LOCAL IMPACTS OF GLOBAL MARKETS

Tasks, Skills, and Wages
in an Open Economy

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based on joint research with
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Wage Inequality, Tasks, and Globalization

- Nexus between globalization and wage inequality
  within industries and occupations
- Wage dispersion between plants, given wage premia at exporters
- Importance of between-employer dispersion for inequality change
- In worker cross section: commanding component of wage variation
  within employers

Research Agenda

- Explore interrelation between job requirements and wages
- Account for technical change, offshoring and export participation
- *Tasks*: Characteristics of workplace
  In Germany time-varying worker-level information over 35 years
- Build employer-level evidence and theory of division of labor
- Combine task information with linked employer-employee data

Related Literature

- **Tasks**. Polarization (Autor, Katz, Kearney 06), offshoring (Levy, Murnane 04)
- **Tasks and trade**. Heckscher-Ohlin (Grossman, Rossi-Hansberg 08), Ricardian (Rodriguez-Clare 10; Acemoglu, Autor 11).
- **Tasks, worker performance and automation**. Ability-job mach quality reduces training costs (Barron, Black, Loewenstein 89) and raises efficiency (Meyer 94; Burgess et al. 10); automation displaces routine tasks (Cortes, Jaimovich, Siu 16)
- **Human resource practices**. Management quality (Bloom, van Reenen 11) or hierarchies (Caliendo, Monte, Rossi-Hansberg 15) and effort incentives (Cunat, Guadalupe 09)
- **Between-firm matching**. Trade-induced changes in match quality (Davidson, Heyman, Matusz, Sjöholm, Zhu 14; Helpman, Itskhoki, Muendler, Redding 17)
- **Within-firm matching**. Lazear, Shaw 09: Wage structure more dependent on employer-internal sorting to occupations than on sorting to employers.
  Bombardini, Orefice, Tito (15): Permanent wage component in firm-worker sorting model based on Eeckhout, Kircher (11)

Trade, Technical Change, and the Labor Market

- Trade in tasks, beyond skills and occupations
  - Radiologists interpret computer tomography images at distance
  - Janitor's or doorman's work not advanced but cannot relocate
- Technical change and automation, and task assignments
- Within-plant workplace organization and multi-tasking

This Talk

- Task evolution over time in Germany
- Concomitant changes in offshoring, exporting and technology use
- Wage inequality, tasks, and the within-plant contribution
- A model of the division of labor in a global economy

Task Data

- German Qualifications and Career survey 1979, 1985-86, 1991-92, 1998-99, 2005-06, 2012
  - "What?" 15 *Activities* (performed/not): e.g. *Produce Goods*; *Develop, Research, Construct*; *Organize, Plan*; or *Oversee, Control*
  - "How?" 9 *Performance requirements* (frequent/not): e.g. *Work procedures prescribed in detail*; *Deadlines/pressure*; *Improve/adopt techniques*; *New situations/activities*
- Around one-tenth of percent of German labor force ($\geq$20 hours work)
- Previously: Becker, Ekholm, Muendler (13), Becker, Muendler (15)

Shares of Routine and Codifiable Tasks

	1979	1986	1992	1999	2006	2012
	(1)	(2)	(3)	(4)	(5)	(6)
Routineness	0.398	0.460	0.447	0.464	0.457	0.506
Codifiability	0.600	0.654	0.622	0.661	0.686	0.693
Observations	29,737	26,361	34,277	34,343	20,000	20,036
U.S. Routineness	0.405	0.406		0.376	0.317	0.312

Source: BIBB-BAuA 1979-2012 and Cortes, Jaimovich & Siu (2016).
Note: For Germany shares of worker observations that indicate frequent requirements of routineness (*Repeated work steps*) and codifiability (*Work procedures prescribed in detail*); for United States shares of occupations with imputed task frequencies from the Dictionary of Occupational Titles (DOT) 1977 and 1991, for 1979, 1989, 1999, 2009, 2014. For German indicators we transform reported frequency into an indicator of frequent (intensity of 3 or 4—occasionally, frequently or almost always) or infrequent requirements (intensity of 1 or 2—never or almost never, or rarely).

How do tasks at German workplaces evolve over time?

Shares of Cumulative Performance Requirements at the Workplace

	1979	1986	1992	1999	2006
	(1)	(2)	(3)	(4)	(5)
0	.056	.022	.009	.004	.004
1	.040	.034	.028	.035	.014
2	.065	.061	.073	.054	.035
3	.103	.099	.159	.101	.074
4	.143	.138	.312	.150	.162
5	.168	.186	.234	.184	.240
6	.156	.196	.185	.182	.228
7	.129	.138		.143	.167
8	.085	.085		.088	.076
9	.055	.041		.059	
Total	1.000	1.000	1.000	1.000	1.000
Average	4.91	5.13	4.18	4.76	5.83
Observations	29,737	26,361	24,090	27,634	16,964

Source: BIBB 1979-2006.

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Shares of Simultaneous Activities at the Workplace

	1979	1986	1992	1999	2006	2012
	(1)	(2)	(3)	(4)	(5)	(6)
0	.184	.071	.105	.034	.008	.008
1	.403	.331	.350	.063	.016	.014
2	.204	.263	.236	.087	.028	.028
3	.096	.156	.138	.114	.049	.046
4	.053	.093	.078	.121	.072	.071
5	.029	.052	.046	.127	.101	.099
6	.015	.023	.025	.119	.123	.121
7	.008	.006	.013	.110	.135	.134
8	.004	.002	.006	.085	.125	.130
9	.002	.001	.003	.062	.114	.116
10	.001	.001	.001	.038	.092	.092
11	.001	.0001	.0004	.025	.068	.068
12 or more	.000		.0004	.015	.070	.073
Average	1.676	2.177	2.105	5.250	7.261	7.316
Observations	29,737	26,361	24,090	27,634	16,964	16,718

Source: BIBB-BAuA 1979-2012.

