

# UNTANGLED CONFERENCE PROGRAMME



Labour Market Effects and Social Impact of Technological Transformation, Globalisation, and Demographic Change

Campus Social Sciences, November 23, 2023

8:30 - 9:00	Coffee & registration, <b>AGORA Couvreur M01.E50</b>		
9:00 - 9.15	<p style="text-align: center;"><b>Opening and welcome</b>  <i>Tine Van Regenmortel, director (HIVA-KU Leuven)</i>  <b>AGORA Couvreur M01.E50</b></p>		
9:15 - 10:15	<p style="text-align: center;"><b>Keynote presentation: De-Routinization in the Fourth Industrial Revolution – Firm-Level Evidence</b>  <i>Melanie Arntz, professor (ZEW)</i>  <b>AGORA Aula Emma Vorlat 00.E20</b>  <i>Discussant: Ludivine Martin (LISER), Chair: Piotr Lewandowski (IBS)</i></p>		
10:15 - 10:30	Coffee break, <b>AGORA Couvreur M01.E50</b>		
10:30 - 12:30	<b>Jobs and their quality</b> <b>HIVA Conference room</b> <i>Chair: Sem Vandekerckhove (HIVA-KU Leuven)</i>	<b>Global value chains</b> <b>HIVA library</b> <i>Chair: Piotr Lewandowski (IBS)</i>	<b>Skills and tasks</b> <b>AGORA Aula Emma Vorlat 00.E20</b> <i>Chair: Francesco Venturini (UNIPG)</i>
	<a href="#"><u>Green investments and human resource management: Evidence from Italian firms</u></a> <i>Fabrizio Pompei (UNIPG)</i>	<a href="#"><u>The role of global value chains for workers tasks and wage inequality</u></a> <i>Karol Madoń (IBS)</i>	<a href="#"><u>Changes in returns to multidimensional skills across cohorts</u></a> <i>Lorenzo Navarini (KU Leuven)</i>
	<a href="#"><u>Generative AI and jobs: A global analysis of potential effects on job quantity and quality</u></a> <i>Pawel Gmyrek (ILO)</i>	<a href="#"><u>The impact of technology and connectivity on trade patterns</u></a> <i>Isabelle Rabaud (University of Orléans)</i>	<a href="#"><u>The diffusion of Artificial Intelligence: Implications for wages and employment</u></a> <i>Eduard Storm (RWI)</i>
	<a href="#"><u>Digital technology, cross-border production links and employee well-being - evidence from Europe</u></a> <i>Aleksandra Parteka (Gdansk University of Technology)</i>	<a href="#"><u>Moving up the value chain: How can EU countries specialise in R&amp;D?</u></a> <i>Zuzana Zavorska (wiiw)</i>	<a href="#"><u>The future of digital automation technologies, tasks and skills. A delphi survey</u></a> <i>Ana Oliveira (USE)</i>
	<a href="#"><u>Working apart: Trends, drivers and consequences of segregation of lower educated workers</u></a> <i>Wouter Zwysen (ETUI)</i>	<a href="#"><u>Labour market inequalities: Impacts of technology and the changing nature of international trade: 2000-2014</u></a> <i>Xianjia Ye (Groningen University)</i>	
12:30 - 13:30	Lunch, <b>AGORA Couvreur M01.E50</b>		

13:30 - 15:00	<b>Inside firms and organisations</b> <b>HIVA Library</b> <i>Chair: Karolien Lenaerts (HIVA-KU Leuven)</i>	<b>Technology, jobs and wages</b> <b>HIVA Conference room</b> <i>Chair: Ludivine Martin (LISER)</i>	<b>Platform and flexible work</b> <b>AGORA Coll. Study Space M00.E67</b> <i>Chair: Uma Rani (ILO)</i>
	<a href="#">How megatrends make impacts and what happens in between – insights from company and sector case studies</a> <i>Ursula Holtgrewe (ZSI)</i>	<a href="#">Assessing the impact of new technologies on wages and labour income shares</a> <i>Antea Barišić (University of Zagreb)</i>	<a href="#">Platform work in developing economies: Can digitalisation drive structural transformation?</a> <i>Uma Rani (ILO)</i>
	<a href="#">Automation in shared service centres: Implications for skills and power dynamics in a global organisation</a> <i>Zuzanna Kowalik (IBS)</i>	<a href="#">Robots and wages: A meta-analysis</a> <i>Florian Schneider (VDMA)</i>	<a href="#">Measuring and understanding job quality in the Belgian platform economy. Precarity and the exposure paradox</a> <i>Elief Vandevenne (VUB)</i>
	<a href="#">Policy responses to labour market risks</a> <i>Anna-Lena Nadler (Leiden University)</i>	<a href="#">Obsolescence rents: teamsters, truckers, and impending innovations</a> <i>Malhotra Raghav (Leicester Univeristy)</i>	<a href="#">Long-term trends in part-time work</a> <i>Rachel Scarfe (Edinburgh University)</i>
15:00 - 15:30	Coffee break, <b>AGORA Couvreur M01.E50</b>		
15:30 - 17:30	<b>Technology adoption</b> <b>HIVA Library</b> <i>Chair: Ursula Holtgrewe (ZSI)</i>	<b>Regional and structural change</b> <b>HIVA Conference Room</b> <i>Chair: Fabrizio Pompei (UNIPG)</i>	<b>Training, skills and working conditions</b> <b>AGORA Coll. Study Space M00.E67</b> <i>Chair: Ilse Tobbacq (HIVA-KU Leuven)</i>
	<a href="#">The effects of robots on the workplace</a> <i>Ainhoa Urtasun (UPNA)</i>	<a href="#">Structural labour market change and fertility in Norway</a> <i>Vegard Fykse Skirbekk (FHI)</i>	<a href="#">Advanced digital technologies and investment in employee training</a> <i>Patricia Wruuck (BMWK)</i>
	<a href="#">Advertised technologies: Identifying adoption of emerging technologies in online job postings</a> <i>Fabien Petit (UCL)</i>	<a href="#">Technological cycles and labour markets: Evidence from European regions</a> <i>Tommaso Ciarli (UNU-MERIT)</i>	<a href="#">Digitalisation and polarisation in nonpecuniary working conditions</a> <i>Sarah Fleche (UNIV - PARIS 1)</i>
	<a href="#">Revealing semantics: Exposure of industries and occupations to emerging technologies</a> <i>Deyu Li (Utrecht University)</i>	<a href="#">Unlicing the pie: AI innovation and the labour share in European regions</a> <i>Francesco Venturini (UNIPG)</i>	<a href="#">Resilient digital skills: A graph-based strategy for optimal training policies</a> <i>Ludivine Martin (LISER)</i>
		<a href="#">AI and employment: A look into the crystal ball</a> <i>Jelena Reljic (Rome University)</i>	
17:30 - 17:40	<b>Closing of the conference, AGORA Couvreur M01.E50</b>		
19h30	<b>Dinner at <a href="#">Restaurant Mykene</a>, Muntstraat 44, Leuven</b>		

