

Lack of Returns

How Routinization Can Explain Rising Low-Wage Risks of Highly Qualified Manpower in Germany

T.A.S.K.S. 2

(Technology, Assets, Skills, Knowledge, Specialisation)

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- Low-wage sector (LWS): measures the proportion of workers at the bottom of the wage distribution
- German LWS has expanded above EU average (with low exit rates)
- Share of university graduates working in the low-wage sector is rising

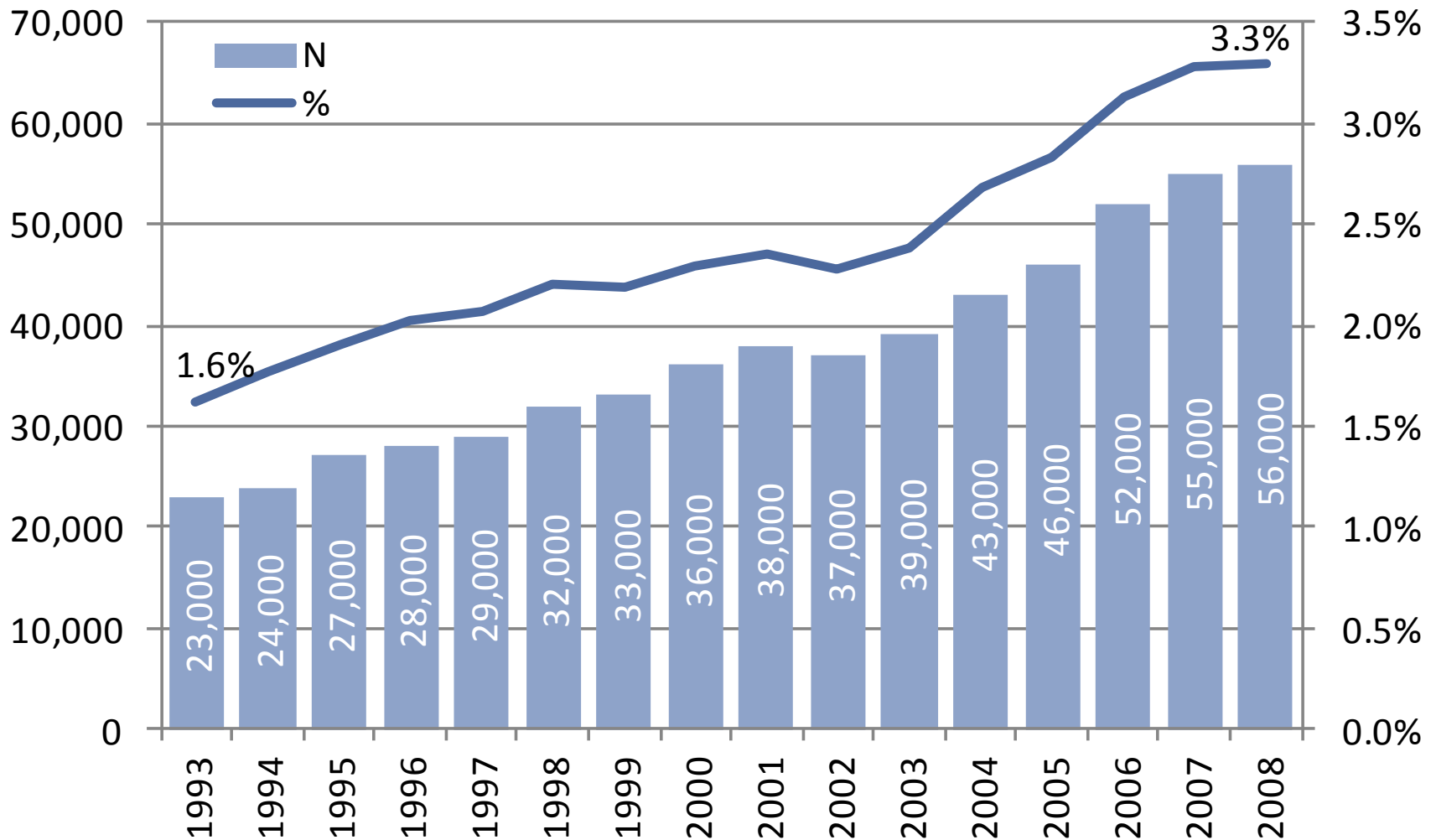
- Human capital theory (Becker 1964)
- Signaling and Screening theories (Spence 1974; Weiss 1995)
- Skill-biased technological change (Katz and Autor 1999)