Shares of Simultaneous Activities at the Workplace

	1979	1986	1992	1999	2006	2012
	(1)	(2)	(3)	(4)	(5)	(6)
0	**.184**	.071	**.105**	.034	.008	.008
1	**.403**	**.331**	**.350**	.063	.016	.014
2	**.204**	**.263**	**.236**	.087	.028	.028
3	.096	**.156**	**.138**	**.114**	.049	.046
4	.053	.093	.078	**.121**	.072	.071
5	.029	.052	.046	**.127**	**.101**	.099
6	.015	.023	.025	**.119**	**.123**	**.121**
7	.008	.006	.013	**.110**	**.135**	**.134**
8	.004	.002	.006	.085	**.125**	**.130**
9	.002	.001	.003	.062	**.114**	**.116**
10	.001	.001	.001	.038	.092	.092
11	.001	.0001	.0004	.025	.068	.068
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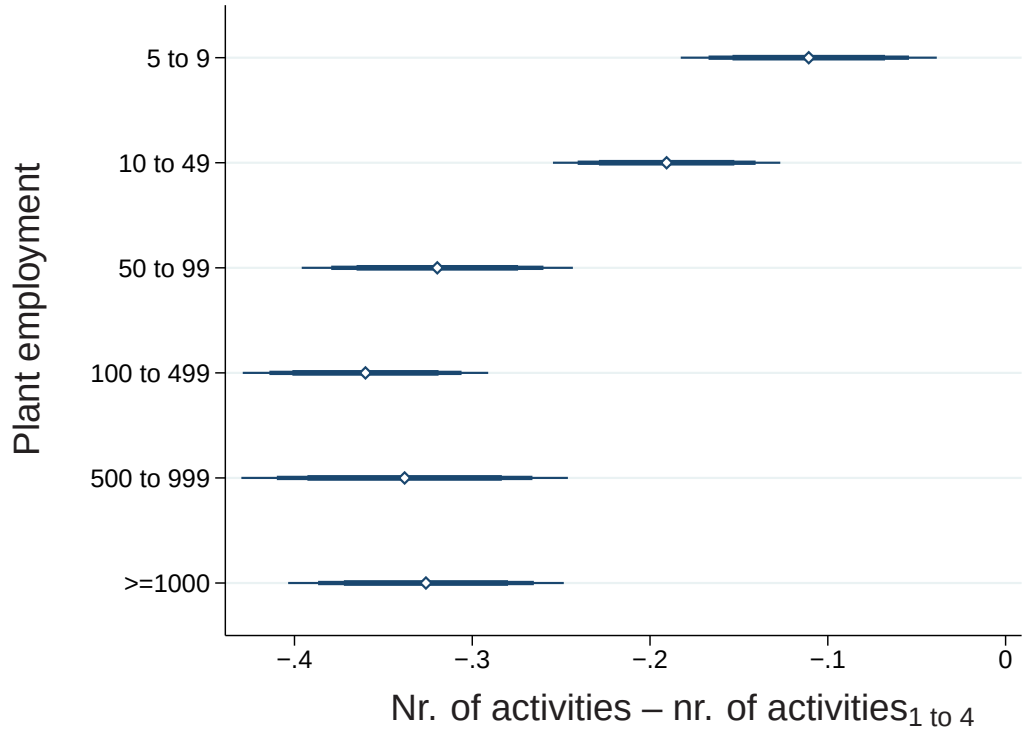
Source: BIBB-BAuA 1979-2012.

How do tasks at German workplaces evolve over time?

- "How?" Performance requirements remain similarly focused.
- "What?" Six times more activities performed in 2012 than in 1979.

How do activity assignments vary between employers?

Range of Activities and Plant Size



Source: BIBB-BAuA 1979-2012. *Note*: Prediction of number of activities by plant employment category, controlling for year, industry, region, occupation and worker characteristics. Results are differences to smallest plant-size category 1 to 4 workers). Thick, medium, and thin lines represent the 99, 95, and 90 percent confidence intervals of the point estimates.

How do activity assignments vary between employers?

- Larger employers assign a strictly narrower activity range.
- Except for the very largest employers (with more than 500 workers). Top plants assign slightly wider activity range than mid-size plants

How do activities relate to requirements and automation?

Shares of Simultaneous Activities at the Workplace in 1979

	Codifiability	Routineness	Computerization	Automation
	(1)	(2)	(3)	(4)
1	0.647	0.444	0.035	0.019
2	0.594	0.396	0.068	0.032
3	0.550	0.340	0.098	0.038
4	0.541	0.315	0.112	0.050
5	0.496	0.275	0.125	0.064
6	0.536	0.332	0.119	0.060
7	0.495	0.309	0.144	0.054
8	0.541	0.287	0.172	0.033
9	0.441	0.309	0.029	0.074
10	0.514	0.314	0.200	0.114
11	0.733	0.200	0.067	0.200
12 or more	0.571	0.571	0.143	0.286
Average	0.549	0.299	**0.088**	**0.068**

Source: BIBB-BAuA 1979. *Note*: Share of workers per activity count who also report performance requirement or main tool use. Computerization indicates that the main tool is a computer, workstation, or CAD equipment. Automation indicates that the main tool is a robot or fully automated equipment.

Shares of Simultaneous Activities at the Workplace in 1986-2006

	Codifiability	Routineness	Computerization	Automation
	(1)	(2)	(3)	(4)
1	0.687	0.529	0.177	0.018
2	0.664	0.480	0.275	0.026
3	0.642	0.435	0.335	0.029
4	0.637	0.414	0.398	0.043
...	...	...	...	...
8	0.615	0.402	0.435	0.095
9	0.609	0.401	0.468	0.125
10	0.620	0.416	0.474	0.149
11	0.631	0.420	0.460	0.186
12	0.627	0.412	0.460	0.174
13	0.721	0.478	0.495	0.229
14	0.674	0.463	0.909	0.273
15	0.574	0.476	.	.
Average	0.644	0.444	**0.415**	**0.102**

Source: BIBB-BAuA 1986-2006. *Note*: Share of workers per activity count who also report performance requirement or main tool use. Computerization indicates that the main tool is a computer, workstation, or CAD equipment. Automation indicates that the main tool is a robot or fully automated equipment.

How do activities relate to requirements and automation?

- Codifiability shows little covariation,
  routineness is negatively associated with multi-tasking

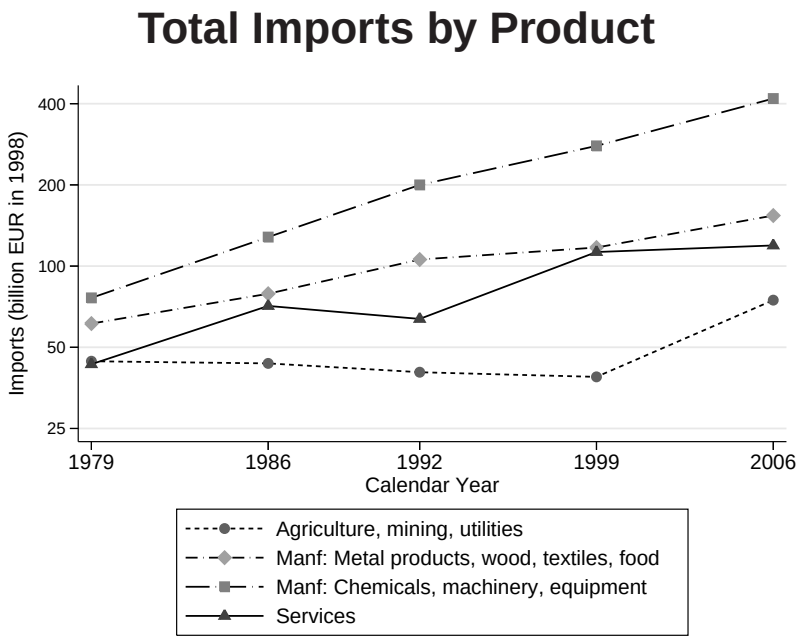
- Computer use and automation of the own workplace
  positively associated with multi-tasking, strongly in 1986-2006

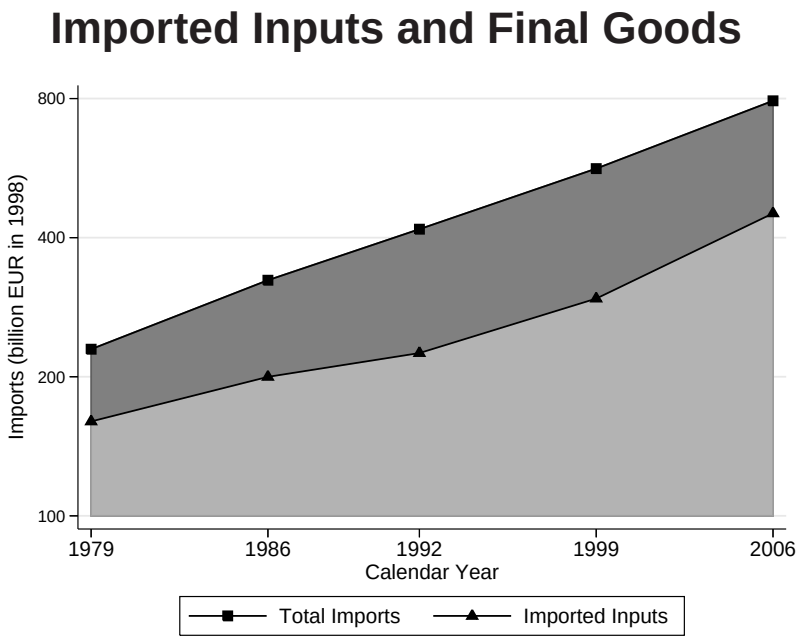
How does offshoring by German industries evolve over time?

