High Tech Electronics Manufacturing Clusters and Local Adjustment under the China Trade Shock

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Motivation

- Chinese import competition generated **large, persistent, geographically concentrated** disruptions to U.S. local labor markets (Autor, Dorn & Hanson, 2013)
- Manufacturing employment collapsed; Not in labor force (NILF) rates rose; Wages stagnated in affected communities.
- Substantial heterogeneity in outcomes : Identical import exposure diverge dramatically in employment, population retention, and household wealth trajectories.
- Effects far more durable than standard trade theory predicted, persisting well into the 2010s
- Recent context for the CHIPS and Science Act of 2022

Research Question

Research Question

1. Does high-tech manufacturing concentration moderate the labor market effects of Chinese import competition, both contemporaneously and in the long run?

2. Which demographic groups disproportionately bear the adjustment burden in low-tech manufacturing areas?

Existing Literature

- **Autor, Dorn, and Hanson (2013)**:
  The China Syndrome: Local labor market effects of import competition in the United States. Documents large, persistent employment losses in trade-exposed Commuting Zones.

- **Autor, Dorn, and Hanson (2016)**:
  Learning from labor-market adjustment to large changes in trade. Reviews aggregate evidence on durability and geographic concentration of effects.

- **Pierce and Schott (2016)**:
  The surprisingly swift decline of US manufacturing employment. Uses PNTR as quasi-experiment to identify causal impact of normalized trade relations with China.

- **Moretti (2010)**:
  High-tech manufacturing jobs generate approximately 4.9 additional local nontradable jobs, nearly three times the multiplier for general manufacturing.

This Paper

- **High-Tech Concentration as a Shock Absorber**
  Using split-sample IV, shows that the estimated effects of import exposure are roughly half as large in high-tech manufacturing CZs.

- **Diverging Paths After the Shock**
  Effects in high-tech CZs are statistically insignificant over 2010–2019, while low-tech CZs continue to decline, so regional gaps persist through 2019.

- **Policy Relevance**
  This paper can speak directly to place-based policies and the CHIPS and Science Act (2022) by identifying conditions for local labor market resilience.

Data

- **Data Source:** Decennial Census (1990, 2000) and American Community Survey (2010, 2019) microdata from IPUMS.
- **Labor Market & Demographic Outcomes:**
  - *Labor status:* Employment rate and Not in Labor Force (NILF) rates.
  - *scale of local economy:* log employment and log population.
  - *Income:* Wages and earnings adjusted to real 1999 dollars using the CPI.
  - *Sub-groups:* Thoroughly sliced by education (College vs. Non-college), and race (White, Black, Asian, Hispanic) to capture distributional impacts.
- **Housing Costs & Wealth:**
  - *Variables:* Log mean home values and rental costs adjusted to 1999 constant dollars.
  - *Tenure Status:* Categorized into property renters vs. owners, capturing wealth destruction dynamics.

Data

- **High-Tech Manufacturing Concentration:**
  - *Source:* 1990 U.S. Census employment share
  - Computed the employment share of advanced computing and electronics industries
    - **322:** Computers and related equipment
    - **341:** Radio, TV, and communication equipment
    - **342:** Electrical machinery, equipment, and supplies, n.e.c.
  - *Classification:* **High-tech CZs** are defined as the top quartile (75^{th} percentile) of this 1990 employment share, while the bottom three quartiles form the **Low-tech CZs**.

- **Chinese Import Penetration:**
  - *Source:* UN Comtrade database matched to Census industry classifications.
  - *Variable (ΔIPW_{it}):* Change in U.S. imports from China per worker, instrumented by Chinese exports to eight other high-income countries following Autor et al. (2013).

Final Sample

- **Geographic Unit:** 722 U.S. Commuting Zones (CZs).
  - Excludes Alaska (State FIPS 2) and Hawaii (State FIPS 15).
  - Constructed by aggregating individual microdata using base-year specific PUMA-to-CZ crosswalks.
- **Panel Structure:**
  - Stacked Panel: 1990, 2000, 2010 ($N = 1,444$).
  - Cumulative Long-Difference: 2010 to 2019 ($N = 722$).
- **Weighting:** Observations are weighted by the CZ working-age population (ages 16-64) at the start of each period.

