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Tasks, technology and trade

# Tasks, technology and trade

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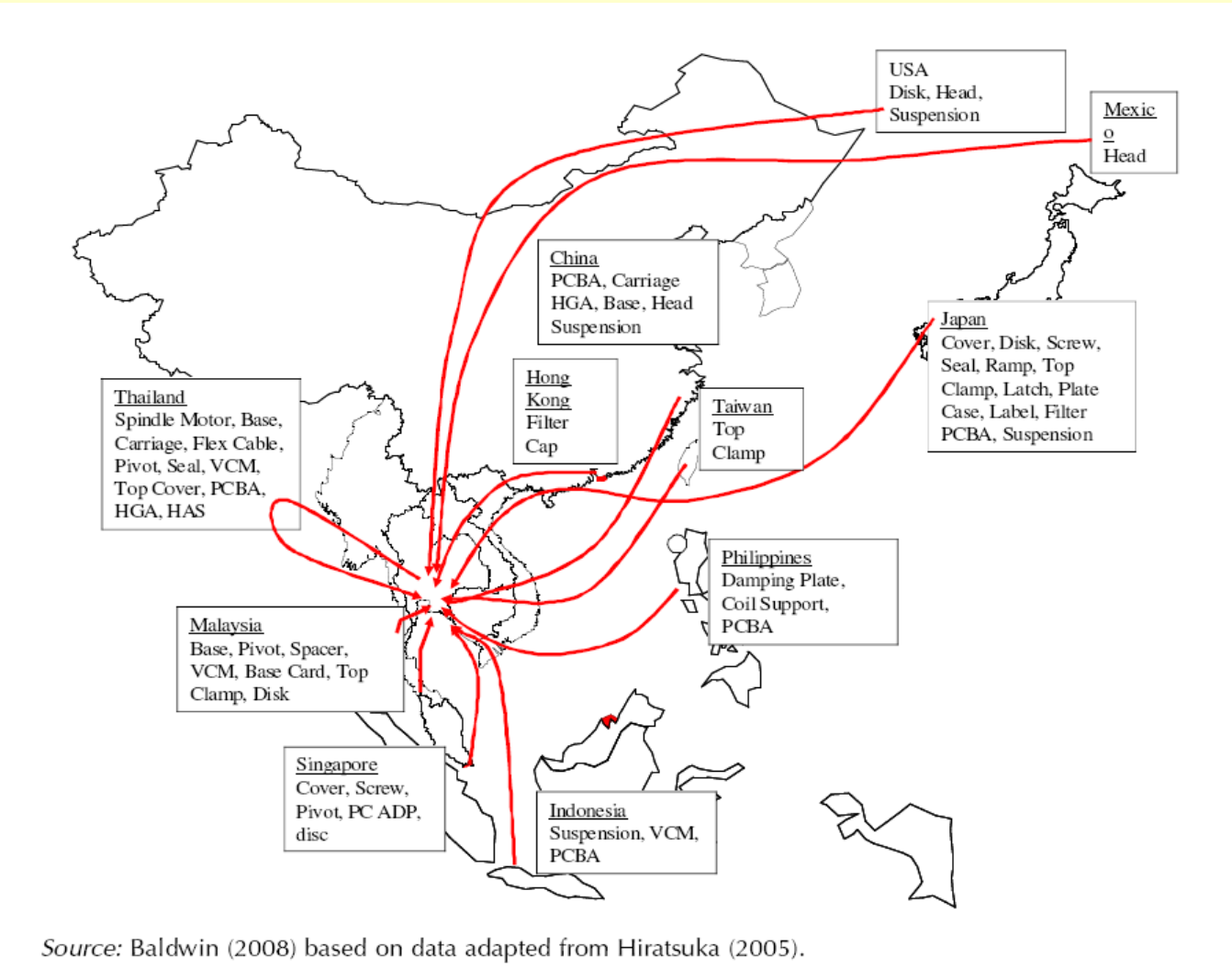
T.A.S.K.S Workshop, Nuremberg, 17-18 May

# Modern production




*Source:* Baldwin (2008) based on data adapted from Hiratsuka (2005).

# Modern production

- What are the effects of trade in tasks on changes in employment?

- Three goals
  - Present a framework to analyse trade in tasks
  - Find empirical body for the framework
  - Document developments in the Netherlands

# Approach

- Three levels and decisions

| Level | Decision |
|---|---|
| Workers | Separate tasks |
| Firms | Outsourcing |
| Space | Bound by local demand |

- Offshoring is possible if
  - Tasks can be separated from the worker
  - Firms can outsource the tasks to other firms
  - There is no local demand binding tasks to the country

# Data

- *Enquete Beroeps Bevolking* and *Sociaal Statistisch Bestand*
  - Occupations, wages, etc.
- British Skills Survey
  - 33 job tasks
- Input-output tables
  - Offshoring and outsourcing measures

# Workers

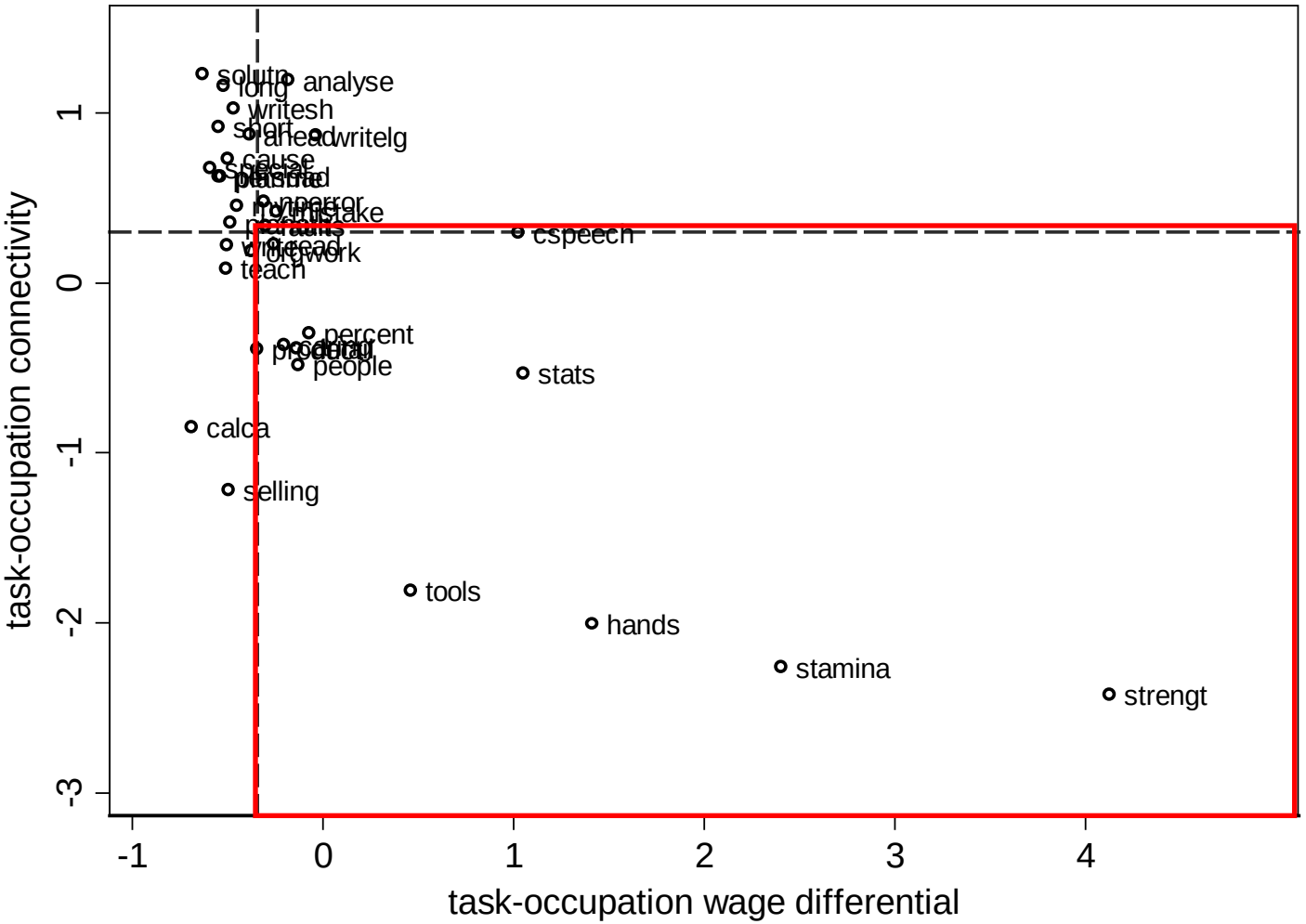
- Task-occupation wage differential
  - Absolute difference between occupation and task wage is the potential productivity advantage from unbundling tasks

