



**Growing Inequality:**  
a Novel Integration of  
transformations research

# New Technologies: End of Work or Structural Change?

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GI-NI contributes to an inclusive Europe of shared prosperity by providing a better understanding of the changes and joint impact of three major transformations: technological progress, globalisation and migration; and offering policy and governance solutions to better equip citizens and companies for future challenges, securing more equal opportunities and outcomes. The project team uses a multidisciplinary research approach with international stakeholder engagement throughout the project.

The contents of this publication are the sole responsibility of the GI-NI project Consortium and do not necessarily reflect the opinion of the European Union.



# Key findings

This Policy Brief highlights the main mechanisms behind digital transformation as a key driver of inequality and changing skill demands. The Policy Brief indicates – based on the scientific insights of the GI-NI project – how policymakers and stakeholders can respond to the new challenges of the digital transformation to reduce inequality and improve workers’ skills. The GI-NI research shows that new technologies have diverse and non-uniform effects on work. According to the GI-NI study, these effects vary across different dimensions. They differ not only among groups of employees but also among types of companies. While new technologies exacerbate existing inequalities among employees, they also give rise to new ones.

These effects require new policies and policy mixes from European, national and regional policymakers:

- Strengthen existing welfare state institutions that deal with unemployment to support workers affected by technology-induced displacement and inequality. Suggestions based on our research of how public employment services could be expanded are:
  - Implement short-cycle education programs that focus on placing displaced workers in companies facing labour shortages.
  - Develop training programmes for workers that focus on cutting-edge technologies. This helps employees cope with technological changes and supports their employers in adopting new technologies to stay competitive.
- Improve job-matching quality and reduce unemployment duration by promoting in-person interactions.
- Be aware of the trade-off between efficiency and equity when deciding policy measures regarding adopting new technologies and consciously choose the desired balance.
- Create targeted programmes to help smaller companies keep pace with technological advancements, reducing the gap between firms and minimising negative competition effects between adopters and non-adopters.
- Improve broadband internet access to assist companies in adapting to technological changes.
- Pair the introduction of performance pay with efforts that promote flexible working hours for women, ensuring that higher-paying firms remain accessible to them.

# Findings of the GI-NI project

This Policy Brief highlights the main mechanisms behind the digital transformation as a key driver of inequality and changing skill demands. The Policy Brief indicates – based on the scientific insights of the GI-NI project – how policymakers and stakeholders can respond to the new challenges of the digital transformation to reduce inequality and improve workers' skills.

## No large net negative employment effects of new technologies.

New technologies increasingly become able to perform tasks that previously only humans could do. This development is associated with large fears of a “jobless future” in the public debate, fuelled by public alarmists who claim that half of the jobs are “at risk of computerisation”.<sup>1</sup> Scientific research, however, finds no evidence in favour of massive technological unemployment. Negative employment effects of new technologies are limited to specific technologies and individual countries.<sup>2</sup> Technological change more broadly generates at least as many jobs as it destroys.<sup>3</sup> Therefore, the question for the future of work is less about how many jobs we will have and more about which jobs we will have.

## Changing Wage Structure and Deteriorating Opportunities for Routine Workers.

While the net employment effects of new technologies are limited, they do lead to large shifts in the structure of jobs, raising inequality and polarisation.<sup>4</sup> Workers are required to adapt to the change. Particularly workers specialised in routine tasks are exposed to technological change. For them, the adoption of new technologies often implies job displacement, potentially associated with unemployment, and the need to be able to find new, different jobs. Finding new jobs when the demand for the skills of these routine workers declines is difficult for them, often leaving them with periods of unemployment, lower earnings, reduced chances to find suitable jobs and scarring effects of job displacement.<sup>5</sup>

## Welfare State Institutions Absorb Displacement Induced Inequality.

Job displacement is not new to the current policy context. Welfare state institutions have already been developed to help workers absorb this shock. Nevertheless, it seems that technology can create more stubborn and difficult adjustments because it affects particular sets of workers that generally do not have great alternatives available to them. Therefore, there is a bigger role for the government than is currently the case to support the transition of workers into growing occupations through information about what are the growing occupations and how they can be made available. However, job mobility cannot successfully be achieved by just digital communication. If we want to really help those impacted by technological impact, we need in-person interaction. Our research suggests that in-person interaction should be encouraged at employment agencies to improve job-match quality and reduce time in unemployment.



<sup>1</sup> See for example Frey and Osborne (2017), whose claims have received widespread attention in the public debate. Among others, Arntz et al. (2017), Nedelkoska and Quintini (2018), Dengler and Matthes (2018), Pouliakas (2018) show such predictions to be massively exaggerated due to methodological problems. Handel (2022) shows that empirical data and official projections from the United States also provide no support for such extreme automation scenarios.

