

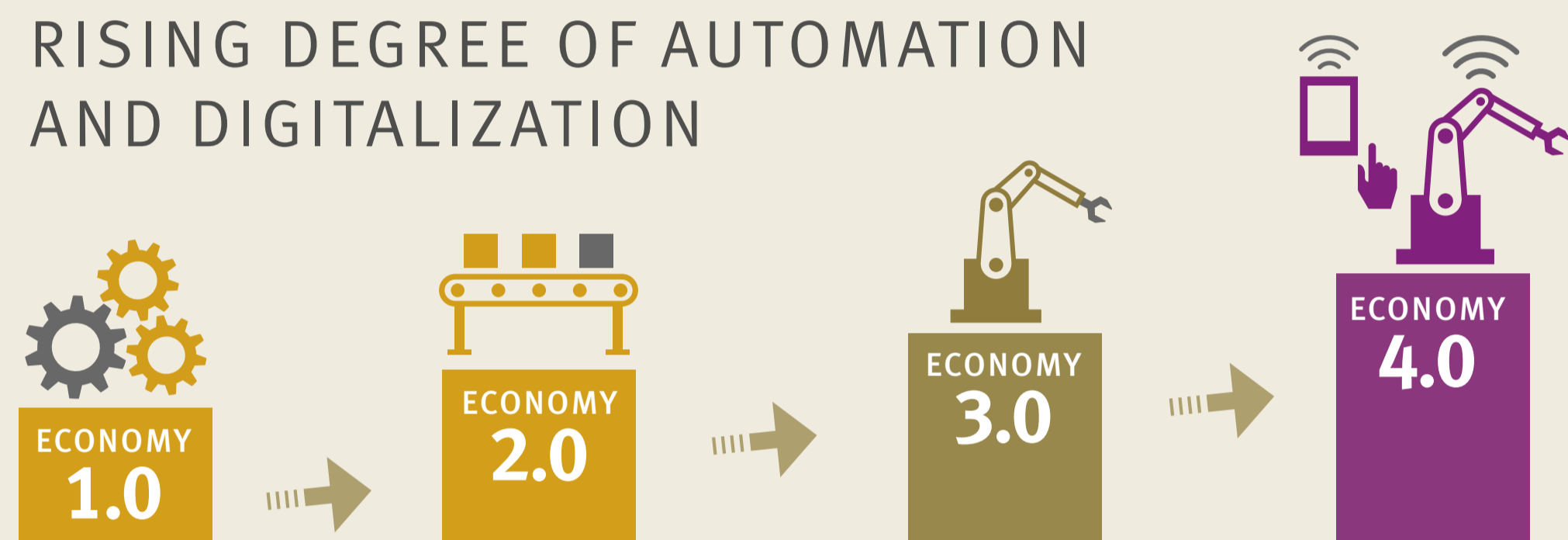
# Technology and Jobs in the Fourth Industrial Revolution

## FIRM-LEVEL EVIDENCE

### 1 CONTRIBUTION //

- » Provide first evidence on the diffusion of cutting-edge 4.0 technologies among German firms
- » Estimate the impact of technology on jobs on a firm-level
- » Estimate complementarity/substitution effects between technologies and worker groups