$$towd_{ij}^{..} = \left| w_{i}^{.} - w_{j} \right|$$

- Task-occupation connectivity
  - Prediction of the presence of task X given the presence and importance of task Y

$$toc^{j,i} = \sum_{jj \neq j} c_{j,jj}^{..} m_{jj,i}^{..}$$

# Connectivity and wage differential

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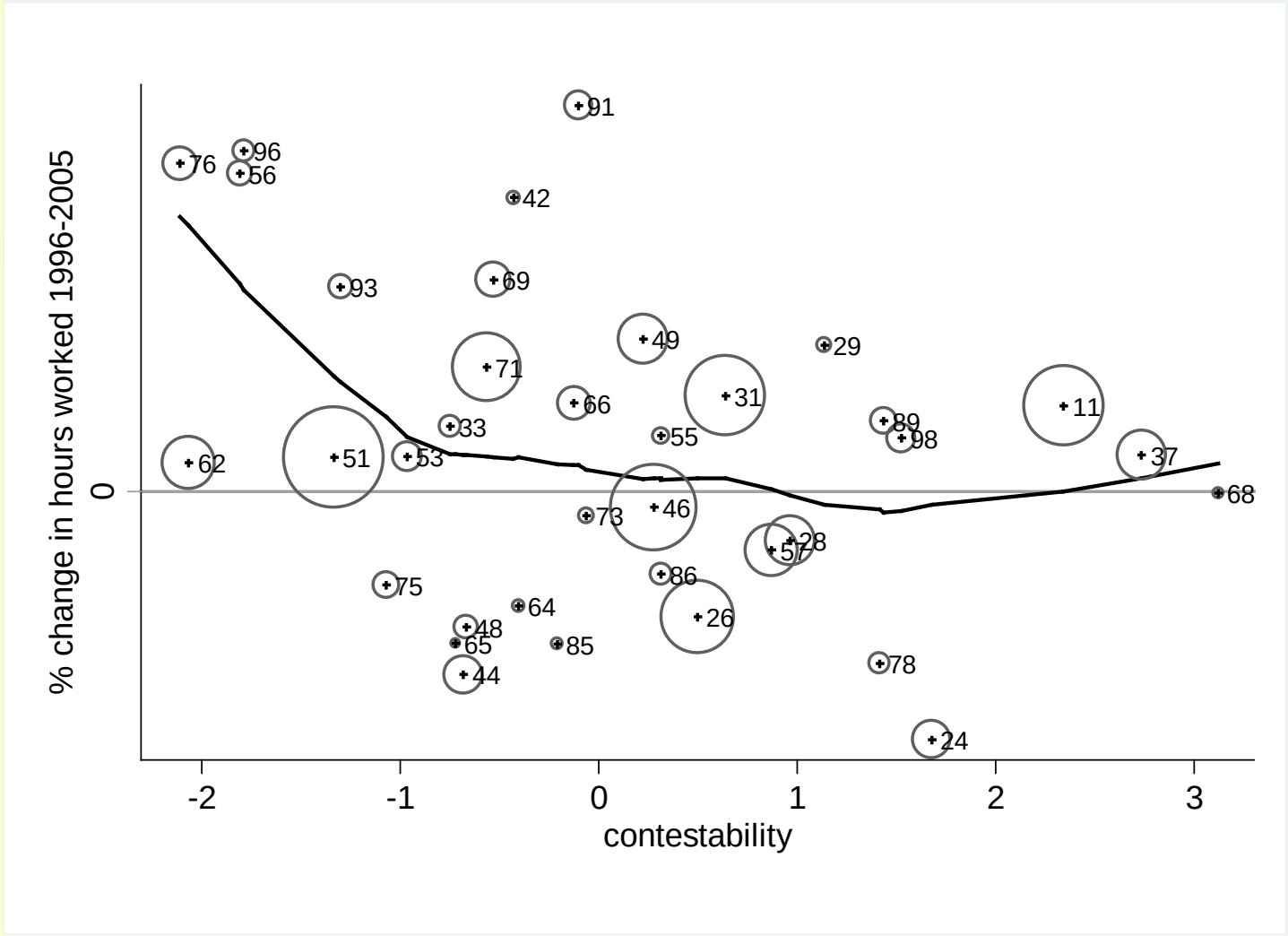
# Changes in task importance

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Dependent variable | Change in task importance 1997-2006, all tasks | Ten least important tasks | Middling important tasks | Ten most important tasks |
| task-occupation connectivity 1997 | 3.048*** | 2.820*** | 2.407*** | 1.106** |
| | (0.485) | (0.843) | (0.474) | (0.548) |
| task-occupation wage differential 1997 | -0.661*** | -0.754*** | -0.211 | -0.087 |
| | (0.290) | (0.221) | (0.242) | (0.374) |
| task importance 1997 | -1.169*** | -1.369*** | -1.877*** | -1.529*** |
| | (0.149) | (0.154) | (0.097) | (0.117) |
| constant | 5.622*** | 0.360 | -0.299 | 3.977*** |
| | (1.106) | (1.033) | (0.854) | (1.483) |
| Observations | 1,188 | 360 | 468 | 360 |
| R-squared | 0.563 | 0.589 | 0.757 | 0.780 |

# Contestability

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# Employment changes

| Dependent variable: Change in employment, 1996-2005 | (1) OLS | (2) OLS | (3) WLS | (4) WLS |
|---|---|---|---|---|
| task-occupation connectivity | 0.075** | 0.153*** | 0.058** | 0.075** |
| | (0.030) | (0.048) | (0.023) | (0.032) |
| task-occupation wage differential | 0.003 | 0.032 | 0.067** | 0.083*** |
| | (0.024) | (0.026) | (0.026) | (0.028) |
| education 1996 | | -0.084 | | -0.011 |
| | | (0.059) | | (0.044) |
| log employment 1996 | | 0.029 | | 0.031 |
| | | (0.027) | | (0.022) |
| Constant | 0.012 | -0.173 | 0.053** | -0.183 |
| | (0.029) | (0.189) | (0.021) | (0.176) |
| Observations | 36 | 36 | 36 | 36 |
| R-squared | 0.168 | 0.273 | 0.329 | 0.370 |

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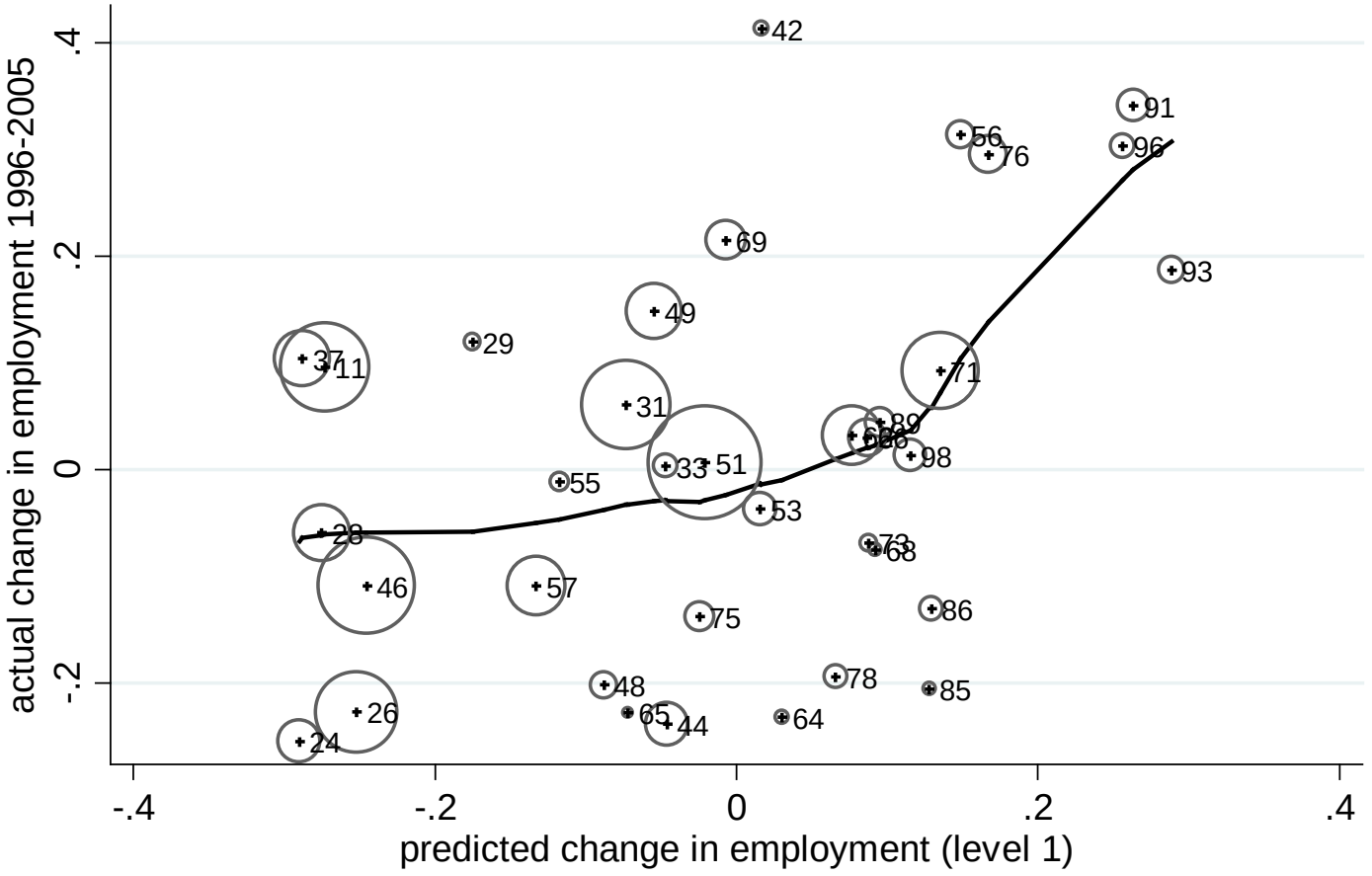
# Predicted and actual changes



