Grant Agreement number: 101132559
Project acronym: ST4TE
Project title: Strategies for just and equitable transitions in Europe
Type of action: RIA

The impact of twin transition on income inequality and employment quality

Deliverable leader	University of Ferrara (UNIFE)
Authors	Andrea Ascani, Nicolò Barbieri, Stefano Basilico, Giacomo Dimarco, Alberto Marzucchi, Alessandro Palma, Ugo Rizzo
Due date	30/09/2025
Actual submission date	11/10/2025
Dissemination Level	Public

Abstract: This report examines how Europe's "twin transition" relates to income inequality and employment quality. Inequality levels are persistent and heterogeneous across countries, with limited convergence over time. Digital employment expands broadly yet unevenly, while green employment displays mixed trajectories; twin jobs remain a small and slowly growing share. At the national level, green employment is relatively more prevalent in higher-inequality economies whereas digital employment is more common in more egalitarian settings; the association for twin jobs is weak. Regional and worker-level evidence highlights pronounced distributional asymmetries: women are over-represented in lower income deciles, younger workers are concentrated toward the bottom, temporary contracts map to lower deciles, and work-from-home opportunities skew to the top. Digital and twin occupations are disproportionately represented in upper deciles, while green roles are more evenly distributed. We conclude that the twin transition is not distributionally neutral. Targeted policies are required to ensure transitions that are both effective and inclusive.

Document Revision History

Date	Version	Author/Editor/Contributor	Summary of main changes / Status
29/09/2025	0.1	Andrea Ascani, Nicolò Barbieri, Stefano Basilico, Giacomo Dimarco, Alberto Marzucchi, Alessandro Palma, Ugo Rizzo	First version of the report to be revised by Giulia Martinelli and Tommaso Ciarli

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

Contents

1. Introduction 5

2. Background literature 7

3. Data and Methods 11

4. Inequality - the national perspective 13

5. Green, digital and twin occupations mapping in EU 19

6. The connection between inequality and the labour market 25

7. The sources of inequality at the regional level 31

8. Conclusions 51

References 53

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

List of Figures

Figure 1. Gini index in the EU (2016-2022) 13
Figure 2. Maps of Gini index in 2016 and 2022 14
Figure 3. Differences in Gini index with respect to the EU average per year 16
Figure 4. Relative change in the Gini index between 2016 and 2022 17
Figure 5. Green, digital and twin labour dynamics (2016-2022) 20
Figure 6. Green, digital and twin enabling occupation labour dynamics (2016-2022) 22
Figure 7. Connecting green, digital and twin employment with inequality 26
Figure 8. Connecting green, digital and twin employment in enabling occupations with inequality 28
Figure 9. Male vs female percentage differences in income distribution by decile (regions) 32
Figure 10. Young vs older worker differences in income distribution by decile (regions) 33
Figure 11. Temporary vs permanent worker differences in income distribution by decile (regions) 34
Figure 12. Single vs multiple job-holder differences in income distribution by decile (regions) 35
Figure 13. Work-from-home differences in income distribution by decile (Any-WFH vs Never, regions) 36
Figure 14. Differences in income distribution between high- and low-green exposure occupations by decile (regions) 37
Figure 15. Differences in income distribution between high- and low-digital exposure occupations by decile (regions) 38
Figure 16. Differences in income distribution between high- and low-twin exposure occupations by decile (regions) 39
Figure 17. Differences in income distribution between high- and low-enabling occupations by decile (regions) 40
Figure 18. Gender differences in income distribution by decile for high- and low-exposure green occupations (Female – Male share) 42
Figure 19. Gender differences in income distribution by decile for high- and low-exposure digital occupations (Female – Male share) 43
Figure 20. Gender differences in income distribution by decile for high- and low-exposure twin occupations (Female – Male share) 45
Figure 21. Age-group differences in income distribution by decile for high- and low-exposure green occupations (share of workers under 30 minus share of workers aged 40–60) 46
Figure 22. Age-group differences in income distribution by decile for high- and low-exposure digital occupations (share of workers under 30 minus share of workers aged 40–60) 47
Figure 23. Age-group differences in income distribution by decile for high- and low-exposure twin occupations (share of workers under 30 minus share of workers aged 40–60) 49

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

1. Introduction

The ongoing transformations driven by the so-called “twin transition,” namely the simultaneous shift towards a digitalised economy and the transition to environmental sustainability, are profoundly reshaping contemporary labour markets. These processes are widely regarded as key drivers of economic performance, technological progress, and environmental resilience. Yet, alongside their potential benefits, the twin transition raises critical questions concerning its distributive implications. Labour markets are not neutral in their adjustment to structural change: occupations differ markedly in their degree of exposure to new technologies and green requirements, and workers themselves are heterogeneously endowed with the skills, resources, and opportunities needed to adapt.

Through the European Green Deal (European Commission, 2019), the EU has made legally binding the strategic objective of achieving climate neutrality by 2050, thereby committing to transform its economic model into a net-zero greenhouse gas emission system. Attaining this goal requires a profound reconfiguration of consumption patterns, production systems, and labour market dynamics, generating new demands in terms of skills, technologies, and governance. Nevertheless, the pursuit of carbon neutrality inevitably creates tensions with economic and social objectives, raising distributive dilemmas and potential policy conflicts. On the one hand, environmental policies require substantial public and private investment that could otherwise be allocated to competing priorities; on the other hand, they impose additional constraints on firms, with compliance costs that may affect international competitiveness and exert pressure on employment levels.

Although the labour market costs of the green transition can be significant - particularly for workers employed in carbon-intensive sectors or in regions with low levels of productive diversification - these effects must be evaluated against the potential benefits of achieving environmental objectives. In a dynamic perspective, decarbonisation can stimulate competitiveness in emerging technological sectors, generate high-quality employment, and improve working conditions through organisational and technological innovation. Moreover, the environmental gains associated with the green transition, while often non-market in nature, contribute directly to collective well-being, public health, and intergenerational sustainability (Pearce et al., 2006). In this sense, the transition should not be regarded merely as a constraint but also as an opportunity to activate complementarities between innovation, skills, and public policy, thereby transforming short-term adjustment costs into medium- and long-term gains in productivity and resilience.

A central issue in this context is the extent to which occupational exposure to the twin transition may engender new forms of inequality or exacerbate existing divides. Theoretical and empirical research on skill-biased technical change or the routine-biased technical change has already shown that digitalisation tends to favour high-skilled workers or disproportionally affect labour demand in routinized occupations, potentially increasing wage dispersion and polarisation. Similarly, the green transition, while essential for long-term sustainability, may entail disruptive effects in carbon-intensive sectors and uneven gains in emerging “green” occupations. When considered jointly, the digital and green transitions may create complementarities that accelerate growth and innovation, but they also risk stratifying the labour force between those able to benefit from new opportunities and those who face obsolescence or precarious employment.

This project has received funding from the European Union’s Horizon Europe under grant agreement No 101132559.

This report examines the relationship between occupational exposure to the twin transition and inequality. By analysing the distribution of workers across the income levels in relation to their exposure to digitalisation and green transformations, it seeks to assess whether the twin transition is associated with systematic disparities in labour market outcomes. Such an analysis contributes to the growing literature on the distributive effects of technological and environmental change, while providing empirical insights into the mechanisms through which structural transformations affect social cohesion.

The analysis builds on several strands of literature that have examined the distributive implications of structural change in the labour market. First, the extensive body of work on skill-biased technical change (SBTC) has shown that digitalisation tends to disproportionately benefit highly educated or highly skilled workers, while contributing to employment polarisation and wage inequality. Second, research on environmental economics and labour markets has highlighted the uneven effects of the green transition, with some occupations and sectors - particularly those reliant on fossil fuels - facing risks of displacement, while others experience new growth opportunities in low-carbon and environmentally sustainable activities (Curtis et al., 2024). More recent contributions have sought to integrate these perspectives by examining the combined dynamics of the "twin transition," stressing both the complementarities and tensions between digital and green transformations (Antonioli et al., 2025). These studies point to the possibility that the distributional effects of digitalisation and greening are not independent but may reinforce one another, thereby amplifying risks of inequality unless carefully managed through policy (Consoli et al., 2023).

From a policy perspective, understanding these dynamics is of paramount importance (European Commission, 2022). The pursuit of a twin transition that is not only efficient but also inclusive requires targeted interventions to mitigate emerging inequalities. Measures such as investment in reskilling and upskilling, active labour market policies, and the design of social protection systems must ensure that no group of workers is disproportionately disadvantaged. By shedding light on the unequal distribution of opportunities and vulnerabilities associated with the twin transition, this report aims to inform evidence-based strategies capable of reconciling technological and environmental imperatives with the principles of fairness and social justice.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

2. Background literature

The distributive implications of structural transformations in labour markets have been extensively studied, albeit often in separate strands of research focusing either on digitalisation/automation or on environmental sustainability. This section reviews the main contributions in these areas, before discussing more recent efforts to integrate them in the framework of the twin transition.

A rich body of work has examined how technological change affects the distribution of employment and wages. Early contributions on skill-biased technological change (SBTC) argued that advances in information and communication technologies tend to increase the relative demand for highly educated workers, thereby raising the skill premium and contributing to rising wage inequality (Autor et al., 1998; Acemoglu, 2002). More recent analyses have nuanced this picture by pointing to job polarisation, whereby digitalisation simultaneously increases the demand for both high-skilled, abstract task-intensive jobs and low-skilled service jobs, while negatively impacts routine middle-skill occupations (Goos, Manning, & Salomons, 2014; Autor, 2015). This phenomenon has been observed in many advanced economies and is regarded as a central driver of labour market inequality.

The mechanisms through which digital technologies affect labour markets have also been studied in greater detail. Automation, artificial intelligence, and robotics may substitute for certain routine tasks, while creating complementarities with analytical and problem-solving skills (Frey & Osborne, 2017). At the same time, the diffusion of digital platforms has altered employment relations, contributing to new forms of precarious or non-standard work. Taken together, these findings highlight that digitalisation, while fostering productivity and innovation, carries a strong potential to exacerbate labour market inequalities, particularly along the skill dimension.

