The World's Rust Belts

The Heterogeneous Effects of Deindustrialization on 1,993 Localities in Six Countries

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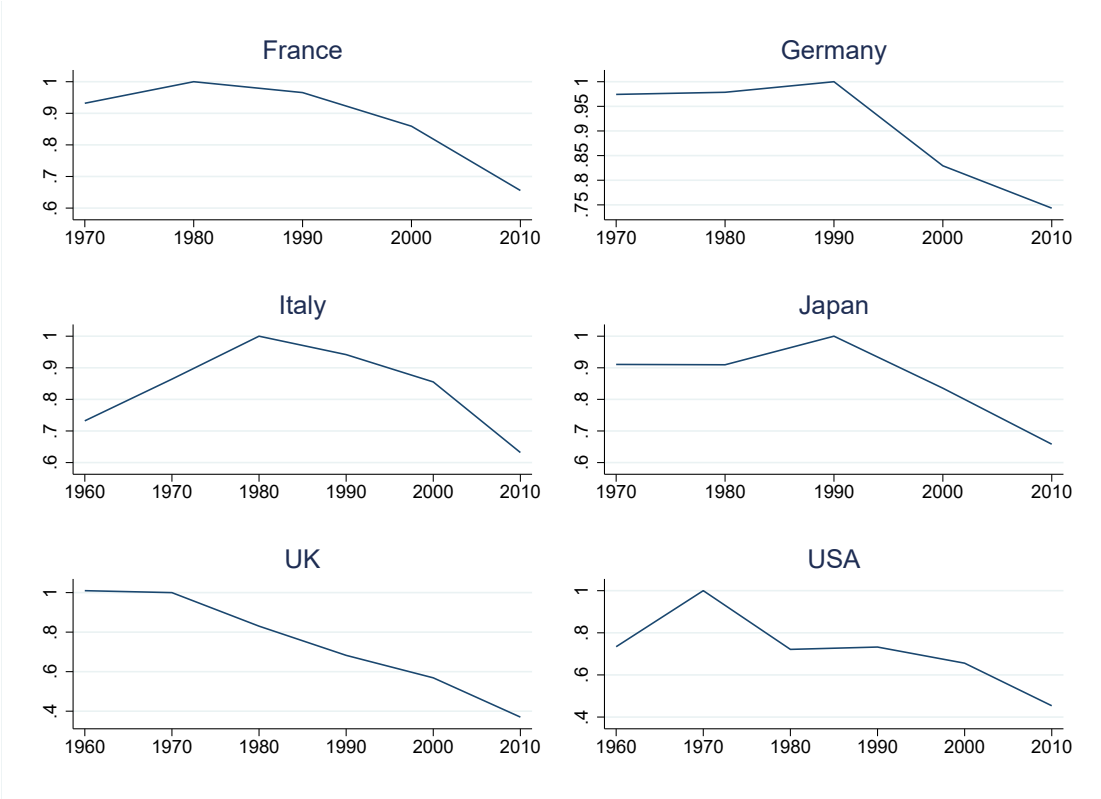
Motivation

Figure: Employment in Manufacturing



Manufacturing employment is normalized to 1 in the period of country's manufacturing peak. Germany includes only West Germany.

Motivation

- Since manufacturing is spatially concentrated, its decline had profound effects on many communities
- Detroit, Duisburg have come to symbolize weak labor markets

Motivation

- These trends have generated a wealth of ideas for place based initiatives
- GER: 2+ B Euro spent annually since 1991; UK: 'Leveling-Up'
- But not obvious whether the Detroit's and the Duisburg's are representative of experience of *all* former manufacturing hubs (limited evidence on *heterogeneity*)
- And if there are indeed cases of economic recovery, what features of a local economy make it more likely to reinvent itself?

What We Do

- We study the employment consequences of deindustrialization for 1,993 local labor markets (LLMs) in 6 industrialized economies (one third of these LLMs are manufacturing hubs)
- Newly-assembled dataset obtained by combining and harmonizing several country-specific sources

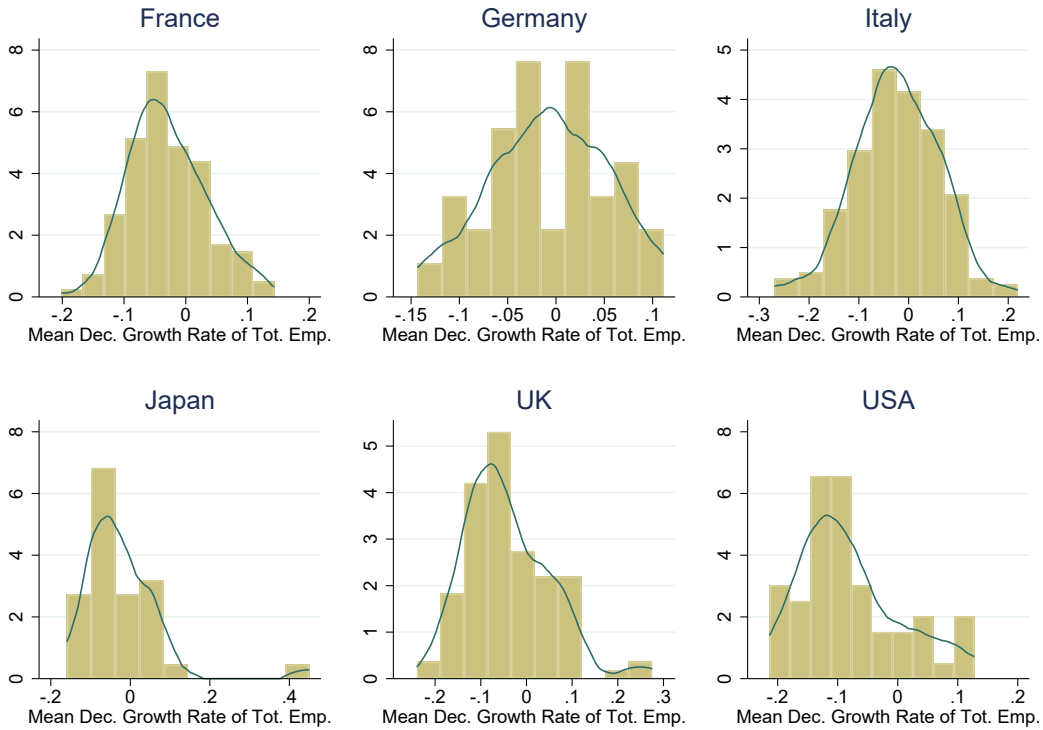
1. Descriptive account of geographical heterogeneity in employment changes in the period of aggregate de-industralization (after each country's manufacturing peak); empirical regularities across 6 countries

