Farm Characteristics and Cost of Borrowing

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Abstract

Interest costs on farm debt are currently the third largest input expense for farmers in the United States. Interest rates should increase with higher financial risk. Further, factors beyond financial metrics may hold additional information value about loan risk. This study uses a repeated cross section of 63,679 individual farm loan data from USDA Agricultural Resource Management Survey to examine the degree to which farm characteristics and farm and lender relationships may provide information on farm risk, and as a result influence interest rates. The results suggest the additional information value of these factors vary by duration of the loan. Specifically, relationships are more important for intermediate term loans, relative to production and farm real estate loans. Additionally, risk of default holds a positive relationship with intermediate and real estate interest rates, but an unexpected inverse relationship with production loans. This study provides a unique examination of the information value of characteristics and relationships in farm loan pricing.

Keywords: interest rate, agricultural credit, relationship,

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Introduction

Debt is an important input for US farms. Interest payments are currently the third largest input category, accounting for 7.4% of 2023 farm operating expenses (U.S. Department of Agriculture, Economic Research Service, 2024). The cost of debt should be directly influenced by risk (Stiglitz and Weiss, 1981). However, lending markets and particularly agricultural credit markets are characterized by imperfect information (Barry and Robison, 2001). As a result, US agricultural lenders have largely adopted risk scoring models to quantify a farm's riskiness (Featherstone et al., 2006). The degree to which a particular risk scoring model truly captures farms' risk is debated (Barry, 1995). Previous studies have shown that additional information may be used to assess risk. For example, older firms with established banking relationships pay lower interest rates (Petersen and Rajan, 1994) and banks in less competitive regions are more willing to accept the risk of lending to beginning firms, as they have a higher probability of benefiting from the young firm's future success (Petersen and Rajan, 1995). This study uses a repeated cross section of farm loans to examine the degree to which a farm's characteristics or relationships with lenders provide information on farm riskiness, and in turn, influence cost of debt.

Previous studies have examined the role of information in the agricultural credit market. First, Barry and Robison (2001) highlight the fact that the farm and lender relationship exhibits the general potential for moral hazard and adverse selection, but is also uniquely complex. Farms' "...small business scale, geographic remoteness, informal accounting practices, and relatively high business and financial risks create intensive information needs to allow lenders to successfully manage credit risks" (Barry and Robison, 2001, pp. 530). Lenders often specialize to effectively manage the described credit risk (Barry and Robison, 2001).

Agricultural economists were instrumental in establishing the quantitative measurement of farm borrower risk. Structural changes in banking during the 1970's and 1980's resulted in greater competition in agricultural lending and motivated evaluations of credit scoring models (Chhikara, 1989). Specifically, the banking regulations of Basel I specified capital requirements to address banks' risk exposure (Durguner, Barry, and Katchova, Durguner et al.). As a result, credit

scoring models emerged as a systematic way to quantitatively measure risk across all banking facets. However, as with all models, a credit score does not perfectly capture borrowers' riskiness (Gustafson, 1989).

Lenders' interactions with borrowers can result in additional information on credit risk. The banking literature considers this type of information "soft information" (see Liberti and Petersen, 2019). Soft information complements quantitative measures, like a credit score, in assessing the risk of a borrower. Often soft information is gathered through relationships, and anecdotal evidence suggests, that agricultural lenders have adopted Berger and Udell's (1995) practice of *relationship lending*. Agricultural economists have also considered farms' or lenders' established goodwill within a community, or "social capital", as it relates to information on borrower risk (Barry and Robison, 2001). The degree to which a borrower possesses social capital may contain information value on the risk of a loan.

Whether the collection of soft information through relationships is beneficial to the lender or the borrower is ambiguous. A lender's repeat interactions with a borrower should increase their information, and as a result, the lender should experience lower costs (Petersen and Rajan, 1994; Sharpe, 1990). Given an efficient competitive lending market, we would assume that these lower costs would manifest in lower interest rates to the borrower. In contrast, large agricultural borrowers may possess market power in the agricultural credit market, and as a result, lenders may offer lower interest rates to remain competitive (Gloy et al., 2005). The described theoretical ambiguity is observed in empirical findings. Several studies have shown that these informational advantages lead to lower rates for borrowers (e.g. Petersen and Rajan, 1994), while others suggest the opposite (e.g. Sharpe, 1990).

Previous studies have examined the degree to which information affects the borrower–lender relationship in agriculture. Farm borrowers in highly competitive agricultural lending markets tend to be less loyal to banks, implying a lower interest rate may be gained by working with multiple lenders (Barry et al., 1997). However, if the farm borrower has a good relationship with their banker, a new bank may have to offer at least 74 basis points to incentivize movement (Hanson et al., 1996). Banks may justify offering lower interest rates to large loans for low and medium

risk borrowers because of the economies of scale (Gloy et al., 2005). As a result, Gloy et al. (2005) suggest that market forces are driving consolidation in the agricultural lending market, lowering competition. However, the same market forces should drive competition for large low risk loans. Yet, farmers could potentially be leveraging inherent competition to procure additional credit from multiple lenders during periods of distress (Brewer et al., 2019). This finding would suggest that additional information on a distressed farm borrower is likely keeping the farms' current lenders from committing more capital.