Parallel to the literature on digitalisation, another body of research has explored the distributive consequences of the transition to a low-carbon economy. Empirical studies suggest that the green transition creates opportunities for new “green jobs,” defined as employment that contributes directly to environmental objectives, such as renewable energy, energy efficiency, or waste reduction (OECD, 2017). However, the distribution of these opportunities is uneven across sectors, regions, and skill levels. Occupations in carbon-intensive industries face risks of displacement as environmental policies tighten, while workers with skills complementary to green technologies stand to benefit.

Several studies have also investigated the skill content of green jobs. Vona et al. (2018) demonstrate that green occupations typically require higher levels of cognitive and technical skills, suggesting that the green transition is not skill-neutral. This insight raises concerns that the benefits of greening may accrue disproportionately to more skilled workers, potentially reinforcing existing inequalities. Furthermore, regional disparities may emerge, as areas dependent on fossil fuel extraction or heavy manufacturing are more exposed to the negative employment effects of decarbonisation. The literature on the “just transition” has therefore stressed the importance of policies that address not only aggregate employment effects but also their distributional and spatial dimensions.

More recently, scholars have begun to examine the twin transition as an integrated process, emphasising the interdependence between digital and green transformations. Digital technologies such as artificial intelligence, the Internet of Things, and big data are increasingly recognised as enablers of the green transition, improving energy efficiency, optimising resource use, and facilitating the diffusion of clean technologies (Consoli et al. 2023). At the same time, investments in green

This project has received funding from the European Union’s Horizon Europe under grant agreement No 101132559.

innovation can stimulate demand for digital solutions, creating complementarities between the two transitions.

At the macroeconomic level, the relationship between technology, innovation, and human capital is central to growth theory. Aggregate production functions highlight that output depends on different forms of capital-manufactured, human, social, and natural-subject to diminishing marginal returns and depreciation. These constraints imply that long-run growth in mature economies is largely driven by technological progress, which both raises productivity and conditions wage dynamics. When technical change is treated as exogenous, growth models predict absolute convergence across economies, as capital accumulation is bounded by the same constraints. By contrast, endogenous growth models emphasise investments in knowledge, spillovers, and skilled migration, leading to relative rather than absolute convergence, and persistent differences in long-run per capita incomes.

From a microeconomic perspective, firm behaviour is shaped by the dual concepts of production and cost functions. The presence of diminishing returns in the use of one factor, holding the other fixed, creates production constraints, while the decomposition of costs into fixed, variable, average, and marginal components highlights the conditions for economies of scale. In competitive markets, firms tend to operate where price equals marginal cost, often at zero-profit equilibria in the long run. Within this framework, the notion of complementarities is particularly relevant. As articulated by Milgrom and Roberts, “doing more of one thing increases the returns to doing more of another,” a principle that has been formalised in the innovation literature and tested empirically.

These theoretical insights are mirrored in empirical studies that connect complementarities in innovation to long-run performance. Combinations of R&D and human capital, or AI adoption and other forms of innovation, expand absorptive capacity and strengthen the effectiveness of policy stimuli in inducing invention. Complementarities are also essential in transforming the short-term costs of environmental or technological policies into medium- and long-term productivity gains through induced technical change. Recent contributions, such as DiBiaggio et al. (2024), underscore that AI adoption depends not only on advanced ICT competences but also on transversal skills such as communication and coordination, which ensure alignment between technologies and organizational objectives. These findings reinforce the need for econometric analysis capable of disentangling the joint effects of technological adoption, human capital, and complementarities on firm performance, regional development, and long-run growth trajectories.

Despite these synergies, concerns have been raised about the distributional consequences of the twin transition. Digital and green transformations may reinforce each other in shaping labour market outcomes, amplifying both opportunities and risks. On the one hand, workers with advanced technical skills may benefit disproportionately from complementarities between digitalisation and green innovation. On the other hand, workers in routine-intensive or carbon-intensive occupations may face a double burden of displacement risk.

The reviewed literature consistently highlights the role of policy in mediating the inequality effects of structural change. In the context of digitalisation, active labour market policies, investments in reskilling, and lifelong learning programmes are frequently identified as essential to mitigate job polarisation (Arntz, Gregory, & Zierahn, 2016). For the green transition, the “just transition” framework emphasises compensation for displaced workers, regional development strategies, and anticipatory measures to align education systems with emerging skill needs (ILO, 2019). With respect to the twin

This project has received funding from the European Union’s Horizon Europe under grant agreement No 101132559.

transition, scholars stress the necessity of integrated policy approaches that simultaneously address digital and environmental skill gaps, while ensuring that vulnerable groups are not excluded from new opportunities (Muench et al., 2022).

Moving towards inequality, research on income distribution has long focused on cross-country differences, identifying robust determinants such as the level of economic development, economic growth, demographic and age structures, unemployment, institutions, and human capital (Furceri & Ostry, 2019; Iacono & Ranaldi, 2022; Tassaeva, 2021). However, fewer contributions address income inequality at the sub-national scale. Studies on U.S. states (Fallah & Partridge, 2007; Frank, 2008; Panizza, 2002) and European regions (Castells-Quintana et al., 2015; Galbraith & Garcilazo, 2005; Perugini & Martino, 2008; Rodríguez-Pose & Tselios, 2009) generally converge in showing rising inequalities over recent decades. Yet, they diverge in pinpointing the underlying causes. For example, Castells-Quintana et al. (2015) report that inequality is negatively related to levels of economic development but positively related to growth and specialization in tradable services, while Royuela et al. (2019) emphasize that inequality can hamper growth more strongly in urban than in rural regions. Perugini and Martino (2008) further highlight that the effect of innovation and human capital on inequality depends on the moderating role of welfare and redistributive policies.

A subset of this literature focuses on the link between human capital and regional inequality. Tselios (2008, 2014) documents a positive association between educational and income inequality in EU regions, moderated by welfare regimes. Similarly, Rodríguez-Pose and Tselios (2009) find that human capital remains a key determinant of income disparities across European regions. Most of these studies, however, rely on quantitative measures of human capital such as educational attainment, while neglecting qualitative aspects like the nature of skills embedded in the workforce.

Parallel to this, a large body of work has investigated the economic impact of digitalization and information and communication technologies (ICTs). ICTs, as general-purpose technologies, have been shown to boost productivity (Brynjolfsson & Hitt, 1996; Kretschmer, 2012), foster innovation (Cardona, Kretschmer, & Strobel, 2013), and support long-term economic growth (Brynjolfsson & McAfee, 2014; Roller & Waverman, 2001). They also generate positive network externalities that reduce barriers to entry (David, 2001; Downes, 2009). At the same time, scholars have highlighted the darker side of ICT diffusion: capital-labor substitution, skill-biased technological change, and the erosion of opportunities for routine and low-skilled workers (Autor et al., 1998; Goldin & Katz, 2007; Karabarbounis & Neiman, 2014). This has contributed to job polarization, whereby middle-skill jobs are disproportionately displaced (Autor & Dorn, 2013; Goos, Manning, & Salomons, 2014).

The concept of e-skills - the competences required to operate, adapt, and innovate with digital technologies-emerges as a central element in this debate. Recent research shows that regions investing in ICT-related activities within Smart Specialisation strategies achieve stronger innovation performance and diversification (Castellacci, Consoli, & Santoalha, 2020). Yet, digital skills development is uneven across territories, and insufficient attention has been devoted to how e-skills affect within-region inequality. While digitalisation can promote entrepreneurship and reduce barriers for new entrants (Jones & Kim, 2017), it can also strengthen the market power of incumbents and increase wage dispersion (Aghion et al., 2019).

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

Taken together, the literature points to a multifaceted relationship between digitalisation, skills, and inequality. Digital technologies can mitigate inequality by creating new opportunities for high-skilled individuals and innovative firms, but they may simultaneously exacerbate disparities by penalising routine-intensive and less educated workers. This duality motivates the empirical investigation of whether and how regional e-skill endowments affect income inequality across different segments of the income distribution (Consoli et al., 2023).

In sum, the literature suggests that while the twin transition holds promise for economic renewal and sustainability, it also carries significant risks of reinforcing labour market inequalities. The challenge for both research and policy is to identify where these risks are concentrated and how they can be effectively mitigated.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

3. Data and Methods

Our analysis is based on three complementary datasets that jointly capture the dynamics of income inequality and structural labour market change in the EU. The first dataset exploits the Eurostat's European Union Statistics on Income and Living Conditions (EU-SILC) which collects comparable cross-sectional and longitudinal multidimensional microdata on income, poverty, social exclusion and living conditions, to build national- and regional-level indicators of income distribution, specifically the Gini coefficient. This indicator is available annually for all EU member states between 2016 and 2022, and provide a consistent and internationally comparable measure of inequality over time. As for the regional perspective, some issues emerge with regard to the geographical coverage and comparability of the EU-SILC microdata. While EU-SILC is designed as a harmonised survey, the degree of disaggregation at the subnational level varies considerably across Member States. In some cases, indicators can be produced at the NUTS-2 level, whereas in others the available sample size only allows for reliable estimation at higher territorial aggregates. Furthermore, the underlying sampling frames, non-response patterns, and weighting procedures are not fully standardised across countries, which can lead to heterogeneous data quality and differences in precision when computing regional indicators of inequality. These limitations imply that caution is required when interpreting regional-level estimates, and that cross-country comparisons at the subnational scale should be approached with particular care.

The other two data sources on which the report draws upon are the European Skills, Competences, Qualifications and Occupations classification (ESCO) and the European Labour Force Survey (EU-LFS). ESCO constitutes a standardized, multilingual taxonomy that systematically links occupations with their associated skills, competences, and qualifications. Through its occupational and skills pillars, together with mapping tables that define "skill-occupation relationships," ESCO enables a granular classification of occupations according to their skill content. It explicitly distinguishes between green, digital, and transversal skills, thereby providing a basis for identifying skill-intensive segments of the labour market. These structured linkages allow researchers to match occupations with skill profiles, detect potential shortages or surpluses, and assess pathways for upskilling and reskilling. ESCO has thus become a crucial resource for analyses that seek to align labour market requirements with educational provision and policy design.

