Istat

LABORATORI tematici

Progetti di ricerca tematica in Istat

Risultati della seconda call

22/23
SETTEMBRE
2025

"The Effects of Firms' Technology Adoption and of the Covid-19 Crisis on the Demand for Workers' Skills in Italy"
Technology Adoption and Skills' Demand in Italian Firms

Manfredi Aliberti, Nicolò Dalvit, Stefano De Santis, Leonardo Iacovone, Silvia Lombardi, Giulio Perani, Fabiano Schivardi

Research Project and Questions:

- The research project was designed as an experience in using statistical and administrative data from Istat to test analytical hypotheses developed by the Economic Research Directorate of the World Bank, with the scientific support of LUISS University.
- Objectives: Provide new evidence on the employment effects in Italy of industrial automation phenomena and the relationship between technology adoption and labor market evolution.
- Given the observation period (2011–2020), delve into the initial effects of the Covid-19 crisis on digitalization processes.

Research Questions:

- What factors are influenced by the rate of digital technology adoption in Italian firms?
- What are the effects on skill demand?

Reference Literature on the impact of new technologies

productivity increase

- Brynjolfsson & Hitt (2003) highlight the impact of computerization on the cost of capital; Dinlersoz & Wolf (2024) document increases in productivity and wages;
- Gal et al. (2019) emphasize the crucial role of skills and intangible assets;
- Nucci et al. (2023) confirm, using Istat data, productivity gains related to the adoption of digital technologies in Italy.

skill demand and employment levels

- Acemoglu, Restrepo (2018, 2019): disappearance of obsolete tasks, productivity increase, capital accumulation, creation of new tasks (replacement of old tasks with new ones.
- Bessen et al. (2023) identify negative effects of automation on workers' income, with potential "disruption" of the labor market.
- By contrast, Benmelech & Zator (2022), using data on German firms, find positive effects of industrial automation technologies on employment.
- Similarly, Aghion et al. (2020) show, for France, a relationship between automation and employment growth, without significant impact on wages.

Reference Literature on the impact of new technologies

Labour market and inequalities

- Autor et al. (2021) developed occupational exposure indices based on the effects of new technologies on existing tasks.
- Webb (2020), Felten et al. (2019), and Montobbio et al. (2021): Complementarity measurement related to the creation of new jobs and professions
- Autor et al. (2021) also showed a positive correlation between their complementarity index and the creation of new occupations and jobs.

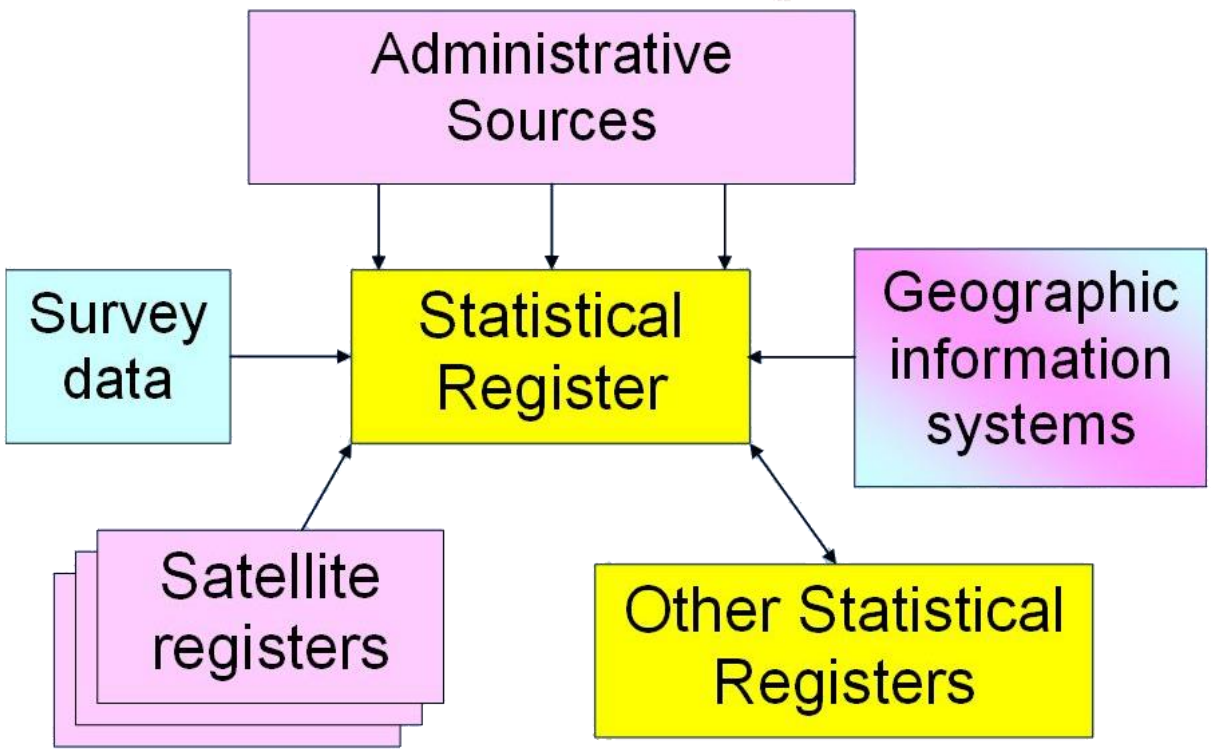
Operational Context, Data Sources, and Methodology

