Rural Innovative Firms and Credit: Findings from the Annual Business Survey

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Motivation

- Access to Capital Gap: Do rural businesses, especially innovative ones, face significant challenges in accessing financial capital compared to their urban counterparts?
- Information Asymmetry: The primary cause of market failure in rural business financing is hypothesized to be information asymmetry between businesses and financial institutions, particularly pronounced for innovative firms
- Small Business Disadvantage: The majority of rural businesses are SMEs, which may face greater difficulties in securing traditional bank loans due to lack of assets and higher perceived risk
- Innovation and Credit Rationing: Previous research suggests that more innovative businesses may face rationing from formal financial institutions, where loan amounts are limited rather than charged higher interest rates due to perceived higher risks

Research Questions

- What factors influence a firm's decision to apply for credit?
- What determines the amount of credit firms receive when successful in their applications?
- Are there differences in credit amounts based on firm owner characteristics, firm size, sector, or innovative activities?
- Do these factors differ between metro and nonmetro areas when applying for and receiving credit?

Preview of Results

- Non-metro and Metro Areas:
  - Advanced Technology Use or New/Improved Goods/Services
    - Positive effect on likelihood of applying for credit
    - Negative effect on credit amount received
    - Effects are consistent across both areas with no major differences
- Other variables
  - Firm characteristics (e.g., manufacturing, foreign-born ownership, female ownership, firm age, owner age, multi-ownership, firm size) and county-level factors (e.g., inventive class percentage, latent innovation, population, poverty rate, unemployment rate, and CRA loan amounts)

Previous Literature

- SMEs and Financial Constraints:
  - Higher costs and risks for SMEs compared to larger firms (Binks et al., 1992)
  - SMEs more likely to rely on informal borrowing (Beck et al., 2009)
- Innovation and Finance:
  - Mixed evidence: Mina et al. (2013) found no disadvantage for R&D-intensive firms
  - Structural challenges: Uncertainty of returns, valuation difficulties (Hall, 2002; O'Sullivan, 2006)
- Factors Influencing Access to Finance
  - Firm size: Smaller firms face more difficulties (Freel, 2007)
  - Industry: High-tech firms more constrained (Canepa and Stoneman, 2007)
  - Location: Rural firms at a disadvantage (Felsenstein and Fleischer, 2002)

Data

- Main Data Sources:
  - 2021 Annual Business Survey (ABS)
  - 2020 Longitudinal Business Database (LBD)
  - Local county-level infrastructure variables
  - Provides comprehensive view of business dynamics and local economic conditions
  - Confidential; requires approved research proposal
  - Accessible only through Federal Statistical Research Data Centers (FSRDC)

SMALL BUSINESS CREDIT

When answering the following questions, please respond based on this business's credit-seeking activity for the 12 months ending December 31, 2020. *Exclude loans that were forgiven as part of a government response to the coronavirus pandemic.*

F.9 New Credit Applications

For the 12 months ending December 31, 2020, did this business submit an application for new credit (e.g., a credit card, loan, line of credit, trade financing, etc.)?

- ☐ Yes
- ☐ No – **Skip to SECTION G: MANAGEMENT PRACTICES** on page 39
- ☐ Don't know – **Skip to SECTION G: MANAGEMENT PRACTICES** on page 39

F.11 New Credit Received

For the 12 months ending December 31, 2020, how much of the total amount of credit requested did this business receive?

- ☐ None
- ☐ Some
- ☐ All
- ☐ Don't know

E.6 New or Improved Goods

During the three years 2018 to 2020, did this business introduce to the market any new or improved goods that differed significantly from this business's previous goods? *This includes the addition of new functions or improvements to existing functions or user utility. Functions include quality, technical specifications, reliability, durability, economic efficiency during use, affordability, convenience, usability, and user friendliness. User utility includes attributes such as affordability and financial convenience.*

Goods: usually a tangible object, such as a smartphone, furniture, or packaged software, but also includes digital goods, such as downloadable software, music and film. *Exclude the simple resale of new goods or changes of a solely aesthetic nature.*

☐ Yes

☐ No

E.7 New or Improved Services

During the three years 2018 to 2020, did this business introduce to the market any new or improved services that differed significantly from this business's previous services? *This includes the addition of new functions or improvements to existing functions or user utility. Functions include quality, technical specifications, reliability, durability, economic efficiency during use, affordability, convenience, usability, and user friendliness. User utility includes attributes such as affordability and financial convenience.*

Services: intangible activities, such as retailing, insurance, educational courses, air travel, consulting, etc.; also includes digital services. *Exclude the simple resale of new services.*

☐ Yes

☐ No

E.3 Business Technologies

In 2020, did this business produce goods or provide services by using or applying any of the following technologies?

Select one for each row.