Summary Statistics

	All CZs (N=722)		High-Tech (N=180)		Low-Tech (N=542)	
Variable	Mean	SD	Mean	SD	Mean	SD
Panel A: Baseline Labor Market Outcomes (1990)						
Employment Rate	0.686	0.065	0.704	0.051	0.680	0.068
NILF Rate	0.271	0.058	0.257	0.046	0.276	0.061
ln Employment	10.730	1.640	11.529	1.405	10.465	1.627
ln Weekly Wage	10.110	0.151	10.162	0.159	10.092	0.145
ln Home Value	11.532	0.321	11.623	0.322	11.501	0.315
Panel B: Import Exposure, Stacked						
ΔIPW ($k/worker)	1.958	2.786	3.289	2.689	1.516	2.677
ΔIPO ($k/worker)	1.787	2.180	3.122	2.763	1.344	1.736
Panel C: Import Exposure, Cumulative						
Δ^{cum}IPW ($k/worker)	3.917	4.586	6.578	4.282	3.033	4.338
Δ^{cum}IPO ($k/worker)	3.575	3.417	6.245	3.818	2.688	2.752

Empirical Strategy : Model Specification

- **Baseline Specification (Stacked First-Differences):**

$$\Delta y_{it} = \beta_0 + \beta_1 \Delta IPW_{it} + X'_{it-1}\gamma + \delta_t + \epsilon_{it}$$

  - Δy_{it}: Change in labor market outcome (e.g., employment rate, log wage, housing value) in CZ i over period t (1990-2000, 2000-2010).
  - ΔIPW_{it}: Change in Chinese import penetration per worker.
  - X_{it-1}: Base-year demographic and economic control variables.
  - δ_t: Time period fixed effect.

- **Extended Time Horizon**
  - Autor et al(2013) traces effects through the shock period (1990–2010) only.
  - This paper adds a cumulative long-difference specification to capture post-shock dynamics (2010–2019):

$$\Delta y_i = \alpha_0 + \alpha_1 \Delta IPW_i^{1990-2010} + X'_{i,2010}\gamma + \epsilon_i$$

Empirical Strategy : Instrumental Variable (IV)

- **The Bartik-Style Instrument:** Following Autor et al. (2013), isolate the supply-side component of Chinese import growth using an Instrumental Variable approach.
  - using Chinese export growth to eight other high-income countries (Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, Switzerland).

$$\Delta IPW_{oit} = \sum_{j} \frac{L_{ijt-1}}{L_{it-1}} \frac{\Delta M^{China}_{j,OCt}}{L_{jt-1}}$$

- $\Delta M^{China}_{j,OCt}$: Change in Chinese exports to the 8 other high-income countries in industry j.
- L_{ijt-1}/L_{it-1}: Initial employment share of industry j in CZ i.
- L_{jt-1}: Total U.S. employment in industry j.

Empirical Strategy : IV Validity & Heterogeneity

- **Validity of the IV:**
  - *Relevance:* Strongly correlated with U.S. imports. The Kleibergen-Paap Wald F-statistic exceeds conventional thresholds (e.g., $F > 30$ in most specifications).
  - *Exclusion Restriction:* Chinese export growth to other high-income countries affects U.S. local labor markets only through the U.S. import competition channel.

- **Estimating Heterogeneous Effects:**
  - The full sample is partitioned into High-tech and Low-tech manufacturing CZ subsamples based on 1990 shares.
  - Separated IV regressions are estimated on each subsample, yielding subsample-specific coefficients ($\hat{\beta}^{High}$ and $\hat{\beta}^{Low}$) that can be compared directly without restricting control variables.

Result Overview

- **1. Contemporaneous Effects (1990–2010)**
  Estimated employment and population losses are smaller in high-tech manufacturing CZs than in low-tech manufacturing CZs.

- **2. Long-run Effects (2010–2019)**
  Effects in high-tech CZs are statistically insignificant, while low-tech CZs show continued population and wealth decline.

- **3. Heterogeneity Analysis: Education & Race**
  Adjustment costs are concentrated among the most vulnerable.