- Starting Point: Growing availability of data allowing operational application of concepts and indicators on a census scale.
- Tool: Creation of data structures and analyses combining the enormous availability of data (Big Data) with knowledge goals.
- Objectives: Official statistics, economic analysis, and policy support.
- Data Sources:

  Microdata integration of information from statistical registers (census) and direct surveys (sample-based) with thematic information:

  - ICT Survey
  - Multipurpose Survey (MPS)

Statistical register:



- A statistical register is a structured approach to managing and linking various data sources to produce official statistics.
- Registers contain core information about statistical units (e.g. individuals, businesses, or locations) and their characteristics.
- They provide an “extensive” longitudinal information (related to few variables), but available at census level

Statistical surveys:

- A “classic” structured approach for collecting, analyzing, and disseminating statistical data to provide insights into a population or phenomenon
- Surveys provide “intensive” information (not otherwise available) on a given subject, but limited to the statistical units involved in data collection (samples)

Methodology: Quasi-Experimental Design:

- The combination of register and survey-based information offers great flexibility for a variety of purposes. One of the most significant is to provide support for policy evaluation.

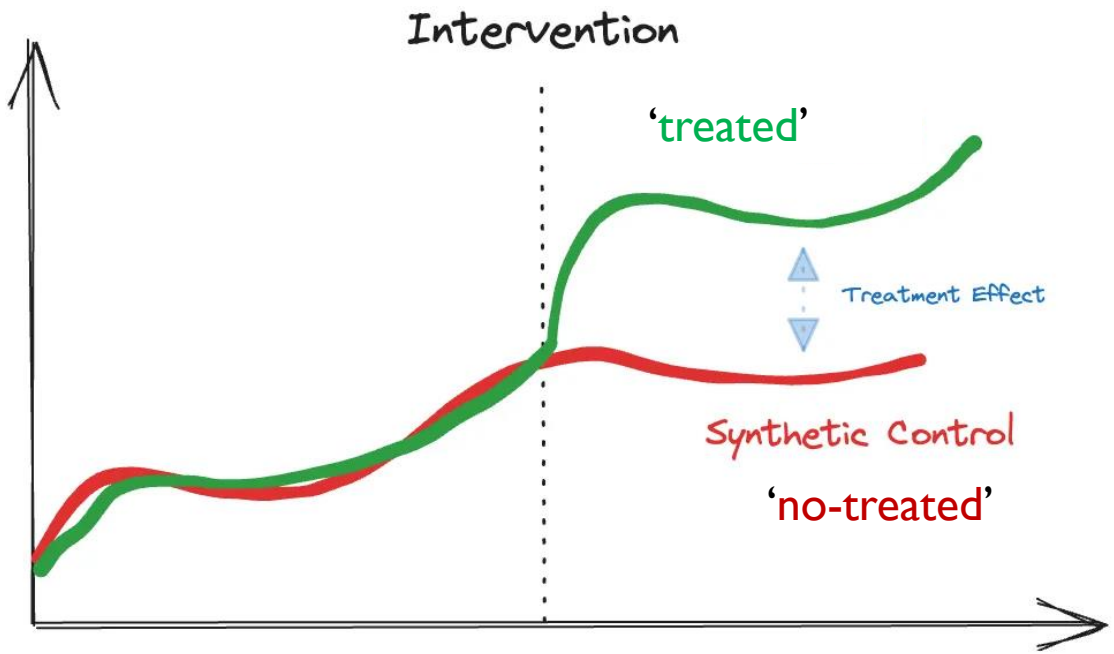
- In socioeconomic context, randomized trials may be unfeasible or unethical. Quasi-experimental studies (a broad range of nonrandomized intervention studies) allow to test the causal effects of an intervention on a target population.