# Firm

- Task-industry connectivity
  - Prediction of the presence of task X given the presence and importance of task Y

$$tic^{j,r} = \sum_{jj \neq j} c_{j,jj} m_{jj,r}$$

where *r* indexes 70 industries and *j* indexes 33 tasks. *cj,jj* is an element of the correlation matrix of 33 tasks that shows how task *j* is correlated with other tasks *jj* at the industry level

- Task-industry wage differential
  - No differentials other than selection effects. We neglect these

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# Analysis

- Changes in task importance
  - Task-industry connectivity correlates positively with changes in task importance
- Changes in employment
  - Task-industry connectivity correlates positively with changes in employment

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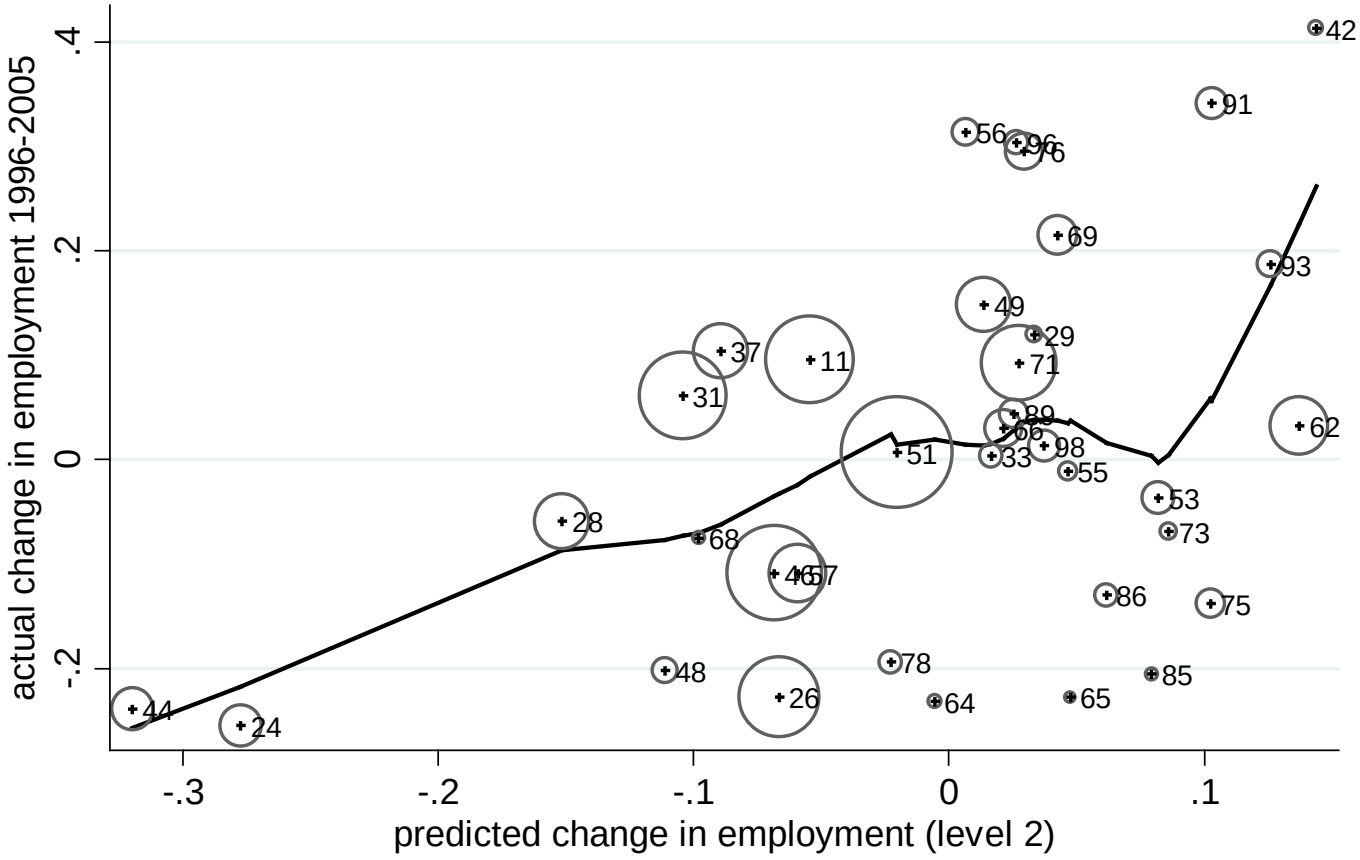
# Predicted and actual changes



# Space

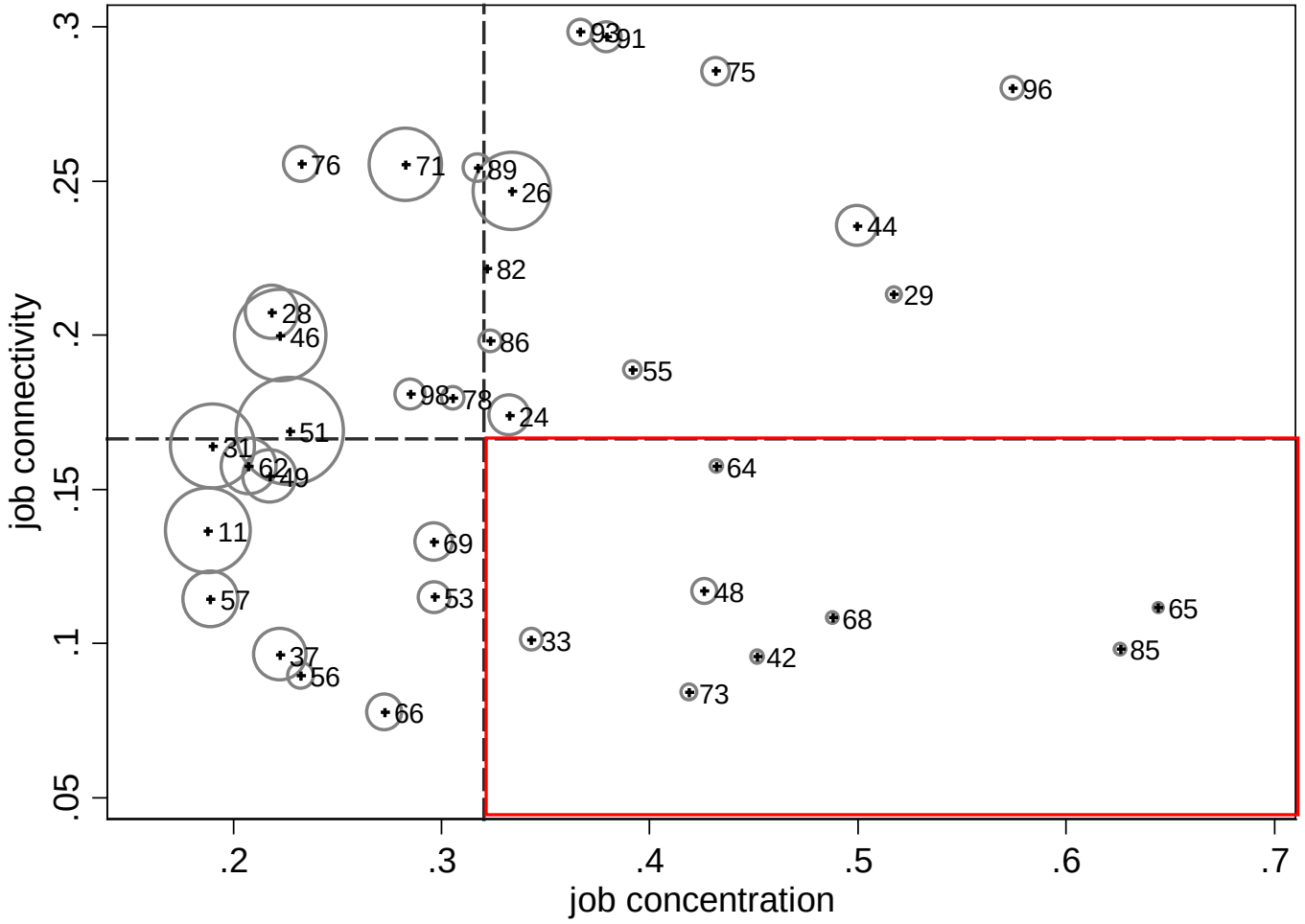
- Job connectivity
  - Prediction of the presence of job X given the presence and importance of job Y
  - Connectivity at the geographical level is measured based on the distribution of occupations. The measured tasks do not capture geographical variation in economics activities well enough

