



Growing Inequality:
a Novel Integration of
transformations research

GI-NI Scientific Conference The Impact of the Global Transformations on Inequality

**25th of May
2023**

**University of Agder
Norway**

BOOK OF ABSTRACTS



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 101004494



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OVERVIEW

Inequality has been growing within and between European countries. This has been of central concern for policymakers and researchers.

The EU-funded GI-NI project aims to improve our understanding of the changes and the joint impact of three major transformations on inequality and inclusive growth: technological progress, globalisation and migration.

The first conference on the economic impact of technological transformation, globalisation and migration took place on May 25th 2023, at the University of Agder, Norway. The GI-NI Scientific Conference: The Impact of Global Transformations on Inequality aimed to bring together researchers from different disciplines to share and discuss findings related to widening income inequality, living standards, and prosperity.

Researchers from all fields of economics, political science and sociology presented research results and discussed possible directions for future research activities. This booklet brings together the contributions made at the conference.



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PROJECT NAME

Growing Inequality: a novel integration of transformations research — GI-NI

COORDINATOR

Nederlandse Organisatie Voor Toegepast Natuurwetenschappelijk Onderzoek
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DURATION

2021 – 2025

FUNDING SCHEME

Grant Agreement no 101004494 — GI-NI — H2020-programme

WEBSITE

<https://www.gini-research.org>



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Inequality Perception and Preferences Globally and Locally – Correlational Evidence From a Large-Scale Cross-Country Survey

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Using a large, representative survey involving 24 countries we establish stylized facts about the attitudes toward cross-country economic inequality and their correlates. For a topic so important to our globalized 21st century, this question has been surprisingly understudied. We show that perceived and desired levels of domestic inequality and one's assessment of their own relative status in their society are very closely correlated with how they think about cross-country economic differences. The objective economic status of the individual matters less. Women, older people, the more schooled, the more-left leaning, the more urban and those who frequently meet people who are poorer than themselves are more likely to be concerned about cross-country economic differences. Though the impact of country level variables is less pronounced than individual characteristics, concern for international inequality is stronger in more affluent and relatively more equal countries. Our findings illustrate that attitudes towards international economic inequality are intrinsically linked to within-country characteristics, mainly attitudes towards domestic economic inequality.



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Implications of Robots and AI on Wage Inequality

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Different technologies change the demand for certain tasks, having their counterpart in the employment structure according to the task requirements of each occupation. For example, ICT has hollowed-out middle-skilled occupations, whereas robotization targets low-skilled workers. More recently, there is evidence suggesting that AI—in contrast to these technologies—has the potential to affect high-skilled occupations as well. Thus, the changes in the occupational structure and the relative demand for different type of workers has consequences on wages and inequality. As such, the objective of this paper is to provide a glance at the relationship between robotization and AI on wage inequality in 19 European countries. We find evidence suggesting that robot exposure is related to a decrease in within-occupation inequality, but an increase in between-occupation inequality. As for AI, it is related to an increase in within-occupation and between-occupation inequality, where the latter is wider at the top of the wage distribution.



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Advanced Digital Technologies and Investment in Employee Training: Complements or Substitutes?

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A key effect of the pandemic on EU economies has been the acceleration of digitalisation. For example, data from the European Investment Bank's Investment survey (EIBIS) shows close to half of the firms in the European Union report that they invested in digitalisation as a response to COVID-19. Digital firms fared better than non-digital firms did through the pandemic. They were less likely to experience a strong decrease in sales from the beginning of 2020, and used the crisis more often as an opportunity to accelerate digitalisation. On average, they were more productive, innovative, grew faster and paid higher wages. Yet the more widespread deployment of digital technologies comes with potentially far-reaching implications for jobs and inequalities across firms and workers.

The empirical literature based on firm-level data that examines the effects of automation and digitalisation typically finds positive effects on productivity but the effect on employment is more controversial. Acemoglu and Restrepo (2020) for instance find that overall employment increases faster in firms adopting robots but the share of production workers fall. Bonfigliani (2020) conclude that robot imports tend to increase the share of high-skilled professions. A reason for the inconclusive results on firms' average firm-wages may well be that some workers may gain but others lose, being replaced by technology (Lane and Saint Martin, 2021; Dinlersoz et al 2018).

The policy discussion linked to automation has focused on the role of training to mitigate the negative effects of digital technologies on employment, promoting upskilling and reskilling measures as a way to help people transition into new jobs (Nedelkoska and Quintini, 2018; Pouliakas 2018). At the same time, the empirical literature examining the effects of training on productivity and wages using firm-level data suggests that trained workers raise productivity (Konigs et al 2015) while the lack of training can limit effective technology deployment in firms and some of the gains associated with it (Healy et al., 2015; Bennet and McGuinness, 2009; Nickell and Nicolitsas, 1997; Haskel and Martin, 1996).

