The Long-Run Effects of Interstate Highways on Rural America

Heejin Kim John Anders Craig Carpenter Marcus Bernard Trey Malone

BayOne · Trinity University · Michigan State University · Kentucky State University · Purdue University

March 23,2026

Acknowledgments & Disclaimers

- Any opinions and conclusions expressed herein are those of the authors and do not represent the views of the U.S. Census Bureau.
- The U.S. Census Bureau has reviewed this data product to ensure appropriate access, use, and disclosure avoidance protection of the confidential source data (DMS: P-7530695; DRB approvals: CBDRB-FY25-SEHSD003-006, CBDRB-FY25-SEHSD003-027, CBDRB-FY26-SEHSD003-023).
- Gratefully acknowledge support from the USDA National Institute of Food and Agriculture (award 2022-68006-36433).

Outline

Motivation: The Policy Question

- Road infrastructure construction is a **central strategy for rural economic development** at both federal and local levels.
  - Biden Administration Bipartisan Infrastructure Law: \$400B+, 135,800 miles of roads
  - Trump Administration: \$140M in rural Community Facilities Programs
- From a **spatial equilibrium** perspective, rural highway investment creates ambiguous effects:
  - Could *accelerate* out-migration to cities (drain rural labor)
  - Could *enable* rural development through market access and diversification
- Empirical evidence on net benefits is **mixed in both direction and magnitude**.

Motivation: The Gap in the Literature

- Most prior work uses **aggregate or cross-sectional data** and focuses on *urban* settings
- Key limitation: cross-sectional data **cannot separate** benefits to rural-born individuals from compositional change due to in- and out-migration
- Consider: if highways attract high-earning in-migrants *and* induce lower-earning rural residents to leave, county-level income may rise even if *no individual* benefits
- Conversely, if rural-born individuals gain substantially but then out-migrate, county-level data will *miss* the gains entirely
- **Fundamental question remains unanswered:** did the Interstate Highway System benefit the people actually born into rural America?

What We Do

- Link **SSA Numident** (universe of Social Security Administration records) to the **2000 Decennial Census** and **2005–2019 ACS**
  - Track ≈**8.5 million individuals** born 1935–1955 in rural (non-MSA) counties from their birth county to adult outcomes
- Outcomes: total income, wages, unemployment, educational attainment, migration, employment industry
- Instrument actual highway construction with the **1947 Federal Highway Plan**—designed to connect metropolitan hubs, not to target rural counties
- **First study** of the U.S. Interstate Highway System using longitudinally linked microdata to estimate *individual* long-run effects

Preview of Main Findings

Labor Market

Income ↑ **4.4%** ($1,960)

Wages ↑ **2.5%**

Unemployment ↓ **5%**

Education & Migration

BA degree ↑ **8%**

Overall out-migration ↓

Strategic migration to hwy/metro ↑

Industry

Agriculture ↓ **21%**

Services ↑ **2%**

- Benefits accrued to **both stayers and movers**
- ≈**80%** of county-level income gains reflect *direct* gains to rural-born individuals
- If had used cross-sectional public county-level data: **no significant effect**—longitudinal linkages essential

Contribution to the Literature (I): Urban Highways

- Large literature on highways in **metro** settings—we shift focus to *rural* America:
  - Baum-Snow (2007): highways drove employment decentralization from central cities
  - Duranton & Turner (2012, 2014): highways reshape urban growth and trade flows
  - Brinkman & Lee (2022): freeway construction and neighborhood growth
  - Baum-Snow et al. (2017, 2020): commuting changes, urban welfare
- Urban findings **may not generalize** to rural contexts where baseline economic composition differs, density is lower, and potential migration effects differ
- Albouy & Seegert (2022): value per dollar of infrastructure investment varies across urban and rural areas

Contribution to the Literature (II): Rural Infrastructure & Individuals

- **Rural U.S. evidence:** mixed results at the county/aggregate level:
  - Chandra & Thompson (2000): positive growth premium in highway counties, negative in adjacent ones
  - Michaels (2008): highways raised skill intensity through trade-barrier reduction
  - Kasu (2019), Dalenberg (1997): some wage and education gains
- **Non-U.S. rural evidence:**
  - Faber (2014) and Baum-Snow (2020): *negative* rural effects in China
  - Asher & Novosad (2020): limited short-run gains in India.
- **Our contribution:** use longitudinally linked microdata to directly track *millions of individuals* born into rural counties—separate compositional from direct effects

Data: Longitudinal Linkage

- **SSA Numident:** universe of individuals who have interacted with the Social Security Administration—birth year and birth county
- Linked to **2000 long-form Decennial Census** and **2005–2019 ACS** for long-run (adult) outcomes
- Outcomes measured: total personal income, hourly wages, unemployment status, educational attainment, migration, employment industry
- **Sample restrictions:**
  - Birth cohorts **1935–1955**: born before interstate rollout; observed in labor market before retirement
  - **Rural (non-MSA) birth counties**: follow IPUMS County Composition of Metropolitan Areas (1940–1950 definition)
- Final sample: $\approx$**8.5 million individuals**

Data: Highway and Plan Variables

- **Highway treatment ($Inter_c$):** indicator for whether birth county c received an interstate highway segment by 1993
  - Exclude openings before 1956 (Fed Highway Act) and after 1993 ($<$0.5% segments)
- **Instrument ($Plan_c$):** indicator for whether the 1947 federal highway plan included a highway through birth county c.
  - Data: 1947 plan digitized and refined by Brinkman & Lee (2022)
- **Pre-period covariates:** 1940 Census via IPUMS NHGIS (Manson et al. 2024)

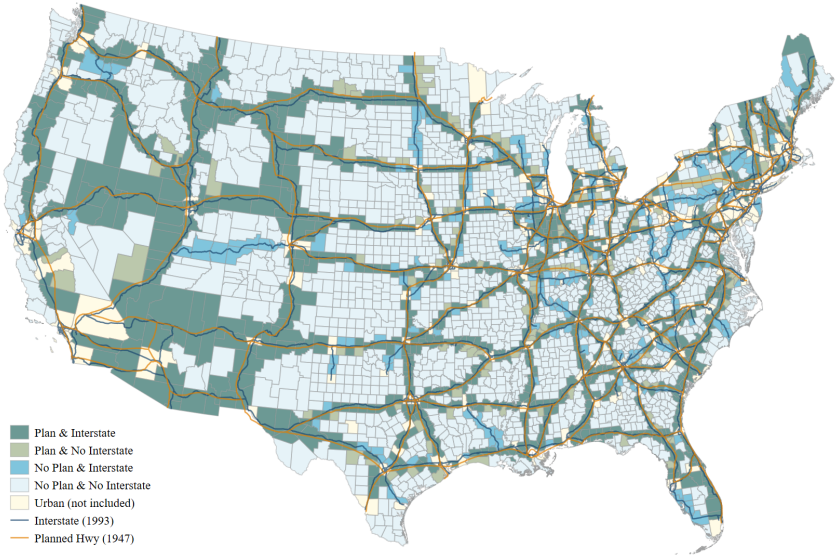
Sample Overview: Treatment Variation

- **2,793 rural counties** total
- **1,087** received an interstate highway (39% treatment rate)
- **1,706** did not receive a highway

Group	Counties
Planned & constructed	852
Planned only	131
Constructed only	235
Neither	1,575

- Substantial **geographic variation** in treatment supports quasi-experimental design.
- 235 counties built without plan; 131 planned but not built—generates variation in first stage.
- Identification compares rural counties that happened to fall on a metro-to-metro route vs. those that did not.

