How Export Performance is Mediated by Varieties of Innovation, Owner Characteristics, and Location

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Introduction

- Rural nonfarm exports in the US are significantly larger than agricultural exports, offering potential to reduce the trade deficit.
- The US trade deficit, primarily in manufactured goods, calls for an alternative solution to protectionism.
- Research on regional or firm-level factors influencing export performance is limited in the US, particularly in rural areas.
- This study examines the link between rural nonfarm exports and innovation by merging confidential firm-level trade and innovation data.
- This study combines LFTTD export data and ABS innovation data to investigate the role of innovation in export performance, owner characteristics, and differences between metro and nonmetro firms, potentially filling a research gap in the US.
- Data from the Longitudinal Firm Trade Transactions Database (LFTTD) and Annual Business Survey (ABS) are used for this analysis.
- The research aims to uncover whether innovation is associated with export behavior, using a two-stage selection model.
- The implications of these findings are relevant for trade policy and rural innovation policy.

Relevant Literature

- A recent analysis indicates that patent-intensive manufacturing tends to concentrate in nonmetro areas with higher shares of inventive occupations, whereas the largest cities show a negative association between patent-intensive manufacturing and inventive occupations (Dotzel and Wojan, 2022).
- Special tabulation of export data at the 3-digit NAICS level reveals a substantial disparity between metro and nonmetro exports, with metro exports being approximately 10 times higher. Exports per employee in metro factories are roughly 2.4 times greater than in nonmetro factories (Wojan, 2019).
- Firm size and human capital intensity are commonly associated with exporting, as larger firms and those with higher human capital tend to export more. Factors related to innovation and technology, such as R&D expenditures and patents, are consistently linked to increased export likelihood. Additional factors, including characteristics of business owners, have not been extensively analyzed at the establishment level but may impact export propensity (Love and Roper, 2015; Wagner, 2010).

Methods and Data

- **Linear Model:** We started with a linear regression model for a firm i:

$$Export_i = \beta_0 + \beta_1 Innovation_i + \beta_2 X_i + \varepsilon_i$$

The dependent variable refers to the total firm export value from 2017-2020 in natural logarithm. $Innovation_i$ is a dummy variable that indicates a specific type of firm innovation orientation, including new-to-market innovation, new-to-business innovation, process innovation, and marketing innovation. X_i is a set of control variables for firm and firm-owner characteristics. The set contains a dummy variable if any of the firm's owner has a bachelor's degree or above; a dummy if any of the firm's owner has a STEM degree; a dummy indicating if any firm owners are younger than 45 years old; a dummy if any of the firm owners are foreign-born; and a dummy if the firm has more than one owner. We also control if the firm is in the manufacturing sector, three firm size categories; the locations of firms in terms of nine rural-urban continuum codes; county-level latent innovation, natural amenity scale, and social capital

- **Endogeneity**: The naïve linear regression above may not capture potential causal effects due to endogeneity issues. For example, as we only observe exporting values for firms that choose to export, the selection into exporting could be endogenous. We use a Heckman Selection Model to address the endogeneity caused by self-selection.
- **Heckman Selection Model:** The export behavior of firms is modeled as a two-stage process: 1) a selection model first estimates the probability of exporting and 2) an outcome equation estimates the growth in exports. This allows examining the independent effects of innovation on the propensity to export and export success:

$$Prob(V = 1|Z) = \Phi(Z\gamma)$$

where V indicates any export activity in 2017-2020, and Z is a vector of firm characteristics (employment size), firm owner characteristics(e.g., foreign-born), community characteristics (e.g., latent innovation). The outcome equation of interest is the total export value from 2017-2020:

$$E[\text{Export}|X, V = 1] = X\beta + \rho\sigma_\mu\lambda(Z\gamma)$$

Results

- In the first stage selection model, firms more likely to export include those with at least one owner with a bachelor's degree, a STEM degree, or being foreign-born. Larger firms, manufacturing firms, and firms with more than one owner were also more likely to export. Firms located in a county that is more innovative, has better amenity are more likely to export.
- The only ownership characteristics associated with a lower probability of exporting was the presence of owners less than 45 years old. Firms located in a county with higher social capital are less likely to export.
- In the second stage for export values, we find consistently positive effects on all the innovation variables. We also interact each innovation variable with a metro dummy to investigate whether firm location affects the importance of innovation.
- We find a positive impact of metro location on export values. However, we do not identify any interaction effects between innovation variables and a metro dummy.

Table 1 Selection Stage on Export Propensity

bachelor_above	0.024***
	(0.0060)
stem_degree	0.055***
	(0.0070)
owner_age_lower_45	-0.096***
	(0.0070)
foreignborn	0.142***
	(0.0070)
multi_owner	0.158***
	(0.0060)
emp between 9 - 250	0.530***
	(0.0060)
emp larger than 250	0.854***
	(0.0230)
manufact	1.114***
	(0.0070)
innovation	0.055***
	(0.0050)
natural_amenity_scale	0.010***
	(0.0010)
social capital	-0.008**
	(0.0040)

Table 2 Second Stage on Export Intensity

	(1)	(2)	(3)	(4)
inno_newmrk	4.022***			
	(0.5820)			
inno_newbus		2.898***		
		(0.5340)		
inno_process			3.144***	
			(0.5010)	
inno_marketing				2.098***
				(0.5010)
metro	0.660**	0.766**	0.994***	0.743**
	(0.3050)	(0.3120)	(0.3250)	(0.3250)
inno. metro interaction	0.639	0.172	-0.594	-0.017
	(0.6140)	(0.5650)	(0.5300)	(0.5300)
bachelor_above	0.182	0.183	0.216	0.179
	(0.1910)	(0.1910)	(0.1910)	(0.1920)
stem_degree	0.639***	0.937***	0.974***	1.057***
	(0.2160)	(0.2160)	(0.2160)	(0.2160)
owner_age_lower_45	-1.763***	-1.799***	-1.774***	-1.816***
	(0.2090)	(0.2090)	(0.2090)	(0.2100)
foreignborn	2.472***	2.494***	2.452***	2.526***
	(0.2340)	(0.2320)	(0.2320)	(0.2320)
multi_owner	1.602***	1.603***	1.629***	1.607***
	(0.1970)	(0.1950)	(0.1950)	(0.1960)
emp between 9 - 250	4.074***	3.871***	3.726***	3.814***
	(0.3900)	(0.3740)	(0.3750)	(0.3760)
emp larger than 250	8.440***	8.239***	8.005***	8.214***
	(0.7740)	(0.7550)	(0.7570)	(0.7580)
manufact	5.294***	5.216***	4.958***	5.237***
	(0.7230)	(0.6870)	(0.6900)	(0.6910)
Observations	466000	466000	466000	466000

Conclusions

- The findings may inform important economic development issues. First, the increasing concentration of manufacturing in rural areas and commensurate decline in urban areas has raised concerns regarding the international competitiveness of the dominant export sector, with implications for the balance-of-trade going forward.
- Second, despite nonfarm rural exports being more than an order of magnitude larger than rural agricultural exports, the topic has generated little academic or policy interest.
- Given the much lower level of export intensity of rural factories, generally, these preliminary results suggest potentially large returns to the investigation of the possible causal effects of rural innovation on trade.

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