The aim of this paper is to analyse whether the adoption of advanced digital technologies and employee training are complements or substitutes. Theoretically, digital technologies can be complements or substitutes to labour with training affecting the nature of this relationship and hence the firm-specific and overall economic effects on employment and inequality. Firms are key actors in the provision of training in Europe but whether the companies adopting digital technologies also train more is not clear. On the one hand, technology adoption may create retraining needs. On the other, as some work is being automated and production processes are changed, firms' needs and expenditure on training may well fall.



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Robots, Meaning, and Self-determination

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We are the first to examine the impact of robotization on work meaningfulness and autonomy, competence, and relatedness, which are key for motivation and human flourishing at work. Using worker-level data from 13 industries in 20 European countries and OLS and instrumental variables estimations, we find that industry-level robotization harms all work quality aspects except competence. We also examine the moderating role of routine and cognitive tasks, skills and education, and age and gender. While we do not find evidence of moderation concerning work meaningfulness in any of our models, noteworthy differences emerge for autonomy. For instance, workers with repetitive and monotonous tasks drive the negative effects of robotization on autonomy, while social tasks and working with computers - a tool that provides worker independence - help workers derive autonomy and competence in industries and jobs that adopt robots. In addition, robotization increases the competence perceptions of men. Our results highlight that by deteriorating the opportunities to derive meaning and self-determination out of work, robotization will impact the present and the future of work above and beyond its consequences for employment and wages.



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Global Value Chain Perspectives on the Impact of Trade on the Gender Employment Gap (2000–2014)

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In many countries in the European Union, female employment has grown faster than male employment. In the literature, several potential causes of this trend have been put forward. Besides supply-side factors related to waves of emancipation, technological progress (mainly machines reducing demand for workers performing physically demanding jobs) and trade have been put forward as explanations. In this report, we focus on quantifying the effects that are due to changes in international trade patterns. The period considered is 2000–2014, which roughly corresponds with the period in which global trade grew at a much faster pace than the global economy.

A large part of the existing literature on the consequences of trade for gender gaps on labour markets focuses on comparative advantages in industries that countries have. If a country has comparative advantage in industries in which physical strength is important, women tend to experience worse outcomes than men if trade intensifies. This effect is not present if the country considered has a comparative advantage in industries in which physical strength of workers is of minor importance. Parts of the literature argue that these comparative advantages have become less important in determining labour market effects, because of increasing capital intensifications. In this paper, we consider such effects, but argue that industry specialization is not the most relevant type of specialization anymore.

In the period studied, production processes became increasingly organised as global value chains (GVCs). The GVC revolution was not only characterised by increased industry specialisation, but also implied 'functional specialisation': whereas industry A in Country 1 is mainly taking care of the headquarter functions (e.g. R&D, marketing, etc.), industry A in Country 2 mainly performs fabrication activities. Like industry specialisation, this type of specialisation is also driven by comparative advantages. Given our objective to quantify the effects of trade on the relatively rapid growth of female employment and the fact that the differences between male and female workers tend to be larger for some business functions than for others, we consider this question using data on employment by function. We present results based on an input-output based accounting approach that considers technological change within GVCs rather than within industries, and that considers changes in trade patterns as relocations of economic activity by function within GVCs.

The data used are the 2016 release of the World Input-Output Database, complemented with new data on



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employment at industry level split by function and gender. In constructing the data, the functional split was based on the occupations of workers, using population censuses and national labour force surveys. The business functions we consider are fabrication, management, R&D and marketing.

We present trends on female employment by function and then quantify the differences and trends in the specialization of countries in exporting products that require relatively much female employment, taking the functional composition of employment into account. In the final part of the paper, we quantify the parts of changes in female and male employment by function attributable to changes in the exports of countries.

If we consider fabrication first, we see that trade changes alone would have reduced employment considerably in Western European countries, both for female and male workers. For the majority of these countries, we find that the reductions in fabrication employment due to trade changes are slightly smaller for female workers than for male workers. In many cases, however, the differences do not exceed five percentage points. Still, globalisation appears to have hit male fabrication workers in Western Europe harder than female fabrication workers in this region. For many Eastern European countries (but not all), we find that changes in trade patterns caused growth of fabrication employment. For this group of countries, we do not find clear patterns regarding the differences between the effects on men and women. For R&D, marketing and management, we also find negative trade effects for employment of both male and female workers in most Western European countries, and positive effects for Eastern European countries. Still, the differences between the two groups of countries are less marked. No clear patterns regarding the relative magnitudes of the effects on male and female employment can be detected, which is in line with the notion that these functions mainly require cognitive capabilities and that differences between male and female workers regarding these tend to be non-existent.

