

# The Automation-Training Gap Revisited: Evidence from PIAAC

A constrained replication and extension with PIAAC data from Cycle 1 and 2

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## A study finds nearly half of jobs are vulnerable to automation

That could free people to pursue more interesting careers

The  
Economist

Schumpeter

## Will a robot really take your job?

A notorious forecast about the automation of jobs has been hugely misunderstood, says one of its authors

Jun 29th 2019

## How AI's threat to entry-level jobs is turning gen Z into 'Generation Entrepreneur'

The  
Guardian

Automation

## Robots threaten jobs less than fearmongers claim

Recessions and pandemics accelerate automation. Yet warnings of a jobless future are overblown

## Growing need to update skills throughout life

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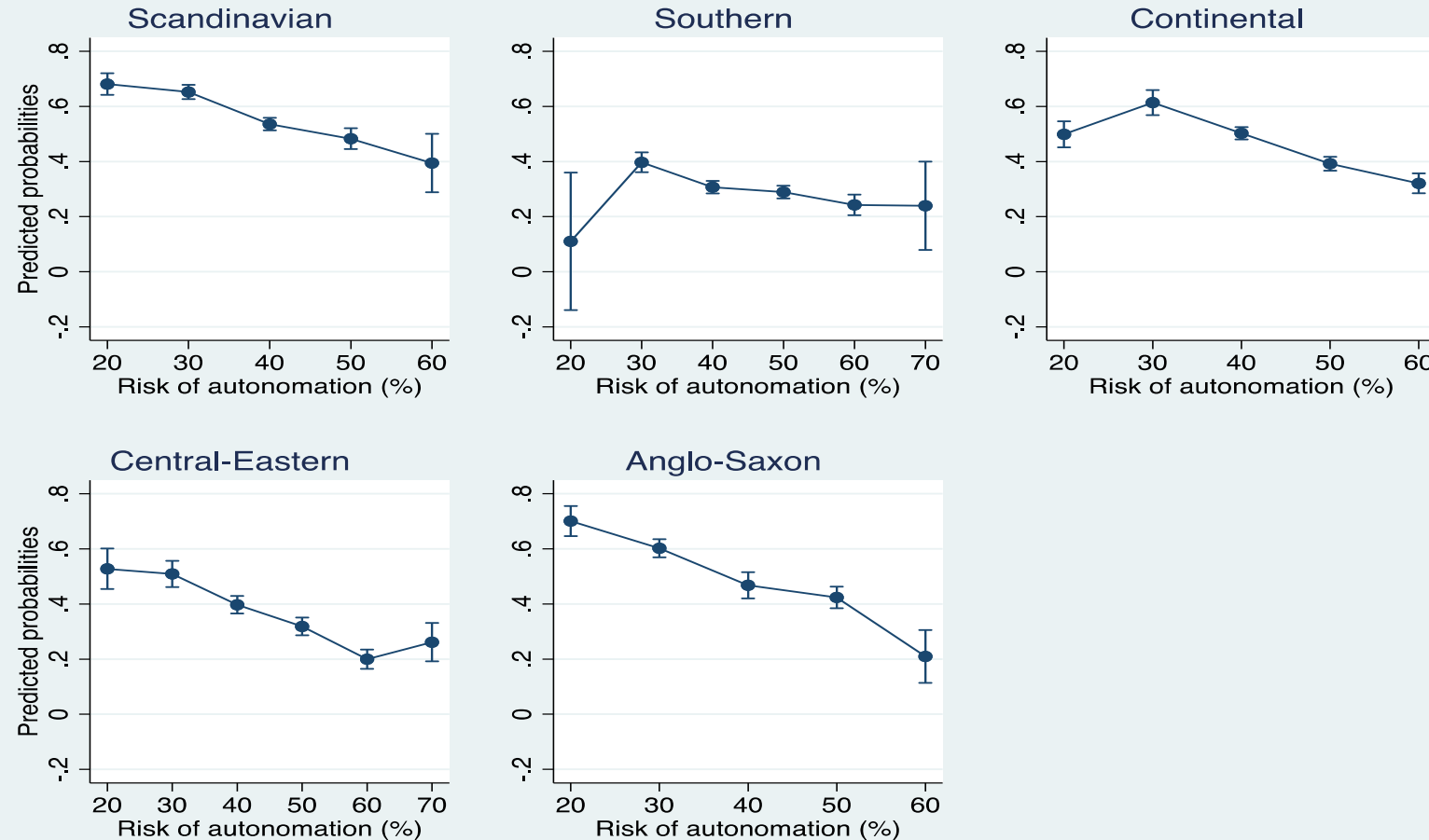
- Some occupations face greater exposure. (Nedelkoska & Quintini 2018; Arntz et al. 2016).
- Gen AI introduced a new dimension: it is increasingly affecting non-routine, cognitive, and creative tasks. (Gathmann et al., 2024; Pouliakas, 2021; Seegers, 2025)
- Re-/Upskilling has become a key challenge in European policy.
- But access to adult education and training is unequal.  
(Desjardins & Rubenson 2013; Saar, Ure, & Desjardins, 2013; Boeren/Cabus/Mackie 2023).
- Workers most exposed to automation are least likely to participate in training  
→ “automation-training gap”. (Montizaan et al., 2025; Heß et al., 2023; Zeyer-Gliozzo 2024).