# Abstracts

## Inside firm and organisation

### **How megatrends make impacts and what happens in between – insights from company and sector case studies**

*Ursula Holtgrewe (ZSI)*

*Authors:*

*Ursula Holtgrewe (ZSI)*

*Abstract:*

This contribution, in the shape of a presentation or as part of a panel discussion, analyses the results of a series of 13 case studies conducted in the UNTANGLED projects in manufacturing, financial services and business services, and explores the interplay of 'megatrends' and 'impacts' on the level of companies and business sectors in Europe and South Africa. On the meso-level of companies and sectors, 'megatrends' take quite varied shapes in varied contexts, as soon as they are filtered through institutional regimes of employment, industrial relations, market regulation and industrial and labour market policies, as well as through the actual and expected developments of markets for products and services. Indeed, which pathways of globalisation emerge, which technologies are implemented and how, which workforces are sought after (and where they are found), is contingent upon companies', business associations' and social partners' decisions, strategies, and modes of cooperation – and of course, on the histories and path-dependencies of previous decisions and actions and their intended and unintended consequences. Whereas the identified 'megatrends' suggest external and irresistible forces, at a closer look through the lens of case studies methodology these megatrends appear both more societally embedded and enacted than expected, and more riddled by tensions and contradictions within and between different trends. The presentation outlines key findings, illustrates the with exemplary case studies, and draws conclusions to connect with UNTANGLED's results.

### **Automation in shared service centres: Implications for skills and power dynamics in a global organisation**

*Zuzanna Kowalik (IBS)*

*Authors:*

*Zuzanna Kowalik, Piotr Lewandowski, Tomasz Geodecki, Maciej Grodzicki*

*Abstract:*

The Central and Eastern European business services sector has experienced a remarkable surge, driven by globalisation, outsourcing trends, and the demand for tech-related expertise. This expansion has given rise to shared service centres (SSCs), designed to enhance service efficiency and reduce costs. However, dynamically developing technologies like Robot Process Automation (RPA) and Artificial Intelligence (AI) threaten routine-intensive tasks within SSCs. This shift in the nature of work profoundly impacts the skills and competencies demanded of SSC employees. As automation progresses, the workforce is compelled to adapt, with employees actively seeking to automate mundane tasks and redirect their efforts towards higher-value activities. Consequently, the evolving skill demands within SSCs directly respond to the automation threat as employees strive to remain relevant and valuable in the face of an ever-evolving technological landscape. Moreover, the intersection of automation, changing skill demands, and workforce dynamics within SSCs presents a multifaceted challenge and opportunity for the sector's continued growth and competitiveness.

This study explores the impact of automation on the skills of SSC employees. We pay particular attention to shifts occurring in skill and competency prerequisites and their potential for dynamics of power relations within companies. Additionally, we look at skills rising and declining in value and the influence of automation on the scope of worker's independence and decision making.

# Policy responses to labour market risks - on the combined effects of the green transition, digitalisation and migration

*Anna-Lena Nadler (Leiden University)*

## *Authors:*

*Daniel Fernandes, Anna-Lena Nadler, Briitta van Staalduinen, Eduard Suari-Andreu, Olaf van Vliet*

## *Abstract:*

How are the three critical structural labour market transformations in Europe, i.e. the green transition, automation and digitalisation, and the internationalisation of the workforce, interrelated and what are their common and distinct consequences on national and EU social protection schemes? In this paper, we provide a new theoretical framework to advance our understanding of the interconnection of these three major labour market transformations in Europe. While recent scholarly work in comparative political economy has provided first insights into the possible consequences of technological changes, climate policies, and mobility for the world of work, to date these structural changes have been addressed mostly independently from each other. Moreover, analyses of the implications of these transitions in terms of support for mitigating policies have been mainly focused on national social and labour market policies. The consequences of structural labour market transformations for policy making at the EU level remains heavily understudied, both empirically and theoretically. Filling these gaps, in this article we develop a more integrative understanding of how these fundamental changes relate to each other in terms of perceived labour market risk and skill requirements for workers, and their potential of shaping political support for enhanced EU social protection policies to mitigate these challenges. Bringing together literatures and theories on political accountability and European integration to study labour market transformations in Europe, our theoretical framework advances that the transnational character of current and future labour market risks brings in the potential to create new political support coalitions for trans- and supranational policy responses. Notably, we argue that when citizens are prompted to perceive labour market insecurities to be the consequences of a transnational phenomenon exogenous to European institutions, there is a potential for increased support for EU level policy solutions to these structural insecurities over national mitigation measures. In that sense, these structural challenges provide a promising opportunity to overcome existing political cleavages between EU-sceptics and Europhiles.

# Global value chains

## **The role of global value chains for workers tasks and wage inequality**

*Karol Madoń (IBS)*

*Author:*

*Piotr Lewandowski, Karol Madoń, Deborah Winkler*

*Abstract:*

This paper studies the relationship between global value chain (GVC) participation, worker-level routine task intensity, and wage inequality within countries. Using unique survey data from 38 countries, we find that higher GVC participation is associated with more routine-intensive work, especially among workers in offshorable occupations. This relationship is particularly strong in industry and in countries at lower development levels. As higher routine task intensity links with to wages, this indirectly widens within-country wage inequality. However, GVC participation directly contributes to reduced wage inequality, except in the richest countries. Overall, GVC participation is negatively associated with wage inequality in most low- and middle-income countries that receive offshored jobs, and positively in high-income countries that offshore jobs.