2. Role played by residents' human capital in affecting probability of employment success; exploit variation coming from *historical* university openings

Outline

- **Evidence**
  - **Spatial Heterogeneity**
  - Human Capital
- Conclusions

Figure: MF Hubs: Distribution of Mean Decadal Growth Rate of Tot. Empl. after Peak of Manuf., by LLM



For each country we identify MF hubs as those LLMs whose MF shares at peak fall in the top tercile. The LLM-level mean decadal growth rate of tot. empl. after peak of manuf. is expressed in deviation from the country-level mean decadal growth rate. Germany includes only LLMs in West Germany.

Geographical Variation in Mean Decadal Growth Rate of Total Employment after Peak of Manufacturing – Manufacturing Hubs

	Percent With Relative Growth >0	**p90–p10**	**p75–p25**	**Std. Deviation**
All Countries	0.341	0.212	0.117	0.089
France	0.303	0.159	0.085	0.063
Germany	0.472	0.177	0.079	0.061
Italy	0.388	0.211	0.114	0.085
Japan	0.361	0.167	0.100	0.104
UK	0.283	0.229	0.130	0.094
USA	0.172	0.234	0.115	0.086

The sample includes former manufacturing hubs, defined as cities that in the year of their country manufacturing peak had a local manufacturing employment share in the top tercile. Cities with full recovery are cities that in the period between their country manufacturing peak and 2010 have gained employment (relative to their country mean). Germany includes only cities in West Germany.

Cities With Decline and Cities with Recovery

		MF Share at Peak	Mean Decadal Growth Rate of Tot. Empl. after Peak (deviation from country mean)
FRA	Dunkerque	0.39	-0.06
	Compiegne	0.38	0.03
GER	Wuppertal	0.46	-0.14
	Erlangen	0.47	0.07
ITA	Udine	0.43	-0.03
	Padua	0.44	0.07
JPN	Ashikaga	0.44	-0.11
	Anjo	0.46	0.06
UK	Middlesbrough	0.44	-0.17
	Slough	0.44	0.08
USA	Toledo, OH	0.39	-0.13
	Columbus, OH	0.35	0.01

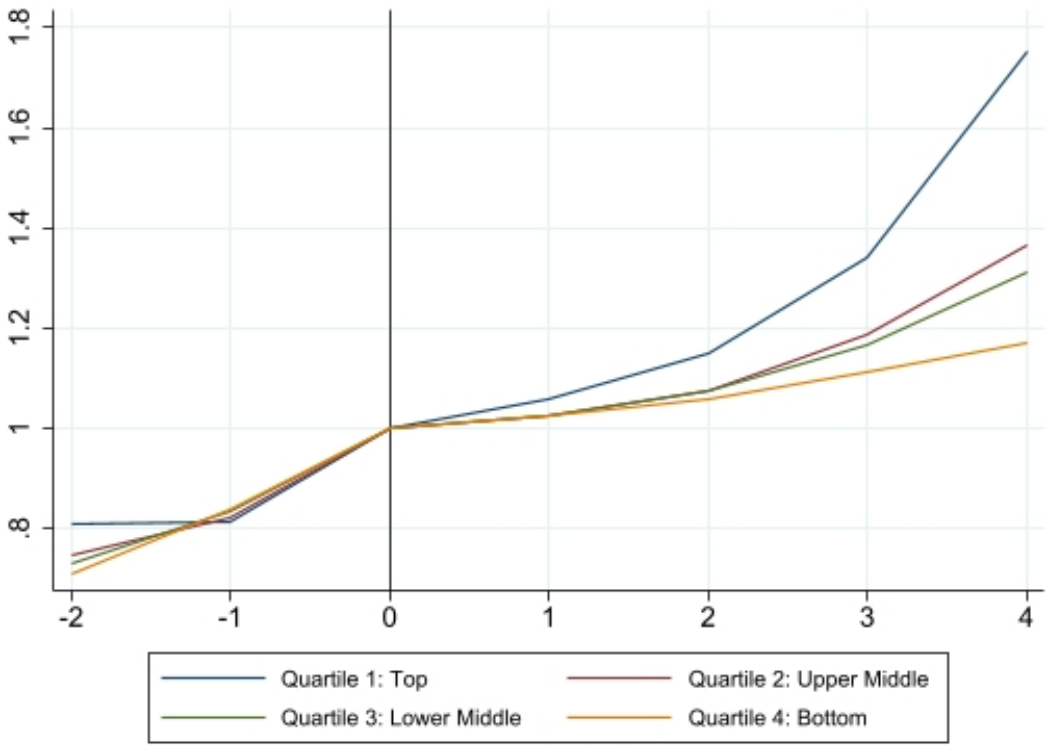
Outline

- **Evidence**
  - Spatial Heterogeneity
  - **Human Capital**
- Conclusions

Human Capital

- Goal: study whether initial differences in human capital across LLMs are systematically associated with their employment growth
- Focus on the share of college educated workers does not imply that human capital is to be considered only possible explanation of geographical variation
- It is certainly possible that other factors played a role. Our analysis is to be considered as first step in understanding geographical differences in growth

Figure: Human Capital & Employment Growth



"Top Quartile" includes LLMs with a share of college-educated residents in the top quartile of their country's distribution in the period of their country's manufacturing peak (t=0). The other quartiles are defined similarly. The Figure shows the percent difference between total employment in a given decade and total employment at the time of the manufacturing peak. The change in employment for a given LLM is computed in deviation from its country's mean.

