

Future Technology Hubs or Backwater?

Lessons on Structural Change from Germany's Coal Regions

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Motivation

- Economic activities are spatially concentrated in most countries (e.g., Blanchard and Katz, 1992; Greenstone, Hornbeck and Moretti, 2010; Helm, 2017)
- Shifts from industry to knowledge-based growth and increasing international trade let to large regional disruptions, particularly, in regions with industrial clusters (e.g., rust belt; Autor, Dorn and Hanson, 2013)
- Governments frequently target policies and public resources toward disadvantaged industrial (and agricultural) areas (Kline and Moretti, 2013)

Motivation *cont.*

Example: U.S. Energy Policy *"We are going to continue to expand energy production, and we will also create more jobs in infrastructure, trucking, and manufacturing."* (President Donald J. Trump)

- Win elections
- Independence of foreign imports
- **Agglomeration spillovers to push the economic development of disadvantage regions and avoid social hardship**

What we do...

Objective

- Do traditional subsidized blue-collar industries indeed generate positive externalities for local economies and labor markets?
- How do they influence structural change?

Approach

- Examining the effect of closures of German coal mines on structural transformation of local economies and labor markets
- Combining three unique data sources: i) German administrative data from Establishment History Panel (BHP), ii) historical data on all German coal mines, iii) (Patent data (PATSTAT))

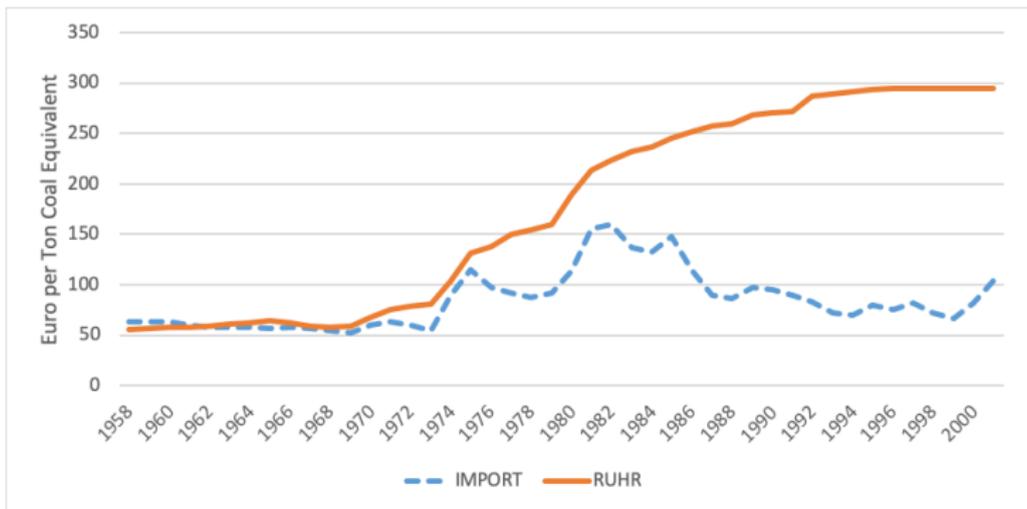
Why German coal mining?

- One of the most heavily subsidized industrial sectors within all OECD countries
- Substantial time and spatial variation allowing to analyze the effects on the micro level under different economic conditions