Additional Data

- Merchandize trade by country from World Trade Flow data (20 industries)
- Services trade by country or group from Deutsche Bundesbank (19 industries)
- Input-output matrices and imported-input matrices from German Statistical Agency *Destatis*
- Labour market tightness: Vacancies per 1,000 unemployed persons by state from German Labour Office (IAB), mapped to industries by regional employment

German Imports 1979-2006 by Product and Use





Sources: WTF for merchandize, BuBa for services, *Destatis* for import matrices, 1979-2006.

Share of Intermediate Product Imports in Total Imports

	1978	1986	1992	1999	2006
	(1)	(2)	(3)	(4)	(5)
Agriculture & Utilities	.844	.838	.771	.718	.790
Manf.: Chemicals and mineral products	.758	.746	.757	.728	.607
Manf.: Iron, steel and metal products	.902	.880	.847	.845	.836
Manf.: Transport equipment	.379	.409	.355	.335	.326
Manf.: Machinery, equipment and misc. prod.	.428	.441	.371	.378	.376
Manf.: Wood, paper and printing	.793	.810	.867	.742	.675
Manf.: Textiles, apparel and leather	.350	.283	.280	.229	.187
Manf.: Food and beverages	.394	.453	.394	.396	.344
Services	.938	.815	.832	.846	.909

Source: *Destatis* import matrices, releases 2009 (1978 and 1986) and 2010 (1992, 1999, 2006).

Share of Intermediate Product Imports in Production

Shares of	1978 (1)	1986 (2)	1992 (3)	1999 (4)	2006 (5)
Intermediate Imports in Total Intermediate Input	.143	.149	.156	.176	.217
× Total Intermediate Input in Production Value	.510	.513	.471	.473	.512
= Intermediate Imports in Production Value	.073	.077	.074	.083	.111

Source: *Destatis* import matrices, releases 2009 (1978 and 1986) and 2010 (1992, 1999, 2006).

How does offshoring by German industries evolve over time?

- Intermediate inputs are smaller share of imports now than in 1979.
- Offshore outsourcing raises share of total outsourcing by one-half.

How do task shifts relate to industry-occupation variation?

Prediction Design

- Summarize evolution of 15 activities and 9 performance requirements over 5 time intervals

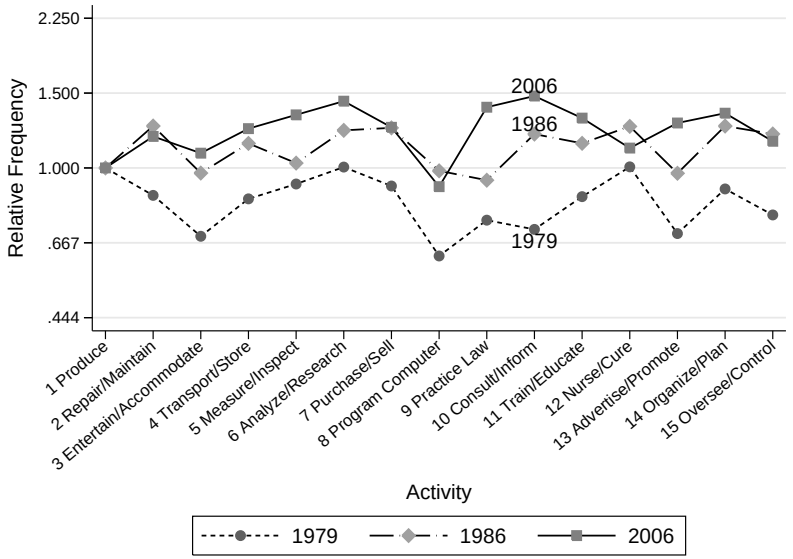
- Aggregate BIBB data to cells by task i, year t, industry j, occupation k, gender s, age a and count heads performing the task within cell (L_{itjksa})

- Estimate ln $L_{itsajk} = \beta_{it} + \beta_t + \beta_s + \beta_a + \beta_j + \beta_k + \varepsilon_{itsajk}$

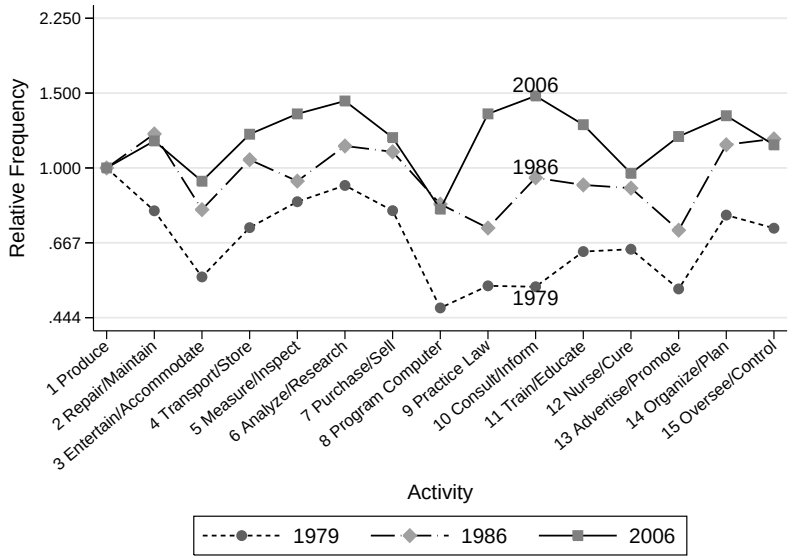
- Report exp$\{\beta_{it}\}$.
  Estimates reflect *relative* frequencies compared to omitted reference

