



# Changes in workplace tasks in Germany

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## evaluating skill and task measures

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1. What is meant by skills and job tasks?
2. How skills and tasks are measured over-time?
3. How tasks can be classified into task groups?
4. How do measures compare?
  1. Do changes in tasks groups implicate a pattern of routinization and polarization?
  2. Is there an increase in over-qualification related to task-change?
5. What do we conclude for analyses following the task-based approach with the data?

# What is meant by skills and job tasks?

- Skills and tasks are characteristics of different units of analyses (e.g. Autor and Handel 2009): Whereas skills are characteristics of workers, tasks are characteristics of jobs
- Skill requirements / demand: job tasks ('application of that workers's skill endowment to a given set of activities' (Autor und Handel 2009, p. 7))
- Routine tasks: can be accomplished by machines following explicit programmed rules (ALM 2003, p. 1283)
- implications
  - Nonroutine cognitive tasks: analytic and interactive tasks:
    - testing hypotheses; medical diagnosis; complex communication tasks
  - Routine cognitive and manual tasks:
    - bookkeeping; clerical work; repetitive assembly tasks
  - Non-routine manual tasks:
    - truck-driving; cleaning

# How skills and tasks are measured over time?

| Year    | Population   | No. of cases |
|---------|--|--------------|
| 1979    | German labour force ( <u>not</u> included: apprentices and other people in qualification schemes, armed forces, foreign workers) age 15-65 | 28,828       |
|         | * active   | 992          |
|         | * unemployed   |              |
| 1985/86 | German active labour force age 15-65   | 26,361       |
| 1991/92 | West-German active labour force  |              |
|         | * German   | 23,476       |
|         | * German speaking foreign workers  | 614          |
|         | New Laender (east Germany)   | 7,851        |
|         | * active   | 1,880        |
|         | * unemployed   | 456          |
|         | * people in retraining schemes   |              |
|         |  | 34,277       |
| 1998/99 | German active labour force (including German speaking foreign workers) age 15 and over, regular employment of 10 hrs/week                  | 34,343       |
| 2005/06 | German active labour force (including German speaking foreign workers) age 15 and over, regular employment of 10 hrs/week                  | 20,000       |

# How skills and tasks are measured over time?

- Sample selection
  - West-German employees, including West-Berlin
  - Between 15 and 65 years old
  - 10 to 168 hours per week („core-employment“)

| Year    | N       |
|---------|---------|
| 1979    | 28,088  |
| 1985/86 | 25,933  |
| 1991/92 | 22,900  |
| 1998/99 | 25,513  |
| 2005/06 | 15,671  |
| Total   | 118,105 |

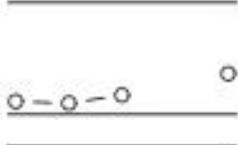
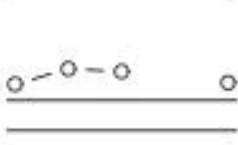
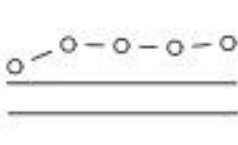

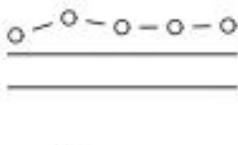
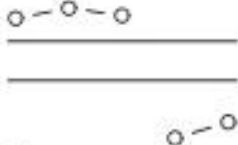

# How skills and tasks are measured over time?

|    | Variable names       | Content   | Missing survey years   |
|----|----------------------|---|------------------------|
| 1  | <i>investigating</i> | Gathering information, investigating, documenting                 | 1979, 1985/86, 1991/92 |
| 2  | <i>organizing</i>    | Organizing, making plans, working out operations, decision making | -                      |
| 3  | <i>researching</i>   | Researching, evaluating, developing, constructing                 | 1998/99                |
| 4  | <i>programming</i>   | Working with computers, programming                               | 1998/99                |
| 5  | <i>applying law</i>  | Applying law, notarizing  | 1998/99, 2006          |
| 6  | <i>teaching</i>      | Teaching, training, educating                                     | -                      |
| 7  | <i>consulting</i>    | Consulting, advising  | -                      |
| 8  | <i>buying</i>        | Purchasing, procuring, selling                                    | -                      |
| 9  | <i>promoting</i>     | Promoting, marketing, public relations                            | -                      |
| 10 | <i>managing</i>      | Managing personnel, leading, employing                            | 1998/99, 2006          |
| 11 | <i>negotiating</i>   | Negotiating, lobbying,  | 1985/86, 1991/92, 2006 |
| 12 | <i>repairing</i>     | Repairing, renovating, restoring                                  | -                      |
| 13 | <i>accommodating</i> | Accommodating, preparing food, serving, (entertaining)            | 1998/99                |
| 14 | <i>caring</i>        | Taking care, healing  | -                      |
| 15 | <i>cleaning</i>      | Cleaning, recycling, waste disposal                               | 1998/99                |
| 16 | <i>protecting</i>    | Protecting, guarding, observing, controlling traffic              | 1998/99                |
| 17 | <i>measuring</i>     | Measuring, testing, quality control                               | 1985/86, 1991/92       |
| 18 | <i>writing</i>       | Clerical work   | 1998/99, 2006          |
| 19 | <i>calculating</i>   | Calculating, bookkeeping  | 1998/99, 2006          |
| 20 | <i>operating</i>     | Operating, controlling machines                                   | -                      |
| 21 | <i>manufacturing</i> | Manufacturing of goods, planting                                  | -                      |
| 22 | <i>storing</i>       | Storing, transporting, shipping, stocking, posting                | 1998/99                |