## **The impact of technology and connectivity on trade patterns**

*Isabelle Rabaud (University of Orléans)*

*Authors:*

*Isabelle Rabaud, Camelia Turcu, Marcel Voia*

*Abstract:*

In this paper, we investigate how new digital technologies and robotisation foster trade in intermediate goods and services. Two sets of estimations are conducted. First, relying on Trade in Value-Added (TiVA) database for 27 EU countries and 63 origin countries for the period 1995-2018, we show that digitalisation strengthens the backward Global Value Chain (GVC) participation. Second, we employ the International Federation of Robotics database along with the OECD Inter-Country Input-Output (ICIO) data set and investigate the effects of intensity in robot use on the forward GVC participation. We consider 61 exporting countries and 20 EU importing economies, over the period 2000-2018. We find that new technologies enhance GVCs participation, with the installation and the stock of robots being the relevant components that cause this enhancement. Our results differ for EU and non-EU exporting countries confirming the new organisation of production in Europe stated by Baldwin (2017).

## **Moving up the value chain: How can EU countries specialise in R&D?**

*Zuzana Zavorska (wiw)*

*Authors:*

*Francesca Guadagno, Zuzana Zavorska*

*Abstract:*

This paper analyses the specialisations of EU economies in global value chains (GVCs) and empirically assesses the role of digital technologies, technological capabilities, and industrial policy efforts in driving specialisations in R&D. Relying on an established method for calculating functional specialisations with greenfield FDI data, we show that the ability to specialise in R&D activities remains largely in the hands of the old Member States. We econometrically model R&D specialisations of 24 EU Member States in 10 manufacturing industries for the period of 2003-2019 as a function of ICT assets, business R&D expenditures and industrial policy efforts proxied by state aid. Our estimations find evidence for the importance of digital technologies and business R&D expenditures for increased specialisations in R&D activities of the value chain, with the effect magnified for the less developed countries of the EU. We obtain inconclusive results for industrial policy efforts, highlighting the need for advancing the quality of available data on industrial policy.

## **Labour market inequalities: Impacts of Technology and the changing nature of international trade: 2000-2014**

*Xianjia Ye (Groningen University)*

*Authors:*

*Bart Los, Gaaitzen J. De Vries, Xianjia Ye*

*Abstract:*

We propose a method to analyse the changing structure of employment in countries by business function, based on the input-output structure of the world economy. Demand for jobs in particular functions, is driven by changes in technology, trade and consumption. Using structural decomposition analysis, we study the relative importance of these drivers for the period 2000-2014. We derive a measure of technological change in GVCs. We find that technological change and changes in trade patterns have both played an important role in the decline of fabrication employment in large West-European countries. The role of trade tends to have been the most important for this business function. For labour demand regarding other business functions, changes in trade have been much less impactful. For East-European countries, somewhat mixed results were obtained regarding the role of trade, but labour-saving technological change exerted a clearly downward pressure on labour demand in all functions.

# Skills and tasks

## Changes in returns to multidimensional skills across cohorts

*Lorenzo Navarini (KU Leuven)*

*Authors:*

*Lorenzo Navarini*

*Abstract:*

From 1984 to 2020 in Germany, I document a significant decline in routine and a substantial increase in social tasks. Using a novel dynamic model incorporating endogenous skills and exogenous ability, I estimate changes in returns to multidimensional skills. I find increasing returns to social skills aligning with the growing demand for social tasks. However, as non-cognitive skills, i.e. diligence, hold a comparative advantage in performing routine tasks, I find decreasing returns to non-cognitive skills and an offsetting effect on increasing returns to social skills. I show that routine task displacement harms individuals with low cognitive, low social and high non-cognitive skills.

## The diffusion of Artificial Intelligence: Implications for wages and employment

*Eduard Storm (RWI)*

*Authors:*

*Eduard Storm*

*Abstract:*

This paper documents the diffusion of Artificial Intelligence (AI) across German firms and explores the resulting effects on wages and employment. Drawing on novel job vacancy data with access to original texts, we employ natural language process techniques to identify AI demand based on firm's skill requirements. We find the share of firms demanding AI skills has increased from 3% in 2017 to 4.8% in 2021 with substantial heterogeneity subject to firm characteristics, job location, and industry. Subsequently, we link our AI measures to administrative data to study the impact of rising AI demand on local employment and wages. We find no effects on employment. Yet, a 10 pp. increase in AI demand is associated with a wage increase of 1%. Contrary to previous automation technologies, our findings suggest AI has stronger wage than employment effects.

## The future of digital automation technologies, tasks and skills. A delphi survey

Ana Oliveira (USE)

### Authors:

Ana Oliveira, Tommaso Ciarl, Rafael Consentino de la Vega, Chiel Scholten

### Abstract:

In this paper we combine expertise from hundreds of experts from science, technology, business, civil society and policy, to make predictions about what are the automation technologies that will become prevalent by 2030, which tasks they will perform, and what skills they will replace. We designed a real-time Delphi platform to collect the data. Preliminary results based on a small initial sample of respondents suggest a focus on NLP and Machine Learning technologies, mobile and collaborative robots, and network management and orchestration technologies. They also suggest that the main work activities these technologies can perform are related to tasks of professionals and technicians, such as analysing data for evaluation, identification and estimation.



# Jobs and their quality

## Green investments and human resource management: Evidence from Italian firms

*Fabrizio Pompei (UNIPG)*

*Authors:*

*M. Damiana, F. Pompei, A. Riccio*

*Abstract:*

This paper analyses the role of green investments in employment relations. We verify whether the amounts of these investments affect the adoption of decentralised bargaining (firm-level and territorial agreements), and single aspects negotiated therein. Using new data on a large representative sample of Italian firms, we find that investing in green technologies increases the overall probability of decentralised agreements. Further, green investments lead to an increase in negotiations on performance-related pay, and welfare benefits. These results are robust to an econometric strategy that controls for firm-level observed and unobserved heterogeneity and endogeneity issues. Our is the first micro evidence supporting the hypothesis that the ongoing ecological transformation of productive processes leads to significant changes in industrial labour relations.