Highway Map: Planned vs. Constructed



Empirical Strategy: Three Equations

$$\underbrace{Inter_{ic}}_{\substack{\text{Actual highway} \\ \text{(1st stage)}}} = \alpha_1 + \delta\, Plan_c + \gamma_s + \gamma_b + \gamma_v + \gamma_s \times b + \varepsilon_{icbv}$$

$$\underbrace{Y_{icbv}}_{\substack{\text{Outcome} \\ \text{(Reduced form)}}} = \alpha_2 + \theta\, Plan_c + \gamma_s + \gamma_b + \gamma_v + \gamma_s \times b + \varepsilon_{icbv}$$

$$\underbrace{Y_{icbv}}_{\substack{\text{Outcome} \\ \text{(2SLS)}}} = \alpha_3 + \beta\, \widehat{Inter_{ic}} + \gamma_s + \gamma_b + \gamma_v + \gamma_s \times b + \varepsilon_{icbv}$$

- $Plan_c$: 1947 plan indicator; $Inter_{ic}$: interstate by 1993; Y_{icbv}: adult outcome
- Fixed effects: birth state (γ_s), birth year (γ_b), survey year (γ_v)
- State $\times$ birth-year linear trends ($\gamma_s \times b$)
- Standard errors clustered at **birth-county level**

Instrument Relevance: First Stage

- The 1947 plan **strongly predicts** actual construction through 1993.
- $\hat{\delta} \approx 0.67$: counties on the plan were $\approx$**two-thirds more likely** to receive a constructed highway
- First-stage F-stat **well above** conventional weak-instrument thresholds
- Consistent with Baum-Snow (2007) which finds similar instrument strength for metro highway rays
- 1993 vs 2000 highway system makes little difference: $<0.5\%$ counties reclassified

First Stage Table

Instrument Validity: Exclusion Restriction (I)

Identifying assumption

Conditional on birth-state, birth-year, and survey-year fixed effects plus state $\times$ birth-year trends, the 1947 plan affects adult outcomes *only* through its effect on actual highway construction.

Concern 1: Plan correlated with unobserved county characteristics?

- Plan designed to connect *distant metro hubs*—rural corridor placement *incidental*
- Parents did not time births based on whether their county fell between metro hubs
- No other federal program in the 1950s was rolled out in a spatial pattern resembling the highway plan
- Campbell & Hubbard (2016): unlike urban areas, rural highways faced *virtually no local resistance* and were built essentially to plan

Instrument Validity: Exclusion Restriction (II)

Concern 2: Plan affects outcomes through non-highway channels?

- Test both reduced-form and 2SLS estimates throughout—patterns consistent
- IV estimates remain within economically plausible bounds across all outcomes
- Duranton & Turner (2012): geographic suitability for roads does not confound IV

Pre-period balance (1940 Census):

- Planned and non-planned counties **broadly similar** on demographics, labor market conditions, and farm characteristics
- No economically meaningful differences in 1940–1950 *trends* either

Balance Tables

Labor Market Results: Overview

- Highway exposure **raised personal income** by ≈$1,960 (4.4% of control mean).
  - Income gain is ≈**40% of the urban–rural income gap** in 1940 ($5,144)
- **Wages** increased by $0.80/hr (2.5%)
- **Unemployment** fell by ≈0.1 pp (5%)
- Lit comparison:
  - > Asher & Novosad (2020) feeder roads in India (near-zero short-run income)
  - < Chaurey (2022) rural India (11–16% wage gains)
  - Differences may reflect relative investment and time horizon
- *Cross-sectional* public county-level Census data: **no significant effect**—compositional mixing masks individual gains

Reduced Form vs. 2SLS Cross-Sectional Comparison

Labor Market Results: Why Cross-Section Shows Nothing

- Cross-sectional estimates use **county of residence** in 2000, not birth county
- Highways reshape *who lives where*: attract in-migrants from non-highway counties
  - In-migrants had less exposure to highway-enabled opportunities and human capital investment over their lifetimes
  - Their weaker outcomes **dilute and offset** the gains of rural-born individuals
- Additionally, highway counties *lost* some high-earning rural-born individuals who migrated out—further obscuring gains
- **Our estimate:** ≈80% of $2,463 aggregate county-level income gain (from cross-sectional IV) directly enjoyed by rural-born individuals; remaining 20% reflects compositional shifts

Cross-Sectional Table

Education Results

- **Years of schooling:** increased by 0.14 years (1% of control mean of ≈12 years)
- **Bachelor's degree or higher:** probability increased by 1.6 pp (8%)
  - Effect *concentrated at the college margin*—highways primarily expanded access to higher education, not overall schooling
- Consistent with rural India evidence (Aggarwal 2018; Adukia et al. 2020): improved road infrastructure raises children's educational outcomes.
- Complements Cucu et al. (2025): no increase in county-level share of high-skill workers in non-metro areas after interstate opening
  - Our individual-level data reveal why: educational gains for rural-born are *obscured* by compositional changes

Migration Results

- **Overall out-migration** from birth county: $\downarrow$ 2 pp ($\approx$-2.7%)
  - Highways reduce need to leave by improving *local* access to markets and jobs
- **Migration to highway-corridor counties:** $\uparrow$ 3.4 pp ($\approx$8%)
- **Migration to metropolitan counties:** $\uparrow$ 1.9 pp ($\approx$7%)
- **Interpretation:** highways simultaneously retain residents (lower overall exit) while enabling *strategic* moves to high-opportunity locations

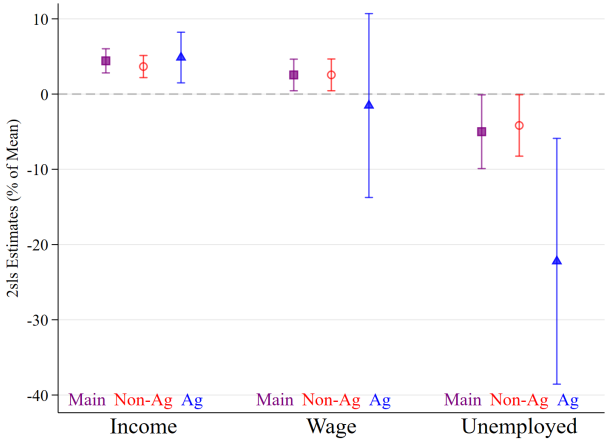
Industry Composition Results

- **Agriculture:** ↓ 0.5 pp (-21%)
  - Consistent with rural India (Asher & Novosad 2020; Chaurey 2022): 19–22% agricultural employment reductions
  - Highways reduce travel time and freight costs, expanding non-farm opportunities
- **Services:** ↑ 1.3 pp (2%)—trucking, warehousing, retail, professional services
  - Consistent with Chandra & Thompson (2000) and Michaels (2008): service sector grows in highway counties
- **Manufacturing:** small, statistically insignificant effect—highways facilitate distribution, not production location
- **"Other" industries** (mining, construction, public admin): modest decline—geographic connectivity shifts labor toward more transport-relevant sectors

Mechanisms: Conceptual Framework

- We cannot isolate a single causal mechanism, but can **directly test** migration, industry choice, and their interactions.
- Industry and migration are *endogenous* to labor market outcomes and each other
  - Conditioning on them can introduce *collider bias*
  - We interpret these estimates as **associations** rather than causal effects
- Two potential mechanisms are not mutually exclusive:
  1. **Local labor market integration:** highways lower commuting costs, attract firms, deepen local markets—non-agricultural workers benefit in place
  2. **Structural transformation:** highways reduce moving costs and increase social capital, enabling ag. workers to out-migrate to cities and higher-wage sectors

Figure 1—Labor Market by Industry

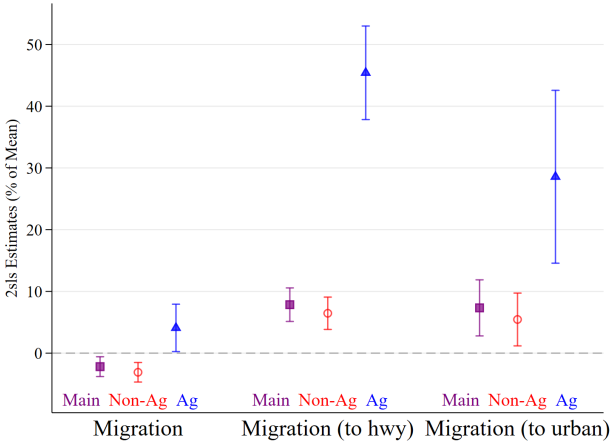


Heterogeneity by Industry: Labor Market (Figure 1)

