Who Benefits from Industrialization? Labor Market Adjustments and Household Welfare in Vietnam

Trinh Pham (tpham@kdischool.ac.kr)
KDI School of Public Policy and Management

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Motivation

- Governments increasingly use place-based policies to spur growth in lagging regions.
  - Limited evidence on labor & welfare impacts, esp. in informal, diversified economies.
- This paper:
  - Do special economic zones **only benefit a narrow segment of the population** (such as more educated workers)
    - or can they **generate broader welfare gains for less advantaged groups**?
    - And if so, what are **the potential mechanisms**?
  - Staggered establishment of 250+ industrial zones (IZs) across 100 Vietnamese districts
  - Empirical strategies: spatial ring + staggered DiD design (de Chaisemartin and d'Haultfoeuille 2020; de Chaisemartin, Ciccia, et al. 2024)

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Preview of Findings

1. IZs do not only benefit the highly educated:
   - Youth (low-educated): shift from work to schooling.
   - Adults (low-educated): move out of agriculture into non-farm work.

2. Broad welfare gains across education groups:
   - Similar income and consumption gains at the household level.
   - Higher wage gains for educated; informal earnings sustain gains for less-educated.

3. Mechanisms:
   - IZ demand shock: formal upgrading (educated) & informal expansion (low-educated).
   - Youth schooling response to rising returns.
   - Segmented labor markets → labor diversification among low-educated households.

▸ Related Literature

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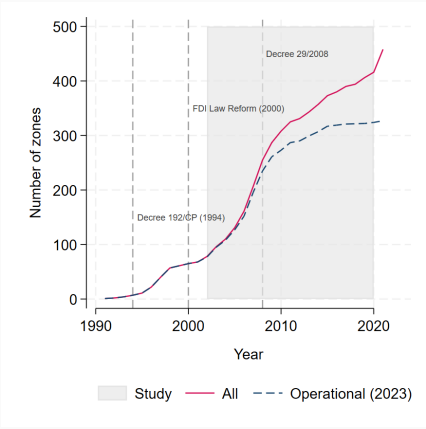
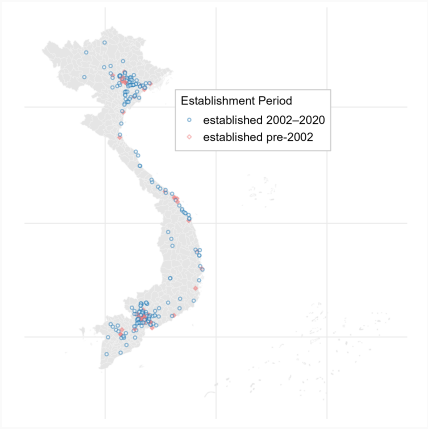
Background and Data

Industrial Zone Establishment in Vietnam

- IZs equipped with dedicated infrastructure and various investment incentives.
- Establishment reflects both central (MPI) planning and provincial needs.





Data and Variable Construction

- Data
  1. Industrial Zone Database (MPI): establishment date, location, status, indicators
     - manually georeferenced & linked to harmonized districts (approximately 650)
  2. Vietnam Household Living Standards Surveys 2002–2020
     - repeated cross sections, approximately 45,000 households each wave
- Variables
  1. Labor market outcomes: primary/secondary jobs, hours of work
     - formal vs. informal work (work for household businesses–employer-based definition)
     - labor compensation (including imputed household business earnings)
  2. Youth outcomes: schooling participation & child labor (10–18)
  3. Household outcomes: consumption (food, non-food, education)
     - labor diversification (across members, across sectors, multiple jobs)

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Empirical Strategy

Empirical Challenges

- Zone establishments are not exogenous. ▸ Comparison of Districts
- Leveraging the staggered roll-out of zones:

$$y_{idt} = \alpha_d + \delta_t + \sum_{k=-3, k\neq 0}^{6} \beta_k \cdot \mathbb{I}(t = \text{Establishment}_d + k) + \varepsilon_{idt}$$

  - y_{idt}: outcome of individual or household i in district d at time t.
  - District fixed effects α_d to absorb district-specific time-invariant heterogeneity.
  - Year fixed effects δ_t to control for year-specific shocks.
  - β_k: dynamic treatment effects k years relative to **establishment**.
  - SE ε_{idt} clustered at the district level to account for temporal/spatial correlation.

Treatment Definition

- **Temporal Variation**: Treatment begins the first year when a zone is **established**.
  - Approval of non-infra. secondary projects (even before full infra. completion).
  - Rationale: Captures onset of land clearance, infrastructure work, and investment decisions → reflects when expectations and development activity begin.

- **Spatial Variation**: Districts classified as treated from the first year they fall **within 10 km of a zone** and remain treated thereafter.
  - The 10-km radius cutoff is supported by a spatial ring analysis ▸ Spatial Ring Analysis
  - Consistent with previous literature: **spatial spillovers** from SEZs tend to diffuse outward from their core areas. (Gallé et al. 2024; Tafese et al. 2025; Abagna et al. 2025)

▸ Treatment Illustration

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Empirical Concerns: Staggered DiD

- Estimating the model using traditional TWFE can have limitations (Borusyak et al. 2024; Goodman-Bacon 2021; de Chaisemartin and d'Haultfoeuille 2020)
  - Implicit distorting weighting schemes (forbidden early–late comparisons).
- These concerns are particularly relevant in this setting:
  - Early zones likely in higher-potential areas → stronger initial impacts.
  - Zone impacts tend to evolve gradually as projects scale and investment deepens.
- Use new estimator (de Chaisemartin and d'Haultfoeuille 2020; de Chaisemartin, Ciccia, et al. 2024)
  - Compares the outcome evolution of group that changes its treatment in a given period ("switcher") to the set of units with the same baseline treatment status who do not change treatment in that period ("stayers").
  - This avoids forbidden comparisons between early and late adopters.

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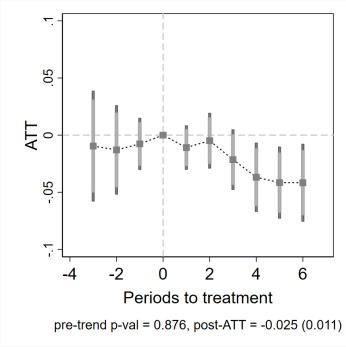
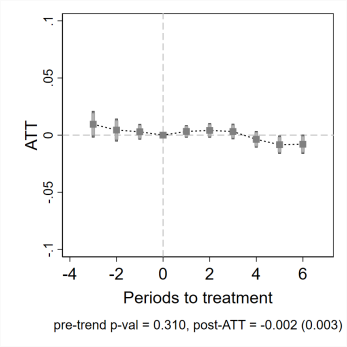
Empirical Results

Labor Participation

- IZs decrease youth labor force participation.