Main Result (1990-2010)

	ΔEmp. Rate	ΔNILF	Δ lnEmp	Δ lnPop	Δ lnWage	Δ lnHouse Value
All CZs	-0.005^{***}	0.004^{***}	-0.017^{***}	-0.008^{**}	-0.001	-0.015^{**}
	(0.002)	(0.001)	(0.004)	(0.004)	(0.002)	(0.008)
	$N = 1{,}444$	Cragg-Donald $F = 611.0$		KP $F = 78.1$		
High-tech CZs	-0.004^{*}	0.004^{*}	$\mathbf{-0.015}^{***}$	-0.009^{*}	0.002	-0.009
	(0.002)	(0.002)	(0.006)	(0.005)	(0.002)	(0.009)
	$N = 360$	Cragg-Donald $F = 146.7$		KP $F = 41.2$		
Low-tech CZs	-0.008^{***}	$\mathbf{0.007}^{***}$	$\mathbf{-0.034}^{***}$	-0.021^{***}	-0.003	$\mathbf{-0.032}^{*}$
	(0.003)	(0.002)	(0.008)	(0.007)	(0.004)	(0.017)
	$N = 1{,}084$	Cragg-Donald $F = 214.7$		KP $F = 30.2$		

Main Result (2010-2019)

	ΔEmp. Rate	ΔNILF	Δ lnEmp	Δ lnPop	Δ lnWage	Δ lnHouse Value
All CZs	0.000	−0.000	−0.002	−0.002	0.001	−0.006
	(0.001)	(0.000)	(0.003)	(0.002)	(0.003)	(0.007)
	$N = 722$	Cragg-Donald $F = 611.0$		KP $F = 111.2$		
High-tech CZs	−0.000	0.000	−0.003	−0.003	0.003	−0.007
	(0.001)	(0.001)	(0.004)	(0.003)	(0.005)	(0.012)
	$N = 180$	Cragg-Donald $F = 132.7$		KP $F = 58.6$		
Low-tech CZs	0.000	−0.000	**−0.008****	**−0.009*****	**−0.006****	**−0.022*****
	(0.001)	(0.001)	(0.004)	(0.003)	(0.003)	(0.007)
	$N = 542$	Cragg-Donald $F = 249.9$		KP $F = 44.9$		

Heterogeneity Analysis: Education

		ΔEmp Rate	Δ lnEmp	Δ lnWage	Δ lnHouse Value
Panel A: Low Education Workers					
Stack 1990–2010	High-tech CZs	−0.005**	−0.023**	0.001	−0.011
		(0.003)	(0.009)	(0.002)	(0.009)
	Low-tech CZs	−0.009***	**−0.046*** **	−0.002	**−0.033****
		(0.003)	(0.011)	(0.005)	(0.015)
Cumulative 2010–2019	High-tech CZs	−0.001*	−0.006*	0.001	−0.007
		(0.000)	(0.003)	(0.002)	(0.010)
	Low-tech CZs	−0.001	**−0.014*** **	0.000	**−0.024*****
		(0.001)	(0.005)	(0.003)	(0.007)
Panel B: High Education Workers					
Stack 1990–2010	High-tech CZs	−0.003***	−0.004	0.001	−0.012
		(0.001)	(0.008)	(0.003)	(0.010)
	Low-tech CZs	−0.006***	−0.013	−0.007	−0.041**
		(0.002)	(0.008)	(0.006)	(0.018)
Cumulative 2010–2019	High-tech CZs	−0.000	−0.000	0.002	−0.007
		(0.001)	(0.004)	(0.006)	(0.013)
	Low-tech CZs	0.000	−0.003	**−0.010*****	**−0.025*****
		(0.001)	(0.004)	(0.004)	(0.008)

Heterogeneity Analysis: Education

Interpretation

- **Low Education Workers**
  - The China Shock hits low-tech CZs twice as hard — job destruction, not wage cuts, is the primary channel.
  - Little recovery through 2019: continued employment losses and housing wealth erosion in low-tech CZs.
- **High Education Workers**
  - Employment effects are smaller than for low-education workers in both CZ types, and all 2010–2019 estimates are insignificant in high-tech CZs.
  - In low-tech CZs, the 2010–2019 effects appear in wages and housing values rather than employment.