Adapting to Import Shocks: The Labour Market Outcomes of Workers Moving into other Regions or Business Functions

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A lot of research has been done on the consequences of import shocks on labour market outcomes for various types of workers. The “China Shock”-literature (initiated by David Autor and co-authors) in particular has become influential, especially in the United States. It provides arguments against policies that promote trade, because it shows that strong increases of imports affect substantial groups of workers negatively. At the same time, most economists agree that the welfare effects of trade intensification are positive for aggregate economies. Therefore, it is important to design policies that reduce the negative effects of trade for specific groups in society, while maintaining the overall positive effects. Two types of policies that are often emphasised in this respect are (i) policies that promote mobility of workers, and (ii) policies that promote the capabilities of workers to switch from one type of job to another. These could enhance the adaptation opportunities of workers who are negatively affected. Only a few studies, however, have addressed questions related to the adaptation of workers to import shocks. Do workers who are very exposed to imports move to other regions? Do they switch from one occupation to another? And if they adapt to import shocks in either of these two ways, are their labour market outcomes better than those of comparable workers who decided not to adapt? Answers to questions like these are essential for the design and implementation of policies aimed at mitigating the negative effects of trade intensification for specific groups of workers.

This paper assesses whether and how import exposure affected German workers’ regional mobility and job switching between 2000 and 2011. We also explore the wage and job satisfaction consequences of moving to another region and job switching following a trade shock. To this end, we develop a novel measure of regional-level trade exposure that also groups occupations with similar characteristics into business functions (management, marketing, R&D, and fabrication). We use trade data from the World Input-Output Database and regional employment data for 96 local labour markets from the German Federal Employment Agency, and combine them with worker-level data from the German Socioeconomic Panel to analyse trade exposure at the region-function level. Our findings show that more intense regional trade shocks made workers more likely to move to another region and switch their functions. In the most exposed regions, the probability that fabrication workers moved to another region more than doubled compared to the baseline probability. The probability of switching functions as a result of increased trade exposure increased by about 50% compared to the baseline. However, this probability of a worker switching functions following a trade shock increased only after a lag, likely



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because individuals need time to acquire new function-specific knowledge and skills. The paper also reveals that workers who chose to move to another German region could offset the negative impact of the trade shock on their earnings and job satisfaction. In fact, moving resulted in higher wages and greater job satisfaction compared to staying behind. Workers who switched to a new function also increased their earnings, but did not improve their job satisfaction (compared to those who remained in the same function). These findings provide policymakers with new insights into the complex ways in which trade affects workers' lives and livelihoods, and how individuals adapt to the changing employment conditions it brings. If the results found in this paper for Germany would be corroborated by studies for other countries, the results suggest that governments should consider improving the opportunities of workers to move to another region and by changing education policies in a way that makes it easier for workers to become employed in different types of occupations.



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Accounting for Changes in Employment Levels in an Interconnected World: The Relative Importance of Technological Change and Trade

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In this paper, 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. We argue that quantifications of these sources of change for a country could be done on the basis of national data for times in which the production process from scratch to final product took almost exclusively place within the borders of such a country. In a world in which the stages of such production processes tend to be spread over multiple countries (often even on different continents), such data do not suffice anymore. With the rapid proliferation of global value chains (GVCs), the second situation has become increasingly important. In this paper, we argue that meaningful alternative measures can be derived, if global intercountry input-output tables are available.

Applying structural decomposition analysis and using data from the World Input-Output Database, we first derive a measure of technological change in GVCs and then argue that quantifying relocation of activities within GVCs and changes in the relative size of GVCs yield useful indicators of the effect of changing trade patterns. We study the relative importance of these drivers for the period 2000-2014. The remaining changes in employment can be attributed to changes in demand by final users.

We explicitly address the fact that the widespread emergence of GVCs has not led to industry specialisation by countries alone. So-called business functions (fabrication, marketing, management, R&D) do no longer need to be performed in close geographical proximity. Consequently, countries can specialise in one or more of these functions. In order to take this 'functional specialisation' into account, we decompose changes in employment in a country for these business functions separately. This is done based on extensions and updates of the occupational data used in Reijnders and de Vries (2018) and Timmer et al. (2019). Using data from labour force surveys and population censuses, these authors provided data on the functional composition of employment by industry in each of the countries included in the World Input-Output Database.

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.



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The Future of EU Cohesion: Effects of the Twin Transition on Disparities across European Regions

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Our results suggest that difficult times lie ahead for regional economic cohesion in the EU. High income EU NUTS-2 regions exhibit the highest potential for economic growth in the twin transition while low-income regions exhibit the lowest. Thus, there is an underlying trend towards economic divergence across the EU.