Age 19-24



Age 25-64

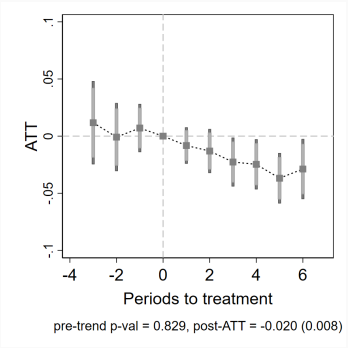
Labor Participation

- IZs decrease youth labor force participation, **but only among low-educated**.

	Without High School Diploma			With High School Diploma		
Age	19-64	19-24	25-64	19-64	19-24	25-64
	(1)	(2)	(3)	(4)	(5)	(6)
Cumulative ATT	-0.004	-0.020***	-0.003	0.012	0.007	0.004
	(0.003)	(0.008)	(0.003)	(0.011)	(0.020)	(0.006)
District FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Mean Outcome	0.92	0.88	0.93	0.77	0.45	0.93
p-value pre-trend	0.136	0.829	0.182	0.922	0.927	0.366
N(Individual-Period)	1226475	1212857	1226475	1212079	1195052	1200185
N(District-Period)	4621	4504	4621	4513	4376	4431
N(Switcher-Period)	1228	1195	1228	1210	1195	1198

Youth Schooling: Individuals Without High School Diploma

- IZs increase low-educated youth school enrollment and degree attainment.



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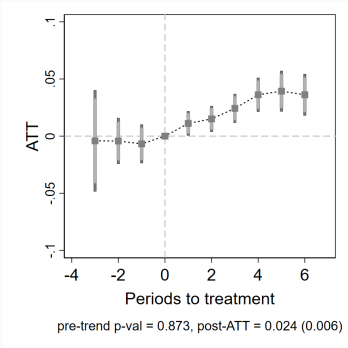
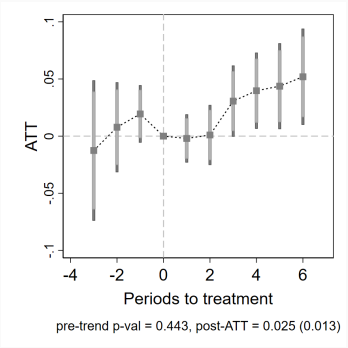


School Enrollment



High School Completion

Youth Schooling, By Skill Requirement

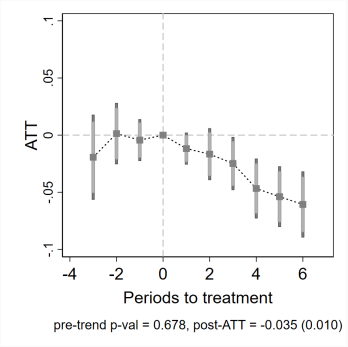
- The schooling effects are more pronounced in high-skill requirement areas.

	19–24 years old			15–18 years old		
	All	Low Skill	High Skill	All	Low Skill	High Skill
	(1)	(2)	(3)	(4)	(5)	(6)
Cumulative ATT	0.024***	0.017**	0.032***	0.058***	0.041***	0.067***
	(0.006)	(0.008)	(0.008)	(0.012)	(0.016)	(0.018)
District FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Mean Outcome	0.04	0.04	0.05	0.67	0.69	0.65
p-value pre-trend	0.873	0.917	0.712	0.594	0.590	0.424
N(Individual-Period)	67566	30261	37295	91256	44193	47030
N(District-Period)	4504	2171	2332	4599	2213	2385
N(Switcher-Period)	1192	1192	1192	1222	1222	1222

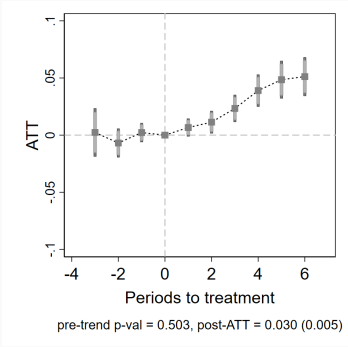
"Low Skill" if the average share of low-skilled workers among all firms in a district is above the national median.

Sectoral Labor Shifts

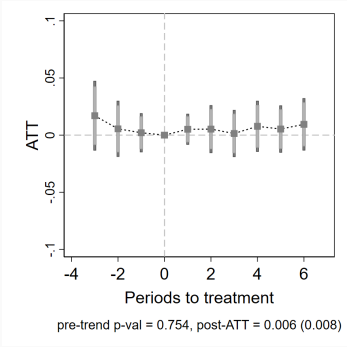
- IZs induce a clear shift out of agriculture.



Agriculture



Formal Non-Agriculture



Informal Non-Agriculture

Sectoral Labor Shifts, By Education Level

- IZs induce a clear shift out of agriculture, with different patterns by education.

	Without High School Diploma			With High School Diploma		
Sector	Agriculture	Formal Non-Ag	Informal Non-Ag	Agriculture	Formal Non-Ag	Informal Non-Ag
	(1)	(2)	(3)	(4)	(5)	(6)
Cumulative ATT	-0.044***	0.024***	0.020**	-0.017	0.043***	-0.026**
	(0.010)	(0.004)	(0.009)	(0.014)	(0.013)	(0.012)
District FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Mean Outcome	0.64	0.05	0.31	0.28	0.43	0.28
p-value pre-trend	0.854	0.588	0.637	0.005	0.046	0.467
N(Individual-Period)	635140	635140	635140	627667	627667	627667
N(District-Period)	4620	4620	4620	4496	4496	4496
N(Switcher-Period)	1228	1228	1228	1210	1210	1210

Household-Level Labor Diversification, By Education Level

- IZs induce a more diversified labor portfolio, only among low-educated households.