In contrast, this study uses cross sectional variation in individual farm loans, and farm financial characteristics to identify the degree to which farmer demographics and relationships with lenders influence interest rates. Farmer respondents to the United States Department of Agriculture (USDA) Agricultural Resource Management Survey (ARMS) provide detailed loan information. Farmers report size, type, and lender classification, along with year of origination and interest rate. We use individual loan observations reported in ARMS from 2008 to 2022. Farm respondents also report financial characteristics of their farm that we use to calculate the credit scoring model of Featherstone et al. (2006). Additionally, we use whether farmers report more loans from the same lender or other lenders as a proxy for the borrower-lender relationship. Using ordinary least squares with time and regional fixed effects, we estimate the degree to which farm characteristics and relationships with their lender influence observed interest rates.

Our preliminary analysis yields several interesting findings. First, the role of farm characteristics and farm and lender relationship on interest rates varies by the duration of loan. Farms' probability of default holds a negative relationship with the interest rates of productions loans, but a positive relationship with intermediate and real estate loans. Additionally, the role of farms' legal organization structure is important for each loan duration, but there is no difference in interest rates on real estate loans for those farms which are organized as a S-corporation or other legal structures, like LLCs. Further, within our analysis, the role of the farm and lender relationship is only important for intermediate term loans. Specifically, our results suggest that more loans with the same lender is related to higher interest rates for intermediate term loans. These findings suggest that patterns in the heterogeneity of interest rates on farm loans is an important area of

research.

The remaining portion of this study is organized as follows. In the next section, we discuss the individual farm loan data from USDA's ARMS survey and our research design, including our preferred empirical specification. Our empirical results for production, intermediate, and real estate loans are presented in the respective order. We conclude with a discussion of the future directions of our analysis.

Data and Methodology

Our data consists of a repeated cross-section of 63,679 newly originated loan records collected from the Agricultural Resource Management Survey (ARMS) for years 2008 to 2022. ARMS is a nationally representative survey that collects information on farm operations and households. We use specific loan information from ARMS records including interest rate, loan type (i.e., production loan, intermediate non-real estate loan, real estate loan), lender type, and origination year. We also collected other variables in ARMS including information on the operation (i.e., commodity specialization, legal status, geographic location, net worth, debt-to-asset ratio, and term debt). For each newly originated loan we calculated a credit score and probability of default associated with the farm borrower, following Featherstone et al. (2006).

We consider loans made by commercial banks, Farm Credit System lenders, and vendors. Interest rates at these institutions are directly influenced by their costs of funds. To control for the between lender variation in cost of funds, we use Farm Credit System issued bonds (for FCS lenders), observed cost of fund earning assets for farm banks (for commercial banks), and Baa corporate bond yields (for vendors). Data on FCS bonds are available at different dated maturities, which we assign to our loan data by loan type. Production loans issued by FCS lenders are assigned the 1-year bond as cost of funds; cost of funds for intermediate loans and real estate loans are assigned the 5-year bond and 10-year bond, respectively. Summary statistics of our data are reported in Table 1.

For each loan type, production, intermediate, and real estate, we use ordinary least squares to

Table 1: Summary Statistics

	Mean	SD	Median	p10	p90
interest rate	4.78	1.83	4.75	2.9	6.75
loan term	3.66	5.54	1.00	1	10
bank cost of funds	0.65	0.38	0.48	0.42	0.94
vendor cost of funds	5.00	0.81	4.94	4.38	6.04
FCS cost of funds 1–year	0.92	0.93	0.44	0.19	2.43
FCS cost of funds 5–year	1.86	0.73	1.81	0.94	3.01
FCS cost of funds 10–year	2.76	0.71	2.75	1.62	3.52
prob. of default	1.82	1.65	1.27	0.63	3.65
net worth ($10,000)	366.87	917.75	168.82	20.33	805.68
debt-to-asset	0.34	1.13	0.20	0.04	0.67
term debt	16.73	596.65	2.67	–1.21	18.85

Source: US Department of Agriculture. Economic Reserach Service
Agricultural Resource Management Survey

estimate the following model:

$$\begin{aligned}\text{spread}_{itr} = \alpha + \beta_1 \text{loan characteristics}_{itr} + \beta_2 \text{farm characteristics}'_{itr} + \beta_3 \text{lender characteristics}'_{itr} \\ + \beta_4 \text{borrower–lender relationship characteristics}'_{itr} + \delta_r + \tau_t + \mu_{itr}\end{aligned} \tag{1}$$

Where spread_{itr}, the effective interest rate spread on loan i in time t in region r, computed as the difference between observed interest rate reported in ARMS and the lender–specific cost of funds. The variable $\text{loan characteristics}_{itr}$ is the term length of the observed loan. Farm characteristics are captured by the vector $\text{farm characteristics}'_{itr}$ which includes probability of default, a binary variable which takes the value of one for a livestock farm, and binary variables which take the value of one for legal organization structure. The observed farm legal organization structures are sole proprietor, legal partnership, C-corporation, S-corporation, and Other legal structure. The vector $\text{lender characteristics}'_{itr}$ include binary variables which take the value of one for observed origination bank (Farm Credit System, Commercial Banks, and Vendors).

The relationship between farm borrower and lender is represented by the vector $\text{borrower–lender relationship characteristics}'_{itr}$, which includes four variables. First, we measure

the volume of farm debt with a binary variable which takes the value of one if the farm respondent to ARMS lists more than one loan. Second, we add an additional measure of volume with then number of reported loans. Third, we measure the concentration of the relationship through the number of reported loans with the same lender. Lastly, we measure the competition in relationship with the number of lenders which are represented by reported loans. It is important to note, as highlighted by Petersen and Rajan (1994), that these variables are only an approximation of the underlying borrower–lender relationship.