The digital and green transition are likely to amplify these diverging growth patterns in Europe. According to our analysis, their impact on regional growth depends on regions' socio-economic and territorial characteristics. Regions most ready for the twin transition are mainly metropolitan regions, specialising in the provision of knowledge-intensive services. This type of region has not only the highest potential for economic growth but is also likely to benefit most economically from the digital and green transition. By way of contrast, agricultural regions, which have the lowest GDP per capita levels in Europe, also have low potential for economic growth – and their economies are least ready for the structural changes that come with the digital and twin transition. As for the other regions, high-tech regions have a higher overall growth potential than regions specialising in low-tech manufacturing. What is more, carbon-intensive manufacturing regions (both low and high-tech) exhibit lower levels of readiness in particular for the green transition, leading to comparatively lower growth rates than in non-carbon intensive regions.

Our results have direct implications for European cohesion and cohesion policy. In the context of the twin transition, reducing existing regional disparities will become even more difficult in the years ahead. Thus, even more so than in the past, EU cohesion policy must overcome the economic forces that favour a growing agglomeration of high-value economic activities in urban and industrial centres if the Union wants to maintain its goal of economic, social and territorial cohesion as enshrined in the Treaty.

Tackling this challenge could mean novel approaches in economic development that are more tailored to the individual types of regions. In the case of agricultural regions for instance, the analysis has shown that they lag behind all other regions in terms of general growth potential as well as digital and green readiness. For these regions suffering multiple disadvantages (for example skills endowment, infrastructure, innovative capacity), optimal policies would need to address these disadvantages. This is difficult under current EU cohesion policy. Presently, the EU follows a rather sectoral approach, for example supporting R&D, SMEs, the development of skills, green investments in different policy priorities and programmes. This makes a coordinated and integrated



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policy approach that addresses many development needs of the least developed regions simultaneously more difficult to enact. Notably, if cohesion policy is to overcome the “natural” differences in specialisation in the EU Single Market, such integrated regional policies should most likely be accompanied by massive investments. They would be necessary to build up a critical mass of economic activity in the face of agglomeration pressures from incumbent economic centres in the EU.

For other regions that specialise predominantly in low-tech manufacturing or carbon-intensive sectors policy approaches can be more gradual, but still tailor-made to their characteristics and needs. Therefore, for such regions specific sectoral programmes, for example supporting companies and households in their green transition, might suffice to keep them on a steady path of economic development. Overall, the results of the analysis provide a strong pointer towards a more differentiated and targeted approach to cohesion policy, switching from using income-related criteria to determine the level of support towards criteria that consider the regions' characteristics and future growth potential, notably how they might fare in the ongoing twin transition.



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Resilience to Automation: The Role of Task Overlap for Job Finding

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Advancing technology is transforming the occupational structure of labor markets: the distributional consequences of these changes depend critically on how workers reallocate between jobs. This paper investigates how similarity in job task content underlies the reallocation of workers exposed to automation and other types of technological change such as software and AI. We analyze the universe of newly unemployed persons and their work history in Flanders, Belgium. Using a language model, we construct a novel job-to-job similarity measure that leverages detailed task content information. This measure highlights a stark divide between jobs performing cognitive versus manual work, with high similarity between jobs within these two clusters. To determine how workers reallocate in response to automation, we estimate a matching function where job finding rates flexibly depend on labor market tightness in jobs with varying task similarity. We find, first, that only the most similar jobs in terms of task content affect job finding rates. Second, job markets highly exposed to automation mostly overlap with other highly exposed job markets. Taken together, this implies that task-based worker mobility does little to mitigate the distributional consequences of automation. Importantly, we show that this is not true for other technological changes such as software or AI exposure, where occupational mobility meaningfully improves worker outcomes. In a policy counterfactual, we highlight the potential for targeted retraining to enhance the resilience of highly automation-exposed job seekers.



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Migration and Occupational Skill Shortage in Western EU Countries

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The shortage of qualified labour supply in some European countries may be addressed by immigration flows. Such labour supply shocks might represent immigrants and natives as substitutes or complements. We adhere to the second hypothesis of a complementarity between arrived migrant workers and native workers. In the paper, we analyse how an exogenous increase of migrant workers affects occupational shortage in receiving countries. We contribute to the literature about the effect of migration on the labour market of host countries. The impact of migration on the receiving labour markets is found to be positive as there is an inverse relationship between the share of migrants and occupational shortage in receiving countries.