	Households Without High School Graduate			Households With High School Graduate		
	(1) Diversification Across Members	(2) Diversification Within Members	(3) Sectoral Diversity Index	(4) Diversification Across Members	(5) Diversification Within Members	(6) Sectoral Diversity Index
Cumulative ATT	0.049***	0.034**	0.014**	0.014	-0.009	0.003
	(0.014)	(0.015)	(0.006)	(0.013)	(0.016)	(0.007)
District FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Mean Outcome	0.54	0.39	0.21	0.67	0.42	0.28
p-value pre-trend	0.309	0.327	0.583	0.412	0.159	0.791
N(Household-Period)	240707	240707	240707	239659	239659	239659
N(District-Period)	3661	3661	3661	3617	3617	3617
N(Switcher-Period)	880	880	880	874	874	874

"Across Members": different members working in different sectors. "Within Members": at least one member working in different sectors. "Sectoral Diversity Index": 1 minus the Herfindahl–Hirschman Index (HHI) using the share of household labor hours in each sector.

Household-Level Labor Diversification Among Low-Educated, By Skill

- IZs induce a more diversified labor portfolio, only in high-skill requirement areas.

	Across Members			Within Members			Sectoral Diversity Index		
	All	Low Skill	High Skill	All	Low Skill	High Skill	All	Low Skill	High Skill
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Cumulative ATT	0.049***	0.010	0.090***	0.034**	-0.001	0.073***	0.014**	0.004	0.028***
	(0.014)	(0.018)	(0.020)	(0.015)	(0.020)	(0.020)	(0.006)	(0.008)	(0.008)
District FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Mean Outcome	0.51	0.54	0.47	0.36	0.38	0.33	0.20	0.21	0.18
p-value pre-trend	0.309	0.452	0.219	0.327	0.545	0.477	0.583	0.747	0.544
N(Household-Period)	152301	73209	79062	152301	73209	79062	152301	73209	79062
N(District-Period)	3661	1633	2027	3661	1633	2027	3661	1633	2027
N(Switcher-Period)	880	510	370	880	510	370	880	510	370

"Across Members": different members working in different sectors. "Within Members": at least one member working in different sectors. "Sectoral Diversity Index": 1 minus the Herfindahl–Hirschman Index (HHI) using the share of household labor hours in each sector. "Low Skill" if the average share of low-skilled workers among all firms in a district is above the national median.

Labor Compensation, By Education Level

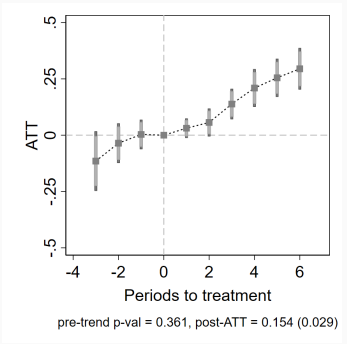
- Higher wage gains for the educated; informal earnings rise for others.

	Without High School Diploma			With High School Diploma		
	Wage Employment	Household Activities	(1) + (2)	Wage Employment	Household Activities	(4) + (5)
	(1)	(2)	(3)	(4)	(5)	(6)
Cumulative ATT	0.136***	0.043*	0.181***	0.156***	-0.014	0.140***
	(0.016)	(0.023)	(0.029)	(0.038)	(0.030)	(0.043)
District FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Mean Outcome	0.279	0.627	0.914	0.889	0.414	1.329
p-value pre-trend	0.003	0.807	0.096	0.152	0.581	0.208
N(Individual-Period)	571305	571305	571305	568365	568365	568365
N(District-Period)	3662	3662	3662	3613	3613	3613
N(Switcher-Period)	880	880	880	874	874	874

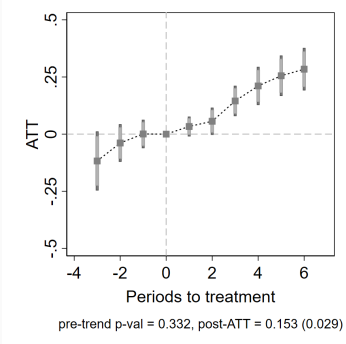
Sample includes all individuals 19-64. Labor compensation for non-working individuals are coded 0. Labor compensation from wage employment includes all wages as well as cash and in-kind benefits. Labor compensation from household activities is estimated based on the share of household profits corresponding to the time spent on these activities. Household profits encompass income from both agricultural and non-agricultural economic pursuits.

Informal Labor Compensation

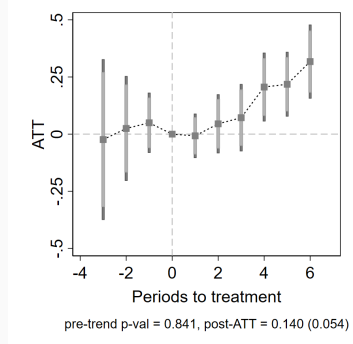
- Informal earners see higher income → spillover effects beyond formal-sector jobs.



All



No High School Diploma

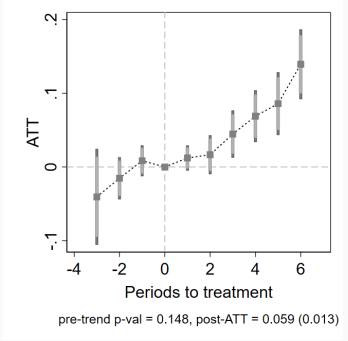


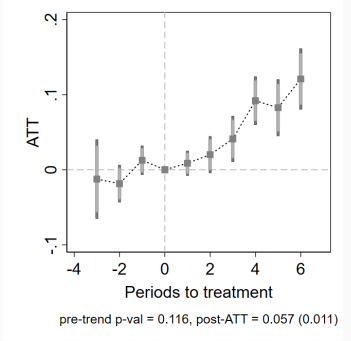
With High School Diploma

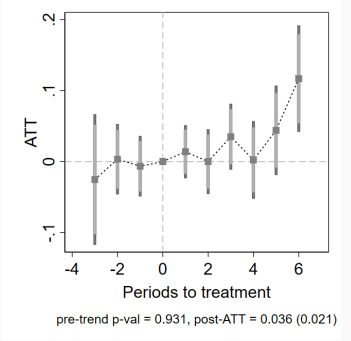
Labor compensation from household activities in logs, conditional on working in this sector.

Household Consumption Expenditure

- Comparable gains in total consumption expenditure across groups.







All Households | No High School Graduate | With High School Graduate

Total household consumption expenditure includes food consumption (regular daily food and special-occasion meals), non-food consumption (routine household items and services—such as fuel, personal care products, small goods, travel, and cultural expenses), health (inpatient and outpatient treatment expenses) and education expenditures (school-related costs, including tuition fees, textbooks and reference materials, general school supplies, and private tutoring for subjects in the official curriculum).