- **Income gains:** spread across both ag and non-ag workers
- **Wage gains:** concentrated in *non-ag* industry employment
- **Unemployment:** falls for both but *larger* decline for ag workers
- Highways benefited ag workers primarily through **reducing unemployment** rather than raising ag wages—consistent with out-migration to better-matched jobs
- Contrasts with cross-sectional evidence of *negative* farm-sector impacts (Chandra & Thompson 2000)—individual-level tracking changes the picture

Full Table: By Industry

Figure 2—Education & Migration by Industry

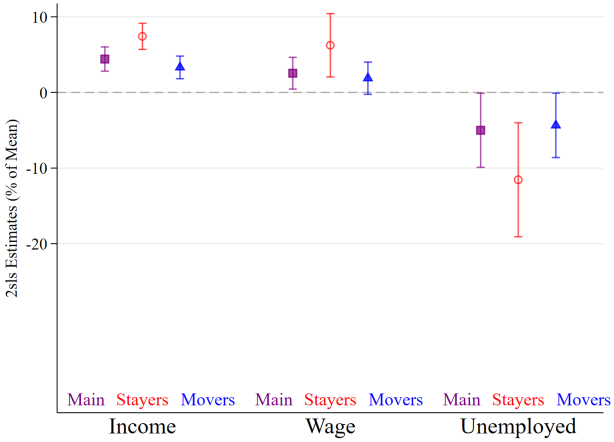


Heterogeneity by Industry: Migration & Education

- **Non-ag workers:**
  - Overall out-migration *falls*—highways reduce need to leave for non-farm workers
- **Ag workers:**
  - Overall out-migration rises
  - Migration along highway corridors ↑ **40%+**; metro migration also rises sharply
  - Highways facilitate employment sorting among remaining ag employment
- **Education:** gains positive for ag & non-ag; slightly larger for ag (possibly reflecting selection into higher-skilled ag roles like farm management)
- **Summary:** highways improved outcomes for both ag & non-ag but through *distinct mechanisms*—local market deepening & rural sorting vs out-migration

Full Table: Migration by Industry

Figure 3—Labor Market by Migration Status



Heterogeneity by Migration: Labor Market (Figure 3)

Stayers

- Income: +$3,600
- Wages: +$1.60/hr
- Unemployment: −0.3 pp
- Industry: bigger ↓ agriculture, bigger ↑ services

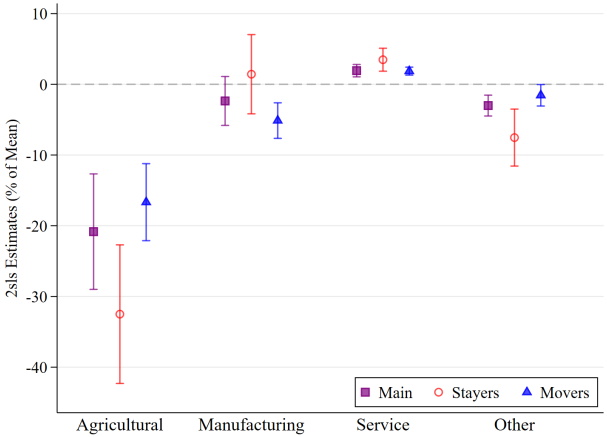
Movers

- Income: +$2,000
- Wages: +$0.60/hr
- Unemployment: −0.1 pp
- Industry: directionally similar, smaller shifts

- **Key finding:** labor market improvements are *not* driven by selective out-migration—**local economic conditions genuinely improved**.
- Contrasts with Weiwu (2024): urban highways harmed central-city children via advantaged families' suburbanization
  - Rural highways benefited *both* those who stayed and those who left

Full Table: By Migration

Figure 4—Industry by Migration Status



Heterogeneity by Migration: Education & Industry

- **Education:** BA attainment rises for both movers and stayers.
  - Movers: +2.1 pp (7%)—consistent with migration for educational access
  - Stayers: +1.3 pp (9%)—consistent with improved local educational access
- **Industry shifts:**
  - Stayers: larger ↓ ag employment, larger ↑ services—reflects structural transformation
  - Movers: smaller—industry shift less via migration to different-industry counties
- **Overall narrative:** highways created varied pathways to success—ag workers and aspiring college students migrated out, while service-sector workers and stayers benefited from improved local conditions

Full Table: Industry by Migration

Heterogeneity by Age at Exposure

- **Motivation:** Chetty et al. (2016) Moving to Opportunity—strong benefits for children exposed before age 13, essentially zero for older children.
  - Do highways follow a similar pattern?
- **Age cutoff: 13**
  - Exposed $\leq$13: income effect $\approx$**26% larger** than pooled; education effects also larger
  - Exposed $\geq$14: income effect $\approx$21% smaller; consistent direction throughout
- **Age cutoff: 30**
  - Exposed $\leq$30: estimates *nearly identical* to pooled
  - Exposed $\geq$31: labor market, education, and industry effects **attenuate to zero**
- **Conclusion:** childhood and early-adulthood exposure drives the gains—consistent with human capital and occupational sorting models

Age Heterogeneity Tables

Heterogeneity by Education Level (I): Bachelor's Degree

- Conditioning on bachelor's degree attainment
- **BA recipients:**
  - Income gains *larger in levels* (but similar as %) than non-BA recipients
  - Wage and unemployment effects: small and statistically insignificant
  - May reflect that BA holders work in occupations with higher pay but longer hours
- **Non-BA recipients:**
  - Stronger *relative* wage gains; larger migration responses
  - Overall migration falls more; highway-corridor migration rises more
  - Industry reallocation (agriculture $\rightarrow$ services) *larger*
- Highways appear to have been particularly important for the **non-college pathway** to upward mobility

Education Heterogeneity Tables

Heterogeneity by Education Level (II): High School Diploma

- **High school diploma holders:**
  - Earnings gains: +$1,953; wage gains: +$0.78/hr
  - More pronounced reallocation away from ag
- **No high school diploma:**
  - Earnings gains 1/2 (as pp and as %) of HS diploma holders
  - Larger unemployment decline (-0.001 vs -0.0004)
  - Larger shift away from ag to services
  - Education/migration estimates similar to HS diploma holders
- **Interpretation:** earnings gains concentrated among those with $\geq$ HS diploma, but least educated had largest positive changes in employment stability & occupational reallocation
  - This complementarity helps explain why controlling for 1940 county HS attainment attenuates estimates: baseline human capital strong proxy for returns to connectivity

Education Heterogeneity Tables

Compositional Shifts: Individual vs. Aggregate

- Direct comparison of **individual-level** vs. **county-level** income estimates:
  - **Individual-level:** +$1,960 income
  - **County-level:** +$2,463 income
- $500 (≈20%) gap suggests highways also attracted **higher-earning in-migrants**, boosting aggregate income beyond direct gains
- ≈**80% of aggregate benefit** enjoyed directly by those born into rural localities

Cross-Sectional Comparison

Robustness: Alternative Treatment Definitions

- Main treatment: binary indicator for interstate segment in birth county by 1993
- **(A) County centroid <30 miles from interstate:** estimates broadly consistent
- **(B) Census Place (population) centroid <30 miles:** estimates broadly consistent
- **(C) County centroid <30 miles from nearest junction:** wage and education effects slightly *attenuate*; some migration magnitudes shift
  - Not preferred because junction locations are chosen *within* the network and may correlate with pre-existing economic nodes
- **(D) Propensity score common support trimming:** restrict to counties in common support of 1947 plan PS distribution—estimates broadly consistent

Treatment Definition Tables

Robustness: Alternative Birth Cohorts (1945–1975)

- Replicate main analysis on cohorts born **1945–1975**—three post-WWII decades.
- First stage remains strong
- **Labor market:**
  - Income: +3.8% vs. +4.4% in main sample
  - Wages: +2.4% vs. +2.5%
- **Education & Industry:** effects very similar
- **Migration:** same pattern—overall migration falls, highway/metro migration rise
- Consistency across cohorts demonstrates **highway effects persisted across decades** and not driven by choice of birth years

Alternative Cohort Tables

Sensitivity: Baseline Covariate Inclusion

- Piecewise adding of covariates:
  - **Distance to nearest MSA, 1940 population density**
    - First stage essentially unchanged
    - Income falls from \$1,960 to \$1,503—*still significant*
    - Variation not absorbed by MSA proximity or density
  - **1940 farm and service employment shares**
    - Further attenuation; migration and industry estimates relatively stable
  - **1940 high school attainment share**
    - Substantial additional attenuation—consistent with human capital complementarity
    - HS share is a strong proxy for baseline development and returns to connectivity
  - Panels C–D are **sensitivity checks**, not preferred specs: employment and education shares are endogenously co-determined with local factors.