<sup>2</sup> Graetz and Michaels (2018) for example find no negative employment effects of robots in a cross-country study. Dauth et al. (2021) find positive employment effects for Germany, while Acemoglu et al. (2020) and Acemoglu and Restrepo (2020) find negative effects for France and the USA, respectively.

<sup>3</sup> See e.g. Gregory et al. (2022) for Computerization or Autor and Salomons (2018) for new technologies more broadly.

<sup>4</sup> See, among others, Autor et al. (2003), Goos et al. (2009, 2014), Acemoglu and Autor (2011), and Ross (2017).

<sup>5</sup> See, among others, Cortes et al. (2017), Bessen et al. (2023), Blien et al. (2021), Goos et al. (2021), Jacobson et al. (1993) and Davis and von Wachter (2011).

# Findings of the GI-NI project

## Training Programmes Support Workers in Finding New Jobs.

GINI research shows that automation exposed job seekers spend more time in unemployment because the occupations available to them based on their skill set offer poor job-finding opportunities. Directing job seekers more actively towards jobs with better prospects may be one approach that governments can take. Our research supports the efforts made by training programmes such as WorkAdvance<sup>6</sup>, where they retrain adult job seekers in short-cycle education programmes that are directly focused on placing them at companies experiencing labour shortages.<sup>7</sup> The goal of sectoral work programmes, like WorkAdvance, is to provide job seekers with non-traditional backgrounds the opportunity to attain high-wage jobs in growing sectors. The programmes are typically led by community-based organisations, and combine some up-front screening of applicants, with soft skills (or

work-readiness) training and occupational skills training. This may also involve job development and placement. Sector-focused programmes have training components that often are 6 months or less and fill an important niche for dislocated workers and for individuals who may not thrive in traditional college programmes. While there are many more reasons that can make it difficult for workers to reallocate, evidence on these sectoral programmes provide hope that there are ways to support workers in this transition.

## Efficiency–Equity–Tradeoff of Technology Adoption.

New technologies help firms to become more productive and employ more workers, raising growth and welfare.<sup>8</sup> This, however, comes at a cost for non-adopting firms, who suffer from competition effects and declining employment.<sup>9</sup> This raises an important *equity-efficiency-tradeoff* that policymakers face: On the one hand, technology adoption raises welfare and growth and induces an efficient allocation of workers to productive fast-growing firms. On the other hand, this implies large restructuring costs for workers and firms that suffer from competition. Whether to place more emphasis on efficiency, or on equity ultimately is a policy decision that policymakers should take deliberately when considering policy measures that affect firms' decisions to invest in new technologies.



<sup>6</sup> WorkAdvance is a retraining project launched in several locations across the U.S.A. WorkAdvance is provided by community-based organizations that provide sectorial employment programs. MDRC provides a comprehensive description and first evaluation in their report: <https://www.mdrc.org/project/workadvance#overview>. Additional scientific evidence on the effectiveness of the program is given by Katz et al. (2022).

<sup>7</sup> Other examples are the efforts made by the Public Employment Services in France to direct job seekers to firms likely to hire, through their online platform (Behaghel et al., 2022)

<sup>8</sup> See Dinlersoz and Wolf (2018), Dixon et al. (2019), Koch et al. (2021), Acemoglu et al. (2020), Aghion et al., (2020), Bonfiglioli et al. (2021), and Bessen et al. (2023).

<sup>9</sup> See Koch et al. (2021) and Acemoglu et al. (2020).

# Findings of the GI-NI project

## Designing a Fruitful Environment for Adoption of Cutting-Edge Technologies.

A potential route for firms and workers suffering from competition effects is adopting new technologies. However, the adoption of cutting-edge technologies requires the right environment, as our GI-NI results highlight. In particular, we find that firms require access to broadband internet to become adopters. Firms that adopt automation technologies become more productive, which they use both to reduce prices - which benefits consumers but hurts competitors - as well as to raise their markups, i.e. to increase their profits.<sup>10</sup> There is further a growing divide between small non-adopters and large adopters, with smaller firms risking losing competitiveness. Policymakers could consider establishing targeted programmes to enable smaller firms to keep up with technological advancements so as to dampen the growing divide and prevent negative consequences from competition effects.<sup>11</sup>

## Cutting-Edge Technologies Require Complementary Skills and Organisational Change.

Firms not only require the right infrastructure but also the right set of skills and complementary organisational change to successfully adopt new technologies, as we find in our GI-NI research. In particular, the adoption of "Industry 4.0" - which covers, for example, Artificial Intelligence, cloud computing, cyber-physical systems, or smart factories - is associated with a large share of the shift in tasks, but only in combination with firm heterogeneity due to scale and composition effects. In particular, the decline of routine tasks is faster among those adopters that are larger, and those

adopters who initially have had lower shares of routine tasks grow faster. This indicates that accompanying investments in complementary organisational change and worker training are prerequisites for successfully adopting cutting-edge technologies.<sup>12</sup> Policymakers, firms and other stakeholders could develop training programmes for cutting-edge technologies, targeted at workers, not only to help those workers to cope with technological change but also to support their employers in adopting new technologies and remaining competitive such as, for example, the learning factory.<sup>13</sup>

<sup>10</sup> See Deliverable 3.1 of the GI-NI project.

