Technical Appendix for "The postal network as economic infrastructure: Evidence from rural small businesses"

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Main econometric specifications

The relationship between postal access and small-business activity is estimated using county-level ordinary least squares (OLS) regression of the form:

$$UnincorpRate_{ct} = \beta_0 + \beta_1 PostalDist_c + \Gamma \mathrm{X}_{ct} + \alpha_s + \delta_t + \varepsilon_{ct}$$

for county c in state s and year t. The outcome variable, $UnincorpRate_{ct}$, measures the number of unincorporated business returns per 1,000 individual tax returns filed in the county. The key independent variable, $PostalDist_c$, is the population-weighted distance (in miles) from census-block centroids to the nearest post office, aggregated to the county level using 2010 population weights. The coefficient $\hat{\beta}_1$ captures how variation in postal access correlates with small-business activity, holding fixed observable county characteristics X_{ct}, state fixed effects α_s, and year fixed effects δ_t.

The vector of controls X_{ct} includes log population, log median household income, the share of adults with a bachelor's degree or higher, the poverty rate, the unemployment rate, and the share of households with broadband access. All regressions restrict the sample to small metropolitan, micropolitan, and noncore counties (NCHS urban-rural codes 4, 5, and 6). Standard errors are clustered at the county level to account for serial correlation within counties over time. Results are reported in Table A1.

Table A1. Greater Distance to Post Offices is Robustly Associated with Fewer Rural Small Businesses

	(1)	(2)	(3)
Miles to Nearest Post Market	-0.989***	-1.196***	-0.514***
	(0.213)	(0.234)	(0.198)
County-Years	11,103	11,103	11,103
Adjusted R2	0.043	0.196	0.363
Within State		x	x
Within Year		x	x
County Socioeconomic Controls			x

Notes: Table reports ordinary least squares estimates of the relationship between distance to the nearest post office and unincorporated business activity. Model 2 adds year and state fixed effects, and Model 3 adds population controls, demographic controls, and broadband access. Outcome is unincorporated businesses per 1,000 tax returns. Standard errors clustered by county.

Industry-specific regressions follow the same specification but replace the outcome with rates for individual 2-digit NAICS industries. Sensitive industries are classified based on whether the coefficient on postal distance is negative and statistically significant at the 5% level for regressions run within-industry. Seven industries meet this criterion: Construction (23), Retail Trade: General Merchandise and Miscellaneous (45), Transportation (48), Professional Services (54), Administrative Support (56), Health Care (62), and Other Services (81). Results are shown in Table A2.

Table A2. Industries Likely to Rely on Routine Physical Transactions are Most Sensitive to Postal Access

	Total Effect	Sensitive Industries	Insensitive Industries
Miles to Post Office	-0.514***	-0.523***	0.00941
	(0.198)	(0.138)	(0.0735)
County-Years	11,103	11,103	11,103
Adjusted R2	0.368	0.294	0.505

Notes: Industries are grouped based on whether distance to the nearest post office is significantly associated with lower unincorporated business activity. Classification is based on industry-specific regressions controlling for state and year fixed effects and county characteristics. Standard errors are clustered by county.

The broadband heterogeneity analysis (Table A3) estimates the baseline specification separately within terciles of broadband coverage to test whether the postal distance effect attenuates in counties with higher digital connectivity.

Table A3. Broadband Expansion Supports Small-Business Activity Regardless of Postal Distance

	Digital Connectivity		
	Low	Medium	High
Miles to Post Office	-0.570***	-0.580***	-0.323*
	(0.167)	(0.168)	(0.194)
County-Years	3,722	3,687	3,693
Adjusted R2	0.272	0.329	0.292

Notes: Table reports estimates of the effect of postal distance on unincorporated business activity, shown separately for counties with low, medium, and high digital connectivity (connectivity terciles). Low, Medium, and High Coverage reflects any broadband rates of <71.9%, 71.9 – 79.5%, and >79.5%, respectively. All models include state and year fixed effects and time-varying demographic controls. Standard errors are clustered by county.

