Institute for Employment Research
The Research Institute of the Federal Employment Agency
IAB

Job Polarization on Local Labour Markets

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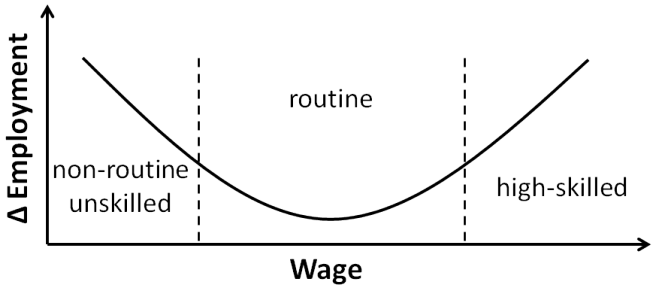
Motivation

- Extensive literature on deepening social inequality.
- Decreasing share of labour of the social product.
- Related phenomenon of job polarization:
  - Quantity of high-paying and low-paying jobs increases relative to the middle of the wage distribution (Goos/Manning, 2007).
- U-shaped wage/employment profile:



Motivation: Regional Dimension

- Several economists find strong regional variation
- Urban sociology study polarization, treat this as a phenomenon of cities (Sassen 2001, Goebel, Gornik, Häußermann 2010)
- Strong regional comparisons are not yet available

Outline

- Data
- Measuring the Polarization of local labor markets (LLM)
  - A Straightforward Index of Polarization
  - Application to Local Labor Markets
- Explaining the Differences in Regional Polarization
  - Theory
  - Variables
  - Results
- Conclusion

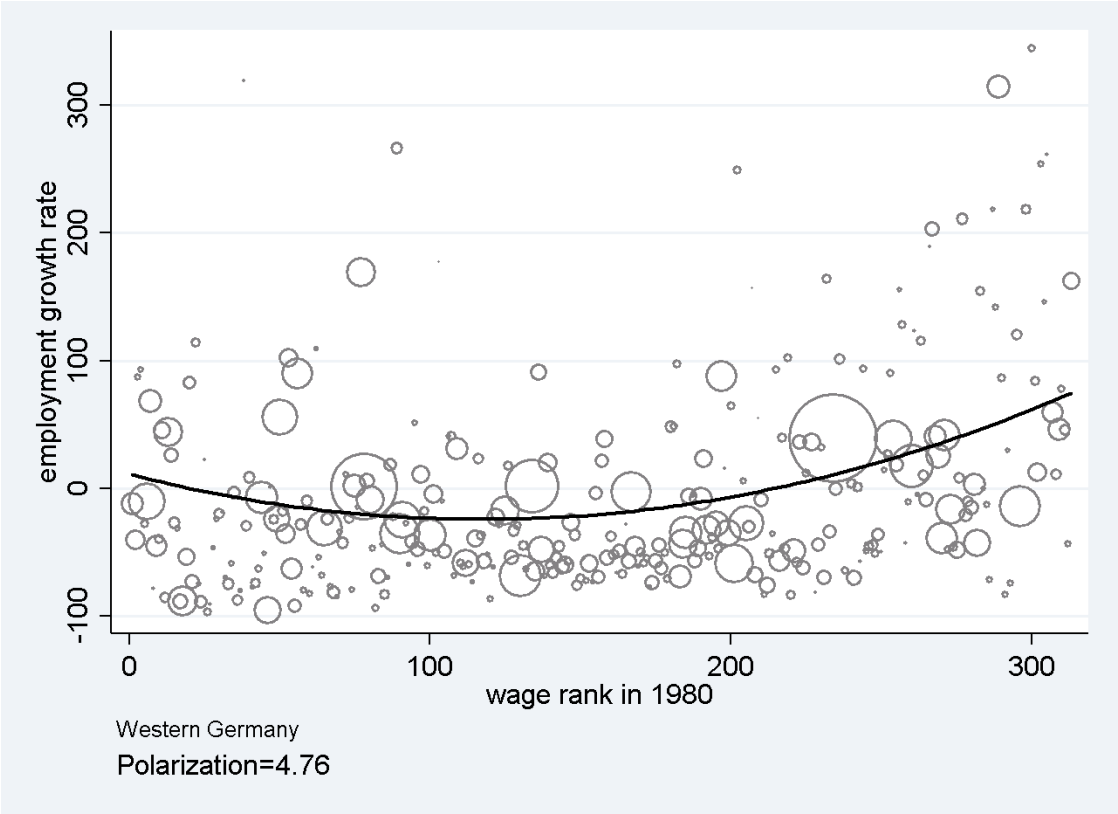
Data

- Administrative data of the German Federal Employment Agency:
  - *Employment History (BeH)*: 100% of all employees subject to social security registered on June 30th from 1978-2010.
  - Covers ~ 80% of German labor force (exceptions: self-employed or civil servants).
  - Wages top-coded at social contribution ceiling (66,000 Euros in 2010) but imputed.
  - > 16,000,000 observations per cross-section in Western Germany.
  - Aggregated to 313 occupations and 204 LLMs in 1980-2010.

