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Farm Loan Concentration and Financial Risk

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October 13, 2022

This research was supported in part by the USDA National Institute for Food and Agriculture Award number 2021-67023-33816. We gratefully acknowledge the cooperation and partnership of staff and members of Kansas Farm Management Association

Introduction

- Multiple borrowing - the use of credit from many lender types- is a common phenomenon: Government, firms & households.
- Such borrowing behavior is also a common feature among farms with growing diversity in lender types (Brewer et. al, 2014; Fiechter & Ifft, 2020).
- Consequently, loan concentration - the extent of depending on one loan type - is different across farms.

Introduction

- Kansas farms are no different.
- However, less is known about factors driving loan concentration and its associated financial risk.

Table 1: Multiple Borrowing Relationships, 2002-2020

Number of Lenders	Frequency	Percent	Cum.
1	4,907	41.8	41.8
2	3,741	31.9	73.7
3	1,935	16.5	90.2
4	828	7.1	97.3
5+	320	2.7	100
Total	11,731	100	

Source: Kansas Farm Management Association (KFMA). 5+ = five or more lenders.

Implications of multiple borrowing

- Multiple borrowing creates opportunities and risks, prompting studies.
  - Benefits: increase supply of credit, mitigation of hold-up
  - Risks: Monitoring, coordination failures, financial contagion/default externality
- Several financial studies measure multiple borrowing under the assumption that producers obtain equal loan volumes from lenders.
- We relax this assumption and account for differences in loan volumes across loan and lender types.

Research questions

- Using data from KFMA and other sources for the period 2002-2020, we respond to the following:
  - What farm and credit market characteristics are associated with multiple borrowing and loan concentration?
  - Do income shocks triggered by extreme weather conditions have a relationship multiple borrowing and loan concentration?

Measurement of Concentration

- We account for loan heterogeneity using loan shares.
  - However, a sum of all loan shares equal one with no variation.
  - We circumvent this by using concentration.
- Concentration measures simultaneous use of multiple, heterogeneous loan or lender types.
  - We employ Herfindahl–Hirschman Index (HHI) to capture this heterogeneity: $HHI = s_1^2 + s_2^2 + ... + s_n^2$
  - Loan concentration: s_n is loan n's share of total loan amount.
  - Lender concentration: s_n is lender n's share of total loan volume.
  - We transform these to range from 0 to 100.