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The Role of Flexible Wage Components in Gender Wage Differences

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A main driver of the gender gap wage gap is the fact that women have a lower chance to enter high paying firms. Also, even upon entering, they receive a lower share of the firm specific wage premium than their male co-workers. We use a novel Hungarian linked employer-employee dataset and AKM decomposition to show that performance and overtime payments are main drivers of these gender differences in firm premia. One fifth of the total gender wage gap can be attributed to the fact that women receive a lower share of the firm specific wage premium at firms with overtime and performance payments. At the same time, labor productivity or firmsize have a negligible effect on the gender difference in firm-specific wage premium conditional on the wage structure.



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The effect of FDI on Skill Retir and Within Firm Inequality Outsourcing and the Return to Tasks in Hungary

**Rita Pető
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The traditional Heckscher-Ohlin model (Leamer, 1995; Stolper & Samuelson, 1941) predicts that reallocation of activities across countries decreases inequality in developing countries. According to the model, developed countries where high-skilled workers are abundant reallocate routine tasks with low skill requirements to developing countries. This reallocation increases the demand for routine tasks done by low-skilled workers in developing countries, and therefore, wage inequality should decrease. In contrast to the prediction of the Hecksher-Ohlin model, empirical results show that inequality in developing countries grows if their economy opens up through export or FDI (Basu & Guariglia, 2007; Bhandari, 2007; Figini & Görg, 2011; Goldberg & Pavcnik, 2007; Herzer et al., 2014). Recent papers explain this contradiction by increasing sorting of workers in developing countries. Sorting of workers increases because trade increases employment at high-paying firms (Arnold et al. 2009; Brown et al. 2006, 2010; Helpman et al., 2016) and these firms upgrade their workforce after entering international markets (Bernard & Jensen, 1997). In contrast to the results on across-firm wage differentials, we have only limited knowledge of the effect of international trade on within-firm inequality. A better understanding of within-firm inequality could give new insights into the effect of international trade on developing economies. On the one hand, international trade can increase the demand for low-skilled workers and thus decrease within-firm inequality as predicted by the Hecksher-Ohlin model. On the other hand, international trade can increase inequality for several reasons. For example, the participation in international trade increases the market size of firms. If the size of the firms grows due to new market access, within-firm inequality can increase even if the technology of the firms does not change (Becker et al., 2019; Card et al., 2018). It is also possible that firms participating in international trade improve their technology and increase their relative demand for high-skilled workers compared to low-skilled workers. In this case, international trade increases wage differentials directly and not only through the sorting of workers. We use Hungarian linked employer-employee data and a novel empirical strategy to estimate the effect of international trade on within-firm inequality. We contribute to the literature in two ways. First, we use an event study approach and control for worker selectivity to filter out the effect of worker sorting on wage inequality. Second, we investigate the potential mechanisms leading to the increase of within-firm inequality. In the main specification, we proxy the participation in international trade with foreign direct investment (FDI) for two reasons. First, firms most likely cannot control whether they are acquired one year earlier or later. Therefore, we can use an event study approach to estimate the causal effect of trade on within-firm inequality. Second, if a Hungarian firm is acquired, it can access the technology of the parent firm, so there is a larger chance of technology transfer than in the case of simple product export. Furthermore, we go



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beyond estimating the wage gap between blue- and white-collar workers. Instead, we follow Firpo et al., 2011 and measure the return to three specific tasks: (i) routine tasks with low skill requirements, (ii) abstract cognitive tasks with high skill requirements, and (iii) tasks which need face-to-face interaction across workers. The importance of this empirical strategy is that it enables us to infer on the effect of FDI on skill demand directly. Finally, we extend our event study approach with firm and worker fixed effects as in (Abowd et al., 1999; Frias et al., 2022) to control for selectivity in FDI and worker composition.