Data

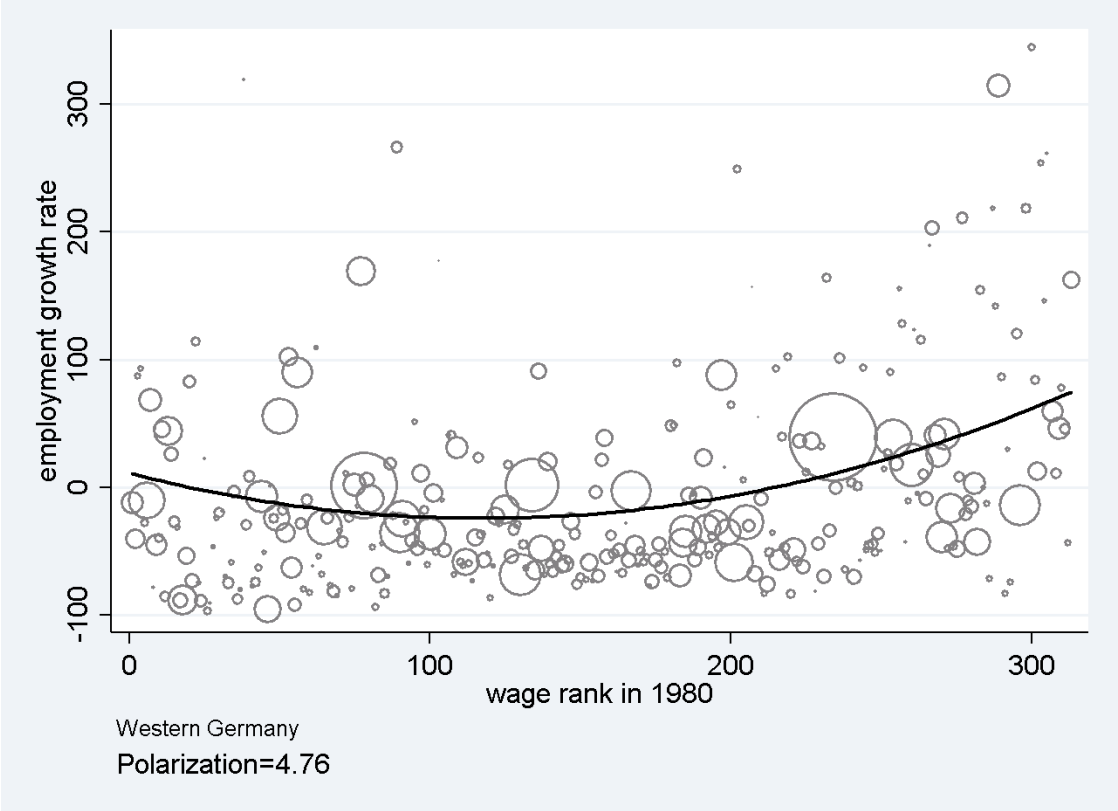
- 1979 BIBB/IAB Qualification and Career Survey:
  - Survey of 30,000 workers.
  - information on the occupation and different activities performed by each individual (can be categorized into tasks).
  - Used to obtain quantity of routine labor and computer usage.
  - Important to open the “Black box” of production processes (measurement of tasks = “Tätigkeitsschwerpunkte”, see Stooß 1988)
- United Nations Commodity Trade Statistics Database.

Measuring Polarization – A Straightforward Index of Polarization



Employment growth rates by Wage Percentile, 1980-2010.

Measuring Polarization – A Straightforward Index of Polarization



Employment growth rates by Wage Percentile, 1980-2010.

$$\Delta \ln Emp \downarrow 1980-2010 = 11.118 \top (0.95) - 0.605 \top (-3.50) \times rank(1980) + 0.003 \top (4.76) \times rank \uparrow 2\ (1980)$$

Measuring Polarization

- Rank 313 occupations according to average wage.
- Quadratic regression of employment growth rate has fairly good fit (here: $R^2 = 0.12$). (Goos/Manning (2009) already use this to demonstrate robustness w.r.t. data and definitions).
- The curvature of this U is an intuitive measure for the magnitude of polarization (only depends on parameter of squared term).
- Yet not robust in face of influential observations.