Covariate Inclusion Tables

Robustness: Borusyak & Hull (2023) Recentered IV

- Remaining concern: highway placement may be correlated with a county's *position in the broader transportation network* and thus its market exposure
- Following Borusyak & Hull (2023): construct **expected market access (MA) growth** by permuting highway opening years across segments
- **Expected MA growth IV:** income +5.6% (vs. +4.4% main); education and migration broadly consistent.
- **Recentered MA growth IV** (Actual − Expected): income +7.7%; but noisier
- **Why recentering changes little:**
  - Rural highways built *essentially to plan* with limited local resistance—plan and reality were similar (Campbell & Hubbard 2016)
  - Expected MA closely tracks actual MA; recentering changes little variation

Borusyak & Hull Tables

Conclusion: What We Find

- The Interstate Highway System generated **long-run, person-level benefits** for rural Americans
  - Income $+4.4\%$ ($1,960), wages $+2.5\%$, unemployment -5%
  - College completion $+8\%$; overall out-migration $\downarrow$; strategic migration $\uparrow$
  - Agriculture $\downarrow$, services $\uparrow$, but outcomes improved for those in ag
- These gains **less clear in cross-sectional data**—longitudinal linkage essential for identifying who benefits from infrastructure
  - $\approx$80% of aggregate county-level income gains reflect **direct benefits** to rural-born individuals; $\approx$20% reflects compositional in-migration
  - Benefits accrued to **both stayers and movers**—highways improved local opportunities *and* facilitated migration to better opportunities
  - Mechanisms: *local market diversification* (non-ag workers) and *strategic out-migration* (ag workers)

Conclusion: Implications & Open Questions

- **For infrastructure policy:** our findings demonstrate that *individual-level* gains from rural infrastructure can be substantial and long-run
- **For welfare analysis:** who wins and who loses from compositional shifts?
  - How are effects distributed across geography, race, and gender?
- **Social capital channel:** low-SES rural residents in highway counties are 14.5% more likely to be connected to a high-SES individual—economic connectedness may be an underexplored mechanism
- **Future work:** do current rural investments (broadband, EV infrastructure) generate comparable individual-level gains?

Thanks!

Craig Carpenter
Department of Agricultural, Food, and Resource Economics
Michigan State University
cwcarp@msu.edu

Appendix Slides

A.1: First Stage

- Column 1 of Table 1 reports the first-stage estimate of equation (1).
- $\hat{\delta} \approx 0.67$: being on the 1947 plan raises the probability of receiving a constructed highway by 67 percentage points.
- Equivalently: for every 3 planned highways, $\approx$2 were built.
- F-statistic: well above conventional weak-instrument thresholds (Stock & Yogo 2005).
- Consistent across alternative cohorts (1945–1975) and covariate specifications—first stage is not sensitive to controls.
- Rural highways were largely built to plan (Campbell & Hubbard 2016), unlike urban highways where local resistance sometimes diverted routes.

Back to Labor Market Results

A.2: Pre-Period Balance (Shares)

- 1940 Decennial Census shares: employment by sector, demographic composition, farm characteristics.
- Planned and non-planned highway counties are **broadly similar** on observable characteristics.
- Expected, modest differences in *manufacturing and sales* shares: the plan was explicitly designed to facilitate commercial product flows.
- Imbalance in these two variables is not evidence of confounding—it is consistent with the plan's stated design rationale.
- No significant imbalance in population shares, housing characteristics, or agricultural measures.

Source: 1940 Decennial Census, IPUMS NHGIS (Manson et al. 2024). See Table A.1 in paper.

A.3: Pre-Period Balance (Values & Changes)

- 1940 values: wages, housing values, farm values.
  - No economically meaningful imbalance between planned and non-planned counties.
- Pre-period *changes* (1940–1950): demographic, labor market, and farm outcomes.
  - Trends in the decade before highway construction also show no significant imbalance.
- Identification does **not rely exclusively on balance**: our strategy also benefits from the exogeneity of place of birth and timing of birth.
- Parents neither had children nor timed births based on whether their county fell on a planned interstate route.

Source: 1940 and 1950 Decennial Censuses, IPUMS NHGIS. See Tables A.2–A.3 in paper.

Back: First Stage

A.4: Table—Balance: Shares (1940 Census)

	No Planned Hwy Counties			Planned Hwy Counties				
	N	Mean	SD	N	Mean	SD	Diff	% Diff
Race								
Share of White	1,809	0.88	0.18	984	0.87	0.19	-0.01	-1.14
Share of Black	1,809	0.11	0.19	984	0.13	0.19	0.01	9.09
Share of Other Races	1,809	0.01	0.03	984	0.01	0.04	<0.01	<0.01
School Enrollment								
Enrollment Rate (5-6 Yrs)	1,809	0.36	0.15	984	0.37	0.14	0.01	2.78
Enrollment Rate (7-13 Yrs)	1,809	0.93	0.12	984	0.95	0.07	0.02	2.15
Enrollment Rate (14-17 Yrs)	1,809	0.74	0.12	984	0.76	0.10	0.02**	2.70
Enrollment Rate (18-24 Yrs)	1,809	0.12	0.04	984	0.13	0.04	<0.01**	<0.01
Educational Attainment								
Share of No High School Degree	1,809	0.80	0.07	984	0.78	0.07	-0.02***	-2.50
Share of High School Graduate	1,809	0.11	0.04	984	0.12	0.04	0.01***	9.09
Share of College Graduates	1,809	0.03	0.01	984	0.04	0.02	0.01***	33.33
Labor Market								
Share of Unemployed/Seeking Work	1,809	0.08	0.05	984	0.08	0.04	<0.01	<0.01
Share of Professional Occupation	1,809	0.05	0.02	984	0.06	0.02	<0.01*	<0.01
Manufacturing Establishment								
Mfg Estab. per sq. mi.	1,721	0.05	0.07	960	0.07	0.07	0.02**	40.00
Housing								
Share of Homeowner (White)	1,809	0.92	0.12	984	0.91	0.13	-0.01	-1.09
Share of Homeowner (Black)	1,809	0.08	0.12	984	0.09	0.13	0.01	12.50
Share of Homeowner (Other)	1,809	0.01	0.03	984	0.01	0.04	<0.01	<0.01
Share of Renter (White)	1,809	0.87	0.21	984	0.85	0.21	-0.01	-1.15
Share of Renter (Black)	1,809	0.13	0.21	984	0.14	0.21	0.01	7.69
Share of Renter (Other)	1,809	<0.01	0.02	984	<0.01	0.01	<0.01	.
Share of Owner-Occupied Units	1,809	0.49	0.12	984	0.49	0.11	<0.01	<0.01
Share of Vacant Units	1,809	0.05	0.04	984	0.05	0.03	<0.01	<0.01
Share of Single-Family Units	1,809	0.85	0.09	984	0.82	0.10	-0.03***	-3.53
Farm								
Share of Farmland	1,809	0.67	0.25	984	0.68	0.24	<0.01	<0.01
Share of Farm Operated By White	1,807	0.90	0.19	984	0.88	0.20	-0.02	-2.22
Share of Farm Operated By Non-White	1,807	0.10	0.19	984	0.12	0.20	0.02	20.00
Share of Farm Less than 10 Acre	1,807	0.08	0.08	984	0.08	0.06	<0.01	<0.01
Share of Full Owner Farmland	1,807	0.49	0.20	984	0.47	0.19	-0.01	-2.04
Share of Tenant Farmland	1,805	0.31	0.15	984	0.31	0.16	<0.01	<0.01

Note: Demographic and employment shares from the 1940 Decennial Census for rural sample counties, by planned-highway status. Diff column: OLS coefficient from regressing planned status on each variable; SEs clustered at state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Values Table Back: Balance Summary