RIISING DEGREE OF AUTOMATION AND DIGITALIZATION

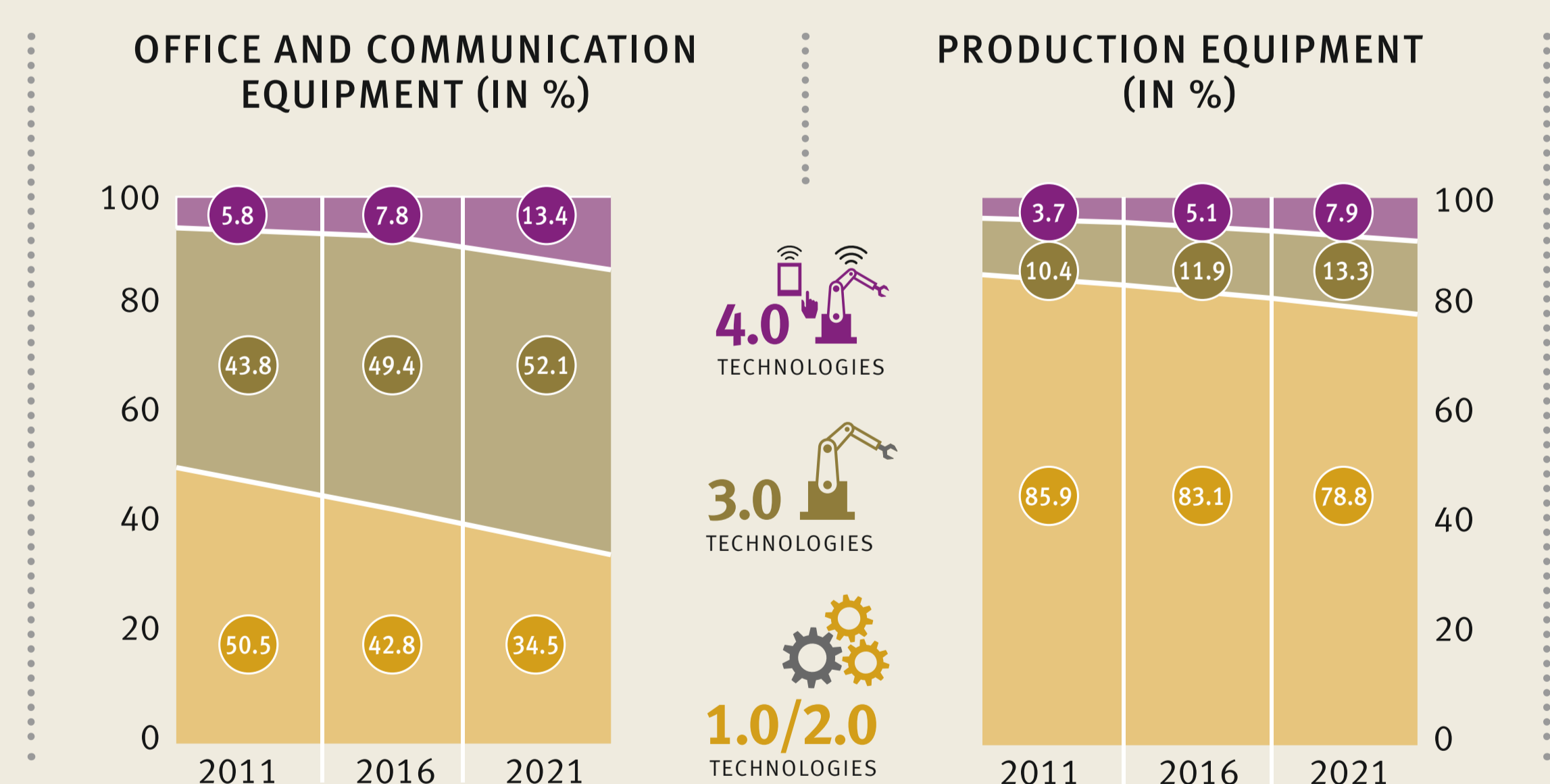


### 2 DATA //

- » Firm survey among 2032 producers and service providers (March 2016)
- » Current, past and future work equipment (machines, computers, robots, etc.)
- » Linked to social security records of all workers employed in the surveyed firms

### 3 DESCRIPTIVES //

COMPOSITION OF FIRMS' WORK EQUIPMENT



- » Small share but fast growth of 4.0 technologies

#### DIGITAL DIVIDE

##### GROUP I: FORERUNNERS

invested in 4.0 technologies

- » mostly larger and more capital-intensive firms
- » larger revenues and profits
- » more aware of chances and risks of digitization
- » a lot of interactive work

##### GROUP II: LATECOMERS

never invested in 4.0 technologies

- » least digitized
- » smaller firms with lower revenues and profits
- » least aware of chances and risks of digitization
- » employ mostly middle skilled workers
- » a lot of manual routine work