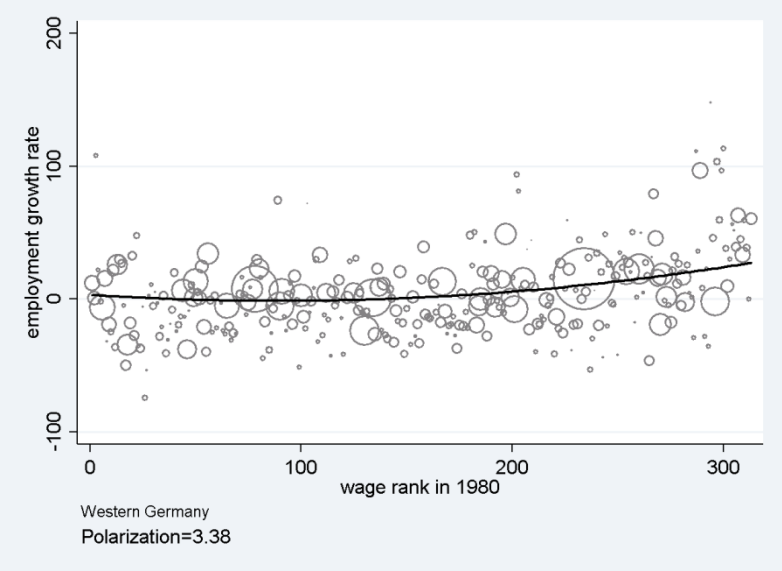
Measuring Polarization – Constructing an Index

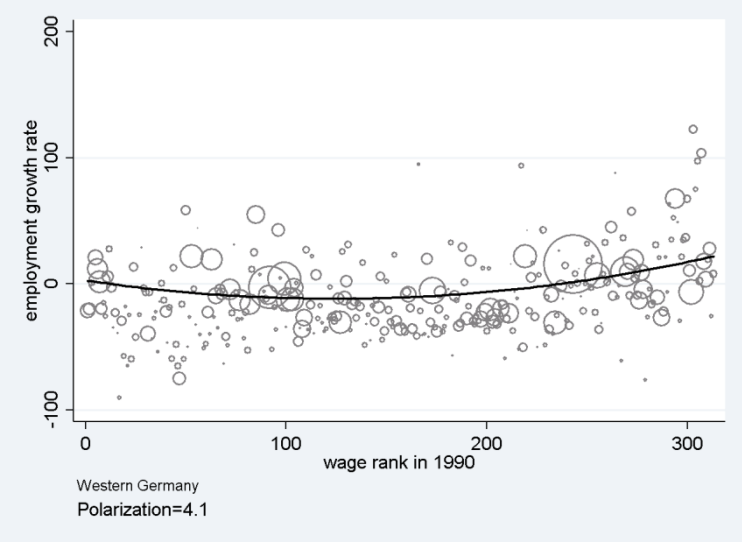
- t-ratio as a robust alternative:

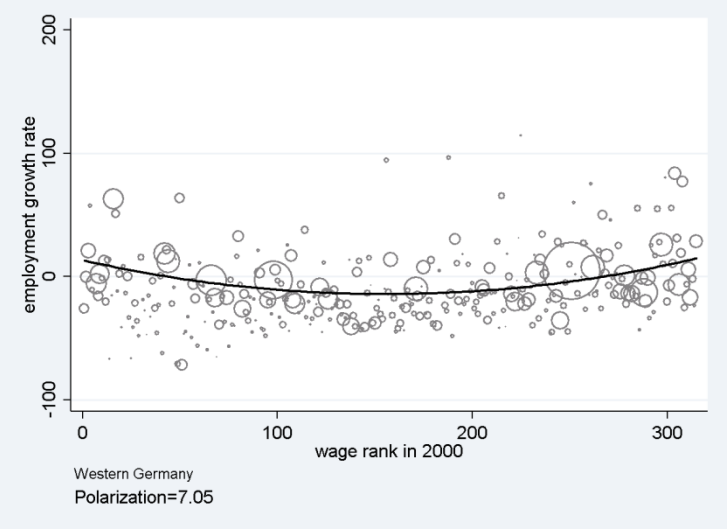
$$t_{rank^2} = \beta_{rank^2} \div \sigma / [SST_{rank^2} (1 - \rho(rank; rank^2)^2)]^{1/2} = \beta_{rank^2} / \sigma \; c \equiv PI$$

- Depends on curvature (β_{rank^2}) and fit (σ) of regression curve.
- Allows test of significance (t-distributed with 310 df; e.g. 1.65 for 10% level).