A.5: Table—Balance: Values & Changes (1940 Census)

	No Planned Hwy Counties			Planned Hwy Counties				
	N	Mean	SD	N	Mean	SD	Diff	% Diff
Payroll and Sales								
Wages in Mfg	1,283	14,734	4,709	789	15,925	4,948	1,191***	8.08
Sales per Establishment (Retail)	1,809	301,664	103,761	984	346,229	110,541	44,565***	14.77
Sales per Establishment (Wholesale)	1,638	1,866,589	1,324,267	933	2,211,759	1,421,067	345,170***	18.49
Sales per Establishment (Service)	1,801	50,953	24,112	981	62,266	27,382	11,314***	22.20
Mfg Product Value per Establishment	1,283	2,832,200	2,891,467	789	3,780,629	3,133,058	948,429***	33.49
Housing								
Avg Housing Value	1,759	37,326	14,176	975	43,044	15,227	5,718***	15.32
Avg Contract Rent	1,775	216	83	977	249	95	33***	15.28
Farm								
Avg Farm Size (acre)	1,807	184	335	984	186	443	2	1.09
Avg Farm Value	1,807	91,099	83,220	984	100,023	85,638	8,924	9.80
Avg Value of Farm Bldg.	1,807	27,693	21,314	984	31,250	21,900	3,557**	12.84
Avg Value of Farm Equip.	1,807	10,158	8,401	984	10,618	8,162	460	4.53
Avg Value of Farm Bldg. (Full Owner)	1,807	30,956	20,916	984	33,940	20,169	2,984*	9.64
Avg Value of Farm Bldg. (Tenant)	1,806	22,378	19,822	984	25,703	20,889	3,325*	14.86
Avg Value of Farm Equip. (Full Owner)	1,807	9,941	7,315	984	10,115	6,500	174	1.75
Avg Value of Farm Equip. (Tenant)	1,806	8,636	8,154	984	9,290	8,149	654	7.57

Note: Wages, housing values, and farm values from the 1940 Decennial Census; 1940–1950 changes in key labor market and demographic variables. Dollar values in 2019 dollars. Diff column: OLS coefficient from regressing planned status on each variable; SEs clustered at state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Shares Table Back: Balance Summary

A.4: Reduced Form vs. 2SLS—Labor Market

- Reports both reduced-form (Plan $\rightarrow$ outcomes) and 2SLS estimates side by side.
- **Reduced form (income):** positive and significant—1947 plan raises adult income.
- **2SLS (income):** +\$1,960, which is reduced form scaled by first stage ($\approx$0.67).
- Consistency between reduced form and 2SLS is reassuring about instrument strength and the exclusion restriction.
- Wages and unemployment: same pattern—reduced form directionally consistent, magnitudes scale as expected.

See Appendix Table in paper (Reduced Form vs. 2SLS, Labor Market).

Back: Labor Market

A.5: Reduced Form vs. 2SLS—Education & Migration

- **Education:** reduced form positive and significant for both years of schooling and BA attainment.
- **Migration:**
  - Overall out-migration: reduced form *negative*—plan counties retain more residents
  - Highway-corridor migration: reduced form *positive*
  - Metro migration: reduced form *positive*
- 2SLS estimates scale from reduced form as expected given $\hat{\delta} \approx 0.67$.
- No evidence that reduced form is inconsistent with the 2SLS interpretation.

See Appendix Table (Reduced Form vs. 2SLS, Education & Migration).

A.6: Reduced Form vs. 2SLS—Industry

- **Agriculture:** reduced form negative and significant—plan predicts lower agricultural employment.
- **Services:** reduced form positive and significant.
- **Manufacturing:** small, insignificant in both reduced form and 2SLS.
- **"Other":** modest negative in reduced form, consistent with 2SLS.
- Pattern of industry reallocation is robust across both specifications.

See Appendix Table (Reduced Form vs. 2SLS, Industry).

Back: RF vs. 2SLS LM

A.9: Table—Main Results: Labor Market

	(1) Interstate Highway	(2) Income	(3) Wage	(4) Unemployed
PLAN 1947	0.680***			
	(0.020)			
INTERSTATE		$1,960***	$0.790**	-0.0006**
		($363)	($0.333)	(0.0003)
As PCT of Mean		4.42%	2.54%	-2.97%
Mean		$44,350	$31.07	0.020
N	8,576,000	8,576,000	4,696,000	8,576,000
First Stage F	1,164			

Note: 2SLS estimates of equation (3) for labor market outcomes. Col. (1): first stage. Cols. (2)–(4): personal income (log and levels), hourly wages, and unemployment. Means for individuals born in non-highway rural counties. Fixed effects: birth state, birth year, survey year, and state×birth-year trends. SEs clustered at birth-county level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Edu/Mig Table Back: RF vs. 2SLS

A.10: Table—Main Results: Education & Migration

	(1) Interstate highway	(2) Bachelor's degree +	(3) Years of education	(4) Migration	(5) Migration (to hwy cnty)	(6) Migration (rural to urban)
PLAN 1947	0.680***					
	(0.020)					
INTERSTATE		0.016***	0.138***	-0.0195***	0.034***	0.019***
		(0.004)	(0.033)	(0.006)	(0.006)	(0.006)
PLAN 1947 (reduced form)		0.011***	0.094***	-0.013***	0.023***	0.013***
		(0.003)	(0.023)	(0.004)	(0.004)	(0.004)
Mean		0.206	13.00	0.732	0.433	0.259
N	8,576,000	8,576,000	8,576,000	8,576,000	8,576,000	8,576,000

Note: 2SLS estimates for education and migration outcomes. Migration outcomes: any out-migration from birth county, migration to a highway-corridor county, and migration to a metropolitan county. See note to A.9 for specification details. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

LM Table Industry Table

A.11: Table—Main Results: Industry

	(1) Interstate highway	(2) Agriculture	(3) Manufacturing	(4) Services	(5) Other
PLAN 1947	0.675***				
	(0.021)				
INTERSTATE		-0.005***	-0.004	0.013***	-0.004***
		(0.001)	(0.003)	(0.003)	(0.001)
As PCT of Mean		-20.83%	-2.35%	1.93%	-3.01%
Mean		0.024	0.170	0.673	0.133
N	4,696,000	4,696,000	4,696,000	4,696,000	4,696,000

Note: 2SLS estimates for industry of employment outcomes: agriculture, manufacturing, services, and other industries. See note to A.9 for specification details. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Edu/Mig Table Back: RF vs. 2SLS

A.7: Associations by Industry—Labor Market

- Table reports 2SLS estimates separately for agricultural and non-agricultural industry workers.
- **Caveat:** industry is post-treatment; these are *associations*, not causal effects.
- **Non-agricultural workers:** positive income and wage gains; unemployment falls.
- **Agricultural workers:** income gains present; wages largely unchanged; unemployment falls more.
  - Suggests agricultural workers benefit via employment stability, not within-sector wage growth
- Relative magnitudes (scaled by means) displayed in Figure 1 of the paper.

See Appendix Table (Labor Market, by Industry).

Back: Main Results

A.8–A.9: Associations by Industry—Education & Migration

- **Education (Figure 2a):** positive for both groups; slightly larger and noisier for agricultural workers—possibly reflecting selection into high-skill agricultural roles (farm management).
- **Migration (Figure 2b):**
  - Non-agricultural: overall out-migration falls; highway/metro corridor migration rises modestly
  - Agricultural: overall out-migration *rises substantially*; highway corridor +40%; metro migration also sharply positive
- **Interpretation:** highways served as an "escape valve" for agricultural workers seeking urban opportunities, while keeping non-agricultural workers anchored to improved local markets.
- These starkly different migration responses by industry explain much of the aggregate pattern.

See Appendix Tables (Education & Migration, by Industry).