	In use	In testing, but not in use	Not in use nor testing	Don't know
a. Augmented reality	☐	☐	☐	☐
b. Automated guided vehicles (AGV) or AGV systems	☐	☐	☐	☐
c. Machine learning	☐	☐	☐	☐
d. Machine vision	☐	☐	☐	☐
e. Natural language processing	☐	☐	☐	☐
f. Radio-frequency identification (RFID) system	☐	☐	☐	☐
g. Robotics	☐	☐	☐	☐
h. Touchscreens/kiosks for customer interface (e.g., self-checkout, self-check-in, touchscreen ordering)	☐	☐	☐	☐
i. Voice recognition software	☐	☐	☐	☐
j. Additive manufacturing (3D printing), including prototyping	☐	☐	☐	☐

Note: We omit h&i when constructing the new technology dummy variable

Methods and Models

- Primary Model: Ordered Probit Heckman Selection Model
  - First Stage: Probit model for firm's decision to apply for credit
  - Second Stage:
    - Ordered probit model for credit amount received
    - Dependent variable categories:0 = None, 1 = Some, 2 = All
    - Larger values indicate higher credit received
  - We excluded all county-level regressors in the second stage while retaining all firm and firm-owner variables in both the first and second stages, as county-level conditions are more likely to affect firms' decisions to apply for credit
  - Our study examines the relationship between credit access and innovation, noting potential limitations in causal interpretation due to endogeneity concerns, while acknowledging that the time frame difference may mitigate reverse causality issues (credit question 2020; innovation 2010-2020)

Table 1 Summary Stats

	Non-metro		Metro	
	Mean	Std. Div	Mean	Std. Div
apply for credit	0.168	0.374	0.146	0.353
credit amount== none	0.013	0.112	0.017	0.128
credit amount== some	0.036	0.186	0.039	0.193
credit amount== all	0.106	0.308	0.079	0.27
bus tech inuse	0.062	0.241	0.075	0.264
inno good	0.055	0.228	0.074	0.262
inno serv	0.058	0.234	0.086	0.281
manufact	0.222	0.415	0.172	0.377
foreignborn	0.071	0.257	0.202	0.402
female	0.508	0.5	0.439	0.496
firmage	17.68	13.43	15.55	12.7
owner age lower 45	0.239	0.426	0.238	0.426
multi owner	0.514	0.5	0.45	0.497
small firm (0-9)	0.725	0.447	0.731	0.444
medium firm (10-250)	0.247	0.432	0.256	0.436
large firm (>250)	0.028	0.164	0.013	0.115
log inventive class	6.388	1.254	10.05	1.439
latent innovation	-0.029	0.763	1.195	0.649
pop 1k 2019	53.85	77.87	1344	1994
pct poverty rate 2019	13.95	5.249	11.33	3.918
unemployment rate 2019	3.871	1.319	3.503	0.947
lg cra loan amount	17.13	3.196	21.06	2.574

Note: There are 22,500 nonmetro firms and 139,000 metro firms

Table 2 Non-metro Heckman Model (three categories of dependent variable, 0=None, 1=Some, 2=All)

	(1) first stage	(2) second stage	(3) first stage	(4) second stage	(5) first stage	(6) second stage
bus_tech_inuse	0.298***	-0.173**				
	(0.039)	(0.073)				
inno_good			0.314***	-0.278***		
			(0.041)	(0.077)		
inno_serv					0.402***	-0.313***
					(0.039)	(0.086)
manufact	0.057**	-0.075*	0.059**	-0.062	0.089***	-0.093**
	(0.025)	(0.041)	(0.025)	(0.044)	(0.025)	(0.046)
foreignborn	-0.126***	-0.05	-0.131***	-0.063	-0.128***	-0.078
	(0.042)	(0.080)	(0.042)	(0.094)	(0.042)	(0.092)
female	-0.072***	0.027	-0.076***	0.022	-0.080***	0.022
	(0.023)	(0.041)	(0.023)	(0.046)	(0.023)	(0.047)
firmage	-0.006***	0.012***	-0.006***	0.012***	-0.006***	0.012***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)
owner_age_lower_45	0.220***	-0.125**	0.220***	-0.105	0.214***	-0.087
	(0.024)	(0.052)	(0.024)	(0.067)	(0.024)	(0.067)
multi_owner	0.096***	0.034	0.097***	0.047	0.103***	0.052
	(0.024)	(0.049)	(0.024)	(0.058)	(0.024)	(0.059)
medium size firm (10-250)	0.277***	-0.071	0.287***	-0.051	0.283***	-0.024
	(0.024)	(0.069)	(0.024)	(0.092)	(0.024)	(0.090)
large size firm (>250)	0.278***	0.142	0.366***	0.13	0.382***	0.145
	(0.096)	(0.122)	(0.097)	(0.128)	(0.096)	(0.134)
county % inventive class	-0.053***		-0.051***		-0.052***	
	(0.014)		(0.014)		(0.015)	
county latent innovation	-0.029**		-0.029**		-0.029**	
	(0.014)		(0.014)		(0.014)	
county_pop_1k_2019	0.0003		0.00018		0.000139	
	(0.0003)		(0.0003)		(0.0003)	
county_pct_poverty_2019	-0.00038		-0.0002956		-0.000418	
	(0.002)		(0.002)		(0.002)	
county_unemploy_rate_2019	-0.008		-0.008		-0.007	
	(0.009)		(0.009)		(0.009)	
log_cra_amount	0.025***		0.026***		0.028***	
	(0.005)		(0.005)		(0.005)	