Estimating Equation

$$Y_{lc} = \beta_h HumanCapital_{lc} + \beta_m MFShare_{lc} + \gamma X_{lc} + \alpha_c + u_{lc}$$

- Y_{lc} : mean decadal growth rate of total employment in the decades after country c peak
- all RHS variables measured at peak
- $HumanCapital_{lc}$: share of LLM l workforce with at least a university degree
- $MFShare_{lc}$: share of manufacturing employment (sample include all LLMs, not only MF hubs)
- α_c: vector of country fixed effects (FEs) that absorbs country-specific time-varying changes; X_{lc}: high-tech manufacturing, urban status, LLM size

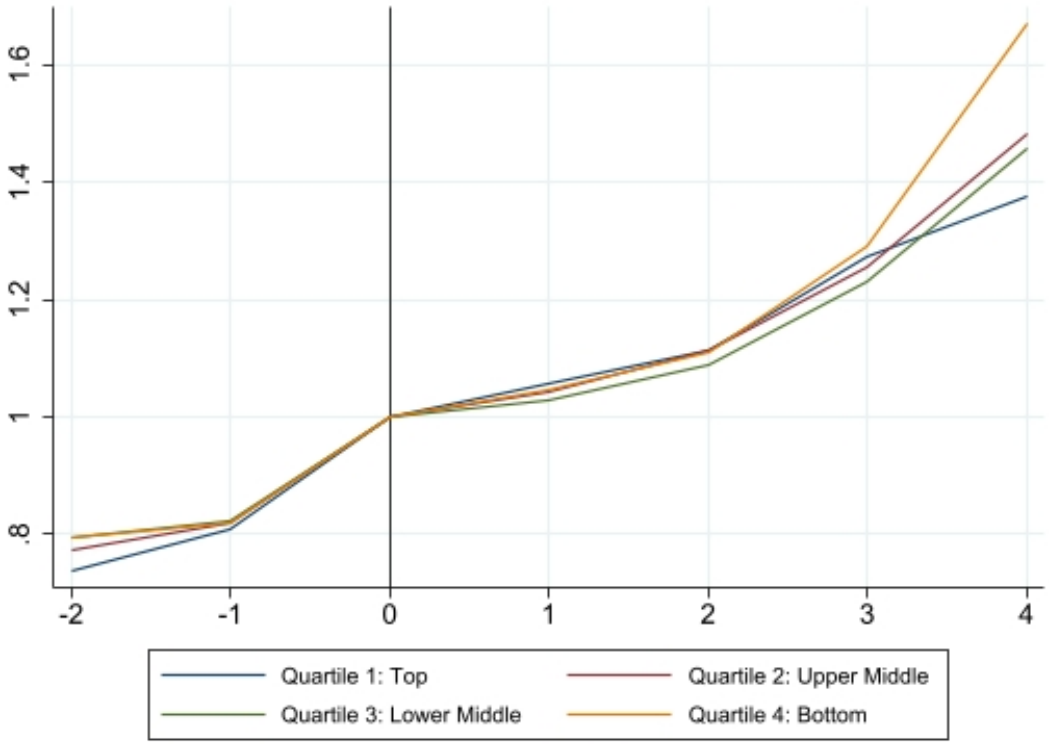
Endogeneity concerns

- Initial level of human capital in the LLM may be correlated with time-varying unobserved factors that affect changes in level of employment
- e.g. if in the years before the country manufacturing peak university educated workers were more likely than workers with lower level of schooling to move to LLMs where employment was expected to grow in the following decades (reverse causality)
- Employment trends do not appear to be particularly consistent with this possibility
- To allay concerns about reverse causality and omitted variables: IV strategy

IV Strategy

- IV: *Ln(1 + Min Distance)*, where *Min Distance* is distance to nearest university that existed 20 years before peak (Card 1995 on college attendance and earnings); before 1950 in UK/US; 1960 in FRA/ITA; 1970 in GER
- Identifying assumption: 20-year lagged distance to universities is orthogonal to any shocks to employment taking place between year of manufacturing peak and 2010 caused by a shift in the unobserved determinants of local labor demand or supply
- e.g.: distance of UK LLMs to nearest university founded before 1950 is uncorrelated with *changes* to unobserved local shifters that occur between 1970 and 2010

Figure: Distance to Unis & Employment Growth



"Top Quartile" includes LLMs with distance from Universities that existed 20 years before the relevant country's manufacturing peak in the top quartile of their country's distribution of distance. The other quartiles are defined similarly. The Figure shows the percent difference between total employment in a given decade and total employment at the time of the manufacturing peak. The change in employment for a given LLM is computed in deviation from its country's mean.

Effect of Initial Share of college-educated Workers on Subsequent Employment Growth

	OLS				IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
College Share	1.02***	1.13***	1.23***	1.22***	1.27**	1.46**	2.43**	2.95***
	(0.13)	(0.13)	(0.14)	(0.18)	(0.57)	(0.62)	(1.08)	(0.88)
Manuf Share	-0.15***	-0.14***	-0.14***	-0.13***	-0.14***	-0.14***	-0.11***	-0.09***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Coeff on College Share equal to OLS (p-value)					0.6593	0.5944	0.2724	0.0548
First Stage								
Log Distance					-0.0048***	-0.0044***	-0.0028***	-0.0042***
					(0.0007)	(0.0007)	(0.0007)	(0.0008)
AP F-statistics					47.67	40.85	15.09	30.41
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total Empl		Yes	Yes	Yes		Yes	Yes	Yes
Urban			Yes	Yes			Yes	Yes
High Tech Share				Yes				Yes
N	1826	1826	1826	1478	1826	1826	1826	1478

The dependent variable is the Mean decadal growth rate of Total Employment. Robust standard errors in parentheses. AP 1st stage F-statistics: Angrist-Pischke multivariate test of excluded instruments F-statistic. % High-Tech MF not available for French cities. Germany includes only Local Labor Markets in West Germany. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Quantitative Implications

- First Stage: distance of 100 KM results in a decline in local university share by 1.4 p.p.
- 2SLS: a LLMs with a 1 p.p higher share of college educated residents is estimated to experience a 3 percent faster employment growth per decade
- 75th vs. 25th pctile in *Human Capital*: 9.6 percent faster employment growth

Table 9: Effect of Initial Share of College-Educated Workers on Subsequent Employment Growth in Knowledge Intensive Services

	OLS				IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
College Share	1.01***	1.18***	1.18***	1.30***	3.54*	3.49*	3.49*	4.33*
	(0.32)	(0.31)	(0.31)	(0.33)	(2.03)	(1.96)	(2.01)	(2.58)
Manuf Share	-0.06	-0.03	-0.03	-0.02	0.05	0.08	0.08	0.13
	(0.05)	(0.05)	(0.05)	(0.05)	(0.10)	(0.10)	(0.11)	(0.14)
First Stage								
Log Distance					-0.0033***	-0.0033***	-0.0036***	-0.0030**
					(0.0012)	(0.0012)	(0.0013)	(0.0013)
AP F-statistics					7.31	7.50	7.21	5.29
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total Empl		Yes	Yes	Yes		Yes	Yes	Yes
Urban			Yes	Yes			Yes	Yes
High Tech Share				Yes				Yes
N	408	408	408	408	408	408	408	408

What have we learned?

