

LOCAL IMPACTS OF GLOBAL MARKETS

Tasks, Occupations, and Wage Inequality in an Open Economy

Sascha Becker	Hartmut Egger	Michael Koch
<i>U Warwick</i>	<i>U Bayreuth</i>	<i>U Bayreuth</i>
Marc Muendler		
<i>UC San Diego/U St Gallen</i>		

ASSA Atlanta: January 6, 2019

Division of Labor, Plant Size and Prosperity

“[M]aking a pin is . . . **divided** into about **eighteen distinct operations**. . . . [T]en persons . . . could make among them upwards of forty-eight thousand pins in a day. But if they had all wrought separately and independently . . . they certainly could not each of them have made twenty, perhaps not one pin in a day.”

“It is the great multiplication of the productions of all the different arts, in consequence of the **division of labour**, which **occasions**, in a well-governed society, that universal **opulence which extends itself to the lowest ranks** of the people.”

Adam Smith, *The Wealth Of Nations*, Book I, Chapter I

Tasks, Wage Inequality, and Trade

- Nexus between globalization and wage inequality
within sectors and occupations
- Wage dispersion between plants, *and within plants*
- In worker cross section: commanding component of wage variation
within employers (and occupations)
- **This paper:** Optimal internal labor market organization
in response to globalization

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); Krugman (Chaney & Ossa 2012).
- **Tasks and worker performance.** Ability-job match quality reduces training costs (Barron, Black, Loewenstein 89) and raises efficiency (Meyer 94; Burgess et al. 10)
- **Human resource practices.** Management quality (Bloom, van Reenen 11) or hierarchies (Caliendo, Monte, Rossi-Hansberg 12) and effort incentives (Cunat, Guadalupe 09)
- **Between-firm matching.** Trade-induced changes in match quality (Amiti, Pissaridis 05; Davidson, Heyman, Matusz, Sjöholm, Zhu 14)
- **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)

Plant-Worker Data 1996-2014: Residual Wage Inequality

Contribution of component (%)		Subsamples			
		high w	age ≥ 45	manager	skilled
within industry*	88	97	88	88	88
within occupation	84	87	82	92	86
within plant	71	88	68	77	79
within plant-layer	65	71	60	73	72
within plant-layer-occupation	54	60	46	63	61
<i>within plant-occupation</i>	54	60	46	63	61

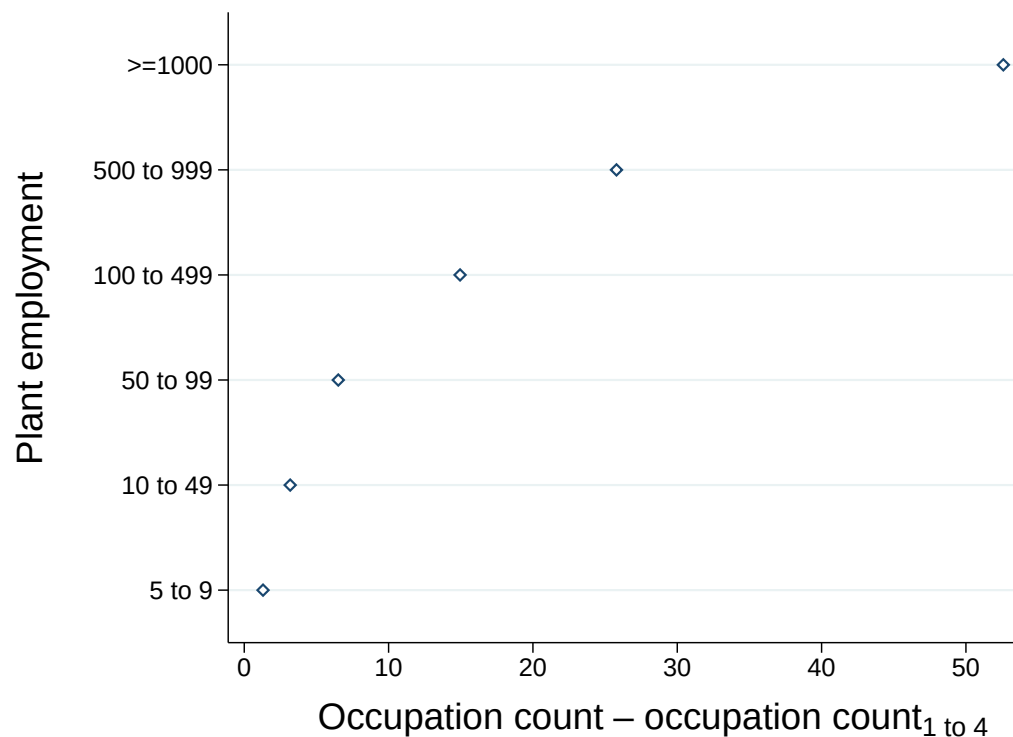
Source: LIAB 1996-2014. Residual log wage from standard Mincer regression. Residual log daily wage from a standard Mincer regression—including demographic, education and tenure information together with time, industry and region fixed effects ($R^2 = 53\%$). (* Mincer regression excludes industry effects, $R^2 = 0.42$.) Occupations: 3-digit KldB-88. Subsample (1): workers with above-median daily wage; (2): workers 45 years old and older; (3): supervisors and managers; (4): high-skilled workers (Abitur or equivalent).

Three Facts and a Hypothesis

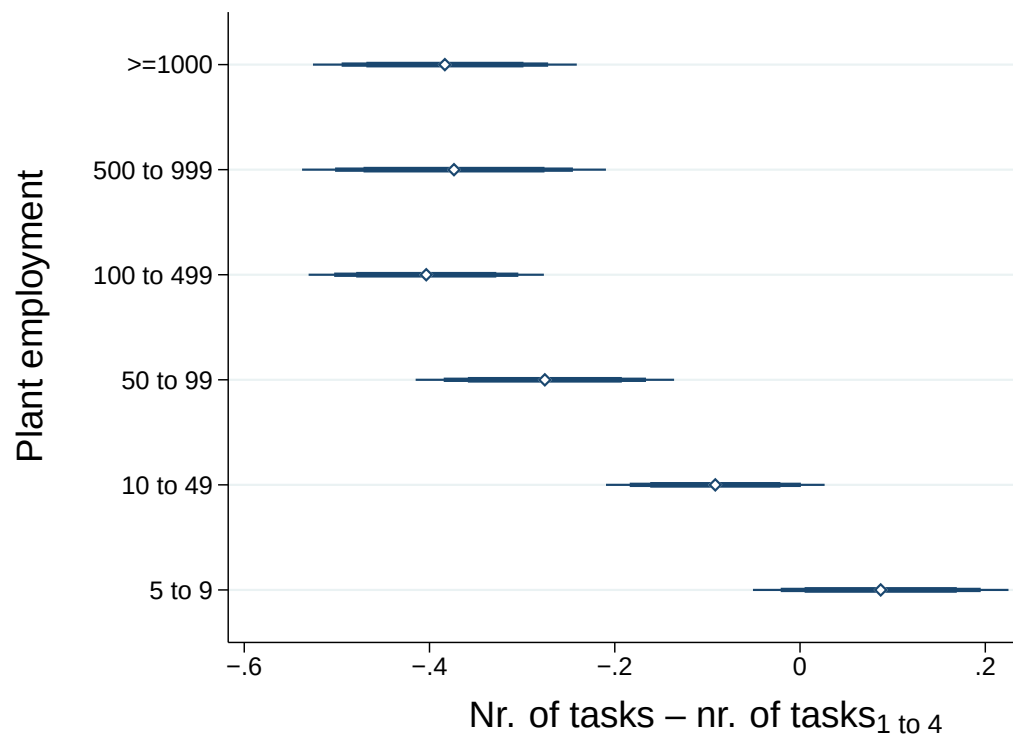
1. Larger plants and exporters adopt more occupations.
 2. Workers at larger plants perform *fewer* tasks *within* occupations.
 3. Wages are more dispersed in plant-occupations with fewer tasks.
- Hypothesis: Workers at larger plants are more specialized in fewer tasks. Their abilities are better matched to these tasks, and their wages more dispersed given their higher surplus variation.