### 4 ECONOMETRIC APPROACH //

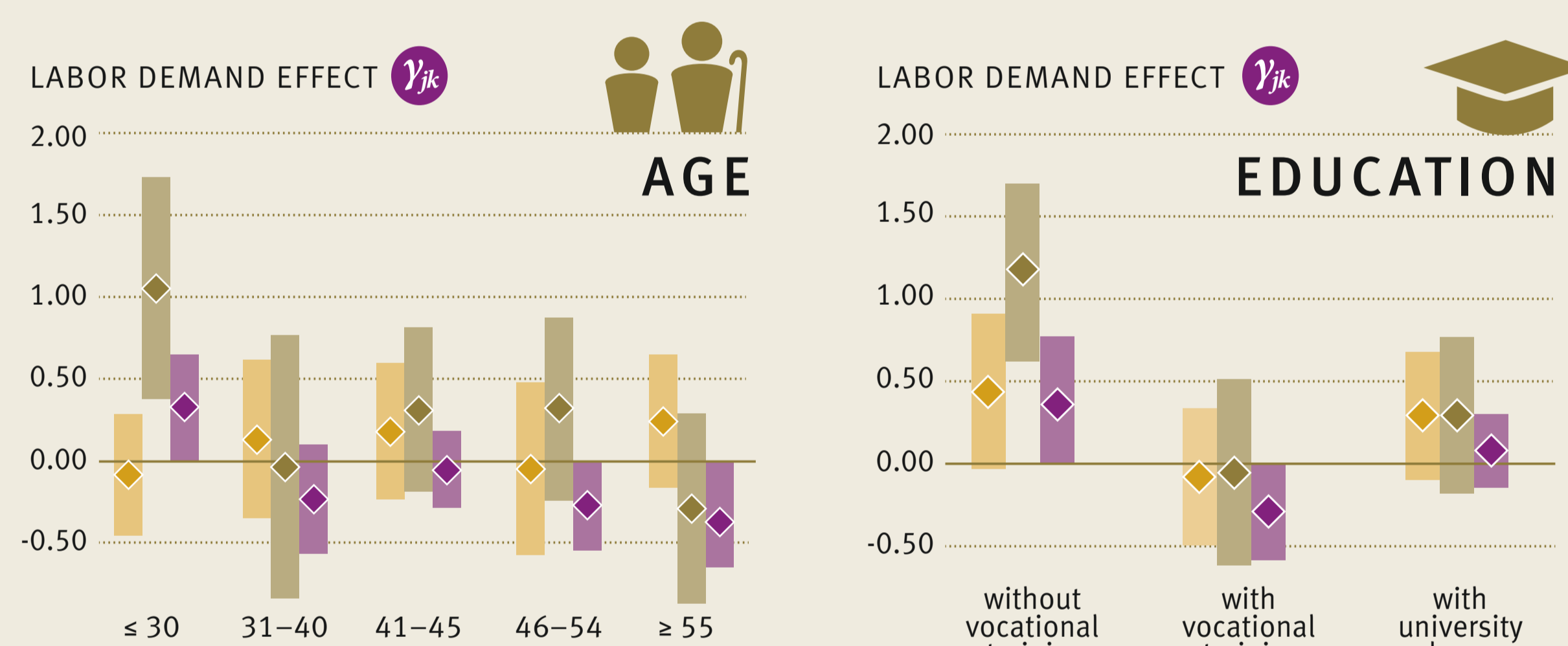
Estimate 5-year changes ( $\Delta$ ) in labor demand in firm  $i$  and worker group  $j$ :

$$\Delta \ln N_{ij} = \alpha \Delta \ln Y_i + \beta \Delta \ln \frac{w_i}{w_{ij}} + \sum_{j=1}^J \sum_{k=1}^K \gamma_{jk} \Delta \ln C_{ik} + \epsilon_{ij}$$

NUMBER OF WORKERS:  $\Delta \ln N_{ij}$   
 VALUE ADDED:  $\Delta \ln Y_i$   
 RELATIVE WAGES:  $\Delta \ln \frac{w_i}{w_{ij}}$   
 TECHNOLOGY TYPE SPECIFIC CAPITAL STOCKS:  $\Delta \ln C_{ik}$   
 COMPLEMENTARITY/SUBSTITUTION EFFECTS BETWEEN CAPITAL TYPE  $K$  AND WORKER GROUP  $J$ :  $\gamma_{jk}$