# Automation-training gap across different European welfare regimes: Evidence from PIAAC Cycle 1

In a previous study, we explored participation in job-related AET by risk of job automation across 14 European countries grouped in five welfare regime using PIAAC data Cycle 1 (Ioannidou & Parma 2021).

## Findings

- The probability to participate in job-related AET is significantly and negatively associated with risk of automation.
- Trend is rather consistent across all welfare regimes.
- Workers in Scandinavian and Anglo-Saxon countries show higher probabilities to participate in AET even after controlling for other factors (age, gender, education, employment status).



- RQ1** ■ Does the negative relationship between risk of job automation and participation in job-related AET persist?  
(Constrained replication with PIAAC Cycle 2 data)
- RQ2** ■ Does this relationship differ across welfare regimes?  
(Constrained replication with PIAAC Cycle 2 data)
- RQ3** ■ Do subjective unmet demands for AET moderate the link between risk of automation and participation in AET?  
(Multivariate regression with PIAAC Cycle 2 data)
- RQ4** ■ Can characteristics of adult learning systems help explain the differences between countries beyond welfare regime classifications?  
(Extension on Adult Learning Systems, ALS)

### PIAAC Cycle 1 (PUF) 2011-18

**14 European countries - 5 welfare regimes**

**Scandinavian:** Denmark, Norway, Sweden

**Southern:** Italy, Spain, Greece

**Continental:** Germany, France, Belgium

**Central-Eastern:** Poland, Czech Republic, Slovakia

**Anglo-Saxon:** UK, Ireland

**Outcome 1:** participation in formal and non-formal job-related AET;

**Outcome 2:** Unmet demand for AET

**Main predictor:** estimated occupation-level automation risk (two-digit ISCO code)

**Analysis:** Descriptive and regression

**Core relationship:** negative

### PIAAC Cycle 2 (PUF) 2022–23

**13 European countries - 5 welfare regimes**

**Scandinavian:** Denmark, Norway, Sweden

**Southern:** Italy, Spain

**Continental:** Germany, France, Belgium

**Central-Eastern:** Poland, Czech Republic, Slovakia

**Anglo-Saxon:** UK, Ireland

**Outcome 1:** participation in non-formal job-related AET; **Outcome 2:** Unmet demand for AET (not restricted to job-related AET)

**Main predictor:** estimated occupational-level automation risk (ISCO missing in most countries in Cycle 2, ISIC industry, job type education/supervisory status)

