Tracking the Digital Divide: Factor Analysis and Time Trends in Italian Firms

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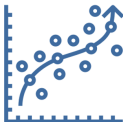
Cumulative Dissertation

Chapter 1

Bibliometric Analysis of European Research on Digital Divide: An Exploration of the Corporate Landscape

Chapter 2

Adapting Van Dijk's Resources and Appropriations Theory: Toward a Resources and Technology Integration Framework at the Firm Level

Chapter 3

Tracking the Digital Divide: Factor Analysis and Time Trends in Italian Firms

1. Introduction

- DT play a pivotal role in reshaping business models (Trischler and Li-Ying, 2023) , driving innovation (Ciarli et al., 2021), and fostering competitive advantages (Jegan Joseph Jerome et al., 2024).

- The unequal adoption of DT has led to significant challenge: the digital divide.

- The digital divide at the firm level is a multifaceted gap characterized not only by disparities in access, skills and usage of DT, but also the derived benefits from different types of use.

- While the digital divide is a global issue, its impact on enterprises, especially in Italy, presents unique challenges and opportunities.

2. Objectives

- ▶ Explore changes over time in the digital divide, focusing on differences across firm sizes, sectors, and regions.

- ▶ Develop composite indices to track trends in the first and second-level digital divide.

- ▶ Evaluate the alignment of resources and technology integration theory with observed data.

- ▶ Propose targeted policy interventions based on research findings.

3. Data

- The dataset was derived from the ICT Usage in Enterprises Survey conducted annually between 2014 and 2019 by ISTAT.

- In total, 29 variables were used to extract three factors that represent the theoretical constructs.

  - Access index: 6 variables
  - Skills index: 9 variables
  - Usage index: 11 variables
  - **Control variable:** Firm size with three categories (small, medium, large)

- Considerations and Limitations.

  - Independence of Annual Data

- Data treatments, codes, and summary statistics, are available on my GitHub repository for replicability and further analysis.

4. Methodology

▶ The indices were constructed using dimensionality reduction techniques Factor Analysis for Mixed Data (FAMD) and Multiple Correspondence Analysis (MCA).

$$\text{Access Index}_i = \sum_{j=1}^{6} a_j \cdot X_{j,i} \cdot w_i$$

$$\text{Skills Index}_i = \sum_{k=1}^{9} b_k \cdot Y_{k,i} \cdot w_i$$

$$\text{Usage Index}_i = \sum_{m=1}^{11} c_m \cdot Z_{m,i} \cdot w_i$$

Where $\mathbf{X}$, $\mathbf{Y}$, and $\mathbf{Z}$ are the matrices of observations, $\mathbf{a}$, $\mathbf{b}$, and $\mathbf{c}$ are the vectors of weights derived from FAMD and MCA contributions of each variable to the retained dimensions, and $\mathbf{w}$ is the vector of weights accounting for the share of groups and years.

5. Results I

**Yearly Trends in Access vs Skills vs Usage**

Index → Access → Skills → Usage
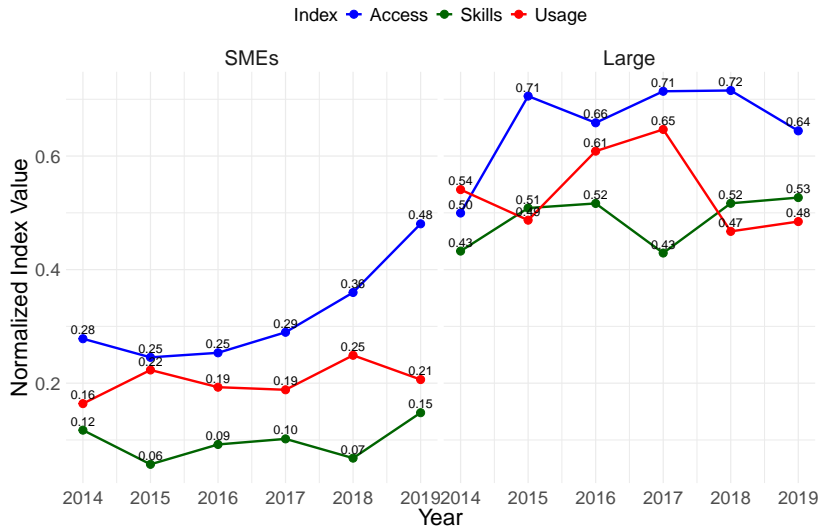
Key takeaways I

- While SMEs can maintain continuous growth in access, larger firms face different challenges.

- These findings align with Bratta et al. (2020), who discuss the hyper-depreciation measure issued in 2016.

- SMEs face more challenges in acquiring digital skills. There is a significant shortage of ICT graduates in Italy according to the "Digital Skills Observatory" in 2019.