German Coal Mining

Heavily shielded & subsidized industry

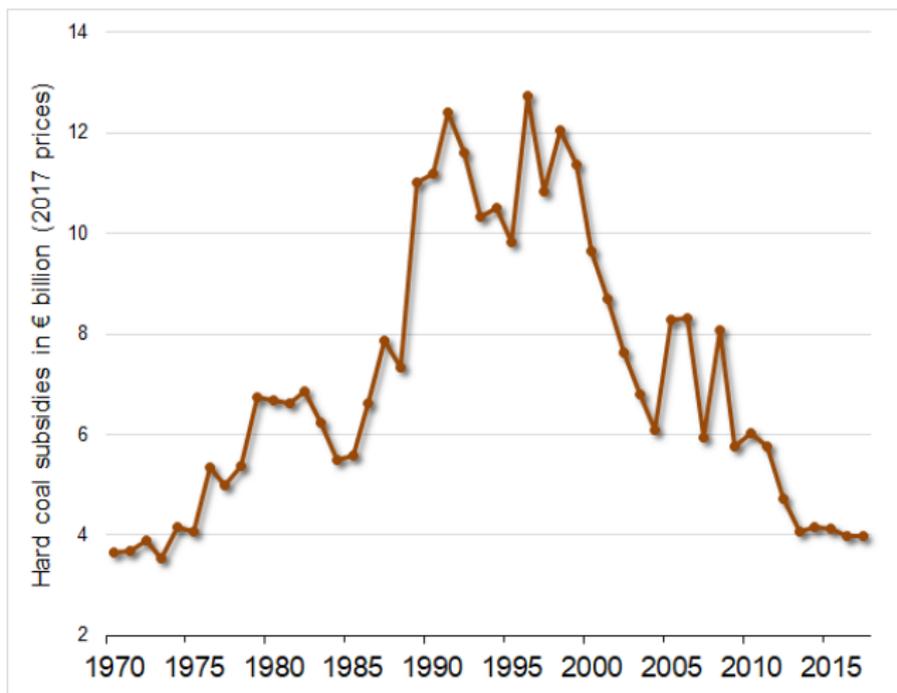
Domestic versus Imported Price of Coal in Germany