Measurement of Concentration

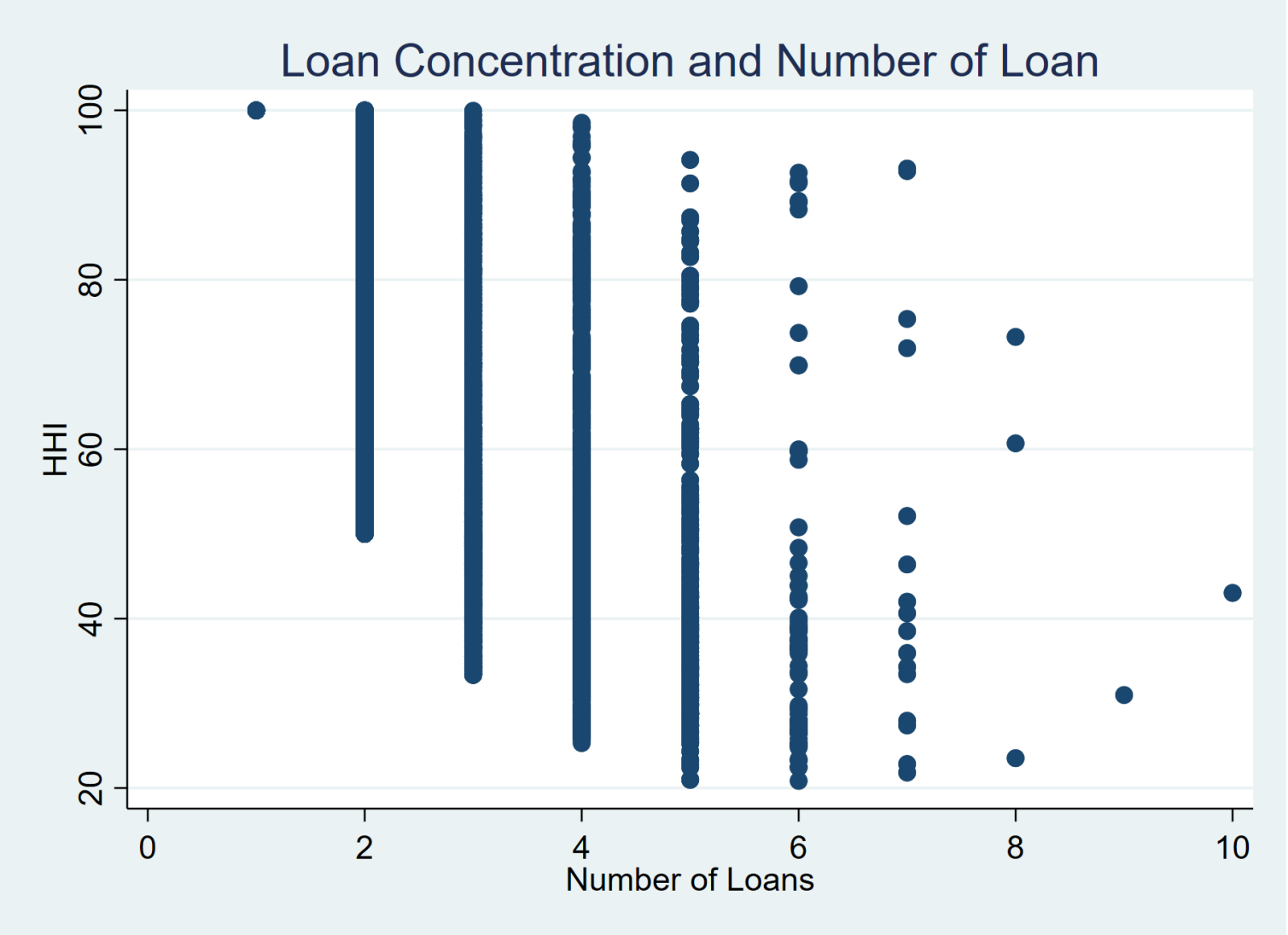
- If a producer obtains only one loan, her loan portfolio is highly concentrated with an HHI of 100.
- Obtaining new credit lowers loan concentration

	Loan 1	Loan 2	Loan 3	HHI	C	Loan Numbers
Farm A	\$120	0	0	100	Highly C	1
Farm B	\$100	\$20	0	72	C	2
Farm C	\$60	\$60	\$0	50	Less C	2
Farm D	\$40	\$40	\$40	33	Less C	3

Note:C=concentrated

- Loan numbers $\neq$ loan concentration
- Concentration accounts for heterogeneity despite loan numbers are 2.

Measurement of Concentration



Methodology

- Two models:
  - Cross-section: Determinants

$$G_{it} = \beta_0 + \beta_1 X_{it} + \tau_t + \epsilon_{it} \quad (1)$$

  - Fixed effects: Income Shocks/Temperature

$$HHI_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 K_{it} + \tau_t + \gamma_i + \epsilon_{it} \quad (2)$$

  where:
  - G_{it} is either HHI_{it} - loan or lender concentration of farm i at time t.
  - K_{it} is an income shock measure induced by extreme temperature of farm i in time t.
  - X_{it} is farm i's characteristics at time t and credit market conditions.
  - τ_t, γ_i & ϵ_{it} are time effects, farm fixed effects and error term respectively

Results: Loan Concentration Determinants

Dependent variable: loan concentration

- Revenue concentration (-)
- Farm size (-)
- Debt-to-asset ratio (-)
- Return-to-asset ratio (-)
- Agricultural Banks (+)
- ~~Presence of Farm Credit Branch~~
- ~~Banks per people~~
- Presence of Farm Credit Outpost (-)
- Business type (-)
- Operator's age (+)
- # of operators & employees (-)