- However, these rely on the availability of data, to construct in the proper way treatment and control groups. The increasing capacity of statistical offices to collect and organize data emphasizes the growing use of quasi-experimental study designs in the field of policy evaluation.

Methodology: a proposal:

Thanks to the wide availability of micro data from statistical sources, it is possible to systematically select comparison groups, by using:

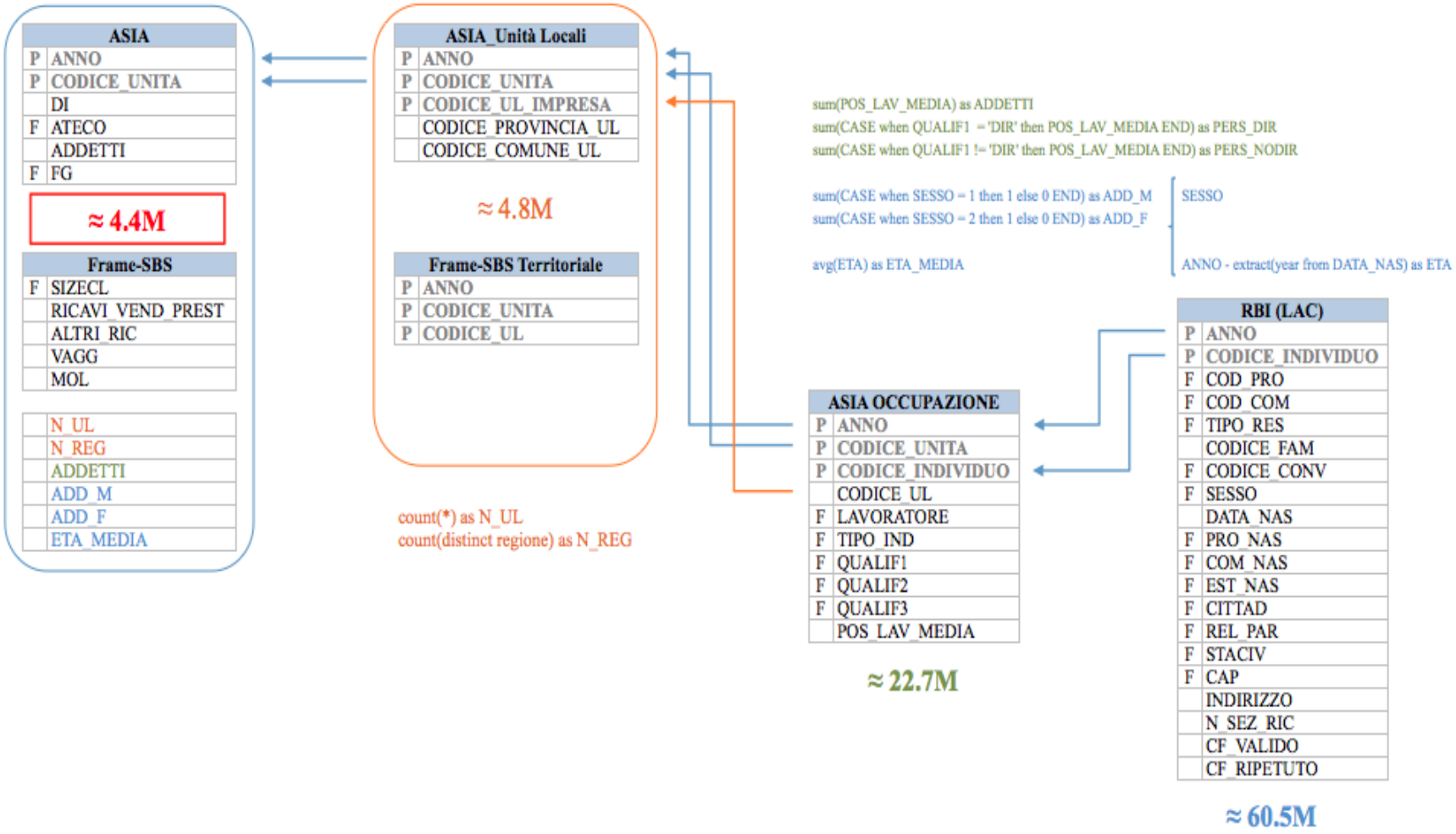
- direct surveys to create treatment variables
- statistical registers to create (multiple) outcome variables



Cutting edge quasi-experimental design techniques increase flexibility in constructing comparison groups via synthetic controls, as well as emphasizing the possibility to use a structured approach to identify them.