- Large spatial heterogeneity in performance during the period of aggregate manufacturing decline - empirical regularities across six industrialized economies

- LLMs that had higher human capital at their country's manufacturing peak experienced faster total employment growth
- faster growth in human capital-intensive services
- In terms of place based policies, it would seem that investment in education of local workers is an industrial policy with the potential to increase probability of economic success.

"Now Main Street's whitewashed windows and vacant stores
Seems like there ain't nobody wants to come down here no more
They're closing down the textile mill across the railroad tracks
Foreman says these jobs are going boys and they ain't coming back"

(My Hometown, Bruce Springsteen, 1984)


DETROPIA
A FILM BY HEIDI EWING & RACHEL GRADY

Some Related Work

- Manufacturing and local economies (Autor, Dorn & Hanson '13); Duranton '07: micro foundations for the geographical churning of U.S. industries; Findeisen & Suedekum '08 on evolution of German regions (1977-2002)
- Human capital and growth, e.g. Glaeser '09, Glaeser & Saiz '14 on the rise of the skilled city in the U.S.
- Universities and local economies (Kantor & Whalley '14, '19; closest to us: Howard et al '22 and Andrews et al '23 on U.S. data)

Data

- Geo unit of analysis: local labor markets (LLMs), areas where most of the residents both live and work
- Combine and harmonize data on employment, industry composition and schooling at the local level: 1970-2010
- FRA, JPN (no schooling): Pop Census; GER (no former East): Establishment History Panel; ITA: Pop Census + MF & Services Census; UK: Business Register and Employment Survey + Office for National Statistics; US: Pop Census + County Business Patterns
- Distance to historical unis: U.S. Statistic's Integrated Postsecondary Education Data System + European Tertiary Education Register; driving distance from open street-map data (Geofabrik); Urbanization: Henderson & Wang '07

Data (1970-2010)

- FRA: 348 *zones d'emploi*
- GER: 108 *Arbeitsmarktregionen*. No former East
- ITA: 955 *sistemi locali del lavoro* (similar conclusions when removing those below 10th pctile in size)
- JPN: 105 employment areas (mostly urban); no human capital
- UK: 309 travel to work areas. No Northern Ireland
- US: 168 *metropolitan* statistical areas

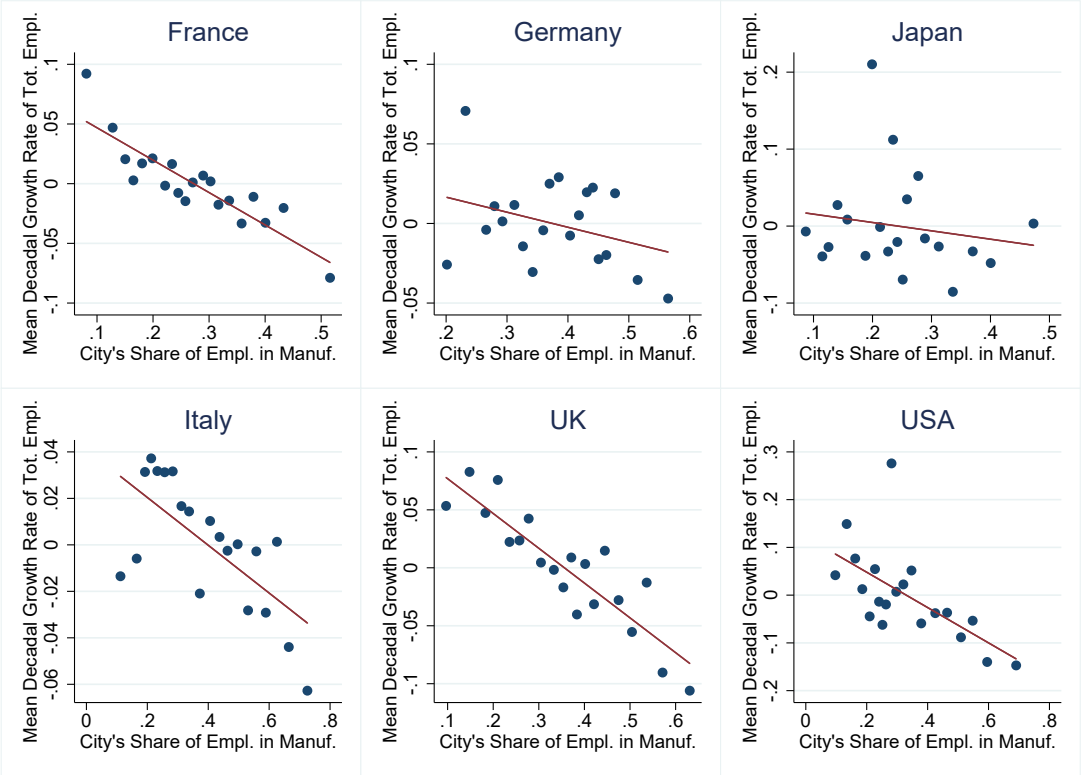
Table: Summary Statistics

Variable	Mean	Std. Dev.	N
Mean Decadal Growth Rate of Tot. Empl. from Peak to 2010	0.075	0.118	1993
Mean Decadal Growth Rate of MF Empl. from Peak to 2010	-0.070	0.168	1993
Manufact. Share at Peak	0.355	0.161	1993
Percent with College Degree at Peak	0.043	0.031	1826
Knowledge Intensive Service Share at Peak	0.116	0.045	477
Manufact. High-Tech Share at Peak	0.054	0.079	1540
Distance to Nearest Historical College (Km)	105.43	117.978	1888
Total Employment at Peak	77272.26	394005.5	1993
Mean Growth Rate of KIS Empl. from Peak to 2010	0.478	0.223	477

