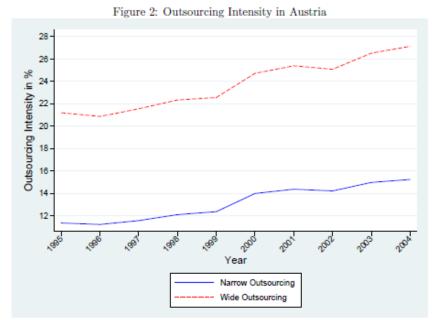# Measuring and Classifying Determinants of Offshoring Jobs

A Methodological Report

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Background:

- Increase in offshoring due to lower costs for transportation, communication, reduction in trade barriers etc.

Figure 2: Outsourcing Intensity in Austria

(cf. Geishecker, 2007)

- Increasing trade in intermediate inputs (cf. discussion on "Basarökonomie" in Germany)

Theory:

- Production processes as a bundle of tasks, with different factor intensities

  - Some tasks are labour intensive and could be performed offshore paying lower wages

- Effects in the country of origin unclear (Grossmann, Rossi-Hansberg, 2008, AER):

  - Positive effects due to increased productivity

  - Negative effects due to different labour market equilibrium

- Numerous empirical studies analyse the effects of decreasing costs of offshoring on labor demand and wages (cf. Antonczyk et al. 2010)

Contribution:

- We analyse the determinants of job offshoreability using German task data
    - Our aim is to generate indicators of offshoring potential
    - These can be used for further analyses

We address the following shortcomings of the literature:

1. We use a large number of determining factors
2. We do not use a subjective measurement of offshoreability
3. We distinguish between outsourcing potential and international tradeability

A (well published) example: Spitz-Oener (2006, JLabE)

Table 1
Assignment of Activities

Classification	Tasks
Nonroutine analytic	Researching, analyzing, evaluating and planning, making plans/constructions, designing, sketching, working out rules/prescriptions, and using and interpreting rules
Nonroutine interactive	Negotiating, lobbying, coordinating, organizing, teaching or training, selling, buying, advising customers, advertising, entertaining or presenting, and employing or managing personnel
Routine cognitive	Calculating, bookkeeping, correcting texts/data, and measuring length/weight/temperature
Routine manual	Operating or controlling machines and equipping machines
Nonroutine manual	Repairing or renovating houses/apartments/machines/vehicles, restoring art/monuments, and serving or accommodating

Quelle: Spitz-Oener (2006)

Most studies have analysed offshoring as a one-dimensional process:

- We differentiate between two dimensions of task offshoring:

  - **Outsourcing Potential**: trading of (intermediate) products on the market instead of production within the own company

  - **International Tradeability / Offshoring Potential**: production of (intermediate) products abroad instead of domestic production

		Outsourcing Potential	
		Low	High
International Tradeability	High	Foreign Direct Investments	Offshoring
	Low		(National) Outsourcing

A number of studies have analysed determinants of offshoring tasks:

- Standardization, e.g. Costinot et al. (2009)
- Interactivity, e.g. Becker et al. (2009)
- Codifiability, e.g. Becker und Muendler (2012)
- Routine, e.g. Autor et al. (2003)
- Geographic restrictions, e.g. Jensen und Kletzer (2010)
- ICT, e.g. Spitz-Oener (2006)
- Complementary tasks, e.g. Goerlich (2010)

Their use has been restricted to selective characteristics and subjective measurement.

Contribution:

- We capture numerous possible factors found in the literature to influence outsourcing potential and international tradeability:

Job Characteristic	International Tradeability	Outsourcing Potential
Codifiability	+	++
Routine	+	++
ICT	+	+
Pressure to Perform	-	
Cultural Linkage	--	
Geographic Restrictions	--	
Interactivity	--	
Complementary Tasks	--	-
New Scopes	-	--

... to be continued …

Our approach allows answering the following questions:

1. Which attributes explain outsourcing potential and international tradeability of jobs?

2. Which job, tasks, occupations, and economic sectors are especially affected by outsourcing and international trade?

3. Which are the economic implications, e.g. for the wages or skill-differentiated labour demand?

➢ We answer these questions empirically, by using representative German task data and multivariate and micro-econometric methods.