Task Imputation to Plant-Worker Data

- Combine BIBB-BAuA task information with LIAB plant-worker data
- Preserve within-occupation and time variation
- In BIBB-BAuA data, regress indicator for task on worker, occupation and plant attributes also observed in LIAB
- Impute with out-of-sample prediction into LIAB data at worker level
Also: Reverse imputation into BIBB-BAuA data for robustness

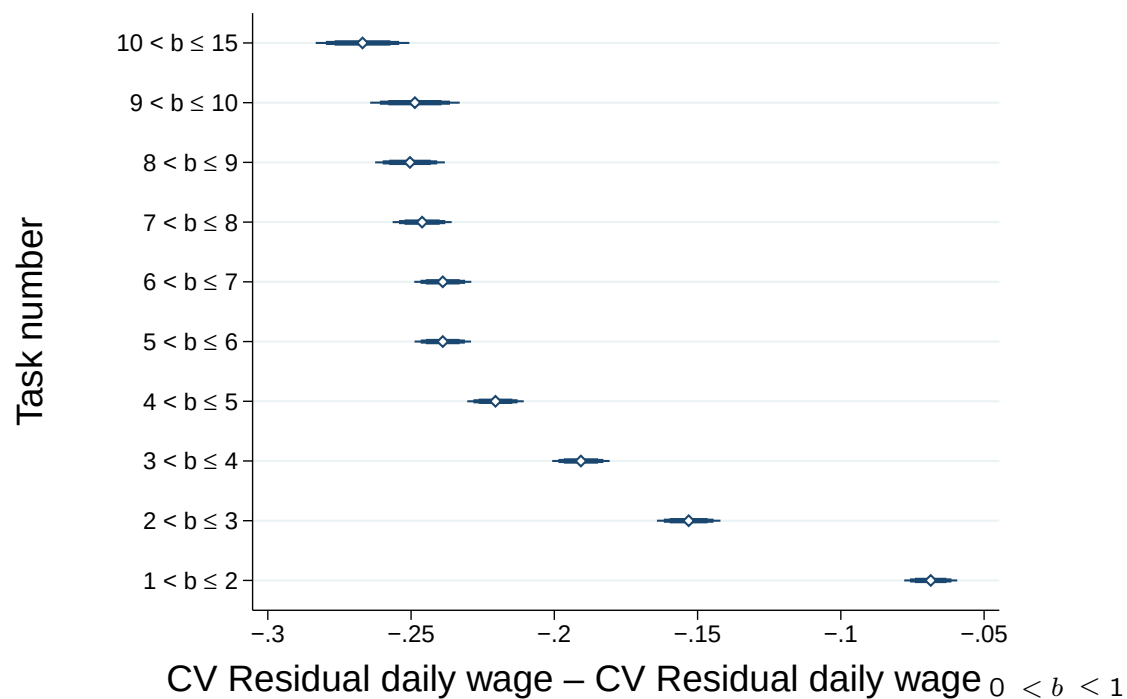
Fact 1: Number of Occupations by Plant Employment

Source: LIAB 1996-2012. Prediction of occupation count n by plant employment category, controlling for sector, 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.

Fact 2: Number of Tasks per Occupation by Plant Employment

Source: BIBB-BAuA 1999, 2006 and 2012. Prediction of number of tasks b within plant-occupation by plant employment category, controlling for sector, 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.

Fact 3: Within-occupation Wage Inequality by Number of Tasks



Source: LIAB 1996-2014, with imputed task information per plant-occupation from BIBB-BAuA 1999, 2006 and 2012. Prediction of coefficient of variation of daily wage residual (exponentiated Mincer residual) CV within plant-occupation by task number, controlling for sector, region, occupation and worker characteristics. Results are differences to smallest task-number category (0 to 1 tasks). Thick, medium, and thin lines represent the 99, 95, and 90 percent confidence intervals.

Model

- Tasks and workers around segment of unit circle
- Employer splits task range into occupations
- More occupations mean narrower task range per occupation, so workers more specialized in fewer tasks
- Workers have core ability, most efficient at specific task in full range
Workers monotonically less efficient at tasks away from core ability

Tasks in Production

- Production: Workers perform tasks in occupations
- Plant ω has elemental productivity $\tilde{\varphi}$ and chooses:
 - count of occupations $n(\omega) + 1$, with $[n(\omega) + 1] = 1, 2, \dots$,
implying occupation-invariant range of tasks $b(\omega)$ per occupation,
 - wage schedule $w(i, b)$ for worker with *core ability* i ,
 - employment $\ell_j(\omega)$ per occupation j .

Task Assignment to Occupations

- Plants must select tasks from (different) subinterval with length $\tilde{z} < 1$
- Plants bundle adjacent tasks into occupations: range $b < \tilde{z}$
- If division of task space mutually exclusive: $b = \frac{\tilde{z}}{n + 1}$
- If tasks overlap between occupations: $b = \frac{\tilde{z}}{\nu n + 1}$ with $\nu \in (0, 1]$
(In limit $\nu = 0$, each occupation exhausts whole task range, regardless of n .)

Ability-Occupation Mismatch and Worker Efficiency

- Worker allocates same amount of time to tasks in occupation.
Worker efficiency falls linearly in distance to core ability i .
Mistakes worse in narrower task ranges, magnifying mismatch

- Mismatch: $m(i, b) = \frac{1}{b} \left\{ \int_0^i (i - t) dt + \int_i^b (t - i) dt \right\} = \frac{b^2 + 2i(i - b)}{2b}$

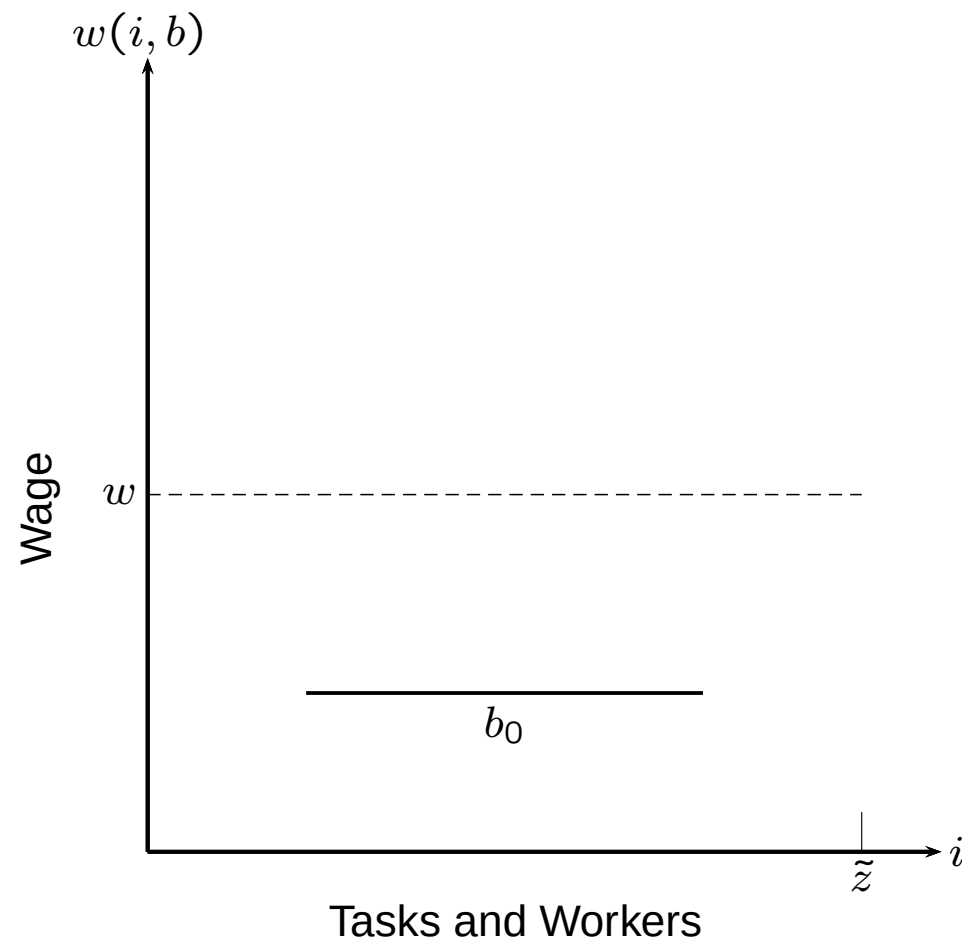
- Worker efficiency:

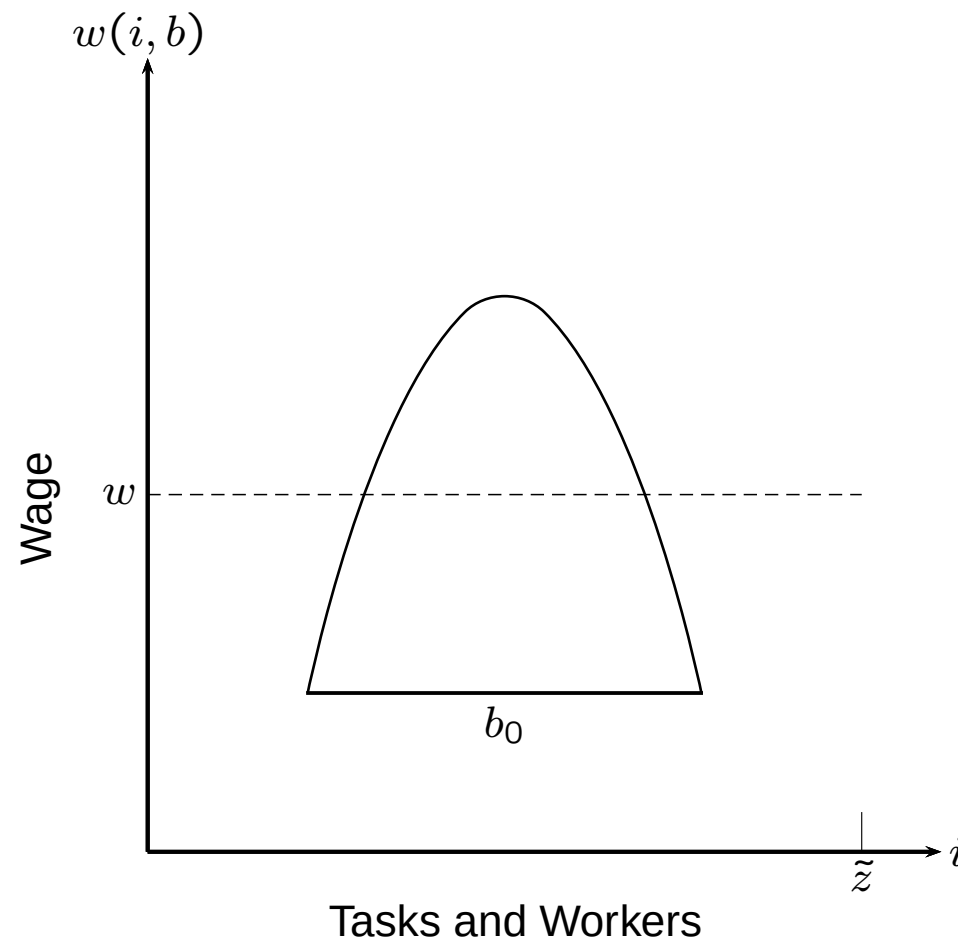
$$\lambda(i, b) \equiv \frac{\tilde{\eta}}{\tilde{z}} + \frac{1}{m(i, b)} = \frac{\tilde{\eta}}{\tilde{z}} + \frac{2b}{b^2 + 2i(i - b)}$$

with **coefficient of performance** $\tilde{\eta} > -2\tilde{z}$.

