

Technology Use, Organisational Flexibility and Innovation: Evidence for Germany

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Plan of the Talk

- Motivation
- Data
- Determinants of flexibility
- Flexibility and innovations
- Conclusions

Motivation

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Determinants of Flexibility

Determinants of Innovative Behaviour

Conclusions

- Organisational Flexibility (Atkinson, 1984)
 - Functional flexibility (team work, flat hierarchies, autonomous work groups)
 - Numerical flexibility (outsourcing, temporary work contracts)
 - Interplay between both forms of flexibility (Kalleberg, 2001)
 - Influence of ICT on organisational flexibility (Brynjolfsson and Hitt, 2000; Caroli, 2003)

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Conclusions

- Determinants of flexibility
- Impact of flexibility on innovation (Chadwick and Cappelli, 2002)
- Compare two German data sets
- Goal: flexibility impact on establishment performance based on matching

IAB Data

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IAB Establishment Panel

- representative for German economy
- waves used: 1999-2002
- administered by federal employment office
- oral interview with trained interviewers
- all establishments included with at least one employee subject to social security
- extensive list of questions on production, investment, sector, employee structure, personnel problems, business strategy, and vocational training
- special set of questions on personnel measures in 1999 and 2001
- sample sizes: 11,000 (1999), 18,000 (2002)

ZEW Data

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- CATI, conducted by ZEW
- 2 waves, 2000 and 2002
- about 4500 firms with more than five employees
- representative for all sectors
- large variety of ICT indicators
- extensive list of questions on production, investment, sector, employee structure, HRM measure

Descriptive Statistics

Measure	IAB Establishment Panel	ZEW ICT Panel
No flexibility	59.32	25.71
Numerical flexibility	27.89	6.95
Functional flexibility	5.09	46.84
Both flexibilities	7.71	20.50
Total observations	100 (6371 obs.)	100 (1898 obs.)

Note: Sample averages

Sources: IAB establishment panel, wave 1999, ZEW ICT Panel, wave 2002, own calculations

Estimation Strategy

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- Establishments can choose between functional and numerical flexibility or both
- Values 1999 have impact on introduction of flexibility in 1999-2001
- Multinomial logistic regression with four alternatives
- Compare results of partially complementary data sets
- Focus: role of ICT

Results IAB Establishment Panel

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- ICT has highest impact on all flexibility decisions in comparison to no flexibility
- all flexibility measures positively influenced by export and continuing training
- functional flexibility in addition by apprenticeship training
- numerical flexibility in addition by establishments with works council, negative: modern technical equipment, East Germany
- both flexibility forms in addition by apprenticeship training, works councils

Determinants of Flexibility (IAB data)

Variables	No flexibility measure		Numerical flexibility		Functional flexibility		Both flexibility measures	
	Marginal effects	Z	Marginal effects	Z	Marginal effects	Z	Marginal effects	Z
ICTINVEST	-0.12 ***	-7.23	0.03 **	2.05	0.05 ***	5.36	0.05 ***	6.68
TRAINEES	-0.04 **	-2.50	0.01	0.69	0.02 **	2.51	0.02 **	2.56
EXPORT	-0.12 ***	-4.75	0.06 ***	2.66	0.03 **	2.35	0.03 ***	3.63
EQUIPMENT	0.03	1.53	-0.03 **	-2.07	0.00	0.09	0.01	1.04
ECONSITUATION	-0.03 *	-1.86	0.02	1.03	0.01	1.00	0.01 *	1.89
TRAINING	-0.08 ***	-4.84	0.04 **	2.47	0.03 ***	3.77	0.02 ***	2.98
COUNCIL	-0.16 ***	-7.69	0.15 ***	7.74	-0.01	-1.33	0.02 ***	3.11
COLLECTBARGAIN	-0.42 **	-2.39	0.03 *	1.75	0.01	1.00	0.01	1.04
GROUP	-0.02	-1.06	0.02	1.38	0.00	0.05	-0.00	-0.66
EAST	-0.06 ***	-3.80	0.06 ***	4.39	-0.00	-0.01	-0.00	-0.81

Results ZEW ICT Panel

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- Share of ICT specialists, ICT training, employees with university degree, and apprenticeship training positively correlated with functional flexibility
- works councils negatively correlated with functional flexibility
- vocational training negative and export, works council and group positively correlated with both flexibility forms