Results: Loan Concentration Determinants

Dep. variable: Loan HHI	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Operator's age	0.30^{+}	0.30^{+}	0.30^{+}	0.21^{+}	0.30^{+}	0.19^{+}	0.18^{+}	0.19^{+}
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)
# of operators & employees	-1.37^{+}	-1.31^{+}	-1.21^{+}	-1.18^{+}	-1.21^{+}	-1.19^{+}	-0.91^{+}	-0.90^{+}
	(0.30)	(0.30)	(0.32)	(0.31)	(0.32)	(0.31)	(0.29)	(0.29)
Total farm size	-0.00^{+}	-0.00^{+}	-0.00^{+}	-0.00^{+}	-0.00^{+}	-0.00^{+}	-0.00^{+}	-0.00^{+}
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Partnership	-2.98$^{\times}$	-2.70$^{\times}$	-2.75$^{\times}$	-2.40*	-2.81$^{\times}$	-2.53*	-1.26	-0.38
	(1.30)	(1.30)	(1.34)	(1.30)	(1.34)	(1.30)	(1.27)	(1.26)
Sole Proprietorship	-7.51^{+}	-7.23^{+}	-7.55^{+}	-7.02^{+}	-7.60^{+}	-7.11^{+}	-7.42^{+}	-7.36^{+}
	(1.17)	(1.17)	(1.21)	(1.17)	(1.21)	(1.17)	(1.14)	(1.13)
Rented land share	-7.12^{+}	-6.75^{+}	-6.39^{+}	-2.89^{+}	-6.45^{+}	-2.79^{+}	-2.67$^{\times}$	-2.04*
	(0.92)	(0.91)	(0.95)	(1.03)	(0.95)	(1.05)	(1.05)	(1.05)
Revenue concentration		-0.04^{+}	-0.05^{+}	-0.05^{+}	-0.05^{+}	-0.05^{+}	-0.04^{+}	-0.03^{+}
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Number of agric. banks			0.80^{+}	0.77^{+}	0.81^{+}	0.80^{+}	0.60$^{\times}$	0.55$^{\times}$
			(0.24)	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)
Farm credit outpost			-2.30^{+}	-2.13^{+}	-2.29^{+}	-2.11^{+}	-1.25	-1.53*
			(0.78)	(0.77)	(0.78)	(0.77)	(0.79)	(0.78)
Debt-to-asset ratio				-15.29^{+}		-16.36^{+}	-16.87^{+}	-17.61^{+}
				(2.54)		(2.94)	(2.89)	(2.98)
Rate of Return to Asset					-3.28^{+}	-7.98^{+}	-7.64^{+}	-9.72^{+}
					(0.90)	(2.51)	(2.48)	(2.50)
Regional Fixed Effects	No	No	No	No	No	No	Yes	Yes
Year Fixed Effects	No	No	No	No	No	No	No	Yes
Observations	11508	11508	10819	10819	10819	10819	10819	10819
Adjusted R^2	0.075	0.078	0.079	0.105	0.080	0.108	0.124	0.140
AIC	109522.32	109475.44	102925.52	102623.22	102921.11	102587.54	102395.91	102208.73

Robust standard errors in parenthesis. * significant at 10%, × significant at 5% and + significant at 1%. Banks per people and farm credit branch are not reported.

Results: Income Shock Model

- Extremely hot weather conditions increase loan concentration.

Table 2: Extreme Weather Conditions and Loan Concentration, 2002-2020

Dep. variable: Loan HHI	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Log Hours above 32degrees	8.45^{+}	3.31^{+}	4.82^{+}	4.87^{+}	4.83^{+}	5.19^{+}	4.84^{+}	5.12^{+}
	(0.63)	(1.11)	(1.11)	(1.11)	(1.13)	(1.12)	(1.13)	(1.12)
Other Covariates	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11731	11731	11508	11508	10819	10819	10819	10819

Robust standard errors in parenthesis. * significant at 10%, x significant at 5% and + significant at 1%.