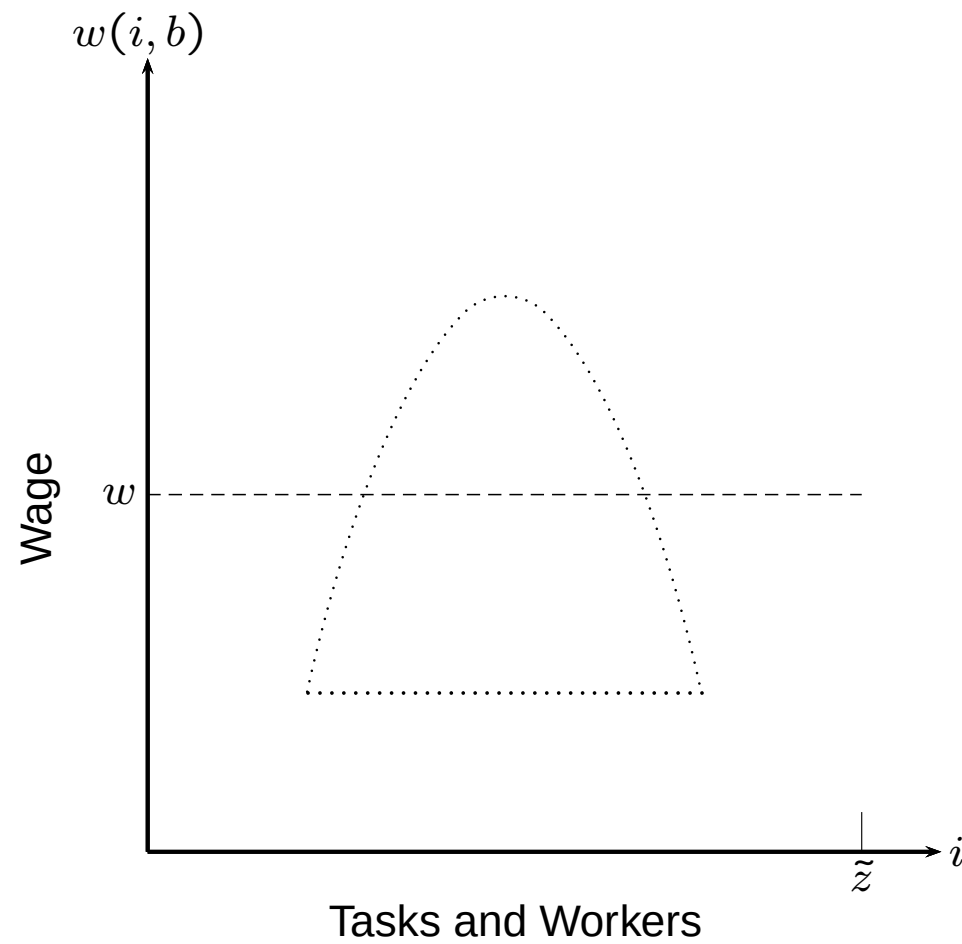
Summary of Remaining Model

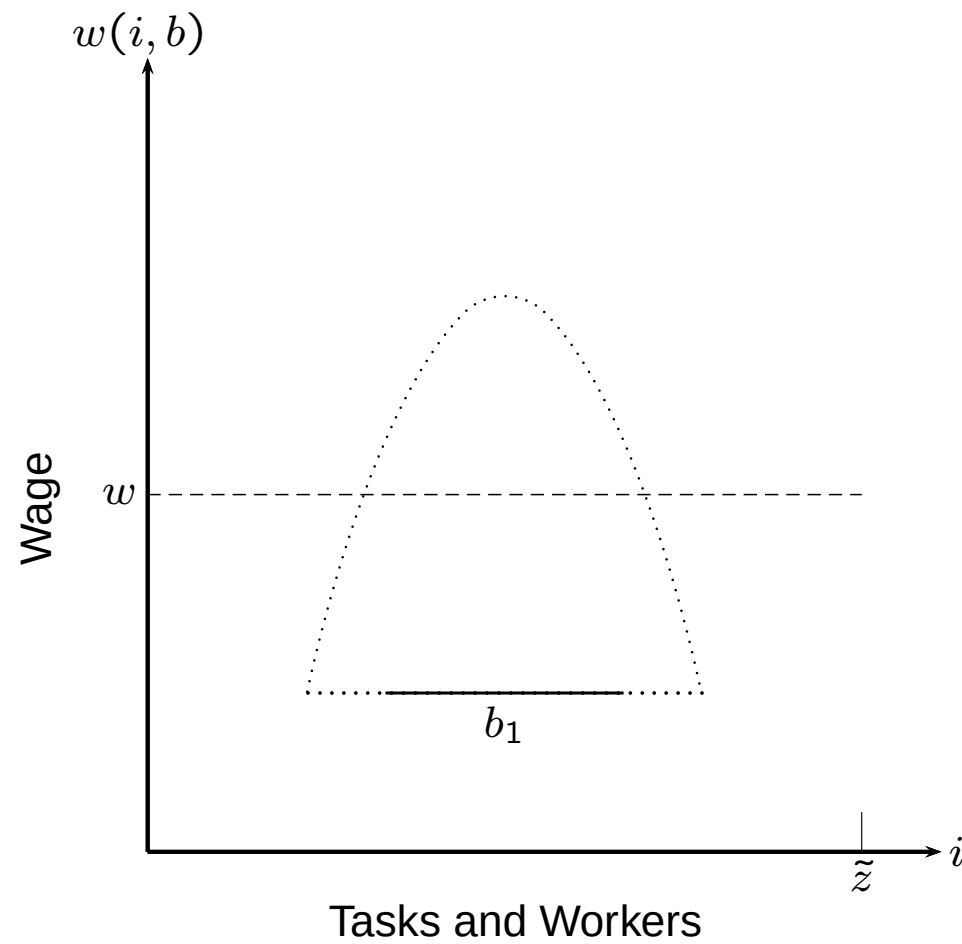
- Cobb-Douglas production: combine occupation outputs into product
- Plants can raise output by creating additional occupations.
Match quality raises occupation-level efficiency in addition
- Stole-Zwiebel wage bargaining over surplus: $w(i, b)/w = \lambda(i, b)/\lambda$
- Span-of-control fixed cost dampen occupation creation in Melitz model
- Larger plants more unequal. Trade raises inequality globally

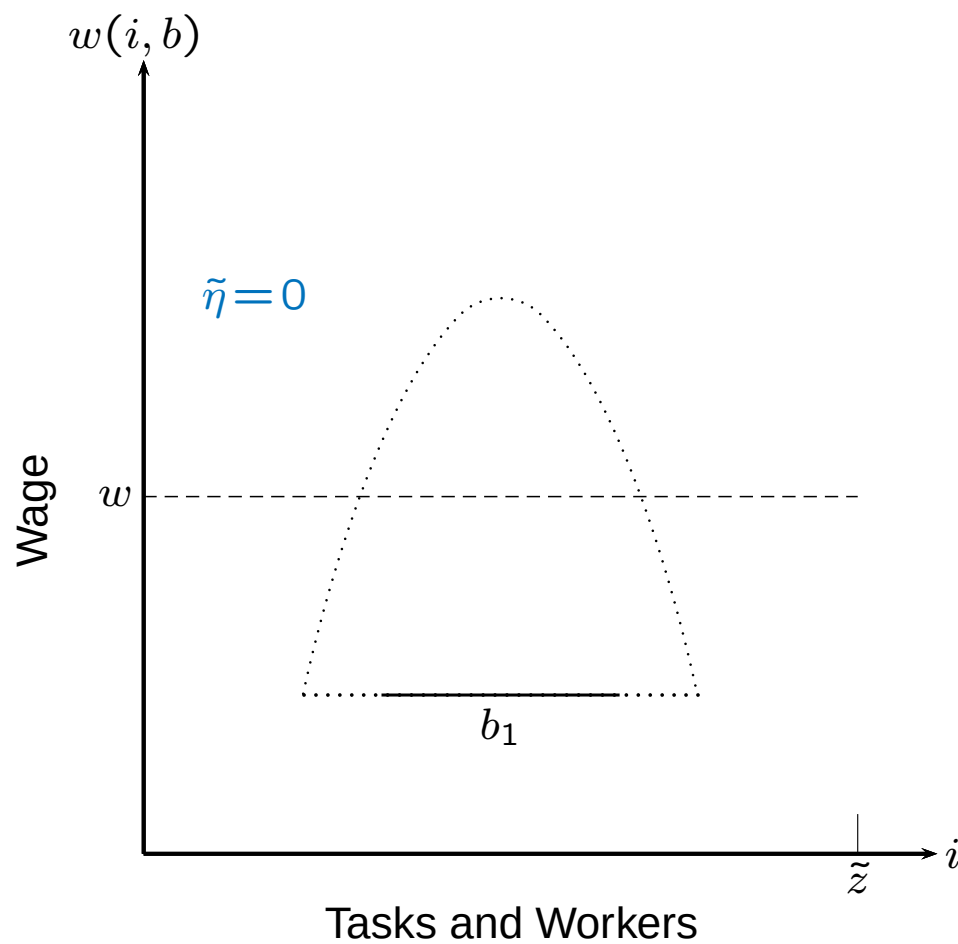
Within-occupation Wage Schedule by Plant Type