Activity Content of German Work

Not Conditional on Industries, Occupations



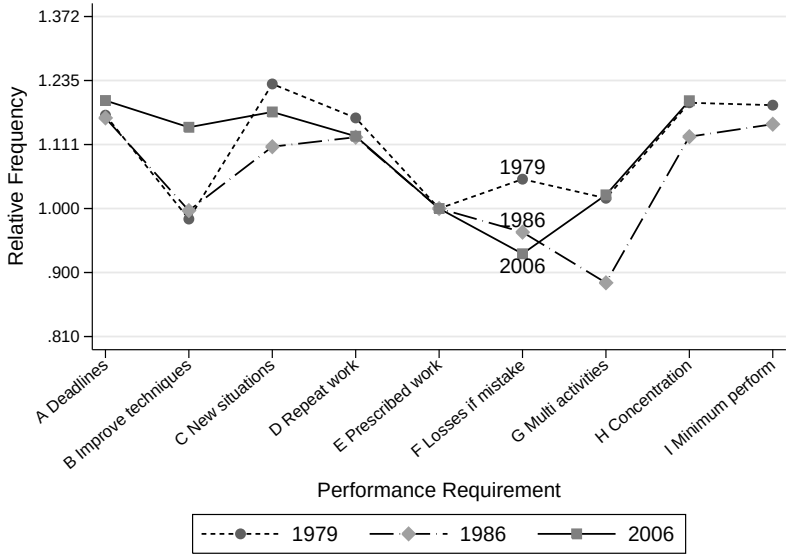
Conditional on Industries, Occupations



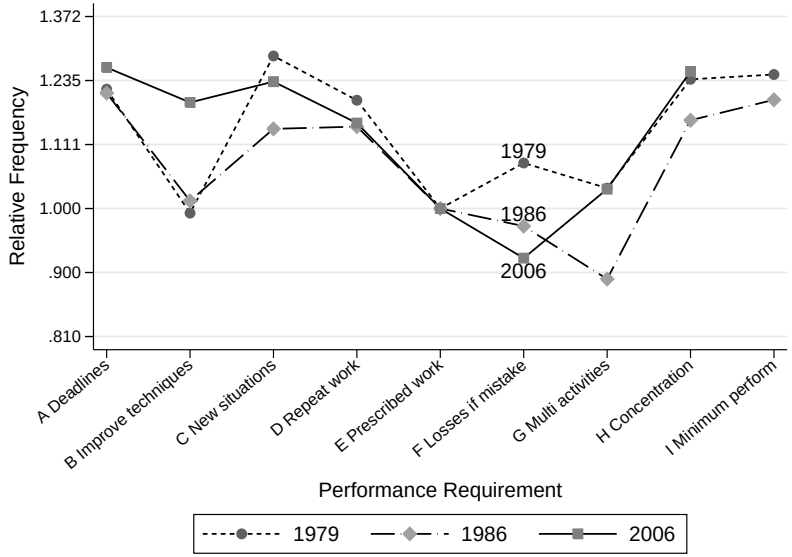
Source: BIBB 1979-2006, workers ages 16 through 65.
Notes: Measures of relative activity frequencies from log employment OLS regression over 168,466 activity-year-gender-age-industry-occupation cells. Coefficients β from log employment regressions reported as $\exp\{\beta\}$ to reflect relative frequencies. Omitted baseline activity from regressions: *1 Manufacture, Produce Goods* in each survey wave. Log scale on vertical axis.

Performance Requirements of German Work

Not Conditional on Industries, Occupations



Conditional on Industries, Occupations



Source: BIBB 1979-2006, workers ages 16 through 65.
Notes: Measures of relative performance requirement frequencies from log employment OLS regression over 180,022 requirement-year-gender-age-industry-occupation cells. Coefficients β from log employment regressions reported as $\exp\{\beta\}$ to reflect relative frequencies. Omitted baseline performance requirement from regressions: *E Work procedures prescribed in detail* in each survey wave. Performance requirements F-H missing in 1992, requirement I missing in 2006. Log scale on vertical axis.

How do task shifts relate to industry-occupation variation?

- Task shifts more pronounced within industries and occupations.

  `Interpretation.` Industries and occupations expand that are less intensive in rising tasks.

Predictions

- Activity Content
  - All activities gain in importance relative to *Manufacture/Produce*, strongest shift by 1986
  - Shift affects “high-end activities” (*Organize/Plan*, *Oversee/Control*) and “low-end activities” (*Repair/Maintain*)
- Performance Requirements
  - Expected U-shape profile: tasks gain relative to *Prescribed work*
  - Small change over time (except *Improve/adopt new techniques*)

How do imported tasks shift?

Task Content of Imports

- Impute implied task trade flows through a weighting procedure. Weights $\sigma_{ijt} \equiv L_{ijt}/(\sum_j L_{ijt})$ for task i, year t, industry j

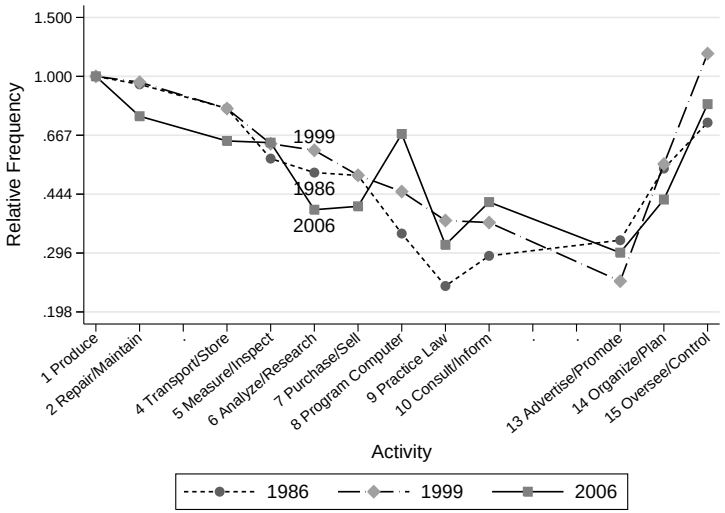
- Volume of product imports associated with task i embedded in total imports from c: $m_{itc} \equiv \sum_j \sigma_{ij,t-7} M_{jtc}$ (across industries j)

- Regression: $\ln m_{itc} = \beta_{it} + \beta_t + \beta_c + \varepsilon_{itc}$.

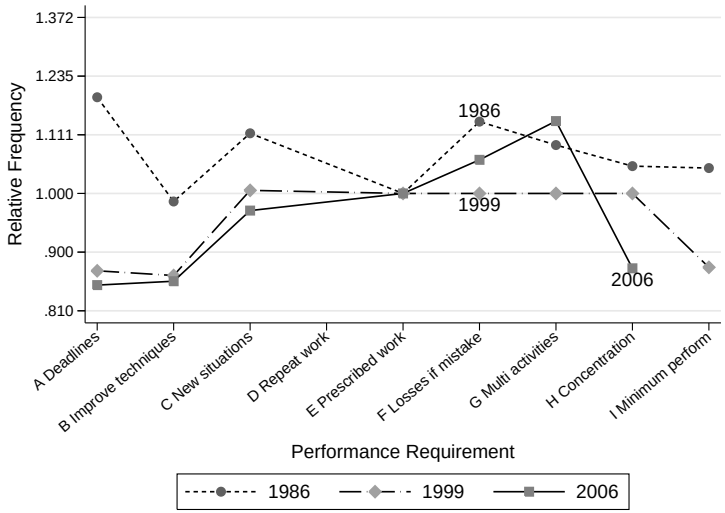
- Results: Counterpart to changes in domestic tasks

Tasks Embedded in German Imports

Activities in Imports



Performance Requirements in Imports



Sources: WTF, *Destatis* for import matrices, 1979-2006; BIBB 1979-2006, workers ages 16 through 65.
Notes: Measures from log import value OLS regression over task-year-source country cells (12,398 observations for activities and 6,918 observations for performance requirements). Services activities 3, 11 and 12 not reported, performance requirement I missing in 2006, requirement D dropped to avert multi-collinearity. Coefficients β from log import regressions reported as $\exp\{\beta\}$ to reflect relative import frequencies. Omitted baseline activity *1 Manufacture, Produce Goods*, omitted baseline performance requirement *E Work procedures prescribed in detail*. Log scale on vertical axis.

How do imported tasks shift?

- Activities in imports lose importance relative to *Manufacture/Produce*, except *Program Computer* and *Consult/Inform*

- Performance requirements other than *Work Procedures Prescribed* lose importance over time.

What trade flows predict domestic task shifts?