Broadband interaction specification

Table A4 provides an alternative test of the relationship between broadband access and the postal distance effect. Rather than stratifying by broadband tercile, this specification interacts postal distance with broadband coverage directly:

$$y_{ist} = \beta_1 \text{Distance}_i + \beta_2 \text{Broadband}_{it} + \beta_3 (\text{Distance}_i \times \text{Broadband}_{it}) + \delta_s + \tau_t + \varepsilon_{ist}$$

The coefficient β_1 captures the effect of postal distance when broadband coverage is zero, β_2 captures the effect of broadband when distance is zero, and β_3 indicates whether broadband moderates the distance penalty. A positive interaction ($\beta_3 > 0$) would suggest that broadband partially substitutes for postal access. State and year fixed effects are captured by δ_s and τ_t, respectively.

Table A4. Alternative Test of the Effect of Digital Connectivity

	Total Effect	**Sensitive Industries**	**Insensitive Industries**
Miles to Post Office	-3.265***	-2.740***	-0.526
	(1.151)	(0.724)	(0.501)
Broadband (%)	1.266***	0.192	1.074***
	(0.186)	(0.122)	(0.0872)
Miles x Broadband	0.0311*	0.0280***	0.00306
	(0.0162)	(0.0100)	(0.00719)
County-Years	11,103	11,103	11,103
Adjusted R2	0.252	0.257	0.293

Notes: Industries are grouped based on whether distance to the nearest post office is significantly associated with lower unincorporated business activity. Classification is based on industry-specific regressions controlling for state and year fixed effects and county characteristics. Standard errors are clustered by county. All models include state and year fixed effects. Standard errors are clustered by county.

Results are reported separately for all unincorporated businesses, postal-sensitive industries, and other industries. For postal-sensitive industries, the interaction term is positive and statistically significant, indicating that broadband does partially offset the distance penalty. However, the implied net effect of distance remains negative across the observed range of broadband coverage. At the sample mean of approximately 78% coverage, the net distance effect is −0.55 per mile; even at 90% coverage, the net effect remains −0.22 per mile. These magnitudes are smaller than the baseline estimates but remain economically meaningful, consistent with the tercile-based results in Table 5. For postal-insensitive industries, there is no direct effect of distance to the nearest postal service and small-business activity, similar to in the main results.

Data sources

This analysis integrates administrative tax data on small-business activity with postal infrastructure records, demographic characteristics, and geographic classifications.

The table below summarizes each dataset and its analytic role.

Dataset	Years Used	Geographic Unit	Key Variables	Use in Analysis
IRS Statistics of Income: Unincorporated Business File	2017–2022	County	Number of returns, gross receipts, and net profit by 2-digit NAICS industry	Core dataset for measuring small-business activity. Excludes agriculture by construction. Used to calculate county-level unincorporated business rates (Tables 1–3, Figures 2–3).
IRS Statistics of Income: County-Level Tax Statistics	2017–2022	County	Total individual returns filed, returns with self-employment tax, returns with Schedule C	Provides denominator for business rate calculations. Used to construct outcome variables.
USPS Postal Facility Files	2024	Address-level (geocoded)	Post office coordinates and identifiers	Used to compute straight-line distance from census-block centroids to the nearest post office; basis for county-level postal access measure (Figure 1).
U.S. Census Bureau Decennial Census	2010	Census block	Block centroids, population counts	Used to calculate population-weighted distances to post offices. 2010 weights ensure postal access measure predates outcome period.

Dataset	Years Used	Geographic Unit	Key Variables	Use in Analysis
CDC NCHS Urban-Rural Classification	2013	County	Six-level urbanicity scheme	Used to define analytic sample (codes 4–6: small metro, micropolitan, noncore) and stratify results by rurality (Tables 1–2).
American Community Survey 5-Year Estimates	2017–2022	County	Median household income, poverty rate, unemployment rate, educational attainment, broadband access	Control variables in county-level OLS regressions (Tables 2–3, 5).