Finally, the EU-LFS complements this framework by providing harmonised, micro-level information on the labour market across all EU Member States. As a large-scale household survey, it offers detailed individual-level data on employment status, occupation, industry, working hours, education, and demographic attributes. Its breadth and consistency across countries and over time make it an pivotal source for studying labour market dynamics, monitoring structural change, and undertaking econometric analyses of employment and inequality.

By integrating ESCO's occupational-skill mappings with EU-LFS microdata, we construct country-year measures of employment in emerging occupational domains. Specifically, we identify "core" green, digital, and twin occupations, as well as "enabling" categories - occupations that are not intrinsically green, digital, or twin, but which are critical for the diffusion and operationalisation of these transformations in the labour market. This integration yields a set of indicators capturing the relative weight of green, digital, and twin employment, which can be merged with country-level measures of inequality, such as the Gini index. The resulting dataset provides the empirical foundation for

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

examining how the diffusion of skill-intensive employment associated with the twin transition correlates with changes in income distribution across European economies.

For descriptive purposes, the combination of these datasets enables us to trace the evolution of inequality alongside the relative weight of green, digital, and twin jobs in national labour markets.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

4. Inequality - the national perspective

In this section, the analysis adopts a national perspective on inequality, examining how income distribution has evolved across EU member states over the period 2016-2022. By focusing on cross-country patterns rather than individual or occupational outcomes, the objective is to highlight the persistent heterogeneity in inequality levels across national contexts, as reflected in indicators such as the Gini index. This approach allows us to identify structural differences between high-inequality and low-inequality clusters of countries, as well as to capture the relative stability of these patterns over time. Framing the discussion at the national level is essential for understanding the broader institutional, policy, and structural conditions that shape distributional outcomes, thereby providing the necessary context for subsequent sections that turn to more granular analyses of inequality across occupational groups and their exposure to the twin transition.

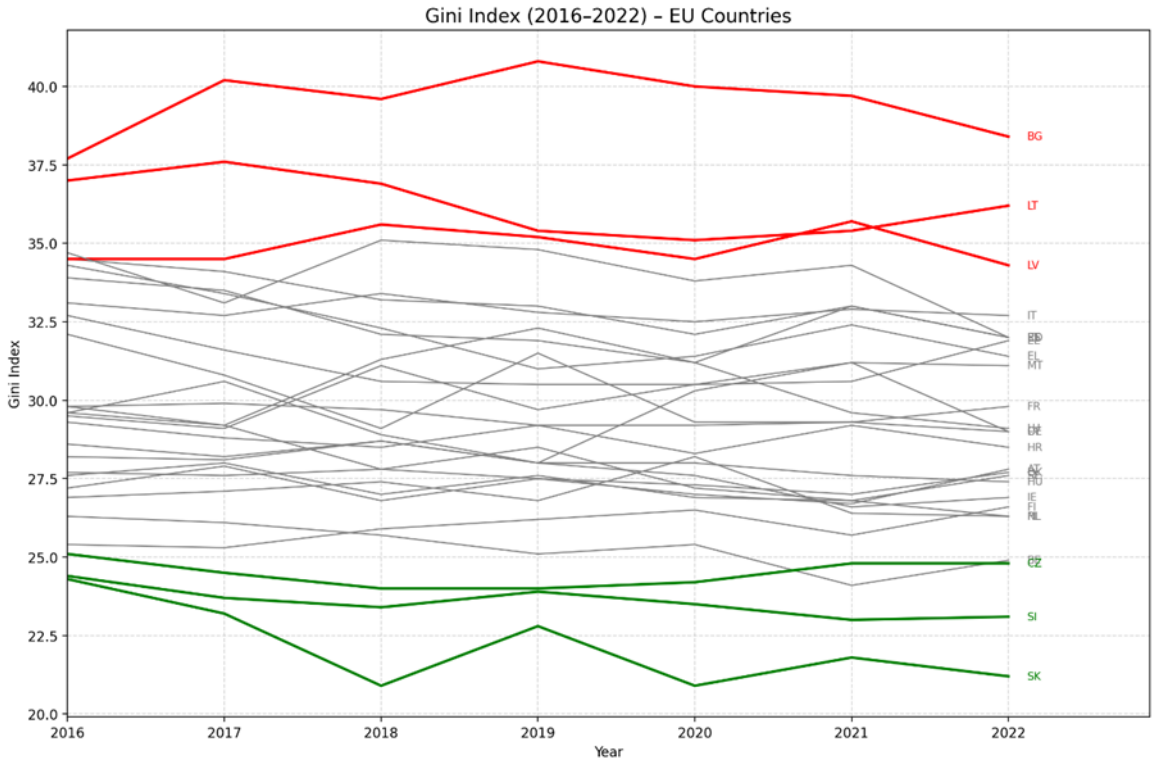


Figure 1. Gini index in the EU (2016-2022)

Source: own elaboration using data from Eurostat

Figure 1 shows national Gini indices for EU member states from 2016 to 2022. Two insights emerge. First, there is a persistent cross-country dispersion with a relatively stable ranking: Bulgaria inequality levels are clearly above the rest throughout, peaking around 2019-2020 at slightly above 40 and finishing 2022 still near the top of the range; Lithuania and Latvia form the remainder of the high-inequality group. At the other end, Czechia, Slovenia, and Slovakia are part of the low-inequality cluster. Most other countries are tightly packed in a narrow band around the high-20s to low-30s, indicating a broad European core where inequality levels differ more by degrees than by orders of magnitude.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

Second, time-series movements are modest relative to the cross-sectional gaps, suggesting limited convergence over this period. Many countries show small drifts rather than structural breaks. The stability of the extremes is noteworthy: the high-inequality and low-inequality clusters remain intact, implying that short-run shocks have not fundamentally altered distributional regimes.

From an interpretative standpoint, the chart is best read as a baseline map of distributional heterogeneity rather than as evidence of rapid change. The dispersion between the top and bottom groups-on the order of 15-17 points-reduces typical within-country year-to-year variation.

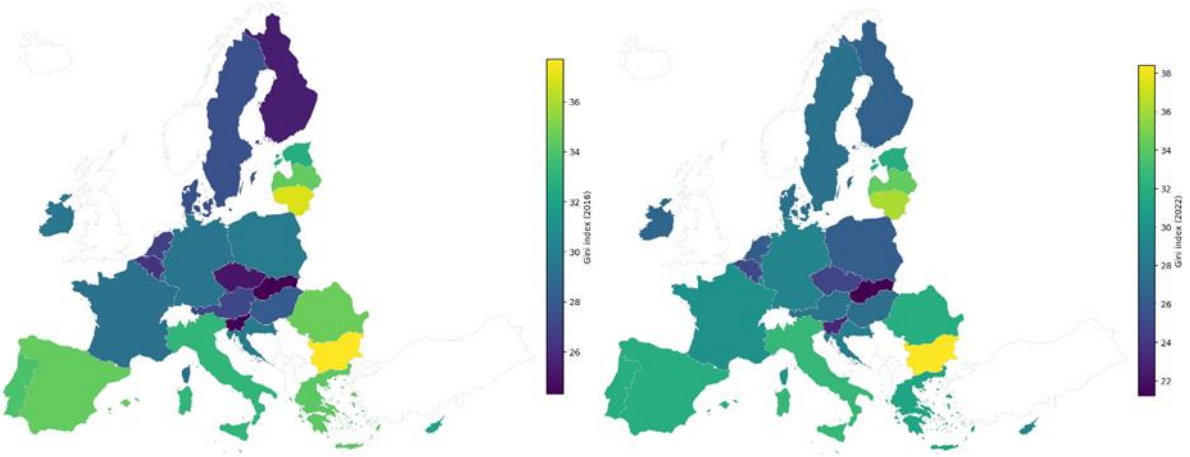


Figure 2. Maps of Gini index in 2016 and 2022

Source: own elaboration using data from Eurostat

Figure 2 provides a spatial representation of income inequality in the EU in 2016 and 2022, as measured by the Gini index. The comparison between the two years highlights both the persistence of structural differences across countries and the modest shifts that occurred during this period.

In 2016, the highest inequality levels (in green and yellow tones) were observed in Bulgaria, Romania, and the Baltic states, with Gini indices above 35. At the other extreme, Central European countries such as the Czech Republic, Slovakia, and Slovenia displayed the lowest levels of inequality (in dark purple tones), with values around 25-26. Southern and Western Europe, including Spain, Portugal, and Italy, clustered in the mid-30s range, while the Nordic countries combined relatively lower inequality with higher income levels, sitting in the middle of the distribution.

By 2022, the overall geographic pattern remained largely intact, underscoring the structural nature of inequality differences across the EU. Bulgaria continued to record the highest Gini index, exceeding 38, while the Czech Republic, Slovakia, and Slovenia preserved their status. Some moderate changes are visible: inequality declined slightly in Latvia and Lithuania, whereas it increased marginally in several Central and Western European countries, including Germany and Italy, which moved closer to the EU average. Importantly, the gap between the most and least unequal countries persists, with more than 12 points separating Bulgaria from Slovenia.

