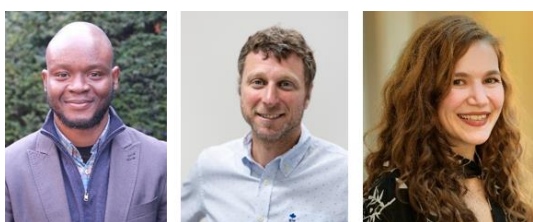


Digitalisation of firms and (type of) employment



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Abstract

This study addresses a critical question in the ongoing debate about the future of work: does digitalisation create or destroy jobs? To do so, we investigate how digitalisation, particularly through investments in Information and Communication Technology (ICT), has influenced firm-level employment and workforce composition in Belgium over the period 2003 to 2019. Through an analysis of a unique dataset that merges ICT expenditure data with detailed administrative employment records, we provide valuable insights into the dynamics of workforce transformation within firms undergoing digitalisation. More precisely, we find that digitalised firms experienced higher employment growth relative to non-digitalised firms, driven by both increased hiring and higher retention rates. Digitalisation also significantly altered workforce composition, leading to a decrease in the share of low-educated workers and an increase in the share of highly educated workers, alongside shifts in the age distribution towards middle-aged workers.

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1. Introduction

The question of how digitalisation influences employment has become increasingly critical in recent years, as advancements in technology continue to reshape economies and societies worldwide. Digitalisation, characterized by the adoption of Information and Communication Technologies (ICT), has transformed business operations, labour markets, and workforce requirements. The impact of digitalisation on employment has been extensively studied in the academic literature, yet the findings remain inconclusive. Two primary views dominate. The first is the employment substitution effect, pursuant to which digital technologies replace workers, leading to job losses and higher unemployment¹. These studies focus primarily on the industry-level implications of technological advancements. The second view, known as the employment creation effect, suggests that digitalisation drives an increase in total employment². Studies supporting this view often analyse the firm-level effects of technology adoption.

This study contributes to the literature on workforce dynamics and technological change by combining detailed administrative employment data with firm-level digitalisation measures. Using a unique dataset of ICT expenditure and employment records from Belgium (2003–2019), the research offers a rare micro-level, longitudinal perspective on digitalisation's effects. Unlike many studies that use broad proxies, it measures ICT adoption precisely through firm-level data. The study also explores the mechanisms behind digitalisation's impact on employment, focusing on firm size, growth rates, and worker turnover. Additionally, it distinguishes sectoral effects, analyzing manufacturing versus non-manufacturing industries in detail. Finally, only few studies look at the impact of technology on skill composition³. Our research extends these insights by investigating how digitalisation affects demand for workers with different education levels, thus contributing to the literature on skill-biased technological change⁴.

2. Data and Methodology

The analysis relies on a rich dataset that combines firm-level records from the National Bank of Belgium with worker-level data from the Crossroads Bank for Social Security. This dataset provides a comprehensive view of both firms' digitalisation expenditures and their workforce characteristics, including education levels and age distribution. We focus on firms continuously active from 2003 to 2019, to ensure a stable sample for our long-term analysis.

Digitalisation is defined in the study based on firms' ICT expenditures as a share of total expenses. A firm is classified as digitalised if its ICT expenditure share exceeds every year the median for the dataset. This definition captures the ongoing and gradual nature of digitalisation, distinguishing it from technologies like robotics, which often involve large, discrete investments. This distinction is crucial for accurately measuring the effects of digitalisation over time.

We employ a long-difference regression approach to analyse the relationship between digitalisation and employment growth. This method is particularly well-suited to studying gradual changes and reduces potential biases arising from autocorrelation. By controlling for initial firm size and sectoral differences, the analysis aims to isolate the effects of digitalisation on employment.

3. ICT Expenditures and Descriptive Statistics

The study includes a detailed examination of ICT expenditures within firms, providing important context for understanding the role of digitalisation in shaping employment trends. Over the 2003 to 2019 period, ICT expenditures evolved significantly, with a notable shift from digital goods, such as hardware, to digital services, including software, cloud computing, and IT support. This shift mirrors broader technological trends where firms increasingly prioritize flexibility and scalability in their digital solutions.

¹ Frey and Osborne, 2017; Brynjolfsson and McAfee, 2014; Acemoglu and Restrepo, 2018, 2020; Graetz and Michaels, 2018.