- Shortage of skilled workers (Bonin et al. 2007)
- Rising wage premiums for highly educated workers in Germany (Dustmann et al. 2009; Antonczyk et al. 2010)

- Growing share of highly educated workers in the low-wage sector in Germany over the past two decades (Kalina and Weinkopf 2009)
- Low-wage risk among highly skilled male employees (25-54 years) more than doubled between 1993 and 2008 (own calculations)

Low-wage risks 1993-2008

Number and share of highly qualified, prime-aged, full-time male employees (subject to social insurance contributions) within the low-wage sector



Source: IAB Employment Register

- Why are low-wage sector shares of highly educated workers rising although ongoing technological change has led to increased demand for higher skilled manpower?

- Skill biased technological change:
 - technological change in favor for higher skilled workers (increasing demand)
- Routinization (‘job polarization’ or ‘task-based approach’)
 - Autor, Levy and Murnane 2003; Autor, Katz, and Kearney 2006
 - cheaper and more powerful computers can substitute for workers who perform *routine tasks*
 - decreasing demand for routine workers → wage pressure
 - *abstract tasks* can be carried out more efficiently with the help of computers → rising productivity of abstract workers → higher wages
 - *manual tasks* can hardly be replaced as they require the flexible use of the human brain and hand (repair bots are science fiction)

- **Model assumption:** highly educated (college) workers perform only abstract tasks, whereas high-school graduates carry out either routine (cognitive or manual) or non-routine manual tasks
- However, are tasks really synonymous with education levels?
→ not very realistic assumption
- **Our assumption:** not all highly educated workers perform mainly non-routine, abstract tasks in their jobs.
 - not all university graduates become abstract workers (researchers or managers)
 - philosophy graduates may work as clerks
 - architecture graduates may work as draughtspersons

Category of Tasks/Workers	Relative Demand	Relative Supply	Relative Probability of Low-Wage Employment
Abstract	Rising	Undersupply	Falling
Routine	Falling	Oversupply	Rising
Manual	Rising	Increased supply through former routine workers	No clear prediction

- Germany's low-wage sector is expanding since the 1990s, however still smaller than in the US (European Commission 2004; Eichhorst et al. 2005; Brenke 2006; Rhein and Stamm 2006; Bosch and Kalina 2007)
- Rising share of low-wage earners even among highly educated workers (Rhein and Stamm 2006; Boushey et al. 2007; Kalina and Weinkopf 2008, 2009)
- Shift across occupations from routine tasks towards abstract and manual tasks over the last decades (e.g., Autor et al. 2003 and Autor et al. 2006 for the U.S.; Spitz-Oener 2006 for Germany)
- Growth in both the highest- and lowest- paid occupations, with declining employment in the middle of the wage distribution (Autor et al. 2003; Autor et al. 2006; Black and Spitz-Oener 2007; Goos and Manning 2007; Autor et al. 2008; Dustmann et al. 2009; Goos et al. 2009; Dustmann et al. 2010)
- Changes in the payment of task usage that occurred between 1999 and 2006 can explain increasing wage inequality at the bottom of the German wage distribution (Antonczyk et al. 2008)

- Employee- and Benefit-Recipient History (BLH)
 - 10% of all German employees covered by social security and recipients of unemployment benefits
 - We use information from 16 reporting dates from 1993 to 2008
 - **final sample:** male workers between 25 and 54 years who are employed full-time, subject to social insurance contributions, and have an university degree (or university of applied sciences)
 - 2.4 million observations in the pooled sample, and between 134,000 to 171,000 observations per year
- Mikrozensus (MZ)
 - Germany's official annual household survey (1% of all households)
 - detailed information on the core job tasks of occupations (comparable over time) → 20 core job tasks predominantly performed
 - task information available in 1996, 2000, 2004, 2007