Prediction Design

- Three types of trade flows T: imported intermediate inputs, imported final products, exports

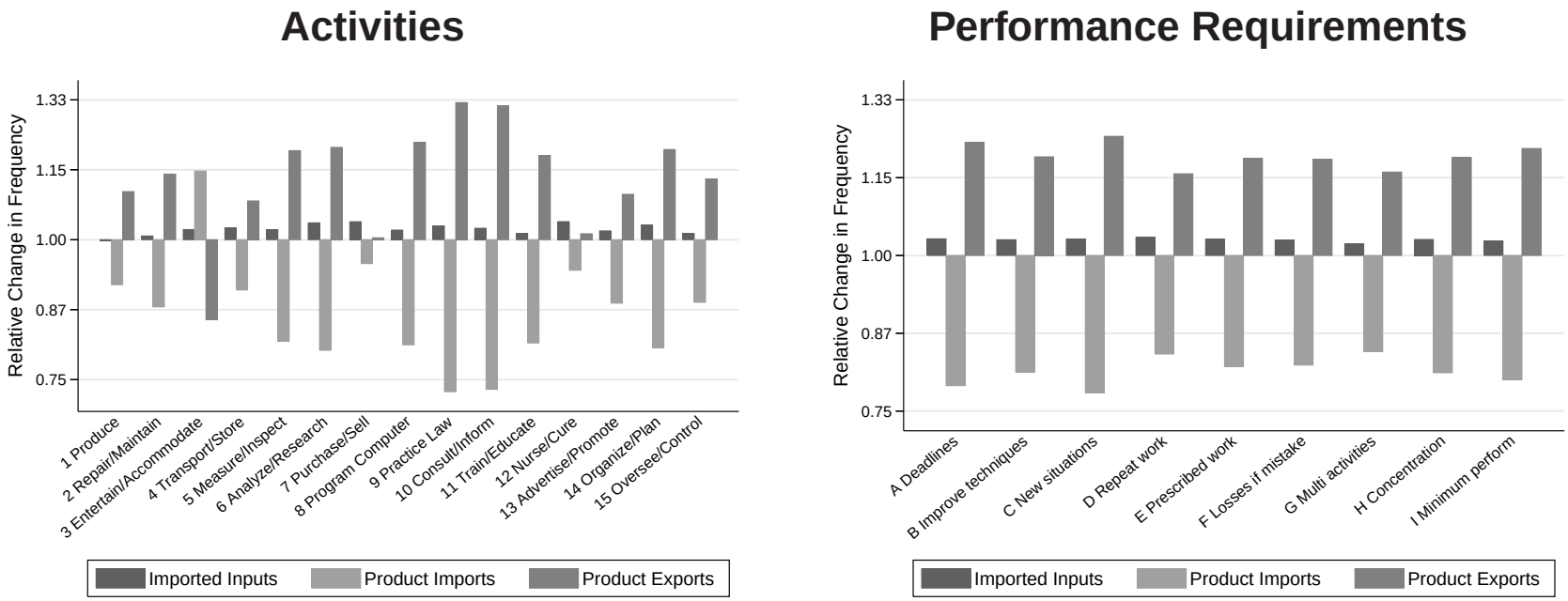
- Extend previous specification

$$\ln L_{itsajk} = \sum_T \beta_i^T X_{jt}^T + \beta_{it} + \beta_t + \beta_s + \beta_a + \varepsilon_{itsajk}$$

- Aggregation over all source and destination countries

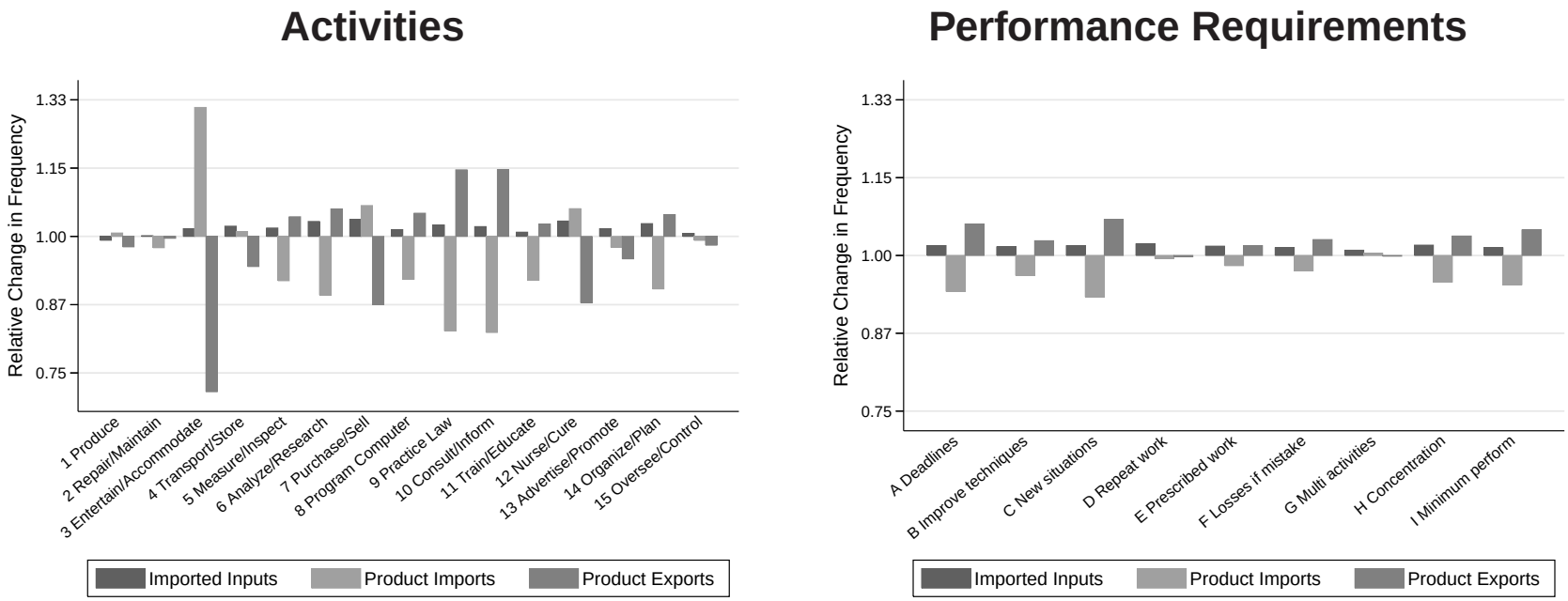
- Full set of β_i^T (all tasks) admissible, no need of reference category

Trade Predictors: Not Conditional on Industries, Occupations



Sources: WTF for merchandize, BuBa for services, 1979-2006.; BIBB 1979-2006, workers ages 16-65.
Notes: Measures from log employment OLS regressions over 168,466 and 180,022 activity-year-gender-age-industry-occupation cells. Coefficients β from log employment regressions reported as $\exp\{\beta\}$ to reflect relative frequencies. Baselines tasks omitted: *1 Manufacture, Produce Goods* and *E Work procedures prescribed in detail*. Performance requirements F-H missing in 1992, requirement I missing in 2006. Log scale on vertical axis.

Trade Predictors: Conditional on Industries, Occupations



Sources: WTF for merchandize, BuBa for services, 1979-2006.; BIBB 1979-2006, workers ages 16-65.
Notes: Measures from log employment OLS regressions over 168,466 and 180,022 activity-year-gender-age-industry-occupation cells. Coefficients β from log employment regressions reported as $\exp\{\beta\}$ to reflect relative frequencies. Baselines tasks omitted: *1 Manufacture, Produce Goods* and *E Work procedures prescribed in detail*. Performance requirements F-H missing in 1992, requirement I missing in 2006. Log scale on vertical axis.

What trade flows predict domestic task shifts?

- *Across* industries and occupations, exports and imported inputs exhibit mostly same signs, raising task frequencies.