# Development of single tasks


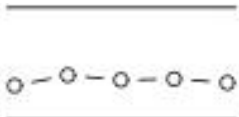
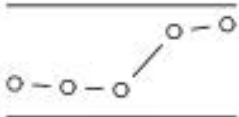
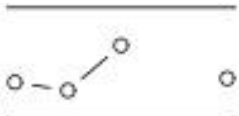



| Variable     | 1979 | 1985/86 | 1991/92 | 1998/99 | 2005/06 |  |
|--------------|------|---------|---------|---------|---------|--|
| promoting    | 2.7  | 8.4     | 17.4    | 11.9    | 12.0    |  |
| caring       | 3.9  | 6.6     | 7.0     | 7.3     | 8.1     |  |
| applying law | 4.5  | 12.7    | 11.5    | NaN     | NaN     |  |
| accomodating | 4.9  | 3.4     | 3.8     | NaN     | 8.1     |  |
| negotiating  | 5.1  | NaN     | NaN     | 23.1    | NaN     |  |
| programming  | 5.1  | 9.8     | 19.5    | NaN     | 64.1    |  |
| teaching     | 7.0  | 17.0    | 14.8    | 17.6    | 21.0    |  |
| protecting   | 7.1  | 4.3     | 4.0     | NaN     | 21.0    |  |

# Development of single tasks

| Variable    | 1979 | 1985/86 | 1991/92 | 1998/99 | 2005/06 |   |
|-------------|------|---------|---------|---------|---------|---|
| cleaning    | 8.1  | 7.0     | 12.0    | NaN     | 25.6    |    |
| researching | 10.1 | 19.7    | 18.0    | NaN     | 11.1    |    |
| operating   | 10.5 | 24.3    | 23.5    | 22.3    | 25.2    |    |
| organizing  | 11.5 | 15.8    | 27.1    | 37.6    | 36.1    |    |
| repairing   | 11.8 | 22.8    | 16.9    | 17.0    | 17.9    |   |
| managing    | 14.4 | 20.8    | 16.2    | NaN     | NaN     |  |
| measuring   | 18.9 | NaN     | NaN     | 33.9    | 43.9    |  |



# Development of single tasks

| Variable      | 1979 | 1985/86 | 1991/92 | 1998/99 | 2005/06 |   |
|---------------|------|---------|---------|---------|---------|---|
| calculating   | 20.5 | 19.9    | 20.6    | NaN     | NaN     |    |
| buying        | 21.1 | 27.7    | 24.6    | 25.3    | 22.9    |    |
| consulting    | 21.1 | 18.8    | 17.2    | 53.6    | 58.2    |    |
| storing       | 23.2 | 18.1    | 46.3    | NaN     | 25.7    |    |
| manufacturing | 34.0 | 20.4    | 16.7    | 15.3    | 17.7    |    |
| writing       | 34.3 | 37.2    | 37.1    | NaN     | NaN     |  |
| investigating | NaN  | NaN     | NaN     | 28.8    | 49.6    |  |



# How tasks can be classified into task groups?

Validation strategy:

1. Competing classifications
  - a) the statistical classification (using factor analysis),
  - b) classification based on literature review
  - c) classification by criterion validation of items by external variables: *manual, routine, computer*
2. Index computation: non-additive, additive
3. Measures in comparison

# Statistical classification

| Variable      | Factor 1<br>“nonroutine-<br>analytic” | Factor 2<br>“routine-<br>cognitive” | Factor 3<br>“nonroutine-<br>interactive” | Factor 4<br>“routine-<br>manual” | Factor 5<br>“nonroutine-<br>manual” | Uniqueness |
|---------------|---------------------------------------|-------------------------------------|--|----------------------------------|-------------------------------------|------------|
| teaching      | 0,7593                                | 0,1272                              | -0,0946                                  | -0,0144                          | 0,2432                              | 0,3390     |
| consulting    | 0,7589                                | 0,1656                              | 0,2303                                   | -0,0896                          | 0,2087                              | 0,2920     |
| measuring     | 0,2587                                | 0,3506                              | 0,0197                                   | 0,7335                           | 0,2101                              | 0,2276     |
| operating     | -0,0003                               | -0,0875                             | -0,1147                                  | 0,7698                           | -0,0197                             | 0,3862     |
| repairing     | -0,0841                               | -0,2791                             | -0,0131                                  | 0,7703                           | -0,1244                             | 0,3060     |
| buying        | 0,0261                                | 0,1695                              | 0,7985                                   | -0,0457                          | 0,1379                              | 0,3118     |
| negotiating   | 0,6127                                | 0,2200                              | 0,6253                                   | 0,0405                           | 0,0026                              | 0,1836     |
| promoting     | 0,2739                                | 0,0626                              | 0,8457                                   | -0,0730                          | 0,0011                              | 0,2005     |
| investigating | 0,7281                                | 0,0053                              | 0,3248                                   | -0,0944                          | -0,1732                             | 0,3254     |
| organizing    | 0,6653                                | 0,2963                              | 0,3706                                   | 0,1176                           | 0,0852                              | 0,3111     |
| Researching   | 0,5255                                | 0,1225                              | 0,0719                                   | 0,3061                           | -0,1689                             | 0,5814     |
| manufacturing | -0,2000                               | -0,4538                             | -0,0250                                  | 0,5854                           | -0,0094                             | 0,4107     |
| accomodating  | 0,0458                                | -0,0566                             | 0,1795                                   | -0,0383                          | 0,8610                              | 0,2197     |
| Caring        | 0,2484                                | -0,0440                             | -0,1672                                  | -0,1584                          | 0,8025                              | 0,2393     |
| managing      | 0,6311                                | 0,2630                              | 0,2721                                   | 0,1990                           | 0,0617                              | 0,4151     |
| Storing       | -0,2889                               | 0,5798                              | 0,3584                                   | 0,2348                           | 0,1823                              | 0,3635     |
| protecting    | 0,3938                                | 0,3520                              | -0,1514                                  | 0,4262                           | 0,3316                              | 0,4064     |
| programming   | 0,4024                                | 0,5370                              | 0,1016                                   | -0,0478                          | -0,1950                             | 0,4992     |
| Cleaning      | -0,1052                               | 0,0005                              | 0,0805                                   | 0,3080                           | 0,7713                              | 0,2927     |
| Writing       | 0,2180                                | 0,8285                              | 0,2542                                   | -0,1695                          | -0,0760                             | 0,1669     |
| calculating   | 0,2040                                | 0,5858                              | 0,4879                                   | -0,1025                          | -0,1747                             | 0,3362     |
| Applying law  | 0,4904                                | 0,6408                              | -0,1247                                  | 0,0314                           | 0,0015                              | 0,3324     |