Variables	No flexibility measure		Numerical flexibility		Functional flexibility		Both flexibility measures	
	Marginal effects	Z	Marginal effects	Z	Marginal effects	Z	Marginal effects	Z
PCWORK	-0.06	-1.46	0.02	0.62	0.01	0.16	0.04	0.95
INTERNET	-0,07*	-1.86	0.02	0.81	0.01	0.20	0.05	1.25
ICTINVEST	-0.02***	-2.80	-0.01	-1.04	0.00	0.26	0.03**	2.71
NICTINVEST	-0.07	-1.17	-0.01*	-1.89	0.01*	1.81	-0.00	-0.14
UNIV	-0.17**	-2.39	-0.03	-0.85	0.30***	3.72	-0.10*	-1.63
VOC	0.47	1.04	-0.03	-1.26	0.09	1.59	-0.10***	-2.47
TRAINEES	-0.31*	-1.90	0.01	0.06	0.42**	2.39	-0.12	-0.89
ITTRAINING	-0.25***	-3.05	-0.08**	-2.13	0.21***	2.77	0.12**	2.40
ITSPEC	-0.15	-1.53	-0.07	-1.08	0.25**	2.35	-0.03	-0.48
EXPORT	-0.05**	-2.09	0.02	1.21	-0.01	-0.48	0.05**	2.11
AGE3	-0.05	-1.33	0.03	0.94	0.06	1.16	-0.04	-1.37
AGE7	-0.04	-1.09	0.02	0.90	0.10**	2.45	-0.83**	-2.40
GROUP	-0.07***	-3.12	0.00	0.28	-0.00	-0.07	0.07***	3.09
COUNCIL	0.03	1.04	0.00	0.25	-0.008**	-2.56	0.05* 12	1.92
EAST	-0.02	-0.88	0.00	0.09	-0.01	-0.33	0.03	1.23

Interpretations

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- ICT enable both flexibility forms
- Flexibility increases training demand
- Export is a driver of organisational change
- Enterprises that invest in human capital or (non)-ICT equipment are interested in functionally flexible and stable staff
- Works councils are not so happy with functional flexibility alone but support core-periphery solutions

Results

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- Hausman tests support independence of irrelevant alternatives (IIA) assumption
- Wald test and LR test reject possibility to collapse categories
- Results apply to both data sets

Flexibility and Innovations

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- Explain Innovation Behaviour of Establishments
- Discriminate between improvements, incremental innovations and radical innovations
- Explanatory variables: ICT dummy, numerical and functional flexibility
- all other covariates from flexibility equations
- after Chow-test: split samples in ICT and non-ICT establishments

Flexibility and Innovations (IAB data)

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- Numerical and functional flexibility have highly significant impact on all levels of product and service innovations
- ICT only positively correlated with improvement and incremental innovation
- Training, modern technical equipment and export dummy have positive impact on all innovation activities
- Apprenticeship training, conglomerate and old establishment (negative) dummy have only impact on improvement and incremental innovation
- in ICT establishments no correlation between numerical flexibility and radical innovation

Flexibility and Innovations (ZEW data)

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Conclusions

- functional and numerical flexibility have positive impact on innovation
- share of IT specialists and export dummy also
- share of PC at work and share of internet connections as well as ICT investment share and ICT training do not have impact on innovation

Results ZEW data

Variables	Coeff.	Z	Coeff.	Z	Coeff.	Z
	Improvement		Incremental Innovation		Radical Innovation	
NUMERFLEX	0.22***	6.33	0.28***	7.96	0.13***	2.92
FUNCTIONFLEX	0.60***	17.84	0.42***	12.45	0.37***	8.72
ICTINVEST	0.13***	4.27	0.12***	3.83	-0.15	-0.37

Conclusions

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Conclusions

- ICT investment play an important role for both flexibility forms
- Collective bargaining and works councils foster numerical flexibility reaction of firms
- Those firms that invest in human capital for example by apprenticeship training and modern technological equipment prefer functional flexibility

To do

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Conclusions

- Harmonise estimations according to data sets
- Impact of flexibility measures on fixed productivity effects
- Multiple propensity score matching between flexible and less flexible firms/establishments