BIBB/IAB/BAuA Worker Survey:

- Representative survey of German employees

- 3 waves (1991, 1998 und 2006) with around 20,000 observations each

- Detailed information about features of the employees and their jobs:

  - Age, sex, firm size, qualification, tenure, household information, …

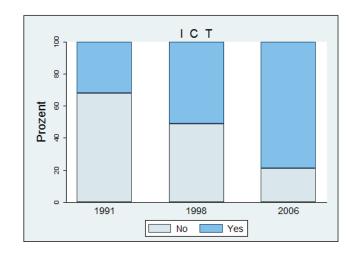 - Performed tasks in occupation, tools used, necessary knowledge, job characteristics…

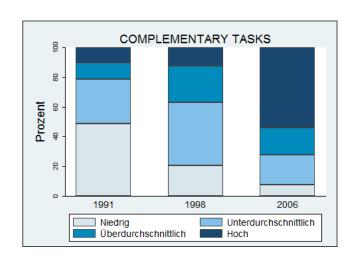(This Data is common in literature, but is used mostly selectively.)

Empirical Approach:

1. Operationalise different relevant **job characteristics** from the BIBB survey.

2. Use **principal component analysis** to avoid multicollinearity

3. Estimate **two job-specific indicators**, which can be used to further analyze the offshoring potential and its effects

➢ We can use these indicators either directly with the BIBB-data or merge them with other data
(Here: direct application on wages)

Selected Characteristics:

- Information and Communication Technologies:
  „Do you us a computer at work?"
  (Yes/No)

- Complementary Tasks:
  Generated variable that shows if an employee performs tasks, which are often performed together
  (Relative Frequency)

Building two indicators:

- After having operationalised the characteristics, we add them up into two individual-specific indicators:

$$Outsourcing\ potential_i =$$
$$w_{11} \cdot Routine_i + w_{12} \cdot ICT_i + w_{13} \cdot Complements_i + \dots$$
$$International\ tradeability_i =$$
$$w_{21} \cdot Routine_i + w_{22} \cdot ICT_i + w_{23} \cdot Complements_i + \dots$$

How should each characteristic be weighted???

- Instead of using arbitrary or subjective weights, we perform PCA to obtain the variance-maximizing weights.

Principal Component Analysis:

- Goal of **reducing the number of dimensions** while simultaneously explaining a maximum amount of variance (multicollinearity problem)

- **Generating components = indicators** as linear combinations of different tasks characteristics

Criteria:

- Interpretability of the indicators

- Statistical fit

- Robustness of the outcomes

- We use a "meta-analysis" by taking median coefficients of a large number of different specifications to show the robustness of our results
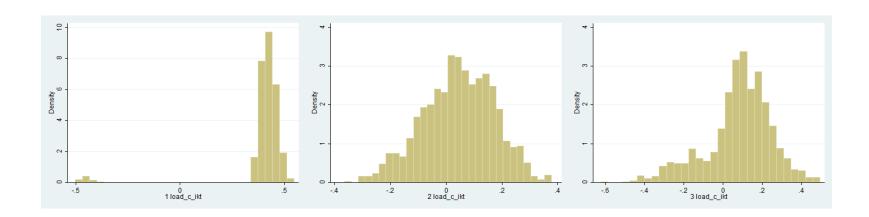
Outcomes from standard PCA:

Job Characteristic	Comp1	Comp2
Codifiability	-0,25	0,62
Routine	-0,28	0,53
ICT	0,41	
Pressure to Perform	0,21	0,47
Cultural Linkage	0,26	
Geographic Restrictions		-0,21
Interactivity	0,32	
Complementary Tasks	0,44	
New Scopes	0,39	

- Two components (eigenvalue >> 1)
- Interpretation?
  - Comp1: (restrictions on) international tradeability
  - Comp2: outsourcing potential

Meta-PCA:

- We re-run the PCAs dropping up to four characteristics

  - This results in $\binom{12}{8}$ different specifications

- We also run the PCAs separate by year

  - To include systematically missing variables

- We take the mean or median loadings as weights for the indicators:

Results:

- We can estimate both indicators for each employee's job according to his/her individual task characteristics:

$$Outsourcing\ potential_i$$
$$= 0.62\ Routine_i + 0\ ICT_i + 0\ Complements_i + \ldots$$

$$International\ tradeability_i$$
$$= 0.25\ Routine_i - 0.41\ ICT_i - 0.44\ Complements_i + \ldots$$

- We can use these indicators either in the BIBB survey or merge them with other data, either using a method by Fitzenberger et al. (2012) or by aggregation on the occupation or sector level.