Spatial Heterogeneity

Goal: descriptive account of geographical heterogeneity in employment changes in the period after each country's manufacturing peak

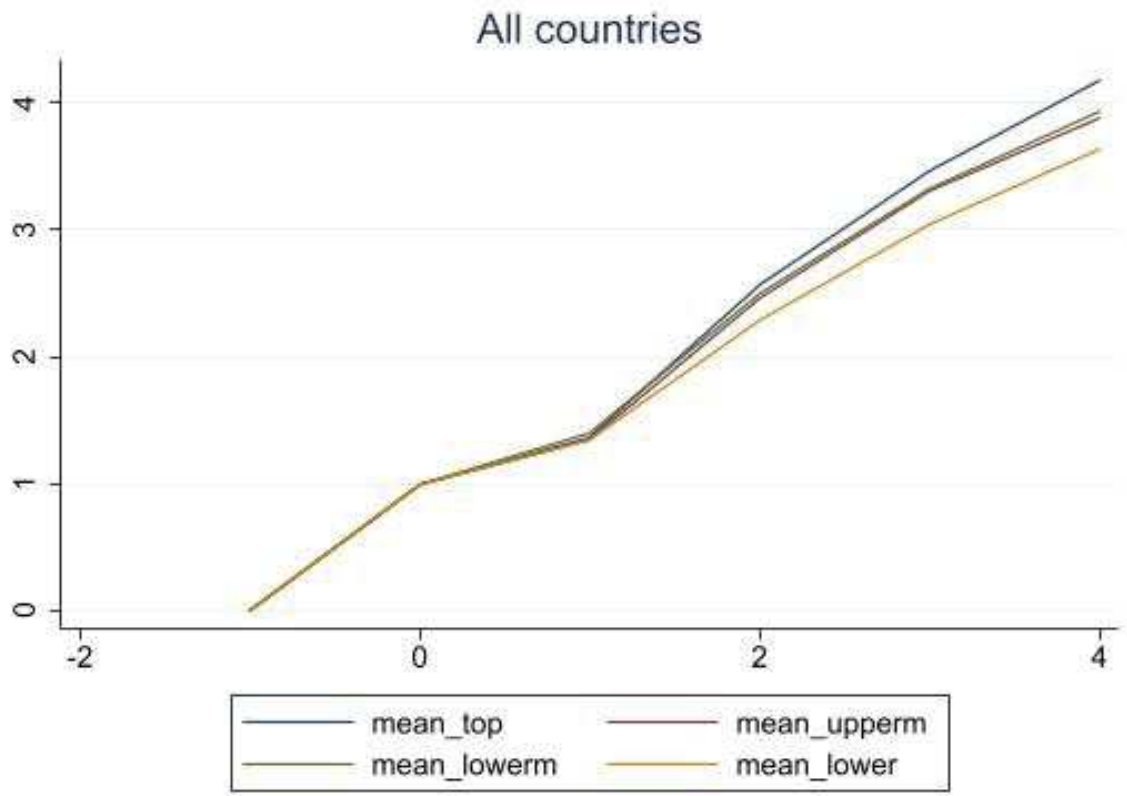
Figure: MF Share at Peak (x-axis) and Mean Decadal Growth Rate of Tot. Empl. after Peak of Manuf. (y-axis)



Binned scatter plots. The solid line shows the best linear fit estimated on the underlying LLM-level data using OLS. The LLM-level mean decadal growth rate of tot. empl. after peak of manuf. is expressed in deviation from the country-level mean decadal growth rate (Same for following graphs). Slope coefficient from pooled regression (using 6 countries) with country FE: -0.169 (SE 0.016). Germany includes only LLMs in West Germany.

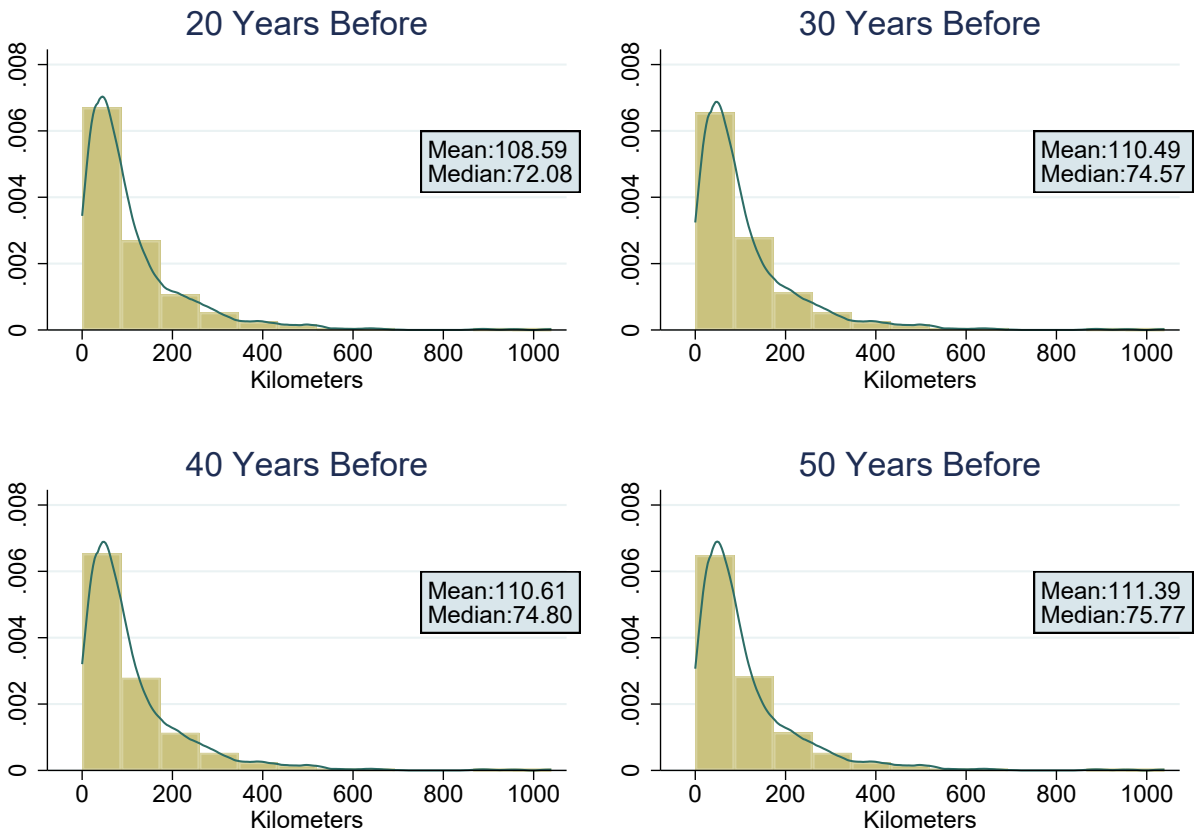
- Negative slopes reflect employment losses directly stemming from decline of manufacturing jobs
- They probably also reflect indirect employment losses due to multiplier/agglomeration effects (Moretti '10; Gathmann, Helm & Schoenberg'20)
- Well documented in the literature
- Average effect can potentially mask a significant amount of spatial heterogeneity
- The amount of heterogeneity has not received much attention