Three time periods







Polarization of Local Labor Markets

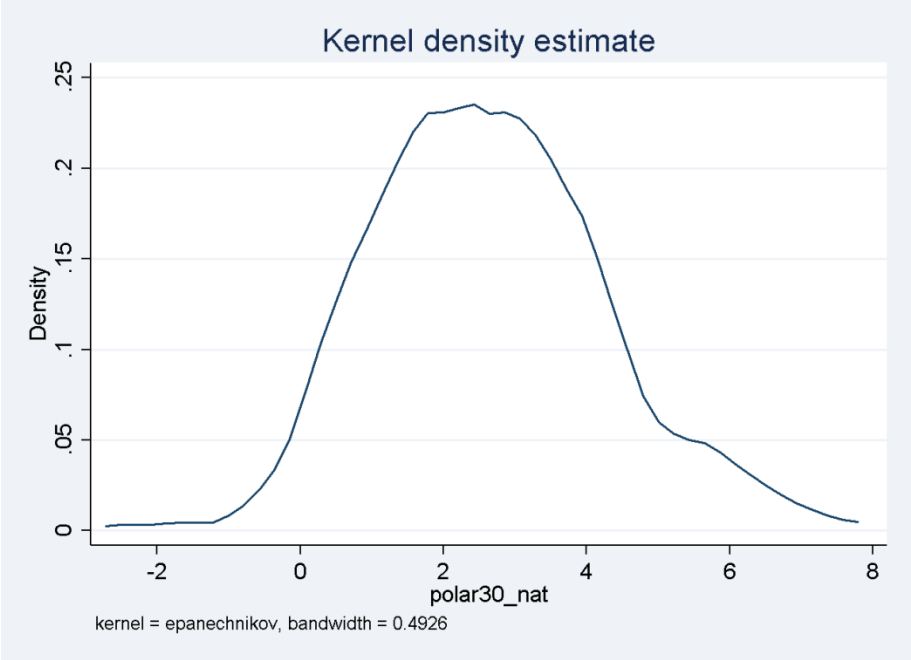
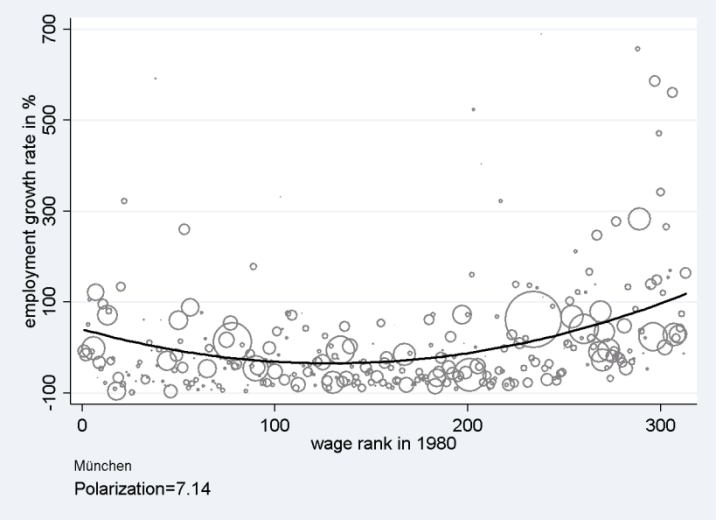
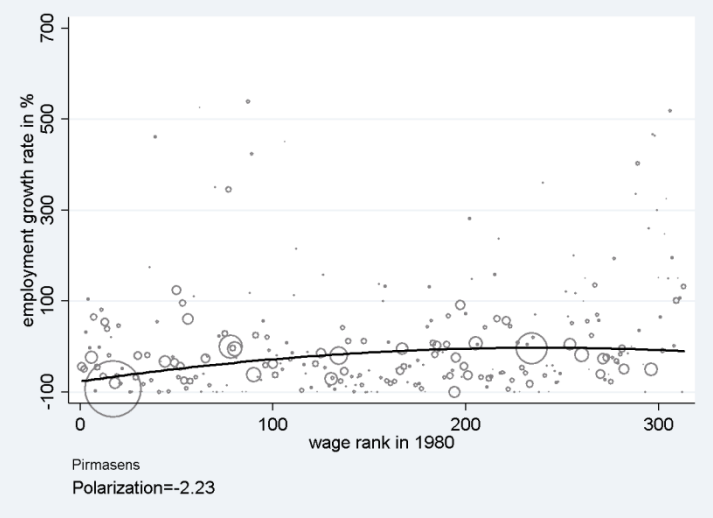


Figure: Kernel density estimate of the 204 regional polarization indices.

- 114 LLM significantly polarized.
- 20 even more strongly polarized than aggregate country.
- 6 negatively polarized, but only 1 significantly.