*Notes:* Sample is restricted to people from the western part of Germany belonging to the labor force (defined as having a paid work) aged 15 to 65, with a regular working time of at least ten hours per week. *Source:* BIBB/IAB – BIBB/BAuA Employment Surveys 1979-2006, weighted values, own calculations.

# Hypothetical and statistical classification

| Task items BIBB/IAB/BAUA<br>1979-2006 |                      | Task categorization           |                            |
|---------------------------------------|----------------------|-------------------------------|----------------------------|
| No.                                   | Content              | Theory / research<br>practice | Statistical classification |
| 1                                     | <i>investigating</i> | Analytic                      | Analytic                   |
| 2                                     | <i>organizing</i>    | Analytic                      | Analytic                   |
| 3                                     | <i>researching</i>   | Analytic                      | Analytic                   |
| 4                                     | <i>programming</i>   | Analytic                      | Routine cognitive          |
| 5                                     | <i>applyinglaw</i>   | Analytic                      | Routine cognitive          |
| 6                                     | <i>teaching</i>      | Interactive                   | Analytic                   |
| 7                                     | <i>consulting</i>    | Interactive                   | Analytic                   |
| 8                                     | <i>buying</i>        | Interactive                   | Interactive                |
| 9                                     | <i>promoting</i>     | Interactive                   | Interactive                |
| 10                                    | <i>managing</i>      | Interactive                   | Analytic                   |
| 11                                    | <i>negotiaing</i>    | Interactive                   | Interactive                |
| 12                                    | <i>repairing</i>     | Non-rout. manual              | Routine manual             |
| 13                                    | <i>accomodating</i>  | Non-rout. manual              | Non-rout. manual           |
| 14                                    | <i>caring</i>        | Non-rout. manual              | Non-rout. manual           |
| 15                                    | <i>cleaning</i>      | Non-rout. manual              | Non-rout. manual           |
| 16                                    | <i>protecting</i>    | Non-rout. manual              | Routine manual             |
| 17                                    | <i>measuring</i>     | Routine cognitive             | Routine manual             |
| 18                                    | <i>writing</i>       | Routine cognitive             | Routine cognitive          |
| 19                                    | <i>calculating</i>   | Routine cognitive             | Routine cognitive          |
| 20                                    | <i>operating</i>     | Routine manual                | Routine manual             |
| 21                                    | <i>manufacturing</i> | Routine manual                | Routine manual             |
| 22                                    | <i>storing</i>       | Routine manual                | Routine cognitive          |

