

Digitally driven employment. Empirical evidence for the European countries
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Doctoral Dissertation Review Report
by Professor Fernando Lera-Lopez

General comments

The dissertation under review represents a comprehensive and ambitious attempt to understand the complex relationship between digitalization, skills, and employment in Europe. At a time when technological change can have negative effects on the labour market, generating new economic inequalities, this work addresses a highly relevant and timely topic. The thesis combines conceptual reflection, systematic literature review, methodological innovation, and empirical application across a 15-year period (2008–2023) and 26 European countries. Furthermore, this dissertation proposes the use of a new composite index—the European Digital Skills Index (EDSI)—designed to capture digital skills across professional, educational, and individual dimensions.

The thesis is organized in six substantive chapters, moving from theoretical framing (Chapters 2–3), methodological settings (Chapter 4), empirical analysis (Chapter 5), and concluding synthesis (Chapter 6). Across these sections, the author demonstrates substantial breadth of knowledge, technical competence, originality and ability to independently conduct scientific and research work. At the same time, the work occasionally suffers from over-descriptiveness, limited causal identification, and underdeveloped policy implications. Nonetheless, the cumulative contribution is significant, and the research adds meaningful new evidence to ongoing academic and policy debates about skill, digital divide and employment in Europe.

Objectives of the dissertation

The dissertation sets out three research aims:

1. Conceptualization and measuring digital skills through the creation of a novel composite indicator (EDSI), capturing professional, educational, and individual aspects of digitalisation in 26 European countries over 15 years.

2. Classification of countries into quartiles (Q1–Q4) based on digital advancement and exploring cross-country differences and trajectories in digital skills and digital adoption.

3. Analysis of the relationship between digitalisation and employment outcomes across 10 occupational groups, verifying whether and how digital technologies reinforce patterns of job polarization, skill-biased technological change, or digital divides.

These goals are ambitious, clear, and logically sequenced. The objectives are consistently revisited in the empirical and concluding chapters, which increases the coherence of the dissertation. Consequently, this doctoral dissertation meets the requirements for doctoral dissertation according to the Polish regulation.

Detailed comments and suggestions

Next, each chapter of the doctoral thesis will be analysed in greater detail, concluding with some general conclusions.

Introduction: research gaps and structure (Chapter 1)

The dissertation begins with an introductory chapter defining some important concepts for the development of the doctoral thesis and setting out the main theory on which the results obtained will focus. It also sets out the research gaps and goals in a clear and didactic manner.

Conceptual and theoretical framework (Chapters 2–3)

The thesis shows a broad exploration of technological revolutions and the socio-economic role of digital technologies. Chapter 2 situates digitalisation technologies as a type of general-purpose technologies, drawing upon Schumpeterian creative destruction, Perez's techno-economic paradigms, and Solow's productivity paradox. This conceptual framework provides historical depth and theoretical context, although at times the narrative becomes overly descriptive (particularly in Section 2.2). The chapter demonstrates impressive command of interdisciplinary literature but would benefit from sharper focus on how these historical insights specifically inform the empirical questions of the dissertation. As potential suggestions, I would like to point out the following ones: a) clarify the purpose of the historical review, b) reduce descriptive passages in favour of

analytical evaluation and implications of digital technologies as general-purpose technologies, and c) incorporate recent empirical studies about the intelligence artificial (IA).

Chapter 3 moves into a systematic literature review of digitalization, skills, and employment, focusing on Europe. This section is one of the thesis' strongest contributions in terms of rigor. The author documents the review protocol, including database searches, narrowing procedures, and selection criteria, culminating in 63 studies analysed. The literature is organized around different theories—skill-biased technological change (SBTC), routine-biased technological change (RBTC), and task-based frameworks, as well as human capital and innovation diffusion theories. The review highlights gaps in empirical knowledge, notably the lack of cross-country, longitudinal evidence linking digital skills with detailed occupational outcomes. This gap motivates the empirical strategy pursued in the following chapters. While comprehensive, the systematic review occasionally lapses into cataloguing results rather than synthesizing them critically. Nonetheless, it provides a valuable foundation for subsequent chapters. As potential suggestions, I would like to include the following ones: a) a better explanation of the criteria for the research strategy; b) an explanation of focusing only on European studies, and c) clarify selection of post-2022 studies. Also, I would suggest replacing the term 'hypotheses' with 'theories', which is more appropriate for the objectives of the literature review, as well as providing a more critical evaluation of these theories.