Examples for outsourcing potential and international:

Tasks:
Producing (PRO)
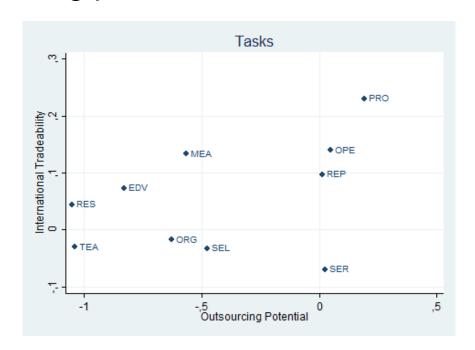Operating (OPE)
Repairing (REP)
Serving (SER)
Selling (SEL)
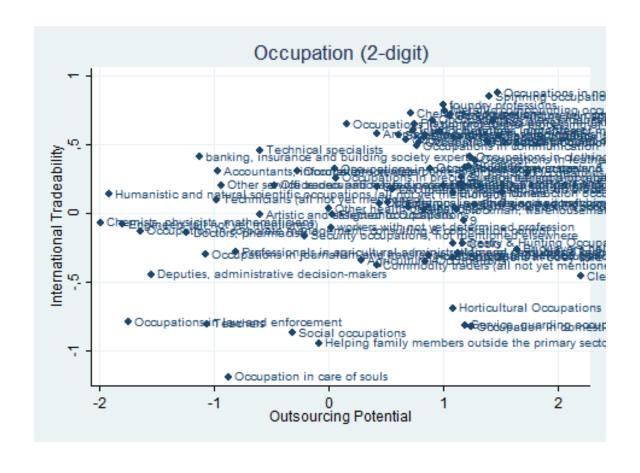Measuring (MEA)
Organising (ORG)
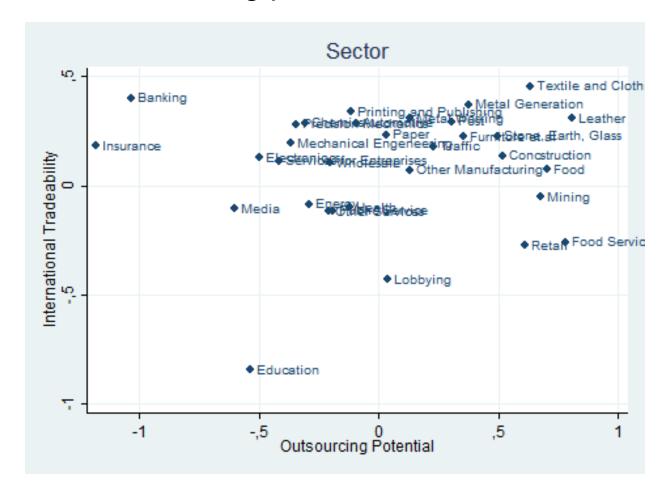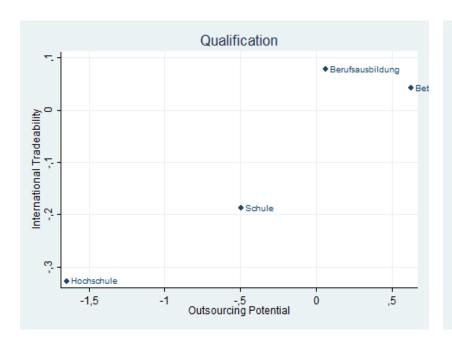Data-Processing (EDV)
Teaching (TEA)
Researching (REA)

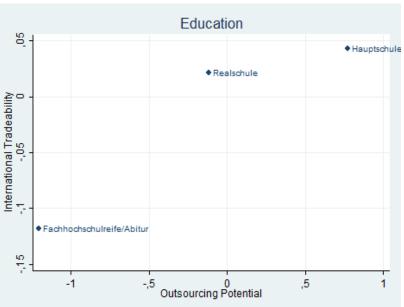➢ A significant number of tasks do not follow the „classical"
one-dimensional view of offshoreability

International Tradeability		Outsourcing Potential	
		Low	High
	High	Foreign Direct Investments	Offshoring
	Low		(National) Outsourcing

Examples for outsourcing potential and international:

Occupation (2-digit)

Examples for outsourcing potential and international:

Examples for outsourcing potential and international:

A first application:

- What is the effect of outsourcing potential and international tradeability on wages?