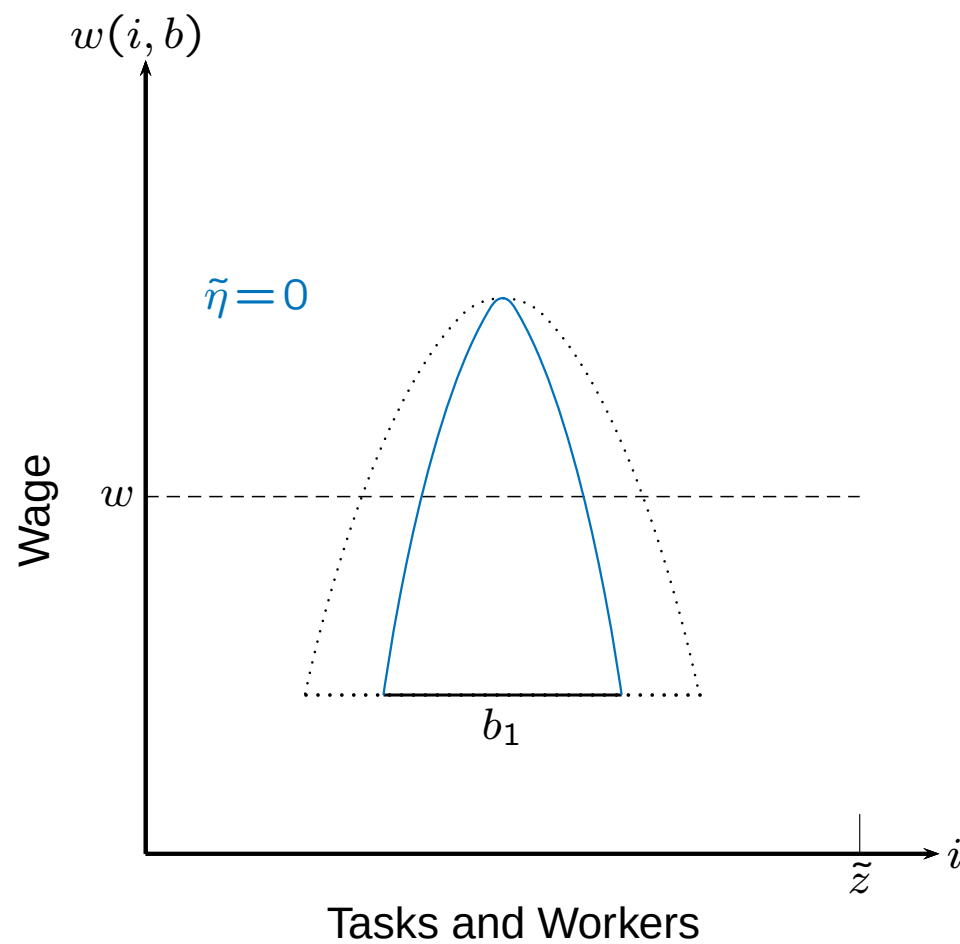
Within-occupation Wage Schedule by Plant Type

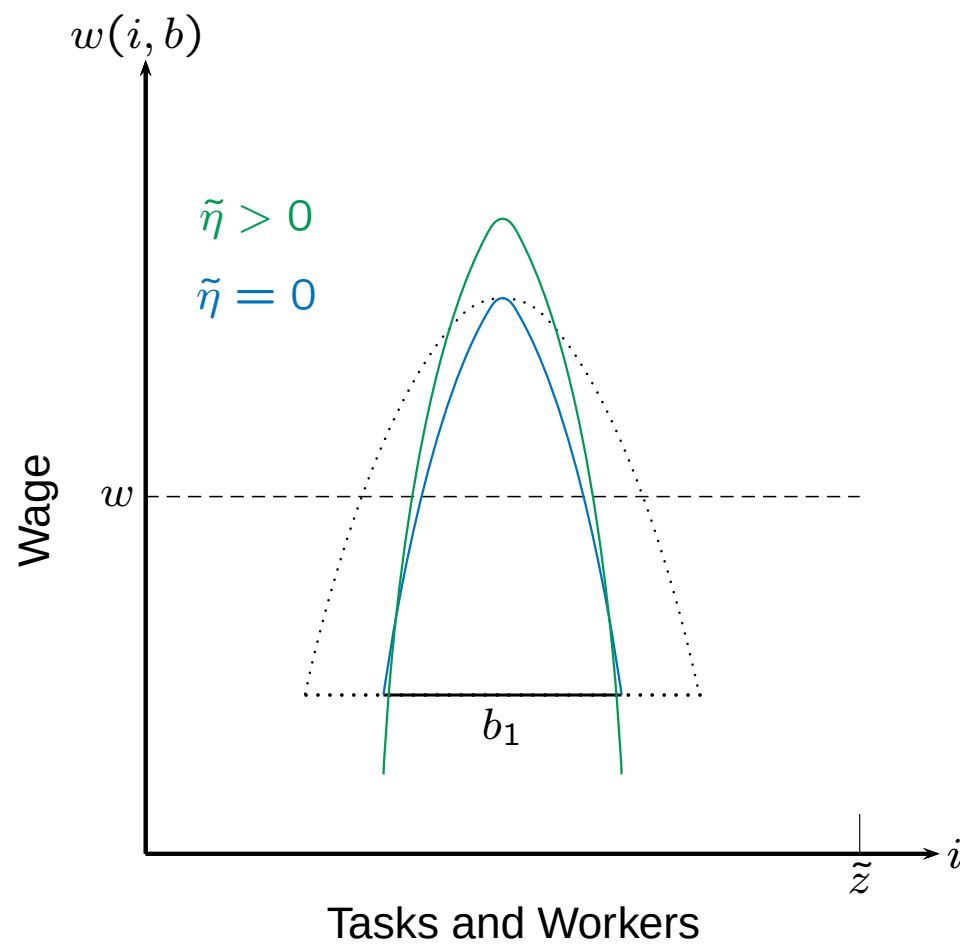
Within-occupation Wage Schedule by Plant Type

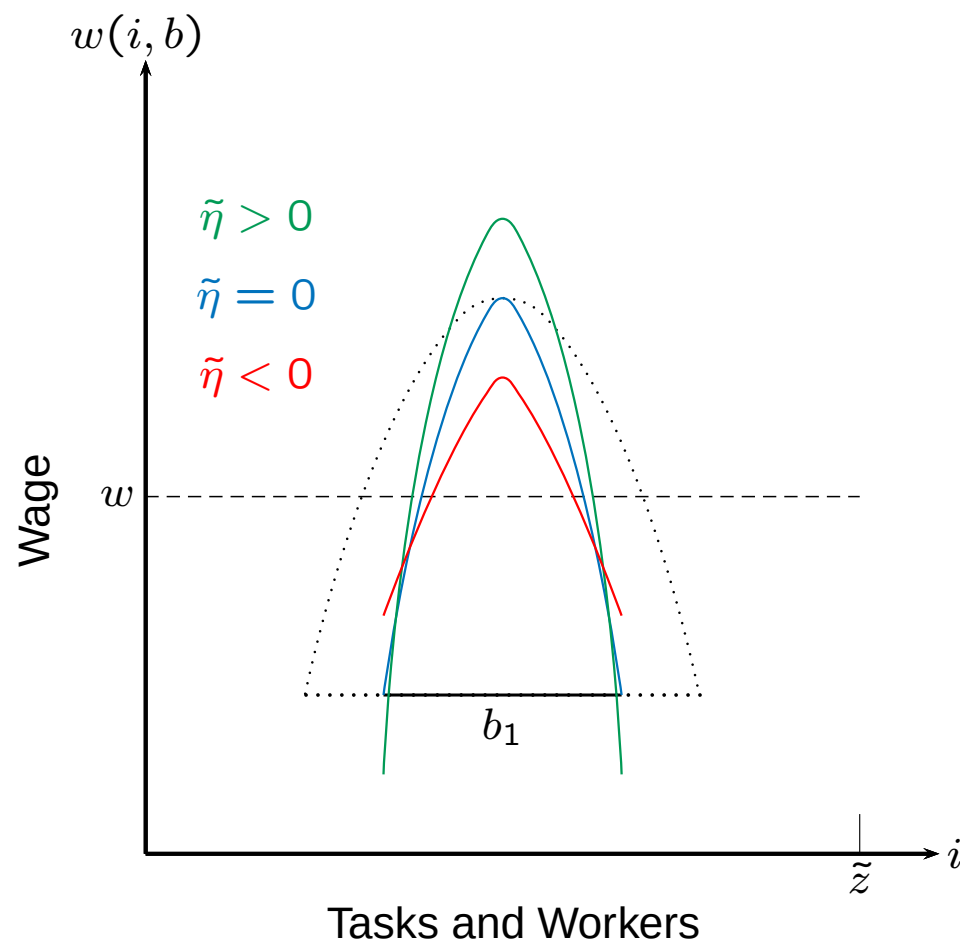


Within-occupation Wage Schedule by Plant Type

Within-occupation Wage Schedule by Plant Type

Within-occupation Wage Schedule by Plant Type

Within-occupation Wage Schedule by Plant Type

Within-occupation Wage Schedule by Plant Type

Towards Estimation and Quantification

- Plant-level Maximum Likelihood

$$\ln r(\omega) = \alpha_0 + \alpha_1 \mathbf{1}_x(\omega) + \xi \ln \tilde{\varphi}$$