$$job\ \ connectivity^{i} = \sum_{ii \neq i} C_{i,ii} M_{i}$$

- Job concentration
  - Tradability of jobs: difference between the occupation and population share

$$job\ \ concentration = \sum_{i=1}^{n} \left| occ_{i} - p_{i} \right|$$

# Concentration and connectivity

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# Job connectivity, job concentration and employment changes

| Dependent variable: Changes in employment, 1996-2005 | (1) OLS | (2) WLS | (3) OLS | (4) WLS |
|---|---|---|---|---|
| job concentration | -0.142** | -0.135** | | |
| | (0.069) | (0.058) | | |
| job connectivity | 0.039 | 0.029 | | |
| | (0.034) | (0.029) | | |
| education 1996 | 0.102*** | 0.133*** | 0.118*** | 0.154*** |
| | (0.037) | (0.031) | (0.034) | (0.034) |
| log employment 1996 | -0.049 | -0.017 | 0.020 | 0.025 |
| | (0.043) | (0.027) | (0.025) | (0.019) |
| log wage 1996 | -0.326*** | -0.285*** | -0.326*** | -0.333*** |
| | (0.113) | (0.091) | (0.102) | (0.093) |
| constant | 3.078*** | 2.276*** | 2.373** | 2.390*** |
| | (0.966) | (0.720) | (0.880) | (0.717) |
| Observations | 36 | 36 | 36 | 36 |
| R-squared | 0.364 | 0.472 | 0.270 | 0.411 |

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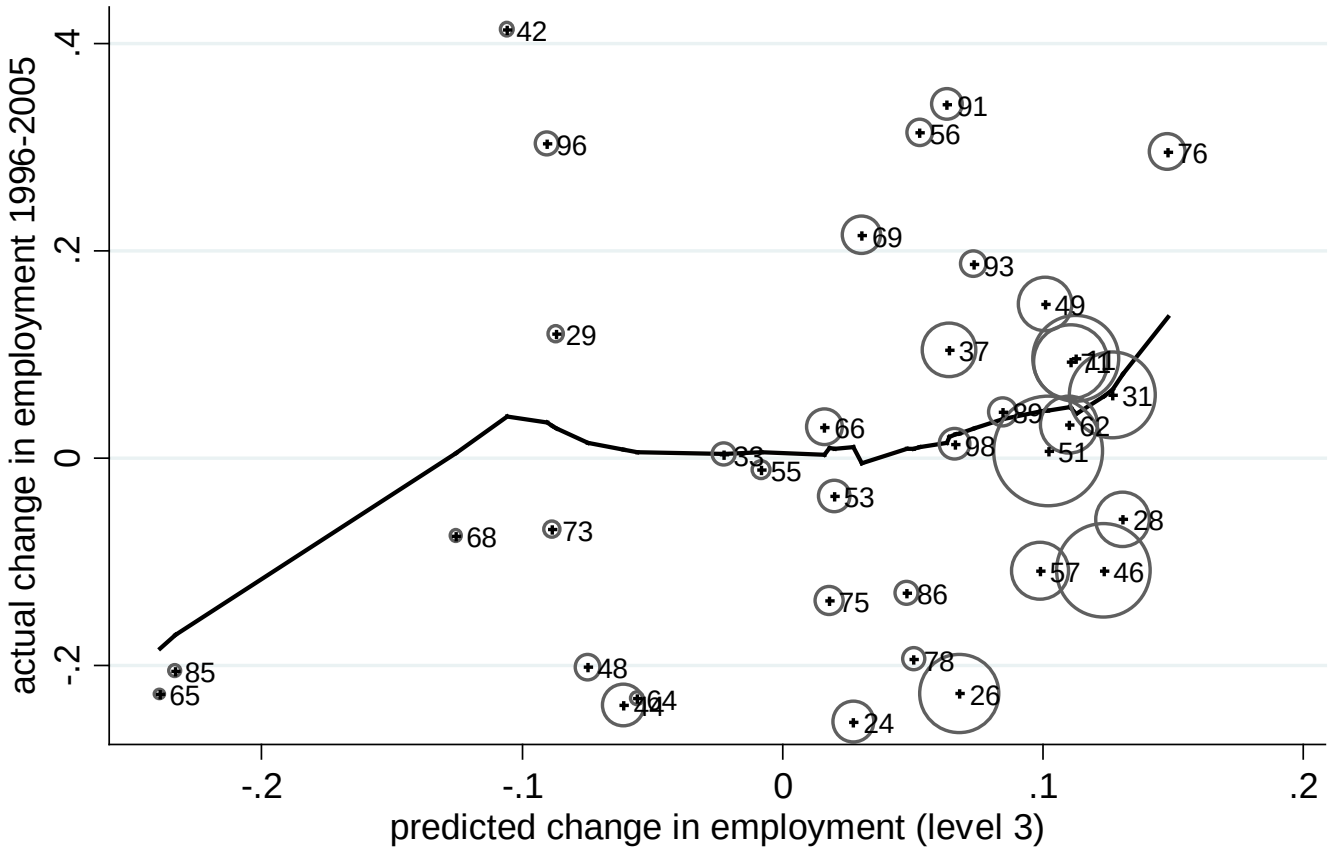
# Predicted and actual changes