Finally, we include δ_r as a regional fixed effect and τ_t for time fixed effects. Local lending markets likely have an influence on effective interest rate spreads. For example, Kandilov and Kandilov (2018) show that state-level bank regulations affect agricultural credit markets. δ_r is defined by the nine USDA Economic Research Service (ERS) farm resource management regions (Heartland, Northern Crescent, Northern Great Plains, Prairie Gateway, Eastern Upland, Southern Seaboard, Fruitful Rim, Basin and Range, Mississippi Portal). In addition to regional variation, τ_t represents the common unobserved effects for each years of interest. The cost of lending is not fully represented by cost of funds. For example, changes in national bank regulations likely affect the transaction costs of lending, and are captured by τ_t.

We are interested in the estimates of β_2 and β_4 in (1). β_2 is the marginal effect of the relationship between interest rate spread and farms' probability of default. Theory suggests that cost of debt should be directly related to the implied risk (Stiglitz and Weiss, 1981). Although, there are many different credit scoring models, all of them are aimed at standardizing risk. We use the credit scoring model of Featherstone et al. (2006), which is the probability of default calibrated for a certain set of borrowers in a certain period of time, to serve as a proxy for measurable farm financial risk. We would expect that on average a higher probability of default would be positively related to interest rate spreads. Estimates of β_2 are suggestive of the role of risk in farm loan interest rate pricing.

β_4 is the marginal effect of the farm and lender relationship on interest rate spread. These marginal effects provide suggestive evidence of the competitive climate in the farm loan market and the ability of either farmers or lenders to extract rents from information obtained through re-

lationship. Anecdotal evidence suggests that some farm borrowers are benefiting from a highly competitive agricultural credit market with lower interest rates. As a result, we would expect a positive relationship between having multiple lenders and interest rate spreads. However, the more concentrated a relationship between a borrower and lender, the more information accrued by the two parties. This information should lower the transaction costs of lending, and in turn, we would expect lower interest rates in more concentrated relationships. Although β_4 can not disentangle the relationships described above, our estimates provide suggestive evidence of agricultural credit market competition and the value of information generated through relationship.

Results

Table 2 reports our ordinary least squares estimates of the degree to which farm characteristics and farms' relationship with lenders influence loan interest rate spreads. Our results are organized by term length of farm loan moving from the left of table 2 to the right. The estimates of 1 for production loans are on the left, followed by intermediate loans, and then real estate loans. Additionally, our primary specification for each loan term is reported and then followed by the primary specification using ARMS survey weights with jackknifed standard errors. We report the specification with ARMS survey weights for completeness. However, we believe the unweighted specification is a more appropriate model of the relationship between farm characteristics and interest rate spreads, because the survey weights are used to approximate a nationally representative farm, rather than a nationally representative farm loan (and these two units of observation may differ considerably). Additionally, given the small percentage of farms that report newly originated loans in a given year, the standard errors using ARMS weights may be unreliable (Jablonski et al., 2022). As a result, our discussion of the estimates will focus on the unweighted preferred specification.

Table 2: Ordinary least squares estimates of the relationship between farm and lender characteristics and effective interest rate spreads in ARMS 2008 to 2022 for Farm loans

	Production		Intermediate		Real Estate	
	Primary	Weighted	Primary	Weighted	Primary	Weighted
Term length	0.000369	0.000706	-0.00139	-0.0199	-0.00332	-0.0099
	[0.02]	[0.03]	[-0.20]	[-0.09]	[-1.80]	[-1.24]
FCS (omitted)						
Commercial Banks	0.535 ***	0.599 ***	1.596 ***	1.806	2.223 ***	2.255 ***
	[28.39]	[8.61]	[44.26]	[1.03]	[72.20]	[18.39]
Vendors	-3.846 ***	-4.083 ***	-4.165 ***	-4.38 ***	-3.307 ***	-3.901 ***
	[-48.45]	[-14.41]	[-96.39]	[-12.94]	[-10.98]	[-4.64]
probability of default	-0.0121 *	0.00182	0.0471 ***	0.0459	0.0288 *	0.0144
	[-2.12]	[0.09]	[3.53]	[0.35]	[2.56]	[0.70]
Crop farm (omitted)						
Livestock Farm	0.0675 **	0.108	0.00241	-0.00308	0.081 *	0.202
	[3.28]	[1.31]	[0.06]	[-0.00]	[2.48]	[2.04]
Sole Proprietor (omitted)						
Legal Partnership	-0.213 ***	-0.0834	-0.103 *	-0.23	-0.132 **	-0.169
	[-8.22]	[-0.63]	[-2.40]	[-0.27]	[-3.05]	[-1.01]
C-Corp	-0.189 ***	-0.104	-0.141 *	-0.0336	-0.187 **	0.0337
	[-4.99]	[-1.75]	[-2.22]	[-0.05]	[-3.02]	[0.21]
S-Corp	-0.193 ***	-0.241 *	-0.135 *	-0.31	-0.0608	0.00109
	[-5.71]	[-2.05]	[-1.99]	[-0.66]	[-1.08]	[0.01]
Other legal structure	-0.222 *	0.206	-0.412 *	0.858	-0.0385	0.615 *
	[-2.50]	[0.43]	[-2.54]	[0.37]	[-0.28]	[2.31]
Multi Loans (binary)	-0.0201	0.0473	0.00781	0.0863	0.0356	-0.088
	[-0.67]	[0.60]	[0.14]	[0.03]	[0.75]	[-0.58]
No. of Loans	-0.0149	-0.0757	-0.0776 *	-0.118	-0.0179	0.029
	[-0.51]	[-1.00]	[-2.18]	[-0.38]	[-0.34]	[0.25]
No. of Loans w/ Lender	0.0196	0.0796	0.0832 *	0.171	0.00121	-0.024
	[0.63]	[1.04]	[2.28]	[0.71]	[0.02]	[-0.19]
No. of Lenders	-0.0605	-0.176	0.0751	0.0809	-0.0579	0.0682
	[-1.50]	[-1.60]	[1.33]	[0.16]	[-0.80]	[0.32]
Constant	2.856 ***	3.343 ***	1.311 ***	1.186 ***	1.188 ***	1.186 ***
	[29.08]	[20.66]	[9.89]	[3.97]	[9.40]	[3.97]
Year Effects	YES	YES	YES	YES	YES	YES
Region Effects	YES	YES	YES	YES	YES	YES
Observations	40850	36449	14854	13151	7975	7141
R-squared		0.263		0.437		0.437

t statistics in brackets

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: US Department of Agriculture. Economic Research Service