Our main results suggest that foreign acquisition increases the return to abstract tasks only and the return to face-to-face tasks, while routine tasks do not change. These changes in task returns increase wage inequality as high-paid workers do more than average abstract tasks. We find that one standard deviation increase in abstract tasks increases wages by 1.8 percent while the return to face-to-face skills does not change. The results are qualitatively similar if we restrict attention only to firms which switch ownership, and in the service and manufacturing sectors. After presenting the main results, we turn to the possible mechanisms. Most importantly, we use an event study approach to show that firms conduct product and process innovation right after FDI, while they do not do more R&D activities than firms which are not acquired. This result provides suggestive evidence that acquired firms implement the technology of the parent firm. We further estimate how FDI affects the task composition within firms. If the labor market competition is imperfect and the firm-level labor supply of workers capable of doing abstract tasks is steeper than the labor supply of other workers, firms paying higher returns to abstract tasks decrease the amount of abstract tasks in production (Card et al., 2018; Lindner et al., 2022). As opposed to this, we find that the share of abstract tasks does not change in the production function after FDI. Besides the literature cited above, we contribute to the literature on firm-specific wage premia. In a perfectly competitive labor market, wages should not change on average if a worker moves from one firm to another. As opposed to this, empirical research showed that some firms offer a systematically larger premium (Abowd et al., 1999; Barth et al., 2016; Card et al., 2013; Song et al., 2019). One part of the premium comes from export (Frias et al., 2022) and FDI (Breau & Brown, 2011). We add to the literature by investigating the potential mechanisms which connect international trade to firm premiums. We also contribute to the literature on rising residual wage inequality. Many papers documented that wage inequality does not only increase across firms or occupations, but also across workers of the same occupation (Lemieux, 2006) or establishment (Mueller et al., 2017). There are many mechanisms which lead to within-firm inequality, such as performance payments (Barth et al., 2012; Lemieux, 2006), decreasing unionization (Bruns, 2019; Freeman, 1982; Svarstad & Nymoen, 2022), the increase of firm size (Mueller et al., 2017) or technological change (Barth et al., 2020; Lindner et al., 2022). We add to this literature by showing that FDI increases residual wage inequality even after controlling for selectivity in FDI and worker composition. We also contribute to the literature on the effect of FDI on within-firm differences. Firms from developed countries pay a higher wage premium for abstract tasks (Hakkala et al., 2014) and use less blue-collar workers (Koerner et al., 2023) after investing abroad. There is also evidence that FDI increases the relative wages of high-skilled workers in developing countries (Chen et al., 2011; Earle et al., 2018; Feenstra & Hanson, 1997). These results are in line with the Vanek-theorem (Vanek, 1968), namely that FDI moves tasks between countries which are unskilled-biased in the developed countries and skilled-biased in the developing countries (Lai & Zhu, 2007; Treffer & Zhu, 2010). We add to this literature by showing that firms in developing countries are more likely to innovate after FDI and thus they may change their technology in a skilled-biased way.



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Algorithmic Management in the Traditional Labour Market: An Exploration on Policy Implications

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Rapid developments in digital technology are changing the world of work. Organisations are collecting more data about work processes, which can be used to automate tasks, but also to manage workers. The practice of using data collection and algorithms to manage workers is, in general, called algorithmic management. It is becoming more prevalent, thanks to digitalization and rapid advancements of artificial intelligence.

Algorithmic management is often associated with and studied within the platform economy. Platform companies aim to completely automate the distribution and management of labour, through algorithmic management. However, algorithmic management is not solely restricted to the platform economy, and not all practices of algorithmic management aim for complete automatization. Our study focuses on the impact of algorithmic management in traditional organisations, where it is increasingly used to replace or supplement certain aspects of management. By not targeting the platform economy, we uniquely study how the majority of the labour force is impacted by algorithmic management.

Repositioning algorithmic management as a phenomenon that is not restricted to the platform economy requires a different view of what algorithmic management is. Algorithmic management is not necessarily an all-encompassing system that is completely automated. We define algorithmic management as a practice that consists out of different “elements” that can be employed and combined in different gradations of automatization and technical complexity. This view is consistent with definitions of algorithmic management, where emphasis is placed on the combination of data collection and algorithms to automate (individual, but not necessarily all) management tasks, such as monitoring, evaluation and task allocation?¹

Our study aims to provide employers, government and social partners insight into algorithmic management and describe which choices are to be made when implementing algorithmic management, and how these choices impact workers. Our study consists of literature review, professional discussions and empirical case studies in The Netherlands. Our main research questions is:

¹ See for example: Mateescu, A., & Nguyen, A. (2019). Explainer: workplace monitoring and surveillance. Or: Lee, M. K., Kusbit, D., Metsky, E., & Dabbish, L. (2015, April). Working with machines: The impact of algorithmic and data-driven management on human workers. In Proceedings of the 33rd annual ACM conference on human factors in computing systems (pp. 1603-1612).

What is the impact of algorithmic management on working conditions and productivity in traditional organisations? And which choices do organisations and policy makers have when implementing algorithmic management?

Findings from our literature study and professional discussions have learned us that the management of workers consists of many tasks, of which some are more easily automated than others. In contrast to the platform economy, traditional organisations have no need to automate every management task. They seek to combine and supplement traditional management with algorithmic management, to increase efficiency or attain other organizational goals. Thus, understanding algorithmic management in traditional organisations rests upon the knowing how management is divided between traditional, human management and algorithmic management. This is why we consider algorithmic management to be divided into elements.