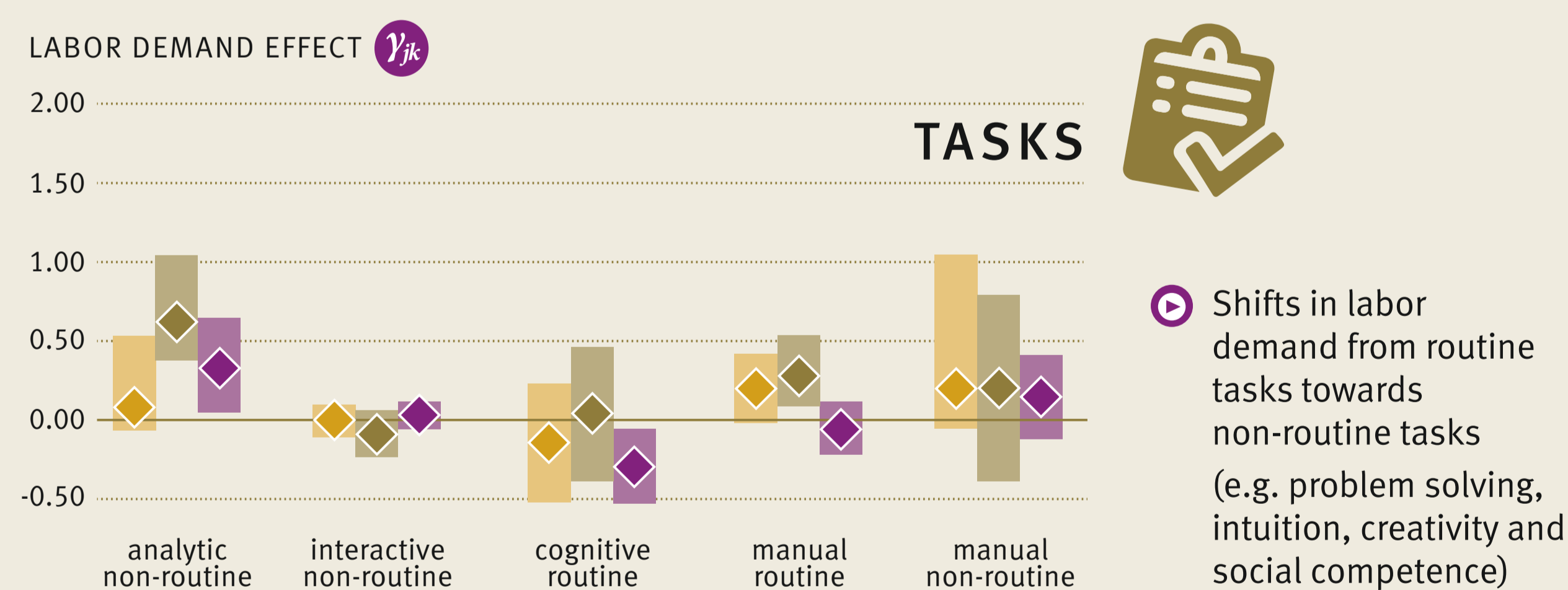
### 5 RESULTS //

IMPACT OF TECHNOLOGY INVESTMENTS ON FIRM LABOR DEMAND BY WORKER GROUP, 2011–2016, IN PERCENT



- » Modern technologies complement younger workers while substituting for older ones

- » Polarization within firms in favor of both low- and high-skilled workers at the expense of the middle-skilled



- » Shifts in labor demand from routine tasks towards non-routine tasks (e.g. problem solving, intuition, creativity and social competence)

### 6 CONCLUSIONS //

- » Slow but accelerating adoption of 4.0 technologies
- » Widening digital divide in the firm landscape
- » Neutral effect on total firm labor demand
- » Labor demand shifts
  - » towards interactive and analytical tasks
  - » from medium skilled to low- and high-skilled workers
  - » in favor of younger workers