Taken together, these maps emphasize two central features: first, inequality within the EU is strongly patterned along geographic and structural lines, with Eastern and Southern states generally more

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

unequal than Central European ones; second, despite the shocks of the pandemic and subsequent inflationary pressures, relative country positions in the inequality ranking have remained stable. This suggests that national institutions, welfare systems, and labour market structures are critical in shaping distributional outcomes, and that convergence in inequality levels across Europe remains limited.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

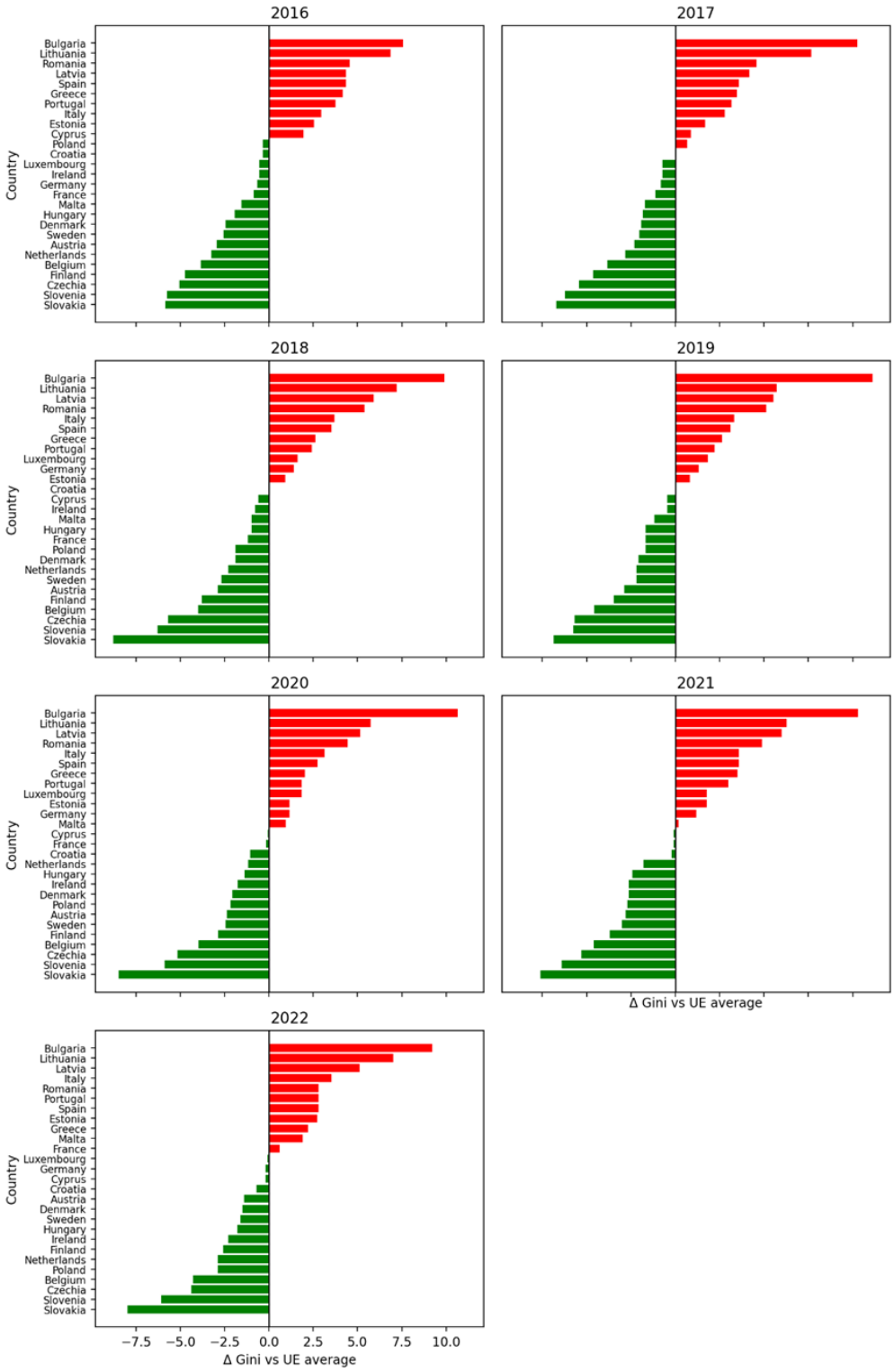


Figure 3. Differences in Gini index with respect to the EU average per year

Source: own elaboration using data from Eurostat

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

Figure 3 traces the relative position of EU member states in terms of inequality by plotting the difference between each country's Gini index and the EU average from 2016 to 2022. The charts make clear not only which countries consistently sit above or below the average, but also the degree of persistence in these relative positions. At the top of the distribution, Bulgaria, Lithuania, Romania, and Latvia remain systematically more unequal than the EU average, with Bulgaria standing out throughout the period at roughly 8-10 points above the mean. Southern European countries such as Spain, Italy, and Greece also register persistently higher Gini indices than the EU average, though their deviations are more moderate, in the range of 2-4 points. Conversely, a cluster of Central and Northern European countries consistently exhibits lower inequality levels than the EU average. The Czech Republic, Slovenia, and Slovakia are the most egalitarian, showing Gini values around 5-7 points below the EU average across the entire period. Belgium, the Netherlands, Austria, Finland, and Sweden also remain consistently below the mean, albeit with smaller margins. This stability suggests that institutional and welfare-state arrangements in these countries provide robust mechanisms for mitigating inequality over time.

These panels demonstrate that while inequality levels fluctuate slightly with shocks and policy interventions, the relative positions of countries vis-à-vis the EU average are strikingly stable, reinforcing the need to account for country-specific characteristics when linking inequality to structural transformations such as the twin transition.

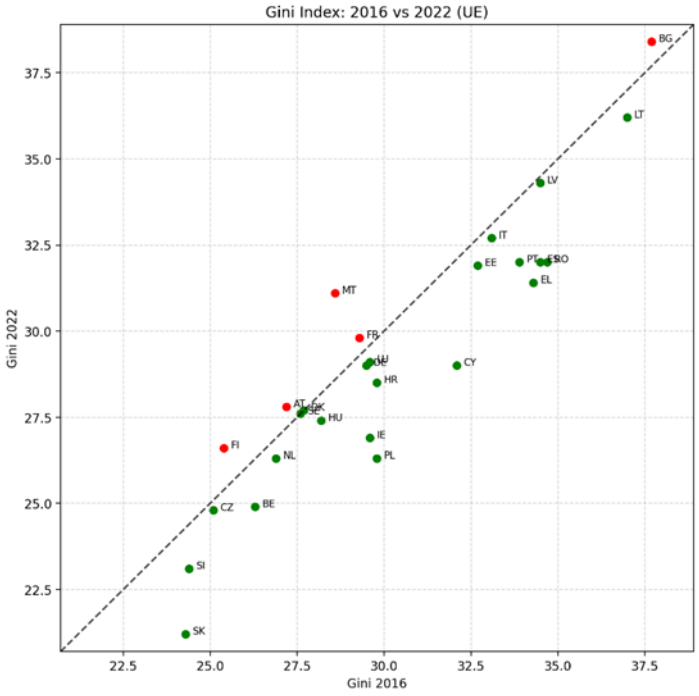


Figure 4. Relative change in the Gini index between 2016 and 2022

Source: own elaboration using data from Eurostat

Figure 4 compares the Gini index of EU member states in 2016 (x-axis) and 2022 (y-axis). The 45-degree line represents perfect stability: countries lying on the line experienced no change in inequality, those above it became more unequal over the period, and those below it saw declines. A first striking feature is the high persistence in inequality rankings across countries. Bulgaria remains the most unequal

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

country in both years, well above 38 in 2022, while Slovenia, Slovakia, and Czechia cluster at the lower end with indices below 27. This confirms that structural, institutional, and policy factors underpin relatively stable inequality regimes. Second, the distribution of points relative to the diagonal indicates that most countries are below the line, implying that inequality in 2022 is slightly lower than in 2016 for a majority of EU states. Notable declines are visible in Latvia and to some extent in Greece, Cyprus, and Portugal, which moved modestly closer to the EU average. By contrast, a handful of countries show increases: Malta, France, Austria, and Finland lie clearly above the diagonal, signalling that their Gini indices rose between 2016 and 2022.

Third, the overall pattern suggests that the extremes are self-reinforcing. The most unequal countries in 2016-Bulgaria and Lithuania-remained at the top in 2022, and their positions relative to the rest of the Union barely shifted. At the same time, the most egalitarian countries preserved their relative advantage. This points to strong persistence in distributional structures: while cyclical shocks such as the COVID-19 pandemic or inflationary pressures left traces, they did not alter the fundamental clustering of countries into high-inequality and low-inequality groups.

In sum, the scatterplot highlights modest reductions in inequality across much of the EU, alongside increases in a smaller set of countries. Cross-country dispersion remains wide-over 15 Gini points separate the most and least unequal members-and convergence is limited.

Takeaway #1.
Persistent cross-country heterogeneity. Inequality levels in the EU are characterised by strong and stable national patterns. The gap between the top and bottom groups - around 15 Gini points - has not narrowed, signalling limited convergence over the period 2016-2022.

Takeaway #2.
Stability outweighs change. Although there are modest year-to-year fluctuations, the broad ranking of countries is strikingly stable. National institutions, welfare regimes, and labour market structures appear more important in shaping inequality than cyclical shocks.

Takeaway #3.
Modest declines in many, increases in a few. Between 2016 and 2022, most EU countries saw slight reductions in inequality, while a smaller set recorded increases. These shifts are small relative to the cross-sectional dispersion, but they indicate that distributional trajectories are not entirely stable.

Takeaway #4.
Regional clustering. Southern Europe tends to sit moderately above the EU average, while Central European countries are below it. Northern and Western European countries form a middle cluster, with Nordic states showing relatively low inequality.