German Coal Mining

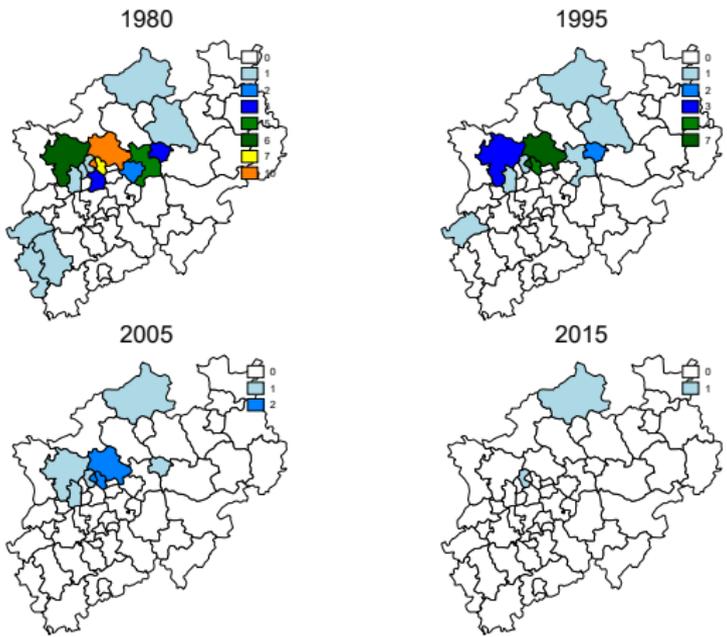
Heavily shielded & subsidized industry

Hard Coal Subsidies in Germany, 1970-2017



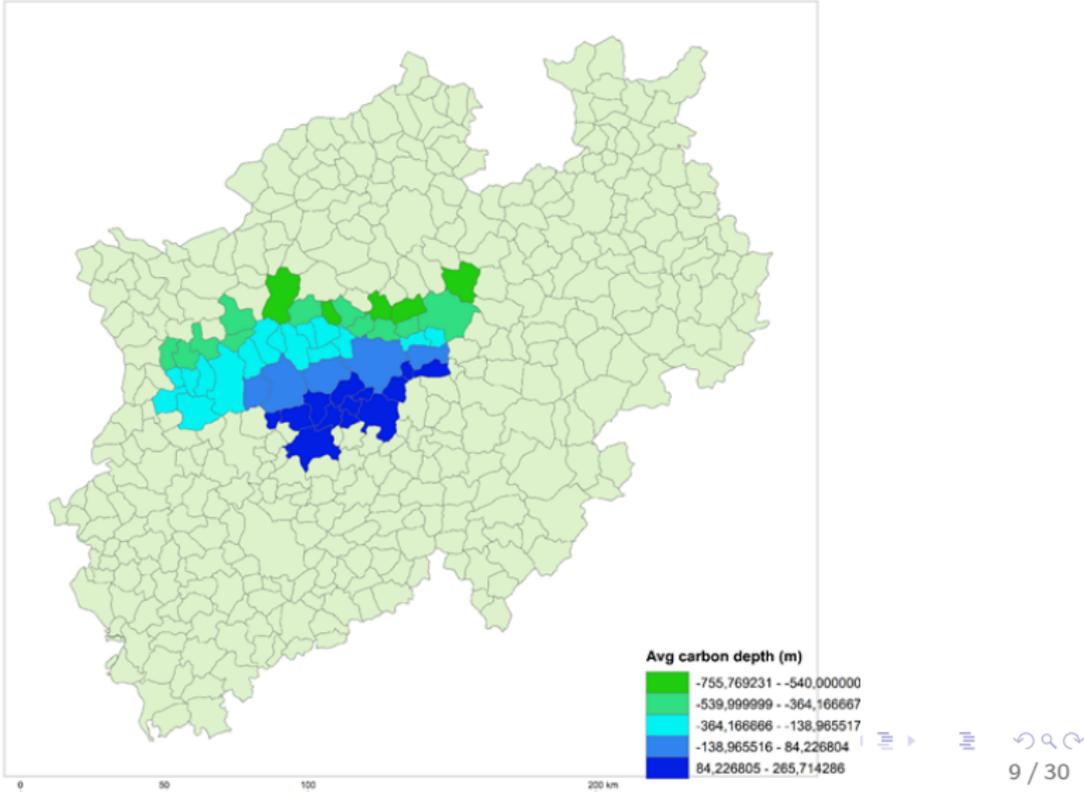
German Coal Regions

Coal mines in the Ruhr area

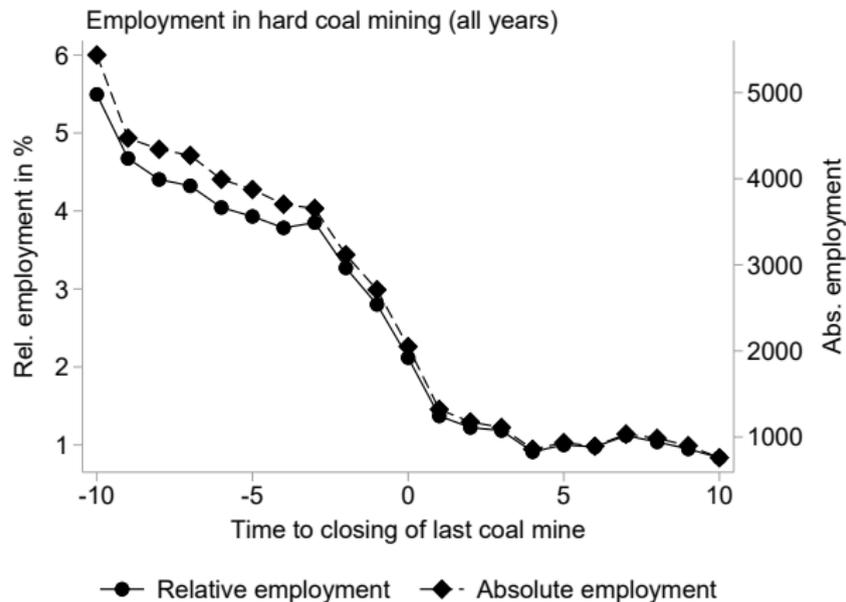


German Coal Regions

Carbon depth in the Ruhr region



Mine Closure & employment effects in mining sector



Data

German coal mine data

- Geo-coded of all coal mines in Germany
- Opening and closing dates
- Exclude coal mines that closed before 1975
- (Exclude coal mines from East-Germany for most of our analysis)

Establishment History Panel

- Establishment History Panel (Betriebshistorikpanel, BHP)
- Entire population of German firms for more than 40 years
- Approximately 2.7 million establishments per year

Empirical Approach I

$$\ln Y_{it} = \alpha_i + \lambda_t + \lambda_t \cdot State + x_{it}\beta + \sum_k D_{it}^k \delta^k + \epsilon_{it} \quad (1)$$

