

SKILL-BIASED TECHNOLOGICAL CHANGE, INTERNATIONAL
TRADE AND THE WAGE STRUCTURE

**New evidence on the determinants of the employment structure
from linked employer-employee panel data for Germany**

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Variables

C	factor costs
K	capital
IT	modern technologies
EXP	exports
LH	labour hoarding
Y	output
w_i	wage of group i

Where i denotes

unskilled	(u)
medium skilled	(m)
highly skilled	(h)

$$C = C(w_1, w_2, w_3, Y, K, IT, EXP, LH).$$

$$C = Y \sum_i \sum_j a_{ij} \sqrt{w_i w_j} + Y^2 \sum_i b_i w_i + \sum_i \sum_k g_{ik} Z_k w_i + u_i \quad i, j=1, \dots, 3, \quad k=1, \dots, 4;$$

$$N_i = Y a_{ii} + Y \sum_{i \neq j} a_{ij} \sqrt{\frac{w_j}{w_i}} + b_i Y^2 + \sum_k g_{ik} Z_k \quad i, j=1, \dots, 3, \quad k=1, \dots, 4.$$

$$h_{N_i, w_i} = \frac{-.5Y \sum_{j \neq i} a_{ij} w_j^5}{N_i w_i^5}.$$

$$h_{N_i, w_j} = \frac{.5Y a_{ij} w_j^5}{N_i w_i^5}.$$

$$h_{N_i, Y} = \frac{Y(a_{ii} + \sum_{j \neq i} a_{ij} w_j^5 w_i^{-5} + 2Y b_i)}{N_i}.$$

$$h_{N_i, Z_k} = \frac{g_{ik} Z_k}{N_i}.$$

$$\frac{\partial(N_i/N_\bullet)}{\partial x} = \left(\frac{\partial N_i}{\partial x} N_\bullet - \sum_j \frac{\partial N_j}{\partial x} N_i \right) \frac{1}{(N_\bullet)^2} = \frac{\partial N_i}{\partial x} \frac{1}{N_\bullet} - \sum_j \frac{\partial N_j}{\partial x} \frac{N_i}{(N_\bullet)^2} \quad i, j=1, \dots, 3;$$

Estimation

$$N_i = Y a_{ii} + Y \sum_{i \neq j} a_{ij} \sqrt{\frac{w_j}{w_i}} + b_i Y^2 + \sum_k g_{ik} Z_k \quad i, j = 1, \dots, 3, \quad k = 1, \dots, 4.$$

$$\frac{N_{ipt}}{Y_{pt}} = a_{ii} + \sum_{i \neq j} a_{ij} \sqrt{\frac{w_{jpt}}{w_{ipt}}} + b_i Y_{pt} + \sum_k g_{ik} \frac{Z_{kpt}}{Y_{pt}} + e_{ipt} \quad i, j = 1, \dots, 3; \quad k = 1, \dots, 4;$$

$$\begin{aligned} \frac{N_{ipt}}{Y_{pt}} - \frac{1}{T} \sum_t \frac{N_{ipt}}{Y_{pt}} &= \sum_{i \neq j} a_{ij} \left(\sqrt{\frac{w_{jpt}}{w_{ipt}}} - \frac{1}{T} \sum_t \sqrt{\frac{w_{jpt}}{w_{ipt}}} \right) + b_i \left(Y_{pt} - \frac{1}{T} \sum_t Y_{pt} \right) + \\ &\quad \sum_k g_{ik} \left(\frac{Z_{kpt}}{Y_{pt}} - \frac{1}{T} \sum_t \frac{Z_{kpt}}{Y_{pt}} \right) + e_{ipt} - \frac{1}{T} \sum_t e_{ipt} \quad i, j = 1, \dots, 3; \quad k = 1, \dots, 4; \end{aligned}$$