Agricultural Resource Management Survey

Production Loans

Our results suggest that more risky farms, as measured by probability of default, pay relatively lower interest rates. A one percent increase in probability default is estimated to decrease the effective interest rate spread by 1.2 basis points. Theory would suggest the inverse relationship. Although beyond the scope of our current study, this finding may be related to the fact that production loans are self-liquidating and lenders often use additional risk mitigating opportunities, like crop insurance.

Effective interest rate spreads for production loans are sensitive to farms' legal structure. A formal legal structure beyond sole proprietorship, is correlated with a decrease in interest rate spread by approximately 20 basis points. This result suggests that lenders perceive a more formal legal structure as less risky. Perhaps lenders perceive that a farm with a legal partnership, c-corporation, s-corporation, or other legal structure have a higher committment to business management, and as a result, are less risky.

The farm and lender relationship is not an important determinant of interest rate spread for production loans. Our estimates for each measure of the farm and lender relationship and interest rate spread are not distinguishable from zero. This result suggests that the additional information associated with relationships is not valuable in the context of production loans, either for the lender or the farmer. This finding may be related to an expanded role of point of sale financing, like John Deere Financial (Dodson et al., 2022).

Intermediate Loans

Our results suggest that farm probability of default and interest rate spread have a positive relationship. More risky farms pay higher interest rates. A one percentage point increase in probability of default is correlated with a 4.7 basis point increase in effective interest rate spread. In contrast to production loans, this finding is predicted by theory.

The farm and lender relationship is an important influence on interest rate spread for intermediate farm loans. The estimate for the measure of number of loans held by the farm (No. of Loans)

is negative and statistically different from zero. An increase of one loan is correlated with a 7.8 basis point decrease in interest rate spread. In contrast, the estimate for the number of loans held by the same lender (No. of Loans w/ Lender) is positive and statistically different from zero. An increase of one loan with the same lender is correlated with an 8.3 basis point increase in interest rate spread. The first finding, that the number of loans is positively related to interest rate, would suggest that there is some benefit to farms for having additional loans. In contrast, in the mechanism described by Gloy et al. (2005), more loans with the same lender yields greater information, and as a result, a lower cost for lenders. We expected the estimate for the number of loans held by the same lender to be negative. This finding is likely related to a loyalty premium which a competing bank must overcome to gain another bank's existing business (Hanson et al., 1996).

Similar to the estimates of production loans, interest rate spreads for intermediate farm loans are sensitive to a farm's legal structure. The result suggests that farms with a legal structures beyond a sole proprietorship have lower interest rates. The estimated premium, relative to sole proprietorship, is greatest for "Other legal structure" (41.2 basis points) and least for "Legal Partnership" (10.3 basis points). This finding suggests that lenders perceive that farms with these legal structures are less risky than a sole proprietorship.

Livestock farms do not pay greater interest rate spreads than their crop farming peers for intermediate term loans. In contrast, for production loans, livestock farmers are estimated to pay an additional 6.8 basis points than crop farmers. As mentioned above, production loans are self liquidating. This finding suggests, that the intermediate term activities of a livestock farm are not relatively more risky than intermediate term activities of crop farms. Perhaps this finding is related to intermediate term loans are often for farm machinery. In the case of default, farm machinery is relatively easy to extract collateral value. As a result, we would not expect a difference in repayment risk for crop vs. livestock farms' machinery investment.

Real Estate Loans

Our results suggest that a farm's probability of default and interest rate spreads for farm real estate loans are positively correlated. A one percent increase in farm probability of default is associated with a 2.8 basis point increase in interest rate spread. This estimate is nearly 2 basis points lower than intermediate term loans. This finding could be interpreted as the marginal effect of probability of default on interest rate spreads is greater for intermediate term loans. As mentioned previously, the intermediate loans could be related to farm machinery. Farm real estate is a long term asset and we would expect the lending process, including collateral requirements, are different. Potentially, these differences in collateral could explain the difference in the marginal effect of probability of default on interest rate spread.

The farm and lender relationship is not an important determinant of interest rate spread for farm real estate loans. For each measure of the presence or intensity of relationship between farmer and lender, our estimates are not distinguishable from zero. This finding suggests, that there are not benefits for farmers or lenders in their relationships when pricing real estate farm loans. This finding may be driven by the fact that the costs of providing long term lending is similar between lenders.

In contrast to both production and intermediate term loans, only legal partnerships and c-corporation legal structure are associated with lower interest rate spreads. Perhaps this finding is related to the collateral requirements mentioned earlier and the transition to cash flow lending for farm real estate (Barry, 1995). A lender is likely conservative with cash flows requirements due to the uncertainty inherent in longer term lending, and as a result, the information communicated through legal structure is less valuable.