## Generative AI and jobs: A global analysis of potential effects on job quantity and quality

*Pawel Gmyrek (ILO)*

*Authors:*

*Pawel Gmyrek, Janine Berg, David Bescond*

*Abstract:*

This study presents a global analysis of the potential exposure of occupations and tasks to Generative AI, and specifically to Generative Pre-Trained Transformers (GPTs), and the possible implications of such exposure for job quantity and quality. It uses the GPT-4 model to estimate task-level scores of potential exposure and then estimates potential employment effects at the global level as well as by country income group. Despite representing an upper-bound estimate of exposure, we find that only the broad occupation of clerical work is highly exposed to the technology with 24 per cent of clerical tasks considered highly exposed and an additional 58 per cent with medium-level exposure. For the other occupational groups, the greatest share of highly exposed tasks oscillates between 1 and 4 per cent, and medium exposed tasks do not exceed 25 per cent. As a result, the most important impact of the technology is likely to be of augmenting work - automating some tasks within an occupation while leaving time for other duties - as opposed to fully automating occupations.

The potential employment effects, whether augmenting or automating, vary widely across country income groups, due to different occupational structures. In low-income countries, only 0.4 per cent of total employment is potentially exposed to automation effects, whereas in high-income countries the share rises to 5.5 per cent. The effects are highly gendered, with more than double the share of women potentially affected by automation. The greater impact is from augmentation, which has the potential to affect 10.4 per cent of employment in low-income countries and 13.4 per cent of employment in high-income countries. However, such effects do not consider infrastructure constraints, which will impede the possibility for use in lower-income countries and likely increase the productivity gap.

We stress that the primary value of this analysis is not the precise estimates, but rather the insights that the overall distribution of such scores provides about the nature of possible changes. Such insights can encourage governments and social partners to proactively design policies that support orderly, fair, and consultative transitions, rather than dealing with change in a reactive manner. Moreover, the likely ramifications on job quality might be of greater consequence than the quantitative impacts, both with respect to the new jobs created because of the technology, but also the potential effects on work intensity and autonomy when the technology is integrated into the workplace. For this reason, we also emphasise the need for social dialogue and regulation to support quality employment.

## **Digital technology, cross-border production links and employee well-being - evidence from Europe**

*Aleksandra Parteka (Gdansk University of Technology)*

*Authors:*

*Aleksandra Parteka , Joanna Wolszczak-Derlacz , Dagmara Nikulin*

*Abstract:*

This paper uses a sample of over 9 million workers from 22 European countries to study the intertwined relationship between digital technology, cross-border production links and employee well-being. We compare the social consequences of technological change exhibited by three types of innovation: computerisation (software), automation (robots) and artificial intelligence (AI). To fully quantify work-related well-being, we propose a new methodology that amends the information on remuneration by reference to such non-monetary factors as the work environment (physical and social), career development prospects, or work intensity. First, we show that employee well-being is related to the type of technological exposure. Employees in occupations with a high degree of software or robot exposure face worse working conditions than those exposed to AI. Secondly, the relationship between digitalisation and working conditions depends on participation in global production. GVC intensification is accompanied by deteriorating working conditions - but only in occupations exposed to robots or software, not in AI-intensive jobs. Thus, we find that AI technologies differ from previous waves of technological progress - also in relation to employee well-being within global production structures.

## **Working apart: Trends, drivers and consequences of segregation of lower educated workers**

*Wouter Zwysen (ETUI)*

*Authors:*

*Wouter Zwysen*

*Abstract:*

Where you work matter increasingly in determining wages and working conditions, both through differences in pay setting and peer effects. Problematically though, there are widening differences between workers with different skills and qualifications in their access to the better workplaces. Using cross-nationally comparable European data enriched with contextual data on technology, trade, and institutional factors this paper (1) describes how workplace composition by education changes over time; (2) points towards key contextual factors shaping such segregation; and (3) analyses how such changes contribute to widening gaps on the labour market. Over time, there is a widening separation between high- and low-qualified workers in where they work. These processes are reinforced by the adoption of new ICT technologies, while stronger worker representation and worker bargaining alleviates it. Partly, such sorting of differently qualified workers also accounts for variations in the returns to higher education by contextual factors.

# Technology, jobs and wages

## Assessing the impact of new technologies on wages and labour income shares

*Antea Barišic (University of Zagrebwiw)*

*Authors:*

*Mahdi Ghodsi, Robert Stehrer, and Antea Barišic*

*Abstract:*

This paper contributes to the literature on the impacts of new technologies on labour markets considering the effects on wage growth and labour income shares. Using a large sample across countries and industries we estimate the impacts of new technologies – proxied by patents, use of ICT capital and robot intensity – on average wages and labour income shares and their changes over time. Our findings indicate that new technologies are significantly positively (for our proxy using patents) or not significantly (robot intensity or ICT capital) related to wage levels. However, we find a small negative relation of patents on the labour income shares indicating that not all technology rents are passed over to labour income. For robot intensity we even find a significantly positive relation to labour income shares, whereas ICT capital has no significant correlation. These results are also broadly confirmed when considering annual changes over time. Results however can be reinforced or counteracted when taking (the joint effects) of GVC linkages into account. Analogously to the recent literature focusing on employment levels, we therefore conclude that there are only limited impacts of new technologies on wages, or the labour income shares as well.

## **Robots and wages: A meta-analysis**

*Florian Schneider (VDMA)*

*Authors:*

*Anne Jurkat, Rainer Klump, Florian Schneider*

*Abstract:*

Given the rather mixed empirical evidence our meta-study aims to uncover a potentially true effect of industrial robots on wages and to identify drivers of the heterogeneous empirical results. By means of a systematic literature research, we collected 53 papers containing 2,143 estimations for the impact of robot adoption on wages. We observe only limited evidence for a publication bias in favour of negative results. The genuine overall effect of industrial robots on wages is close to zero and both statistically and economically insignificant. With regard to the drivers of heterogeneity, we find that more positive results are obtained if primary estimations (a) include more countries in their sample, (b) control for ICT capital, demographic developments, or tenure, (c) focus on employees that remain employed in the same sector, (d) consider only non-manufacturing industries, (e) are specified in long differences, and (f) come from a peer-reviewed journal article. More negative effects, in turn, are reported for primary estimations that are (i) weighted, (ii) aggregated at country level, (iii) control for trade exposure, (iv) and consider only manufacturing industries. We also find some evidence for skill-biased technological change. and little evidence for data dependence.