Figure: Human Capital & Growth in Knowledge Intensive Service (KIS)



KIS: e.g. R&D, education, finance, telecommunication. y: KIS employment in each quartile. "top" means top quartile in college share in t=0 (country peak year). For each group index peak year=1.

Figure: Distance to nearest historical university

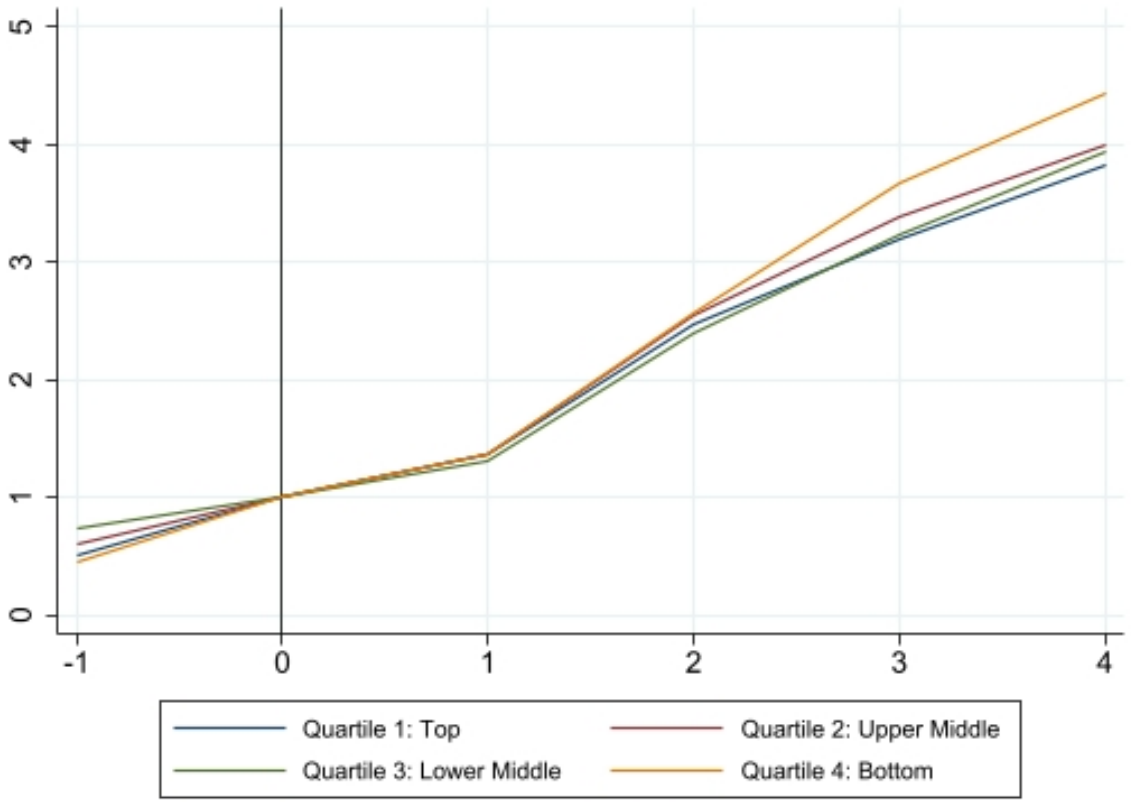


Notes: Driving distance, in Km.

Validity of our Identification Assumption

- Unobserved Heterogeneity in Cons. or Prod. Amenities
- We can't rule out that there is a correlation between uni proximity and time-varying determinants of local labor supply or demand.
- We can look at pre-trends