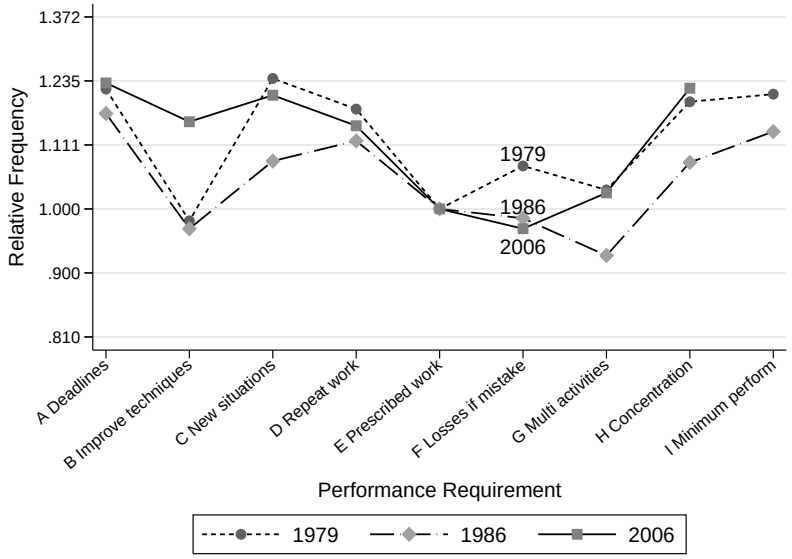
- Relatively weak effect of intermediate-input trade.

- *Within* industries and occupations, positively affected by exports and imported inputs are coordination related tasks: *8 Program Computer*, *10 Consult/Inform*, *14 Organize/Plan*, *A Deadlines*, *C New situations*.

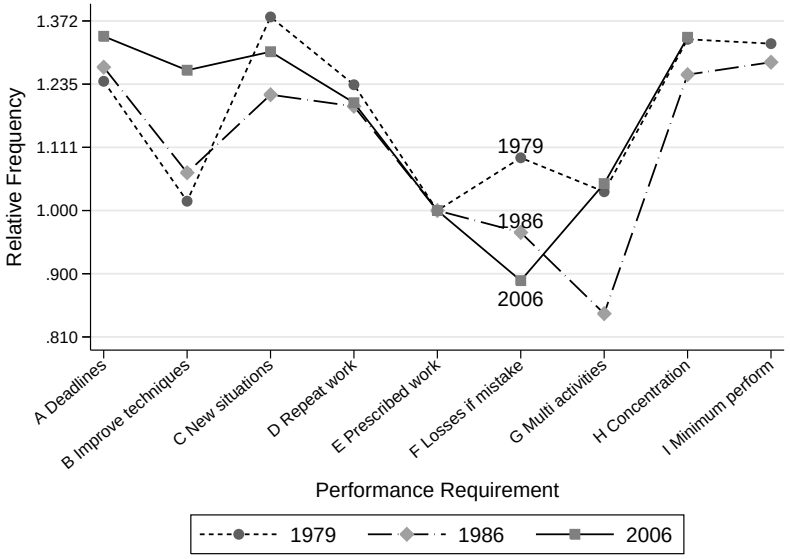
How do market conditions relate to task shifts?

Labour Market Tightness: Perf. Req. Within Industries and Occupations

Industries Exposed to High Tightness



Industries Exposed to Low Tightness



Sources: BIBB 1979-2006, workers ages 16 through 65; GSOEP select years with unionization.
Notes: Measures of relative activity frequencies from log employment OLS regression over 76,676 activity-year-gender-age-industry-occupation cells with high unionization and 84,480 cells with low unionization. Coefficients from log employment regressions reported as $\exp\{\beta_{it}\}$ to reflect relative frequencies. Omitted baseline performance requirement *E Work procedures prescribed in detail*. Log scale on vertical axis.

How do market conditions relate to task shifts?

- Change in tasks more pronounced in less tight labour markets.

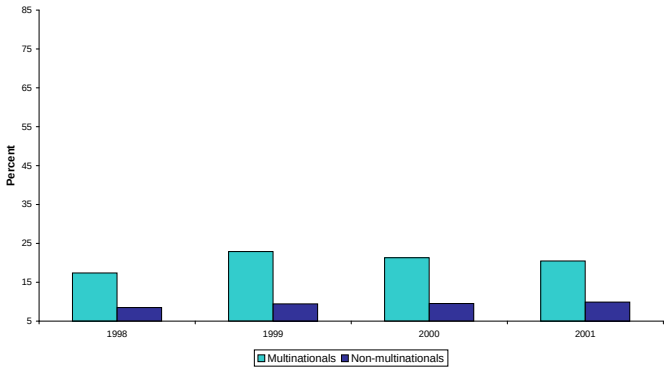
Once tasks are accounted for, what role do skills play?

Additional Data

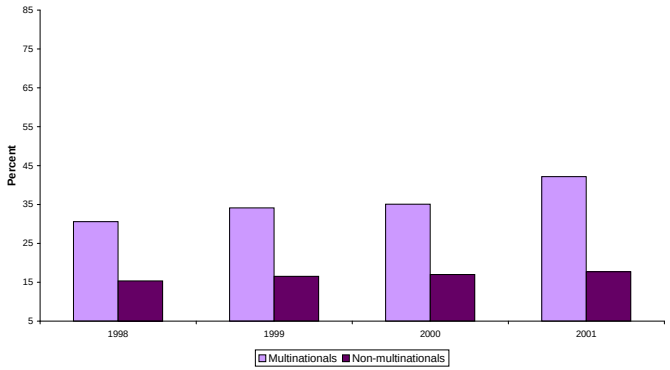
- German MNEs and offshore affiliates (MiDi-Ustan Dt. Bundesbank)
- Offshore-affiliate employment rises from 3.1 to 3.7 million (1998-2001)
- Link plants to MNEs for manufacturing and services, 1998-2001 through Social-security records (German Federal Labor Agency BA)
- Include workplace tool use (from BIBB)
  1. workplace tool implies interactive tasks (interaction with others)
  2. workplace tool implies non-routine tasks (non-repetitive methods)

Wage-bill shares of upper-secondary education

Manufacturing



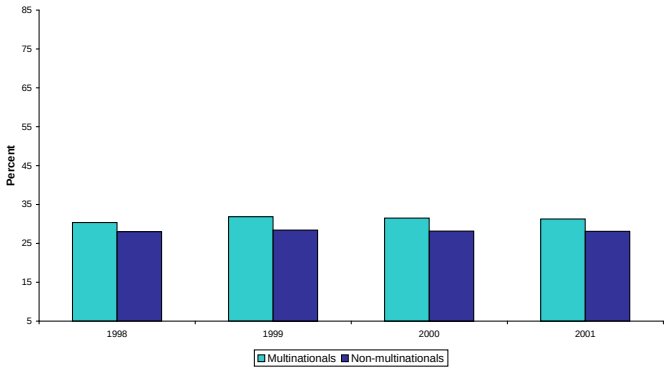
Services



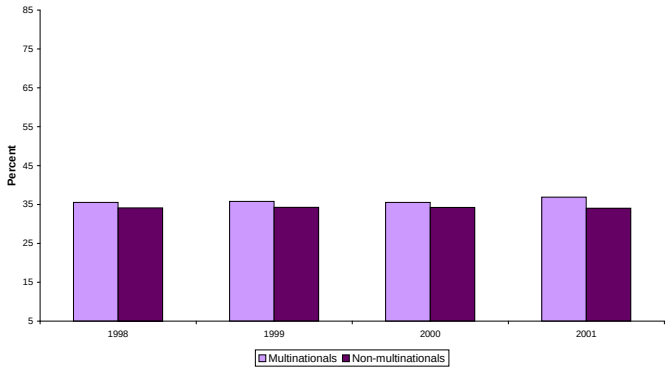
Source: Linked BA-MIDI data 1998-2001 and BIBB-IAB worker survey 1998/99. Task measures under strict interpretation. Services exclude commerce.