## **Obsolescence rents: Teamsters, truckers, and impending innovations**

*Malhotra Raghav (Leicester University)*

*Authors:*

*Costas Cavouridis, Qingyuan Chai, Kevin Lang, and Raghav Malhotra*

*Abstract:*

We consider large, permanent shocks to individual occupations whose arrival date is uncertain. We are motivated by the advent of self-driving trucks, which will dramatically reduce demand for truck drivers. Using a bare-bones overlapping generations model, we examine an occupation facing obsolescence. We show that workers must be compensated to enter the occupation - receiving what we dub obsolescence rents - with fewer and older workers remaining in the occupation. We investigate the market for teamsters at the dawn of the automotive truck as an `a propos parallel to truckers themselves, as self-driving trucks crest the horizon. As widespread adoption of trucks drew nearer, the number of teamsters fell, the occupation became `grayer', and teamster wages rose, as predicted by the model.

# Platform and flexible work

## Platform work in developing economies: Can digitalisation drive structural transformation?

Uma Rani (ILO)

### Abstract:

The rapid development of digital infrastructure since the early 2000s has led to the current phase of digital transformation in the world of work, driven by the increasing importance of data in the digital economy. There is increasing debate over whether digitalisation can help developing countries to catch-up and achieve economic prosperity and development in the same way that developed countries did through industrialisation. Platforms play a critical role in the digital economy, and platform work has gained prominence within the development agenda in recent years, as it is viewed to have the potential to create income and employment opportunities. This paper is concerned with the expansion or penetration of digital economic activity in the context of developing economies, and what this may mean for economic or structural transformations for countries in the global South. We ask what possibilities new jobs and forms of work in the digital economy – and in particular platform work - hold for the transformation of economies in ways that contribute to a productive transformation of low-income economies and to achieving the goals of human, inclusive and sustainable development. What are the impacts on work and workers in this process? The question of whether a 'digital transformation' can spur development, and if so how, and to whose benefit, depends in large part on the nature of employment created, and whether labour can move to higher productivity sectors which in turn raises incomes while also strengthening the capacity to finance public goods and services, including social protection. Drawing on the stylised facts concerning skills and productivity, investment in human capital and infrastructure, and the role of capital and technology we assess how digitalisation, and specifically work through platforms, has affected the conditions of work and workers. Finally, we suggest some of the key policies, institutional arrangements and regulatory steps necessary to link digitalisation with structural transformation as development.

## Measuring and understanding job quality in the Belgian platform economy. Precarity and the exposure paradox

Elief Vandevenne (VUB)

### Authors:

Vandevenne, Elief; Vanroelen, Christophe & Gevaert, Jessie

### Abstract:

The platform economy generates jobs that bypass the stability and social protection of the standard employment relationship (Kalleberg & Dunn, 2016; Sutherland & Jarrahi, 2018). This can result in insecure contracts, boundaryless working hours, piece-rate wages, and little social protection, potentially jeopardising the health and well-being of workers (Goods *et al.*, 2019). Besides concerns about the volatile and precarious nature of employment arrangements within platform jobs, the intrinsic aspects of these jobs also come into play. For example, previous research shows that platform workers appreciate the autonomy, flexibility and intrinsic nature of the work which might partially offset or buffer the negative impact of precarious employment conditions on well-being (Barratt *et al.*, 2020; Wood *et al.*, 2019). Simultaneously, the high work intensity and social isolation within these professions are also recognised as potential hazards to well-being (Wu *et al.*, 2022). Questions arise about how intrinsic job characteristics such as autonomy, social support and work intensity are related to precarious employment arrangements (Wood *et al.*, 2019) and how precarious employment impacts the overall well-being of platform workers (Apouey *et al.*, 2020). Despite these concerns, there is little research that attempts to assess job quality among platform workers. **Objectives:** the aim of this study is to explore the relationship between employment quality and worker well-being and whether this relationship is mediated by intrinsic job quality characteristics. **Methods:** we used primary survey data collected among Belgian platform workers (N=396) to construct an employment quality measure based on three dimensions: employment conditions, employment relations and working hours, each consisting of several subdimensions. Structural equation modelling (SEM) was employed to investigate the relationship between

employment quality and well-being, as well as to explore the potential mediating influence of intrinsic job quality characteristics (i.e. autonomy, skill discretion, work intensity, social support, and physical demands). Results: while analyses are still ongoing the preliminary results show a positive, consistent relationship between poor employment conditions and poor well-being. This relationship is partly mediated by a lack of social support at work. These findings suggest that it's primarily the detrimental aspects of poor employment conditions that relate to well-being, irrespective of most of the intrinsic job characteristics. Conclusion: our findings contribute to the ongoing debate on how to systematically measure job quality in the platform economy and assess its health outcomes. This empirical evaluation of job quality can also be an important instrument to inform policies aimed at sustainable work in times of digitalisation.

## Long-term trends in part-time work

*Rachel Scarfe (Edinburgh university)*

*Authors:*

*Rachel Scarfe*

*Abstract:*

In this paper I document new stylised facts about part-time work. First, in many European countries, including the UK, there has been a substantial increase in the percentage of men working part-time since the 1990s as labour markets have become more flexible. At the same time, the female part-time share has been stable, or fallen slightly, so that the net effect is a slight increase in the overall part-time share. There has also been an increase in part-time work on the extensive margin; fewer people work very low hours and more work between 20 and 30 hours per week. Second, despite this increase in the quantity of part-time work, the difference in average hourly pay for part-time and full-time work has steadily decreased. Observing these equilibrium outcomes does not identify whether these changes are caused by changes in workers' preferences or by structural changes in firms' technology. In the second part of the paper I develop a model of the labour market which can explain both firms' and workers' preferences for part- and full- time work. In the equilibrium of the model, part- and full-time workers undertake different tasks. As a result, the model can endogenously generate earnings that are non-linear in hours worked. The model can thus be used to disentangle the effects of changes in workers' preferences and in firms' production technologies on the relative quantities and prices of part- and full-time labour.

# Technology adoption

## The effects of robots on the workplace

Ainhoa Urtasun (UPNA)

Authors:

Adrianto, Avner Ben-Ner, and Ainhoa Urtasun

Abstract:

## Advertised technologies: Identifying adoption of emerging technologies in online job postings

Fabien Petit (UCL)

Authors:

Anna Giabelli, Ekaterina Prytkova, Fabien Petit, Tommaso Ciarli

(Extended) abstract:

Over the past decade, a multitude of digital automation technologies, such as artificial intelligence (AI) and 3D printing, have emerged (Chaturvedi *et al.* 2023; Prytkova *et al.* 2023). As firms adopt them, these technologies are likely to reshape the future of work by taking over some tasks and creating new ones, hence, transforming industries and occupations. (1) Understanding the pace at which firms effectively adopt these emerging technologies is crucial to quantifying the speed at which economies are progressing toward a new technological landscape that carries significant implications for employment, growth, and inequality.