Potential Expansion

We made a number of modeling choices in our preferred specification which mask interesting heterogeneity and limits our ability to examine causality. To address these two issues, potential future research could include a number of variations. First, our preferred specification does not control

for unobservable characteristics of farms which are related to interest rate spreads, like social capital (Barry, 1995). Using different subsets of our data, researchers could introduce a farm fixed effect that will control for these unobserved factors. Second, our preferred specification utilizes the credit scoring model of Featherstone et al. (2006). This measure masks the importance of the information provided by the underlying financial inputs. Researchers could use the financial components of the credit score model in the specification and effectively decompose the information value of each metric.

We make a number of assumptions about lenders' cost of funds which could be addressed in future research. First, our interest rate spread outcome variable is the difference between observed loan specific interest rate and a proxy for year and lender specific cost of funds. This modeling choice masks the degree to which a lender in a certain region and year passes on the cost of funds. To address this choice, a researcher could specify observed interest rate as the outcome variable and add cost of funds as an independent variable. Additionally, we examine the relationship between the observed variation in lender types (region and year) with interaction terms.

Farm respondents to ARMS provide information on up to five specific loans, including their year of origination. Our preferred specification utilizes the repeated cross section of *newly originated* loans, so that we are able to compute the probability of default (A farms financial situation in year t is not the same as when a loan was originated in year $t-2$). However, with the potential to subset the data and include farm fixed effects, a researcher could relax the newly originated restriction and incorporate all observed loans. This additional step should add confidence to the estimates of our preferred specification.

Lastly, the competition in agricultural lending and the affect on our estimates is likely region specific. For example, different state banking regulations affect the cost of agricultural credit (Kandilov and Kandilov, 2018). A researcher could address this challenge through estimation of our preferred specification on geographic specific subsets of ARMS data.

This intention to evaluate the role of competition in agricultural lending is informed by an extension of our current methodology. We calculate the predicted interest rate spreads using our estimates of 1, to examine changes in loan spreads over time. Figures 1, 2, and 3 plot the predicted

value of interest rate spread (and the 95% confidence interval) for each of the years in our analysis. For all loan types, spreads have trended upwards, with intermediate loan spreads increasing the most, by 234 percent or 1.47 percentage points from 2008 to 2022. Given that funding costs trended broadly lower over the analysis period, these trend in rising spreads suggest lenders did not reduce charged interest rates by the same amount that funding costs declined. In contrast, the results suggest lenders captured a larger portion of the total charged interest rate. This may have been aided by structural changes in the market for agricultural credit, including increased consolidation among FCS and commercial bank lenders. Alternatively, the trend higher in spreads could be driven by increased borrower risk due to lower average (or more volatile) farm profitability (He and Tauer, 2023; Meyer and Westhoff, 2021; Scott, 2023). The degree to which these factors influence interest rate spreads is beyond our preferred specification. However, change in interest rate spreads plotted in figures 1, 2, and 3 suggest the need for further research.

References

Barry, P., P. Ellinger, and L. Moss (1997). Lending relationships, customer loyalty, and competition in agricultural banking. *Agricultural Finance Review 57*, 17–28.

Barry, P. J. (1995). *The Effects of Credit Policies on US Agriculture*. American Enterprise Institute.

Barry, P. J. and L. J. Robison (2001). Agricultural finance: Credit, credit constraints, and consequences. *Handbook of Agricultural Economics 1*, 513–571.

Berger, A. N. and G. F. Udell (1995). Relationship lending and lines of credit in small firm finance. *Journal of Business*, 351–381.

Brewer, B. E., J. S. Bergtold, A. M. Featherstone, and C. A. Wilson (2019). Farmers' choice of credit among the farm credit system, commercial banks, and nontraditional lenders. *Journal of Agricultural and Resource Economics 44*(2), 362–379.

Chhikara, R. K. (1989). The state of the art in credit evaluation. *American Journal of Agricultural Economics 71*(5), 1138–1144.

Dodson, C. B., B. L. Ahrendsen, and G. Short (2022). Does use of nontraditional credit increase risk? *Agricultural Finance Review 82*(2), 359–378.

Durguner, S., P. J. Barry, and A. L. Katchova. Credit scoring models: A comparison between crop and livestock farms. *2006 Agricultural and Applied Economics Association Annual Meeting, July 23-26, Long Beach, CA*.

Featherstone, A. M., L. M. Roessler, and P. J. Barry (2006). Determining the probability of default and risk-rating class for loans in the seventh farm credit district portfolio. *Applied Economic Perspectives and Policy 28*(1), 4–23.

Gloy, B. A., M. A. Gunderson, and E. L. LaDue (2005). The costs and returns of agricultural credit delivery. *American Journal of Agricultural Economics 87*(3), 703–716.

Gustafson, C. R. (1989). Credit evaluation: monitoring the financial health of agriculture. *American Journal of Agricultural Economics 71*(5), 1145–1151.

Hanson, S. D., L. J. Robison, and M. E. Siles (1996). Impacts of relationships on customer retention in the banking industry. *Agribusiness: An International Journal 12*(1), 27–35.

He, Y. and L. W. Tauer (2023). Agricultural credit association efficiencies over time and with mergers. *Agricultural and Resource Economics Review 52*(3), 520–546.

Jablonski, B., N. Key, J. Hadrich, A. Bauman, S. Campbell, D. Thilmany, and M. Sullins (2022). Opportunities to support beginning farmers and ranchers in the 2023 farm bill. *Applied Economics Perspectives and Policy 44*(3), 1177–1194.

Kandilov, A. M. and I. T. Kandilov (2018). The impact of bank branching deregulations on the us agricultural sector. *American Journal of Agricultural Economics 100*(1), 73–90.