Task category	Main task in the MZ questionnaire (1996, 2000, 2004, 2007)
Abstract	Measuring, checking, testing, controlling
	Developing, constructing products, plans, ideas
	Advertising, marketing, PR
	Management activities
	Interpreting and using the law, certifying
	Educating, training, teaching
	Counseling, informing
	Artistic/journalistic work, entertaining
	For doctors and scientists: medical/social help, caring, treating medically/cosmetically
Manual	Medical/social help, caring, treating medically/cosmetically
	Mining, pumping, extracting raw materials
	Repairing, renovating
	Hosting, preparing and serving meals
	Cleaning, waste management
	Securing, protecting, monitoring, regulating traffic (incl. Police and military)
Routine	Setting up, controlling, monitoring, maintaining machines/technical systems/equipment
	Producing, processing, constructing/converting, installing
	Buying, selling, facilitating, encashing
	Clerical work, calculating, data processing, bookkeeping, drawing
	Packing, driving, loading, sorting, delivering

- Mikrozensus-Respondants are asked to pick the *core task* they predominantly perform
- We aggregate core tasks to *task categories*:
 - *abstract, routine, manual*
- For every occupation (2-digit-code-list) we get *task intensities*
 - Engineers: **78.1% abstract**, 20.2% routine, 1.6% manual
 - Cabinet makers: 15.5% abstract, **77.2% routine**, 7.2% manual
 - Cooks: 0.9% abstract, 5.7% routine, **93.4% manual**
- Finally, we match *occupation specific task-intensities* to BLH-Data

MZ	1996					2000					2004					2007		
BLH	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008		

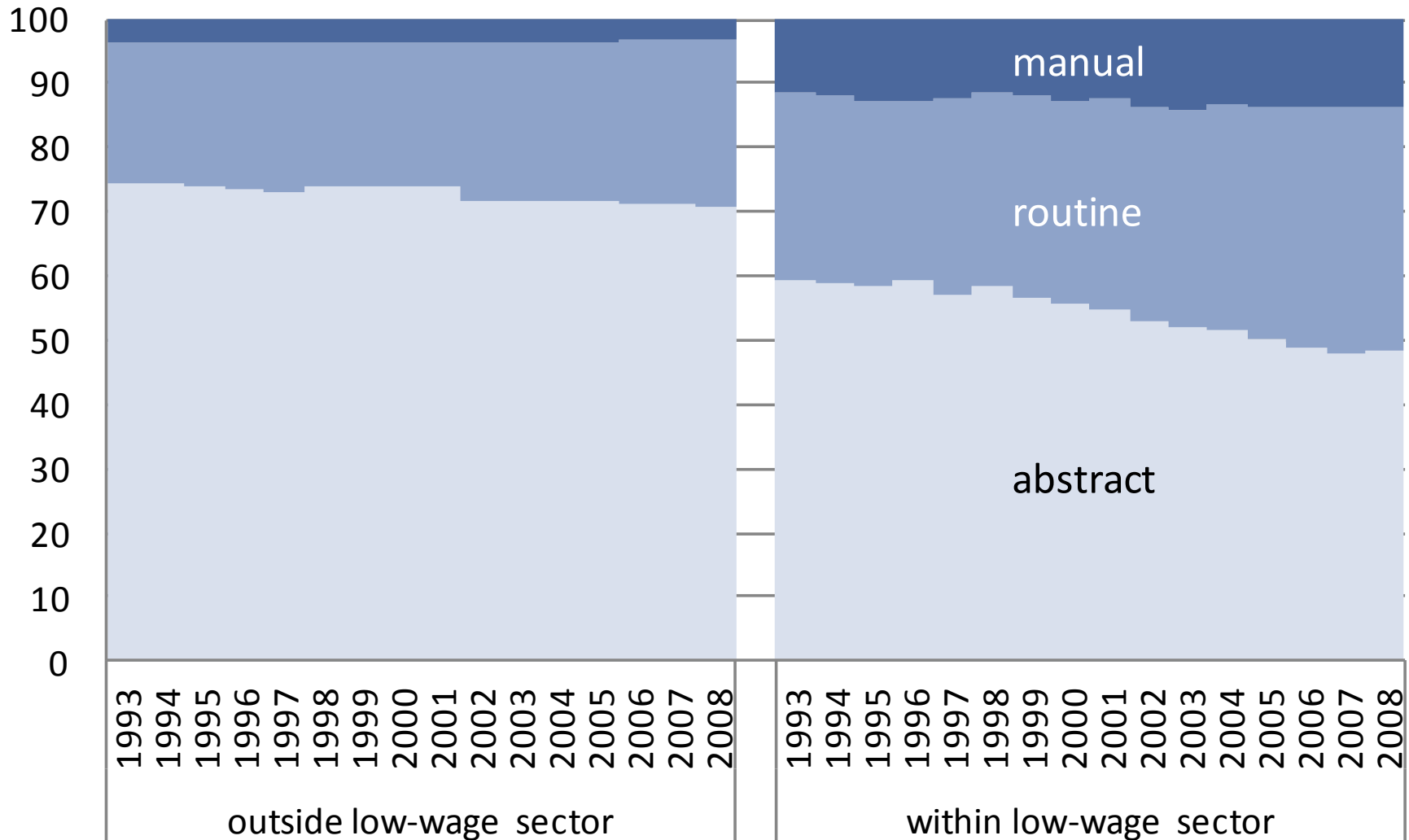
- Low-wage sector (LWS)
 - 1: the person is employed in the low-wage sector
 - 0: the person is not employed in the low-wage sector
 - LWS threshold: 2/3 of the median income