Polarization of Local Labor Markets





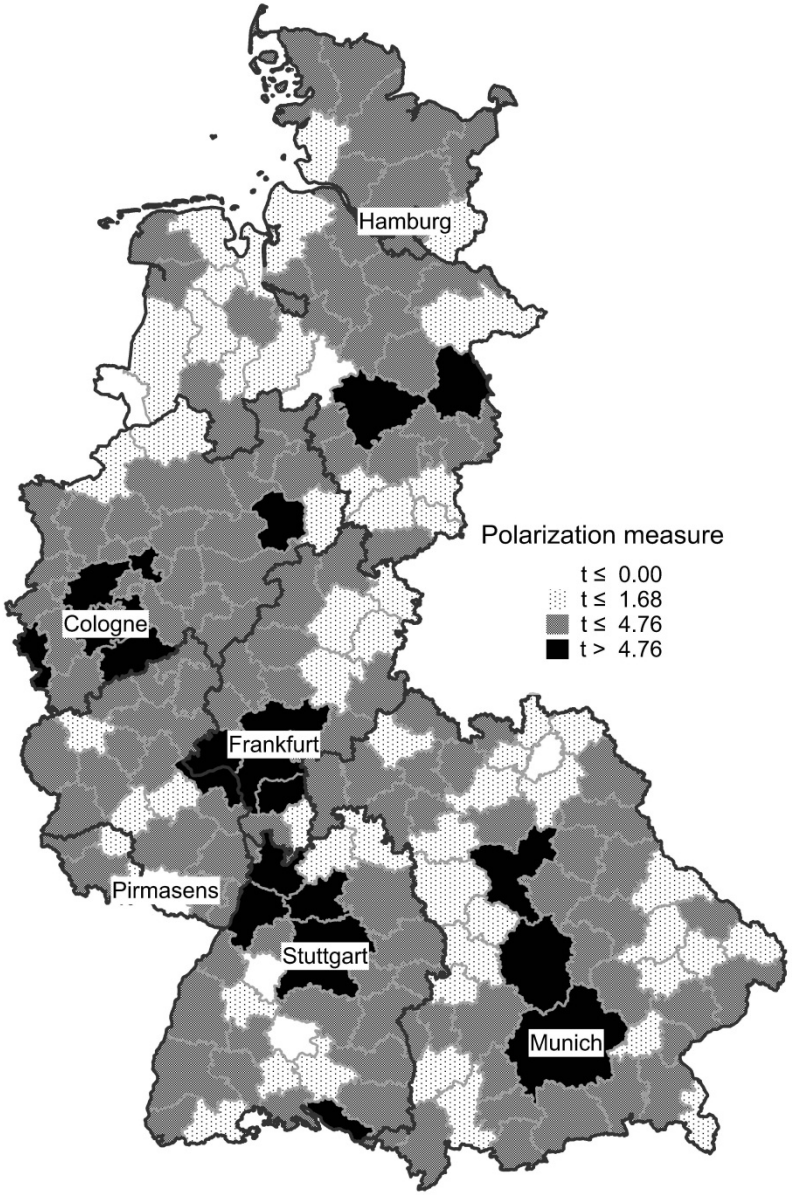
Munich

- Capital city of Bavaria,
- modern economic structure,
- steady growth of high paying jobs,
- and growth of service occupations catering to wealthy people.

Pirmasens

- Rural Rhineland-Palatinate,
- structurally weak,
- but strong decline of shoe manuf. due to competition from low wage countries.

Map of Regional Polarization



Occupations affected: Low income

Rang		Occupation	Growth
7		Waiters	0,40
11		Guardians	0,15
13		Cooks	0,44
20		Publicans	0,14
22		Cleaners	0,10
49		Nursery teachers	0,42
50		Doctor‘s assistance	0,97
51		Transport workers	0,83
77		Helpers (in general)	1,61
89		Physical therapists	0,42

Occupations affected: Mittle income

Rang		Occupation	Growth
112		Assembler of electrical equipment	-0,50
130		Brick Layers	-1,37
137		Building locksmith	-0,37
183		Concrete worker	-0,41
184		Selector	-0,42
185		Chemical worker	-0,41
192		Factory mechanic	-0,33
198		Lathe operator	-0,28
202		Stenographers/ typists	-1,03
204		Engine fitter	-0,38

Occupations affected: High income

Rang		Occupation	Growth
234		Office workers	3,61
237		Locksmiths	0,50
254		Shopkeepers	0,64
260		Bankers	0,38
267		Tax advisors	0,49
271		Technicians	0,48
290		Information technology experts	1,93
298		Management consultants	0,69
306		Engineers	0,85
313		Physicians	0,51