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# Offshoring

- Contestable tasks are
  - Unconnected
  - Concentrated

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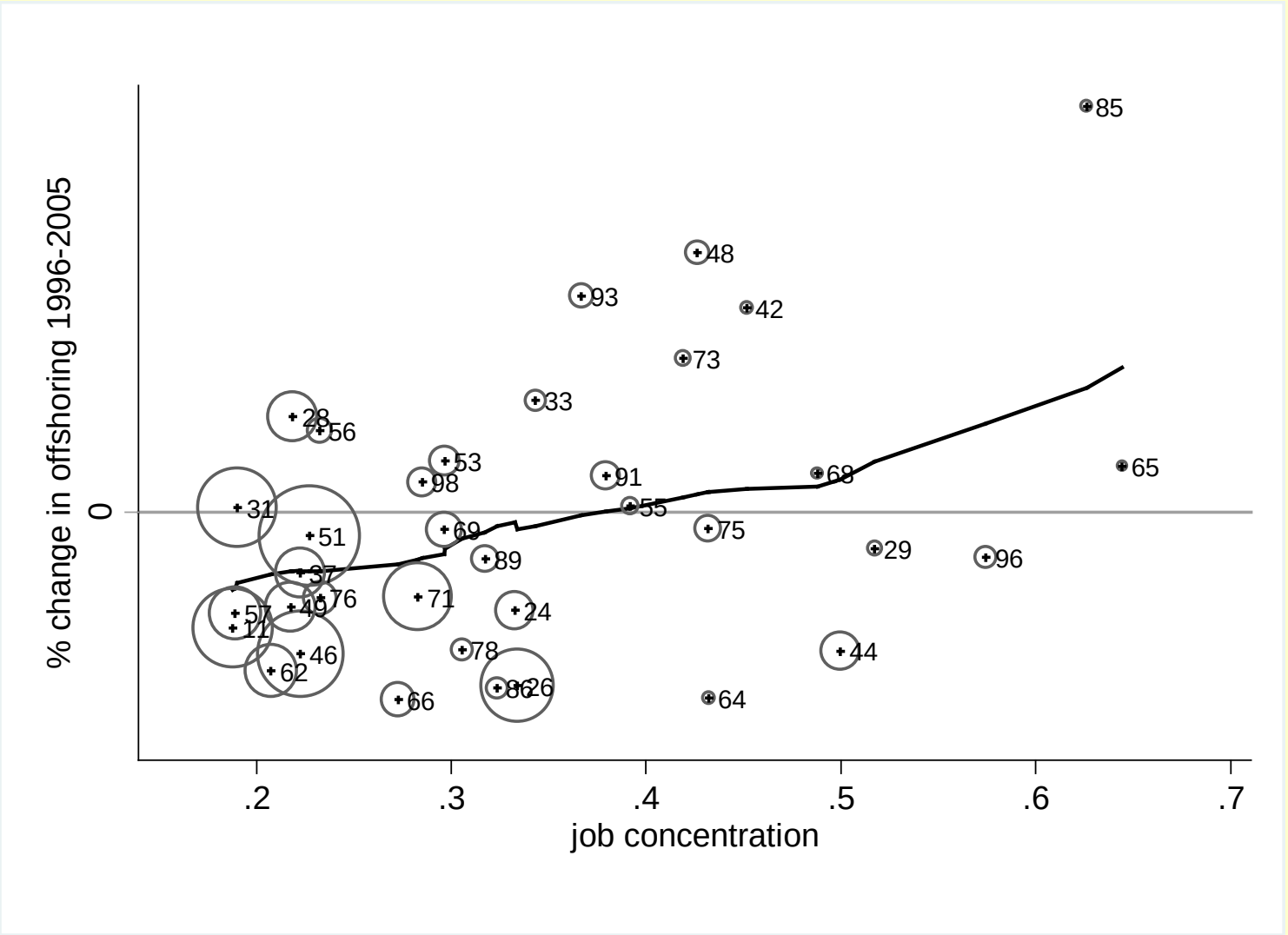
# Offshoring



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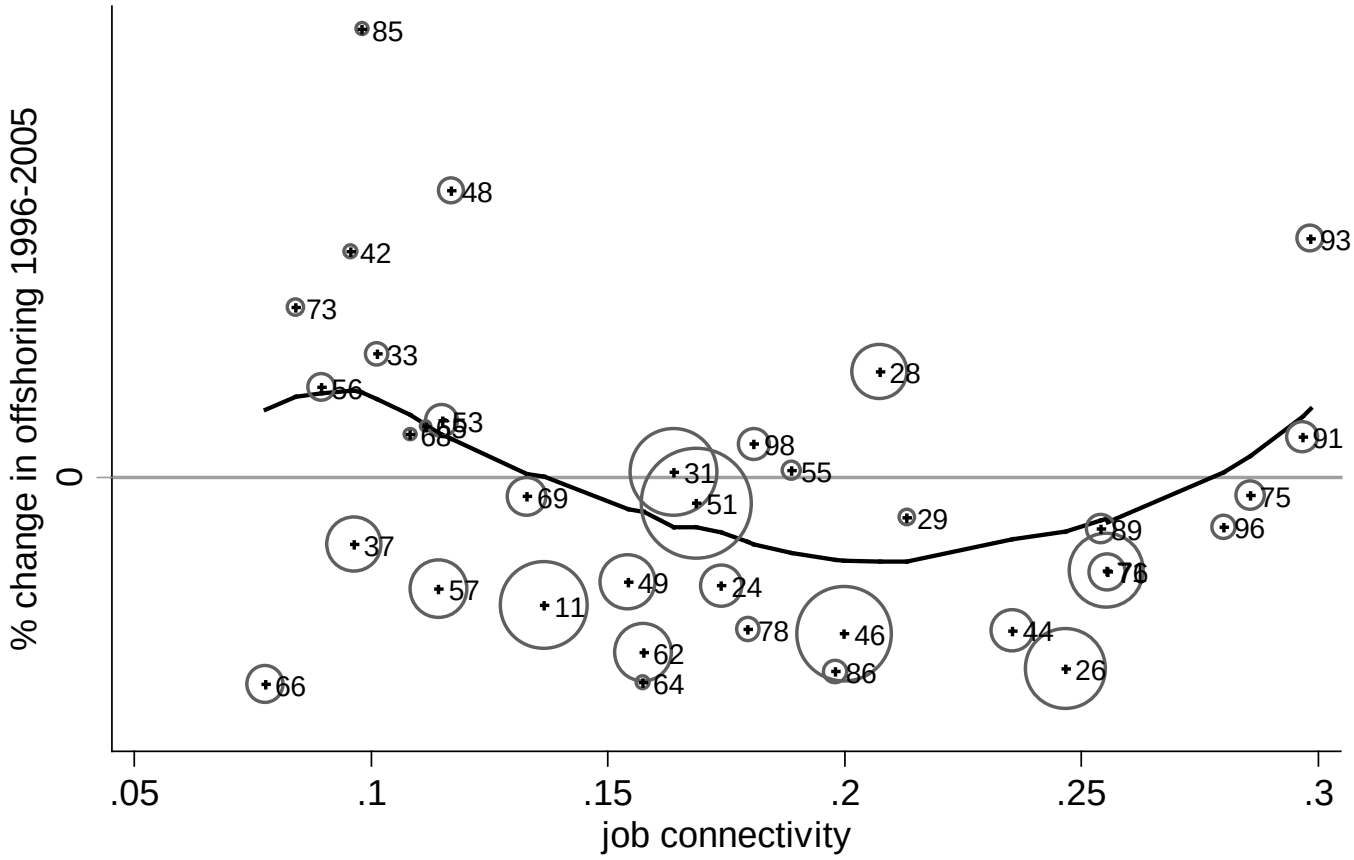
# Offshoring



# Offshoring

| Dependent variable: Changes in offshoring, 1996-2005 | (1) OLS | (2) OLS | (3) OLS | (4) WLS |
|---|---|---|---|---|
| job concentration | 0.059** | | 0.060** | 0.029 |
| | (0.025) | | (0.023) | (0.023) |
| job connectivity | | -0.020 | -0.021 | -0.005 |
| | | (0.015) | (0.013) | (0.012) |
| offshoring 1996 | -0.023* | -0.014 | -0.023* | -0.022** |
| | (0.012) | (0.085) | (0.011) | (0.010) |
| constant | 0.024* | 0.017 | 0.024* | 0.007 |
| | (0.014) | (0.013) | (0.013) | (0.015) |
| Observations | 36 | 36 | 36 | 36 |
| R-squared | 0.248 | 0.090 | 0.317 | 0.218 |

# Conclusion

- Trade in tasks effects employment
  - Framework of workers, firms and space helps understand why some tasks are contested
    - Workers connectivity and price effect
    - Firms connectivity
    - Space connectivity and concentration
  - Empirical evidence suggests that
    - low connectivity and large wage differentials induce separation

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# Conclusion

- Will my job be offshored?
- It depends …
  - How well connected are the tasks within your job?
  - How large is the price differential in your job?
  - When tasks are separated from your job, to what extent will they be outsourced by the firm?
  - How well connected is your job to other jobs?
  - How concentrated is your job in space?