Where i denotes

- unskilled (u)
- medium skilled (m)
- highly skilled (h)

and t = 1994, 1995, 1996, 1997

Table 1: Descriptive statistics of regression sample

Variables	Manufacturing		Services	
	Mean	Std. Dev.	Mean	Std. Dev.
N_u	238	418	143	401
N_m	297	459	208	332
N_h	65	130	32	84
w_u	144	16.5	131	21.4
w_m	180	17.4	165	20.1
w_h	251	32.4	234	33.5
Y (mill. DM)	223	469	193	307
K (mill. DM)	23.9	64.2	27.5	77.4
Export Share	.254	.251	.042	.132
$\frac{\Delta Y^{Expected}}{Y} * 100$	.019	.104	.022	.107
Investment Dummies:				
Π	.679	.467	.703	.457
Production Units	.839	.369	.672	.470
Property, Buildings	.295	.456	.363	.481
Dummy: Technical Level of Machinery Up-to-Date	.211	.408	.243	.429
Number of cases	1955		515	

^a The subscripts u , m and h denote unskilled, medium skilled and highly skilled respectively.

Table 2: Constrained seemingly unrelated regressions for different skill groups, manufacturing

	Unskilled	Medium skilled	Highly Skilled
$Y\sqrt{w_m / w_u}$	1.066*** (2.67)		
$Y\sqrt{w_h / w_u}$	-0.026 (-0.18)		
$Y\sqrt{w_u / w_m}$		1.066*** (2.67)	
$Y\sqrt{w_h / w_m}$		0.260** (2.03)	
$Y\sqrt{w_u / w_h}$			-0.026 (-0.18)
$Y\sqrt{w_m / w_h}$			0.260** (2.03)
Y^2	-0.0006*** (-5.61)	-0.0007** (-2.34)	-0.0002*** (-2.63)
C	0.070 (1.53)	0.526*** (4.51)	0.036 (1.41)

Table 2: Constrained seemingly unrelated regressions for different skill groups, manufacturing

- continued -

Export Share	4.858	15.214*	2.777
	(1.45)	(1.78)	(1.48)
$\frac{\Delta Y^{Expected}}{Y} * 100$	0.003***	0.006***	0.001**
	(2.97)	(2.60)	(2.06)
Investment-Dummies			
IT	-0.200	1.311	0.289
	(-0.61)	(1.56)	(1.58)
Production Units	0.614**	1.605**	0.192
	(2.03)	(2.07)	(1.13)
Property, Buildings	1.947***	3.329**	0.563*
	(3.24)	(2.16)	(1.67)
Dummy: Technical Level of Machinery Up-to-Date	0.415	-0.869	0.014
	(0.94)	(-0.77)	(0.06)
χ^2	83.34***	70.63***	34.91***

Table 3: Constrained seemingly unrelated regressions for different skill groups, services

	Unskilled	Medium skilled	Highly skilled
$Y\sqrt{w_m/w_u}$	3.336*** (2.99)		
$Y\sqrt{w_h/w_u}$	0.178 (0.40)		
$Y\sqrt{w_u/w_m}$		3.336*** (2.99)	
$Y\sqrt{w_h/w_m}$		-0.577* (-1.77)	
$Y\sqrt{w_u/w_h}$			0.178 (0.40)
$Y\sqrt{w_m/w_h}$			-0.577* (-1.77)
Y^2	-0.0006 (-1.12)	-0.001*** (-2.72)	-0.0002 (-1.62)
C	0.122 (0.46)	0.750*** (3.70)	0.150*** (2.85)

Table 3: Constrained seemingly unrelated regressions for different skill groups, services

- continued -

Export Share	17.174 (0.89)	25.817* (1.76)	5.043 (1.32)
$\frac{\Delta Y^{Expected}}{Y} * 100$	0.026*** (6.66)	0.021*** (7.02)	0.002** (2.54)
Investment-Dummies			
IT	-5.889*** (-4.12)	-3.024*** (-2.79)	0.011 (0.04)
Production Units	-1.153 (-0.76)	0.267 (0.23)	0.398 (1.33)
Property, Buildings	1.620 (1.13)	1.015 (0.93)	0.276 (0.97)
Dummy: Technical Level of Machinery Up-to-Date	-3.299** (-2.07)	5.451*** (4.51)	1.581*** (5.03)
χ^2	91.85***	136.08***	58.66***