Summary of Findings

Outcome	Less-educated	More-educated
Youth labor	↘	—
Work In Agriculture	↘	↘
Work In Informal Non-Agriculture	↗	↘
Work In Formal Non-Agriculture	↗	↗
Labor Diversification	↗	—
Labor Compensation	↗	↗
Household consumption	↗	↗

- Less-educated youth reduce labor supply, increase schooling & degree attainment.
  - Stronger in higher-skill labor markets → skill-biased labor demand shocks.
- Household labor diversification rises only among less-educated households.
  - Only in higher-skill markets → adaptation to limited access to formal job gains.

▸ Robustness Checks, Placebo Test, Leave-One-District-Out Test ▸ Additional Results: Child Schooling and Educational Expenses

Concluding Remarks

Concluding Remarks

- Industrial zones reshape local labor markets and accelerate structural change.
- Heterogeneous adjustments by educational level:
  - More-educated: ↗ formal jobs and experience faster wage growth.
  - Less-educated: (↘ labor, ↗ schooling), ↗ informal non-farm work, ↗ diversification.
- These adaptive responses raise household labor income and welfare
  - even without direct access to formal jobs
  - highlighting the importance of multi-activity livelihoods in developing economies.
- Effects are stronger where skill demand is higher → skill-biased ind. expansion.

→ To broaden gains, the policy should be paired with skill upgrading and support for productive informal activity.

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Appendix

Related Literature

1. **Industrial policy, structural transformation and labor reallocation**
   - Classic views: sharp transition from agriculture to industry (Lewis 1954; Kuznets 1973; Herrendorf et al. 2014)
   - Recent evidence: gradual, uneven reallocation (Merotto et al. 2018; McMillan et al. 2014)
   - SEZs literature: workers' primary employment and aggregate sectoral outcomes (e.g., Gallé et al. 2024; Abagna et al. 2025; Tafese et al. 2025)
   - This paper leverages data on both primary and secondary jobs
     - reductions in agricultural labor concentrate in secondary work, with core agricultural workers' hours remaining stable
     - workers with different educational levels respond differently to the new employment opportunities generated by industrial zones

▸ Preview of Findings

Related Literature

2. **Labor market shocks and household resource reallocation**
   - Classic views: diversification as a risk-coping strategy, especially in the absence of complete insurance or credit markets (Rosenzweig and Stark 1989; Udry 1996; Barrett et al. 2001; Dercon 2002)
   - This paper shows the observed diversification responses are entirely driven by areas with high skill requirement
     - consistent with the view that under segmented or rationed formal labor opportunities, individuals/households may be induced to combine agricultural, informal, and irregular formal work as an adaptation strategy
     - informality re-framed not as marginal but as a flexible and re-distributive labor market channel (Maloney 2004; Fields 2011; La Porta and Shleifer 2014; Ulyssea 2020)

▸ Preview of Findings

Related Literature

3. **Determinants of human capital investment**
   - Previous literature: schooling decisions are shaped by perceived returns to education and opportunity costs, including the trade-off with child labor (e.g., Basu and Van 1998; Edmonds 2005; Jensen 2010; Atkin 2016)
   - EIZ literature: Place-based policies can have heterogeneous effects on educational attainment (Lu et al. 2023)
   - This paper shows industrial zone expansion increases not only youth schooling but also credentials
     - disproportionately larger effects in areas with higher skilled labor demand
     - localized industrial development can foster dynamic human capital accumulation, rather than merely prompting job switching
     - underscore the importance of education-labor market complementarities as a key margin of adjustment in structural transformation (Glewwe and Muralidharan 2016)

▸ Preview of Findings

Comparison of Districts (1)

	Districts with Zones before 2002 (1)	Districts with Zones after 2002 (2)	Difference (2)-(1) (3)	Districts with Zones 2002-2011 (4)	Districts with Zones 2011-2020 (5)	Difference (5)-(4) (6)
Panel A: Demographics						
share of urban population	0.423	0.151	-0.272	0.154	0.162	0.009
	[0.428]	[0.221]	(0.044)	[0.224]	[0.201]	(0.051)
share of ethnic minority population	0.026	0.088	0.062	0.094	0.067	-0.027
	[0.068]	[0.187]	(0.013)	[0.194]	[0.147]	(0.034)
share of long-term registration (2004)	0.947	0.988	0.042	0.989	0.982	-0.007
	[0.066]	[0.016]	(0.007)	[0.015]	[0.021]	(0.006)
Panel B: Adult Labor Outcomes						
share of agricultural labor	0.356	0.616	0.260	0.619	0.629	0.010
	[0.284]	[0.203]	(0.030)	[0.205]	[0.204]	(0.054)
share of formal non-agricultural labor	0.234	0.092	-0.142	0.091	0.096	0.004
	[0.173]	[0.090]	(0.017)	[0.089]	[0.104]	(0.027)
share of informal non-agricultural labor	0.410	0.292	-0.119	0.290	0.275	-0.015
	[0.170]	[0.155]	(0.019)	[0.159]	[0.127]	(0.034)

▸ Empirical Challenges

Comparison of Districts (2)

	Districts with Zones before 2002 (1)	Districts with Zones after 2002 (2)	Difference (2)-(1) (3)	Districts with Zones 2002-2011 (4)	Districts with Zones 2011-2020 (5)	Difference (5)-(4) (6)
Panel B: Adult Labor Outcomes						
labor compensation from wage employment	0.734	0.284	-0.450	0.286	0.285	-0.001
	[0.563]	[0.206]	(0.057)	[0.207]	[0.218]	(0.057)
labor compensation from household activities	0.721	0.646	-0.075	0.656	0.572	-0.084
	[0.271]	[0.228]	(0.031)	[0.236]	[0.140]	(0.038)
HH labor diversification: across members (2004)	0.599	0.620	0.021	0.610	0.655	0.045
	[0.176]	[0.173]	(0.020)	[0.176]	[0.124]	(0.031)
HH labor diversification: within members (2004)	0.332	0.457	0.125	0.442	0.501	0.059
	[0.250]	[0.219]	(0.028)	[0.218]	[0.191]	(0.049)
HH labor diversification: HHI index (2004)	0.245	0.249	0.004	0.245	0.261	0.016
	[0.074]	[0.078]	(0.009)	[0.079]	[0.062]	(0.015)
Panel C: Child Outcomes						
share of 10-18 attending school	0.798	0.756	-0.041	0.753	0.763	0.011
	[0.125]	[0.118]	(0.014)	[0.121]	[0.090]	(0.021)
share of 10-18 working	0.193	0.277	0.084	0.278	0.296	0.018
	[0.142]	[0.154]	(0.017)	[0.153]	[0.178]	(0.046)