Methodological and data section (Chapter 4)

Chapter 4 is the methodological centrepiece of the dissertation. The author introduces the European Digital Skills Index (EDSI), an original composite indicator built from three sub-dimensions: professional, educational, and individual digital skills. Following OECD and Joint Research Centre guidelines, the index employs normalization, equal weighting, correlation checks, and linear aggregation. The justification for linear rather than geometric aggregation is sound, emphasizing proportional interpretation across countries. The EDSI is applied to classify 26 European countries into quartiles (Q1–Q4), representing varying levels of digital advancement. The harmonization of multiple datasets (Eurostat, OECD, UNESCO) adds value. This represents a substantive methodological contribution. However, it lacks discussion of alternative index construction methods (PCA, factor analysis) and their implications.

The originality of the EDSI cannot be overstated. While existing indices such as DESI and RTI capture aspects of digitalization, none incorporate the multidimensional structure applied here, nor provide consistent time series coverage across 15 years. The EDSI thus fills an important methodological gap. The chapter also outlines econometric strategies, including LOWESS approximations for descriptive analysis and fixed-effects panel regressions to estimate digitalization's impact on occupational employment. While appropriate, the econometric approach is limited by potential endogeneity (reverse causality between digitalization and employment), which the author acknowledges but does not fully address. Alternative methods such as instrumental variables or dynamic panel approaches could strengthen causal inference. Nevertheless, the methodological transparency and innovation of Chapter 4 represent one of the thesis' most significant contributions. As potential suggestions, I would suggest reducing the subsection 4.1. to avoid repetition of terms and ideas.

Empirical findings (Chapter 5)

The empirical chapter applies the EDSI and associated econometric models to investigate the relationship between digitalisation and employment in 26 European countries. Countries are grouped into quartiles, and occupational employment is disaggregated into 10 ISCO categories. This design allows for unprecedented granularity: 280 fixed-effects regressions were estimated across quartiles and occupations.

The chapter employs a dual methodological approach: descriptive and econometric. First, it provides descriptive statistics, visualizations, and quartile-based comparisons of digital skills trajectories across countries. The descriptive analysis illustrates the dynamics of digital advancement in individual, professional, and educational dimensions of the EDSI. Second, it applies panel data econometrics, specifically fixed-effects regressions, to estimate the relationship of digitalisation proxies (internet use, ICT trade, STEM graduates, ICT R&D, share of ICT sector in GVA) with employment outcomes disaggregated by ISCO occupational groups.

The descriptive analysis reveals expected patterns: higher digital skills correlate with higher shares of professionals and technicians, while routine occupations (agricultural workers, clerks, craft workers, plant operators) decline. The quartile approach is a methodological innovation that allows for differentiated analysis across stages of digital maturity. This enhances the interpretative depth of results, showing that the impact of digitalization is not homogeneous.

Regression analyses confirm the SBTC hypothesis: digitalization complements high-skilled work but displaces low- and medium-skilled jobs. Importantly, the strength of these relationships varies across quartiles: digitally advanced countries show weaker or insignificant associations, suggesting possible saturation effects, while catching-up countries exhibit stronger polarization. These results enrich the literature, demonstrating that the use of digitalisation is not homogeneous but contingent on developmental stage.

Despite these strengths, the empirical results must be interpreted cautiously. Without addressing endogeneity or conducting robustness checks, the results should be interpreted as correlations rather than causal effects. The absence of robustness checks (heteroskedasticity, serial correlation, omitted variable bias) reduces confidence in the estimates. Moreover, the reliance on proxies such as Internet use may not fully capture complex dimensions of digitalization. The author recognizes these limitations, and they do not invalidate the analysis but highlight the need for cautious interpretation.

The originality of this chapter lies in combining a novel composite indicator (EDSI) with detailed occupational employment data across multiple European countries over a long period. Few existing studies have examined the relationship of digital skills with employment at this level of detail—both in terms of occupations (10 ISCO groups) and country groupings (four quartiles). The inclusion of 280 fixed-effects regressions demonstrates both scope and ambition. The contribution is also conceptual: by disaggregating occupations rather than collapsing them into broad categories, the chapter shows that digitalisation is differently associated with occupational groups, even within the same skill category. This provides a more nuanced understanding of polarisation and complements the literature on SBTC and RBTC.