Wage-bill shares of interactive tasks

Manufacturing



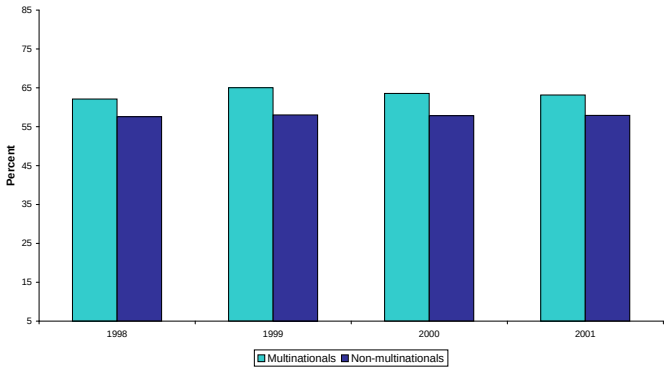
Services



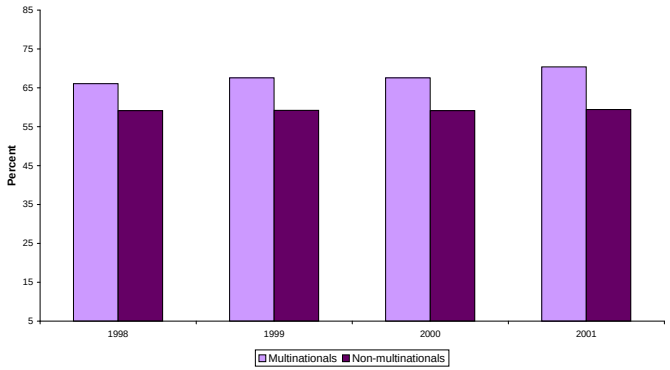
Source: Linked BA-MIDI data 1998-2001 and BIBB-IAB worker survey 1998/99. Task measures under strict interpretation. Services exclude commerce.

Wage-bill shares of non-routine tasks

Manufacturing



Services



Source: Linked BA-MIDI data 1998-2001 and BIBB-IAB worker survey 1998/99. Task measures under strict interpretation. Services exclude commerce.

Offshoring, Education and Occupations

Sectors	Upper-secondary education				White-coll. occ.	
	Manuf.	Serv.	All	All	Manuf.	Serv.
	(1)	(2)	(3)	(4)	(5)	(6)
Offshore employmt	7.486	12.328	8.443	**5.819**	9.726	2.233
	(3.573)**	(4.724)***	(2.251)***	(1.796)***	(5.056)*	(3.748)
Log Cap./Val. add.	.123	1.100	.890	.370	-.877	-.705
	(.607)	(1.143)	(.538)*	(.497)	(.717)	(.697)
Log Value added	.383	1.120	.969	.789	-3.371	.786
	(.539)	(.829)	(.369)***	(.325)**	(1.096)***	(1.325)
Non-routine perc.				**79.370**		
				(7.068)***		
Interactive perc.				8.827		
				(14.831)		
Obs.	1,871	1,007	4,921	4,921	1,876	1,020
R^2 (within)	.038	.036	.013	.107	.096	.022

Source: Linked BA-MIDI data 1998-2001 and BIBB-IAB survey 1998/99, balanced MNE-plant panel.
Notes: Wage-bill shares in percent, varying between zero and 100. Estimators are plant random effects, conditional on year effects. Standard errors in parentheses: * significance at ten, ** five, *** one percent.

How do market conditions relate to task shifts?

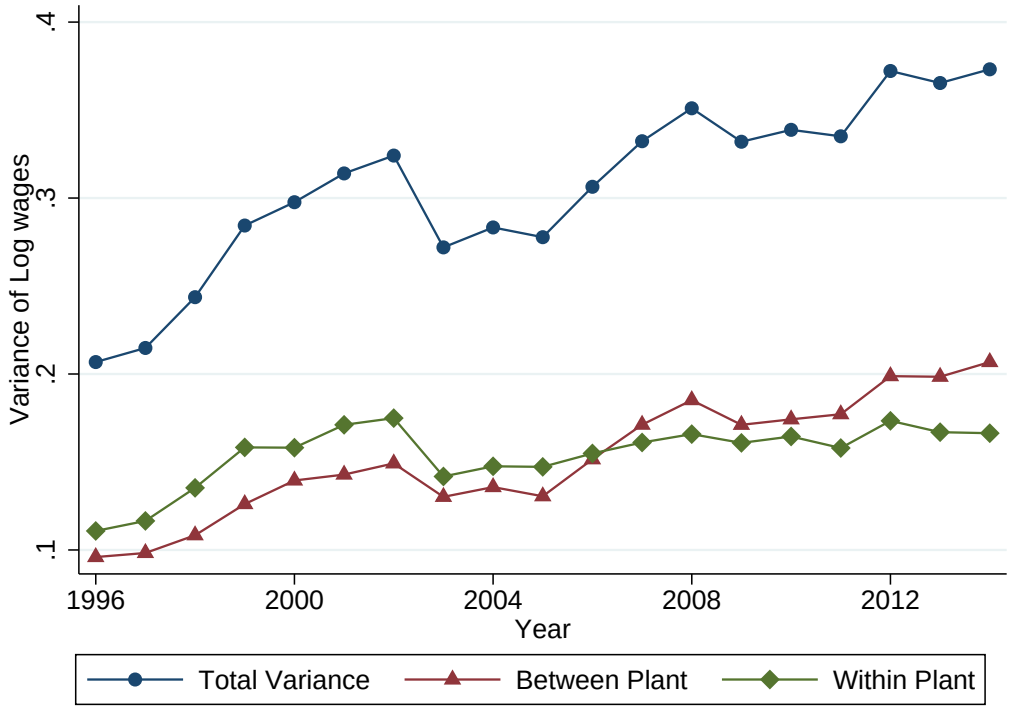
- Skilled wages strongly relate to in-house offshoring beyond task shifts.

How does wage inequality evolve?

Plant-Worker and Additional Data

- Federal Employment Office, Institute for Employment Research (IAB): **Linked plant-worker data** extract for plant random sample
- LIAB: Administrative worker-level data (social security records) combined with **plant survey information** since 1996
- UN Comtrade: **Bilateral merchandise trade**,
  World Bank TSD: **Bilateral services trade**.
- Consolidated data with 39 longitudinally consistent industries, based on an aggregation of NACE 1.1

Variance of log Daily Wages Within and Between Plants



Source: LIAB 1996-2014.

Residual log Daily Wage Inequality in LIAB 1996-2014

Contribution of component	1996-2014
within plant	71
within occupation	84
within plant-occupation	54
within plant-hierarchy	65
within plant-hierarchy-occupation	54

Source: LIAB 1996-2014. Residual from log daily wage Mincer regression on age, gender, education, and potential labor-market experience. Hierarchical layers defined as in Caliendo, Monte, Rossi-Hansberg (2015).

How does wage inequality evolve?

- Log wage inequality increases over time.
- Between- and within-plant components contribute roughly equally.
- Most residual wage inequality is within plants and occupations.

To what extent may task assignments relate to inequality?

Three Facts and a Hypothesis

1. Larger plants and exporters offer more occupations.

2. Workers at larger plants perform fewer tasks within occupations.

3. Overall and residual wages are more dispersed at larger plants.

- `Hypothesis`: Workers at larger plants are more specialized in fewer tasks. Their abilities are better matched to these tasks, and wages therefore more dispersed.