**Analysis:** Descriptive and regression

**Core relationship:** ?

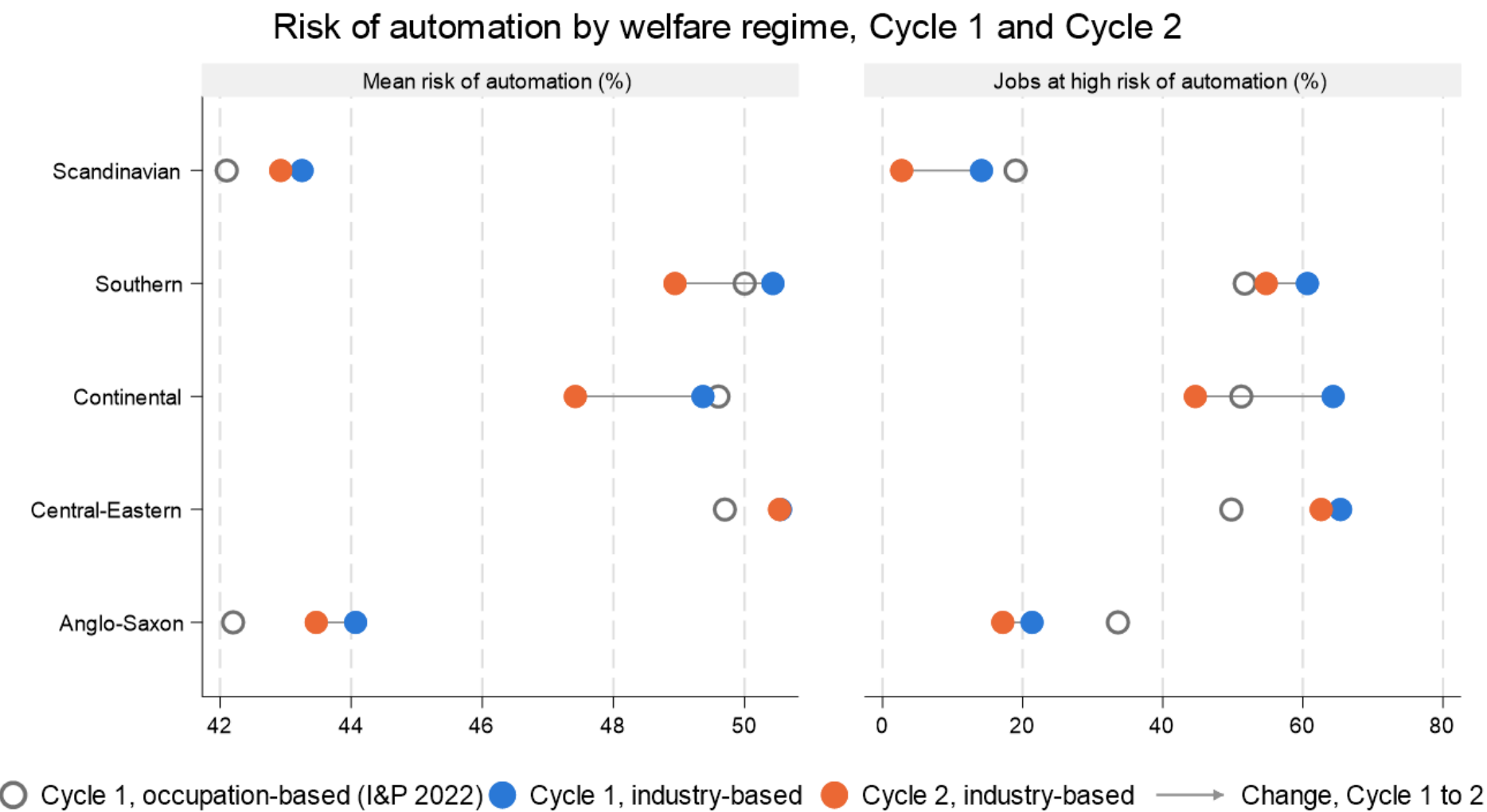
## Limitations: what the comparison can (not) establish

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- **Automation risk is an approximation.**
  - An occupation-level estimated probability, not the probability that an individual respondent will lose their job.
  - Based on previous pre-AI estimates. New risk measures probably necessary to get more up-to-date risk assessments.
- **Participation in AET between Cycle 1 and Cycle 2 not directly comparable**
  - Change in instrument, data measurement and availability and:
    - Cycle 1 – formal and non-formal job-related
    - Cycle 2 – non-formal job-related
- **Welfare regimes in 2023 include data for less countries** (Greece is missing from South-European, unmet demand released only for Denmark for Scandinavian)
- **Association is not causation.**
  - regime classifications are endogenous with risk, AET and demand
  - We lack longitudinal (within-person) data
- **Explanation remains open.**

Regime comparisons and reported barriers motivate an institutional explanation, but they do not explain cross-country differences.