This paper measures the adoption of 40 emerging digital automation technologies by UK firms leveraging textual descriptions from online job vacancies (OJV). Using state-of-the-art natural language processing (NLP) techniques, we propose a novel methodology to identify technologies directly from the description of OJV posted by employers. We find that firms' adoption is consistent with the measurement of occupational and industrial exposure to emerging technologies in Prytkova *et al.* (2023), although firms' adoption suggests more complementarity between technologies than exposure measures. We find that education and experience requirements from the labour demand differ between technologies and that few emerging technologies are associated with higher wages when accounting for these latter factors as well as occupation and industry fixed effects.

Our approach builds upon prior work in which the labour demand for AI skills in OJV can proxy for the use of AI technologies (see Webb, 2019; Alekseeva *et al.*, 2021; Acemoglu *et al.*, 2022). Our contribution is threefold. First, we directly identify technologies in descriptions without using skills as a proxy, thus providing an effective measure of adoption. Second, we focus not only on AI but also consider an array of emerging technologies, including but not limited to AI. This allows us to document the adoption technologies that are often disregarded in the literature (e.g. predictive energy management, automated workflow, cloud computing) as well as their complementarity pivotal to understanding technological adoption. Third, we are the first (to the best of our knowledge) to use the sample of the Web Intelligence Hub Online Job Advertisements database for this exercise instead of the usual LightCast (formerly BurningGlass) data.

We start our identification of firms' adoption by taking the set of 40 technologies constructed in Prytkova *et al.* (2023) based on a sample of novel patents identified in Chaturvedi *et al.* (2023). We create a representative vocabulary per technology for further search in job postings. To do so, for each technology separately, we create a list of trigrams and cluster their embeddings hence grouping trigrams by topic. For example, consider neural network technology; groups of trigrams describe the following topics: types of neural networks, various training techniques, data modalities (image, sound, text, etc.), application domains, etc. Then, we select groups of trigrams that are representative of a technology inside each cluster. These trigrams become our search terms to form queries at the next step.

We search for a technology using queries in the OJV descriptions. An individual query is an average embedding of 7 trigrams randomly sampled from the representative vocabulary described in the previous step; we create multiple queries per technology. In turn, the OJV descriptions are partitioned into chunks of 20 words with



10–word moving window to address potential truncation problem and their embeddings are produced. The matching is established based on the cosine similarity between embeddings for each chunk–query pair and retains the one with the highest cosine similarity. We then retain OJV–technology pairs that have a cosine similarity of at least 0.5, which is a cut-off that reflects meaningful semantic link. Our paper provides three main results. First, the technology complementarity within occupation is more important than the one suggested by exposure scores. This suggests that firms hire workers to use a bundle of technologies rather than specific technologies. For instance, the adoption of neural networks (which is the core technology of AI) is often supplemented with cloud computing and cloud storage. Similarly, the adoption of 3D printing pairs up with industrial robotic automation and large-scale monitoring systems.

Second, the education and experience required for workers differ substantially across the use of the different technologies. For instance, firms adopting neural networks, cloud computing, and cloud storage tend to search for more experienced and educated workers. Conversely, the use of workflow management systems is targeted at less educated and less-experienced workers. Third, only four emerging technologies are associated with a positive wage premium when accounting for education and experience requirements as well as occupation and industry fixed effects, namely, cloud computing (+8.1Ke in yearly salary), cloud storage (+3.7Ke), industrial robotic automation (+2.1Ke) and workflow management systems (+0.7Ke). Conversely, 10 technologies are associated with a negative wage premium such as electronic payment systems (-4.3Ke), online learning platforms (-3.1Ke), intelligent food ordering systems (-3Ke), and remote health monitoring (-1.6Ke). This indicates that firms' adoption of emerging technologies is associated with lower wages for new hires, except for those relating to AI or robotics.

## **Revealing semantics: exposure of industries and occupations to emerging technologies**

*Deyu Li (Utrecht University)*

*Authors:*

*Ekaterina Prytkova, Fabien Petit, Deyu Li, Sugat Chaturvedi, Tommaso Ciarlill*

*Abstract:*

This paper proposes a novel methodology to estimate occupation and industry exposure to digital automation technologies and research areas. We measure the semantic connection between patents and publications documenting emerging digital automation technologies and descriptions of industries (NACE) and occupations (ISCO) using Natural Language Processing (NLP). We distinguish industries exposure between technology users and producers, leveraging the firm's patent portfolios. We find that, besides machine operators, technicians and professionals (non-routine occupations) are also highly exposed to digital automation technologies, with managers positioned in the middle of the exposure distribution. Then, we estimate if highly exposed occupations– industries in Europe are associated with changes in employment between 2011 and 2019. We find that highly exposed occupations are associated with employment growth in sectors producing automation technologies and employment decline in sectors using automation technologies. Using more granular German data we show that the nature of user industries matters, as tasks across industries differ for the same occupation.

# Regional and structural change

## Structural labour market change and fertility in Norway

*Vegard Fykse Skirbekk (FHI)*

*Authors:*

*Bernt Bratsberg, Ole Røgeberg, Vegard Skirbekk*

*Abstract:*

Our research question is whether structural economic risk is associated with fertility differentials. To answer this, we examine statistical associations between an indicator of occupational structural risk (routine task intensity which is measured for all Norwegians employed in the baseline year of 2006) and their total fertility across the 14-year follow-up period 2007-2020. Our data extract consists of 214,134 men and 190,111 women born between 1971 and 1981. From these records, we construct subsamples for the purpose of conducting sibling comparisons, identifying 109,452 men and 96,049 women with a sibling in the employee extract. These samples are further reduced in specifications using both family and firm fixed effects, resulting in observation counts of 86,494 men and 78,980 women in the most exhaustive specifications. We find that occupational structural risk at baseline covaries with long-term fertility outcomes, with similar coefficient sizes for men and women. The association is markedly attenuated in analyses adjusting for individual age and education at baseline, but no further attenuation was observed in models additionally adjusting for time-invariant differences between firms and families. More routine intense jobs tend to have a greater risk of being displaced through automation or offshoring, with a one standard deviation increase in routine intensity associated with a reduction of 0.04 (95 CI: 0.03-0.06 for men and 0.02-0.06 for women) children born within the observational window. In percentage terms relative to sample means, this is a fertility reduction for both men and women of about 4%. These results from the main analysis are consistent with a causal effect of structural economic risk on fertility.