Heterogeneity Analysis: Race

		ΔEmp Rate	Δ lnEmp	Δ lnPop	Δ lnHouse Value
Panel A: Black Workers					
Stack 1990–2010	High-tech CZs	−0.002 (0.002)	−0.000 (0.011)	0.005 (0.010)	−0.003 (0.010)
	Low-tech CZs	−0.005 (0.004)	−0.039*** (0.012)	−0.025* (0.013)	−0.036 (0.025)
Cumulative 2010–2019	High-tech CZs	−0.001 (0.001)	−0.001 (0.005)	0.000 (0.005)	−0.005 (0.010)
	Low-tech CZs	−0.001 (0.002)	**−0.019**** (0.008)	**−0.021***** (0.006)	**−0.020**** (0.010)

Heterogeneity Analysis: Race

		ΔEmp Rate	Δ lnWage	Δ lnHouse Value
Panel B: Hispanic Workers				
Stack 1990–2010	High-tech CZs	−0.005 (0.003)	−0.008** (0.003)	−0.034** (0.016)
	Low-tech CZs	−0.010* (0.005)	−0.016 (0.011)	−0.060* (0.031)
Cumulative 2010–2019	High-tech CZs	−0.001 (0.001)	0.007* (0.004)	−0.007 (0.017)
	Low-tech CZs	0.002 (0.002)	−0.000 (0.006)	**−0.059***** (0.021)
Panel C: Asian Workers				
Stack 1990–2010	High-tech CZs	−0.004*** (0.001)	0.002 (0.004)	−0.021 (0.014)
	Low-tech CZs	−0.004 (0.010)	−0.012 (0.020)	−0.086 (0.055)
Cumulative 2010–2019	High-tech CZs	**+0.003**** (0.001)	0.008 (0.012)	0.012 (0.018)
	Low-tech CZs	−0.005 (0.007)	−0.018 (0.019)	**−0.086***** (0.030)

Heterogeneity Analysis: Race

Interpretation

- **Black Workers**
  - Low-tech CZs show large losses in log employment and population, persisting through 2019.
  - High-tech CZs provide near-complete insulation.
- **Hispanic Workers**
  - Housing wealth collapses persistently in low-tech CZs.
- **Asian Workers**
  - High-tech CZs generate a unique post-shock employment gain.
  - Low-tech CZs suffer the largest housing wealth destruction of any racial group.

Policy Implications

1. **CHIPS and Science Act**
   The findings suggest that semiconductor investment may generate crucial labor market stabilization spillovers well beyond the high-tech sector itself.

2. **Targeted Place-Based Interventions**
   Economic adjustment has not concluded even a decade after the primary shock.
   Interventions should heavily prioritize low-tech manufacturing CZs, where compounding multi-dimensional disadvantages persist.

3. **Targeted Workforce Programs**
   Retraining and income support programs are most urgently needed for low-educated and minority workers in low-tech CZs.

Conclusion

1. **Recovery is uneven**
   Effects in high-tech CZs are statistically insignificant over 2010–2019, while low-tech CZs continue to show population decline, wage declines, and housing wealth losses a decade after the shock.

2. **Inequality operates through place, not just skill**
   Adjustment costs are concentrated in low-tech CZs, especially among less-educated and minority workers.

3. **Policy must be place-based and forward-looking**
   The CHIPS Act's investment may generate spillovers, but complementary policies targeting low-tech CZs are likely needed.

Appendix: First-Stage F-Statistics

	Observations			Cragg-Donald F			KP F-stat		
Specification	All	High-tech	Low-tech	All	High-tech	Low-tech	All	High-tech	Low-tech
Aggregate (Stack)	1,444	360	1,084	611.0	146.7	214.7	78.1	41.2	30.2
Aggregate (Cumulative)	722	180	542	611.0	132.7	249.9	111.2	58.6	44.9
Low-edu (Stack)	1,444	360	1,084	592.8	154.2	207.9	86.0	43.0	31.0
Low-edu (Cumulative)	722	180	542	630.8	145.8	254.1	129.2	66.4	45.4
High-edu (Stack)	1,444	360	1,084	608.6	140.7	205.7	69.6	38.7	28.7
High-edu (Cumulative)	722	180	542	586.0	123.0	238.4	97.0	52.8	43.4
Black (Stack)	1,438	357	1,081	810.7	134.1	615.9	48.6	28.2	25.6
Black (Cumulative)	720	180	540	629.5	112.1	501.2	55.8	34.6	40.1
Hispanic (Stack)	1,444	360	1,084	930.4	234.7	238.6	53.8	32.7	118.9
Hispanic (Cumulative)	722	180	542	736.6	166.8	230.9	71.7	39.7	64.3
Asian (Stack)	1,437	358	1,079	1374.2	359.8	190.3	201.2	185.5	25.3
Asian (Cumulative)	715	178	537	1146.6	265.1	199.2	197.9	174.7	44.9