- $\ln Y_{it}$: dependent variable of municipality i at time t , e.g., employment, wages etc.
- D_{it}^k set of dummies 1 in the k 'th year before after closure of last coal mine
- λ_t time fixed effects
- $\lambda_t \cdot State$ time x state fixed effects
- α_i municipality fixed effects
- x_{it} control variables

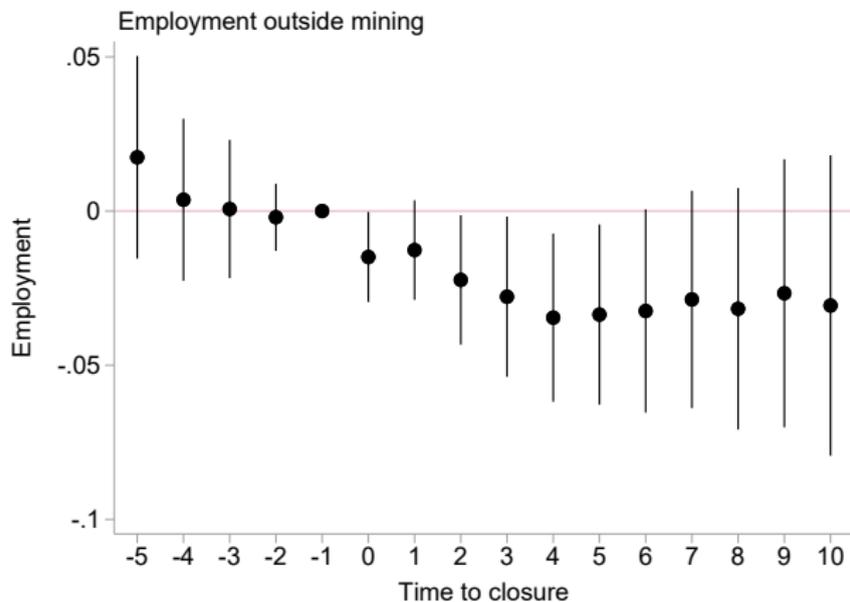
Empirical Approach II

$$\ln Y_{it} = \alpha_i + \lambda_t + \lambda_t \cdot State + x_{it}\beta + \delta \sum MineClosures + \epsilon_{it} \quad (2)$$

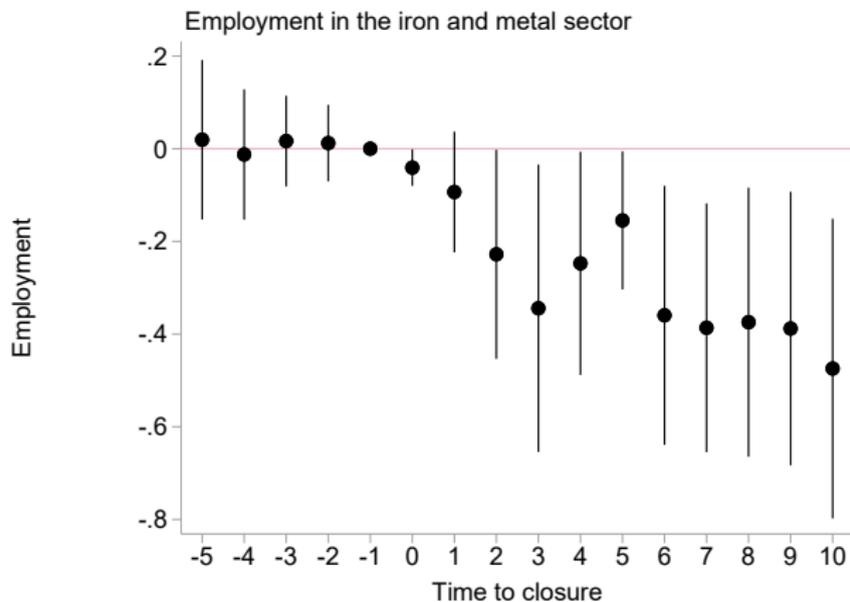
- $\ln Y_{it}$: dependent variable of municipality i at time t , e.g., employment, wages etc.
- D_{it}^k set of dummies 1 in the k 'th year before after closure of last coal mine
- λ_t time fixed effects
- $\lambda_t \cdot State$ time x state fixed effects
- α_i municipality fixed effects
- x_{it} control variables