Liberti, J. M. and M. A. Petersen (2019). Information: Hard and soft. *Review of Corporate Finance Studies 8*(1), 1–41.

Meyer, S. and P. Westhoff (2021). Estimates of farm income and the outlook for program crops and livestock, pre–and post-covid-19. *Choices 36*(3), 1–7.

Petersen, M. A. and R. G. Rajan (1994). The benefits of lending relationships: Evidence from small business data. *The Journal of Finance 49*(1), 3–37.

Petersen, M. A. and R. G. Rajan (1995). The effect of credit market competition on lending relationships. *The Quarterly Journal of Economics 110*(2), 407–443.

Scott, F. (2023). How mergers in the farm credit system have affected ag banks. *Economic Review-Federal Reserve Bank of Kansas City 108*(3), 43–65.

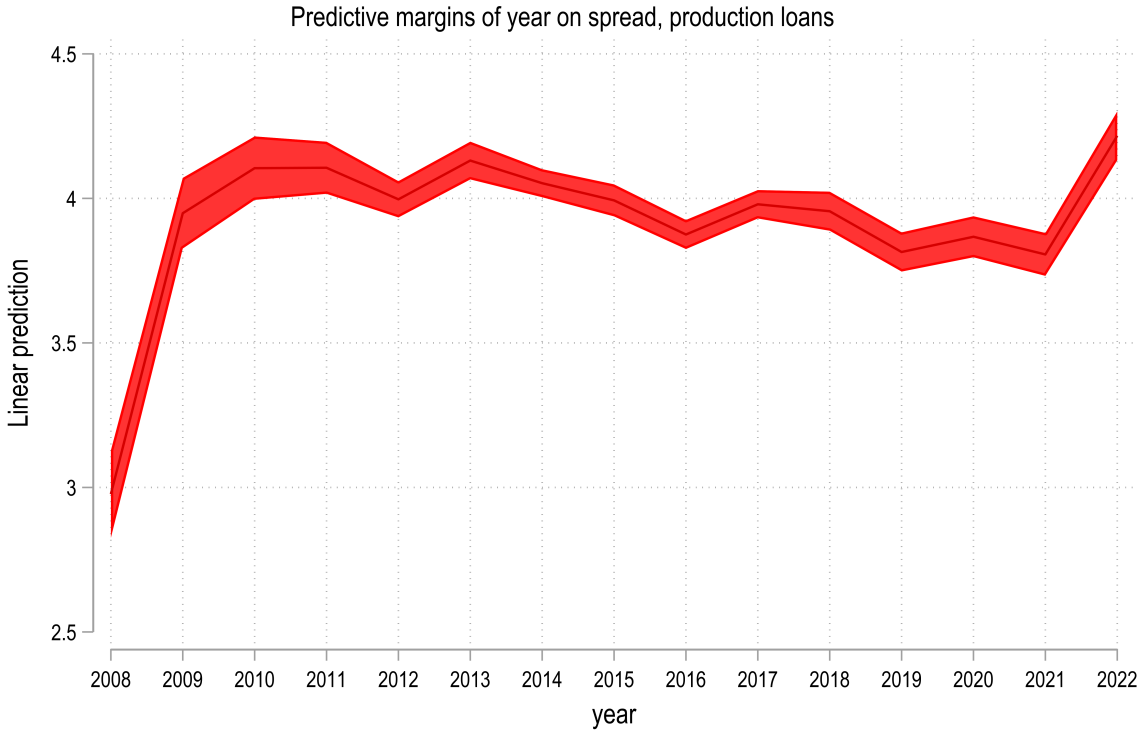
Sharpe, S. A. (1990). Asymmetric information, bank lending, and implicit contracts: A stylized model of customer relationships. *The Journal of Finance 45*(4), 1069–1087.

Stiglitz, J. E. and A. Weiss (1981). Credit rationing in markets with imperfect information. *The American Economic Review 71*(3), 393–410.

U.S. Department of Agriculture, Economic Research Service (2024). *Farm Sector Income Finances: Assets, Debt, and Wealth*. Technical report. February 7, 2024.