	West Germany	East Germany
1993	8.65	5.95
1994	8.79	6.32
1995	9.07	6.66
1996	9.16	6.83
1997	9.24	6.89
1998	9.41	6.97
1999	9.61	7.07
2000	9.80	7.20
2001	9.99	7.42
2002	10.20	7.61
2003	10.38	7.70
2004	10.47	7.70
2005	10.58	7.75
2006	10.66	7.74
2007	10.79	7.78
2008	11.00	7.89

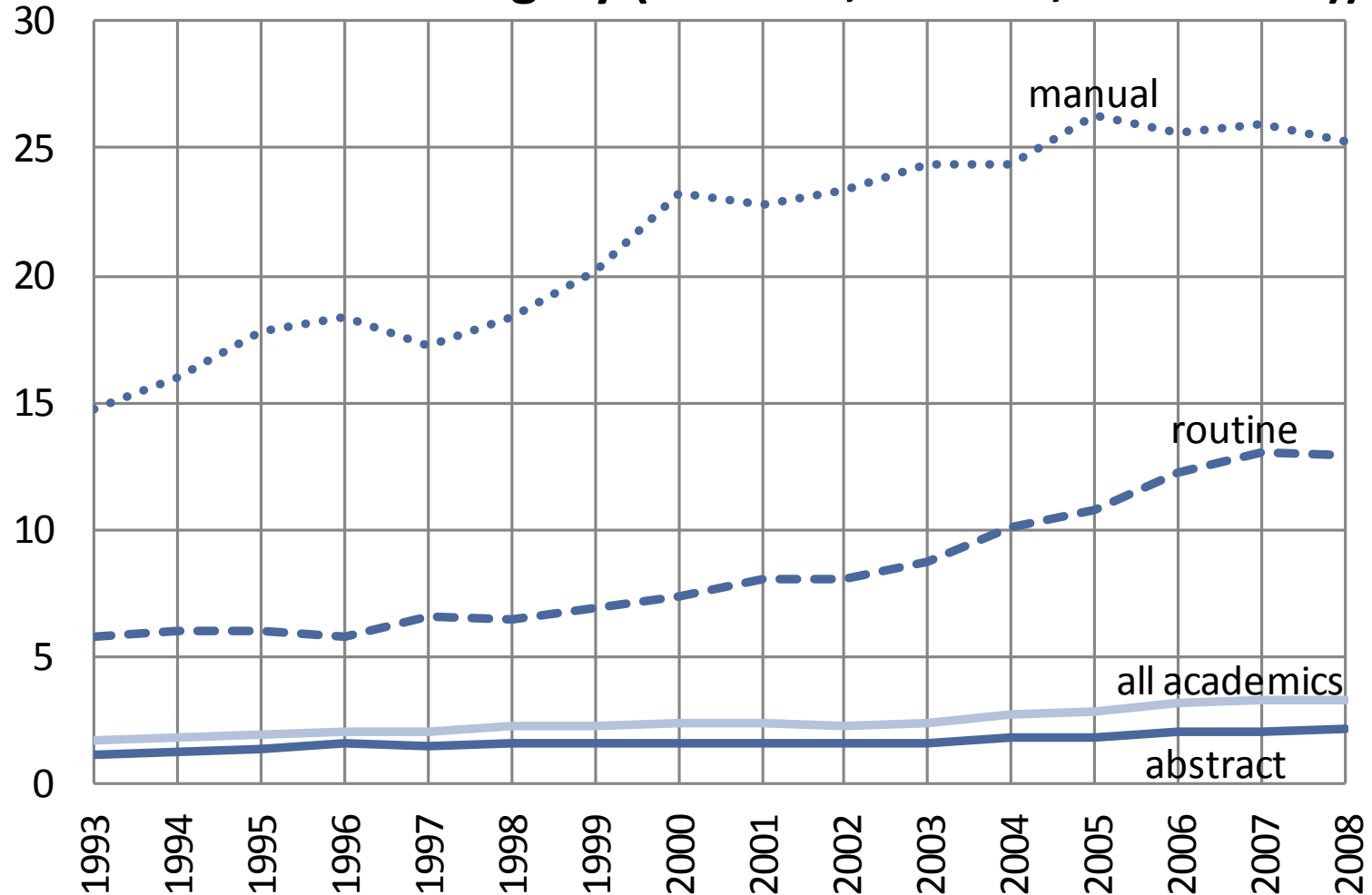
Low-Wage Threshold for East and West Germany 1993-2008 (Hourly Wages in Euros)