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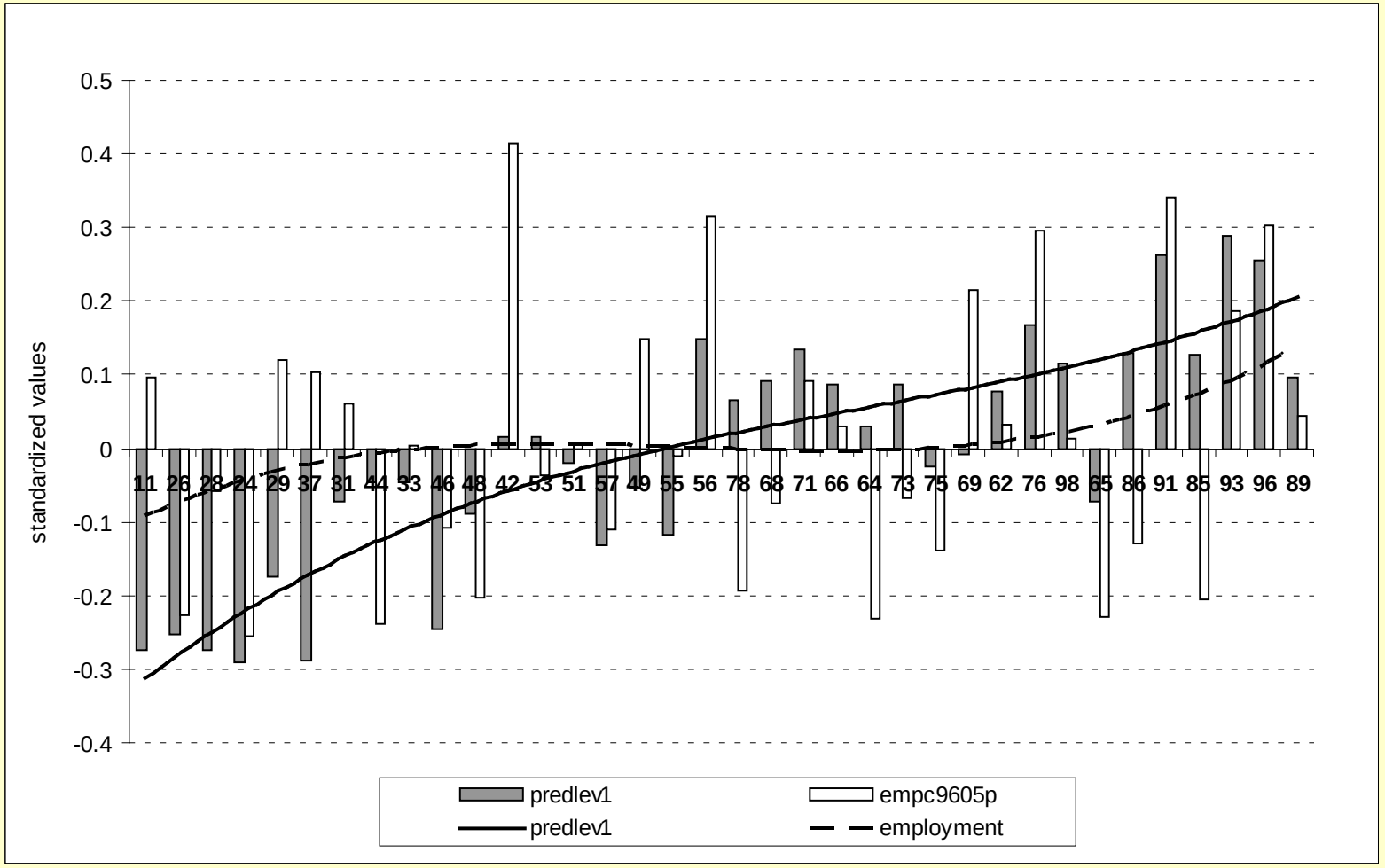
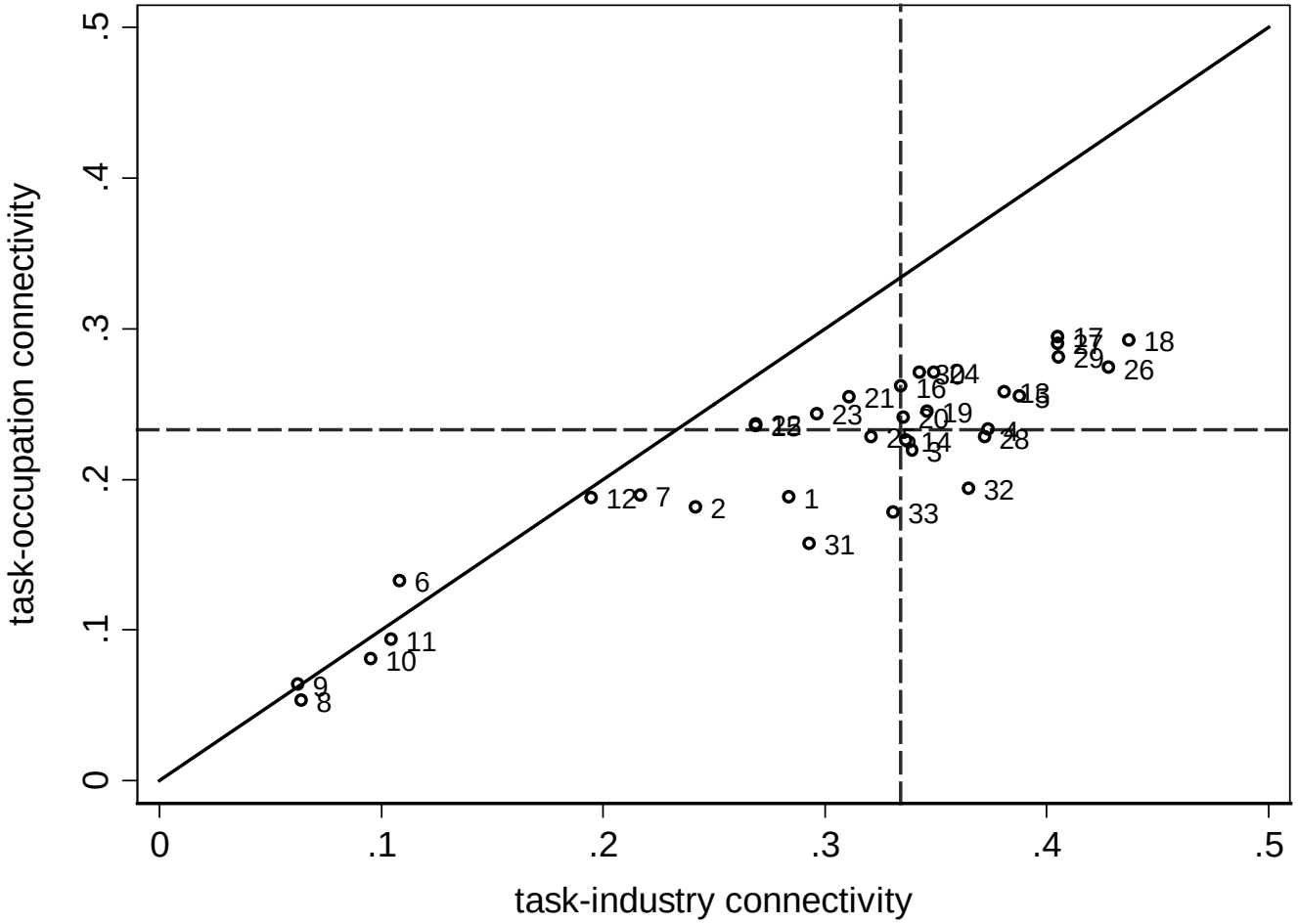
# Predicted and actual changes by level of education



# Tasks are more connected to the industry than the occupation



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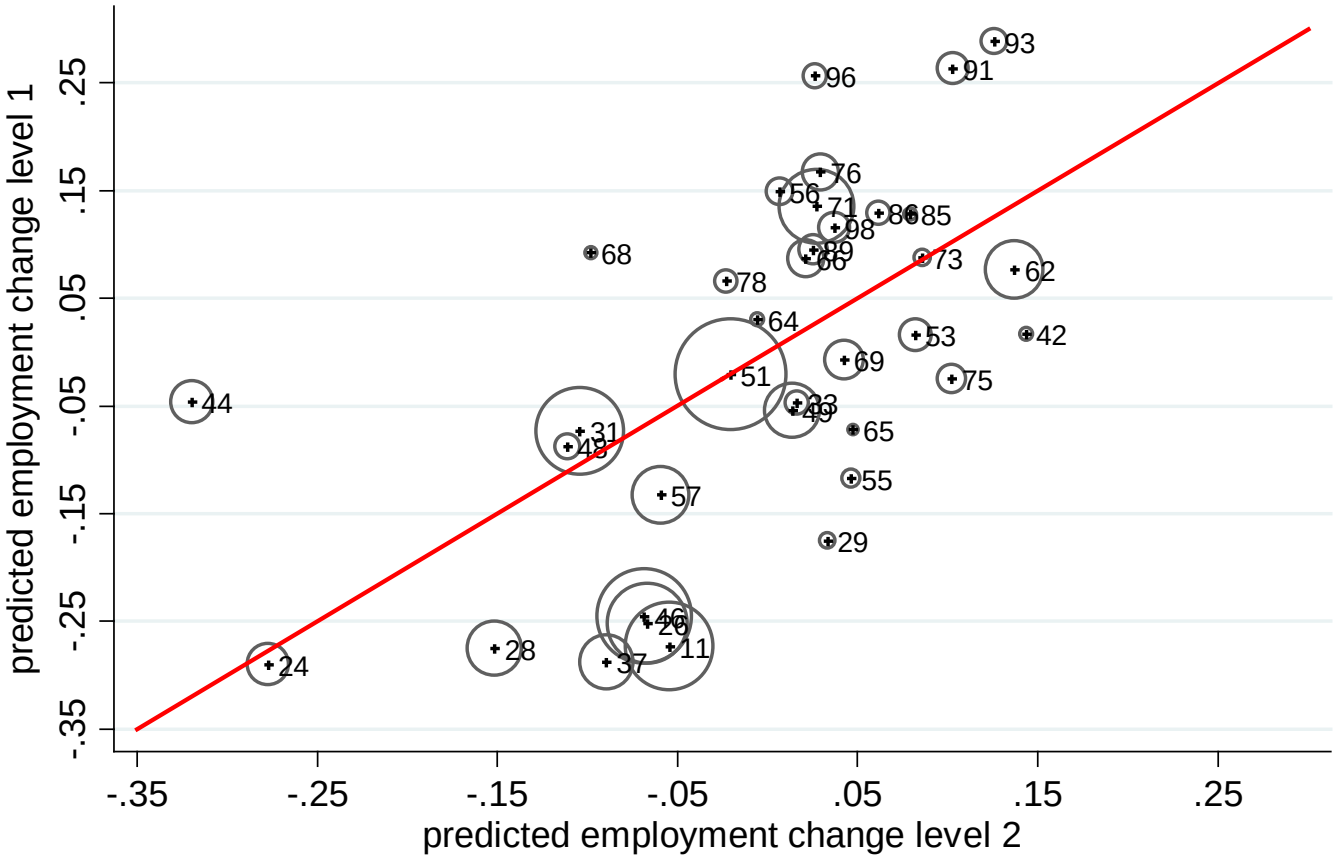
# Predicted and actual changes



