Tasks, Employment and Wages
An Analysis of the German Labor Market from 1979 to 2012

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Motivation

- German labor market experienced similar development to the U.S. in terms of wage inequality and polarization Spitz-Oener (2006) and Dustmann et al. (2009)
- wage inequality started to rise in the 1980s and 1990s
  skill-biased technological change (SBTC) hypothesis
- non-monotonous relationship for the U.S. in 1990s
  polarization, Autor et al. (2003)
- evidence from other countries
  - Germany: employment polarization 1979 to 1999 (Spitz-Oener, 2006)
  - UK (Goos and Manning, 2007)

Motivation II

- recent works questioned general validity of polarization hypothesis
  - demand for cognitive tasks reversed after 2000 (Beaudry et al., 2013)
  - even in the U.S., wage polarization occurred only in one or two decades non-monotonic relationship not for Canada (Green and Sand, 2014)
- German labor market underwent significant changes since 2000

  fundamental reforms designed to cut the high and persistent unemployment of the 1990s and early 2000s

- industry structure moved towards services
- wage moderation kept labor costs down and contributed to a steady rise of productivity
=> Germany moved from being "the sick man of Europe" to becoming an "economic superstar" (Dustmann et al., 2014)

Research Questions

1. **Has job polarization continued after 2000?**
   extend and update the analysis provided by Spitz-Oener (2006) that ends in 1999, taking account of the findings of Beaudry et al. (2013)

2. **Do wages display a polarized pattern?**
   - U.S. wage polarization an exception instead of a general pattern of developed countries?
   - Germany particularly interesting object of study (more regulated by institutions than the liberal U.S. or Canadian labor market)

Data
- occupation panel data set from six large-scale surveys carried out between 1979 and 2012
- detailed information on activities performed during work, sociodemographic, personal, job-related and company-related topics

Key Results

1. **employment polarization 1979 to 1999 reversed pattern 1999 to 2012**
   - non-routine tasks substituted routine tasks from 1979 to 1999
   - employment growth for routine tasks but employment losses for non-routine tasks after 1999 (in line with Beaudry et al., 2013)
   - non-routine tasks much more important today than in 1979 but routine tasks continue to be performed by still a large and significant share of people

2. **work complexity has risen**

3. **no strong indications for wage polarization in Germany**
   - wages for all tasks have grown since 1979
   - after 1999, hourly wages stayed virtually constant (wage moderation)
   - small polarization in the wage structure can be found for 1999 to 2012

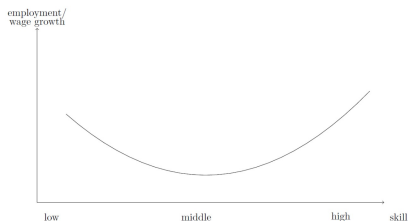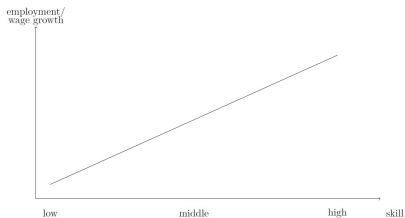# Framework

Skill-Biased Technological Change

- technological change
  - complements high skilled labor
  - substitutes low skilled labor

- "nuanced version"

  evidence for non-monotonicity
  - employment growth in high and low skilled occupations
  - employment decrease in middle skilled occupations

=> hollowing-out, polarization

Technology in the "nuanced version" of SBTC

Autor et al. (2003)

- technology affects labor market through tasks workers perform
- two kinds of tasks
    - routine: limited in scope and well-defined, easily expressible in computer code; substitutes
    - non-routine: problem-solving and more comprehensive communication; complements
- most occupations include both routine and non-routine
- => SBTC affected task composition of jobs
  rather than substituting whole occupations

Task Categories as in Autor et al (2003)