Main Results: General outcomes

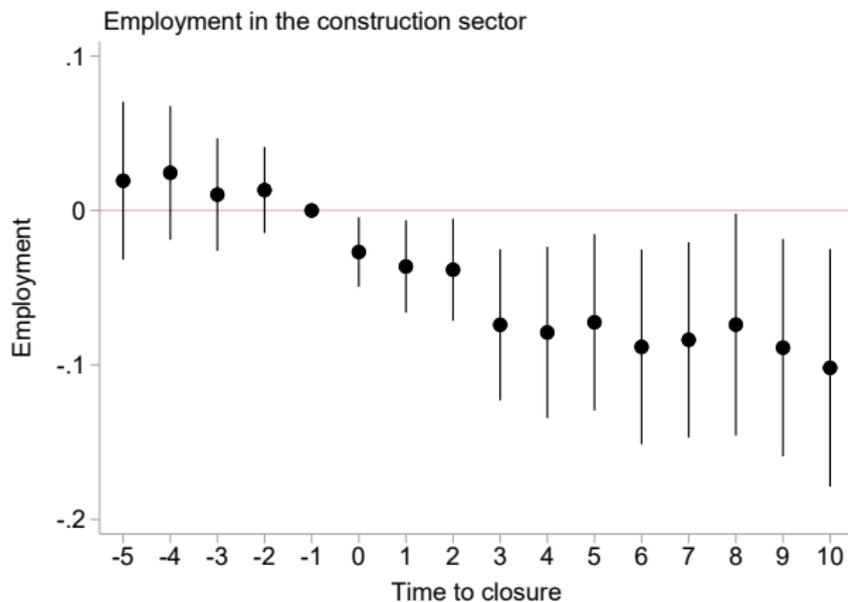
Mine closure & employment effects outside mining sector



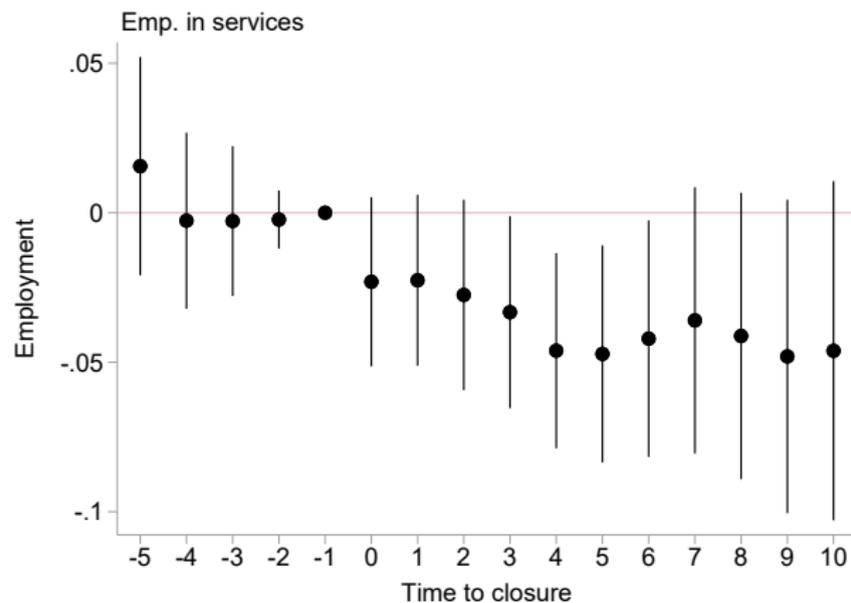
Mine Closure & Employment Effects in Iron and Steel Production