$$\ln CV(\omega) + \ln b(\omega)/z(\omega) = \beta_0 - (1/\gamma) \ln r(\omega) + \ln \tilde{\zeta}$$

$$\mathbf{1}_x(\omega) = 1 \Leftrightarrow \gamma_0 + \xi \ln \tilde{\varphi} \geq \ln \tilde{f}_x(\omega)/f_0$$

$$\ln r(\omega) = . \Leftrightarrow \xi \ln \tilde{\varphi} < a$$

- Variables: $r(\omega), \mathbf{1}_x(\omega), CV(\omega), b(\omega)/z(\omega)$

Stochastic terms: $\tilde{\varphi}^\xi, \tilde{\zeta}, \tilde{f}_x; \tilde{\eta}$

Parameters: $a; \gamma; \alpha_0, \beta_0, \alpha_1, \gamma_0, f_0$ (functions of fundamentals)

Evidence to Date

- Number of tasks in occupation *negatively* related to plant revenues
(IV: trade predicted revenues)
- Within-occupation wage inequality *positively* related to plant revenues
(IV: trade predicted revenues)
- **Financial Losses from Small Mistakes**
Performance Coefficient (sensitivity of surplus to mismatch) $e\tilde{t}a$
positively related to reported losses from small mistakes

Performance Coefficient and Financial Losses from Small Mistakes

Dependent variable: $\tilde{\eta}$	for Wages		for Residual wages	
	(1)	(2)	(3)	(4)
Financial losses from small mistakes				
seldom	.304 (.031)***	.456 (.029)***	.401 (.027)***	.536 (.026)***
occasionally	.347 (.033)***	.577 (.031)***	.495 (.030)***	.704 (.028)***
frequently	.725 (.031)***	.997 (.029)***	.833 (.028)***	1.084 (.026)***
Plant size FE		yes		yes
Adj. R^2	.0005	.006	.001	.010
Observations	43,029	41,389	46,406	44,733

Source: LIAB 1996-2014 and BIBB-BAuA 1999, 2006 and 2012. Plants with more than 2 full-time workers.

Note: Performance coefficient: $\tilde{\eta}(\omega) = \left[\sqrt{4 - \pi(\pi - 2)/CV(\omega)} - \pi \right] \cdot z(\omega)/b(\omega)$.

Financial losses from small mistakes in four categories as reported in BIBB-BAuA, omitted category: never or almost never. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Concluding Remarks

- Task ranges within occupations markedly negatively associated with plant size and occupation counts per plant
- Firm-level model of endogenous division of labor with worker sorting to occupations by ability yields related predictions
- Reduced-form estimation of collection of structural relationships offers promise for quantification
- Globalization may be associated with increasing within-plant wage dispersion in all economies

BACKUP

Task Data

- German Qualifications and Career survey 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 (≥ 20 hours work)
- Previously explored in Becker & Muendler (2015)

Frequency of “What” Tasks (*Operations*) at the Workplace

“What” Task (Activity)	All Layers	Managers
Manufacture, Produce Goods	.19	.15
Repair, Maintain	.36	.31
Entertain, Accommodate, Prepare Foods	.28	.30
Transport, Store, Dispatch	.45	.34
Measure, Inspect, Control Quality	.60	.63
Gather Information, Develop, Research, Construct	.75	.92
Purchase, Procure, Sell	.47	.50
Program a Computer	.10	.18
Apply Legal Knowledge	.52	.69
Consult and Inform	.84	.95
Train, Teach, Instruct, Educate	.51	.70
Nurse, Look After, Cure	.27	.35
Advertise, Promote, Conduct Marketing and PR	.40	.55
Organize, Plan, Prepare (others’ work)	.65	.80
Oversee, Control Machinery and Techn. Processes	.35	.28
<i>Total Number of Tasks (Sum)</i>	6.66	7.58

Source: BIBB-BAuA 1999, 2006 and 2012. Frequencies at the worker level (inverse sampling weights).

Shares of Simultaneous “What” Tasks at the Workplace

	1999	2006	2012
	(1)	(2)	(3)
0	.034	.008	.008
1	.063	.016	.014
2	.087	.028	.028
3	.114	.049	.046
4	.121	.072	.071
5	.127	.101	.099
6	.119	.123	.121
7	.110	.135	.134
8	.085	.125	.130
9	.062	.114	.116
10	.038	.092	.092
11	.025	.068	.068
12 or more	.015	.070	.073
<i>Average</i>	5.250	7.261	7.316
<i>Observations</i>	27,634	16,964	16,718

Source: BIBB-BAuA 1999, 2006 and 2012.

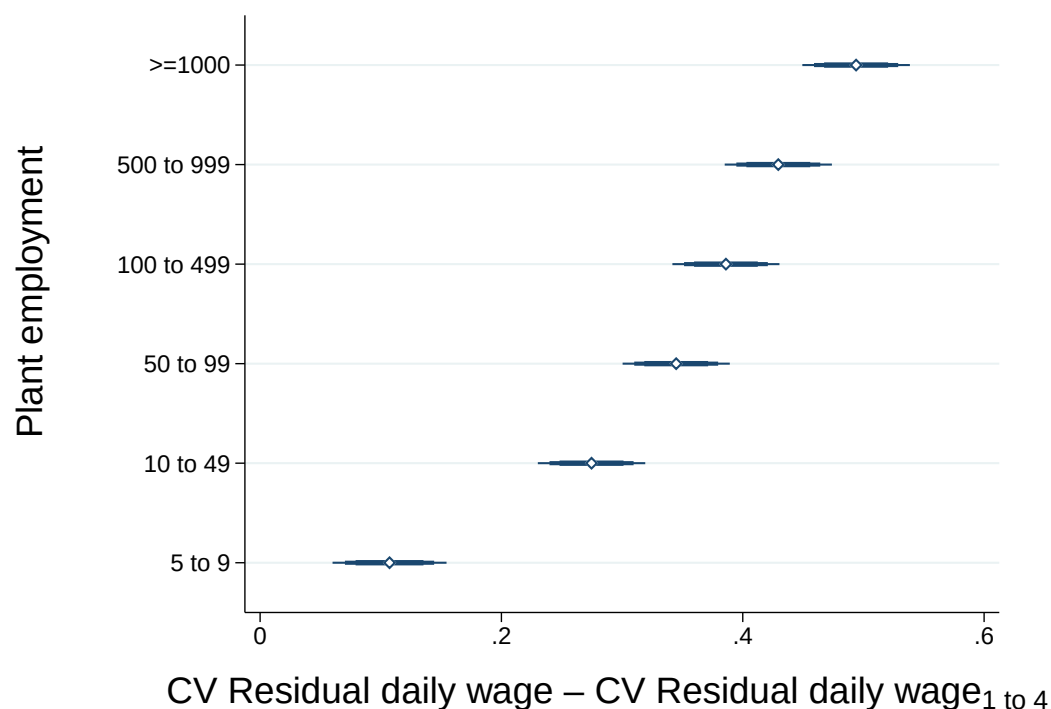
Shares of Simultaneous “What” Tasks at the Workplace

	1999	2006	2012
	(1)	(2)	(3)
0	.034	.008	.008
1	.063	.016	.014
2	.087	.028	.028
3	.114	.049	.046
4	.121	.072	.071
5	.127	.101	.099
6	.119	.123	.121
7	.110	.135	.134
8	.085	.125	.130
9	.062	.114	.116
10	.038	.092	.092
11	.025	.068	.068
12 or more	.015	.070	.073
<i>Average</i>	5.250	7.261	7.316
<i>Observations</i>	27,634	16,964	16,718

Source: BIBB-BAuA 1999, 2006 and 2012.