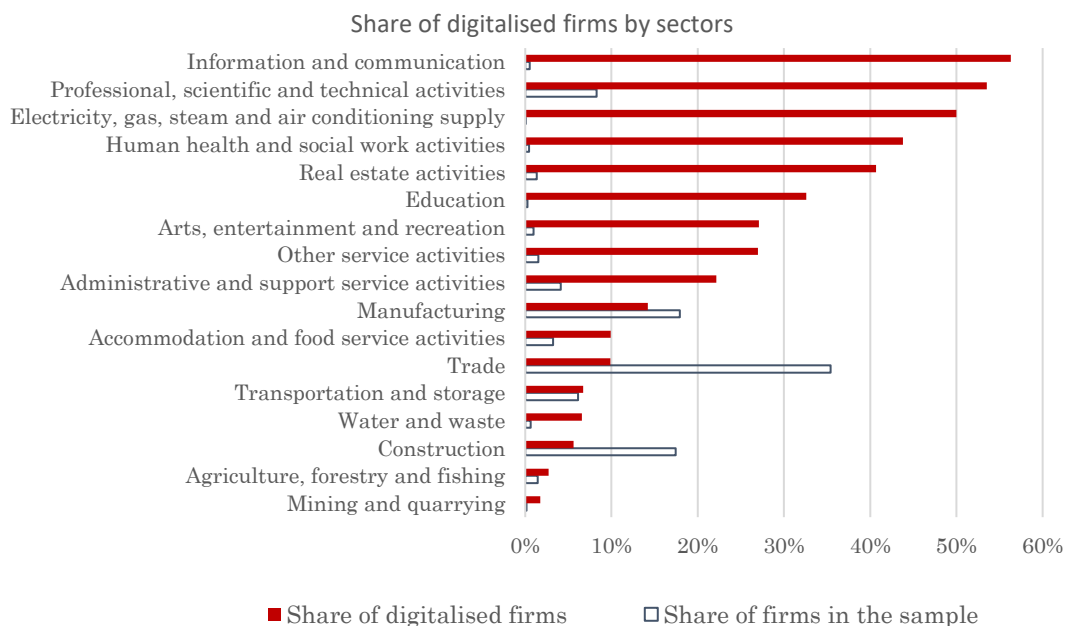
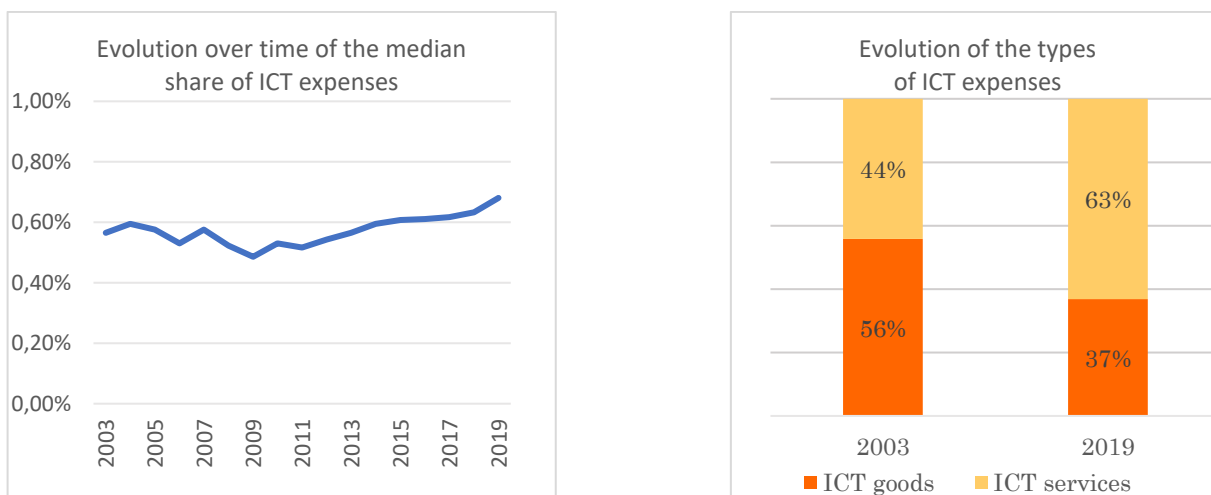
² Autor, 2015; Dutz et al., 2018; OECD, 2019; Stehrer, 2024; Koch et al., 2021; Dixon et al., 2021; Aghion et al., 2022.

³ Autor et al., 2003, Akerman et al., 2015; Michaels et al., 2014.

⁴ Katz and Murphy, 1992; Autor et al., 2003; Michaels et al., 2014.

Between 2003 and 2019, the share of ICT services in total ICT expenditures rose from 44% to 63%, at the expense of ICT goods which decreased from 56% to 37%. This trend indicates a gradual transition toward service-oriented digital investments, which likely aligns with the growing importance of data analytics, online platforms, and software as key drivers of firm competitiveness.