- Non-routine manual
  repair, renovate, restore, nurse

- Routine manual
  operate, control machines

Illustration by Chris Gash
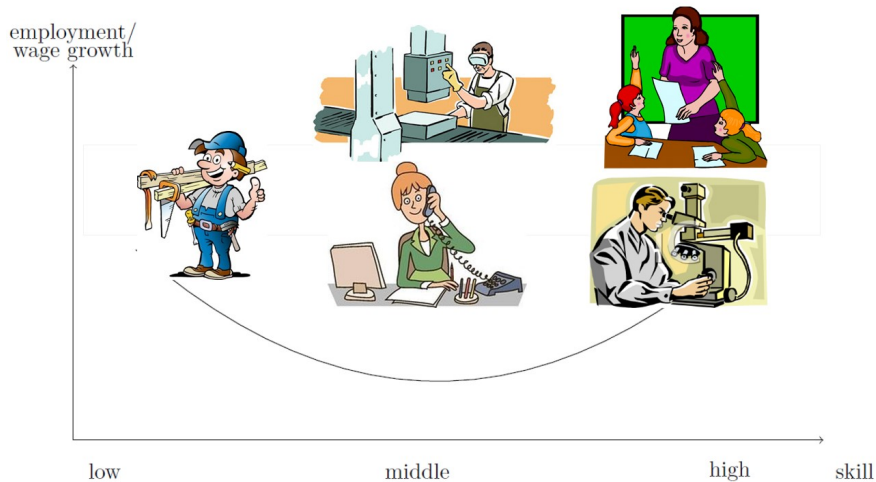
Task Categories as in Autor et al (2003)

- Routine cognitive
  calculating, measuring, book-keeping

- Non-routine interactive
  negotiate, teach, entertain, manage personnel

- Non-routine analytic
  research, evaluation, planning, interpret rules

Task Categories

employment/
wage growth

low   middle   high   skill

Empirical Analysis

Data: Qualification and Career Survey (Erwerbstätigenbefragung)

- six cross sections: 1979, 1985/6, 1991/2, 1998/9, 2006, 2012
  $8112 < n < 20,438$
- "quasi panel" over occupations
  1988 Federal Statistical Office's Classification of Occupations
- sample restrictions
  - West German residents with German nationality
  - aged between 16 and 65
  - excluding self-employed, employees in the public sector, private households, unemployed
- dummy variables for each task category
- sociodemographic, personal, job-related and company-related variables

Task Employment in %
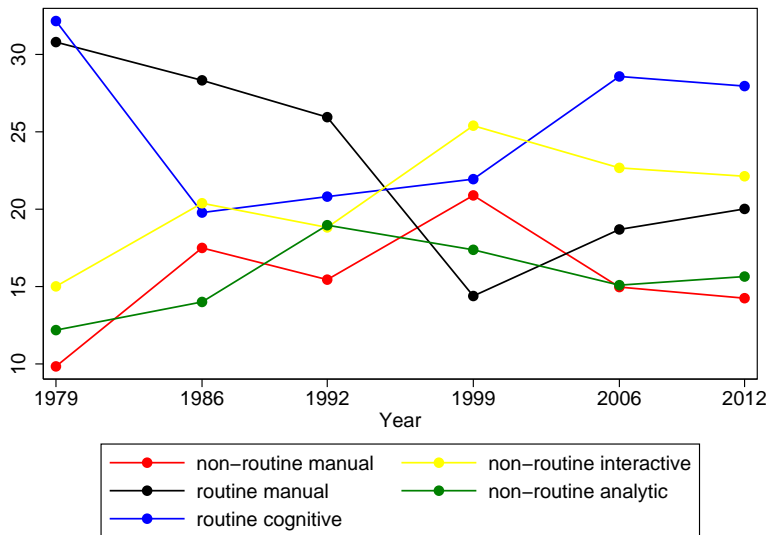
Complexity Development, shares: 0.2=20%
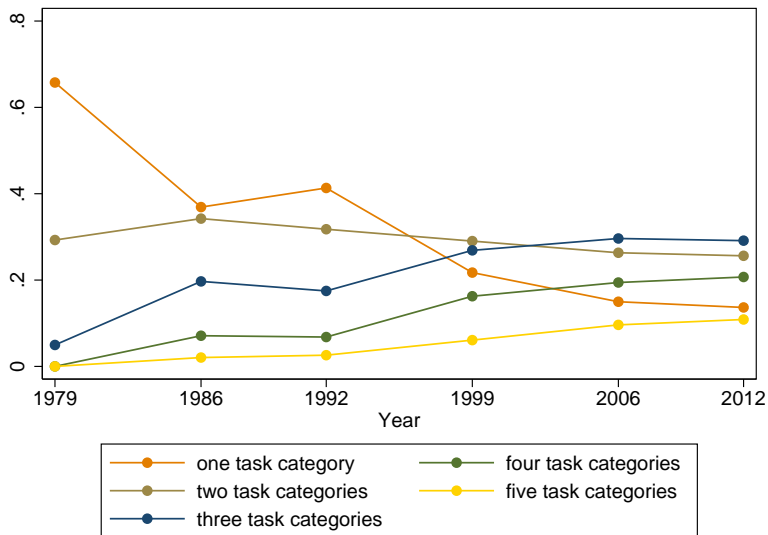
Wages by Tasks index; 1979=1
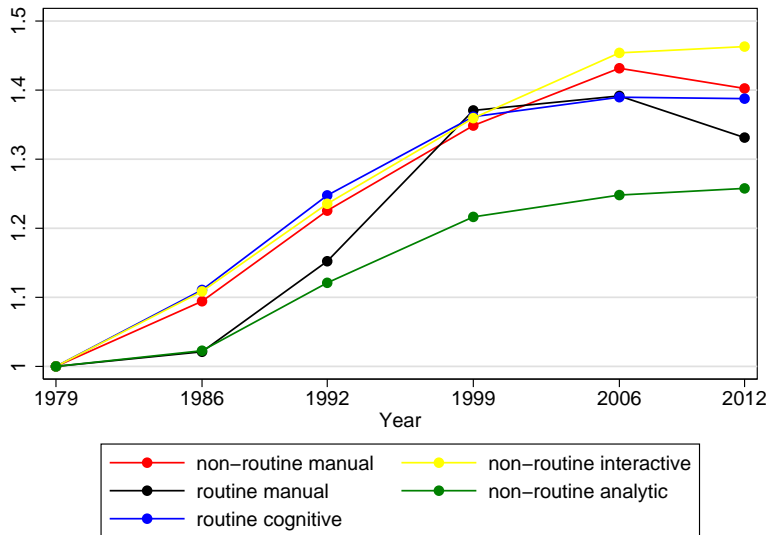
Polarization?