▸ Empirical Challenges

Spatial Ring Analysis (1)

- Estimating Model:

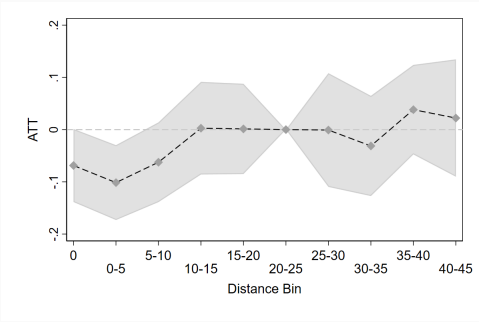
$$y_{dt} = \alpha_d + \delta_t + \sum_{b=0, b\neq 5}^{9} \delta_b \text{POST}_t \times \text{Distance}_{d=b} + \theta \text{POST}_t + \varepsilon_{dt}$$

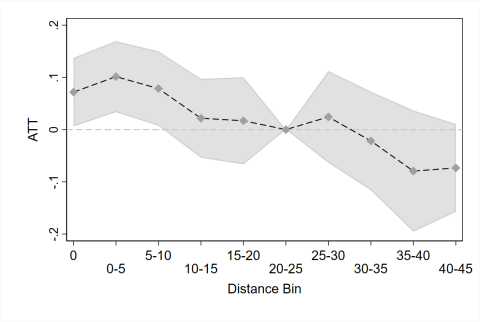
  - POST_t is a binary indicator for the post-treatment period.
  - $\text{Distance}_{d=b}$ indicates whether district d falls within distance bin b from the zone.
  - $b = 0$ represents the zone-hosting district.
  - $b = 1$ corresponds to districts within 0-5 km from the zone.
  - $b = 2$ represents districts within 5-10 km.
  - $b = 3$ for districts within 10-15 km, in 5 km increments up to 45 km for $b = 9$.
  - $b = 5$ (20-25km) as the reference bin.

▸ Treatment Definition

Spatial Ring Analysis (2)

Outcome: Labor participation (left) and school enrollment (right) of 15-24 years old without high school diploma.

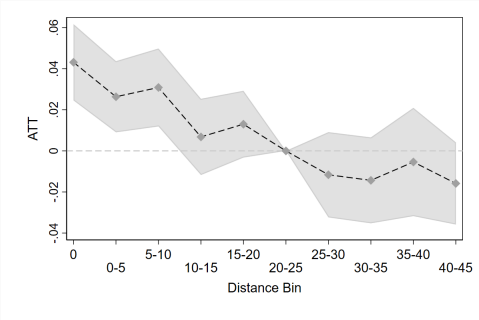


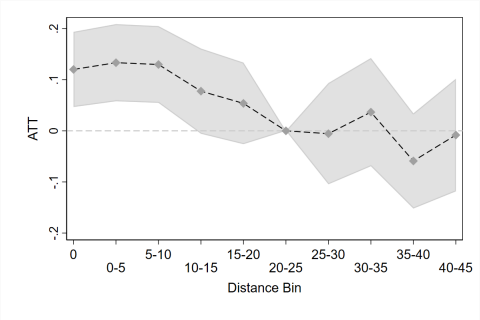


▸ Treatment Definition

Spatial Ring Analysis (3)

Outcome: Formal non-agricultural employment of 19-64 working individuals without a high school diploma (left) and with a high school diploma (right).

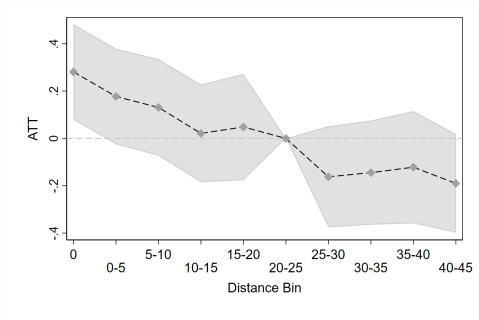


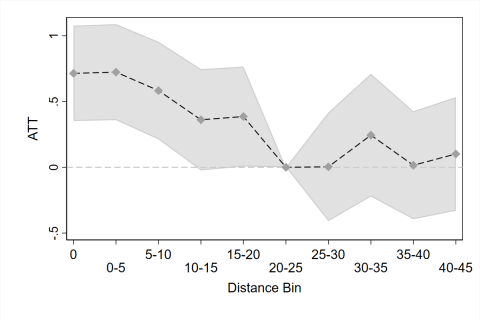


▸ Treatment Definition

Spatial Ring Analysis (4)

Outcome: Wage income of 19-64 working individuals without a high school diploma (left) and with a high school diploma (right).

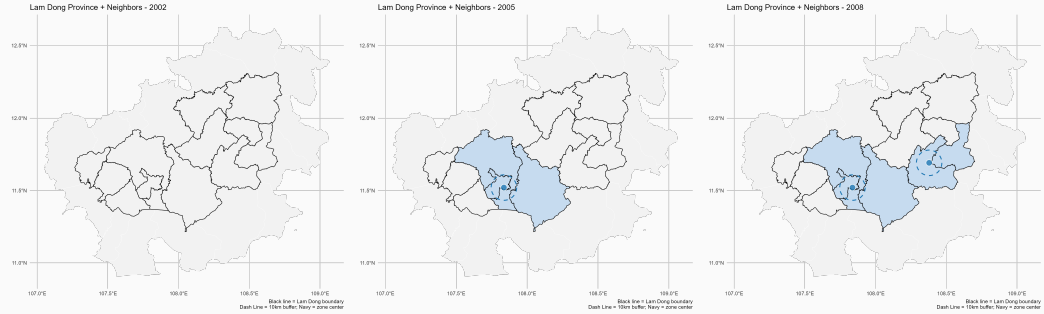




▸ Treatment Definition

Illustration of Treatment

Districts classified as treated from **the first year they fall within 10 km of a zone**.



▸ Treatment Definition

Child Labor and Schooling: All Households

	Economic Participation		School Enrollment		Education Expenses	
Age	10–14	15–18	10–14	15–18	10–14	15–18
	(1)	(2)	(3)	(4)	(5)	(6)
Cumulative ATT	-0.004	-0.037***	-0.007	0.058***	0.013***	0.024***
	(0.010)	(0.014)	(0.005)	(0.011)	(0.003)	(0.005)
Mean Outcome	0.116	0.441	0.922	0.595	0.052	0.074
p-value pre-trend	0.178	0.090	0.383	0.414	0.224	0.755
N(Individual-Period)	227350	227174	227350	227174	227350	227174
N(District-Period)	4616	4604	4616	4604	4616	4604
N(Switcher-Period)	1228	1222	1228	1222	1187	1148
District FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y

A child is classified as participating in economic activities if, within the past 12 months, they engaged in household farm or non-farm work, or in wage employment outside the household. Education expenses (monthly, 2010 million VND) encompass all school-related costs, including tuition fees, textbooks and reference materials, general school supplies, and private tutoring for subjects in the official curriculum.