Mine closure & employment effects in construction sector



Mine Closure & Employment Effects in Services



Cumulative mine closures (empirical approach II)

	ln(Employment variables)			
	(1)	(2)	(3)	(4)
	Outside mining	Metal	Construction	Services
CumMineClose	-0.075*** (0.018)	-0.278*** (0.088)	-0.099*** (0.015)	-0.077*** (0.015)
Municipality f.e.	YES	YES	YES	YES
State x Time f.e.	YES	YES	YES	YES

N=354,602 Robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

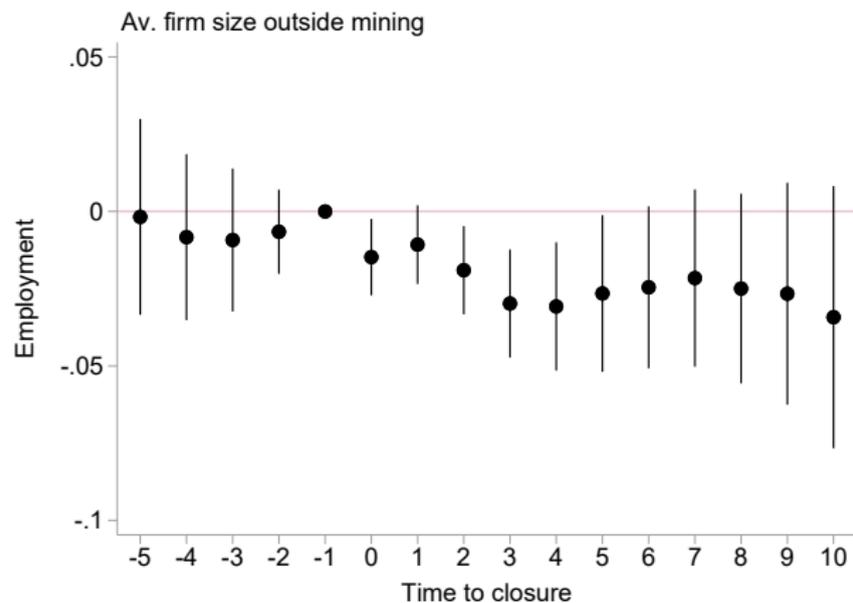
SEs are clustered at Municipality level.

Main results: effects on structural change

Effects on structural change

- Coal mining attracts large resource-intensive companies that crowd out innovation and entrepreneurship (e.g., Chinitz (1961) and Glaeser, Kerr, and Kerr (2015))
- Polarization of the labor market → returns to high (non-routine) skills (e.g., Autor, Levy and Murnane, 2003; Deming, 2017)

Mine Closure & Average firm size



Effects on structural change

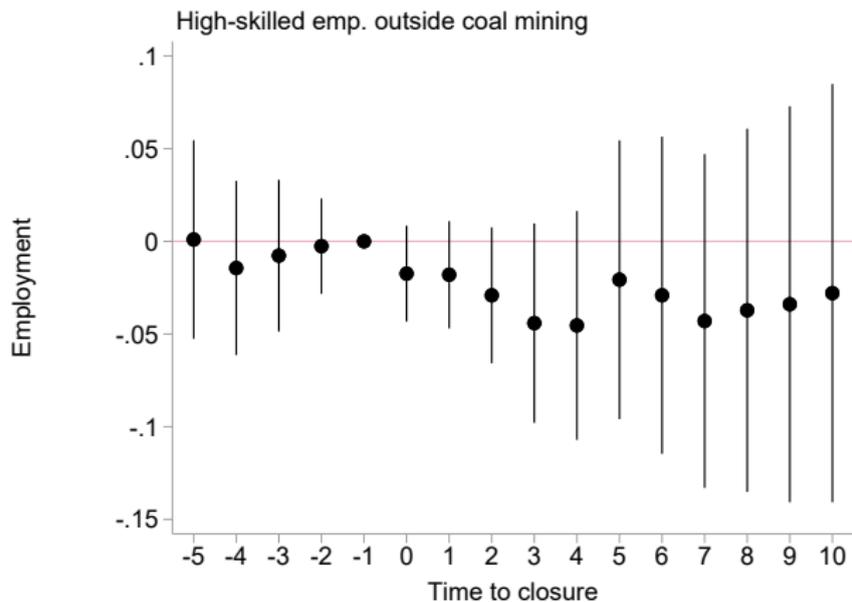
(5)	ln(Employment variables)			
	(1)	(2)	(3)	(4)
	IT	R&D	# IT estab.	# R&D estab.
CumMineClose	0.172** (0.076)	0.330** (0.153)	0.165*** (0.032)	0.166*** (0.043)
Municipality f.e.	YES	YES	YES	YES
State x Time f.e.	YES	YES	YES	YES