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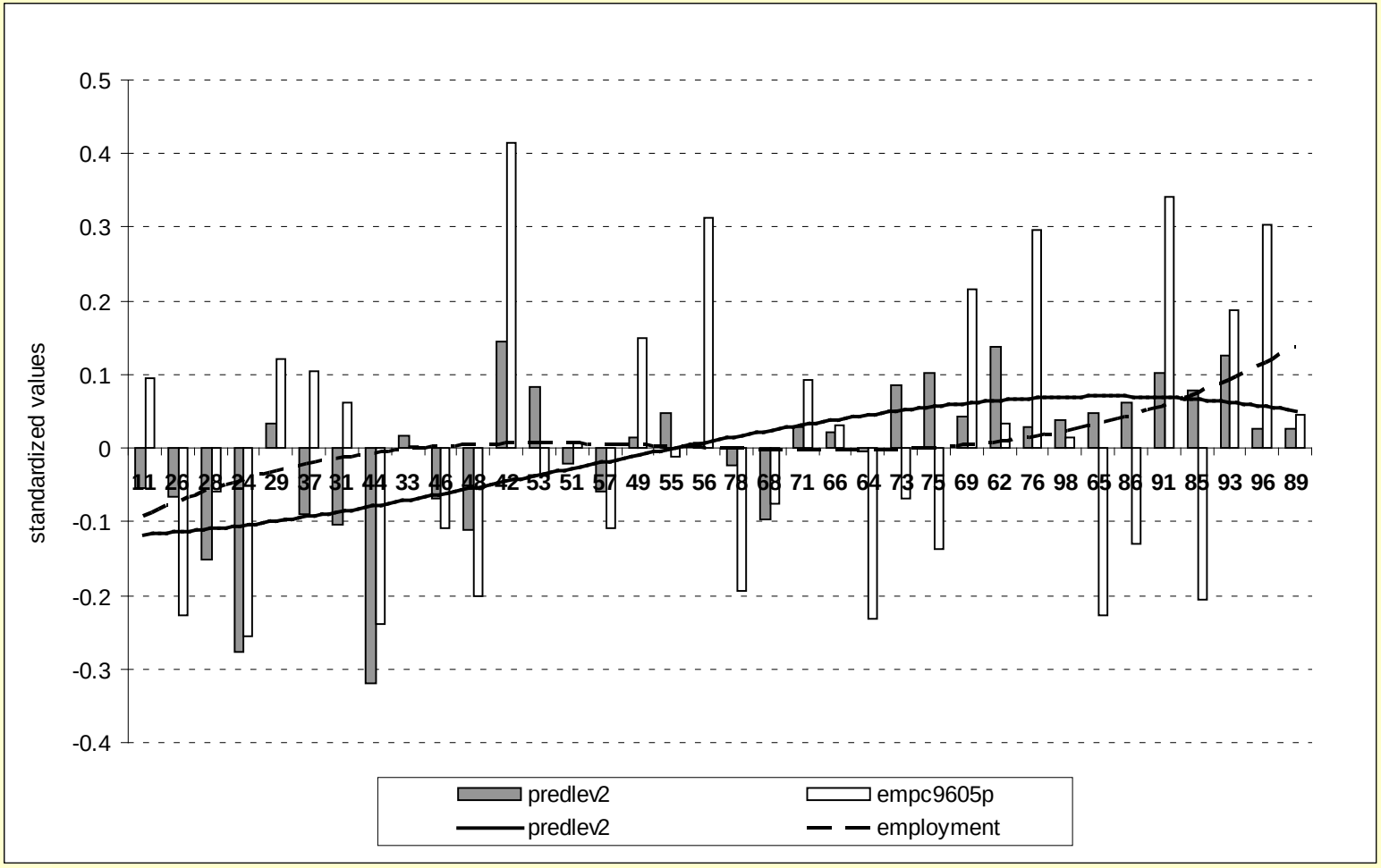
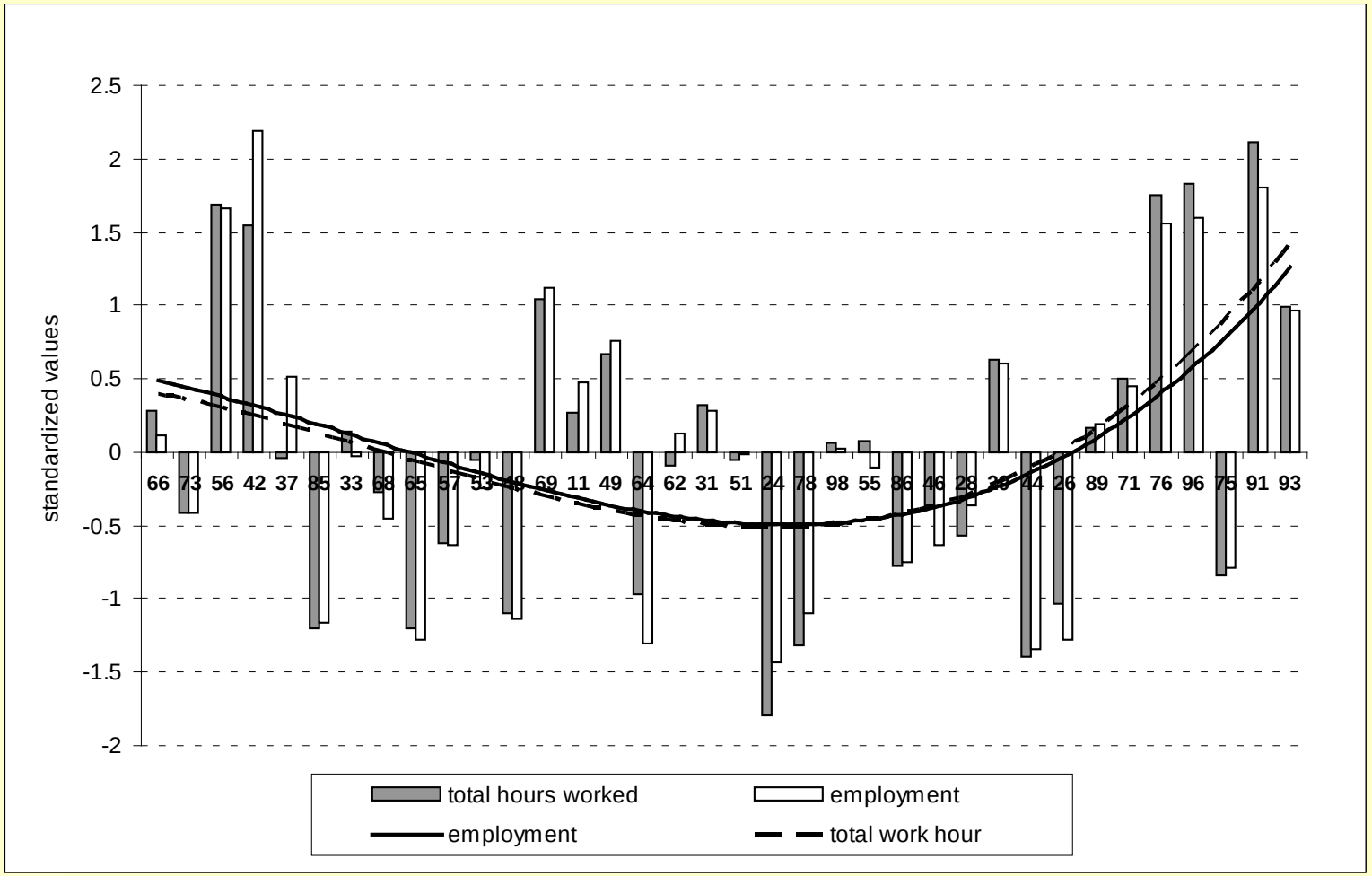
# Predicted and actual changes by level of education