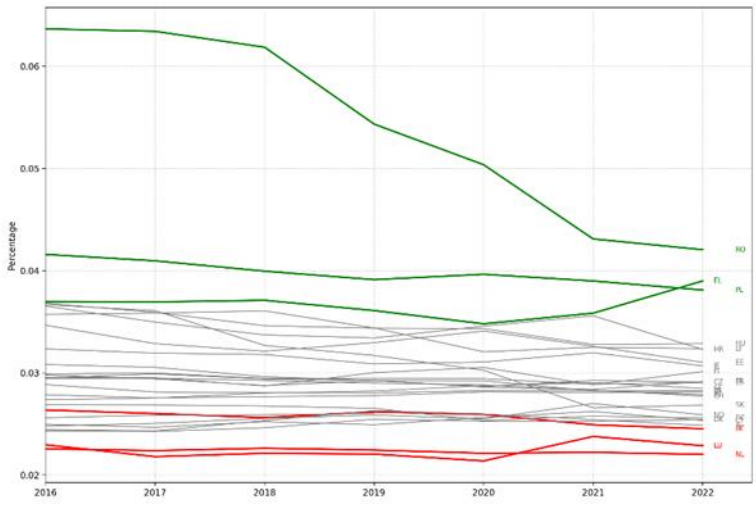
This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

5. Green, digital and twin occupations mapping in EU

Having considered inequality dynamics at the national level, we now turn to the distribution of labour exposure to the green transition, digitalisation, and their intersection in the form of the twin transition. The focus on the national dimension is essential, as the capacity of countries to adapt to structural change is mediated by their economic structures, sectoral specialisations, and institutional frameworks. Countries differ markedly in the extent to which their labour forces are engaged in green or digital occupations, reflecting historical trajectories of industrial development, educational systems, and policy priorities.

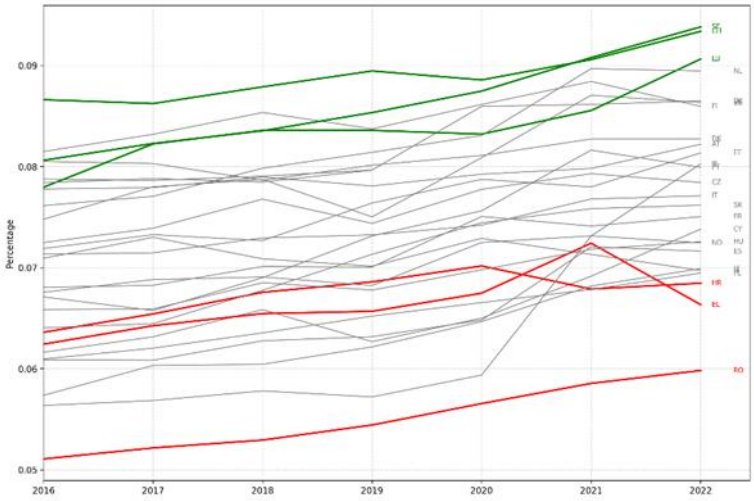
A national perspective allows us to identify structural asymmetries in the exposure of the workforce to transformative technologies and sustainability imperatives. These asymmetries are not merely descriptive: they can translate into differentiated opportunities for growth, innovation, and job creation, but also into divergent risks of displacement, skills mismatches, and inequality. In particular, countries with a higher concentration of employment in carbon-intensive sectors may face more acute adjustment costs in the green transition, while those lagging in digital diffusion may encounter barriers to productivity and competitiveness. Conversely, economies with balanced complementarities between green and digital labour may be better positioned to harness the synergies of the twin transition.

By mapping and comparing national profiles of green, digital, and twin labour, this section seeks to uncover the heterogeneity of transition exposure across the EU. This provides the necessary background for assessing whether, and to what extent, differences in labour force composition contribute to cross-country disparities in distributional outcomes and shape the capacity of member states to implement a fair and inclusive twin transition.

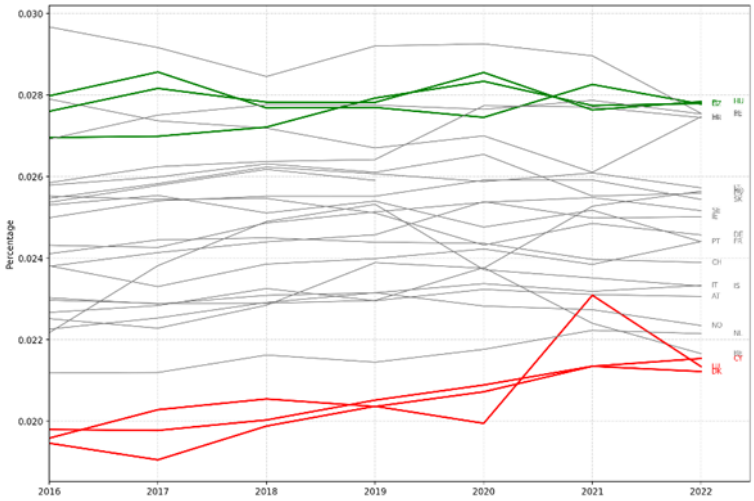


a) Green employment share

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.



b) Digital employment share



c) Twin employment share

Figure 5. Green, digital and twin labour dynamics (2016-2022)

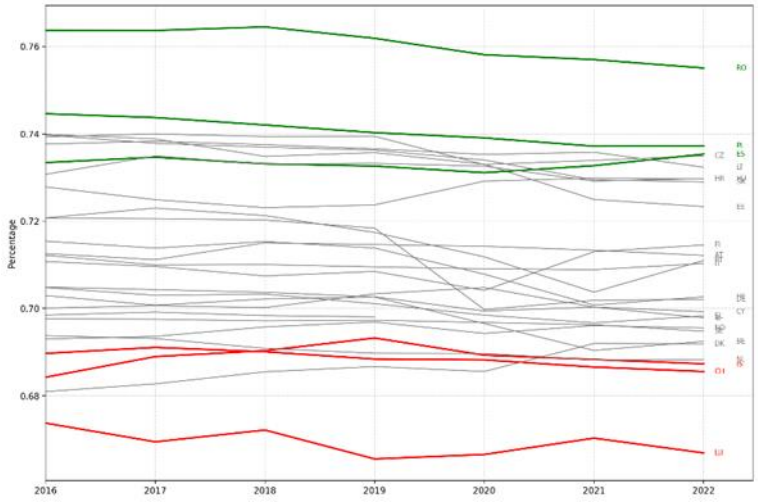
Source: own elaboration using data from EU-LFS and ESCO

Figure 5 depicts the evolution of the share of employment in digital, green, and twin occupations across European countries between 2016 and 2022. Together, they provide a comparative picture of how labour markets are positioned with respect to the twin transition, highlighting both persistent national asymmetries and dynamic trajectories over time. As for the green employment share (a), patterns are not uniformly upward and in some cases declining. Romania starts as the clear leader in 2016, with more than 6% of employment in green jobs, but experiences a continuous drop, falling closer to 4% by 2022. Greece and Poland maintain relatively high shares, while the Netherlands and Luxembourg are persistently at the bottom, with green employment around 2%. This indicates that structural features of national economies-such as reliance on agriculture, energy, or environmental services-strongly shape green employment, and that in several countries green labour has not expanded in relative terms despite the policy emphasis of the European Green Deal.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

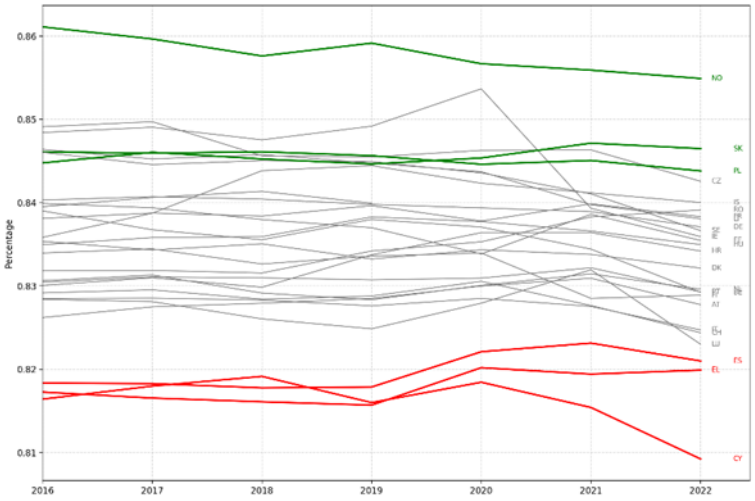
The share of digital occupations (b) is steadily increasing across most countries, underscoring the pervasive diffusion of digitalisation. The leaders are Sweden, Luxembourg, and Finland, all above 9% of total employment by 2022, with clear upward trajectories. By contrast, Romania, Greece, and Croatia remain at the lower end, with digital employment shares still below 7% despite some growth. The divergence suggests that Northern and Western European countries are more advanced in integrating digital competences into their labour markets, while Southern and Eastern states continue to lag, reflecting differences in technological adoption, educational systems, and investment in ICT sectors. Finally, the share of twin occupations (c) is overall low across the Union, hovering between 2% and 3% of total employment, but differences are nonetheless visible. Hungary and Czechia lead with slightly higher shares, close to 2.8-2.9%, whereas Luxembourg, Denmark, and Belgium remain at the bottom, with values around 2%. Importantly, trajectories are relatively flat compared to digital labour, suggesting that while digital and green occupations may be expanding individually, their overlap-the true indicator of twin transition exposure-remains limited and progresses only slowly. This highlights the difficulty of aligning digitalisation and greening within the same sectors and occupations.

Overall, these graphs together illustrate the asymmetric pace of the twin transition. Digital labour is expanding broadly but unequally, green labour shows mixed trends with leaders experiencing relative decline, and twin labour remains a niche category with only incremental growth. The implication is that countries are engaging with the digital and green transitions in uneven and often uncoordinated ways, which may exacerbate cross-country disparities. For policy, this underscores the challenge of fostering complementarities between digital and green transformations, rather than treating them as parallel but separate processes.