N=87,331 Robust standard errors in parentheses

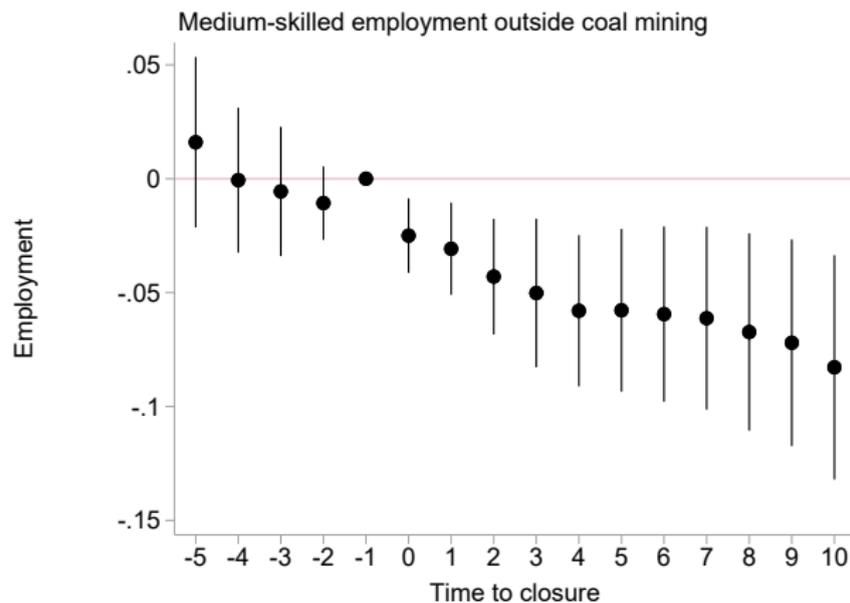
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

SEs are clustered at Municipality level.

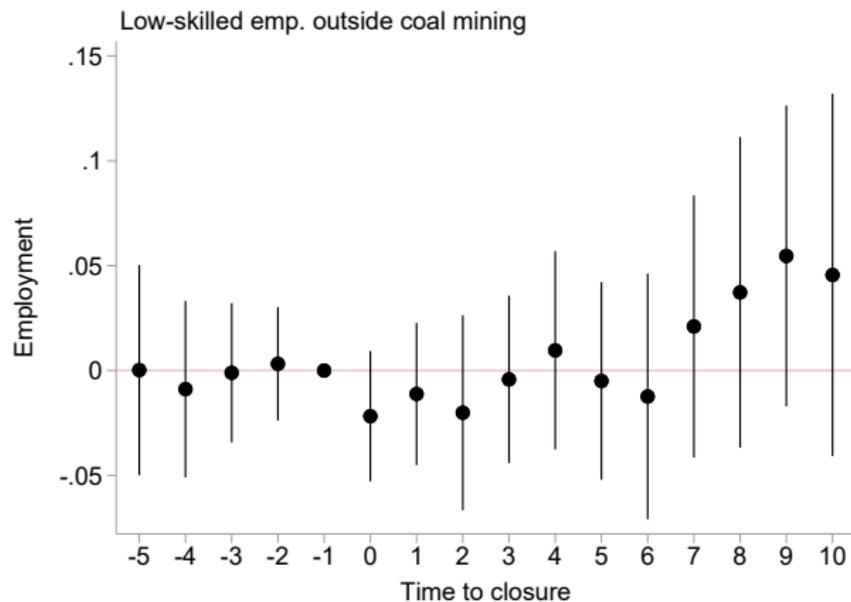
Mine Closure & Employment effects high skilled