Explanations and observations

- Polarization by technical progress and for cost reduction (Braverman 1974, Kern, Schumann 1977).
- Strategies of rent seeking and reduction of competition used to explain changes in the income/ wage distribution (Sorensen 2000, Giesecke, Verwiebe 2009).
- Globalization and relocation of jobs due to direct investment in foreign countries and due to trade expansion following the integration of Eastern Europe and China into the world market (gobal effects assed by Autor, Dorn, Hanson 2013 and by Dauth, Findeisen, Südekum 2014)
- Urban sociology (Goebel, Häussermann 2012, Sassen 2001)

Another explanation: The task approach

Skill biased technical change (SBTC) affects „tasks“ (Tätigkeits-schwerpunkte) differently (Autor, Levy, Murnane 2003). Five classes of tasks:

- Nonroutine analytical
- Nonroutine interactive
- Routine cognitive
- Routine manual
- Nonroutine manual tasks

Routine tasks (can be described by an algorithm) are affected by rationalization via computer technology in recent times.

The task approach (II)

- Many qualified jobs are complementary to computer technology
- Low qualified service jobs are complementary to qualified jobs if „the elasticity of substitution in production between computer capital and routine labour is high relative to the elasticity of substitution between goods and services“ (Autor/Dorn 2013, p. 1566).

Variables

- Regional share of routine tasks (see Senftleben/Wielandt 2013):
  - Number of routine activities performed by worker in relation to all activities (cf. Antonczyk/Fitzenberger/Leuschner 2009).
  - Use occupation to match this share to administrative data on worker level.
  - Construct average routine share at regional level.
- Average trade exposure per worker: $TradeExp_{it} = \sum_j \frac{E_{ij}}{E_{jt}} \frac{Tradeval_{jt}}{E_{it}}$ (cf. Autor/Dorn/Hanson 2013, Dauth/Findeisen/Südekum 2014).
- Share of manufacturing,
- Urban dummy, according to regional classification of BBSR.

Multiple regressions – long time period

	Dependent variable: polarization measure 1980-2010				
	(1)	(2)	(3)	(4)	(5)
Dummy urban=1	1.425***	1.386***	0.878***	0.785***	0.742***
	(0.13)	(0.13)	(0.14)	(0.13)	(0.12)
% Routine tasks		0.083***			
		(0.03)			
% Routine cognitive tasks			0.448***	0.480***	0.478***
			(0.05)	(0.04)	(0.04)
% Routine manual tasks			0.053**	-0.001	0.029
			(0.02)	(0.03)	(0.03)
% Manuf.				0.021**	0.012
				(0.01)	(0.01)
Imports					-0.003**
					(0.00)
Exports					0.002*
					(0.00)
Constant	1.468***	-2.773**	-8.482***	-7.762***	-8.474***
	(0.25)	(1.33)	(1.44)	(1.48)	(1.47)
R2	0.256	0.268	0.391	0.402	0.412

Notes: 204 Observations. All covariates are from the respective initial year. All models include federal state dummies. Robust standard errors in parentheses. Levels of significance: *** 1 %, ** 5 %, * 10 %.

Multiple regressions – pooled 10-year periods

	Dependent variable: polarization measures				
	(1)	(2)	(3)	(4)	(5)
Dummy urban=1	1.091***	1.051***	0.601***	0.548***	0.521***
	(0.17)	(0.17)	(0.15)	(0.15)	(0.14)
% Routine tasks		0.083**			
		(0.04)			
% Routine cognitive tasks			0.396***	0.414***	0.411***
			(0.06)	(0.06)	(0.06)
% Routine manual tasks			0.039	0.008	0.031
			(0.03)	(0.04)	(0.04)
% Manuf.				0.012	0.006
				(0.01)	(0.01)
Imports					-0.002
					(0.00)
Exports					0.002
					(0.00)
Constant	0.642**	-3.647*	-7.739***	-7.329***	-7.868***
	(0.30)	(1.98)	(1.78)	(1.77)	(1.71)
R2	0.295	0.304	0.371	0.374	0.377

Notes: 204 Observations. All covariates are from the respective initial year. All models include federal state and base-year dummies. Robust standard errors, clustered by LLM, in parentheses. Levels of significance: *** 1 %, ** 5 %, * 10 %.