Back: Industry LM

A.14: Figure 1—Labor Market by Industry (scaled by mean)

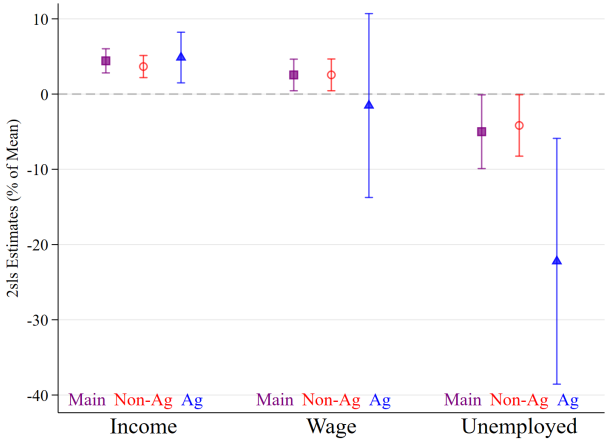


Figure 2 Back: Industry Summary

A.15: Figure 2—Education & Migration by Industry (scaled by mean)

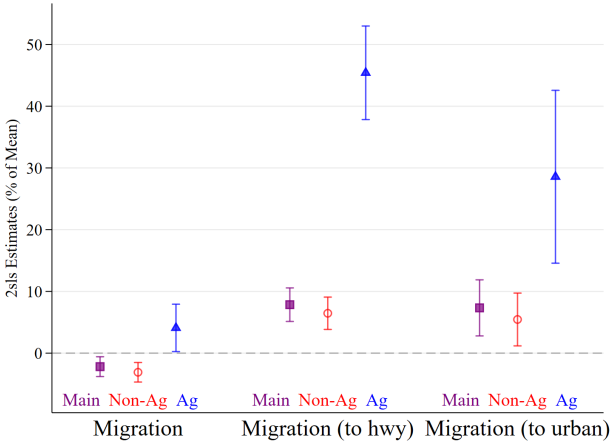


Figure 1 Back: Industry Summary

A.16: Table—Associations by Industry: Labor Market

	(1) Interstate Highway	(2) Income	(3) Wage	(4) Unemployed
Panel A: Non-Agricultural Industry Workers				
PLAN 1947	0.674***			
	(0.021)			
INTERSTATE		2,176***	0.795**	-0.001***
		(446)	(0.335)	(0.0003)
Mean		59,460	31.12	0.024
N	4,600,000	4,600,000	4,600,000	4,600,000
Panel B: Agricultural Industry Workers				
PLAN 1947	0.708***			
	(0.021)			
INTERSTATE		2,671***	-0.444	-0.008***
		(944)	(1.820)	(0.003)
Mean		54,990	29.19	0.036
N	96,500	96,500	96,500	96,500

Note: 2SLS estimates separately for agricultural and non-agricultural workers. Industry of employment is post-treatment; interpret as associations. See note to A.9 for specification details. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Edu/Mig Table Back: Industry Summary

A.17: Table—Associations by Industry: Education & Migration

	(1) Interstate highway	(2) Bachelor's degree +	(3) Years of education	(4) Migration	(5) Migration (to hwy cnty)	(6) Migration (rural to urban)
Panel A: Non-Agricultural Industry Workers						
PLAN 1947	0.674***					
	(0.021)					
INTERSTATE		0.015***	0.112***	-0.026***	0.029***	0.015**
		(0.004)	(0.029)	(0.006)	(0.006)	(0.006)
Mean		0.249	13.48	0.742	0.449	0.275
N	4,600,000	4,600,000	4,600,000	4,600,000	4,600,000	4,600,000
Panel B: Agricultural Industry Workers						
PLAN 1947	0.708***					
	(0.021)					
INTERSTATE		0.018***	0.177***	0.0214**	0.094***	0.012***
		(0.005)	(0.057)	(0.011)	(0.008)	(0.003)
Mean		0.153	12.47	0.561	0.207	0.042
N	96,500	96,500	96,500	96,500	96,500	96,500

Note: 2SLS estimates of education and migration outcomes separately for agricultural and non-agricultural workers. Industry is post-treatment; interpret as associations. See note to A.9 for specification details. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

LM Table Back: Industry Summary

A.10: Associations by Migration—Labor Market

- **Stayers** (birth county = survey county): income +$3,600, wages +$1.60/hr, larger unemployment decline.
- **Movers** (birth county ≠ survey county): income +$2,000, wages +$0.60/hr, unemployment also falls.
- Both groups experience **positive, significant labor market gains**—benefits are not simply an artifact of out-migration.
- Stayers' larger gains consistent with *local labor market deepening*: highways attract firms and reduce commuting costs for those remaining in highway counties.
- Movers' gains consistent with highways *enabling strategic relocation* to better-paying jobs.

See Appendix Table (Labor Market, by Migration).

Back: Main Results

A.11: Associations by Migration—Industry & Education

- **Education:**
  - Stayers: BA +1.3 pp (9% of mean)—local educational access improved
  - Movers: BA +2.1 pp (7.4% of mean)—migration facilitated pursuit of higher education
- **Industry:**
  - Stayers: larger ↓ agriculture (−0.7 pp), larger ↑ services (+1.8 pp)
  - Movers: directionally similar but smaller industry shifts
- Stayers' larger industry shifts consistent with county-level structural transformation documented by Chandra & Thompson (2000) and Michaels (2008).
- Movers' industry shifts partly occur through relocating to counties with different industry composition.

See Appendix Table (Industry & Education, by Migration).

Back: Migration LM

A.20: Figure 3—Labor Market by Migration Status (scaled by mean)

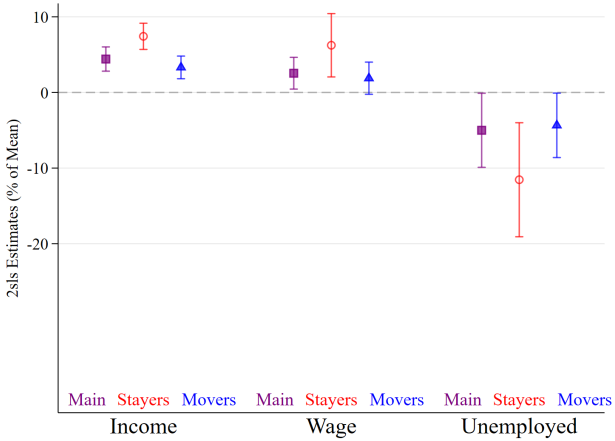


Figure 4 Back: Migration Summary

A.21: Figure 4—Education & Industry by Migration Status (scaled by mean)

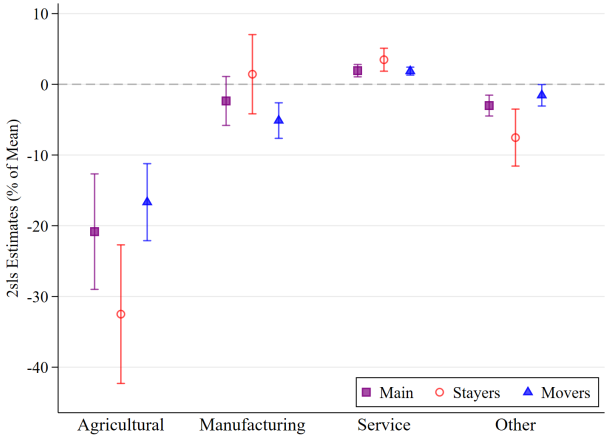


Figure 3 ▸ Back: Migration Summary

A.22: Table—Associations by Migration: Labor Market

	(1) Interstate Highway	(2) Income	(3) Wage	(4) Unemployed
Panel A: Not-Migrated (Stayers)				
PLAN 1947	0.639***			
	(0.024)			
INTERSTATE		3,657***	1.606***	-0.003***
		(428.6)	(0.554)	(0.001)
Mean		48,960	26.27	0.026
N	1,308,000	1,308,000	1,308,000	1,308,000
Panel B: Migrated (Movers)				
PLAN 1947	0.689***			
	(0.020)			
INTERSTATE		2,158***	0.669*	-0.0006*
		(475.1)	(0.356)	(0.0003)
Mean		63,050	32.78	0.023
N	3,389,000	3,389,000	3,389,000	3,389,000

Note: 2SLS estimates separately for stayers (birth county = survey county) and movers. Migration status is post-treatment; interpret as associations. See note to A.9 for specification details. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Ind/Edu Table | Back: Migration Summary