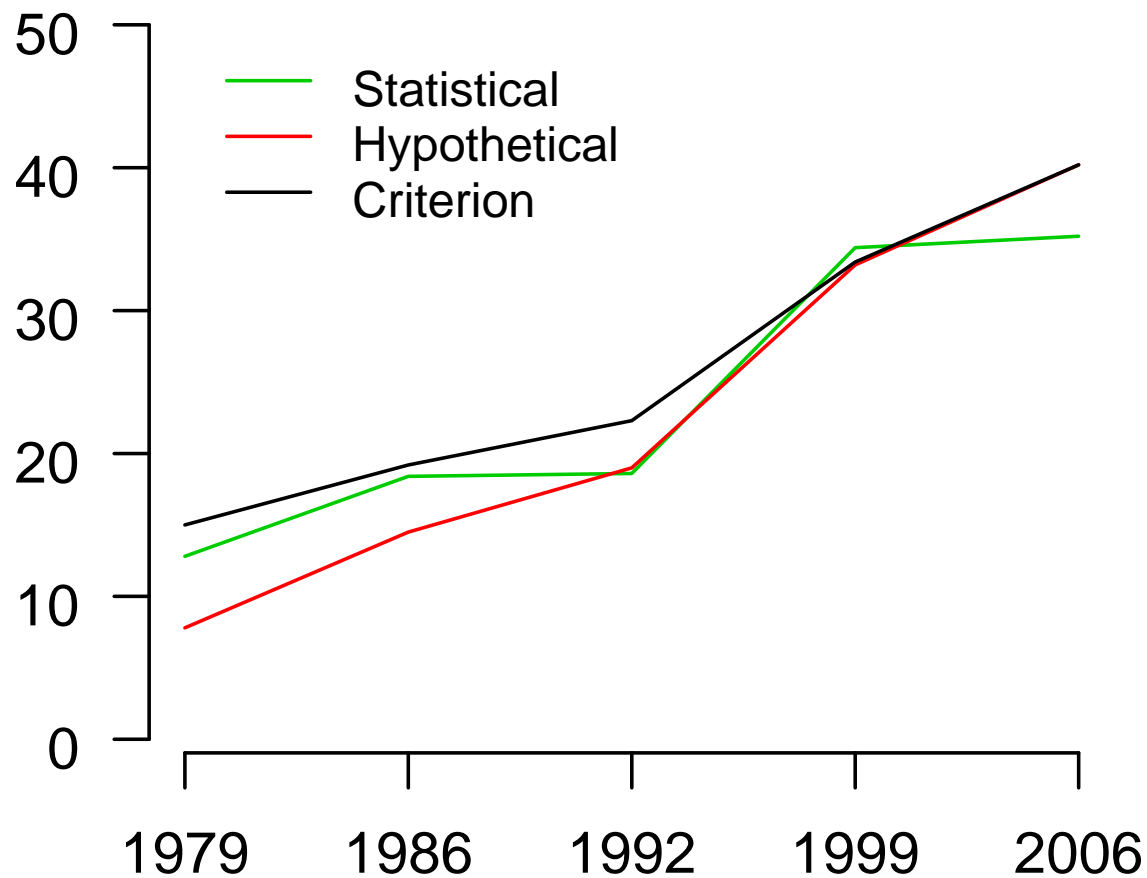
# Criterion validation

| No. | Content              | Hypoth.           | Manual  | Routine    | Computer           | Task category       |
|-----|----------------------|-------------------|---------|------------|--------------------|---------------------|
| 1   | <i>investigating</i> | analytic          | -       | -          | +                  | Non-rout. cognitive |
| 2   | <i>organizing</i>    | analytic          | -       | -          | +                  | Non-rout. cognitive |
| 3   | <i>researching</i>   | analytic          | -       | -          | +                  | Non-rout. cognitive |
| 4   | <i>programming</i>   | analytic          | -       | -          | +                  | Non-rout. cognitive |
| 5   | <i>applyinglaw</i>   | analytic          | -       | -          | +                  | Non-rout. cognitive |
| 6   | <i>teaching</i>      | analytic          | -       | -          | +                  | Non-rout. cognitive |
| 7   | <i>consulting</i>    | analytic          | -       | -          | +                  | Non-rout. cognitive |
| 8   | <i>buying</i>        | interactive       | -       | -          | +(06 -)            | Non-rout. cognitive |
| 9   | <i>promoting</i>     | interactive       | -       | -          | +                  | Non-rout. cognitive |
| 10  | <i>managing</i>      | interactive       | -       | -          | +                  | Non-rout. cognitive |
| 11  | <i>negotiating</i>   | interactive       | -       | -          | +                  | Non-rout. cognitive |
| 12  | <i>repairing</i>     | Non-rout. manual  | +       | -          | -                  | Non-rout. manual    |
| 13  | <i>accommodating</i> | Non-rout. manual  | +*      | -(06 +)    | -                  | Non-rout. manual    |
| 14  | <i>caring</i>        | Non-rout. manual  | +*      | -(06 +)    | -                  | Non-rout. manual    |
| 15  | <i>cleaning</i>      | Non-rout. manual  | +       | +          | -                  | Routine manual      |
| 16  | <i>protecting</i>    | Non-rout. manual  | +       | -          | 79 +; 06 -         | Non-routine manual  |
| 17  | <i>measuring</i>     | Routine cognitive | +       | -(06 n.s.) | 79+, 99 n.s., 06 - | Non-rout. cognitive |
| 18  | <i>writing</i>       | Routine cognitive | -       | -          | +                  | Non-rout. cognitive |
| 19  | <i>calculating</i>   | Routine cognitive | -       | -          | +                  | Non-rout. cognitive |
| 20  | <i>operating</i>     | Routine manual    | +       | +(79 n.s.) | -(79, 85/6 +)      | Routine manual      |
| 21  | <i>manufacturing</i> | Routine manual    | +       | +          | -                  | Routine manual      |
| 22  | <i>storing</i>       | Routine manual    | +(92 -) | +(92 -)    | -(92 +)            | Routine manual      |

Notes: -=stat. sig. negative association with criterion variable +=stat. sig. positive association with criterion variable. \*Manual='working standing'.