	employment			hourly wage		
	79-99	99-12	79-12	79-99	99-12	79-12
nrm	112.31	-31.80	44.81	34.86	3.99	40.24
rm	-53.28	39.10	-35.01	37.06	-2.87	33.13
rc	-31.77	27.40	-13.07	36.15	1.92	38.77
nri	69.17	-12.87	47.39	35.95	7.61	46.30
nra	42.58	-9.95	28.40	21.64	3.39	25.77

(n)rm: (non-)routine manual, rc: routine cognitive, nri: non-routine interactive, nra: non-routine analytic

- employment but no wage polarization from 1979 to 1999
- "reversed" employment polarization from 1999 to 2012 Beaudry et al., 2013
- weak wage polarization from 1999 to 2012

Estimation Strategy

$$Y_{ot} = TI_{ot}'\beta + X_{ot}'\gamma + \alpha_0 + u_{ot}. \tag{1}$$

- Y_{ot}: occupation o's log hourly wage in a given year t
- TI_{ot}: task dummies
- X_{ot}: control variables (time dummies, sociodemographic and company characteristics)

interpretation of coefficient of interest β

- cross-section models: task measures (between 0 and 1)
  if task category is performed (=1), wage changes by β*100 %
- panel model: task dummies
  10ppt change in task measure (0.1), wage changes by β*10 %

Panel Models

model	non-routine manual	routine manual	routine cognitive	non-routine interactive	non-routine analytic
			full period		
1	0.054	0.057	0.156***	0.222***	0.147**
	(0.041)	(0.061)	(0.036)	(0.068)	(0.065)
2	0.053	−0.008	0.054	0.046	0.023
	(0.036)	(0.045)	(0.041)	(0.065)	(0.059)
3	0.023	−0.063	0.055	−0.074	0.037
	(0.045)	(0.047)	(0.047)	(0.075)	(0.073)
			first period, 1979-1999		
1	0.016	−0.104**	0.120***	0.365***	0.084
	(0.035)	(0.041)	(0.038)	(0.062)	(0.070)
2	−0.038	−0.122***	0.050	0.213***	−0.075
	(0.027)	(0.038)	(0.037)	(0.057)	(0.062)
3	−0.055	−0.136***	0.093*	0.138	−0.018
	(0.055)	(0.049)	(0.049)	(0.106)	(0.105)
			second period, 1999-2012		
1	−0.060	0.090	−0.003	0.062	0.236*
	(0.107)	(0.085)	(0.106)	(0.166)	(0.129)
2	0.001	0.018	−0.058	0.040	0.069
	(0.094)	(0.077)	(0.101)	(0.128)	(0.101)
3	−0.003	0.126	−0.103	−0.032	−0.042
	(0.081)	(0.077)	(0.093)	(0.108)	(0.101)

Data sources: IAB, BIBB, BAuA.