A.23: Table—Associations by Migration: Industry & Education

	(1) Interstate highway	(2) Bachelor's degree +	(3) Years of education	(4) Agriculture	(5) Manufacturing	(6) Services	(7) Other
Panel A: Not-Migrated (Stayers)							
PLAN 1947	0.639***						
	(0.024)						
INTERSTATE		0.013***	0.1190***	-0.013***	0.0023	0.021***	-0.011***
		(0.003)	(0.026)	(0.002)	(0.006)	(0.005)	(0.003)
Mean		0.141	12.80	0.040	0.210	0.604	0.146
N	1,308,000	1,308,000	1,308,000	1,308,000	1,308,000	1,308,000	1,308,000
Panel B: Migrated (Movers)							
PLAN 1947	0.689***						
	(0.020)						
INTERSTATE		0.021***	0.1500***	-0.003***	-0.008***	0.013***	-0.002**
		(0.005)	(0.031)	(0.0005)	(0.002)	(0.002)	(0.001)
Mean		0.284	13.70	0.018	0.156	0.697	0.129
N	3,389,000	3,389,000	3,389,000	3,389,000	3,389,000	3,389,000	3,389,000

Note: 2SLS estimates of industry and education outcomes for stayers and movers. Migration status is post-treatment; interpret as associations. See note to A.9 for specification details. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

LM Table Back: Migration Summary

A.12: Associations by Bachelor's Degree

- **BA recipients:**
  - Income gains larger in levels; wage and unemployment effects small and imprecise
  - Smaller education/migration responses (already at the top of the attainment distribution)
  - Industry reallocation (agriculture $\rightarrow$ services) present but smaller than non-BA group
- **Non-BA recipients:**
  - Stronger relative wage gains; larger fall in overall migration; larger rise in highway-corridor migration
  - Industry reallocation substantially larger: bigger $\downarrow$ agriculture, bigger $\uparrow$ services
- Highways appear especially important for the **non-college path to mobility**.

See Appendix Tables (by Bachelor's Degree).

Back: By Industry

A.13: Associations by High School Diploma

- **HS diploma holders:** earnings +$1,953; wages +$0.78/hr; more pronounced sectoral reallocation.
- **No HS diploma:** larger unemployment decline; even stronger shift from agriculture to services; education and migration estimates broadly similar.
- **Key pattern:** earnings gains concentrated among HS graduates; employment and occupational gains concentrated among the less educated.
- Suggests highways helped the less educated through **employment stabilization and occupational reallocation**, while HS graduates benefited through **higher earnings within their jobs**.
- The HS attainment share covariate attenuates main estimates because it captures variation in *baseline human capital*, which drives the returns to highway connectivity.

See Appendix Tables (by High School Diploma).

Back: BA Heterogeneity

A.14: Age at Exposure—Age-13 Cutoff

- Split sample at **age 13 at first highway opening** in birth county.
- **Exposed $\leq$ age 13:**
  - Income effect $\approx$26% *larger* than pooled
  - Education effects also somewhat larger
  - Migration and industry impacts broadly similar to pooled
- **Exposed $\geq$ age 14:**
  - Income effect $\approx$21% *smaller* than pooled
  - Directionally consistent throughout
- Results broadly consistent with childhood investment models—early exposure compounds through schooling choices and occupational sorting.

See Appendix Tables (Age-13 Cutoff, all outcomes).

Back: Age Heterogeneity

A.15: Age at Exposure—Age-30 Cutoff

- Split sample at **age 30 at first highway opening**.
- **Exposed $\leq$ age 30:** estimates nearly *identical* to pooled sample across all outcomes.
- **Exposed $\geq$ age 30:**
  - Labor market, education, and industry coefficients **attenuate to zero** or become negative
  - First stage is also weaker for this group
  - Overall migration becomes more negative; highway-corridor migration increases
- Those already established in a career by age 30 face high switching costs—highways have little effect on their occupational or educational trajectories.
- Sharp discontinuity at age 30 is consistent with **career lock-in** models.

See Appendix Tables (Age-30 Cutoff, all outcomes).

Back: Age-13

A.28: Table—Age at Exposure $\leq$ / $>$ 13: Labor Market

	(1) Interstate highway	(2) Income	(3) Wage	(4) Unemployed
Panel A: Pooled Ages				
PLAN 1947	0.680***			
	(0.020)			
INTERSTATE		$1,960***	$0.790**	-0.0006**
		($363)	($0.333)	(0.0003)
As PCT of Mean		4.42%	2.54%	-2.97%
Mean		$44,350	$31.07	0.020
N	8,576,000	8,576,000	4,696,000	8,576,000
Panel B: Age < 13				
PLAN 1947	0.576***			
	(0.030)			
INTERSTATE		2,469***	0.800**	-0.001**
		(565.9)	(0.368)	(0.000)
As PCT of Mean		5.57%	2.58%	-4.46%
Mean		44,350	31.07	0.0202
N	5,696,000	5,696,000	3,242,000	5,696,000
Panel C: Age ≥ 13				
PLAN 1947	0.660***			
	(0.022)			
INTERSTATE		1,539***	0.411	-0.0004*
		(348.0)	(0.404)	(0.000)
As PCT of Mean		3.47%	1.32%	-1.98%
Mean		44,350	31.07	0.0202
N	7,457,000	7,457,000	3,932,000	7,457,000

Note: Sample split by age at first highway exposure in birth county (cutoff: age 13). 2SLS estimates of labor market outcomes. See note to A.9 for specification details. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Age-30 Table Back: Age Summary

A.29: Table—Age at Exposure $\leq$ / $>$ 30: Labor Market

	(1) Interstate highway	(2) Income	(3) Wage	(4) Unemployed
Panel A: Pooled Ages				
PLAN 1947	0.680***			
	(0.020)			
INTERSTATE		$1,960***	$0.790**	-0.0006**
		($363)	($0.333)	(0.0003)
As PCT of Mean		4.42%	2.54%	-2.97%
Mean		$44,350	$31.07	0.020
N	8,576,000	8,576,000	4,696,000	8,576,000
Panel B: Age <30				
PLAN 1947	0.702***			
	(0.020)			
INTERSTATE		2,003***	0.769**	-0.001**
		(362.4)	(0.330)	(0.000)
As PCT of Mean		4.52	2.47	-2.97
Mean		44,350	31.07	0.0202
N	8,169,000	8,169,000	4,532,000	8,169,000
Panel C: Age ≥ 30				
PLAN 1947	0.331***			
	(0.040)			
INTERSTATE		72.53	-1.383	0.000
		(986.1)	(1.189)	(0.001)
As PCT of Mean		0.16	-4.45	1.49
Mean		44,350	31.07	0.0202
N	4,985,000	4,985,000	2,643,000	4,985,000

Note: Sample split by age at first highway exposure in birth county (cutoff: age 30). 2SLS estimates of labor market outcomes. See note to A.9 for specification details. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Age-13 Table Back: Age Summary

A.16: Cross-Sectional Evidence (Public 2000 Data)

- Replicate main estimation using **public IPUMS 5% sample** of 2000 Decennial Census.
- Key difference: treatment is *county of residence* in 2000, not birth county.
- Results: **no statistically or economically significant effects** on income, wages, or unemployment.
- **Why?**
  - In-migrants from non-highway counties dilute the gains of rural-born individuals
  - Rural-born individuals who gained and then out-migrated are counted in destination counties, not origin counties
  - Compositional mixing produces near-zero aggregate estimates even when individual effects are large
- Back-of-envelope: individual gains ($1,960) vs. county aggregate ($2,463)—the ≈$500 gap reflects compositional in-migration of higher earners.

See Appendix Table (Public Cross-Sectional Data).

A.31: Table—Cross-Sectional Estimates (Public 2000 Data)

	(1) OLS	(2) IV
	Per Capita Income	Per Capita Income
Interstate	2,792***	2,464**
	(687)	(1,218)
N	2,793	2,793

Note: Replicates main 2SLS strategy using the public IPUMS 5% sample of the 2000 Decennial Census. Treatment defined at county of *residence* in 2000 (not birth county). Fixed effects: state of residence, birth year, and state×birth-year trends. SEs clustered at residence-county level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Back: Cross-Sectional Summary

A.17: Social Capital

- Using Social Capital Atlas data from Chetty et al. (2022): economic connectedness and social mobility indices from Opportunity Insights.
- OLS estimates of the correlation between interstate highways and social capital in rural counties.
- **Low-SES rural residents** born in highway counties are **14.5% more likely** to be connected to a high-SES individual (Panel A, above-median parental income connections).
- **High-SES rural residents** show smaller and less significant associations.
- Highways may have improved rural residents' *economic connectedness*—access to professional networks, information about opportunities—beyond direct labor market channels.
- Future work: disentangle social capital as a distinct mechanism from market access and commuting cost channels.