Another insight is the degree of which the algorithmic management system(s) are automated and autonomous. We call this gradations or algorithmic management, drawing inspiration from an earlier classification of automation of algorithmic management by A.J. Wood . The platform economy strives for fully automated algorithmic management, with no role human for managers. This represents the highest gradation of algorithmic management and is rare. Traditional employers mostly use a lower gradation of algorithmic management, that is not fully automated, and has plenty room for human managers to correct or ignore algorithmic decisions. In these contexts algorithmic often supports management decision making, or simply saves managers time.

Even though algorithmic management has a more supporting nature in traditional organisations, the effects of algorithmic management on working conditions should not be underestimated. Work autonomy and intensity can all be heavily impacted. In contrary, employers (and sometimes workers) can have much to gain on the topics of quality control and productivity. For example, a simple productivity score, gained from data collection or reviews, can be very effective in increasing productivity. Yet for workers this means a higher work intensity, with possible (mental) health consequences. A system that instructs workers how to do a certain task, can lead to less mistakes and better quality control, but can also reduce worker autonomy and in effect deskill certain types of work. Currently, we are conducting empirical case studies on the latter topic. At the GI-NI conference, we will present the final results and conclusions, and discuss on what employers, social partners and governments need to pay attention to when they are regulating algorithmic management, or putting it in practice.

² Wood, A. J. (2021). Algorithmic management consequences for work organisation and working conditions (No. 2021/07). JRC Working Papers Series on Labour, Education and Technology.



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Productivity Growth and Demand for Apprentices: How Does Catch-Up to the Productivity Frontier Influence an Establishment's Demand for Apprentices?

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In this paper, we study how closing the productivity gap influences firm behaviour towards hiring apprentices in Germany. Empirical literature on firm productivity documents a widening in productivity growth between firms within the same industry. Although this literature emphasizes on the industry- and firm level causes of this widening, consequences to firm behaviour as a firm closes the productivity gap represents an untapped research avenue. On the one hand, closing the productivity gap might have a positive effect on demand for apprentices due to increase in labour demand, presence of internal labour markets and monopsony power. On the other hand, changes to skill requirement due to technological intensity, competitive pressure and innovative pursuits might render firms to hire fewer apprentices. Using the IAB Establishment Panel - a representative establishment-level data for Germany, I use hybrid negative binomial regression models to control for time-invariant unobserved heterogeneity at the firm level whilst allowing random intercepts for each firm. Our preliminary results show that a 1-percentage point increase in closeness to the productivity frontier contributes to a decline in demand for apprentices by approximately a fifth, holding other factors constant. Firms that are closer to the frontier have a larger negative effect than firms further away from the frontier. We argue that the negative effect is a consequence of firm's shifting their skill requirement to a polarized within-firm skill distribution, i.e., exhibiting an increase in demand for high and low-skilled workers at the cost of medium skilled workers. Since the skill-requirement shifts against medium-skilled workers, firms have a perverse incentive to hire apprentices for those medium-skilled occupations when they catch up to the productivity frontier. Our study is consequential, since the financial "mantra" of catching-up to the frontier comes at the cost of the traditional and institutionalized system of apprenticeship training in Germany.



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How Can Culture and Institutional Arrangements Mitigate the Unintended Effects of Global Events on Inequality?

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Institutions and culture are seen as important elements in the social fabric. There is wide agreement that institutions matter. There is less agreement on how or why they matter, as to what extent they can be politically influenced. Less so with culture. Still, for most, one seeks to develop institutions in the belief that they are good for society. Subsequently, in the GI-NI project one writes:

“This is crucial in understanding, not just how various institutions interplay in the present situation, but also to provide a set of realistic policy recommendations on how to strengthen institutional arrangements that mitigate the unintended effects of global events and crisis locally.” (GI-NI, application to H2020, 2019, Appendix A, p 13)

The authors of the paper are all involved in the GI-NI project. In this conceptual paper, we reflect on the role of culture and institutions more generally. We start from the observation that societies differ in how they are institutionally endowed, as in their systemic tolerance for various forms of inequality. We go on with presenting some of the typologies of cultural and institutional set-up that apply to the European context. Using the concept of “a narrow corridor”, our core thesis is that it is the particular and contextual interaction between institutional arrangements and cultural processes that successfully mitigate the unintended effects of global events on inequality.