▸ Summary of Findings

Child Labor and Schooling: Households Without HS Grad

	Economic Participation		School Enrollment		Education Expenses	
Age	10–14	15–18	10–14	15–18	10–14	15–18
	(1)	(2)	(3)	(4)	(5)	(6)
Cumulative ATT	-0.006	-0.037**	-0.004	0.062***	0.010***	0.013***
	(0.012)	(0.016)	(0.006)	(0.015)	(0.003)	(0.005)
Mean Outcome	0.138	0.557	0.899	0.468	0.045	0.046
p-value pre-trend	0.116	0.180	0.312	0.398	0.639	0.769
N(Individual-Period)	227038	225928	227038	225928	227038	225928
N(District-Period)	4580	4517	4580	4517	4580	4517
N(Switcher-Period)	1222	1197	1222	1197	1072	968
District FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y

A child is classified as participating in economic activities if, within the past 12 months, they engaged in household farm or non-farm work, or in wage employment outside the household. Education expenses (monthly, 2010 million VND) encompass all school-related costs, including tuition fees, textbooks and reference materials, general school supplies, and private tutoring for subjects in the official curriculum.

▸ Summary of Findings

Child Labor and Schooling: Households With HS Grad

	Economic Participation		School Enrollment		Education Expenses	
Age	10–14	15–18	10–14	15–18	10–14	15–18
	(1)	(2)	(3)	(4)	(5)	(6)
Cumulative ATT	-0.004	-0.034*	0.001	0.049***	0.010	0.028***
	(0.009)	(0.019)	(0.004)	(0.015)	(0.006)	(0.010)
Mean Outcome	0.056	0.235	0.988	0.820	0.072	0.131
p-value pre-trend	0.811	0.316	0.462	0.234	0.194	0.037
N(Individual-Period)	217095	219122	217095	219122	216294	217756
N(District-Period)	4246	4309	4246	4309	4214	4253
N(Switcher-Period)	1128	1188	1128	1188	723	857
District FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y

A child is classified as participating in economic activities if, within the past 12 months, they engaged in household farm or non-farm work, or in wage employment outside the household. Education expenses (monthly, 2010 million VND) encompass all school-related costs, including tuition fees, textbooks and reference materials, general school supplies, and private tutoring for subjects in the official curriculum.

▸ Summary of Findings

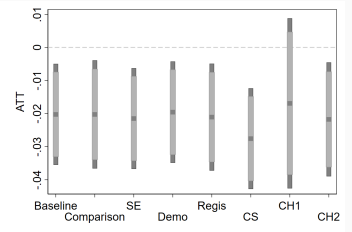
Robustness Checks

- The results are robust to the following checks:
  1. The Choice of Comparison Group: excluding not-yet-treated districts.
  2. Alternative Inferences: standard errors clustered at the province level.
  3. SUTVA and Spillover Effects: spillover effects concentrated in the 10-km radius.
  4. Demographic Composition: controlling for demographics (age and gender).
  5. Migration Concerns: restricting the sample to long-term residents.
  6. Alternative Staggered DiD Estimator (Callaway and Sant'Anna 2021).
  7. Potential Mis-alignment Between Treatment and Outcome Timing (de Chaisemartin and d'Haultfoeuille 2024; de Chaisemartin, Ciccia, et al. 2024).

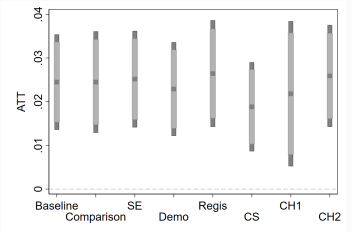
- The results also pass two additional checks:
  1. Monte-Carlo Permutation-based Placebo Test: results not arise by chance. ▸ Permutation
  2. Leave-One-District-Out: results not driven by outlier districts. ▸ Sensitivity

▸ Summary of Findings

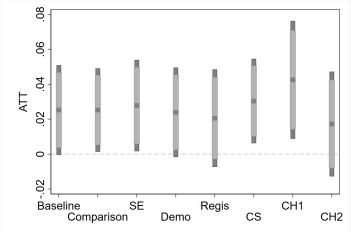
Robustness: Labor Participation among Youth Aged 15 to 24



Labor Participation



School Attendance

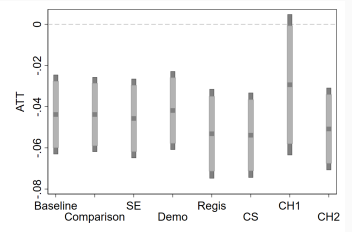


High School Qualification

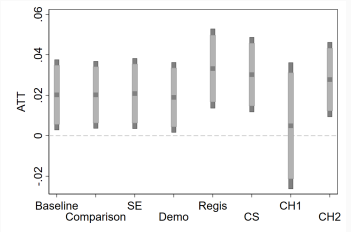
Notes: This figure displays the average cumulative (total) effects and corresponding 90-95% confidence intervals from different specifications indicated along the horizontal axis. The "Baseline" specification represents the baseline model estimated using the approach of de Chaisemartin and d'Haultfoeuille (2024), without controlling for demographic characteristics. A district is considered treated in the year it enters 10-km buffer of any zones. The comparison group includes both never-treated and not-yet-treated units, and standard errors are clustered at the district level. Subsequent specifications introduce incremental modifications to the baseline: "Comparison" restricts the comparison group to never-treated districts only; "SE" clusters standard errors at the province level rather than the district level; "Demo" adds controls for demographic characteristics: gender and age; "Regis" restricts the analysis to observations that have long-term household status in the same dwelling in the same commune or ward; "CS" adopts the alternative estimation approach proposed by Callaway and Sant'Anna (2021); "CH1" and "CH2" are estimated on the two sub-samples where changes in treatment status align and do not align, respectively, with household survey years, using de Chaisemartin and d'Haultfoeuille (2024). Outcomes are defined in the main text.