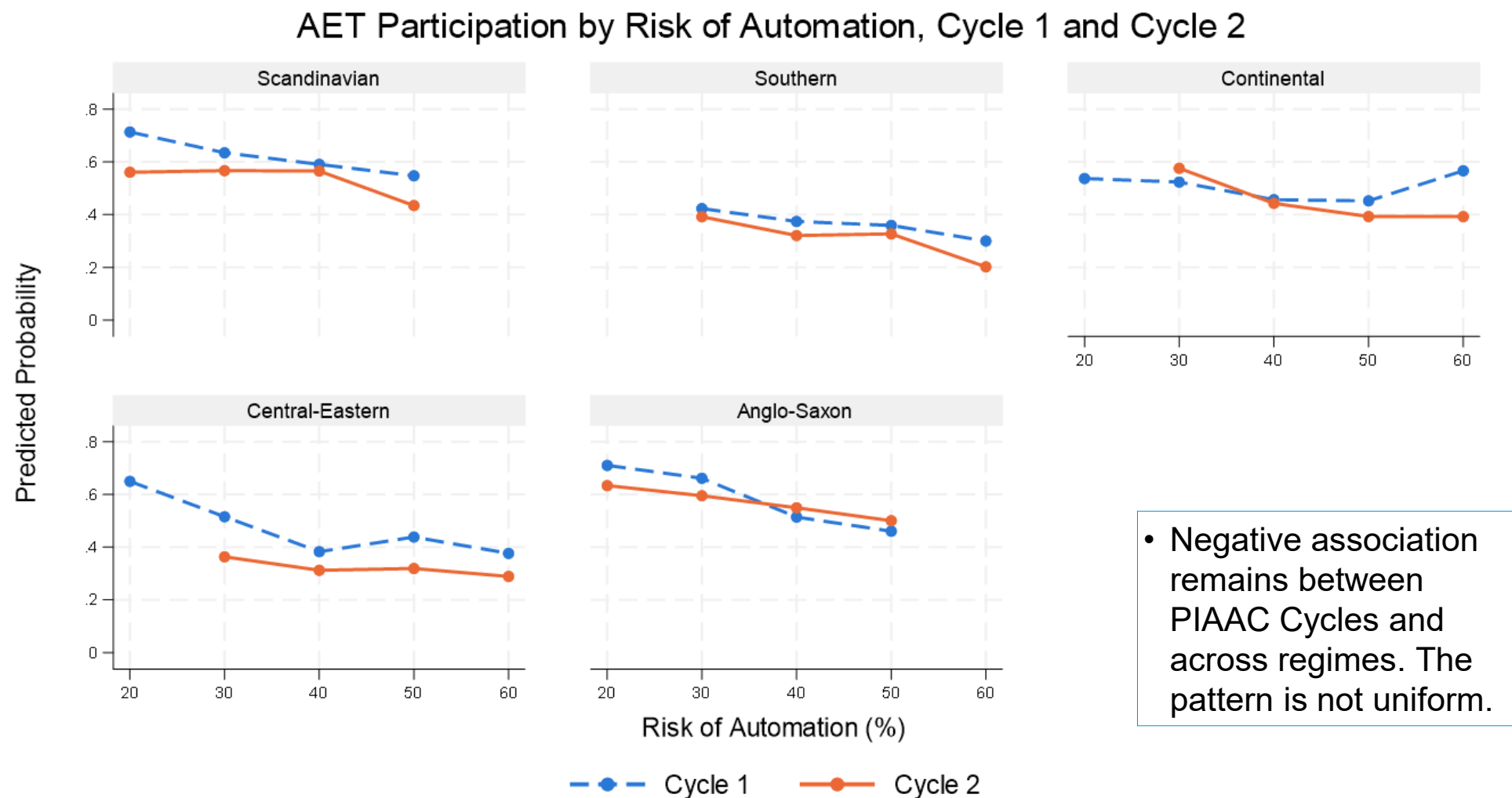
# Findings: Occupational automation exposure by welfare regime in Cycle 1 and Cycle 2



- Note: Only the industry-based pairs are comparable.
- Scandinavian and Anglo-Saxon regimes show lowest risk of automation
- Decrease in industry-based automation risk in Southern and Continental European regimes
- Central-Eastern European show highest risk, no decrease.