These methods are therefore increasingly utilized across disciplines (political science, health policy, economics, etc.) and can be applied using data from National Statistics Institutes.

Data integration strategy

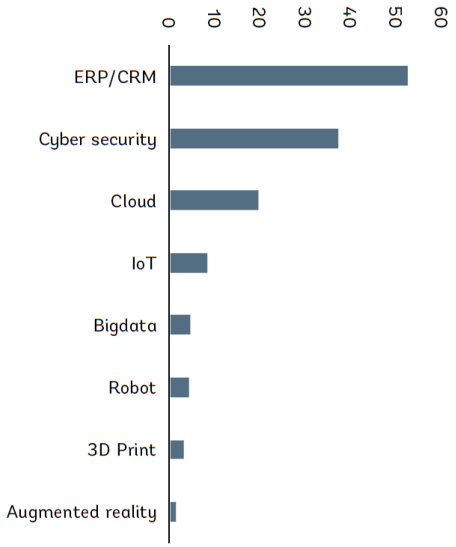


- Linking administrative data on employees with surveys' employer data.
- A set of data from firms' annual reports is matched with survey data.

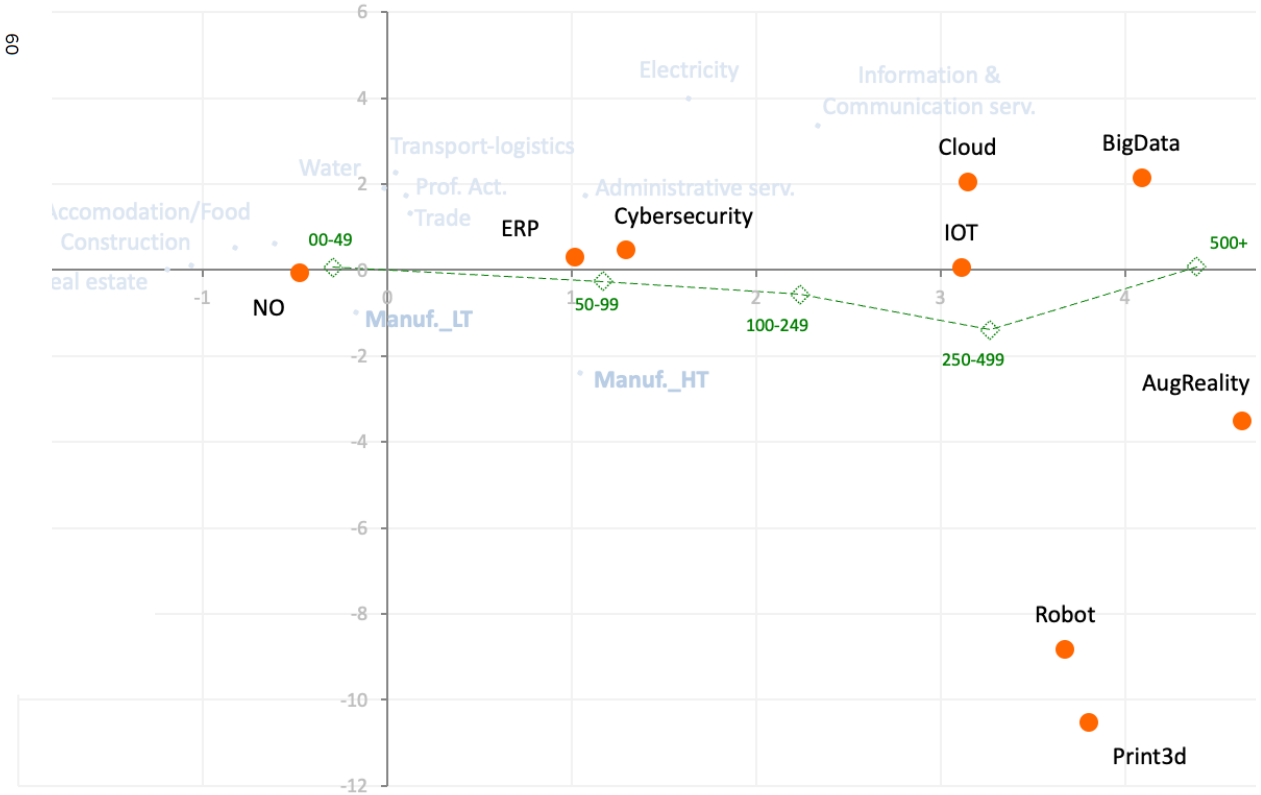
LABORATORI tematici

Istat

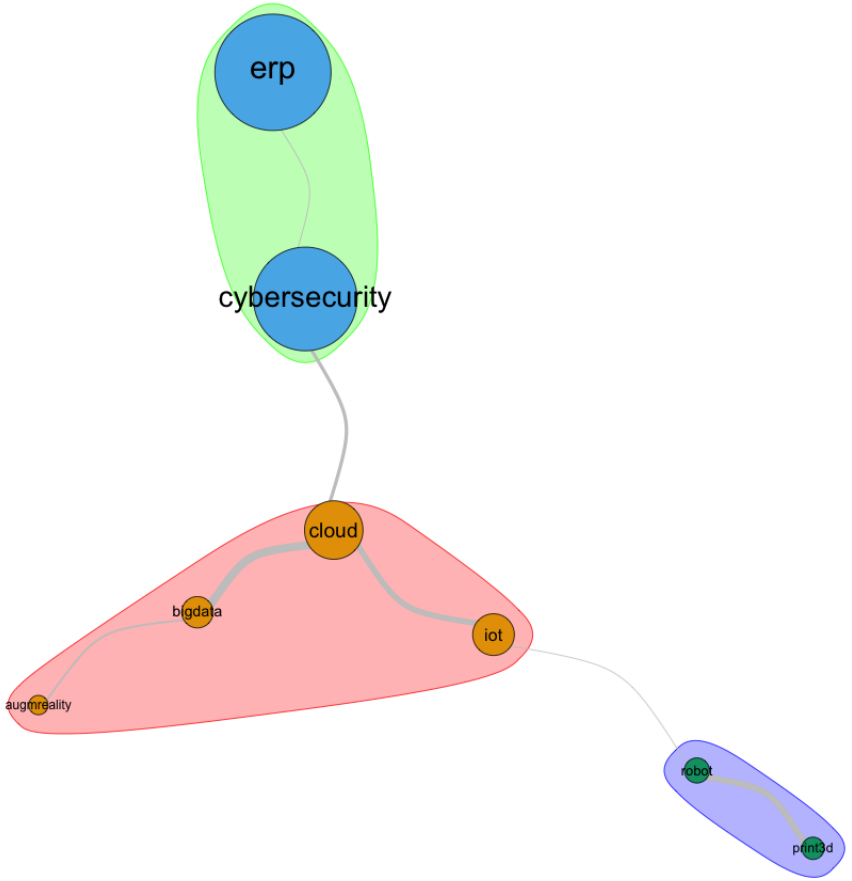
Rate of adoption of digital technologies (ICT survey 2017)