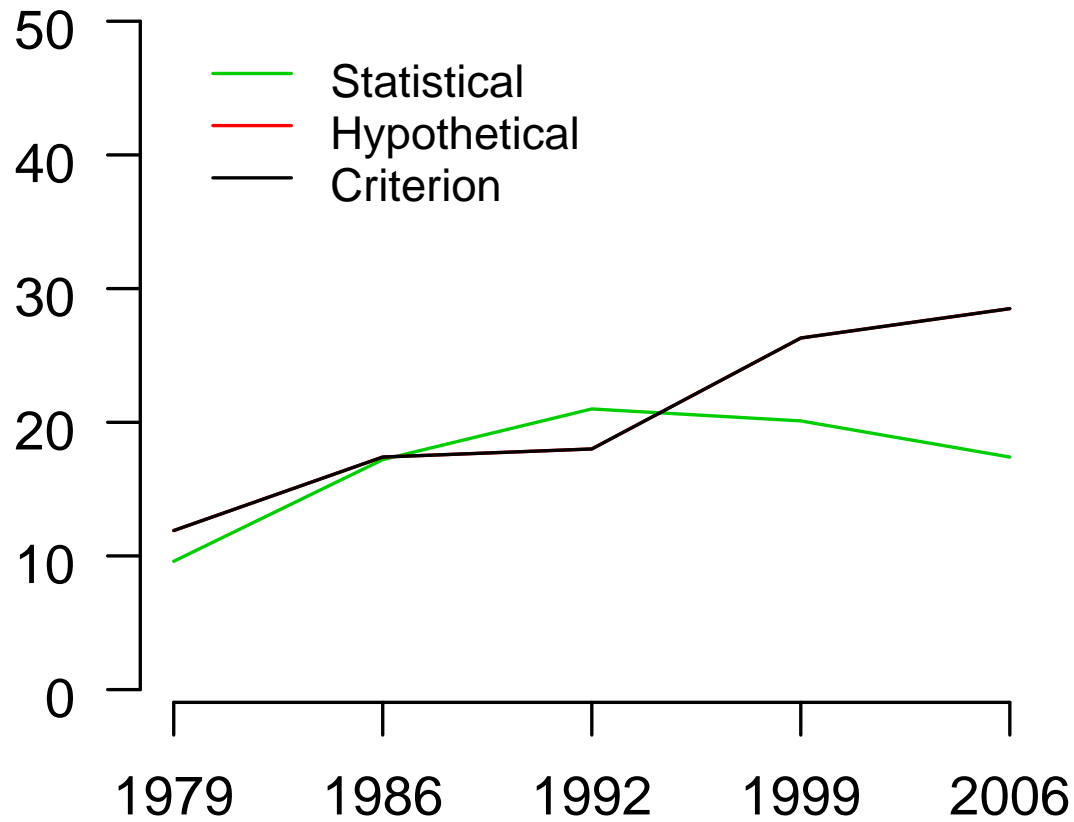
# Routinization?

## Analytic



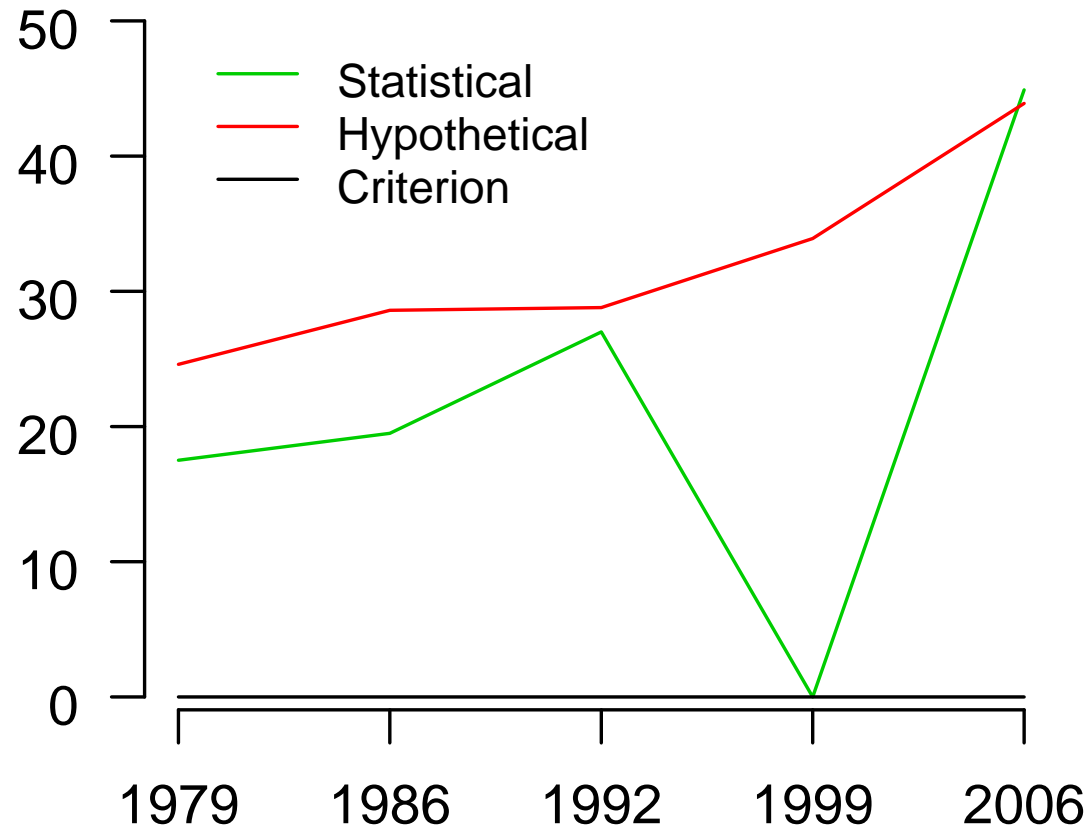
# Routinization?