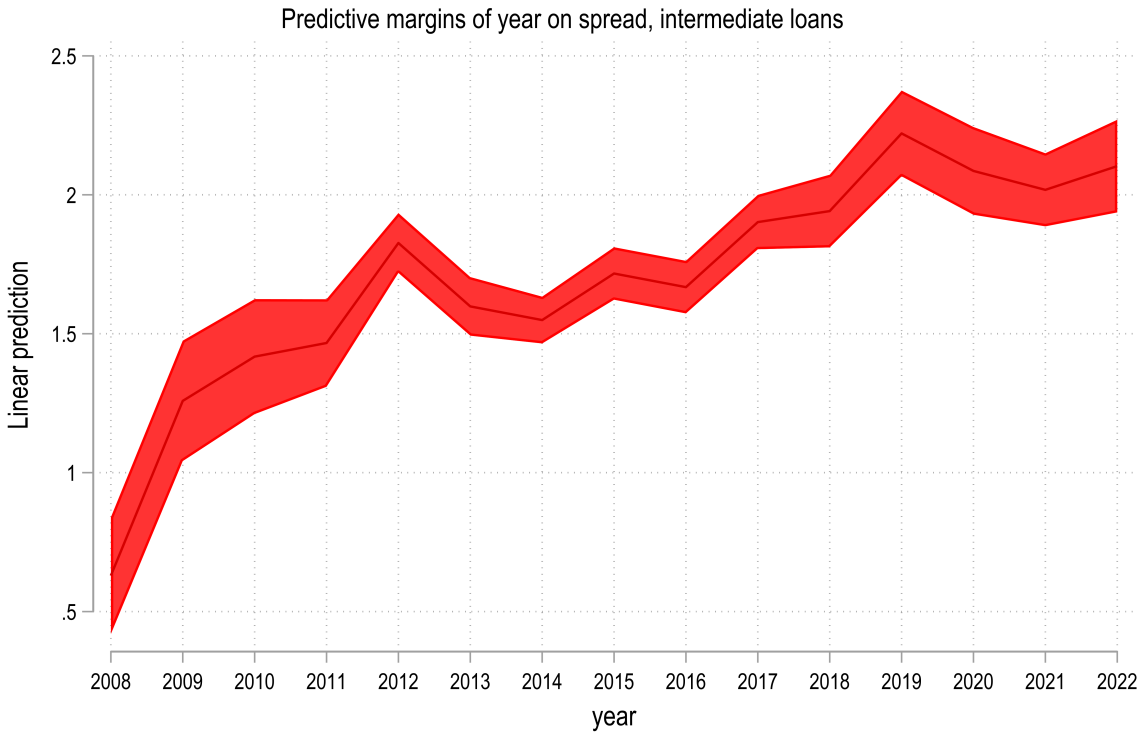
Figures

Figure 1: Predictive Margins calculated from estimates of (1) of year on Interest Rate Spread for Production Loans



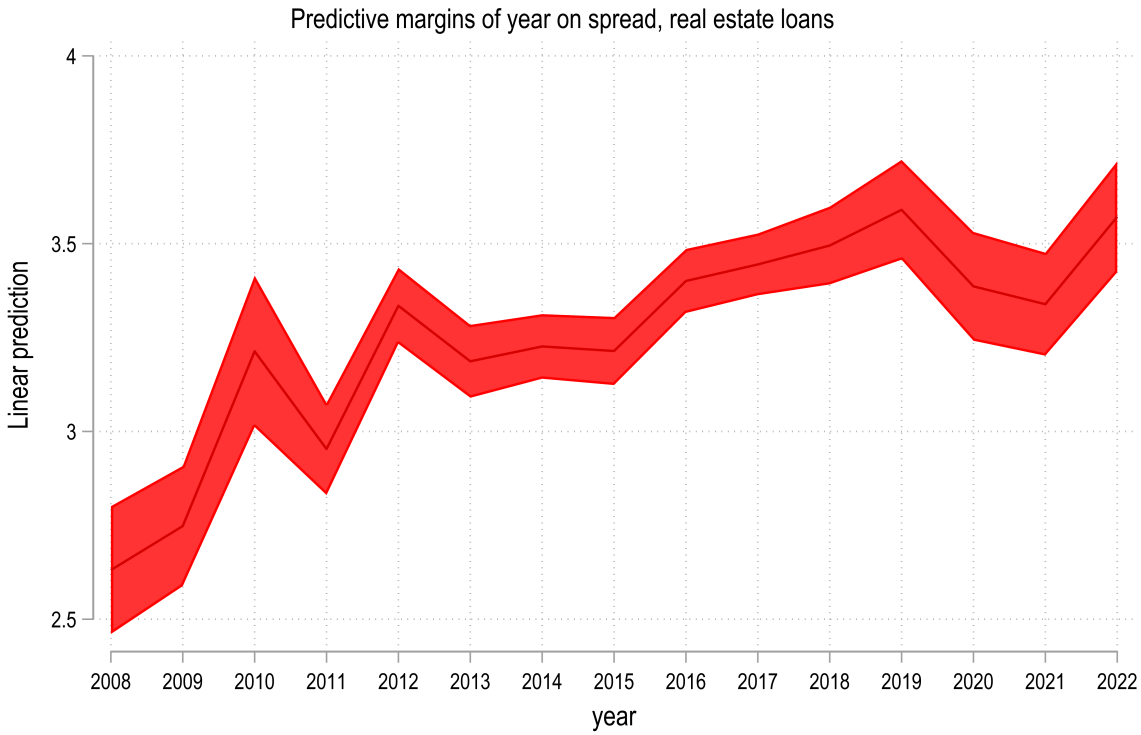
Source: USDA ARMS 2008 to 2022

Figure 2: Predictive Margins calculated from estimates of (1) of year on Interest Rate Spread for Intermediate Loans



Source: USDA ARMS 2008 to 2022

Figure 3: Predictive Margins calculated from estimates of (1) of year on Interest Rate Spread for Real Estate Loans



Source: USDA ARMS 2008 to 2022

Appendix

Table A1: Continuation of table 2. Ordinary least squares estimates of the year fixed effects in (1) (relationship between farm and lender characteristics and effective interest rate spreads in ARMS 2008 to 2022 for Farm loans)