▸ Robustness Checks ▸ Summary of Findings

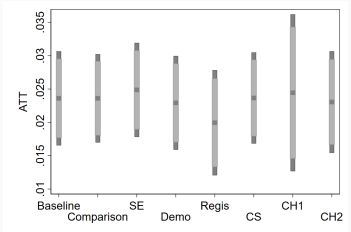
Robustness: Sectoral Shifts, Low-Educated Workers



Agriculture



Informal Non-Agriculture

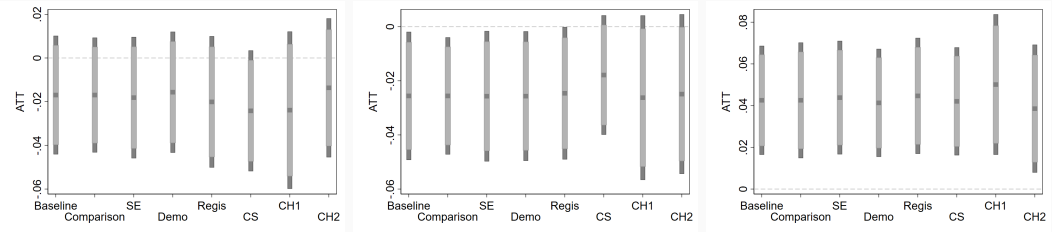


Formal Non-Agriculture

Notes: This figure displays the average cumulative (total) effects and corresponding 90-95% confidence intervals from different specifications indicated along the horizontal axis. The "Baseline" specification represents the baseline model estimated using the approach of de Chaisemartin and d'Haultfoeuille (2024), without controlling for demographic characteristics. A district is considered treated in the year it enters 10-km buffer of any zones. The comparison group includes both never-treated and not-yet-treated units, and standard errors are clustered at the district level. Subsequent specifications introduce incremental modifications to the baseline: "Comparison" restricts the comparison group to never-treated districts only; "SE" clusters standard errors at the province level rather than the district level; "Demo" adds controls for demographic characteristics: gender and age; "Regis" restricts the analysis to observations that have long-term household status in the same dwelling in the same commune or ward; "CS" adopts the alternative estimation approach proposed by Callaway and Sant'Anna (2021); "CH1" and "CH2" are estimated on the two sub-samples where changes in treatment status align and do not align, respectively, with household survey years, using de Chaisemartin and d'Haultfoeuille (2024). Outcomes are defined in the main text.

▸ Robustness Checks ▸ Summary of Findings

Robustness: Sectoral Shifts, More-Educated Workers

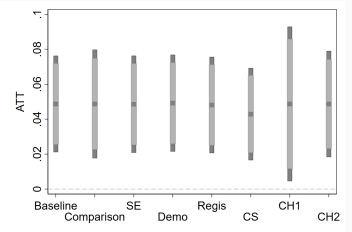


Agriculture | Informal Non-Agriculture | Formal Non-Agriculture

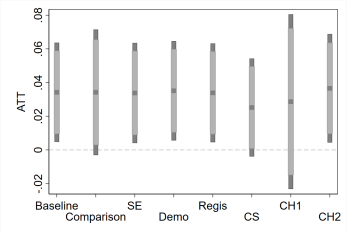
Notes: This figure displays the average cumulative (total) effects and corresponding 90-95% confidence intervals from different specifications indicated along the horizontal axis. The "Baseline" specification represents the baseline model estimated using the approach of de Chaisemartin and d'Haultfoeuille (2024), without controlling for demographic characteristics. A district is considered treated in the year it enters 10-km buffer of any zones. The comparison group includes both never-treated and not-yet-treated units, and standard errors are clustered at the district level. Subsequent specifications introduce incremental modifications to the baseline: "Comparison" restricts the comparison group to never-treated districts only; "SE" clusters standard errors at the province level rather than the district level; "Demo" adds controls for demographic characteristics: gender and age; "Regis" restricts the analysis to observations that have long-term household status in the same dwelling in the same commune or ward; "CS" adopts the alternative estimation approach proposed by Callaway and Sant'Anna (2021); "CH1" and "CH2" are estimated on the two sub-samples where changes in treatment status align and do not align, respectively, with household survey years, using de Chaisemartin and d'Haultfoeuille (2024). Outcomes are defined in the main text.

▸ Robustness Checks ▸ Summary of Findings

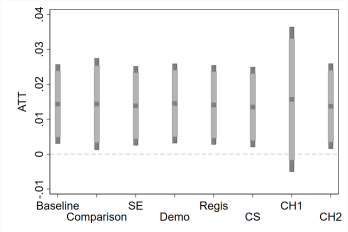
Robustness: Household Labor Diversification, Less-Educated Households



Across-Member Diversification



Within-Member Diversification

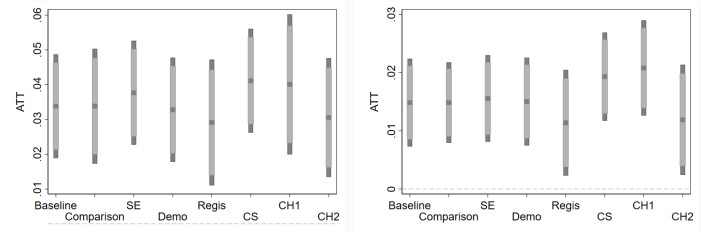


Sectoral Diversification Index

Notes: This figure displays the average cumulative (total) effects and corresponding 90-95% confidence intervals from different specifications indicated along the horizontal axis. The "Baseline" specification represents the baseline model estimated using the approach of de Chaisemartin and d'Haultfoeuille (2024), without controlling for demographic characteristics. A district is considered treated in the year it enters 10-km buffer of any zones. The comparison group includes both never-treated and not-yet-treated units, and standard errors are clustered at the district level. Subsequent specifications introduce incremental modifications to the baseline: "Comparison" restricts the comparison group to never-treated districts only; "SE" clusters standard errors at the province level rather than the district level; "Demo" adds controls for demographic characteristics: gender and age; "Regis" restricts the analysis to observations that have long-term household status in the same dwelling in the same commune or ward; "CS" adopts the alternative estimation approach proposed by Callaway and Sant'Anna (2021); "CH1" and "CH2" are estimated on the two sub-samples where changes in treatment status align and do not align, respectively, with household survey years, using de Chaisemartin and d'Haultfoeuille (2024). Outcomes are defined in the main text.