## Interactive



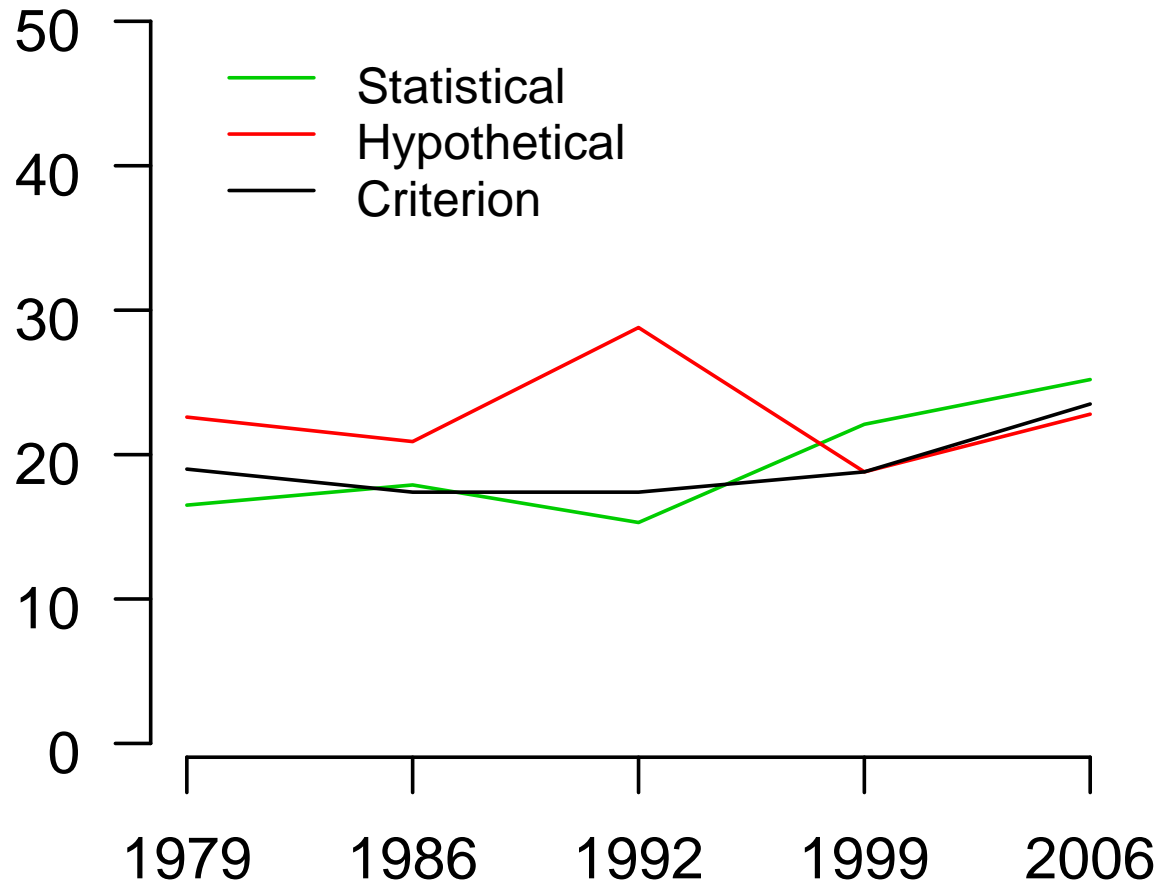
# Routinization?