- We use a classic Mincerian (1974) wage equation:

$$\log(wage)_{it} = \alpha_{it} + \beta_1\, outp_{it} + \beta_2\, itrade_{it} + \beta_2\, outp_{it} \cdot itrade_{it} + \gamma\, \boldsymbol{X}_{it} + \varepsilon_{it}$$

- Control Variables: Gender, Age, Occupational Education, Education, Occupational Experience, Firm Affiliation, Size of Household, Children, Income of the Partner, Nationality, Company Size, Region, Economic Sector, Occupational Group, Year Dummies

First results:

Variable	Income Class		Ln(Wage)	
Outsourcing Potential	0.1037*** (0.0063)	-0.0296*** (0.0060)	0.0709*** (0.0065)	0.0031 (0.0049)
International Tradeability	-0.6145*** (0.0047)	-0.2032*** (0.0059)	-0.2361*** (0.0045)	-0.0715*** (0.0054)
OutP * Itrade	0.0437*** (0.0042)	0.0086** (0.0040)	0.0429*** (0.0042)	0.0134*** (0.0041)
Control variables	No	Yes	No	Yes
Number of observations	57057	34212	13396	7244
R²	0.25	0.66	0.20	0.67

*Robust standard errors in parentheses: p<0.10, ** p<0.05, *** p<0.01. Source: BIBB Survey 1992,1998, 2006; own calculations. Controls include: sex, age, tenure, experience, education, qualification, household size, working partner, kids in household, foreign citizen, industry, region and firm size dummy variables.*

- Mostly negative correlation of outsourcing potential and international tradability with income class and gross wage

- International tradeability has much larger impact, positive interaction

- Control variables mostly significant and with the expected sign

Summary, conclusion, further research:

- We analyse the offshoring potential of jobs by differentiating between outsourcing potential and international tradeability.

- We systematically utilize a load of job characteristics to estimate two job-specific indicators of offshoreability

- Evidence shows that there is significant variation between the two dimensions.

- First applications indicate that both outsourcing potential and international tradeability are negatively correlated with wages.

- Further analysis of these offshoring-indicators will follow

- Indicators can be obtained (please cite us ;-))

Project Overview (ongoing):

Module 1

- Measuring and Classifying the Offshoreability of Jobs
  - Using BIBB data to generate indicators that (a) allow for the differentiation between outsourcing potential and international tradeability and (b) systematically use a large number of determinants

- Offshoring Potential and Firm Characteristics
  - Applying the indicators to LIAB data and analyse the individual-level and plant-level determinants of task offshoring

Project Overview (next summer):

Module 2

- Offshoring Potential and Realised Offshoring
  - Using IAB BP Data and use information on realised offshoring (outsourcing to foreign countries, increased import of intermediate inputs) to analyse the differences between (further task) offshoring potential and already realised offshoring
  - Estimate potentially 'risky sectors'

- Offshoring Potential and FDI
  - Merging BuBa MIDI Data on FDI to the IAB Data to analyse FDI patterns and their relationship to task offshoring

Project Overview (next winter):

Module 3

- Offshoring Potential and the Wage Structure
  - Using LIAB data to analyse the effects of task offshoring on the wage level and its dispersion
  - Identifying factors that potentially mitigate (negative) wage effects of task offshoring
- Offshoring Potential and the Change of Employment
  - Using LIAB data to analyse the effects of task offshoring on employment (growth) and changes in employment structure (atypical employment)
- Offshoring Potential and Collective Bargaining
  - Using LIAB data and analyse whether task offshoring leads to lower collective bargaining coverage and/or lower bargained wages