Cross-Section Models

year	model	non-routine manual	routine manual	routine cognitive	non-routine interactive	non-routine analytic
1979	1	-0.038^{***}	-0.004	0.062^{***}	-0.041^{***}	0.305^{***}
		(0.011)	(0.010)	(0.010)	(0.011)	(0.011)
	2	-0.048^{***}	-0.093^{***}	0.051^{***}	0.000	0.139^{***}
		(0.010)	(0.010)	(0.009)	(0.010)	(0.010)
1986	1	0.104^{***}	-0.072^{***}	0.067^{***}	-0.025^{**}	0.247^{***}
		(0.010)	(0.011)	(0.012)	(0.010)	(0.012)
	2	0.024^{**}	-0.077^{***}	0.071^{***}	0.042^{***}	0.114^{***}
		(0.011)	(0.012)	(0.013)	(0.011)	(0.013)
1992	1	0.101^{***}	-0.043^{***}	0.063^{***}	-0.038^{***}	0.266^{***}
		(0.011)	(0.011)	(0.012)	(0.010)	(0.011)
	2	0.004	-0.064^{***}	0.042^{***}	0.035^{***}	0.137^{***}
		(0.012)	(0.011)	(0.011)	(0.010)	(0.011)
1999	1	-0.110^{***}	0.037^{***}	0.133^{***}	-0.008	0.208^{***}
		(0.010)	(0.012)	(0.011)	(0.011)	(0.012)
	2	-0.048^{***}	-0.019^{*}	0.051^{***}	0.030^{***}	0.116^{***}
		(0.010)	(0.011)	(0.010)	(0.011)	(0.011)
2006	1	-0.085^{***}	-0.113^{***}	0.110^{***}	0.042^{***}	0.194^{***}
		(0.014)	(0.014)	(0.017)	(0.014)	(0.013)
	2	-0.038^{***}	-0.083^{***}	0.047^{***}	0.079^{***}	0.090^{***}
		(0.011)	(0.011)	(0.014)	(0.011)	(0.011)
2012	1	-0.080^{***}	-0.206^{***}	0.076^{***}	0.031^{**}	0.200^{***}
		(0.013)	(0.013)	(0.016)	(0.014)	(0.012)
	2	-0.039^{***}	-0.097^{***}	0.038^{***}	0.071^{***}	0.106^{***}
		(0.011)	(0.010)	(0.013)	(0.011)	(0.010)

Polarization?

- non-routine manual tasks mostly lead to wage decreases X
- routine cognitive tasks increase wages X
- wage penalties for routine manual task performances ✓
- large wage increases for non-routine analytic tasks ✓

Alternative Task Measures

task measures for each individual i in t and task category j

- Spitz-Oener (2006)

$$TI_{ijt}^{SO} = \frac{\text{number of activities in category j performed by i in t}}{\text{total number of activities in category j at time t}} \quad (2)$$

- Antonczyk et al. (2009)

$$TI_{ijt}^{AFL} = \frac{\text{number of activities in category } j \text{ performed by } i \text{ in } t}{\text{total number of activities performed by } i \text{ at time } t} \quad (3)$$

$=>$ Results are robust to alternative task measures

Discussion

Questions

1. Why did the initial employment polarization reverse after 1999?
2. Why was the initial employment polarization not accompanied by a similar polarization of the wage structure?

Reversed employment polarization after 1999: demand reversal for (non-routine) cognitive tasks <small>Beaudry et al., 2013</small>

1. 1979 to 1999: computer technology diffused throughout the economy
   - demand for non-routine cognitive tasks ↑
     - non-routine analytic tasks demanded to make full use of the immense analysis opportunities
     - non-routine interactive tasks demanded to intensify communication between all economic actors
   - computers could replace many routine cognitive tasks ↓
   - routine manual tasks ↓ replaced by technology that had to be maintained and repaired (non-routine manual tasks ↑)
2. after 1999: process of adaptation completed
   - demand for non-routine tasks stopped to rise, while supply still continued to rise
   - work content changed
     - substantial part of the non-routine tasks during the adaptation process became routine
     - new working processes and patterns were well-established

The (declining) role of labor unions in the wage setting process

- unions do not focus on increasing the wage level but on reducing wage inequality
- Antonczyk et al. (2011)
    - wage inequality has risen sharply over the last 25 years
    - union membership rates have fallen steadily since 1980
      (20% in 2000, industry-wide bargaining contract coverage 47% for men in West Germany)
    - share of low qualified people stopped to decline since the mid-1990s
- Fall of the Iron Wall, the emergence of new markets, production opportunities for companies $=>$ erosion of union power
- $=>$ polarization did not develop while unions were an important player in the wage setting process
- $=>$ erosion of union power was reflected in new agreements (less protective against wage inequalities)

Conclusion

- employment
  - polarization from 1979 to 1999: routine tasks were substituted for non-routine tasks
  - reversed employment polarization from 1999 to 2012
    repetitive long-run pattern of cyclical changes?
- wages
  - wage growth not polarized (at best slightly from 1999 to 2012)
  - routine cognitive and non-routine analytic tasks associated with wage gains
- rising task complexity

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