## Technological cycles and labour markets: Evidence from European regions

*Tommaso Ciarli (UNU-MERIT)*

*Authors:*

*Tommaso Ciarli, Florencia Jaccoud, Fabien Petit, Maria Savona*

*Abstract:*

This paper examines the labour market implications of exposure to automation over technological cycles in 163 NUTS-2 regions in 12 European countries for 1995-2017. We introduce a novel methodology to identify investment trends in robots, communication technology, information technology, and software and database. We examine how exposure to automation technology affects employment and wages over the different phases of technological cycles. We find that the estimated technological cycles are consistent with major technological breakthroughs observed in those periods. Further, we observe that the short-term impacts on employment and average wages tend to either cancel out or disappear over the long-run. We also find that the overall results are not driven by regions' structural characteristics, but rather by the phase of the cycle of each technology.

## Un slicing the pie: AI innovation and the labour share in European regions

Francesco Venturini (UNIPG)

Authors:

Francesco Venturini

Abstract:

## AI and employment: A look into the crystal ball

Jelena Reljic (Sapienza University)

Authors:

Dario Guarascio, Jelena Reljic, Roman Stöllinger

Abstract:

This study provides evidence of the employment impact of AI exposure in European regions, addressing one of the many gaps in the emerging literature on AI's effects on employment in Europe. Building upon the occupation-based AI-exposure indicators proposed by Felten *et al.* (2018, 2019, 2021), which are mapped to the European occupational classification (ISCO), following Albanesi *et al.* (2023), we analyse the regional employment dynamics between 2011 and 2018. After controlling for a wide range of supply and demand factors, our findings indicate that, on average, AI exposure has a positive impact on regional employment. Put differently, European regions characterised by a relatively larger share of AI-exposed occupations display, all else being equal and once potential endogeneity concerns are mitigated, a more favourable employment tendency over the period 2011-2018. We also find evidence of a moderating effect of robot density on the AI-employment nexus, which however lacks a causal underpinning.

# Training, skills and working condition

## Advanced digital technologies and investment in employee training

Patricia Wruuck (BMWK)

Authors:

Giorgio Brunello, Désirée Rückert, Christoph T. Weiss, Patricia Wruuck

Abstract:

Using firm-level data covering the 27 EU countries, the UK and the US and a differences-in-differences approach, we show that employers adopting advanced digital technologies reduce their investment in training per employee after adoption, compared to non-adopting firms. This reduction is sizeable in the two years after adoption (-11.1 and -10.6 per cent). Employment instead increases, by 2.1 per cent in the adoption year and by 3.6 to 4.2 per cent in the following two years. One probable reason for the decline in training investment is that the use of advanced digital technologies and employee training are substitutes in production, implying that an increase in the former negatively affects the marginal productivity of the latter. Our findings point to challenges in realising high levels of firm-sponsored training for employees in increasingly digital economies.

## Digitalisation and polarisation in nonpecuniary working conditions

Sarah Fleche (UNIV - PARIS 1)

Authors:

Sarah Flèche, Eva Moreno Galbis, Ariell Reshef, Lorenzo Rotunno, Claudia Senik

(Extended) abstract:

The economic literature analysing the impact of digitalisation on employment structure has largely converged on the finding that during the late 90s and 2000s, job polarisation occurred at the extremes of the wage distribution (e.g. Autor *et al.*, 2003; Goos *et al.*, 2019; Michaels *et al.*, 2014). However, in the past decade, this trend appears to have shifted. In many countries, the process of replacing labour input in routine tasks appears to have ended, and instead, we observe an occupational upgrading, with employment increasingly concentrated in high-wage jobs where new technologies have been used most intensively (Eurofound, 2015). These structural changes are not free of consequences on working conditions. Yet, so far, the existing literature analysing the impact of digitalisation has fallen short in addressing its broader impact on working conditions. This is the aim of this paper.

We seek to provide a comprehensive analysis of how the adoption of information and communication technologies (ICT) has changed (i) the working conditions experienced by workers, (ii) the disparities in working conditions across and within jobs and (iii) ultimately the changing distribution of employment along the working condition distribution. This allows us to identify a hitherto unknown feature of the recent labour market evolution: the polarisation of jobs across the working condition distribution, with the most substantial growth of employment in the upper echelons of working conditions, a relative decline in middle-range condition jobs, and a notable stability in low-condition jobs observed over the last decade. Strikingly, this trend in the distribution of working conditions is pervasive and can be observed in various European countries.

To perform our analysis, we primarily rely on matched employer-employee data from the French Working Conditions Survey, with detailed information on employees' working conditions, including autonomy, support, stability, psychological integrity, flexibility and work intensity among others, captured in both 2013 and 2019. Existing studies that analyse the influence of technology on working conditions typically focus on specific aspects, such as work-life balance, job insecurity, or work intensification (e.g. Bloom *et al.*, 2014; Menon *et al.*, 2020; Gihleb *et al.*, 2020). (1) We here contribute to this small literature by taking a multiple component perspective. (2) Another advantage of our database is that it permits to measure ICT use both at the worker level and at the firm level – which is rare in observational data. Thanks to this information, we can exploit firm variations in ICT use as an instrument for individual ICT use (adjusted for firms' and workers' characteristics). Again, the majority of existing studies feature worker-level analyses and display correlations, rather than causal

inference, although some recent studies rely on instrumental variables to tackle endogeneity issues (e.g., Bloom *et al.*, 2014; Anton *et al.*, 2021).