Source: BLH 1993-2008. Thresholds are based on wage data for 25-54-year-old men with and without academic degrees in full-time employment

Development of Average Task Intensities Outside and Within the Low-Wage Sector 1993-2008 (in Percent; men, 25-54 years)



Low-Wage Risks of Different Task Groups (in Percent; Task groups are defined as groups of occupations containing 50 percent and more of a certain task category (abstract, routine, or manual))



- logit model: LWS probability
 - (1) $p(LWS = 1 | z) = 1/(1+e^{-z})$
 - (2) $z = (\text{tasks } \beta + \text{years } \gamma + \text{tasks} * \text{years } \varphi + X \delta)$
- z represents the set of explanatory variables
 - *tasks*: three task-intensity measures (*abstract as reference measure, manual and routine in the regression*)
 - *years*: time dummies for the years 1993 to 2008
 - ***tasks*years***: interactions between task-intensity measures and time dummies
 - X : additional control variables for changes in the workforce composition

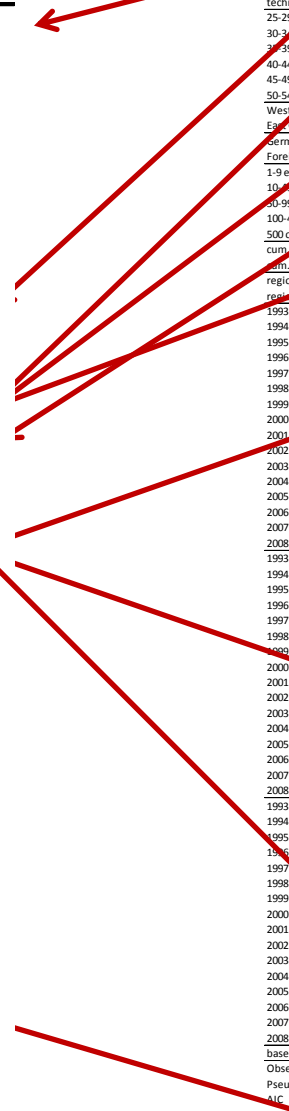
- Based on the condition of a *constant omitted variable bias*, we can interpret growing interaction effects between *routine*years* as evidence in support of our hypothesis.
- We assume the condition of a *constant omitted variable bias* to hold because we control additionally for changes in the workforce composition in the regression (X)
- The control variables in X :
 - the individual's past labor market history
 - German nationality, age, living in East/West Germany
 - type of academic degree, firm size
 - local rate of unemployed academics, local rate of academics in the labor force