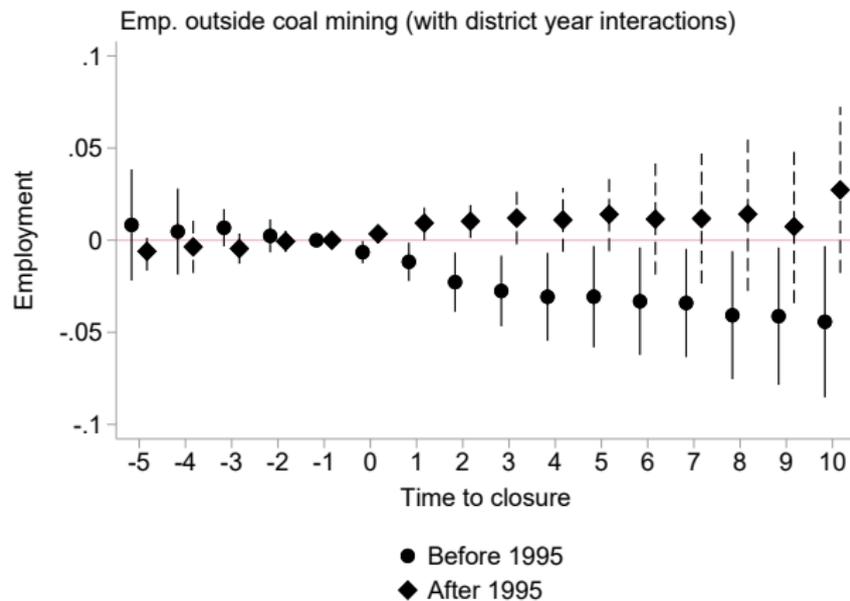
Mine closure & Employment effects medium skilled



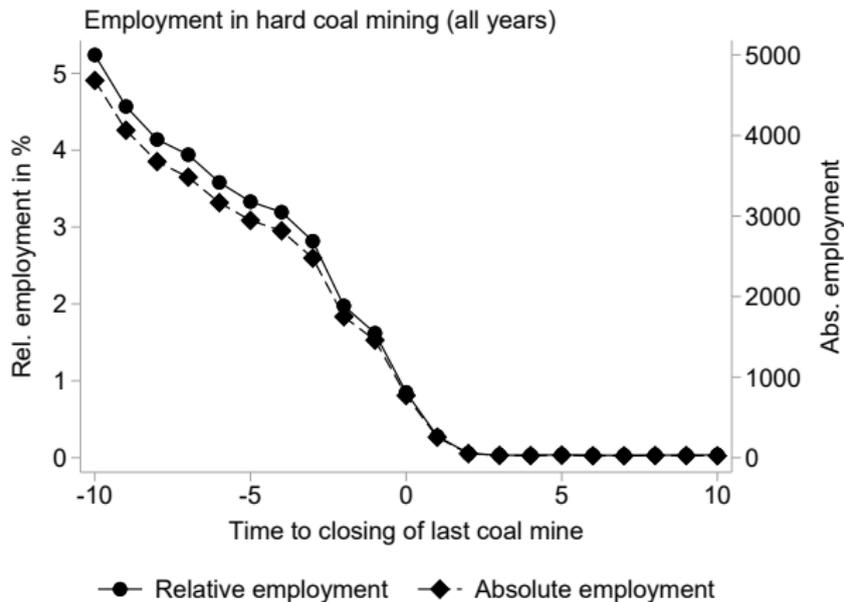
Mine closure & Employment effects low skilled



Mine closure & inter-temporal effects



Mine closure & mining employment after 1995



Conclusion

- Evidence for spillover effects of mine closure
- Mine closure lowers overall employment, especially in energy-intensive industries (manufacturing, iron & steel)
- No spillovers to knowledge-based industries
- Spillovers depend on overall economic conditions

Next Steps...

- Diving into the mechanisms of large spillover effects and regional adjustment
 - ▶ Individual data to account for sectoral and regional labor mobility
 - ▶ Patent and university data to elaborate entrepreneurship innovation spillovers
- Quantify aggregate implications via a theoretical model:
 - ▶ combining elements of specific-factors model and Rosen-Roback model