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

Alternative Fact 3: Within-occ. Wage Inequality by Plant Employment

Source: LIAB 1996-2014. Prediction of (log) coefficient of variation of daily wage residual (exponentiated Mincer residual) CV within plant-occupation by plant employment category, controlling for sector, 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.

Consumers

- L identical risk-neutral individuals (heterogeneous budget sets)
- CES preferences over continuum of differentiated goods $\omega \in \Omega$

- Economy-wide demand for variety ω : $x(\omega) = \left(\frac{p(\omega)}{P} \right)^{-\sigma} \frac{Y}{P}$,
where $P \equiv \left[\int_{\omega \in \Omega} p(\omega)^{1-\sigma} d\omega \right]^{1/(1-\sigma)}$ is the CES price index

- Each variety produced by unique monopolistically competitive plant, labor is only input

Production and Occupations

- Cobb-Douglas combination of individual occupation outputs $q_j(\omega)$:

$$q(\omega) = \tilde{\varphi} \tilde{z} [n(\omega) + 1] \exp \left\{ \frac{1}{n(\omega) + 1} \sum_{j=1}^{n(\omega)+1} \ln q_j(\omega) \right\}$$

with parameter $\tilde{z} < 1$ standardizing production quantity

- Plants can raise output by creating additional occupations
(Plants may also outsource: $\tilde{z} = z(\omega) \cdot \tilde{\zeta}$)
- Distinct possible tasks located around unit circle
Worker core abilities differentiated, also around unit circle

Employment and Occupation-level Worker Efficiency

- Plant employs $\ell_j(i, b)$ workers with ability i in occupation j

Workers per occupation $\ell_j(b) \equiv \int_0^b \ell_j(i, b) \, di$ (plant with task range b).

- Occupation-level efficiency (preview): $\lambda_j(b) = \frac{1}{\ell_j(b)} \int_0^b \lambda(i, b) \ell_j(i, b) \, di$.

- Occupation-level output: $q_j = \lambda_j(b) \ell_j(b)$.

(If $\ell_j(i, b)$ same for all workers i in occupation j , then q_j same for all j .)

Occupation-level and Plant-level Efficiency

- Occupation-level efficiency in j : $\lambda_j(b) = \frac{1}{\ell_j(b)} \int_0^b \lambda(i, b) \ell_j(i, b) di$

- Differentiate with respect to the task range b per occupation

$$\lambda'_j(b) = \frac{\ell_j(b, b)}{\ell_j(b)} [\lambda(b, b) - \lambda_j(b)] < 0.$$

- Smith's *Division of Labor*:
Average worker efficiency higher in specialized occupations
- Plant-level efficiency: $\lambda(\omega) = [\tilde{\eta} + \pi(\nu n(\omega) + 1)] / \tilde{z}$

Economics after Physics: Plant-level Trade-Offs

- Workers assortatively match to occupations that include core ability
- At plant with narrower task range, less ability-occupation mismatch
At plant with narrower task range, average worker more efficient
- Finite occupation counts at plants because
fixed cost of operation increases with count of occupations
- Coordinating more occupations raises span-of-control cost
- Melitz (2003): Productive plants (exporters) offer more occupations

The Plant's Problem

- Stage four. Stole-Zwiebel bargaining over individual wages.
- Stage three. Plant employment $\ell(\omega)$, same in all occupations.
Price: $p(\omega) = \frac{\sigma}{\sigma-1}c(\omega)$, with $c(\omega) \equiv \frac{w}{\tilde{\varphi}\{\tilde{\eta} + \pi[\nu n(\omega) + 1]\}}$.
- Stage two. Number of occupations $n(\omega)$,
positively related to revenues in optimum.
- Stage one. Participation in draws of $\tilde{\varphi}, \tilde{\zeta}, \tilde{\eta}, \tilde{f}_x$; entry decisions.

Stole-Zwiebel Bargaining and Wage Dispersion

- Employer could pay same wage to all workers within occupation despite mismatches (profit maximizing)
- By filled vacancy, plant and worker bargain under bilateral monopoly
- Plant pays worker-specific wage (ability observed in job interview):

$$w_j(i, b) = w \frac{\lambda(i, b)}{\lambda_j(b)}$$

Employer is indifferent between all workers in a specific occupation.

(Workers uniformly distributed, so indifference implies $\ell_j(i, b)$ same for all i in j .)

Plant-level Relationships and Outcomes

- Plant-level efficiency: $\lambda(\omega) = \frac{1}{\tilde{z}} [\tilde{\eta} + \pi(\nu n(\omega) + 1)]$
- Fixed cost of operation: $f(\omega) = f_0 + [\tilde{\eta} + \pi(\nu n(\omega) + 1)]^\gamma \quad (\gamma > 0)$
- Profits: $\psi(\omega) = r(\omega)/(2\sigma - 1) - f(\omega)$
- Wage dispersion: $var(\omega) = w^2 \frac{[4 - \pi(\pi - 2)](\nu n(\omega) + 1)^2}{[\tilde{\eta} + \pi(\nu n(\omega) + 1)]^2}$.

Open-economy Equilibrium

- Trade opening leads productive plants into exporting, raising welfare
- Variance of wages increases at exporters (if wage dispersion high at productive plants), declines at non-exporters
- Asymmetry implies counteracting effects on economy-wide inequality
- Economy-wide wage inequality higher in the open than in the closed one if and only if coefficient of performance positive
- Globalization may aggravate wage inequality in all open economies

Tests of the Model

Hypothesis 1. Number of tasks per occupation and revenues inversely related.

Hypothesis 2. Within-occupation wage dispersion positively related to plant size iff $\tilde{\eta} \geq 0$.

- Linear predictions
- Instruments for exporting: Foreign market shocks in China, Eastern Europe (Autor, Dorn, Hanson 13; Dauth, Findeisen, Suedekum 14)

Descriptive Statistics in joint BIBB-BAuA/LIAB data 1996-2014

	Obs.	Mean	Median	StDev.	Min.	Max.
log Revenues	144,775	13.45	13.22	1.40	8.54	24.63
log Export revenues	39,771	17.05	16.95	2.16	10.31	29.01
Export indicator	144,775	0.14	0	0.34	0	1
Employment	144,775	15.87	5	96.85	2	55,040
log Daily wage	144,775	3.95	3.99	0.48	0.35	6.37
CV Daily wage	136,702	0.25	0.21	0.19	0.0001	3.67
CV Residual daily wage	136,379	0.24	0.20	0.19	0	2.72
Plant-level occupations	144,775	3.61	2	4.55	1	157
Plant-level tasks per occ. b	144,775	5.18	5.22	1.10	0.01	9.21
Plant-level no. of tasks z	144,775	10.87	11.10	2.76	0.98	15
Normalized no. of tasks b/z	144,775	0.50	0.48	0.12	0.001	1

Source: LIAB 1996-2014 and BIBB-BAuA 1999, 2006 and 2012. Plants with more than 2 full-time workers. Occupations at 3-digit KldB-88 level.