All other variables are included in same order as in tables above.

Results

- Are more leveraged farms impacted differently by income shocks induced by extreme weather conditions?

Table 3: Extreme Weather Conditions and Concentration

Dependent Variable	Loan Concentration			Lender Concentration		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Log Hours above 32degrees	5.170^{+}	6.805^{+}	4.843^{+}	3.126^{x}	2.555^{*}	2.181^{x}
	(1.590)	(1.449)	(1.133)	(1.322)	(1.327)	(0.938)
Observations	5239	5580	10819	5239	5580	10819

Robust standard errors in parenthesis. * significant at 10%, x significant at 5% and + significant at 1%.
Models 1 & 4 are for less leveraged farms, Models 2 & 5 are for more leveraged farms. All farms are in Models 3 & 6
All other covariates are included in the model.

Other Results: Probability of Multiple Borrowing

Dependent variable: Multiple Borrowing is one if loan numbers >= 2, zero otherwise.

- Revenue concentration (+)
- Farm size (+)
- Debt-to-asset ratio (+)
- Return-to-asset ratio (+)
- Agricultural Banks (- $\sim$)
- ~~Presence of Farm Credit Branch~~
- Rented land share (+ $\sim$)
- ~~Banks per people~~
- ~~Presence of Farm Credit Outpost~~
- Business type (+)
- Operator's age (+)
- # of operators & employees (-)

Other results: Probability of multiple borrowing

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Operator's age	-0.00^{+}	-0.00^{+}	-0.00^{+}	-0.00^{+}	-0.00^{+}	-0.00^{+}	-0.00^{+}	-0.00^{+}
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
# of operators & employees	0.02^{+}	0.02^{+}	0.02^{+}	0.02^{+}	0.02^{+}	0.02^{+}	0.02^{+}	0.02^{+}
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total farm size	0.00^{+}	0.00^{+}	0.00^{+}	0.00^{+}	0.00^{+}	0.00^{+}	0.00^{+}	0.00^{+}
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Partnerships	0.03	0.03	0.02	0.02	0.03	0.02	0.01	-0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Sole Proprietor	0.08^{+}	0.08^{+}	0.08^{+}	0.07^{+}	0.08^{+}	0.07^{+}	0.07^{+}	0.07^{+}
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Rented land share	0.05^{+}	0.05^{+}	0.05^{+}	0.00	0.05^{+}	0.00	-0.00	-0.01
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
Revenue concentration		0.00^{+}	0.00^{+}	0.00^{+}	0.00^{+}	0.00^{+}	0.00^{+}	0.00^{+}
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Number of agric. banks			-0.01^{x}	-0.01*	-0.01^{x}	-0.01^{x}	-0.01	-0.00
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Debt-to-Asset ratio				0.21^{+}		0.22^{+}	0.23^{+}	0.24^{+}
				(0.04)		(0.04)	(0.04)	(0.04)
Rate of Return to Asset					0.05^{+}	0.12^{+}	0.12^{+}	0.14^{+}
					(0.02)	(0.04)	(0.04)	(0.04)
Regional Fixed Effects	No	No	No	No	No	No	Yes	Yes
Year Fixed Effects	No	No	No	No	No	No	No	Yes
Observations	11508	11508	10819	10819	10819	10819	10819	10819
Adjusted R^2	0.036	0.038	0.040	0.062	0.040	0.066	0.074	0.087
AIC	12030.81	12002.84	11420.12	11160.63	11414.02	11124.23	11028.12	10891.96

R. std. errors in parenthesis. * significant at 10%, x significant at 5% and + significant at 1%. Dep. variable is one if loan numbers >= 2, zero otherwise.

Farm credit branch, outpost and banks/people were included but they are stat. insignificant.

Conclusion

- Insights: Income shocks are not a major driver of multiple borrowing in KFMA farms; multiple borrowing appears to be driven by its advantages for new investment
- Future Research:
  - Heterogeneity in income shock model
  - What factors drive the use of a specific lender?
  - Other measures of income shocks or financial stress?


THANK YOU