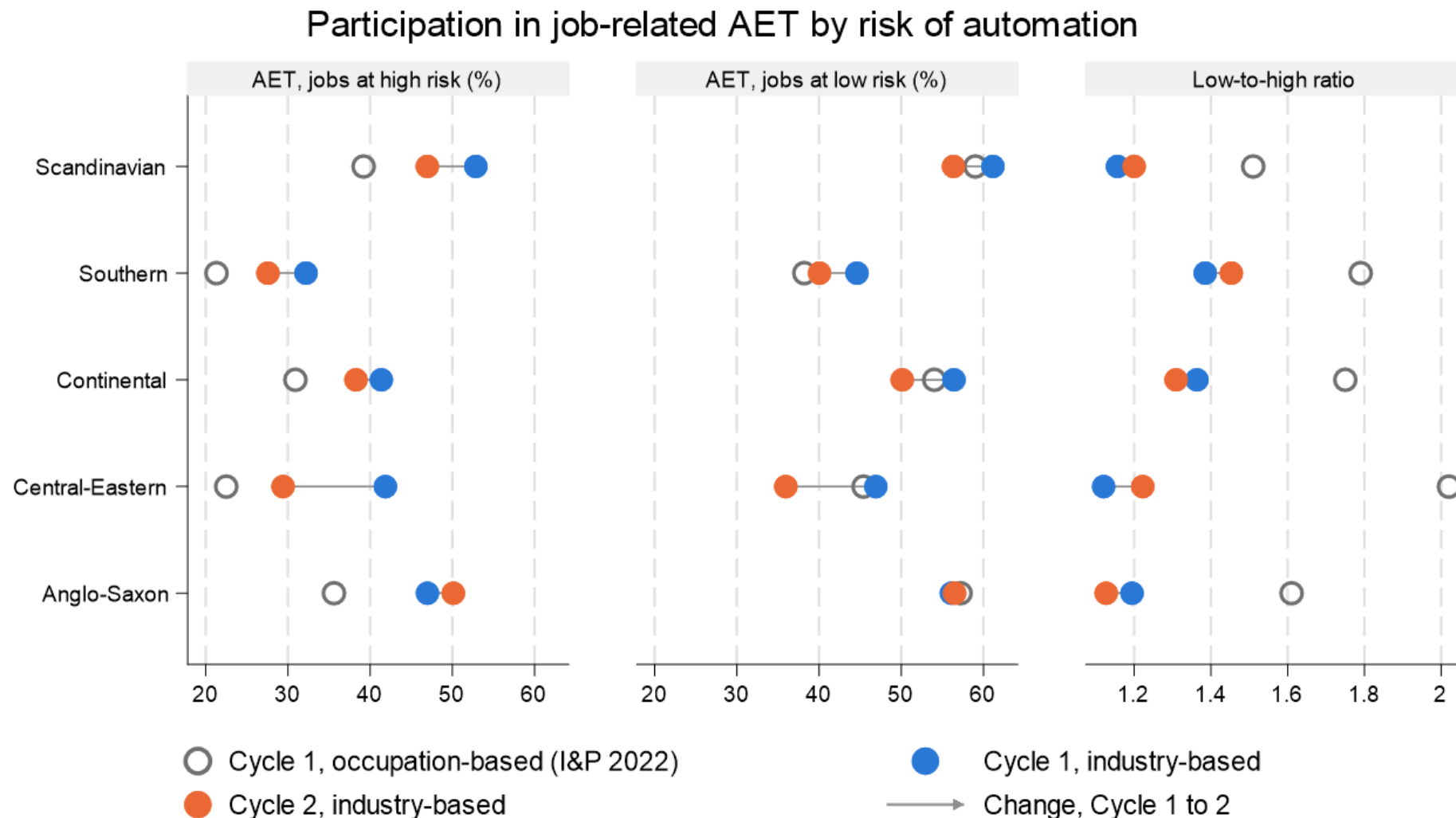
High risk = probability of automation above 50%. Occupation-based: I&P (2022), country x ISCO 2-digit risk, 14 countries.  
Industry-based: task-model risk averaged by country x industry x job type; currently employed, 25+; equal country weights; 13 countries (no Greece).

## Findings: AET participation by automation exposure by welfare regime in Cycle 1 and Cycle 2



Predicted probabilities from one logit per regime (controls: gender, age, education, employment status). Industry-based risk in both cycles. Job-related non-formal AET. Risk classes with fewer than 30 respondents are not shown.