Figure 1. ICT expenses evolved over time and are not equally spread across sectors



Sources: CBSS, NBB.

Moreover, the study highlights sectoral differences in digitalisation patterns. For example, information and communication sectors had the highest concentration of digitalised firms, with 56% of firms in this category classified as digitalised. By contrast, sectors like manufacturing and construction showed lower digitalisation rates, at 14% and 6%, respectively. These variations suggest that industry-specific factors, such as technological readiness and competitive pressures, play a crucial role in shaping digitalisation trends.

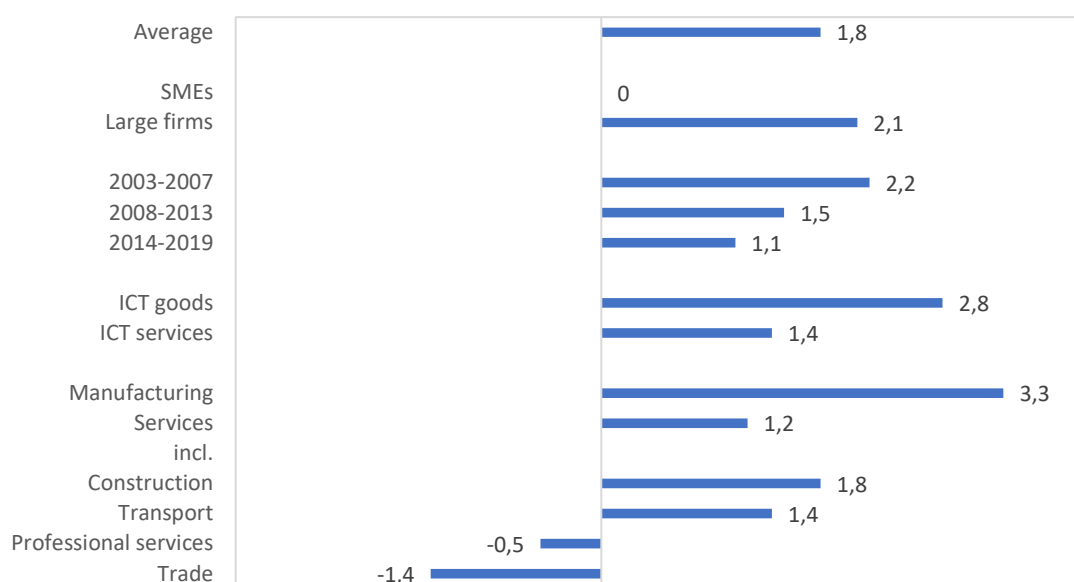
4. Key Findings

4.1. Employment Growth

One of the most significant findings is that digitalised firms experienced higher employment growth than their non-digitalised counterparts. Digitalised firms, on average, experienced 19% higher employment growth than non-digitalised counterparts over the study period, translating to an annual growth rate of 1.1%. This effect was amplified in larger firms, where digitalisation correlated with 39% higher employment growth, or 2.1% per year.

This positive relationship persisted even after controlling for various factors, such as initial firm size, capital, and productivity. Moreover, our study found that digitalisation had a stabilizing effect on employment in shrinking firms, suggesting that ICT investments help firms adapt and maintain their workforce during economic downturns.

Figure 2. Digitalisation and employment growth in Belgium
(average variation per year in % compared with non-digitalised firms)



Sources: CBSS, NBB.

Note: based on an econometric analysis controlling for initial employment within firms and their sector of activity at the NACE4-digits level, firms are weighted by size.

Redefining digitalisation based on ICT expenditure per employee produced even stronger effects, with digitalised firms showing nearly double the baseline employment growth rates. Differentiating digital expenditure into goods and services revealed that investments in ICT goods had a doubled impact on employment growth compared with investments in ICT services.

Robustness tests confirmed the persistence of digitalisation's positive impact across different sub-periods, though the effects were stronger in earlier years. From 2003 to 2007, digitalised firms experienced a 2.2% annual employment growth boost, compared to 1% in 2014-2019. This trend aligns with the initial phases of digital adoption, where significant efficiency gains and opportunities for workforce expansion were realized. Over time, as digitalisation matured and became more widespread, its incremental effects on employment appeared to moderate. This temporal pattern suggests that the transformative effects of digitalisation are strongest during the early stages of adoption. As technologies become more ubiquitous, firms may achieve diminishing returns on their investments, resulting in a plateauing of employment growth. However, emerging technologies such as artificial intelligence and machine learning could potentially reignite the growth trajectory by enabling new applications and efficiencies.