Note: Annual plant observations, inverse probability weights for national representativeness. CV: coefficient of variation of observed daily wage. *CV Residual daily wage:* coefficient of variation of (exponentiated) daily (log) wage residual from Mincer regression, including demographic, education and tenure information as well as time, sector and region fixed effects and plant log revenues.

Towards Quantification

- Elasticity of fixed costs with respect to occupation count significant.
Manageable in size so employers have scope to narrow task range
- Coefficient of performance strictly positive: Positive relation between plant size and within-plant wage dispersion.
Corroborates descriptive relationship, maintaining internal consistency

Tests of the Model

Hypothesis 1. Number of tasks per occupation and revenues inversely related.

Hypothesis 2. Within-occupation wage dispersion positively related to plant size iff $\tilde{\eta} \geq 0$.

- Linear predictions
- Instruments for exporting: Foreign market shocks in China, Eastern Europe (Autor, Dorn, Hanson 13; Dauth, Findeisen, Suedekum 14)

Tests of the Model

Hypothesis 1. $r(\omega) = \frac{\sigma}{\sigma-1} \gamma w \{ \tilde{\eta} + \pi z / b(\omega) \}^\gamma$

Hypothesis 2. $var(\omega) = w^2 \frac{[4 - \pi(\pi - 2)](\nu n(\omega) + 1)^2}{[\tilde{\eta} + \pi(\nu n(\omega) + 1)]^2}.$

- Linear predictions
- Instruments for exporting: Foreign market shocks in China, Eastern Europe (Autor, Dorn, Hanson 13; Dauth, Findeisen, Suedekum 14)

First Stage: Revenues, Jobs and Exports, Imports

Dep. var.	log Rev. (4.1)	log Rev. (5.1)	log Occ. (5.2)	Interac. (5.3)	log Rev. (6.1)	log Occ. (6.2)	Interac. (6.3)
export dum _{<i>t-1</i>}	0.125***	0.224***	0.169***	3.052***	0.223***	.169***	3.044***
× log exports _{<i>CHN</i>}	(0.006)	(0.020)	(0.016)	(0.260)	(0.018)	(0.016)	(0.259)
log imports _{<i>CHN</i>}	-0.015 (0.010)				-0.173*** (0.006)	-0.074*** (0.006)	-1.239*** (0.081)
export dum _{<i>t-1</i>}		-0.201***	-0.141***	-2.575***	-0.203***	-0.140***	-2.553***
× log exports _{<i>EE</i>}		(0.020)	(0.017)	(0.273)	(0.018)	(0.017)	(0.270)
mill. rev. dis. _{<i>t-1</i>}		0.001***	0.0004***	0.007***	0.001***	0.0004***	0.007***
× log imports _{<i>EE</i>}		(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.	71,562	71,781	71,781	71,781	71,562	71,562	71,562

Source: LIAB 1996-2014 and BIBB-BAuA 1999, 2006 and 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 Number of Tasks

	Dependent variable: log Normalized number of tasks b/z					
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	IV	IV	IV
log Revenues	-0.0917*** (0.002)	-0.080*** (0.002)	-0.063*** (0.005)	-0.066*** (0.008)	-0.294*** (0.108)	-0.295*** (0.111)
log Nr. of Occ.		-0.640*** (0.016)	-0.604*** (0.038)		4.476 (2.952)	4.755 (3.104)
log Revenues × log Nr. of Occ.		0.034*** (0.001)	0.031** (0.003)		-0.246 (0.163)	-0.256 (0.172)
Plant FE			yes			
Adj. R^2	0.314	0.442	0.876			
Hansen J (p-val.)				0.477	.	0.784
Obs.	144,775	144,775	144,775	71,562	71,781	71,562

Source: LIAB 1996-2014 and BIBB-BAuA 1999, 2006 and 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-occupation Residual Wage Dispersion

Dependent variable: log CV Residual daily wage						
	(1) OLS	(2) OLS	(3) OLS	(4) IV	(5) IV	(6) IV
log Revenues	0.056*** (0.007)	0.063*** (0.015)	0.081*** (0.031)	0.124*** (0.033)	-0.303 (0.283)	-0.278 (0.267)
log Nr. of Occ.		-0.135* (0.079)	-0.071 (0.218)		3.215 (4.179)	2.808 (3.966)
log Revenues × log Nr. of Occ.		0.007 (0.006)	0.002 (0.015)		-0.148 (0.219)	-0.127 (0.208)
Plant FE			yes			
Adj. R^2	0.115	0.115	0.557			
Hansen J (p-val.)				0.943	.	0.782
Obs.	136,378	136,378	136,678	68,208	68,423	68,208

Source: LIAB 1996-2014 and BIBB-BAuA 1999, 2006 and 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)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	IV	IV	IV
log Revenues	0.082*** (0.007)	0.109*** (0.016)	0.062* (0.034)	0.067* (0.036)	0.087 (0.245)	0.036 244
log Nr. of Occ.		0.046 (0.046)	-.205 (0.227)		0.091 (3.697)	0.887 (3.701)
log Revenues × log Nr. of Occ.		-0.006 (0.006)	-0.009 (0.016)		0.007 (0.195)	-0.049 (0.195)
Plant FE			yes			
Adj. R^2	0.113	0.113	0.686			
Hansen J (p-val.)	n.a.	n.a.	n.a.	0.172	n.a.	0.376
Obs.	136,702	136,702	136,7023	68,420	68,635	68,429

Source: LIAB 1996-2014 and BIBB-BAuA 1999, 2006 and 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: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Tests and Quantification of the Model

Hypothesis A. Average performance coefficient positive on average.

Hypothesis B. Fixed Cost Semi-elasticity strictly positive.

Hypothesis C. Performance coefficient positive if task range sensitive to small mistakes.

- Linear predictions

Performance Coefficient $\bar{\eta}$: $\frac{\sqrt{4-\pi(\pi-2)}}{CV(\omega)} - \pi = \bar{\eta} \cdot b(\omega)/z(\omega)$

Fixed Cost Semi-elasticity γ : $\ln CV(\omega)b(\omega)/z(\omega) = \ln \frac{\sqrt{4-\pi(\pi-2)}}{\gamma^{1/\gamma}} - \frac{1}{\gamma} \ln \ell(\omega)$

Dep. var.	$\sqrt{4-\pi(\pi-2)}/CV - \pi$			$\log CV \cdot b/z$		
	(1)	(2)	(3)	(4)	(5)	(6)
Nm. nr. tasks b/z	65.702*** (16.061)	75.534*** (17.650)	98.519*** (30.119)			
log Employment				-0.039*** (0.005)	-0.012*** (0.005)	0.163*** (0.021)
Sector, Region FE		yes	yes		yes	yes
Plant FE			yes			yes
Adj. R^2	0.003	0.005	0.045	0.004	0.127	0.569
Obs.	136,378	136,378	136,378	136,378	136,378	136,378

Source: LIAB 1996-2014 and BIBB-BAuA 1999, 2006 and 2012. Plants with more than 2 full-time workers.

Note: CV is coefficient of variation of Residual daily wage. Regressions include time, region, and sector fixed effects. IV estimation based on GMM. Standard errors in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.