Figure: Distance to Unis & KIS Growth

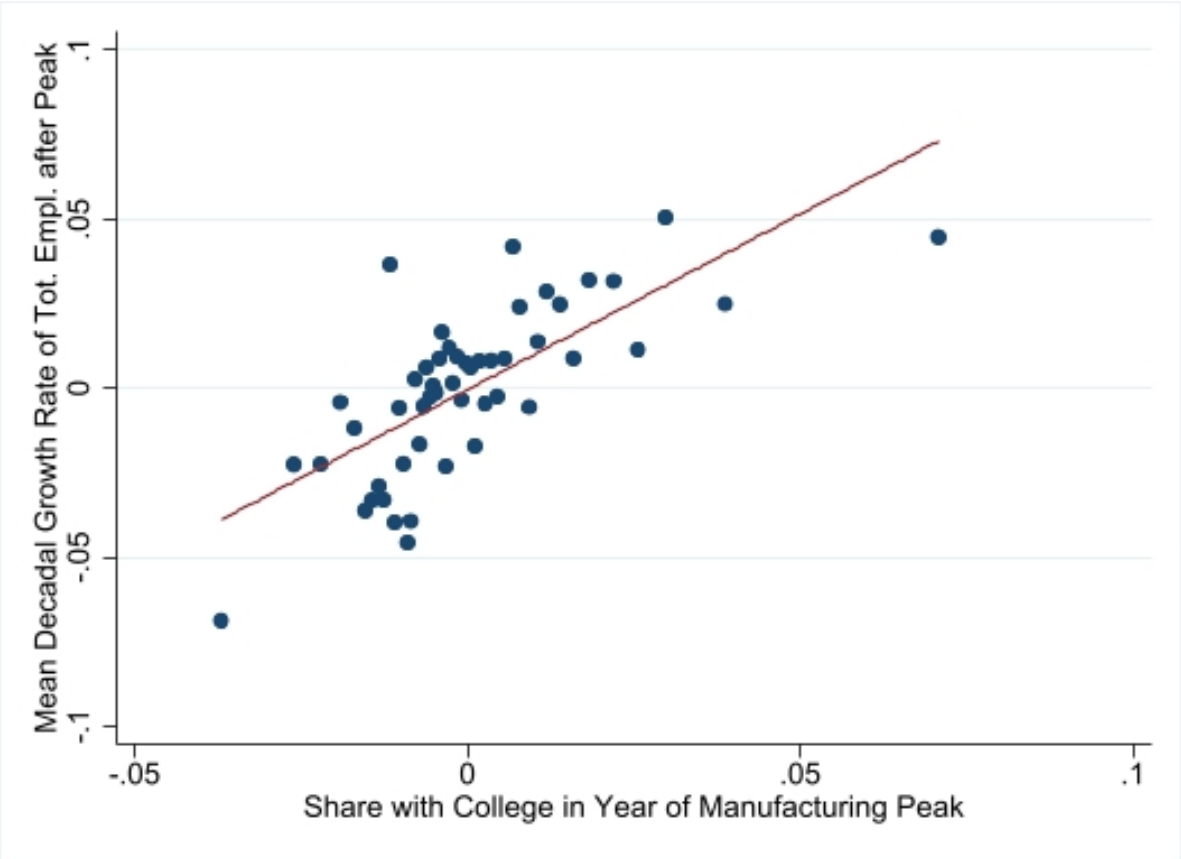


y: KIS employment in each quartile. "top" means top quartile in distance to uni. t=0 is country peak year. For each group index peak year=1.

Validity of our Identification Assumption

- Reverse Causality
- Overestimation if new unis tend to locate in LLMs where demand for higher education is rising, and demand for education is correlated with omitted factors that increase growth.
- But most unis are historical + we can shift IV in time.

Figure: Human Capital and Performance



Binned scatter plot. The LLM-level share of college educated workers is expressed in deviation from the country-level mean. The solid line shows the best linear fit estimated on the underlying LLM-level data using OLS. The slope is 1.18 (SE 0.13).

Effect of Initial Share of college-educated Workers on Subsequent Employment Growth – IV Measured Further Back in Time

When IV is Measured:	20 Years Before Peak	30 Years Before Peak	40 Years Before Peak	50 Years Before Peak
	(1)	(2)	(3)	(4)
College Share	2.95***	2.60***	2.63***	2.54***
	(0.88)	(0.88)	(0.88)	(0.83)
Manuf Share	-0.09***	-0.10***	-0.09***	-0.10***
	(0.03)	(0.03)	(0.03)	(0.03)
Coeff on College Share equal to col 1 (p-value)		0.2880	0.3260	0.2516
First Stage				
Log Distance	-0.0042***	-0.0041***	-0.0041***	-0.0042***
	(0.0008)	(0.0008)	(0.0008)	(0.0007)
AP F-statistic	30.41	28.37	28.63	32.07
Country FE	Yes	Yes	Yes	Yes
Total Empl	Yes	Yes	Yes	Yes
Urban	Yes	Yes	Yes	Yes
High Tech Share	Yes	Yes	Yes	Yes
N	1478	1478	1478	1478

The dependent variable is the mean decadal growth rate of Total Employment. Robust standard errors in parentheses. AP 1st stage F-statistics: Angrist-Pischke multivariate test of excluded instruments F-statistic. Germany includes only Local Labor Markets in West Germany. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

By sector

- Effect of college share on total employment growth is not explained by smaller job losses in manufacturing
- Gains in Knowledge Intensive Services in high human capital LLMs?

Quantitative Implications

- 2SLS: a LLMs with a 1 p.p higher share of college educated residents is estimated to experience a 4.3 percent faster KIS employment growth per decade
- 1 SD increase in *Human Capital* : 17.2 faster employment KIS growth

Figure: Spatial Distribution of Mean Decadal Growth Rate of Total Employment After Peak of Manufacturing – All LLMs