A.18: Borusyak & Hull (2023)—Background & Method

- **Concern:** highway placement may correlate with a county's position in the broader transport network and thus its *market exposure*.
- Borusyak & Hull (2023): construct a "recentered IV" that isolates as-good-as-random variation in market access by removing the predictable component given county locations.
- **Market access:** $MA_{it} = \sum_{j \neq i} pop_j \cdot \exp(-\alpha \cdot \tau_{it,j})$, with decay parameter $\alpha = 0.02$ (Zheng & Kahn 2013).
- **Expected MA growth:** permute highway opening years (K times) across segments; average the resulting MA distributions at 1970.
- **Recentered MA growth:** Actual MA growth − Expected MA growth.
- We use expected MA growth as our *preferred* alternative IV (less sensitive to realized timing); recentered as a robustness check.

See Appendix C in paper for full methodology

A.19: Borusyak & Hull (2023)—Results

- **Expected MA growth IV:**
  - Income: +5.6% (vs. +4.4% main)—somewhat larger but consistent
  - Years of schooling: +0.18 (1.3% of mean; vs. 0.14 main)
  - Migration to highway corridors: +2.4 pp (5.5%; vs. 3.4 pp main—slightly smaller)
  - Industry: agriculture ↓, services ↑—directionally consistent
- **Recentered MA growth IV:**
  - Income: +7.7% (vs. +4.4%)—larger and noisier
  - Other outcomes: directionally consistent, generally larger in magnitude
- **Why little difference from main IV:** rural highways built essentially to plan (Campbell & Hubbard 2016)—expected MA closely tracks actual MA; recentering removes minimal variation.
- Alternative instruments **corroborate** the main identification strategy.

See Appendix Tables (Borusyak & Hull, all outcomes).

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A.35: Table—Borusyak & Hull (2023) IV: Labor Market

	(1) Interstate highway	(2) Income	(3) Wage	(4) Unemployed
Panel A: Using E(MA Growth) as IV				
EXPECTED MA GROWTH	2.039***			
	(0.204)			
INTERSTATE		2,516***	3.024*	-0.001***
		(647.6)	(1.576)	(0.000)
N	8,576,000	8,576,000	4,696,000	8,576,000
First Stage F	100			
Panel B: Using Actual $-$ E(MA Growth) as IV				
RECENTERED MA GROWTH	2.103***			
	(0.511)			
INTERSTATE		3,446*	2.398	-0.002*
		(1,787)	(2.540)	(0.001)
N	8,576,000	8,576,000	4,696,000	8,576,000
First Stage F	17			

Note: Replicates Table 1 using expected market access (MA) growth (Panel A) and recentered MA growth (Panel B) as instruments, following Borusyak & Hull (2023). Market access computed as Laplace transform of population over transit time with decay α=0.02; expected MA averages over K permutations of highway opening years at 1970. See note to A.9 for other specification details. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Edu/Mig Table Back: BH Summary

A.35b: Table—Borusyak & Hull (2023) IV: Education & Migration

	(1) Interstate highway	(2) Bachelor's degree +	(3) Years of education	(4) Migration Migration	(5) Migration (to hwy cnty)	(6) Migration (rural to urban)
Panel A: Using E(MA Growth) as IV						
EXPECTED MA GROWTH	2.039***					
	(0.204)					
INTERSTATE		0.020***	0.180***	-0.017**	0.024***	0.016**
		(0.006)	(0.052)	(0.008)	(0.008)	(0.007)
N	8,576,000	8,576,000	8,576,000	8,576,000	8,576,000	8,576,000
First Stage F	100					
Panel B: Using Recentered MA Growth as IV						
RECENTERED MA GROWTH	2.103***					
	(0.511)					
INTERSTATE		0.020	0.244	-0.091***	-0.030	-0.006
		(0.018)	(0.157)	(0.033)	(0.027)	(0.024)
N	8,576,000	8,576,000	8,576,000	8,576,000	8,576,000	8,576,000
First Stage F	17					

Note: Replicates Table 2 using expected MA growth (Panel A) and recentered MA growth (Panel B) as instruments. See notes to A.35 for instrument construction details. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

LM Table Back: BH Summary

A.20: Robustness to Birth Cohorts 1945–1975

- Replicate all main tables for cohorts born **1945–1975**.
  - Broader window: spans three decades after WWII; includes those born up to 20 years after the earliest main-sample cohort
- **First stage:** strong and consistent.
- **Labor market:** income $+3.8\%$, wages $+2.4\%$—nearly identical to main.
- **Education:** BA attainment $+5.1\%$—somewhat smaller, but significant.
- **Industry:** agriculture -28.6% of mean (larger than main); services $+1.8\%$.
- **Migration:** same directional pattern—overall $\downarrow$, highway/metro corridors $\uparrow$.
- Consistency confirms results are **not driven by specific cohort selection** and that highway effects persisted across decades.

See Appendix Tables (Cohorts 1945–1975, all outcomes).

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A.37: Table—Alternative Cohorts (1945–1975): Labor Market

	(1) Interstate Highway	(2) Income	(3) Wage	(4) Unemployed
PLAN 1947	0.673***			
	(0.022)			
INTERSTATE		$1,774***	$0.673**	-0.001*
		($464)	($0.270)	(0.0004)
As PCT of Mean		3.83%	2.43%	-2.51%
Mean		$46,270	$27.70	0.032
N	13,810,000	13,810,000	10,220,000	13,810,000
First Stage F	953.7			

Note: Replicates Table 1 using birth cohorts 1945–1975 instead of the main sample (1935–1955). See note to A.9 for specification details. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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A.21: Covariate Inclusion

Panel	Added covariates & income effect
A (main)	— $1,960 (sig.)
B	Distance to nearest MSA, 1940 pop. density $1,503 (sig.)
C	+ 1940 farm & service employment shares Attenuated (some sig.)
D	+ 1940 HS attainment share Attenuated substantially

- First stage is **not sensitive** to any covariate set.
- Panel B shows variation is **not absorbed** by proximity to MSAs.
- Panels C–D: attenuation consistent with human capital *complementarity*, not omitted variable bias—HS share captures baseline returns to connectivity.
- Panels C–D are sensitivity checks, *not* preferred: employment/education shares may be endogenously co-determined with highway access (pre-treatment covariates but

A.22: Treatment Definitions

- **Main definition:** binary indicator for any interstate segment in birth county by 1993.
- **(A) County centroid $<$ 30 miles from interstate:** estimates broadly stable.
- **(B) Census Place (population) centroid $<$ 30 miles:** similar to main—population centroids approximate where residents actually live.
- **(C) Centroid $<$ 30 miles from nearest junction:**
  - Wage and education effects attenuate; migration magnitudes shift
  - Junction locations are chosen *within* the network and may proxy for pre-existing commercial nodes—noisier measure of highway access
- **(D) Propensity score common support trimming:**
  - Restricts to counties in common support of 1947 plan propensity score
  - Estimates stable—support restriction does not drive results

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A.23: Industry Classification Details

Agricultural (NAICS 11)

- Crop production
- Animal production
- Forestry, except logging
- Logging
- Fishing, hunting, trapping
- Support activities for ag./forestry

Manufacturing (Census codes 107–399)

- Food, textiles, chemicals, machinery, etc.

Service Industry (BLS)

- Trade, transportation, utilities
- Information
- Financial activities
- Professional & business services
- Education & health services
- Leisure & hospitality
- Other services (excl. public admin)

Other Industry

- Mining, construction
- Public administration, military

Note: Public administration separated from services to isolate private-sector responses. Non-ag group includes farm-related manufacturing (e.g., dairy, meat processing).