▸ Robustness Checks ▸ Summary of Findings

Robustness: Household Consumption, Less-Educated Households

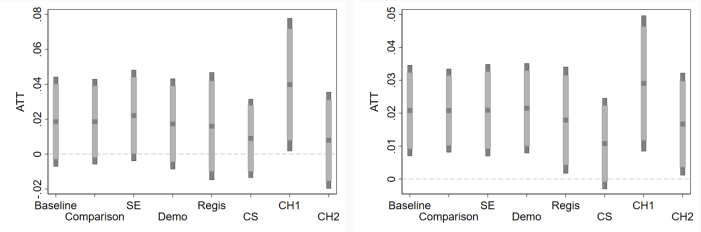


Food Non-Food

Notes: This figure displays the average cumulative (total) effects and corresponding 90-95% confidence intervals from different specifications indicated along the horizontal axis. The "Baseline" specification represents the baseline model estimated using the approach of de Chaisemartin and d'Haultfoeuille (2024), without controlling for demographic characteristics. A district is considered treated in the year it enters 10-km buffer of any zones. The comparison group includes both never-treated and not-yet-treated units, and standard errors are clustered at the district level. Subsequent specifications introduce incremental modifications to the baseline: "Comparison" restricts the comparison group to never-treated districts only; "SE" clusters standard errors at the province level rather than the district level; "Demo" adds controls for demographic characteristics: gender and age; "Regis" restricts the analysis to observations that have long-term household status in the same dwelling in the same commune or ward; "CS" adopts the alternative estimation approach proposed by Callaway and Sant'Anna (2021); "CH1" and "CH2" are estimated on the two sub-samples where changes in treatment status align and do not align, respectively, with household survey years, using de Chaisemartin and d'Haultfoeuille (2024). Outcomes are defined in the main text.

▸ Robustness Checks ▸ Summary of Findings

Robustness: Household Consumption, More-Educated Households

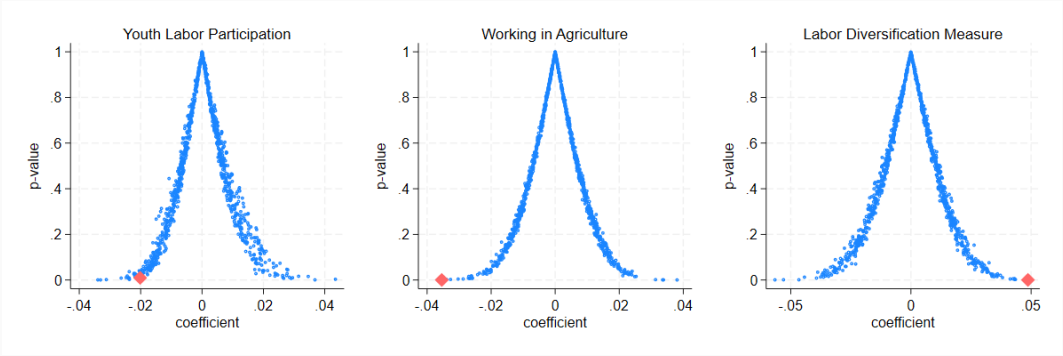


Food Non-Food

Notes: This figure displays the average cumulative (total) effects and corresponding 90-95% confidence intervals from different specifications indicated along the horizontal axis. The "Baseline" specification represents the baseline model estimated using the approach of de Chaisemartin and d'Haultfoeuille (2024), without controlling for demographic characteristics. A district is considered treated in the year it enters 10-km buffer of any zones. The comparison group includes both never-treated and not-yet-treated units, and standard errors are clustered at the district level. Subsequent specifications introduce incremental modifications to the baseline: "Comparison" restricts the comparison group to never-treated districts only; "SE" clusters standard errors at the province level rather than the district level; "Demo" adds controls for demographic characteristics: gender and age; "Regis" restricts the analysis to observations that have long-term household status in the same dwelling in the same commune or ward; "CS" adopts the alternative estimation approach proposed by Callaway and Sant'Anna (2021); "CH1" and "CH2" are estimated on the two sub-samples where changes in treatment status align and do not align, respectively, with household survey years, using de Chaisemartin and d'Haultfoeuille (2024). Outcomes are defined in the main text.

▸ Robustness Checks ▸ Summary of Findings

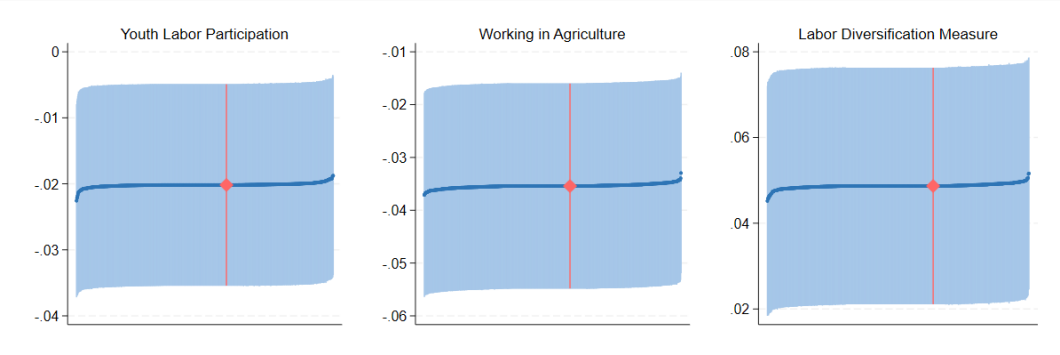
Monte-Carlo Permutation Test



Notes: Each panel shows the distribution of estimated coefficients (blue circles) for the average cumulative (total) effects of industrial zones on three outcomes: youth labor participation among individuals aged 19–24 without a high school diploma (left), employment in agriculture among individuals aged 19–64 (middle), and diversification of household labor ("across-member" measure, right). The vertical axis indicates the p-value associated with each estimate. These estimates are generated from 1,000 Monte Carlo simulations in which the treatment status of one district is randomly reassigned to another district's labor and household data. The red diamonds represent the baseline (observed) estimates.

▸ Robustness Checks ▸ Summary of Findings

Leave-One-District-Out Test



Each panel displays the distribution of estimated coefficients (blue circles) and their 95% confidence intervals for the average cumulative (total) effects of industrial zones on three outcomes: (1) youth labor participation among individuals aged 19–24 without a high school diploma (left), (2) employment in agriculture among individuals aged 19–64 (middle), and (3) diversification of household labor ("across-member" measure, right). The estimates are derived from a leave-one-district-out exercise, in which all observations from a given district are randomly excluded from the sample. Red diamonds indicate the baseline (observed) estimates, and red bars show the corresponding 95% confidence intervals.

▸ Robustness Checks ▸ Summary of Findings

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