	Production		Intermediate		Real Estate	
	Primary	Weighted	Primary	Weighted	Primary	Weighted
2008 (*omitted*)						
2009	0.972 ***	0.629 ***	0.629 ***	0.432	0.117	0.335
	[9.78]	[3.85]	[4.08]	[1.07]	[0.98]	[1.42]
2010	1.128 ***	0.751 **	0.788 ***	0.302	0.583	0.47
	[11.84]	[3.35]	[5.23]	[0.03]	[4.26]	[1.62]
2011	1.129 ***	0.874 ***	0.837 ***	0.618	0.322 **	0.324
	[12.58]	[6.58]	[6.24]	[1.84]	[3.01]	[1.22]
2012	1.02 ***	0.738 ***	1.197 ***	0.861 ***	0.704 ***	0.713 ***
	[12.23]	[4.46]	[9.97]	[1.38]	[6.95]	[4.79]
2013	1.154 ***	0.892 ***	0.969 ***	0.737 ***	0.556 ***	0.478 *
	[13.74]	[6.62]	[8.09]	[1.87]	[5.42]	[2.55]
2014	1.076 ***	0.717 ***	0.92 ***	0.633 ***	0.596 ***	0.783
	[13.28]	[6.83]	[7.95]	[0.74]	[6.12]	[1.84]
2015	1.016 ***	0.696 *	1.087 ***	0.626 ***	0.583 ***	0.561 **
	[12.37]	[2.48]	[9.21]	[0.94]	[5.93]	[2.85]
2016	0.898 ***	0.613 ***	1.038 ***	0.775 ***	0.77 ***	0.895 **
	[11.04]	[5.22]	[8.83]	[1.57]	[7.91]	[3.34]
2017	1.003 ***	0.565 ***	1.272 ***	0.974 *	0.814 ***	0.821 **
	[12.36]	[6.10]	[10.77]	[2.19]	[8.49]	[2.94]
2018	0.979 ***	0.423 *	1.312 ***	1.005 ***	0.864 ***	0.836 ***
	[11.63]	[2.68]	[10.40]	[1.14]	[8.47]	[3.83]
2019	0.838 ***	0.311 *	1.591 ***	1.448 *	0.959 ***	0.952 ***
	[9.92]	[2.17]	[11.90]	[2.31]	[8.71]	[3.95]
2020	0.89 ***	0.629 ***	1.457 ***	0.984 ***	0.756 ***	0.682 **
	[10.46]	[4.96]	[10.87]	[1.08]	[6.62]	[3.19]
2021	0.829 ***	0.413 **	1.388 ***	1.268 ***	0.708 ***	1.041 **
	[9.65]	[3.43]	[11.00]	[1.97]	[6.34]	[3.05]
2022	1.239 ***	0.861 ***	1.474 ***	1.574 ***	0.941 ***	1.037 **
	[14.07]	[4.53]	[10.78]	[1.24]	[8.16]	[3.47]
Constant	2.856 ***	3.343 ***	1.311 ***	1.186 ***	1.188 ***	1.186 ***
	[29.08]	[20.66]	[9.89]	[3.97]	[9.40]	[3.97]
Observations	40850	36449	14854	13151	7975	7141
R-squared		0.263		0.437		0.437

t statistics in brackets

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: US Department of Agriculture. Economic Research Service

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Table A2: Continuation of table 2. Ordinary least squares estimates of the region fixed effects in (1) (relationship between farm and lender characteristics and effective interest rate spreads in ARMS 2008 to 2022 for Farm loans)

	Production		Intermediate		Real Estate	
	Primary	Weighted	Primary	Weighted	Primary	Weighted
Heartland						
Northern Crescent	0.172 ***	0.142	0.203 ***	0.113	0.237 ***	0.124
	[4.81]	[0.92]	[3.82]	[0.02]	[5.26]	[0.53]
Northern Great Plains	0.145 ***	0.0663	0.162 **	0.106	0.139 *	-0.0344
	[4.47]	[0.66]	[2.60]	[0.29]	[2.24]	[-0.23]
Praire Gateway	0.39 ***	0.376 **	0.322 ***	0.393	0.305 ***	0.114
	[14.94]	[2.72]	[6.06]	[1.01]	[5.90]	[0.89]
Eastern Upland	0.157 **	0.161	0.346 ***	0.327	0.383 ***	-0.146
	[3.02]	[1.02]	[4.38]	[0.33]	[6.07]	[-1.09]
Southern Seaboard	0.245 ***	0.487 *	0.25 ***	0.647	0.376 ***	0.244
	[6.03]	[2.10]	[3.76]	[0.88]	[6.71]	[1.29]
Fruitful Rim	0.146 ***	-0.0412	0.366 ***	0.116	0.193 ***	0.0512
	[4.47]	[-0.39]	[5.38]	[0.36]	[3.33]	[0.23]
Basin and Range	0.321 ***	0.0984	0.411 ***	0.44	0.328 **	-0.161
	[5.93]	[0.69]	[3.84]	[0.60]	[3.21]	[-0.73]
Mississippi Portal	0.3 ***	0.235	0.415 ***	0.0117	0.389 ***	0.337
	[6.22]	[1.52]	[5.88]	[0.01]	[3.98]	[0.80]
Multiple Loans (binary)	-0.0201	0.0473	0.00781	0.0863	0.0356	-0.088
	[-0.67]	[0.60]	[0.14]	[0.03]	[0.75]	[-0.58]
Number of Loans	-0.0149	-0.0757	-0.0776 *	-0.118	-0.0179	0.029
	[-0.51]	[-1.00]	[-2.18]	[-0.38]	[-0.34]	[0.25]
Number of Loans w/ Lender	0.0196	0.0796	0.0832 *	0.171	0.00121	-0.024
	[0.63]	[1.04]	[2.28]	[0.71]	[0.02]	[-0.19]
Number of Lenders	-0.0605	-0.176	0.0751	0.0809	-0.0579	0.0682
	[-1.50]	[-1.60]	[1.33]	[0.16]	[-0.80]	[0.32]
Constant	2.856 ***	3.343 ***	1.311 ***	1.186 ***	1.188 ***	1.186 ***
	[29.08]	[20.66]	[9.89]	[3.97]	[9.40]	[3.97]
Observations	40850	36449	14854	13151	7975	7141
R-squared		0.263		0.437		0.437

t statistics in brackets

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: US Department of Agriculture. Economic Research Service

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