# Job connectivity and employment changes

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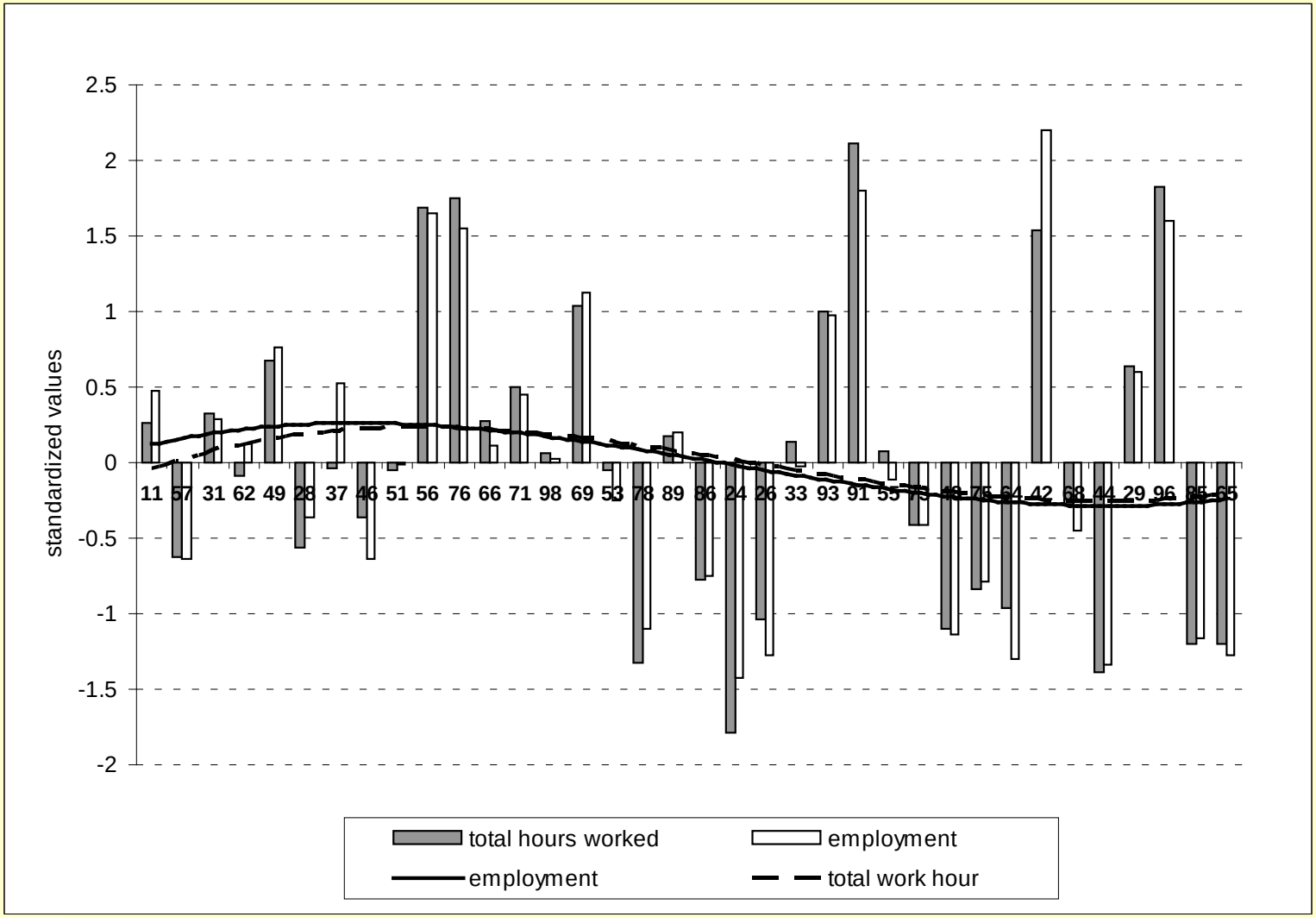
# Job concentration and employment changes

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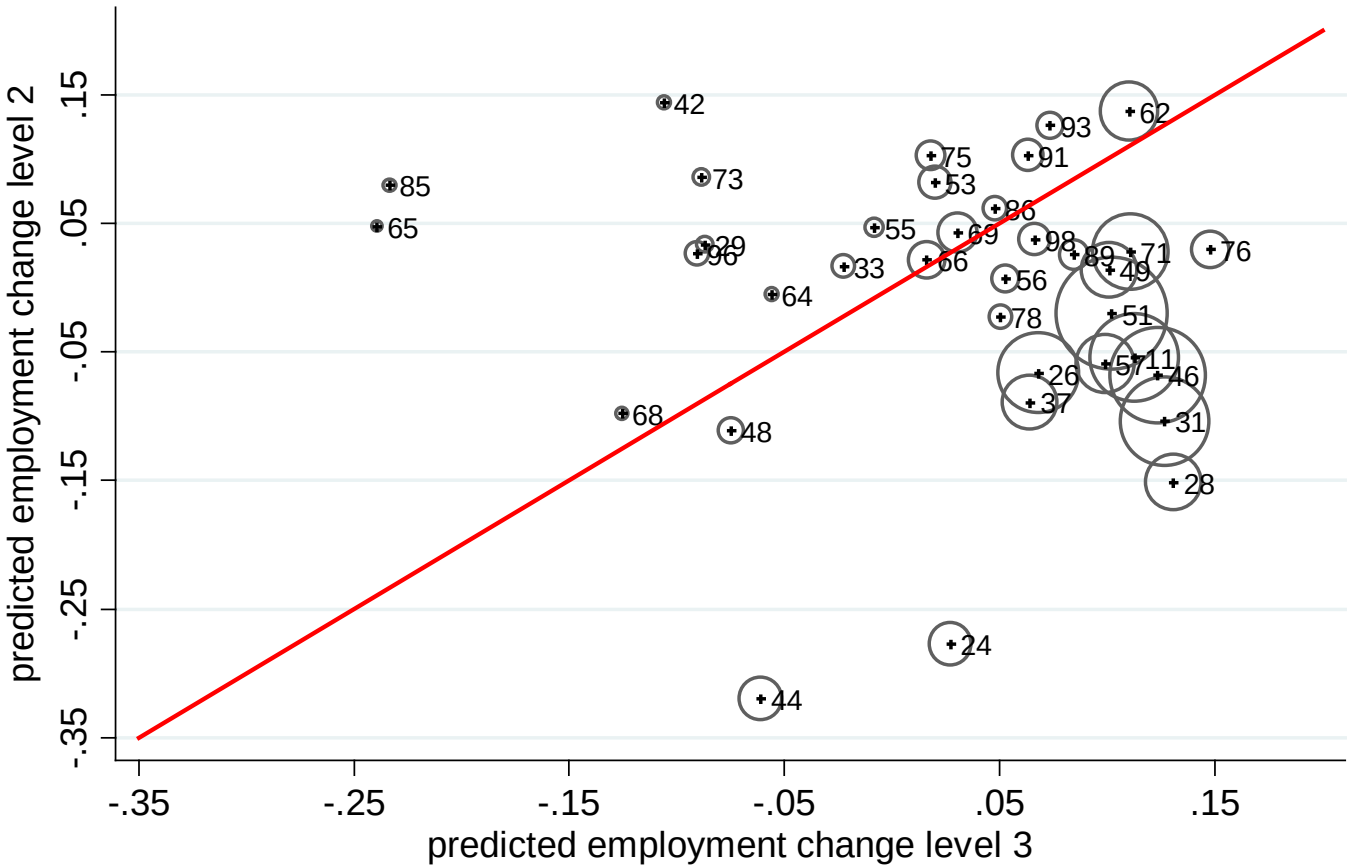
# Predicted and actual changes