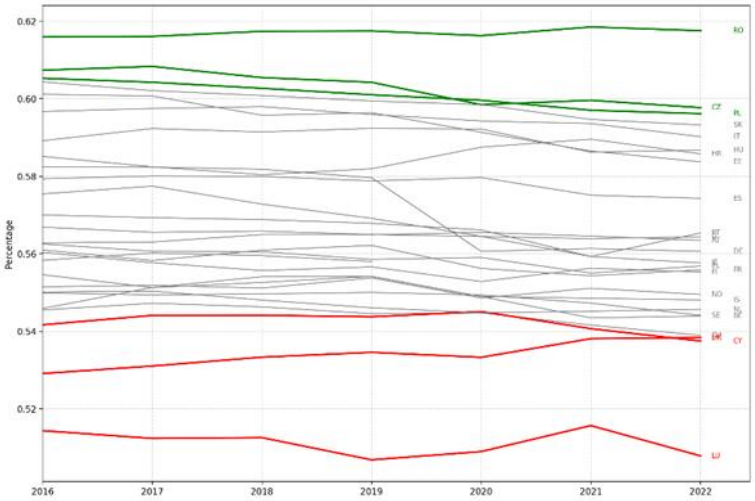


a) Employment share in green enabling occupations

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.



b) Employment share in digital enabling occupations



c) Employment share in twin enabling occupations

Figure 6. Green, digital and twin enabling occupation labour dynamics (2016-2022)

Source: own elaboration using data from EU-LFS and ESCO

Figure 6 shows the evolution of the share of enabling occupations between 2016 and 2022. Unlike core green or digital jobs, enabling occupations do not themselves require green or digital competences, but they involve skills that frequently co-occur with them, making them complementary and crucial for the diffusion of the twin transition. For enabling green occupations (a), we can observe that shares are lower than for digital (b) but still substantial, ranging between 68% and 76%. Romania stands out with the highest proportion of enabling green jobs, above 75% throughout the period, while Luxembourg, Switzerland, and the Netherlands are at the bottom, with values closer to 68%. A mild downward trend is visible in many countries, suggesting that the relative weight of enabling green skills in the labour market has declined slightly over time, despite growing policy attention to environmental objectives. The persistence of high shares in Eastern and Southern countries points to structural employment in sectors like agriculture, construction, or manufacturing where skills enabling

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

green tasks are more common. The share of enabling digital occupations (b) is very high across all EU countries (above 80%), reflecting the fact that many jobs contain skills that support or complement digitalisation even if they are not explicitly digital. Norway, Slovakia, and Poland consistently register the highest shares (above 85%), while Spain, Greece, and Cyprus remain at the bottom (around 81-82%). The general trend is one of stability, with only minor fluctuations over time. This indicates that enabling competences for digitalisation are widely embedded in European labour markets, though their relative prevalence differs systematically across countries. As for enabling twin occupations (c) the shares are lower still, ranging between 54% and 62%, but they remain stable across time. Romania, Czechia, and Poland lead with values above 60%, while Luxembourg and Cyprus sit at the bottom, closer to 54%. The distribution indicates that while many occupations support either digital or green competences individually, fewer combine enabling skills for both transitions simultaneously. Moreover, trajectories are remarkably flat, pointing to limited structural change in the overlap between green- and digital-related enabling skills during 2016-2022.

These graphs suggest that enabling occupations form a broad foundation for the twin transition, covering the majority of the labour force in every country. However, there are systematic national differences: Eastern and Central European countries tend to show higher shares of enabling jobs, while smaller service-oriented economies (e.g. Luxembourg, Cyprus, the Netherlands) display lower ones. Importantly, while digital enabling skills are nearly universal, green and twin enabling competences are less pervasive and in some cases declining. This implies that the capacity of countries to leverage complementarities between digital and green transformations will depend not only on the presence of specialised occupations but also on the strength of this enabling layer of the workforce.

Takeaway #5.
Heterogeneity across countries. Labour market exposure to the green, digital, and twin transitions is highly uneven across EU member states. Northern and Western economies tend to be leaders in digital occupations, while Eastern and Southern countries are more reliant on green or green-enabling jobs. This asymmetry reflects different industrial structures, skill endowments, and investment trajectories, and it implies that the costs and benefits of the transitions will not be evenly distributed.

Takeaway #6.
Uneven trajectories of change. Digital employment shares show steady and widespread growth, whereas green employment shares are more mixed, in some cases declining in relative terms despite strong policy implementation. Twin jobs - those requiring both green and digital competences - remain marginal and display only incremental increases. This suggests that the complementarities between digitalisation and decarbonisation are still weakly embedded in labour markets.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

Takeaway #7.
The role of enabling occupations. Enabling jobs, defined by the presence of co-occurring skills that support green or digital working activities, account for a large share of total employment across all countries. These occupations provide the backbone for diffusion, but their prevalence varies systematically. While digital enabling skills are almost universal, enabling green and twin competences are less widespread and in some cases declining, raising concerns about the absorptive capacity of some economies.

Takeaway #8.
Institutional resilience and vulnerability. The persistence of high or low shares in particular occupational categories points to structural rather than cyclical determinants. Countries with low digital penetration or shrinking green occupations may face increasing vulnerability as the twin transition accelerates, while those with broad enabling layers are better positioned to adapt and reallocate labour.

Takeaway #9.
Distributional implications. The uneven geography of labour market exposure means that the distributive effects of the twin transition will be mediated by national labour structures. Countries that combine relatively high inequality with weak exposure to digital or twin occupations may see risks of polarisation deepen, while more egalitarian states with robust enabling structures are better placed to turn transitions into inclusive opportunities.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

6. The connection between inequality and the labour market

The preceding analysis has shown that income inequality, as measured by the Gini index, exhibits strong persistence across European Union member states. Clear clusters emerge: countries such as Bulgaria, Lithuania, and Latvia display consistently high inequality, while Czechia, Slovenia, and Slovakia stand out for their comparatively egalitarian structures. Between these extremes lies a majority of countries characterised by moderate but relatively stable inequality levels. Importantly, these patterns have proved resilient over time, with the relative ranking of countries hardly altered by cyclical shocks such as the COVID-19 pandemic.

In parallel, the dynamics of the labour market are being transformed by the twin transition, encompassing both digitalisation and the shift toward a low-carbon economy. As documented in the previous sections, the degree of exposure to digital, green, and twin occupations varies widely across countries, reflecting divergent developmental trajectories and sectoral specialisations. Northern and Western European countries have been more successful in integrating digital competences, while Eastern and Southern member states often retain higher shares of green or enabling occupations. Yet, the overlap between digital and green skills-the hallmark of the twin transition-remains relatively modest, signalling that complementarities between these transformations are not evenly diffused.

Bringing these two strands together raises a crucial set of questions: to what extent do differences in occupational structures and exposure to the twin transition intersect with pre-existing patterns of inequality? Do countries with higher inequality face additional risks of polarisation as the twin transition progresses, or can enabling occupations provide a buffer by broadening access to complementary skills? Conversely, do more egalitarian countries possess institutional advantages that allow them to harness the opportunities of the twin transition more inclusively? These questions are central because labour markets are the primary channels through which structural transformations affect income distribution, either by creating new opportunities or by amplifying risks of exclusion.

The aim of this section is therefore to explore the linkages between inequality and labour market transformation in the EU. By jointly considering Gini dynamics and the distribution of green, digital, and twin occupations, we seek to identify whether countries with different inequality profiles are differently positioned to face the challenges of the twin transition. This perspective highlights not only the static coexistence of inequality and labour market structures but also the dynamic interplay through which structural change may reinforce or mitigate distributive tensions. In doing so, the analysis contributes to a broader understanding of how the twin transition interacts with national institutional frameworks, and how it may shape the prospects for a fair and inclusive transformation across Europe.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

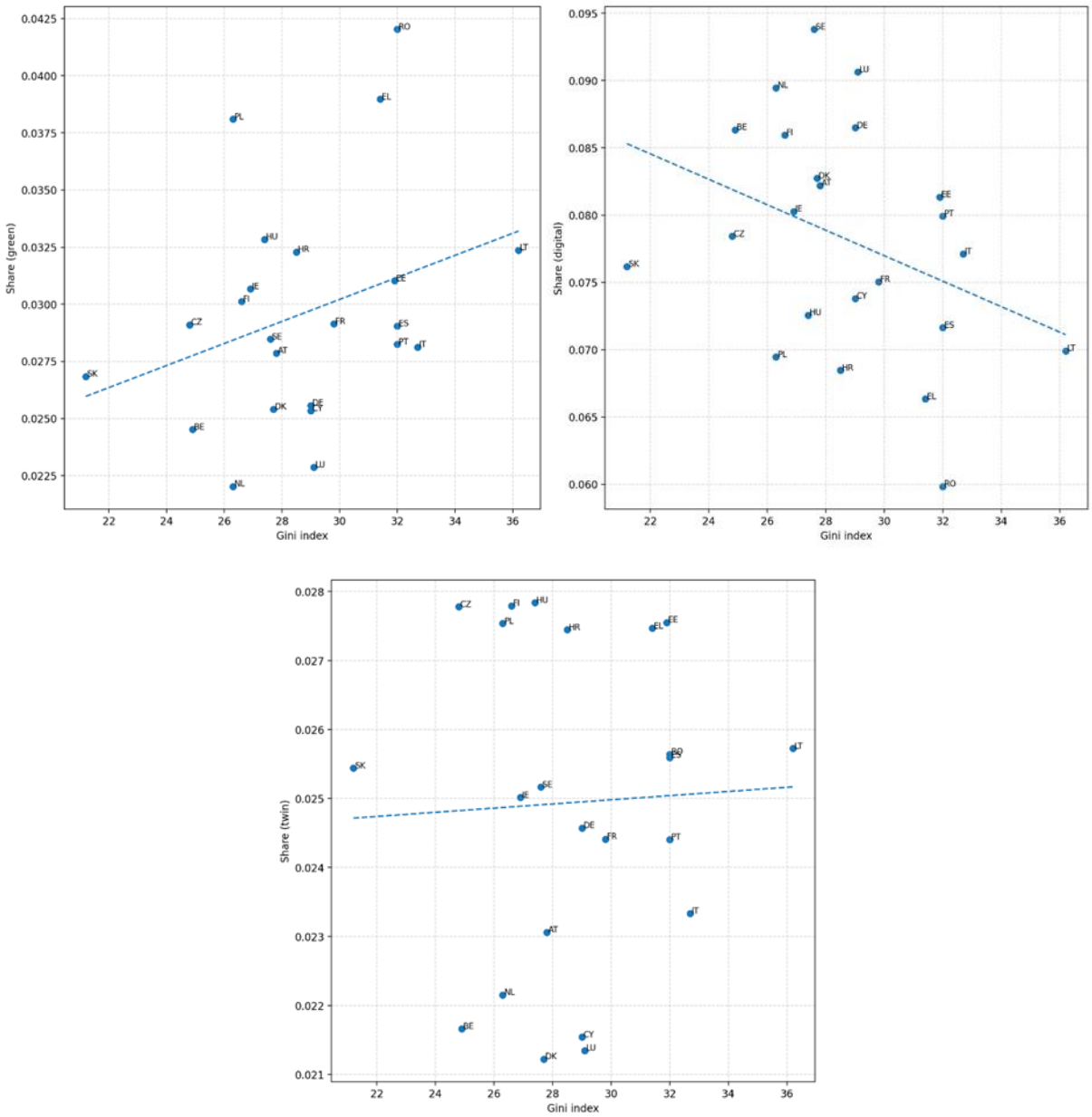


Figure 7. Connecting green, digital and twin employment with inequality

Source: own elaboration using data from EU-LFS, ESCO and Eurostat

Figure 7 presents the relationship between income inequality, measured by the Gini index, and the share of employment in green, digital, and twin occupations in 2022. Together, they offer an interesting perspective on whether labour market structures associated with the twin transition are systematically linked with distributional outcomes across EU countries.