Multiple regressions – 1980-1990

	Dependent variable: polarization measure 1980-1990				
	(1)	(2)	(3)	(4)	(5)
Dummy urban=1	0.926***	0.914***	0.432**	0.441*	0.404*
	(0.24)	(0.25)	(0.22)	(0.23)	(0.23)
% Routine tasks		0.021			
		(0.04)			
% Routine cognitive tasks			0.356***	0.354***	0.336***
			(0.10)	(0.10)	(0.10)
% Routine manual tasks			-0.002	0.002	0.041
			(0.04)	(0.05)	(0.06)
% Manuf.				-0.002	-0.027
				(0.01)	(0.02)
Imports					-0.001
					(0.00)
Exports					0.004*
					(0.00)
Constant	1.965***	0.887	-4.336	-4.415	-4.992*
	(0.43)	(2.15)	(2.77)	(2.87)	(2.81)
R2	0.177	0.178	0.274	0.274	0.285

Notes: 204 Observations. All covariates are from the respective initial year. All models include federal state dummies. Robust standard errors in parentheses. Levels of significance: *** 1 %, ** 5 %, * 10 %.

Multiple regressions – 1990-2000

	Dependent variable: polarization measure 1990-2000				
	(1)	(2)	(3)	(4)	(5)
Dummy urban=1	1.440***	1.403***	0.788***	0.680***	0.641***
	(0.26)	(0.26)	(0.27)	(0.25)	(0.24)
% Routine tasks		0.113*			
		(0.06)			
% Routine cognitive tasks			0.553***	0.586***	0.574***
			(0.09)	(0.09)	(0.09)
% Routine manual tasks			0.057	-0.006	0.034
			(0.05)	(0.06)	(0.06)
% Manuf.				0.023	0.015
				(0.02)	(0.02)
Imports					-0.005*
					(0.00)
Exports					0.003
					(0.00)
Constant	0.000	-5.819*	-11.989***	-11.055***	-11.858***
	(0.39)	(3.04)	(2.78)	(2.83)	(2.80)
R2	0.272	0.286	0.412	0.422	0.435

Notes: 204 Observations. All covariates are from the respective initial year. All models include federal state dummies. Robust standard errors in parentheses. Levels of significance: *** 1 %, ** 5 %, * 10 %.

Multiple regressions – 2000-2010

	Dependent variable: polarization measure 2000-2010				
	(1)	(2)	(3)	(4)	(5)
Dummy urban=1	0.906***	0.826***	0.620**	0.579**	0.603**
	(0.23)	(0.23)	(0.24)	(0.24)	(0.25)
% Routine tasks		0.161***			
		(0.05)			
% Routine cognitive tasks			0.295***	0.322***	0.331***
			(0.08)	(0.08)	(0.08)
% Routine manual tasks			0.122**	0.091	0.073
			(0.06)	(0.08)	(0.08)
% Manuf.				0.012	0.026
				(0.02)	(0.02)
Imports					-0.001
					(0.00)
Exports					-0.000
					(0.00)
Constant	2.193***	-5.939**	-7.218***	-6.965**	-6.664**
	(0.40)	(2.73)	(2.77)	(2.85)	(3.03)
R2	0.174	0.210	0.228	0.231	0.237

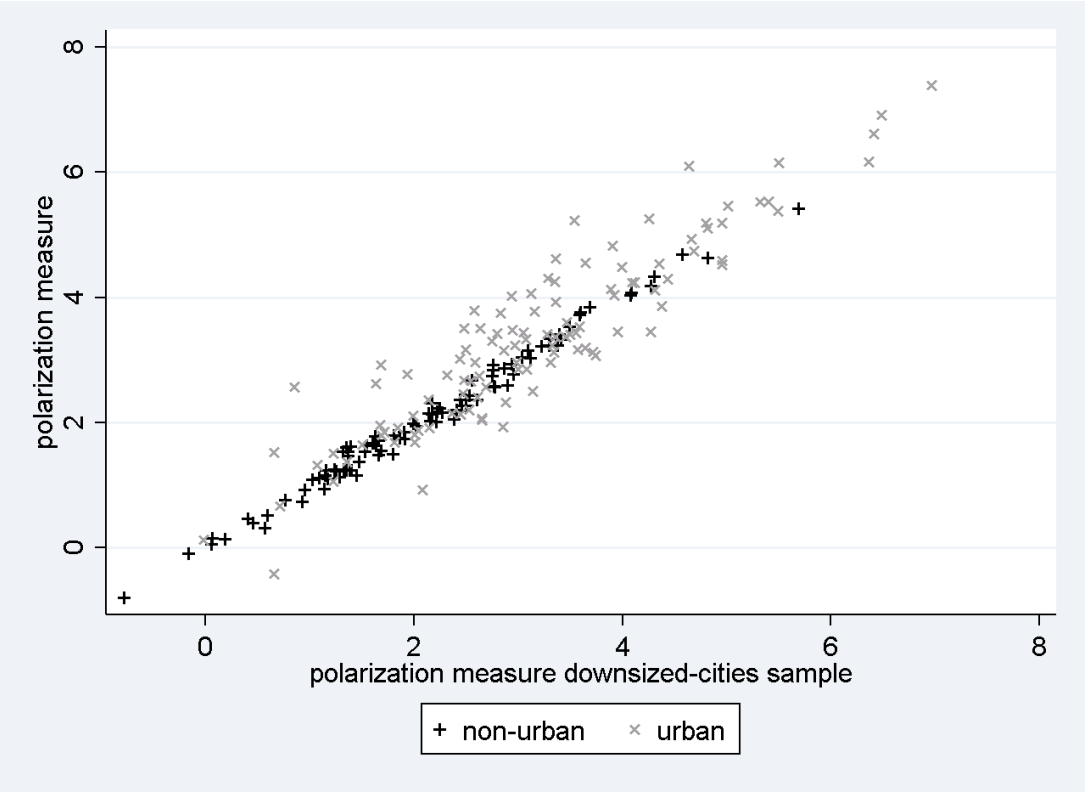
Notes: 204 Observations. All covariates are from the respective initial year. All models include federal state dummies. Robust standard errors in parentheses. Levels of significance: *** 1 %, ** 5 %, * 10 %.