Table 4: Employment elasticities for different skill groups, manufacturing

	Unskilled	Medium skilled	highly skilled
Elasticities			
Wages:			
Unskilled	-.572**	.378***	-.035
Medium skilled	.588***	-.500***	.397**
Highly Skilled	-.017	.122**	-.362**
Output	1.262***	1.608***	1.091***
Capital	.003	.020***	.006
Export Share	.005	.013*	.011
$\frac{\Delta Y^{Expected}}{Y} * 100$	.00002***	.00004***	.00003**
Semi-Elasticities			
Investment Dummies:			
Π	-.0008	.004	.004
Production Units	.003**	.005**	.003
Property, Buildings	.008***	.011**	.009*
Dummy: Technical Level of Machinery: Up-to-Date	.002	-.003	.0002

* / ** / *** denotes significance on the 10 / 5 / 1 % level.

Table 5: Employment Elasticities for different skill groups, services

	Unskilled	Medium skilled	Highly skilled
Elasticities			
Wages:			
Unskilled	-2.684***	1.383***	.404
Medium skilled	2.524***	-1.064**	-1.467*
Highly Skilled	.160	-.319*	1.063
Output	1.873	1.749*	1.178
Capital	.023	.099***	.129***
Export Share	.005	.005*	.007
$\frac{\Delta Y^{Expected}}{Y} * 100$	.0004***	.0002***	.0001**
Semi-Elasticities			
Investment Dummies:			
IT	-.041***	-.014***	.0003
Production Units	-.008	.001	.012
Property, Buildings	.011	.005	.009
Dummy: Technical Level of Machinery: Up-to-Date	-.023**	.026***	.049***

* / ** / *** denotes significance on the 10 / 5 / 1 % level.

Table 6: Impacts on the the employment share of different skill groups, manufacturing

	Unskilled	Medium skilled	Highly skilled
$\frac{\partial(N_i / \sum N_j)}{\partial X / X}$			
Wages:			
Unskilled	-.210**	.222***	-.012
Medium skilled	.209***	-.262***	.053*
Highly Skilled	.001	.040*	-.041**
Output	-.061	.096	-.035
Capital	-.007***	.008***	-.001***
Export Share	-.0017	.0016*	.0001
$\frac{\Delta Y^{Expected}}{Y} * 100$	-4.0e-06	4.0e-06*	-4.6e-08
$\frac{\partial(N_i / \sum N_j)}{\partial X}$			
Investment Dummies:			
Π	-.0012***	.0010***	.0002***
Production Units	-.00057	.00069*	-.00012*
Property, Buildings	-.0006	.0007	-.0001
Dummy: Technical Level of	.00098	-.0011**	.00010
Machinery: Up-to-Date			

Calculated with parameters reported in Table (1) and at sample means of the respective variables.
 */ **/ *** denotes significance on the 10/ 5/ 1 % level.

Table 7: Impacts on the the employment share of different skill groups, services

	Unskilled	Medium skilled	Highly skilled
$\frac{\partial(N_i / \sum N_j)}{\partial X / X}$			
Wages:			
Unskilled	-.922***	.870***	.052
Medium skilled	.853***	-.710**	-.143**
Highly Skilled	.069	-.160	.091
Output	.047	.0008	-.048
Capital	-.019*	.014	.005
Export Share	-.000088	-.000026	.00014
$\frac{\Delta Y^{Expected}}{Y} * 100$	.00004**	-.00003***	-.00001***
$\frac{\partial(N_i / \sum N_j)}{\partial X}$			
Investment Dummies:			
Π	-.0067***	.0047**	.0020***
Production Units	-.0025	.0014	.0011
Property, Buildings	.0014	-.0015	-.0001
Dummies: Technical Level	-.012***	.012***	.003***
Of Machinery Up-to-Date			

Calculated with parameters reported in Table (2), at sample means of the respective variables.
 */ **/ *** denotes significance on the 10/ 5/ 1 % level.