Table 3 Metro Heckman Model (three categories of dependent variable, 0=None, 1=Some, 2=All)

	(1) first stage	(2) second stage	(3) first stage	(4) second stage	(5) first stage	(6) second stage
bus_tech_inuse	0.261***	-0.189***				
	(0.015)	(0.019)				
inno_good			0.309***	-0.282***		
			(0.015)	(0.019)		
inno_serv					0.326***	-0.299***
					(0.014)	(0.018)
manufact	0.116***	-0.097***	0.113***	-0.088***	0.150***	-0.123***
	(0.011)	(0.015)	(0.011)	(0.015)	(0.011)	(0.015)
foreignborn	-0.036***	-0.098***	-0.039***	-0.093***	-0.036***	-0.098***
	(0.011)	(0.016)	(0.011)	(0.016)	(0.011)	(0.016)
female	-0.049***	0.052***	-0.049***	0.050***	-0.052***	0.053***
	(0.009)	(0.012)	(0.009)	(0.012)	(0.009)	(0.012)
firmage	-0.005***	0.011***	-0.005***	0.011***	-0.005***	0.011***
	0.000	(0.001)	0.000	(0.001)	0.000	(0.001)
owner_age_lower_45	0.171***	-0.127***	0.172***	-0.128***	0.166***	-0.122***
	(0.010)	(0.014)	(0.010)	(0.014)	(0.010)	(0.014)
multi_owner	0.047***	0	0.045***	0.004	0.051***	-0.001
	(0.010)	(0.013)	(0.010)	(0.013)	(0.010)	(0.013)
medium size firm (10-250)	0.285***	-0.108***	0.290***	-0.110***	0.288***	-0.107***
	(0.010)	(0.015)	(0.010)	(0.015)	(0.010)	(0.015)
large size firm (>250)	0.333***	-0.111**	0.360***	-0.127***	0.352***	-0.118**
	(0.034)	(0.048)	(0.034)	(0.048)	(0.034)	(0.049)
county % inventive class	-0.035***		-0.035***		-0.037***	
	(0.005)		(0.005)		(0.005)	
county latent innovation	-0.004		-0.004		-0.005	
	(0.008)		(0.008)		(0.008)	
county_pop_1k_2019	<0.001		<0.001		<0.001	
	(<0.001)		(<0.001)		(<0.001)	
county_pct_poverty_2019	0.002*		0.002*		0.002*	
	(0.001)		(0.001)		(0.001)	
county_unemploy_rate_2019	-0.014***		-0.014***		-0.014***	
	(0.004)		(0.004)		(0.004)	
log_cra_amount	0.007***		0.007***		0.008***	
	(0.002)		(0.002)		(0.002)	

Discussions

- Key findings:
  - Innovation and Credit Application: Advanced technology use and innovation in goods or services increase likelihood of applying for credit in both metro and non-metro areas
  - Innovation and Credit Amount: These same factors negatively associated with the amount of credit received, consistent with asymmetric information explanations of credit rationing
  - Metro vs. Non-Metro Comparison: These results are consistent across both areas, with slight variations in magnitude
- Implications:
  - Information Asymmetry: Results suggest persistent information asymmetry between innovative firms and lenders
  - Risk Perception: Lenders may view innovative activities as higher risk, leading to lower credit amounts
  - Rural Innovation Challenges: Innovative rural firms face similar challenges to their urban counterparts in accessing credit

Areas for future research

- Replicate analysis using 2023 ABS with a much larger sample when available that contains full innovation module (e.g. new-to-market vs new-to-business innovation) to assess robustness of results from thin innovation module in 2021 ABS
- Current findings are ambiguous with respect to credit rationing in innovation finance: are innovation projects denied adequate funds or just innovative firms? Question on financing innovation projects to be examined in 2014 Rural Establishment Innovation Survey
- Are Federal loan guarantee programs addressing the apparent innovation finance gap: Link ABS to USDA/Rural Business Service Loan Guarantee Program records to examine whether innovative firms are likely participants and if loan requests are more likely to be fulfilled

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