Logit model: LWS probability; odds ratios [p-values]

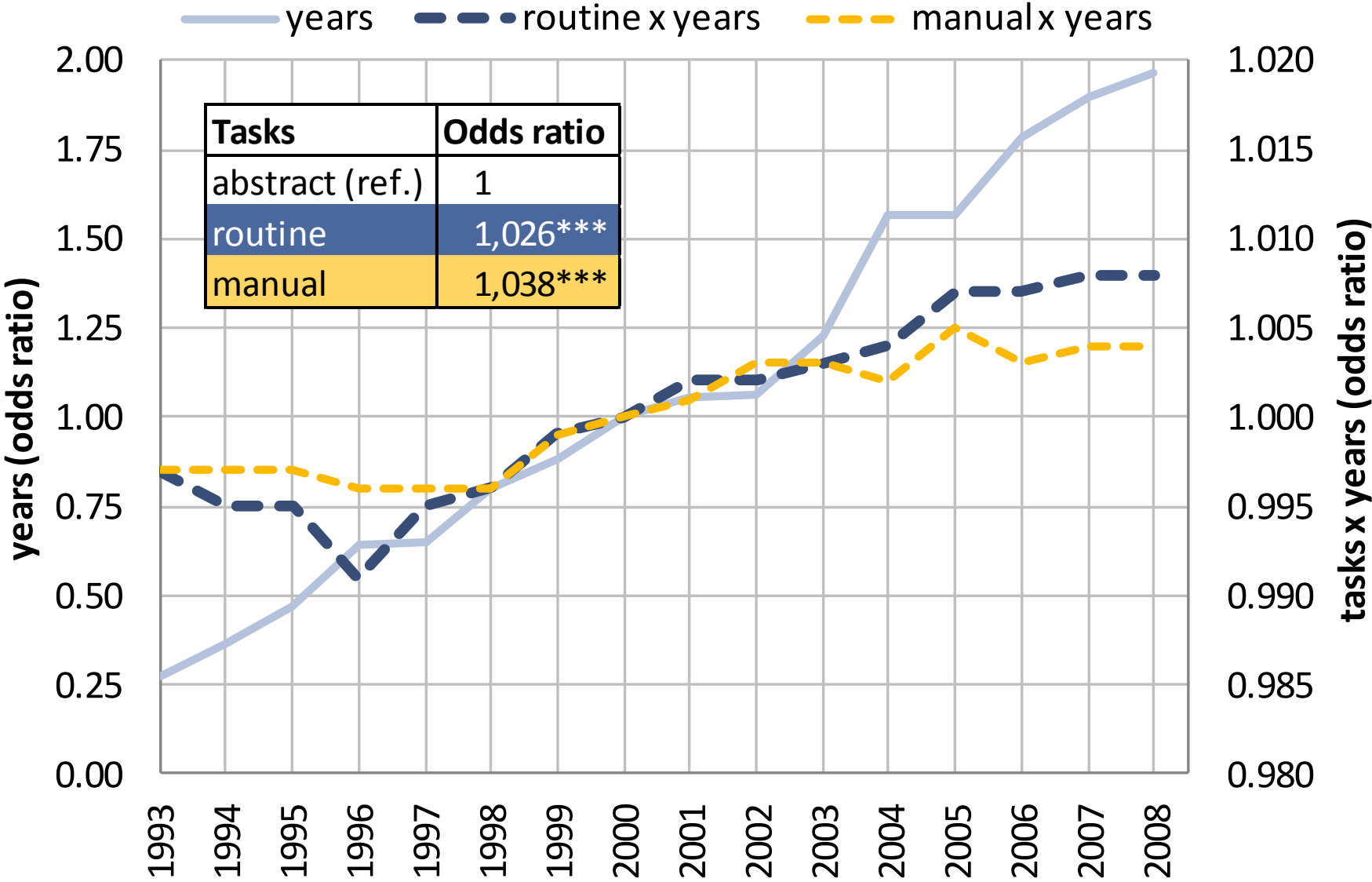


1993 x manual
 1994 x manual
 1995 x manual
 1996 x manual
 1997 x manual
 1998 x manual
 1999 x manual
 2000 x manual (reference)
 2001 x manual
 2002 x manual
 2003 x manual
 2004 x manual
 2005 x manual
 2006 x manual
 2007 x manual
 2008 x manual