<sup>11</sup> See Deliverable 3.1 of the GI-NI project.

<sup>12</sup> See Deliverable 3.1 of the GI-NI project.

<sup>13</sup> See Pittich et al. (2020).

# Findings of the GI-NI project

## **Innovation raises the Gender Wage Gap via Performance Pay.**

While such policies could help workers and firms, there remains a risk that innovation negatively affects gender equality. In particular, our research shows that a significant part of the gender wage gap can be attributed to the gender difference in firm-specific wage premia.<sup>14</sup> These differences are largely driven by women working at firms with a lower wage premium. In particular, women work less often in larger firms which innovate and participate in international trade and are more likely to pay flexible wages. GI-NI research accordingly finds that new technologies which support performance pay can lead to rising gender wage gaps. These results should make policymakers aware of the side effect of new technology that supports performance pay because it strengthens the gender wage gap.

Therefore, policymakers should accompany developments in performance pay with other efforts that support flexible working times for women, such that these higher-paying firms remain accessible. The EU work-life balance directive is a step in the right direction. Promoting flexible working times, for example, through part-time work, still leaves a dilemma for mothers and fathers that would like to combine full-time work with parenthood. Therefore, having accessible and affordable childcare is equally important.

# Main Recommendations

The effects of new technologies on work are diverse and not uniform. According to the GI-NI study, these effects vary across different dimensions. They differ not only among groups of employees but also among types of companies. While new technologies exacerbate existing inequalities among employees, they also give rise to new ones. Moreover, the impacts are such that solutions cannot solely rely on digital support for employees. It is essential to address these impacts at the company level as well. This leads us to the following recommendations:

National policymakers should focus on new measures to deal with **employment impacts:**

1. Strengthen existing welfare state institutions to support workers affected by technology-induced displacement and inequality.
2. Employment agencies need to improve job-matching quality and reduce unemployment duration by promoting in-person interactions. They should implement short-cycle education programmes that focus on placing displaced workers in companies facing labour shortages.
3. Develop training programmes for workers that focus on cutting-edge technologies. This helps employees cope with technological changes and supports their employers in adopting new technologies to stay competitive.

EU and national policymakers, regional development agencies:

4. Be aware of the trade-off between efficiency and equity when deciding about policy measures regarding the adoption of new technologies and consciously choose the desired balance.
5. Create targeted programmes to help smaller companies keep pace with technological advancements, reducing the gap between firms and minimising negative competition effects between adopters and non-adopters.
6. Improve broadband internet access to assist companies in adapting to technological changes.
7. To deal with gender discrimination, national policymakers should pair the introduction of performance pay with efforts that promote flexible working hours for women, ensuring that higher-paying firms remain accessible to them.



## Recommended reading

Acemoglu, D. and David Autor (2011). "Skills, Tasks and Technologies: Implications for Employment and Earnings." In Handbook of Labor Economics, Vol. 4, edited by O. Ashenfelter and D. Card. Elsevier, pp. 1043–1171.

Acemoglu, D. and P. Restrepo (2019): Automation and New Tasks: How Technology Displaces and Reinstates Labor, *Journal of Economic Perspectives*, 33(2), pp. 3-30.

Arntz, M., Gregory, T., and U. Zierahn (2020): Digitization and the Future of Work: Macroeconomic Consequences. In K. F. Zimmermann (Ed.), *Handbook of Labor, Human Resources and Population Economics* Springer.  
[https://doi.org/10.1007/978-3-319-57365-6\\_11-1](https://doi.org/10.1007/978-3-319-57365-6_11-1)

This Policy Brief is based on the research of the GI-NI project. For the relevant research, please look at the website of GI-NI: <https://gini-research.org>



# Project Identity

## Project name

Growing Inequality:  
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## Coordinator

Nederlandse Organisatie Voor Toegepast  
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## Consortium

CNAM – CEET, Centre d'études de l'emploi et du travail (France)  
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Centre for European Policy Studies (Belgium)  
University of Adger (Norway)  
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