## Routine-Cognitive

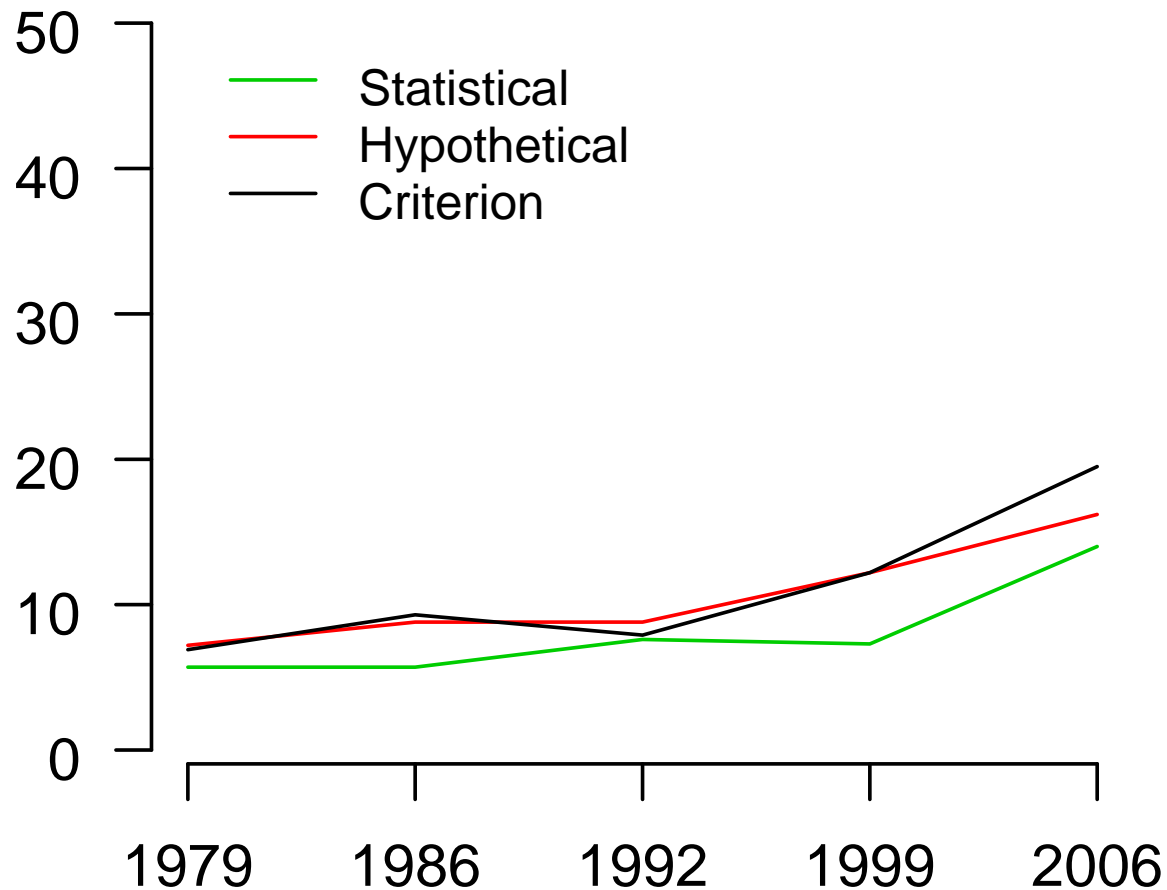




## Routine-Manual

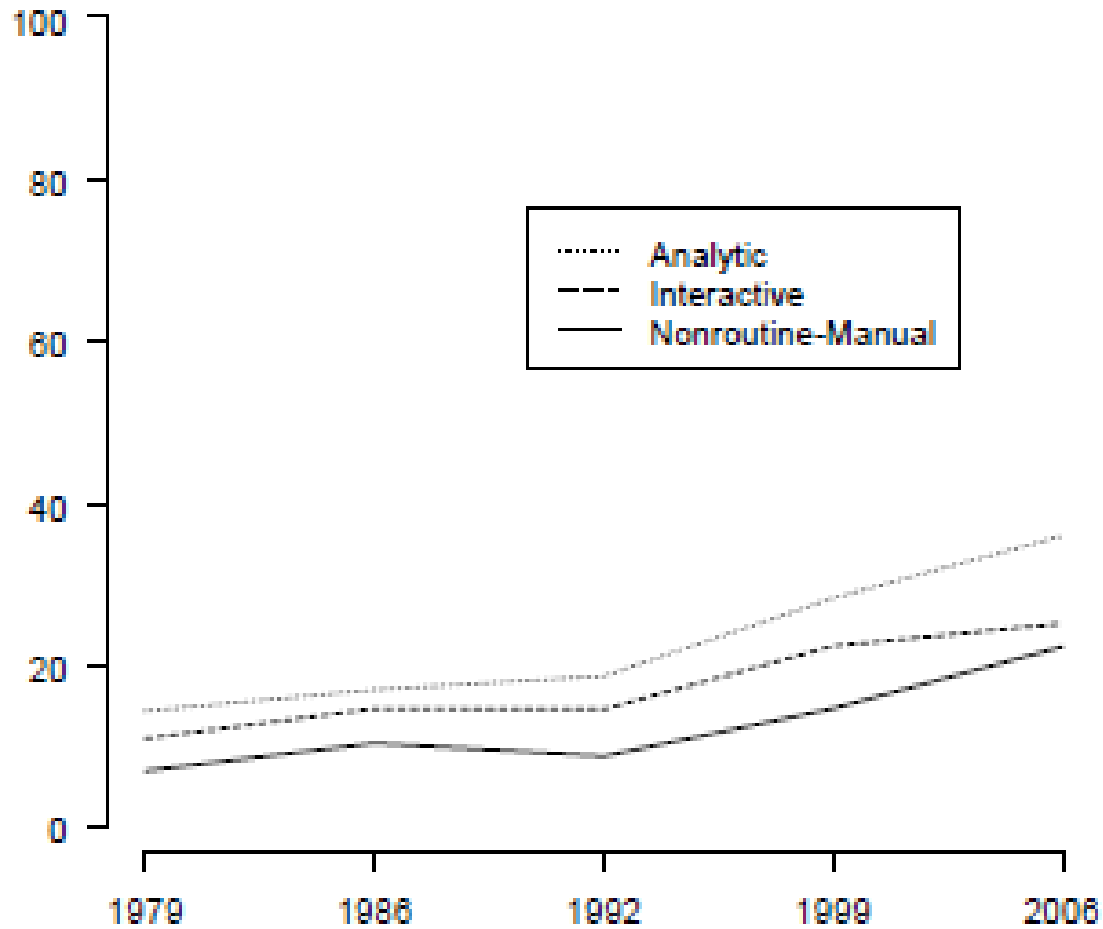


## Nonroutine-Manual



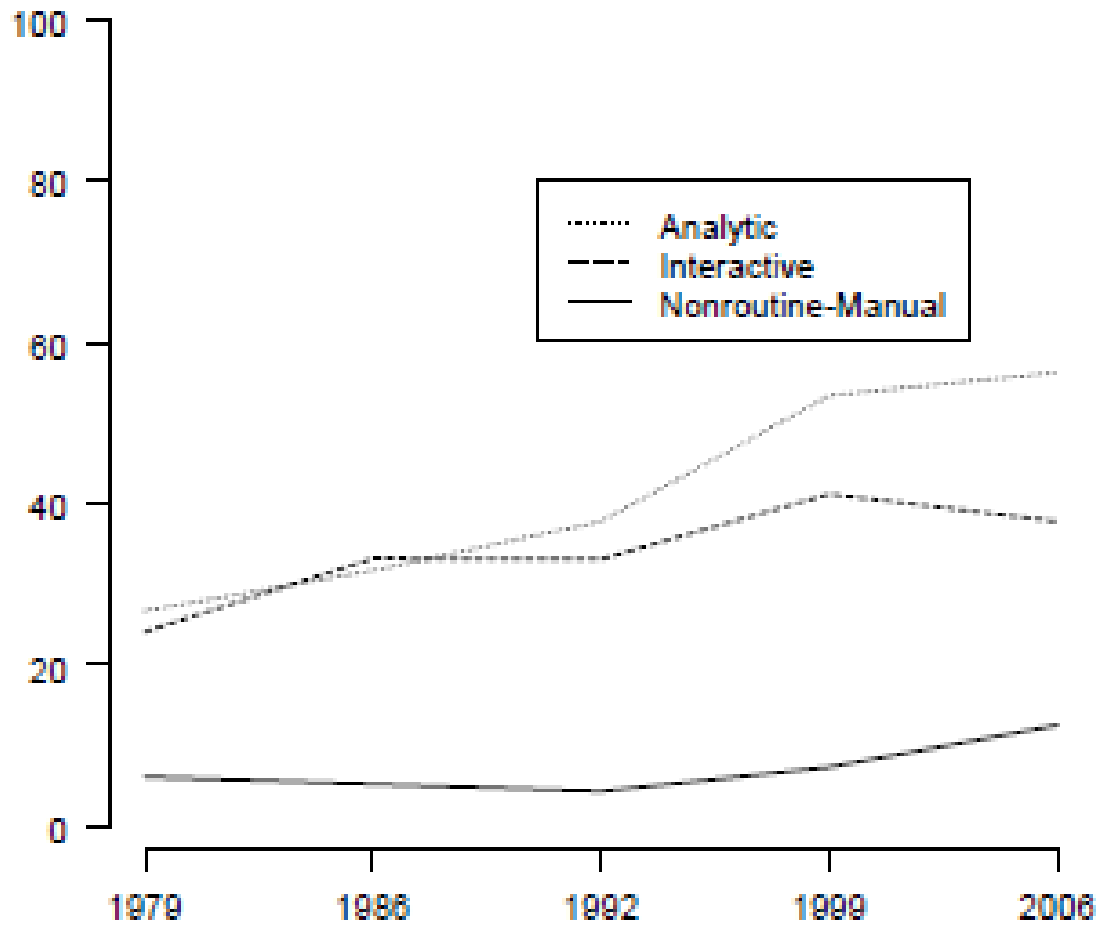
# Polarization?

## ISCED 3B



# Polarization?

## ISCED 5A




# Under-utilization of skills from polarization?

Table 7: Job tasks by over-qualification and over-skilling


|                           | Over-qualification                             |   | Over-skilling                              |   |
|---------------------------|--|---|--|---|
|                           | Over-qualified<br>(n <sub>ij</sub> =24,671-96) | Not over-qualified<br>(n <sub>ij</sub> =61,342) | Over-skilled<br>(n <sub>ij</sub> =4,012-8) | Not over-skilled<br>(n <sub>ij</sub> =36,974) |
| <i>Analytic</i>           | 15.7   | 25.3  | 31.8                                       | 36.6  |
| <i>Interactive</i>        | 13.9   | 20.2  | 23.6                                       | 27.5  |
| <i>Non-routine manual</i> | 7.0  | 9.7   | 14.5                                       | 14.8  |

Notes: Sample is restricted to people from the western part of Germany belonging to the labor force (defined as having a paid work) aged 15 to 65, with a regular working time of at least ten hours per week. Source: BIBB/IAB – BIBB/BAuA Employment Surveys 1979-2006, weighted values, own calculations.



# What do we conclude for analyses following the task-based approach with the data?

- focus on the increase in non-routine tasks
- If routine, focus on manual routine tasks (routine cognitive tasks are not sufficiently measured over time) or use other measures of routinization
- additive and non-additive measures: consider the number of items within each cross-section as well as the availability of items between waves



# What do we conclude for analyses following the task-based approach with the data?

- with some limitations and careful data handling the German worker-level cross-sections on tasks can be fruitfully used for analyses following a task-based approach.
- Task change as predicted by the routinization hypothesis is pervasive in Germany and might be an explanandum for rising over-qualification or other labor market changes to be studied.



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**Thank you!**

**Please send comments and nquestions to**  
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