The first graph focuses on green employment shares. Here, the regression line shows a positive association, suggesting that countries with higher levels of inequality also tend to have larger proportions of workers in green occupations. This result may appear counterintuitive given the normative expectations that green transitions should promote inclusiveness, yet it can be explained

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

by structural characteristics of more unequal economies. In countries such as Romania, Greece, and Lithuania, relatively high inequality coincides with a strong reliance on agriculture, construction, or energy-related sectors, which increases the prevalence of green jobs. In more egalitarian economies, by contrast, green employment appears to play a more modest relative role, pointing to a structural, sector-driven link between inequality and the greening of labour markets.

The second graph turns to digital occupations. Here the pattern is reversed: a negative relationship emerges between the Gini index and the share of digital jobs. Economies with lower inequality, such as Sweden, Finland, Luxembourg, and the Netherlands, register some of the highest digital employment shares, while more unequal countries, including Romania, Greece, and Italy, record some of the lowest. This result is consistent with the idea that digitalisation is more advanced in wealthier, skill-intensive economies, which tend to have stronger redistributive institutions and more compressed wage structures. In this case, digitalisation appears correlated not with higher inequality but rather with more egalitarian outcomes, suggesting that digital capacity is embedded in institutional environments that also promote equality.

The third graph, which examines twin occupations combining both green and digital competences, shows a much weaker pattern. The regression line is nearly flat, indicating only a slight positive association between inequality and twin employment shares, but with little statistical or substantive strength. Countries with very different levels of inequality, such as Lithuania, Romania, Czechia, and Finland, exhibit comparable levels of twin employment, while others with low or moderate inequality, including Belgium, Denmark, and Luxembourg, record relatively low shares. This dispersion suggests that the overlap between green and digital competences is not systematically associated with inequality levels. Instead, twin jobs appear to be shaped by specific industrial and policy trajectories rather than broad distributional regimes.

Taken together, the three graphs point to an important asymmetry. Green employment is more prevalent in unequal economies, reflecting sectoral structures rather than redistributive outcomes. Digital employment, by contrast, is concentrated in more egalitarian economies, where institutional and educational systems support both technological adoption and inclusive distribution. Twin jobs, still relatively marginal in most labour markets, show no clear link with inequality, underscoring the early and uneven stage of their diffusion. For economists and econometricians, this evidence suggests that the distributive implications of the twin transition cannot be generalised across all components: the relationship with inequality is context-dependent, shaped by the balance between green and digital trajectories and mediated by structural and institutional factors unique to each country.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

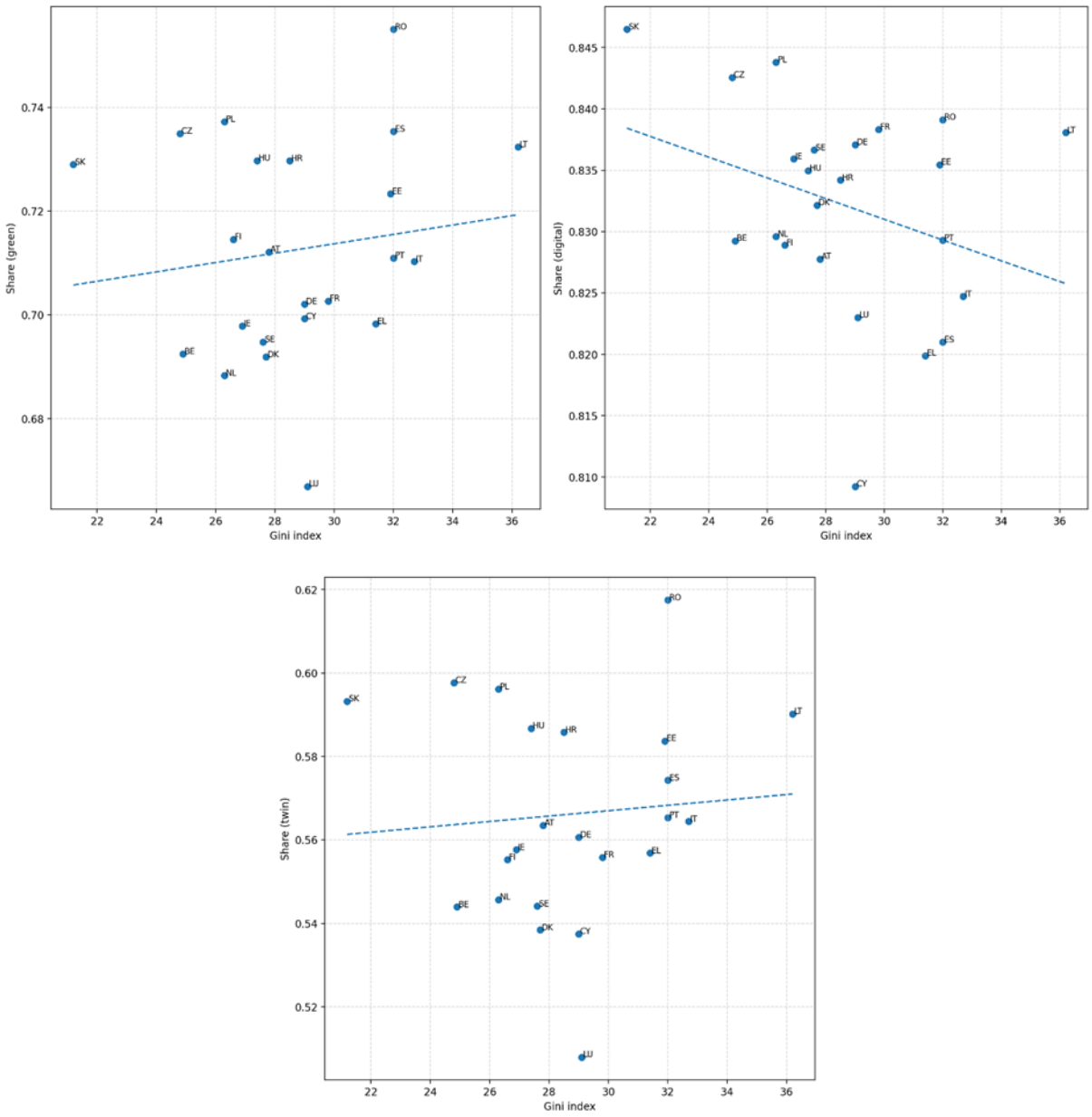


Figure 8. Connecting green, digital and twin employment in enabling occupations with inequality

Source: own elaboration using data from EU-LFS, ESCO and Eurostat

These three scatterplots examine the association between inequality, measured by the Gini index, and the share of enabling occupations in 2022. Unlike directly green or digital jobs, enabling occupations capture skills that co-occur with green or digital competences and therefore form the supporting layer that allows the twin transition to diffuse across the wider labour market.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

Starting with enabling digital occupations, the fitted regression line points to a modest negative association with the Gini index. Countries with lower inequality, such as Slovakia, Czechia, and Poland, record the highest shares of enabling digital jobs, while more unequal economies, including Italy, Spain, and Greece, tend to have lower shares. This pattern suggests that more egalitarian economies embed digital-supporting competences more broadly across their workforce, while more unequal countries may struggle to diffuse such enabling skills beyond specialised sectors.

The picture is somewhat different for enabling green occupations, where the regression line shows a slight positive slope. Here, higher inequality is weakly associated with a greater prevalence of enabling green jobs. Romania, Greece, and Lithuania-all relatively unequal economies-are positioned at the top of the distribution, while countries with more compressed income distributions, such as the Netherlands, Belgium, and Luxembourg, sit closer to the bottom. This result echoes earlier findings for direct green employment: more unequal countries may still rely heavily on sectors such as agriculture, construction, or energy, where enabling green competences are structurally embedded.

Finally, enabling twin occupations also show a mild positive relationship with inequality, but the correlation is weak. Romania, Lithuania, and Italy combine relatively high Gini indices with larger shares of enabling twin jobs, whereas Luxembourg and some northern European countries with lower inequality record the smallest shares. The overall dispersion of points, however, indicates that there is no strong systematic alignment between inequality levels and the prevalence of enabling twin competences, reflecting the fact that these skills remain at an early stage of integration in most labour markets.

Taken together, the three graphs suggest that enabling digital competences are more broadly diffused in egalitarian economies, reinforcing complementarities between equality and digital diffusion, while enabling green competences are more prominent in unequal economies, reflecting sectoral specialisation rather than redistributive outcomes. Enabling twin skills, meanwhile, appear weakly correlated with inequality, underscoring the incipient and uneven character of their development. For economists and econometricians, these results highlight that the interaction between inequality and enabling occupations is not homogeneous across dimensions of the twin transition but instead shaped by structural economic profiles and national labour market institutions.