a. Tech adoption rates



b. MCA analysis and variables clustering



c. Network analysis and graphs clustering

IT Adoption and grouping for the *diff-in-diff* analysis

Data Sources and Group Identification

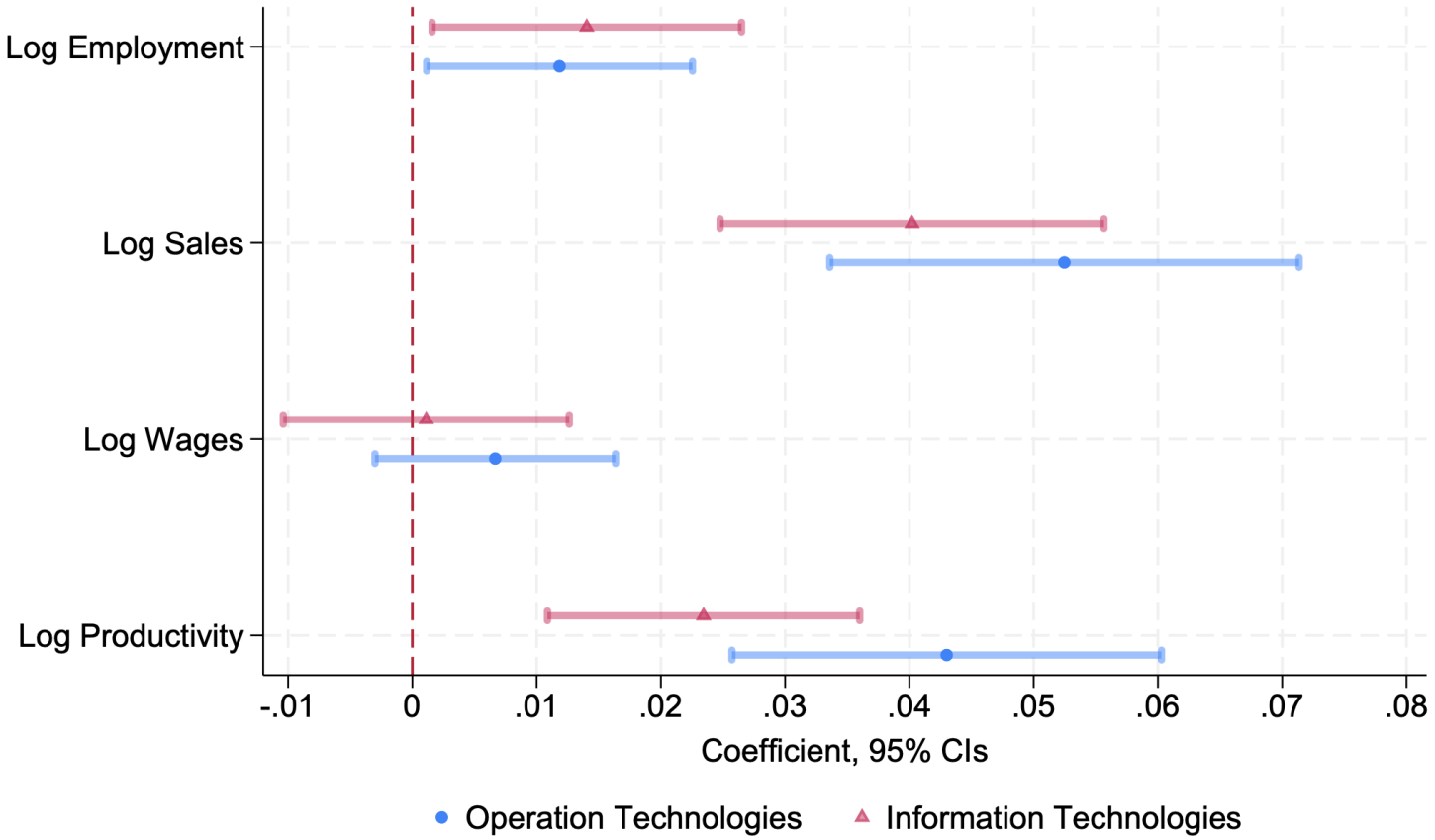
- ICT 2017: Data from 2014–2016
- MPS 2019: Data from 2016–2018 (overlap year: 2016)
- Analysis Unit: Firms with 10+ employees.

Control Group Identification

Since technology adopters differ from average firms, a quasi-experimental design is needed to assess causal effects.

We address this by combining matching with synthetic control methods, which strengthens identification and comparability across outcomes.

Firm outcomes



Both operation and information technologies increases sales, productivity, and employment among adopters.

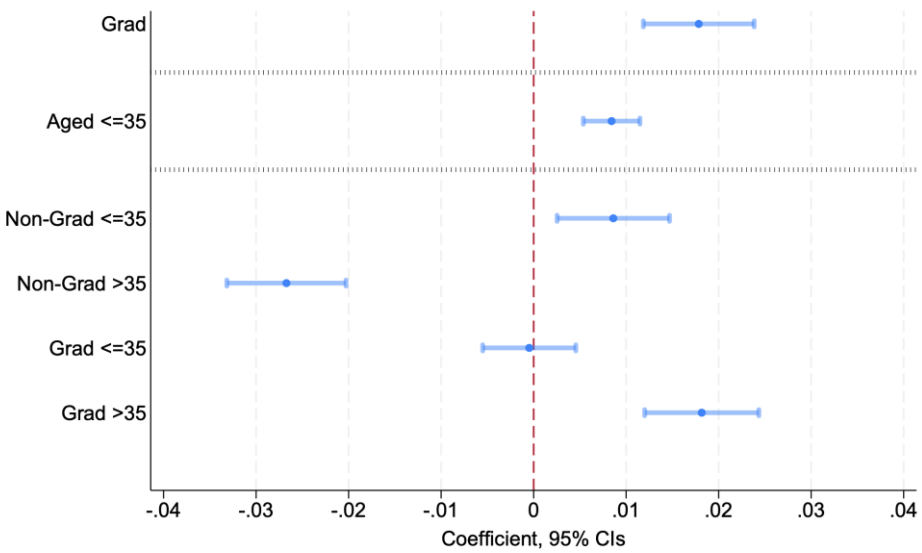
Technology adoption expand firm sales, on average, between 4% (information technologies) and 5% (operation technologies).