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Innovating For the Good or For the Bad. An EU-wide Analysis of the Impact of Technological Transformation on the Labour Market

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This article investigates the links between the technological transformation and the job polarization and unemployment by looking at the three consecutive stages of such relationship: tangibles and intangibles investments, innovation output and labour market outcomes. Periods of radical changes such as those happening during technological revolutions usually raise concerns about the widespread substitution of machines to labour and the rise of inequalities. The current digital revolution has stretched once again the fear of massive skills and job destruction due to automation, robotics and Artificial Intelligence (Frey and Osborne 2013; Brynjolfsson & MacAfee, 2014). Moreover, emerging digital technologies seem to affect workers in all industries and across different occupational ranks (Bailey, 2022). Nevertheless, each technological revolution also generates new goods and services, which by raising demand, create new jobs that use new skills. This paper steps into this debate and offers an original empirical analysis exploiting an innovative EUwide dataset which aggregates data at the country-sector level to combine employer and employee level sources. In the analysis of the impact of technological transformation on the labour market we consider that the innovation strategies and choices made by companies in how digital technologies are embedded in the production process are key. This is why the paper adopts a framework proposed by Greenan and co-authors (2022) in which technological transformation have been disentangled in: i) a direct measure of investments in technology adoption and use that takes into account the diversity of ICTs and digital technologies as well as their continual renewal; ii) a measure of the learning capacity of organisations as a distinct argument of the knowledge production function of enterprises able to capture the implementation of those management tools concerned with the improvement of individual and organisational learning; and iii) an extended measure of innovation that includes technological innovation (product and process innovation) and non-technological innovations (organizational and marketing innovation). We offer new evidence about the relation between innovation inputs, innovation outputs and two outcomes on the labour market. The first one is the unemployment rates at the country-sector level, which thus refer to the loss of employment of people who were employed in a specific sector, but who, despite being available for work and having taken specific steps to find a job, have not been recruited in their former sector or in another one. The second one refers to indicators of polarisation that accounts for the change in the share of employment at the sector-country level for occupations belonging to the first, second or third tercile of a wage ranking with respect to a base year (2011). We analyse econometrically the relationship between the technological transformation and the selected labour market outcomes implementing structural equation models (SEM) that allow to simultaneously



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estimating multiple casual relations between the innovation inputs and outputs and between the inputs, the outputs and the labour market outcomes. It also allows conducting a mediation analysis, which assumes that the relationship between inputs and outcomes is mediated by a third variable, the innovation outputs of our model. Our findings show that the investment into the learning capacity of the organisation appears as a winwin strategy leading to more innovativeness and improved labour market outcomes. In particular, higher learning capacity in a sector favours all forms of innovation. and is also related with more labour market resilience, in particular less sector level unemployment and less occupational polarisation. Digital technology adoption and use has also a direct effect on innovativeness. Sectors with a high level of digital technology adoption and use experience lower unemployment rates. Higher digital intensity adoption and use is also associated with occupational upgrading, more precisely with a within sector shift of the structure of occupations from the middle to the upper part of the wage hierarchy. The innovation strategy adopted by firms plays a crucial role in mediating the effect of investments in learning capacity and digital technology adoption and use. Product innovation mediates positively the relationship between learning capacity and digital technology and labour market outcomes. At the sector level, it is associated with less unemployment, less occupational downgrading and more upgrading. The mediation effect of marketing innovation is clearly the opposite: it induces more unemployment, less occupational upgrading, and more occupational downgrading.



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The Pandemic Push: Digital Technologies and Workforce Adjustments

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Based on a unique survey and administrative employer-employee data, we show that the COVID-19 pandemic acted as a push factor for the diffusion of digital technologies in Germany. About two in three firms invested in digital technologies, in particular in hardware and software to enable decentralized communication, management and coordination. The investments encouraged additional firm-sponsored training despite pandemic-related restrictions indicating that investments in digital technologies and training are complements. We then demonstrate that the additional investments helped firms to insure workers against the downturn during the pandemic. Firms that made additional investments relied less on short-time work, had more of their regular employees working normal hours and had to lay off fewer marginal workers. Male, younger and medium-skilled workers benefitted the most from the insurance effect of digital investments.



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Training, digital skills, and the adaptability to technological change

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The recent waves of automation in recent decades have made workers with a high share of routine tasks particularly vulnerable to technological substitution. On the contrary, the importance of digital skills in the labor market has increased dramatically in recent decades due to their potential complementarity with technology. In this context, on-the-job training can enable workers to improve their digital skills and perform more non-routine tasks, reducing their individual risk of automation by upgrading their tasks. However, existing studies of the returns to job training using large observational datasets suffer from selection bias. We investigate whether job training can improve workers' digital skills, their task composition in terms of vulnerability to automation, and their success in the labor market. To this end, we use international micro-survey data from the Program for the International Assessment of Adult Competencies (PIAAC) on education, skills, and task use from 32 countries. We apply entropy adjustment to observable characteristics to tightly control for selection into education, while additionally controlling for numeracy to account for unobserved skills. Our results suggest that vocational training significantly increases digital skills and wages and reduces the share of tasks at risk of automation at the individual level. Finally, we examine how the effectiveness of training on digital skills, task composition, and wages varies by individual and country characteristics.



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