## Findings: Participation in job-related AET by risk of automation

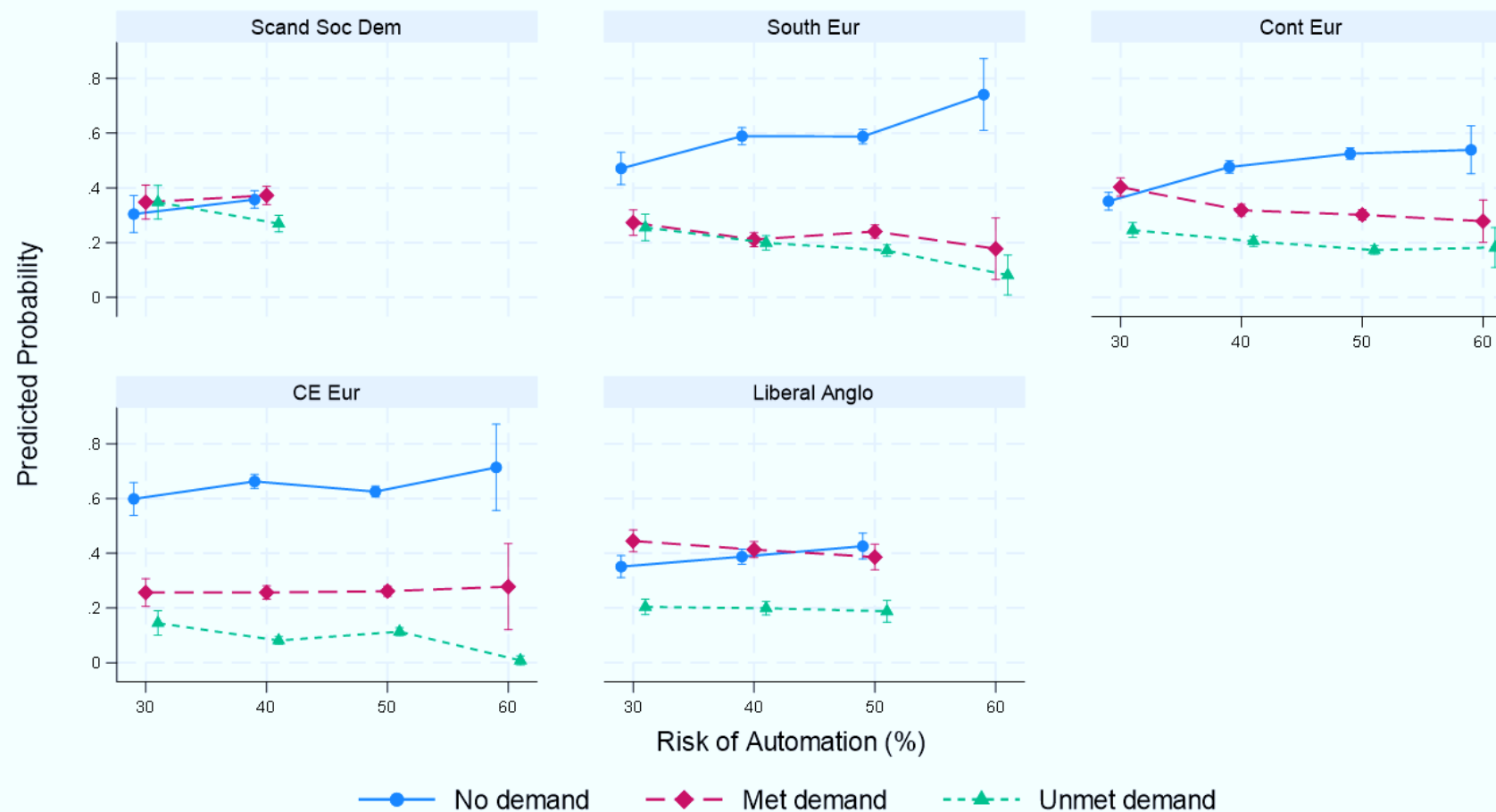


- AET participation decreases almost everywhere.
- But the instrument changed between PIAAC cycles (not exactly comparable).
- Scandinavian and Anglo-Saxon regimes show smaller gaps, risk independent.
- The gap looks roughly stable (industry-based pairs).

AET: I&P (2022) formal or non-formal job-related AET; industry-based rows: non-formal job-related AET only, so levels differ by definition. Ratio = participation in low-risk jobs / participation in high-risk jobs (1 = no gap). High risk = probability of automation above 50%.

## Demand for AET by risk of automation Cycle 2

Figure 7: Demand for AET by Risk of Automation



Workers in high-risk occupations participate less in AET, and report less unmet demand. Note: The Cycle 2 item is not job-related and is not released for Norway and Sweden.

This may reflect less expressed demand, less awareness of training possibilities, adaptation to constrained opportunities, or other factors

Why do workers not participate in (job-related) AET?

Research has shown that there are country specific institutional arrangements that determine the levels of barriers and enable individuals to overcome them (Breznau & Offerhaus 2026; Cabus, Ilieva-Trichkova, & Štefánik, 2020; Hovdhaugen & Opheim, 2018; Roosmaa & Saar, 2016; Rubenson & Desjardins 2009; Cross 1981).