Employment also grows, but at a rate (1% on average) that is slower than that observed for sales. As a result, sales per worker increase.

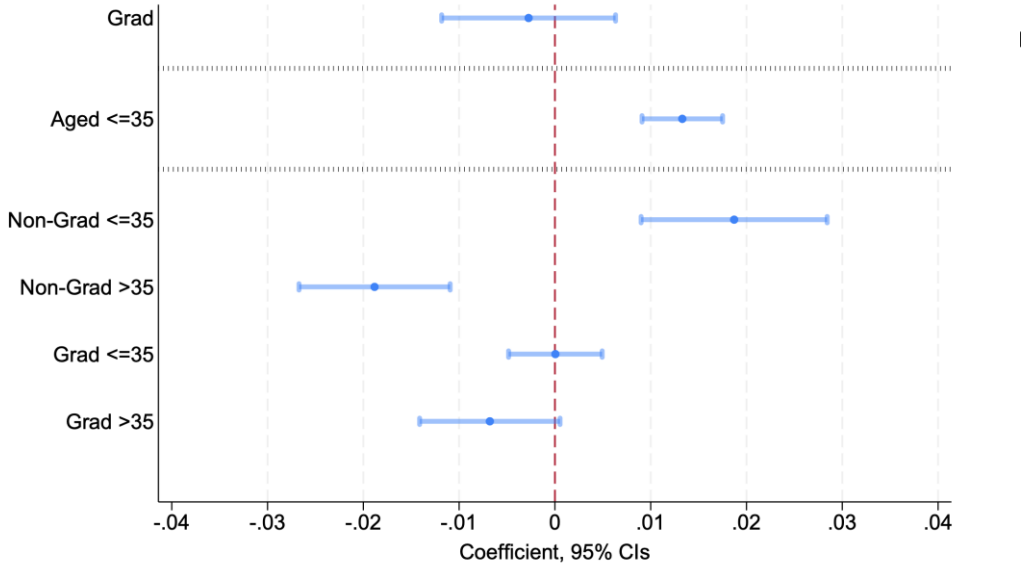
- Operation technologies refer to physical and digital tools involved in industrial processes (robots, 3D printing, internet of things, augmented reality).
- Information technologies refer to systems and tools that manage, process, and analyze data to support decision-making, communication and digital services within and across organizations (big data, cloud computing and cybersecurity).

Workers outcomes

information technologies



operation technologies



Neither information nor operation technologies affect average wages, but both kind of tecnologies show effect in terms of workforce composition.

information technologies -> benefit workers who possess both a college degree and substantial labor market experience, suggesting that formal education and on the job learning are complements; Among workers without a college degree, older individuals are replaced by younger ones, suggesting that, in the absence of higher education, labor market experience may be a disadvantage when adapting to new technologies.

operation technologies -> Unlike information technologies, operation technologies do not alter the overall skill composition. However, the age dynamics resemble those observed for information technologies

Conclusions

- This paper provides new evidence on the effects of digital technology adoption on firm performance and workforce composition, using matched firm and worker administrative data for Italy.

- Our identification strategy relies on a propensiy score matching + synthetic difference-in-differences. Tecnology adptions are associated with significant productivity gains (around 4% on average), alongside increases in sales (5%) and employment (1%), but no significant effect on wages.

- On the labor side, there is no pattern on wages, but some compositional changes (skill upgrading that reflects the interaction of education and experience, driving by information tecnologies; and an overall age-based shifts—replacing older non-graduates with younger ones—without altering the educational mix

- Overall, our findings confirm the central role of digital adoption in driving firm-level productivity growth, while highlighting uneven effects on workforce composition.

Thank you for your attention

Stefano De Santis | sdesantis@istat.it

Istat | Istituto Nazionale di Statistica