's market was developed, based on county-level agricultural production data and the distribution of each bank's branches across those counties. To account for apparent censoring in the farm loan data, the empirical analysis was based on a model of bank decisionmaking in which a bank lends only if the quantity of loans the bank can make exceeds a bank-specific threshold.

How "agricultural" a bank's local markets are is the single most important variable influencing agricultural lending. The proxy for agricultural loan demand, which is based on agricultural output in a bank's market areas, is highly significant in a statistical sense; moreover, of the variables that are statistically significant, it has the greatest quantitative impact on expected farm loans for a typical bank. This "market composition" variable is most influential in determining the quantity of farm loans held by banks that decide to engage in lending. Thus, the results strongly suggest that banks, even in these statewide-branching states, tend to lend to borrowers located near the banks' branches.

A number of additional factors influence the choice of whether or not to engage in farm lending. Notably, the results support the "folklore" that large banks are less likely to hold farm loans, even when they have branches in agricultural areas. Moreover, banks with head offices in MSAs are less likely to engage in farm lending, even after controlling for differences in size and in the agricultural composition of their markets, suggesting that the physical location of key decisionmakers plays an important role. Both large and MSA-headquartered banks are significantly less likely to hold farm loans because they appear to set higher threshold levels for engaging in agricultural lending.

Results related to ownership structure are important, in view of concerns raised by banking industry consolidation; although the cross-sectional results presented here do not directly address the effects of mergers, they are suggestive. The analysis shows that whether or not a bank is owned by a holding company, the size of that holding company, and whether or not it is headquartered in-state or out-of-state have no significant effect on either the probability of engaging in agricultural lending or the quantity of loans held. The absence of such effects, and the overwhelming importance of market characteristics as opposed to bank structure in determining agricultural loan patterns, makes it unlikely that changes in ownership structure resulting from mergers and acquisitions will have a substantial effect on farm credit.

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