**We focus on barriers among people who report unmet demand and distinguish between**

- **Situational barriers:** employer support; too busy at work; childcare and family responsibilities.
- **Institutional barriers:** did not have the prerequisites; costs; inconvenient time or place.

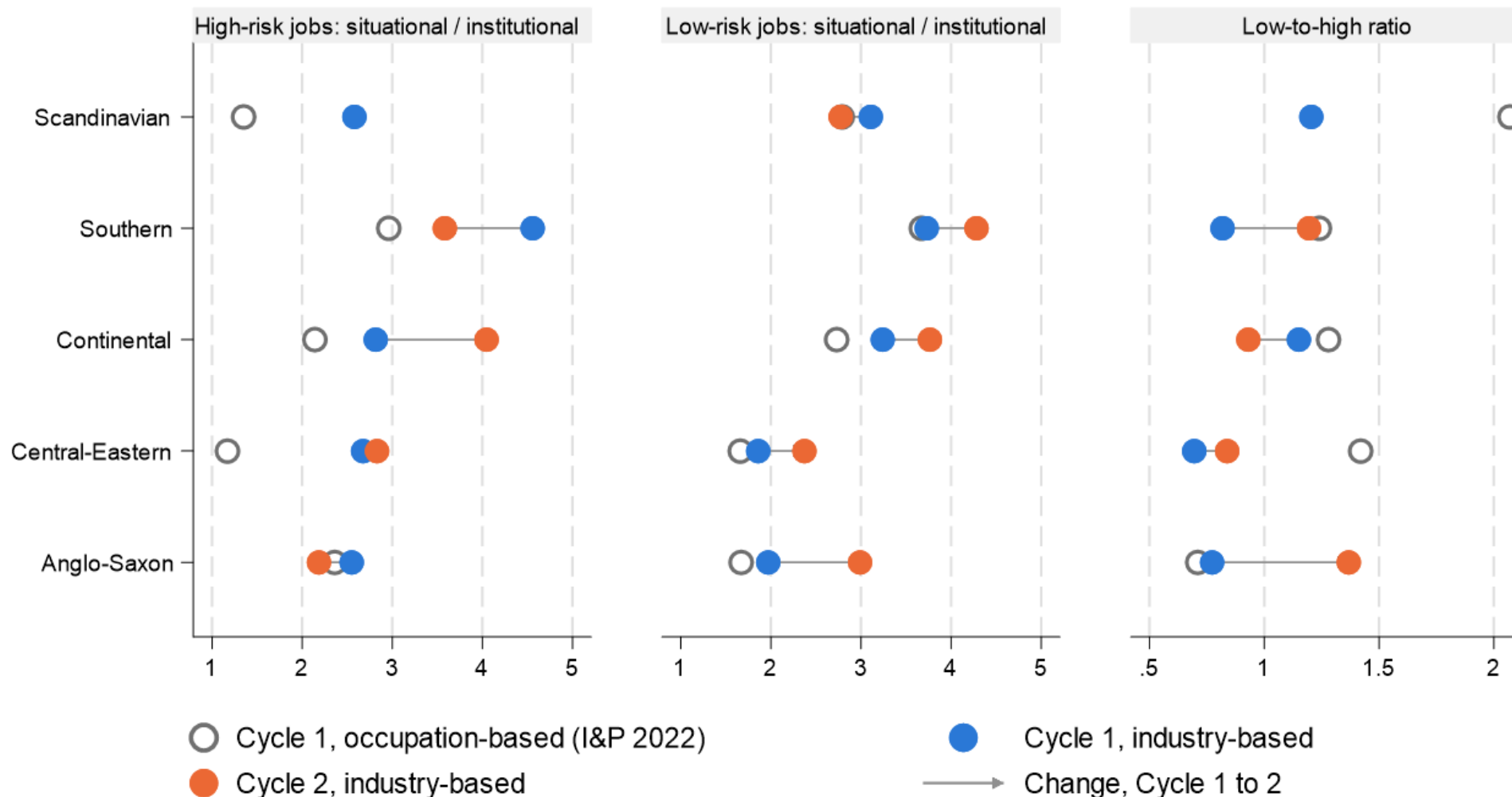
## Findings: Type of barriers Cycle 2

**Situational barriers dominate** the reported categories (Cycle 2),  
but this does not establish that they are the main causal mechanism behind the participation gap (decriptive).