Main Models		Main Models	
Model 1	Model 2	Model 1	Model 2
Model 2		abstract (reference)	1.000
0.997 [0.028]		routine	1.028 [0.000]
0.997 [0.049]		manual	1.039 [0.000]
0.997 [0.024]		University (reference)	1.000
0.996 [0.003]		technical college	0.884 [0.000]
0.996 [0.001]		25-29 years	1.503 [0.000]
0.996 [0.000]		30-39 years	1.006 [0.751]
0.999 [0.269]		40-44 years (reference)	1.000
		45-49 years	1.250 [0.000]
		50-54 years	1.569 [0.000]
		55-59 years	1.680 [0.000]
		West Germany (reference)	1.000
		East Germany	0.616 [0.000]
		German nationality (reference)	1.000
		Foreign nationality	1.761 [0.000]
		1-9 employees (reference)	1.000
		10-49 employees	0.300 [0.000]
		50-99 employees	0.288 [0.000]
		100-499 empl.	0.194 [0.000]
		500 or more empl.	0.145 [0.000]
		cum. empl. duration	0.070 [0.000]
		unempl. benef. duration	0.977 [0.000]
		regional unemployment rate*	1.073 [0.000]
		regional rate of highly educated	1.031 [0.000]
		1993	0.984 [0.000]
		1994	0.245 [0.000]
		1995	0.311 [0.000]
		1996	0.389 [0.000]
		1997	0.472 [0.000]
		1998	0.537 [0.000]
		1999	0.679 [0.000]
		2000 (reference)	1.000
		2001	1.149 [0.000]
		2002	1.176 [0.000]
		2003	1.401 [0.000]
		2004	1.794 [0.000]
		2005	2.073 [0.000]
		2006	2.338 [0.000]
		2007	2.555 [0.000]
		2008	2.643 [0.000]
		1993 x routine	0.997 [0.034]
		1994 x routine	0.995 [0.001]
		1995 x routine	0.995 [0.000]
		1996 x routine	0.991 [0.000]
		1997 x routine	0.995 [0.002]
		1998 x routine	0.996 [0.000]
		1999 x routine	0.999 [0.364]
		2000 x routine (reference)	1.000
		2001 x routine	1.002 [0.016]
		2002 x routine	1.002 [0.041]
		2003 x routine	1.003 [0.006]
		2004 x routine	1.004 [0.001]
		2005 x routine	1.007 [0.000]
		2006 x routine	1.007 [0.000]
		2007 x routine	1.008 [0.000]
		2008 x routine	1.008 [0.000]
		1993 x manual	0.997 [0.028]
		1994 x manual	0.997 [0.049]
		1995 x manual	0.997 [0.024]
		1996 x manual	0.996 [0.003]
		1997 x manual	0.996 [0.001]
		1998 x manual	0.996 [0.000]
		1999 x manual	0.999 [0.269]
		2000 x manual (reference)	1.000
		2001 x manual	1.001 [0.168]
		2002 x manual	1.003 [0.009]
		2003 x manual	1.003 [0.010]
		2004 x manual	1.002 [0.111]
		2005 x manual	1.005 [0.000]
		2006 x manual	1.003 [0.014]
		2007 x manual	1.004 [0.002]
		2008 x manual	1.004 [0.001]
		baseline	0.131 [0.000]
		Observations	2,463,064
		Pseudo-R2	0.266
		AIC	414,339.2
		BIC	414,771.5
		Chi2	164,827.6
		Df	34



Summary: LWS probability; odds ratios [p-values]



- Separate Models with
 - younger workers between 25 and 34 years
 - older workers between 35 and 54 years
- Microcensus (MZ) analyses with direct measures of task usage
 - sample of highly qualified employees similar to that of the BLH data
 - MZ provides only an individual net income (no wages)
 - **low income**
 - further individual information to increase the comparability of the MZ income estimations with the BLH wage estimations
 - marital status
 - number of employed persons in the household
 - the availability of capital income
 - receipt of welfare
- Our results are very robust