As potential suggestion for improvements, I would like to suggest three questions. Firstly, in terms of the methodology, it could be of interest address endogeneity concerns through instrumental variables or dynamic panel methods (e.g., system GMM). Also, the results would improve if the analysis may incorporate robustness checks for heteroskedasticity, multicollinearity, and serial correlation. Secondly, in terms of variables, it should be improved the arguments for using Internet use as proxy of digitalisation as well as include the limitations associate to this variable (it may not fully capture complex digitalization dynamics). Thirdly, it should be emphasised the economic magnitude of coefficients, not only statistical significance. Finally, I cannot see the point

in considering under analysis some occupations such as armed forces and agriculture workers.

Major findings and discussion (Chapter 6)

The concluding chapter synthesizes the dissertation's contributions and situates them within the literature. Four main findings stand out:

1. A new and broad index to measure digitalisation in Europe: The European Digital Skills Index (EDSI). The main strengths of the EDSI approach are its multidimensional nature and longitudinal coverage.
2. Confirmation of skill-biased technological change and polarization: Digitalisation favours high-skilled professions (professionals, technicians) while is negatively associated with low- and medium-skilled groups.
3. Heterogeneity across country quartiles: Less digitally advanced countries show weaker associations, while intermediate ones exhibit strong polarization dynamics.
4. Added value of occupational disaggregation: Unlike many studies that aggregate into broad categories, this thesis demonstrates meaningful variation across 10 occupational groups, offering a more nuanced understanding of digitalisation's labour market effects.

The chapter effectively situates findings within the broader literature. It confirms support for skill-biased technological change (SBTC) and job polarisation hypotheses. The discussion is balanced, acknowledging similarities with previous empirical studies while also highlighting divergences. Also, the discussion demonstrates awareness of the diversity of findings in the literature, attributing differences to methodological approaches, data, and scope. The thesis adds value by extending coverage to a wider geography and longer period than most studies. In addition, the dissertation shows comprehensive integration of empirical results into theoretical debates.

The author emphasizes that methodological differences—timeframe, geography, occupational disaggregation—explain much of the variation in results. Importantly, the chapter acknowledges conceptual ambiguity in definitions of digitalisation and digital skills, recognizing this as both a limitation and an opportunity for further research. The dissertation also outlines limitations and future research directions, including expanding to additional proxies (computer use, online learning, e-government), analysing sectoral data (NACE classification), broadening geographical scope, and addressing labour policy variables.

As suggestion for improvements, I would like to suggest the necessity for expanding the policy discussion: what do findings imply for skills training, education, labour market implications, or digital inclusion strategies? This might be complemented by possible recommendations for the EU or for national strategies to achieve a more uniform development of digitalisation in Europe. The evidence of polarization and digital divides suggests urgent needs for upskilling policies and supporting for vulnerable groups of employment. Also, the results have potential implication for national policy interventions and integration of labour and innovation policies.

Overall evaluation

This dissertation presents a complete trajectory: from conceptual framing and literature review, through methodological innovation, to empirical application and concluding synthesis. The cumulative strengths lie in the ambitious scope, originality of the EDSI index, systematic literature review, and detailed empirical results across countries and occupations. The main weaknesses remain in causal identification, robustness of empirical findings, and depth of policy implications. Overall, the dissertation represents a significant and original contribution to the understanding of digitalisation, skills, and employment in Europe.

The contribution of this thesis can be summarized as follows:

- **Methodological innovation:** The creation of EDSI represents a significant advance in measuring digital skills, offering a tool that could be used by both researchers and policymakers.
- **Empirical depth:** By covering 26 countries, 15 years, and 10 occupational groups, the thesis provides one of the most comprehensive analyses of digitalisation and employment in Europe.
- **Emphasis on heterogeneity:** The quartile-based approach reveals differentiated trajectories, avoiding overgeneralisations about digitalisation's relationship with employment.
- **Integration of theory and empirics:** The thesis situates findings within debates on SBTC, RBTC, polarisation, and digital divides, contributing to ongoing theoretical refinement.

To sum up, this dissertation is a substantial, original, and timely contribution to the study of digitalisation, skills, and employment in Europe. Its greatest strength lies in methodological innovation—the creation of the EDSI—and in the empirical breadth of its analysis. The findings confirm and refine key hypotheses about skill-biased technological change, job polarisation, and digital divides, while also revealing important heterogeneities across occupations and countries.

Overall, this dissertation represents a significant and original contribution, meeting the requirements for a rigorous doctoral dissertation. It demonstrates strong research capacity and provides a foundation for future research about digitalisation and employment in both academic and policy domains.

I conclude that the dissertation meets the required scientific criteria in the domain of Social Sciences, discipline of Economics and Finance, and I recommend that it be accepted for public defense at the Faculty of Management and Economics of Gdańsk University of Technology.

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Signed by

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