- Interestingly, we see a higher usage index in SMEs. This is because existing technologies need to be operated, and SMEs often address this by either outsourcing digital skills or maximizing the efficiency of their existing workforce.

5.1. Results II

Yearly Trends in Access vs Skills vs Usage

Index → Access → Skills → Usage
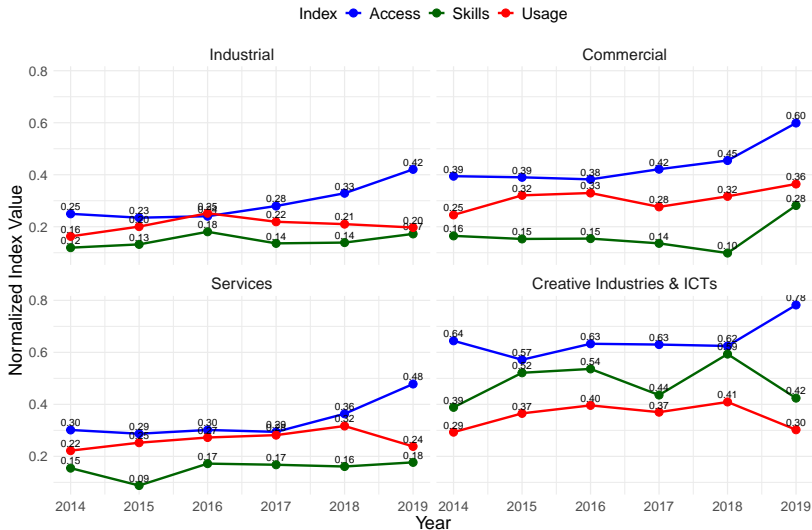
Key takeaways II

- ▶ Notable progress in digital access across sectors due to effective policy measures like hyper-depreciation.

- ▶ The digital skills index remains low, highlighting challenges in developing necessary competencies.

- ▶ Commercial, Industrial, Service Sectors: Growing digital access and stable usage, but significant skills gap.

- ▶ Creative Industries and ICT Sector: High levels of access and skills but moderate usage, reflecting different technological needs in workflows.

5.2. Results III

Yearly Trends in Access vs Skills vs Usage

Index → Access → Skills → Usage
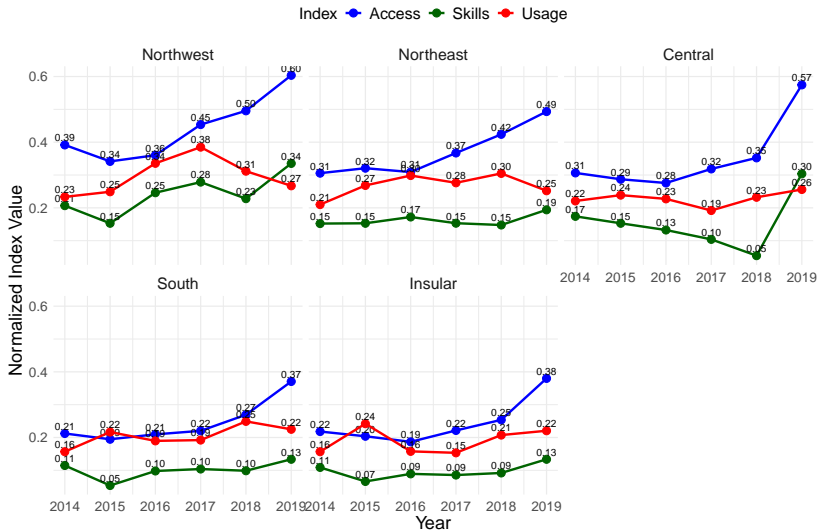
Key takeaways III

- Northern and Central Regions:
    - Significant improvements in digital access.
    - Benefits from robust industrial bases and policy interventions.
    - Persistent skills gap, slight increase towards the end.

- South and Insular Regions:
    - Lag behind in both access and skills. Reflecting systemic issues.
    - Need targeted policy efforts.

- Usage Trends:
    - Similar trends across regions.
    - DT integration driven by national policies, market forces, and sectoral requirements.

Evaluating Theory in Light of Data

While the theory posits a sequential model of technology adoption (access → skills → usage), our data shows that skills development has not kept pace with access, and usage sometimes surpasses skills. This indicates that firms may adopt technologies without fully developing digital skills, relying on external support or simpler applications.

Key Interventions

Accelerate Digital Skills Acquisition: Promoting e-learning platforms and certification programs for rapid, flexible digital skills training.

Enhance Digital Infrastructure and Support for SMEs in Lagging Regions: Expand broadband and mobile network coverage in under-served regions through public-private partnerships.

6. Q&A

Thank you for your attention

References I

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