| Regime                              | Situational<br>Barriers | Institutional<br>Barriers | Sit. / Instit.<br>Ratio | Situational<br>High-Risk | Institutional,<br>High-Risk | High-Risk<br>Ratio | Situational,<br>Low-Risk | Institutional,<br>Low-Risk | Low-Risk<br>Ratio |
|-------------------------------------|-------------------------|---------------------------|-------------------------|--------------------------|-----------------------------|--------------------|--------------------------|----------------------------|-------------------|
| Scandinavian                        | 59.6%                   | 21.4%                     | 2.78                    | 53.2%                    | 13.2%                       | 4.03               | 59.7%                    | 21.5%                      | 2.77              |
| Southern<br>European<br>Continental | 65.7                    | 16.6                      | 3.96                    | 64.3                     | 17.5                        | 3.69               | 66.6                     | 15.9                       | 4.19              |
| European<br>Central                 | 55.9                    | 14.5                      | 3.86                    | 52.9                     | 13.1                        | 4.05               | 57.5                     | 15.3                       | 3.77              |
| European                            | 53.3                    | 23.6                      | 2.25                    | 52.6                     | 20.4                        | 2.58               | 53.8                     | 26.3                       | 2.04              |
| Anglo-Saxon                         | 58.2                    | 20.4                      | 2.85                    | 52.2                     | 24.0                        | 2.18               | 59.3                     | 19.8                       | 2.99              |

## Findings: Barriers to AET participation by risk of automation

### Barriers to AET participation by risk of automation



- Situational / institutional barriers most prominent in Southern and Continental European regimes.
- Southern and Anglo-Saxon large increase in situational / inst. barriers in last 10 years.
- Scandinavian regime includes only Denmark.

Situational: employer support, busy at work, family. Institutional: prerequisites, cost, time or place. Values above 1: situational barriers dominate. Cycle 2 Scandinavia = Denmark only (no unmet-demand items for Norway and Sweden); values on fewer than 30 respondents are not shown.

## What the results tell us, and what remains open

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- Workers in occupations with high estimated automation exposure are less likely to participate in AET (accounting for gender, age, education, employment status); the disadvantage is still visible with Cycle 2 data).
- The pattern across welfare regimes is negative in most regimes, weak or imprecise in some.
- They report lower rates of unmet demand.
- Previous research shows that they face multiple, overlapping disadvantages (e.g. fewer workplace training opportunities, which lead to lower awareness of their training needs).
- The institutional mechanism behind the variation remain to be established.

## What can the study of adult learning systems as an institutional lens add?

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Our first study focused on the question:

Are welfare regimes sufficiently precise to explain differences in adult learning opportunities by risk of occupation automation?

- Rather than assuming that all countries belonging to a welfare regime provide comparable learning opportunities, the ALS perspective offers a more specific lens for investigating how learning opportunities are organised and assessed.
- It directs attention towards governance structures, financing arrangements, stakeholder coordination, employer involvement and support structures for targeting disadvantaged groups.
- While the risk of job automation creates the need for reskilling and upskilling, individuals choose to participate in AET in interaction with broader structural conditions and the institutional configurations of their country's ALS (bounded agency).

## Conclusions

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- Low and medium-skilled workers are likely to bear the brunt of the adjustment costs to technological changes as their jobs are facing a higher risk of automation compared to highly qualified workers.
- PIAAC Cycle 2 data allow us to revisit the automation–training gap with new data, but measurement changes limit direct comparisons with Cycle 1 (constrained replication).
- The descriptive pattern between occupational automation risk and AET participation reappears, with differences across the five regimes.
- Welfare regimes provide a useful comparative starting point, but they may conceal substantial institutional variation.
- The ALS perspective provides a next-step explanatory framework to investigate which features of adult learning systems help explain the variation (Desjardins and Kalenda 2025; Kalenda 2024).

## Discussion

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- **Comparability**

Given the changed outcome and exposure measures, what is the most defensible way to assess whether the automation–training gap persists over time?

- **Measurement**

How credible is an industry-by-job-type proxy for automation exposure when occupation codes are unavailable?

Which sensitivity checks would convince you?

- **Adult learning systems**

Which country-level indicators of governance, financing, coordination, employer involvement and targeted support would be comparable across countries and relevant to this specific research question?

- **Explanatory mechanisms**

What research design would allow us to test whether ALS characteristics moderate the relationship between automation exposure and participation, rather than simply correlate with participation rates?

# Time for your questions...



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