Conclusion

- Interesting finding:
  - Low-skilled services grow faster in routine intensive regions;
  - Routine-intensity positively related to polarization.
  - Especially routine cognitive tasks positively related to polarization.
- Results driven at least partly by SBTC
- Strong regional structure: The rural country is hardly affected by polarization, as has been observed in urban sociology for some time (Sassen 2001).
- This paper is complementary to the very recent literature on job polarization (Autor, Dorn, 2013 and Senftleben, Wielandt, 2013, in particular).

Backup

Polarization measure an artefact of city sizes? – No!



Robustness check: downsize urban LLM's to have the same avg. size as non-urban ones by randomly dropping observations.

→ Polarization measures are barely affected!

Robustness w.r.t. Occupational classification and sex

					1980-1990	base	55 occs	male only
					national	3.55	1.25	5.24
					mean	1.57	0.99	2.13
					strong	17		9
					significant	139	43	161
					negative	27	26	15
1980-2010	**base**	**55 occs**	**male only**		**1990-2000**	**base**	**55 occs**	**male only**
national	4.36	1.38	5.12		national	3.48	2.09	4.17
mean	2.76	1.66	3.21		mean	2.24	1.27	2.77
strong	27		22		strong	41		36
significant	129	101	148		significant	115	68	134
negative	3	4	0		negative	15	23	9
					2000-2010	**base**	**55 occs**	**male only**
					national	5.97	1.84	7.68
					mean	3.13	1.55	3.77
					strong	3		1
					significant	153	89	169
					negative	0	9	1

Wage Polarization?

What drives employment growth at the bottom?

	Dependent variable: 100x 10-yr differences of average wages in the bottom tercile			
	(1)	(2)	(3)	(4)
Polarization measure	-0.161***	-0.141***	-0.110***	
	(0.03)	(0.03)	(0.04)	
Dummy urban=1		-0.229**	-0.131	-0.188**
		(0.10)	(0.09)	(0.09)
% Routine cognitive tasks			-0.179***	-0.224***
			(0.03)	(0.03)
% Routine manual tasks			-0.036*	-0.040*
			(0.02)	(0.02)
% Manuf.			-0.013*	-0.014*
			(0.01)	(0.01)
Imports			-0.003***	-0.003***
			(0.00)	(0.00)
Exports			0.002***	0.002**
			(0.00)	(0.00)
Constant	0.127	0.173	4.930***	5.796***
	(0.16)	(0.13)	(0.89)	(0.85)
R2	0.812	0.813	0.823	0.820

Notes: 204 Observations. All covariates are from the respective initial year. All models include federal state and base-year dummies. Robust standard errors, clustered by LLM, in parentheses. Levels of significance: *** 1 %, ** 5 %, * 10 %.

What drives employment growth at the bottom? (ctd.)

- The dependent variable in the previous table is average wage growth of jobs in the lower tercile, purged by overall regional wage growth.
- Regions with higher polarization have (relatively) declining wages in low-paying jobs
- Regions with many routine jobs also have (relatively) declining wages in low-paying jobs
- Hence, employment growth at the bottom is not driven by higher **demand** (of high earners for personal services) but by **higher supply** from people who would otherwise work in routine (cognitive) jobs

Conclusion

- What can other countries learn from this?
  - Decline of German manufacturing less severe than in other countries.
  - Relatively generous social security might partially prevent downward mobility.
  - Personal services less relevant in Germany.
- Might reduce wage inequality if growth in high paying jobs increases