- Research question
 - How could low-wage risks for academics rise significantly besides an increase in the demand and wage premium for academics?
- One answer
 - *Routinization* rather than *skill-biased technological change* may help to solve this puzzle.
 - Decreasing demand for routine workers → rising LWS probability
 - Increasing productivity of abstract workers → falling LWS probability
- Empirical Evidence
 - Increasing low-wage probabilities over the last two decades
 - *Routine workers* are much more affected than *abstract workers*
 - Increasing penalties for routine workers over time (*routine*years*)
 - Our results are very robust

- Routinization took place in the jobs of male academics in Germany between 1993 and 2008
- Technological change is an important driving force behind wage changes
 - even at the bottom of the wage distribution
 - even for highly educated workers

Backup

Case numbers in BLH data



Variable	Category	n	%
All academics		2,463,064	100
Within low-wage sector	No	2,403,571	97.6
	Yes	59,493	2.4
Region	West	1,997,700	81.1
	East	465,364	18.9
Degree	University	1,528,978	62.1
	University of applied sciences	934,086	37.9
Age	25-29 years	177,992	7.2
	30-34 years	472,662	19.2
	35-39 years	557,270	22.6
	40-44 years	509,770	20.7
	45-49 years	408,073	16.6
	50-54 years	337,297	13.7
Nationality	German	2,367,505	96.1
	Foreign	95,559	3.9
Firm size	1-9 employees	199,566	8.1
	10-49 employees	433,568	17.6
	50-99 employees	259,801	10.6
	100-499 employees	674,635	27.4
	500 and more employees	895,494	36.4

Variable	Category	n	%
Reporting dates	1993	139,780	5.7
	1994	138,384	5.6
	1995	140,149	5.7
	1996	134,034	5.4
	1997	135,449	5.5
	1998	147,007	6.0
	1999	152,248	6.2
	2000	158,388	6.4
	2001	163,568	6.6
	2002	164,290	6.7
	2003	162,686	6.6
	2004	161,602	6.6
2005	162,127	6.6	
2006	164,415	6.7	
2007	167,523	6.8	
2008	171,414	7.0	
		mean	std. dev.
Labor market experience since 1993 in months			
Average employment duration		74.3	49.6
Average unemployment benefit duration		1.2	3.7
Average duration in low-wage sector in months			
Younger workers (25-34 years)		8.8	9.8
Older workers (35-54 years)		12.7	18.9

- The odds ratios for *routine* and *manual* show that this probability is higher for manual and routine workers than for abstract workers.
- With regard to *routine*, the odds ratio is 1.026.
 - The odds of being in the low-wage sector increase by a factor of 1.026 (i.e. 2.6%) for a 1% increase in routine intensity in the year 2000, holding the other covariates (except the interaction terms) at a fixed value .
- The interaction terms tell by how much the effect of *routine* differs between the other years (1993 to 1999 and 2001 to 2008) and the year 2000.
 - *Routine* does indeed increase over time. For the year 1993, the odds ratio is 0.997, so the effect of routine intensity on low-wage employment decreases by a factor of 0.997 (i.e. -0.03%).
 - For 2008, *routine* increases by a factor of 1.008 (i.e. +0.08%).

- Increasing low-wage probabilities over time for our sample of prime-age male academics
 - for routine workers more than for abstract workers (growing interaction effects *years*routine*)
- Positive coefficient of *manual* and growing interaction terms *manual*years*
 - routine workers are imperfect substitutes for abstract workers but can substitute for manual workers.
- Routinization took place in the jobs of male university graduates between 1993 and 2008
 - increase in the relative probability of low-wage employment for academic routine workers over time.

- The baseline odds in model 2 are 0.14.
- In the reference category we expect to find 0.14 men in the low-wage sector for every man not in this sector.
- The reference category are
 - male university graduates
 - aged 35-39 years
 - in the year 2000,
 - living in West Germany,
 - holding German nationality,
 - and employed in small companies (1-9 employees).

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