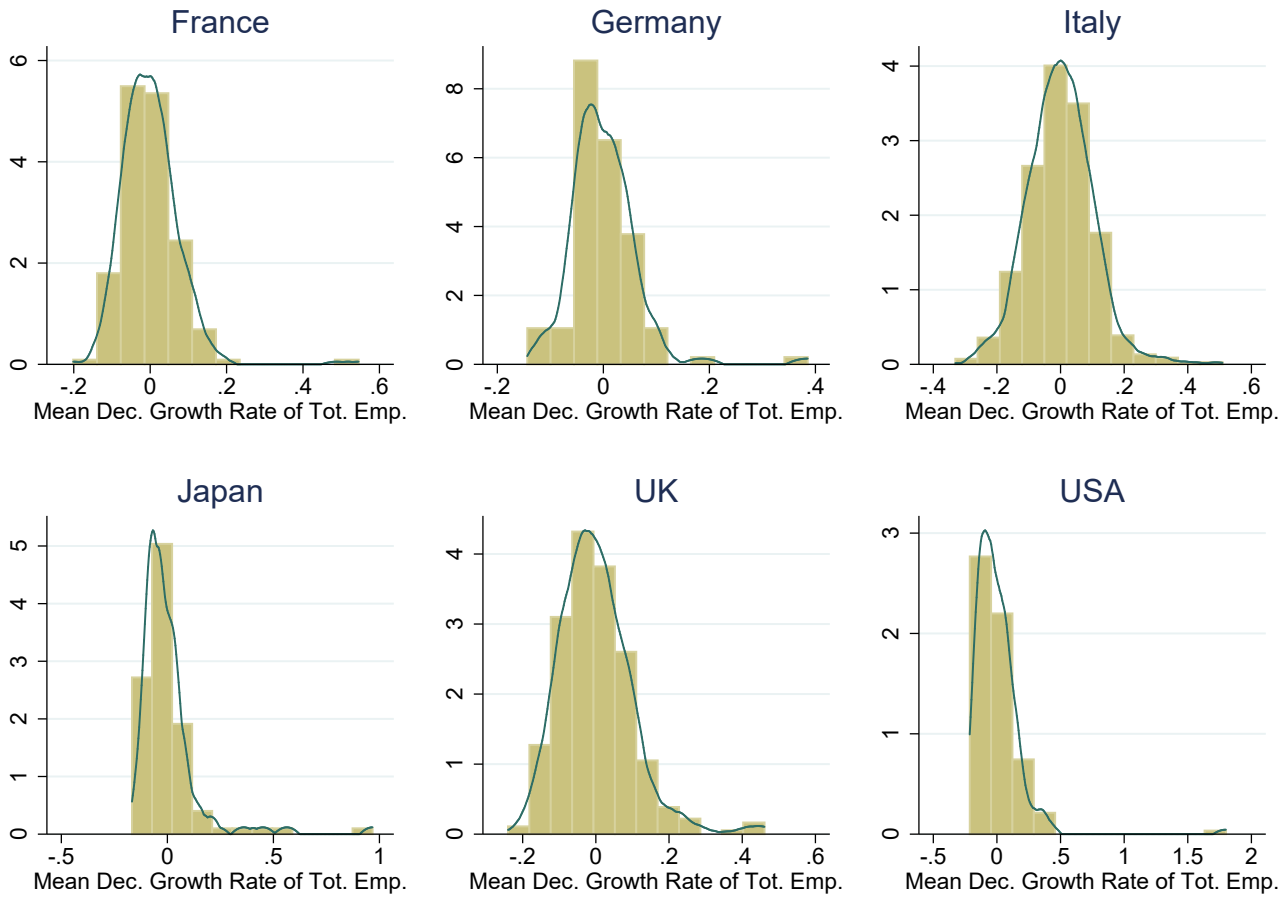


Table: Degree of Variation in Mean Decadal Growth Rate of Total Employment after Peak of Manufacturing, by LLM

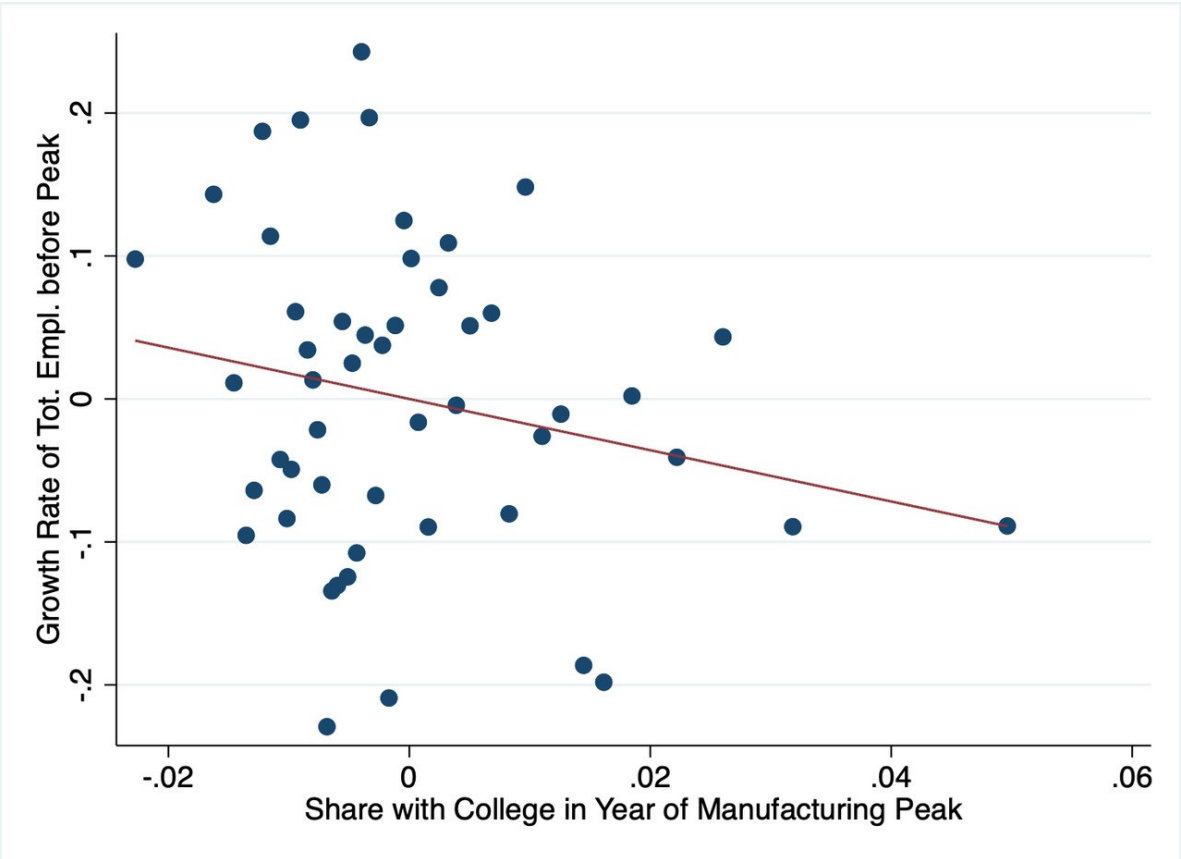
	p90–p10	p75–p25	Std. Deviation
France	0.172	0.088	0.076
Germany	0.124	0.071	0.064
Italy	0.247	0.128	0.103
Japan	0.216	0.102	0.146
UK	0.227	0.126	0.101
USA	0.316	0.186	0.190

Figure: Service Sector Breakdown

Knowledge-intensive services	61	Water transport;
	62	Air transport;
	64	Post and telecommunications;
	65 to 67	Financial intermediation;
	70 to 74	Real estate, renting and business activities;
	80	Education;
	85	Health and social work;
	92	Recreational, cultural and sporting activities
High-tech KIS	64	Post and telecommunications;
	72	Computer and related activities;
	73	Research and development
Market KIS (excl. financial intermediation and high-tech services)	61	Water transport;
	62	Air transport;
	70	Real estate activities;
	71	Renting of machinery and equipment without operator and of personal and household go
	74	Other business activities

Breakdown feasible at LLM level for UK and US. Source: Eurostat

Figure: Human Capital and Performance pre-Peak



Y: growth between -2 and 0. Binned scatter plot. The LLM-level share of college educated workers is expressed in deviation from the country-level mean. The solid line shows the best linear fit estimated on the underlying LLM-level data using OLS.