We find that overall, increased utilisation of ICT is associated with improvements in non-pecuniary working conditions. However, there are some notable differences across the working condition components. Specifically, increased use of ICT leads to improvements in skills, support, stability, physical integrity, scheduling, and flexibility. In contrast, it results in reductions in autonomy, psychological integrity, and unconstrained work pace. We then test for heterogeneous impacts of ICT on occupations. Because different occupations offer distinct combinations of working conditions, we expect the impact of ICT to differ across occupations. We provide evidence that changes in working conditions have exhibited a slight U-shaped pattern across working condition percentiles. There has been an improvement for high-condition jobs during the last decade, while middle-condition jobs, such as intermediate occupations or civil servants and public service employees, have experienced a decline in their working conditions. Additionally, there have been some improvements observed at the lower end of the working condition spectrum. However, a significant decline in working conditions has also been observed for occupations such as craftsmen, tradesmen and business owners, which were already situated at the lower tail of the distribution.

High-skilled professions, such as executives and advanced intellectual roles, which have enjoyed improved working conditions over time, may have witnessed an increase in labour supply. Conversely, low-skilled jobs, like craftsmen, tradesmen, and business owners, could have seen a decline in relative labour supply. Surprisingly, while we do see employment growth in high-condition jobs, we do not see a decline in less favourable jobs such as craftsmen, tradesmen and business owners. We rather observe a polarisation of jobs across the working condition distribution, with a notable stability of low-condition jobs. To the best of our knowledge, we are the first to identify this largely unexamined correlation between ICT adoption, changes in working conditions, and the distribution of jobs across the working condition spectrum. Two potential explanations for this polarisation: first, employment growth has been primarily concentrated in occupations that utilise new technologies more intensively. Low condition jobs, such as craftsmen, tradesmen and business owners have substantially increased their use of ICT over the period, which presumably help them maintain their labour demand through better productivity. As such, the increased use of ICT in low-condition jobs over the last decade, has per se helped to sustain some of the jobs with less favourable working conditions in the labour market. Second, relatively high wages may have substituted for worse working conditions in some occupations and explain why labour supply did not decrease over the period in those occupations. By contrast, at the upper tail of the working condition distribution, occupations are likely to have experienced both better working conditions and higher wages, following the diffusion of ICT, hence increasing even more the overall disparities among workers.

## Resilient digital skills: A graph-based strategy for optimal training policies

Ludivine Martin (LISER)

Authors:

Thiago Brant, Ludivine Martin

(Extended) abstract:

Amid the recent rise of digital transformation and especially Artificial Intelligence, the adaptability of digital skills is crucial for the future of work. Studies since the 2010s have predicted significant job market disruption due to automation and AI. To address these challenges, the OECD and the European Union have emphasised the importance of lifelong learning and investment in upskilling the workforce. Existing research focuses on identifying broad digital skills or specific ones (mainly AI) using survey data, task descriptions, training curricula, or job vacancies (Alekseeva *et al.*, 2021; Acemoglu *et al.*, 2022; Felten *et al.*, 2021; Tolan *et al.*, 2021; Webb, 2020).

In this context, policymakers face a new challenge in rapid reskilling and upskilling the workforce to meet the demands of the ever-evolving job market. Policymakers aim to optimise the employability of their citizens; however, the vast array of digital skills required by employers necessitates a rationalisation and prioritisation of the digital skill sets being offered. Consequently, even training policies targeting specific professions can end up with a vast list of digital skills demanded on the job market.

Adding to this complexity is the rapid transformation of the job market, fuelled by the integration of artificial intelligence-based tools, which can affect several fields of the labour market (Righi *et al.*, 2020). Consequently, contemporary training programs must not only focus on equipping the population with relevant skills but also account for the potential decline or obsolescence of specific competencies, even in a highly technological domain like the IT domain, skill obsolescence can occur (Deming & Noray, 2020).

Previous studies have shown that labour market skills can be more portable than previously thought; some skills are more general as they find utility across many occupations (Alabdulkareem *et al.*, 2018). However, the way these skills are amalgamated and used to perform various tasks varies across occupations (Gathmann & Schonberg, 2010). Skills, however, do not exist in isolation; their true value lies in the combinations they form. As demonstrated by Stephany *et al.* (2022), the price of a particular skill is heavily influenced by its complementarity, which refers to the number of other high-value skills with which the competency can be combined. In other words, the more complementary skills a person possesses, the greater the combined value and overall versatility they offer in the job market.

This study expands this literature by distinguishing between eleven digital skill domains covering basic digital skills, information brokerage digital skills, applied/management use of digital skills, man-aging data, analysing data, software and app development, computer programming language, digital security and privacy, operating systems, and AI.

In this paper, we aim to understand digital skill combinations and their interrelationships. In addition, we will significantly expand upon existing analyses on the complementarity between skills by delving deeper into the intricacies of skill sets and identifying the central skills from peripheral skills. Additionally, we will explore the concept of skill flexibility and its influence on adaptability and versatility in an ever-changing job market. By understanding the different relationships between digital skills, we will gain valuable insights into the key competencies that both employees and organisations should prioritise to enhance adaptability and resilience in the face of changing labour market demands.

This paper proposes a novel methodology that employs a graph-theoretic approach, leveraging the connections between skills found in job advertisement data to rank digital skills based on their flexibility regarding access to different job positions, thus maximising employability. Still, we also consider the resilience of the skills for job market transformations in our rank. Public policies focusing on training the population can be costly, so prioritising which skills should be provided is an important task for policymakers. We address the question of skill complementarity, the centrality and periphery roles in the context of determining the optimal training scheme to guide policymakers. This optimisation is grounded in the notion that digital skills should not only be in high demand but also possess the flexibility to be combined with a wide range of other digital skills while remaining resilient to changes in the job market.

We focus our analysis on four Western EU countries labour markets: Belgium, France, Germany and Luxembourg. We use Online Job Vacancies (OJV) data collected by Lightcast to identify the digital skills

required by employers in the last months. We identified around 1,300 selected digital skills covering eleven digital skills domains from basic digital skills to Artificial Intelligence provided by Martin *et al.* (2023). The empirical strategy consists of using graph theory on these job advertisement data, we identify skill communities and rank these skills using the PageRank algorithm. We then construct a directed graph using the skill ranks, facilitating the development of a decision tree to guide optimal training policies dedicated to the improvement of digital skills.

The main preliminary results of the paper highlight the complementarities, the centrality and periphery roles by unbundling between digital skills covering eleven digital skills domains from basic digital skills to Artificial Intelligence. As the training policies should consider skill demand, complementarity, and resilience to market changes, our results provided as a data-driven approach to skill prioritisation will help key challenges for policymakers amidst an evolving job market.