The impact of digitalisation varied across sectors. Manufacturing and service industries, particularly construction and transport, showed the strongest positive employment effects. In contrast, the trade and professional services sectors presented more nuanced results. Larger firms in these sectors sometimes experienced workforce reductions, likely due to automation and efficiency gains that reduced the need for certain roles. These findings underscore the importance of sector-specific dynamics in understanding the employment effects of digitalisation.

4.2. Workforce Composition and dynamics

The relationship between digitalisation and the composition of the workforce, particularly with regard to education levels, has been a key focus in the academic literature on the future of work. Numerous studies show that digitalisation tends to benefit more educated workers, as digital technologies complement cognitive and analytical skills typically associated with higher education. Conversely, it poses risks for those with less education, whose jobs are more susceptible to automation or whose do not have the necessary digital skills⁵.

Some studies have also explored how technological changes affect younger and older employees differently, given that age often correlates with digital skills, adaptability to new technologies, and job types. Research points out that digitalisation tends to benefit younger workers, who generally possess stronger digital skills and are more adaptable to technological changes. In contrast, older workers face greater risks of job displacement or may require re-skilling to remain competitive in increasingly digitalised work environments⁶.

Our microdata on personal characteristics of workers provides a unique opportunity to measure how digitalisation influences the labour force composition within firms. To do so, we examine how the share of workers with a specific characteristic change between 2003 and 2019, depending on the fact that the firm is digitalised or not.

Our results show that digitalisation significantly reshaped the workforce within firms. The study observed a clear shift toward higher educational attainment among employees. Digitalised firms employed more highly educated workers and reduced their reliance on low-educated labour. Specifically, the share of highly educated workers in digitalised firms increased by 4 percentage points more than in non-digitalised firms, while the share of low-educated workers declined by 2 percentage points more.

Age distribution within firms also changed. Digitalised firms tended to hire more middle-aged workers (aged 25-54) while reducing the share of older employees (aged 55-64), the shift being equal to 3 percentage points. This pattern likely reflects the skills requirements of digitalised environments, where middle-aged workers may possess a balance of experience and adaptability that aligns with digital technologies. Younger workers' representation remained relatively stable, although some evidence suggested a slight decline in larger digitalised firms.

The analysis of workforce dynamics revealed higher rates of both worker entries and exits in digitalised firms compared to non-digitalised ones. This finding points to greater labour market fluidity and suggests that digitalised firms are actively restructuring their workforces. While these firms hired more employees, they also experienced higher turnover.

The higher turnover rates observed in digitalised firms reflect an ongoing adaptation process. As firms implement digital technologies, they may need to realign their workforce to match changing skill requirements. This process likely involves hiring new employees with expertise in digital tools while phasing out roles that become redundant due to automation or efficiency improvements. This dynamic underscores the importance of workforce flexibility and adaptability in the digital age.

⁵ Autor, 2015; Goos et al., 2014; Brynjolfsson & McAfee, 2014.

⁶ Friedberg, 2003; Berger and Frey, 2016; Aisa et al., 2023; Bessen et al., 2023.

5. Policy Implications and limitations

The findings of this study have several important implications for policymakers and business leaders. The overall positive relationship between digitalisation and employment suggests that investments in ICT is accompanied by job creation and economic growth. Policymakers should consider initiatives to encourage digital adoption, particularly among smaller firms, which may face resource constraints in undertaking such investments.

The workforce restructuring observed in digitalised firms highlights the need for targeted reskilling and upskilling programs. These initiatives should focus on equipping workers, especially older and less-educated individuals, with the skills required to thrive in a digitalised economy. Programs tailored to the needs of specific sectors could further enhance their effectiveness.

The study's findings emphasize the importance of continuous monitoring and evaluation of digitalisation's effects on employment. As new technologies, such as artificial intelligence, continue to emerge, their implications for workforce dynamics must be carefully assessed to inform policy and business decisions. Policymakers should prioritize the collection and analysis of data on technological adoption and its labour market effects to ensure evidence-based decision-making.

While this study provides robust evidence of the relationship between digitalisation and employment, it does not establish causality. The possibility that firms predisposed to growth are more likely to invest in digitalisation cannot be ruled out. Additionally, the study focuses on the period up to 2019 and does not capture the impacts of more recent technological advancements. Future analyses could extend this work to include technologies like artificial intelligence and examine their effects on workforce dynamics. Emerging trends such as remote work and digital platforms also warrant further investigation, as they may reshape the relationship between digitalisation and employment.

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