Revenues and the Range of Activities

	Dependent variable: log Normalized number of activities					
	(1) OLS	(2) OLS	(3) OLS	(4) IV	(5) IV	(6) IV
log Revenues	-0.091***	-0.057***	-0.051***	**-0.021***	**-0.259***	**-0.257***
	(0.003)	(0.007)	(0.009)	(0.013)	(0.077)	(0.076)
log Nr. of jobs		-0.257***	-0.328***		4.363**	4.428**
		(0.037)	(0.075)		(1.975)	(2.010)
log Revenues		0.009***	0.013**		-0.226**	-0.230**
$\times$ log Nr. of jobs		(0.003)	(0.005)		(0.110)	(0.112)
Plant FE			yes			
Adj. R^2	0.234	0.243	0.793			
Hansen J (p-val.)	.	.	.	0.288	.	0.872
Obs.	126,488	126,488	126,488	64,616	64,777	64,563

Source: LIAB 1996-2014 and BIBB-BAuA 1992-2012. Plants with more than 2 full-time workers.
Note: Regressions include time, region, and sector fixed effects. IV estimation based on GMM. Standard errors in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Revenues and the Within-plant Residual Wage Dispersion

	Dependent variable: log StDev Residual daily wage					
	(1) OLS	(2) OLS	(3) OLS	(4) IV	(5) IV	(6) IV
log Revenues	0.185***	0.174***	0.104***	**0.293*** **	0.065	0.059
	(0.005)	(0.013)	(0.019)	(0.025)	(0.093)	(0.093)
log Nr. of jobs		1.042***	1.232***		**5.783*** **	**6.006** **
		(0.078)	(0.173)		(2.429)	(2.458)
log Revenues		-0.055***	-0.067***		**-0.309*** **	**-0.321** **
$\times$ log Nr. of jobs		(0.006)	(0.012)		(0.135)	(0.137)
Plant FE			yes			
Hansen J (p-val.)	.	.	.	0.165	.	0.685
R^2	0.293	0.345	0.836			
Adj. R^2	0.292	0.345	0.781			
Obs.	126,483	126,483	126,483	64,614	64,775	64,561

Source: LIAB 1996-2014 and BIBB-BAuA 1992-2012. Plants with more than 2 full-time workers.
Note: Regressions include time, region, and sector fixed effects. IV estimation based on GMM. Standard errors in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Theory and the Implications for Inequality

- Plants optimally partition task range into occupations
- Productive plants assign narrower task ranges, improve match quality
- Globalization leads productive plants into exporting, raising prosperity
- Variance of wages increases at exporters, declines at non-exporters
- Economy-wide wage inequality higher in open economies

Conclusions

- Increasing importance of “high end” tasks in Germany.
  Organizing and consulting activities under deadlines, changing business conditions and tougher performance standards

- Significant offshoring since 1979, predicts observed task frequencies

- Task ranges within occupations narrower at large plants and exporters

- Globalization can raise within-plant wage dispersion in all economies

Speculations and a Suggestion

- Computerization and automation likely explain multi-tasking
  because growth of specialized exporters predicts less multi-tasking

- Technology adopters typically large, raising between-plant inequality

- Shared surplus from globalization raises between-plant inequality

- Technical change and globalization raise economy-wide prosperity.
  Distribution of the prosperity gains uneven up to a threshold.

  Redistribute without slowing innovation or globalization.

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BACKUP

Shares of Simultaneous Activities at the Workplace in 2012

	Codifiability	Routineness	Computerization	Automation
	(1)	(2)	(3)	(4)
1	0.853	0.533	0.253	
2	0.840	0.544	0.379	
3	0.826	0.575	0.471	
4	0.763	0.553	0.530	
...	...	...	...	
8	0.649	0.489	0.475	
9	0.666	0.483	0.448	
10	0.657	0.502	0.405	
11	0.672	0.518	0.360	
12	0.694	0.520	0.357	
13	0.723	0.551	0.333	
14	0.738	0.503	0.262	
15	0.882	0.471	0.294	
Average	0.742	0.512	**0.394**	

Source: BIBB-BAuA 2012. *Note*: Share of workers per activity count who also report performance requirement or main tool use. Computerization indicates that the main tool is a computer, workstation, or CAD equipment. Automation indicates that the main tool is a robot or fully automated equipment.

MNE Estimation Strategy

- Predict relative demand for work type i at onshore plant j of MNE k

$$\theta_{ijt} = \sum_{\ell} \gamma_{\ell} \, OE_{k\ell t} + \beta_K \ln \frac{K_{kt}}{Y_{kt}} + \beta_Y \ln Y_{jt} + \beta_w \ln \frac{w_{ijt}}{w_{-ijt}} + \alpha_j + \alpha_t$$

- γ_{ℓ} measures differential MNE responses to offshoring

- Wage ratio w_{ijt}/w_{-ijst} omitted as in Slaughter (2000) and Head and Ries (2002) baseline

- Non-routine and interactive tasks (i); routine and non-interactive ($-i$)
  Upper-secondary schooling (i); less schooling ($-i$)

First Stage: Revenues, Jobs and Exports, Imports

Dep. Variable:	log rev. (4.1)	log rev. (5.1)	log jobs (5.2)	interac. (5.3)	log rev. (6.1)	log jobs (6.2)	interac. (6.3)
export dum$_{t-1}$	0.116***	0.219***	2.428***	0.129***	0.212***	2.373***	0.126***
$\times$ log exports$_{CHN}$	(0.007)	(0.020)	(0.243)	(0.015)	(0.018)	(0.239)	(0.015)
log imports$_{CHN}$	-0.017				-0.193***	-1.201***	-0.069***
	(0.010)				(0.007)	(0.088)	(0.006)
export dum$_{t-1}$		-0.201***	-2.007***	-0.104***	-0.191***	-1.935***	-0.101***
$\times$ log exports$_{EE}$		(0.021)	(0.259)	(0.016)	(0.019)	(0.253)	(0.016)
mill. rev. dis.$_{t-1}$		0.001***	0.007***	0.0004***	0.001***	0.007***	0.0004***
$\times$log imports$_{EE}$		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
F-stat.	160.5	6,290.4	1,416.8	1,074.1	4674.5	1044.3	800.5
Obs.	64,616	64,563	64,563	64.563	64,563	64,563	64,563

Source: LIAB 1996-2014 and BIBB-BAuA 1992-2012. Plants with more than 2 full-time workers.
Note: Regressions include time, region, and sector fixed effects. IV estimation based on GMM. Standard errors in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Revenues and the Within-plant Overall Wage Dispersion

	Dependent variable: log CV Daily wage					
	(1) OLS	(2) OLS	(3) OLS	(4) IV	(5) IV	(6) IV
log Revenues	0.086***	0.056***	0.067***	0.127***	0.038	0.026
	(0.005)	(0.013)	(0.021)	(0.027)	(0.067)	(0.067)
log Nr. of jobs		-0.827***	1.425***		0.118	0.221
		(0.083)	(0.208)		(2.111)	(2.148)
log Revenues		-0.040***	-0.075**		0.003	-0.001
$\times$ log Nr. of jobs		(0.006)	(0.014)		(0.121)	(0.123)
Plant FE			yes			
Hansen J (p-val.)	.	.	.	0.172	.	0.196
Adj. R^2	0.156	0.195	0.688			
Obs.	126,483	126,483	126,483	64,614	64,775	64,561

Source: LIAB 1996-2014 and BIBB-BAuA 1992-2012. Plants with more than 2 full-time workers.
Note: Regressions include time, region, and sector fixed effects. IV estimation based on GMM. Standard errors in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.