When comparing enabling occupations with their direct green, digital, and twin counterparts, clear differences in their relationship to inequality emerge. In the case of digital labour, the negative association with inequality is visible in both direct and enabling jobs, but the mechanisms appear distinct. For direct digital employment, the pattern reflects the concentration of high-skill digital jobs in more egalitarian economies with advanced technological sectors. For enabling digital occupations, which are far more widespread across the workforce, the negative slope suggests that in more equal societies digital-supporting skills are diffused more broadly across occupational groups, whereas in more unequal economies these competences remain unevenly distributed. Thus, while both direct and enabling digital competences correlate with lower inequality, the former is about technological leadership, the latter about diffusion capacity.

Green labour exhibits the opposite tendency. For direct green jobs, more unequal economies such as Romania, Greece, and Lithuania record higher shares, a result linked to the structural importance of agriculture, construction, and energy-intensive industries. This pattern is mirrored by enabling green occupations, which also display a weak positive association with inequality. The difference lies in

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

scope: direct green jobs are more narrowly defined, while enabling green competences are more broadly distributed across sectors. Taken together, the findings suggest that green competences-whether direct or enabling-are not inherently equality-enhancing, but rather reflect sectoral structures that are more prevalent in unequal economies.

The case of twin occupations reveals perhaps the most important contrast. For direct twin jobs, the association with inequality was negligible, reflecting their still marginal role in most labour markets. By contrast, enabling twin occupations show a slightly stronger, though still weak, positive relationship with inequality. This suggests that while relatively few jobs directly combine green and digital competences, enabling skills that support such complementarities are somewhat more developed in more unequal economies. Here again, the explanation is structural: countries with high inequality often have a larger share of enabling competences linked to green-intensive sectors, while digital diffusion remains less advanced, producing enabling but not yet direct twin overlaps.

Overall, these contrasts highlight that direct and enabling occupations capture different facets of the labour market's adaptation to the twin transition. Direct jobs represent the technological frontier, where adoption and integration of digital and green competences is most explicit, while enabling occupations reflect the wider absorptive capacity of labour markets. From a distributional perspective, the enabling layer appears less strongly tied to institutional equality regimes and more closely to sectoral structures, whereas direct occupations are more clearly associated with national models of technological leadership and institutional inclusiveness.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

7. The sources of inequality at the regional level

In this section we investigate the intersection between labour market structures, distributional outcomes, and demographic characteristics by exploiting individual-level microdata aggregated at the regional (NUTS2) level. The analysis builds on weighted shares of workers across income deciles, where the weights reflect survey coefficients, and proceeds to measure systematic differences across groups of interest. By constructing relative distributions, the aim is to uncover whether specific worker groups - defined by gender, age, or by their exposure to green, digital, and twin occupations - are over- or under-represented in different segments of the income distribution. In addition, we also investigate the characteristics of jobs (e.g., duration of the contract, possibility to work from home, number of jobs, etc.) This approach provides a transparent framework to link structural change and inequality.

The rationale behind this empirical strategy is to identify potential sources of inequality in the labour market. By systematically comparing the income-decile distributions of men and women, younger and older workers, and those employed in occupations with higher or lower exposure to the green, digital, and twin transitions, the analysis highlights where asymmetries in labour market positioning emerge. These asymmetries can be interpreted as underlying mechanisms through which structural transformations may reinforce or mitigate inequality. In this sense, the descriptive evidence provided here does not merely document differences across groups, but it also serves as a diagnostic tool to uncover which combinations of demographic characteristics and occupational exposures are most likely to generate distributional tensions. This perspective is essential for informing subsequent econometric modelling, as well as for understanding the policy levers needed to ensure that the twin transition unfolds in an inclusive manner.

The empirical strategy is organised in several steps. First, the analysis examines gender differences by comparing the decile shares of male and female workers within each region. The focus is on the difference between women's and men's shares (female − male) across income deciles, thereby identifying whether women are disproportionately concentrated in the lower or upper segments of the income distribution.

Second, the analysis extends to age-related differences. Individuals are grouped into three categories: under 30, between 40 and 60, and above 60, with those aged 30–39 excluded by design. Pairwise differences in decile shares are then computed (<30 vs. 40–60, <30 vs. >60, and 40–60 vs. >60), allowing us to identify whether younger, middle-aged, or older workers are systematically more represented in certain parts of the distribution.

Third, we investigate the role of job characteristics beyond wages, which are often considered important non-wage dimensions of inequality. These include the number of jobs held by an individual, the possibility to work from home, and the duration of the contract (permanent versus temporary). For each of these dimensions, workers are split into groups, and differences in decile shares are calculated, showing how these job characteristics intersect with inequality across the income distribution.

Fourth, the framework incorporates occupational exposure to the twin transition. Workers are divided into high- and low-exposure groups depending on whether their average exposure to green, digital, or twin occupations is above or below the national mean. For each case (green, digital, twin), we compute the distribution of workers across income deciles and plot the differences between high- and low-

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

exposure groups (high − low). This provides a descriptive assessment of whether workers in occupations more exposed to transformative technologies are systematically concentrated in higher or lower income deciles.

Fifth, the same high–low grouping is used to assess whether these transformations interact with gender and age inequalities. For each exposure dimension (green, digital, twin), we compute differences in decile shares between men and women and between age groups separately within high- and low-exposure groups. This step explicitly examines whether the gender and age gaps widen or narrow in contexts where exposure to the twin transition is more intense.

Through this sequence of steps, the analysis provides a coherent empirical mapping of distributional asymmetries in European labour markets. By systematically comparing weighted decile shares across gender, age, job characteristics, and exposure to transformative occupations, the approach allows us to connect inequality measures to structural features of the workforce. This descriptive framework lays the foundation for subsequent econometric investigation of whether, and to what extent, the green and digital transitions amplify or mitigate existing labour market inequalities.

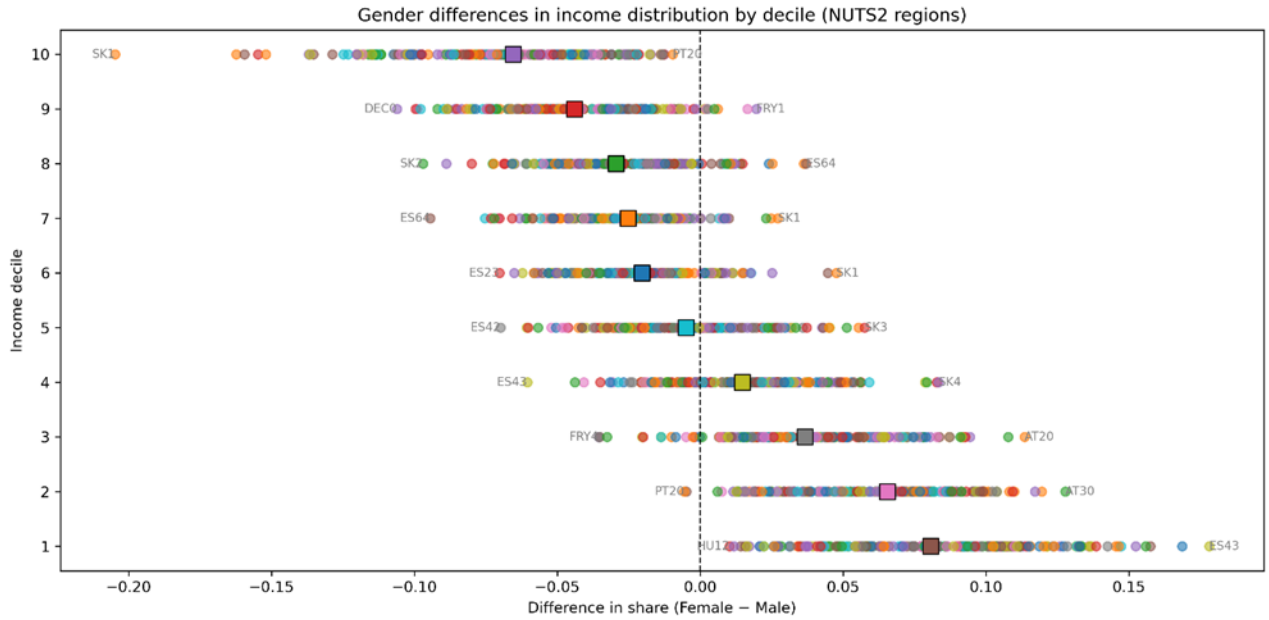


Figure 9. Male vs female percentage differences in income distribution by decile (regions)

Figure 9 illustrates the extent to which the distribution of men and women across income deciles differs within European regions. The horizontal axis measures the difference in share between females and males, with values to the right of the vertical line indicating an over-representation of women and values to the left indicating an over-representation of men. The vertical axis represents the income deciles, running from the lowest (1) to the highest (10). Each point corresponds to a NUTS2 region, while the larger squares mark the median region within each decile.

The overall pattern reveals that gender imbalances vary significantly across the income distribution. In the lower deciles, particularly the first and second, women tend to be over-represented, as shown by the concentration of positive differences. This suggests that women are more prevalent in the bottom segments of the income distribution, pointing to persistent gendered occupational and wage

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

structures that push women towards lower-income positions. In contrast, in the upper deciles, particularly the ninth and tenth, the differences are smaller and often in favour of men, indicating that high-income deciles are still disproportionately male-dominated. The middle deciles show more balanced outcomes, with gender differences clustering closer to zero, though some regions still display sizeable deviations in both directions.

Taken together, the figure underscores a form of "gender polarisation" in income distribution. Women are more concentrated in the lowest deciles, men are relatively more present in the highest deciles, and the middle of the distribution remains comparatively balanced. This pattern aligns with broader evidence of gender inequality in European labour markets, where women face structural barriers to upward mobility and higher-paying occupations, despite comparable or higher participation rates in lower-paying sectors.

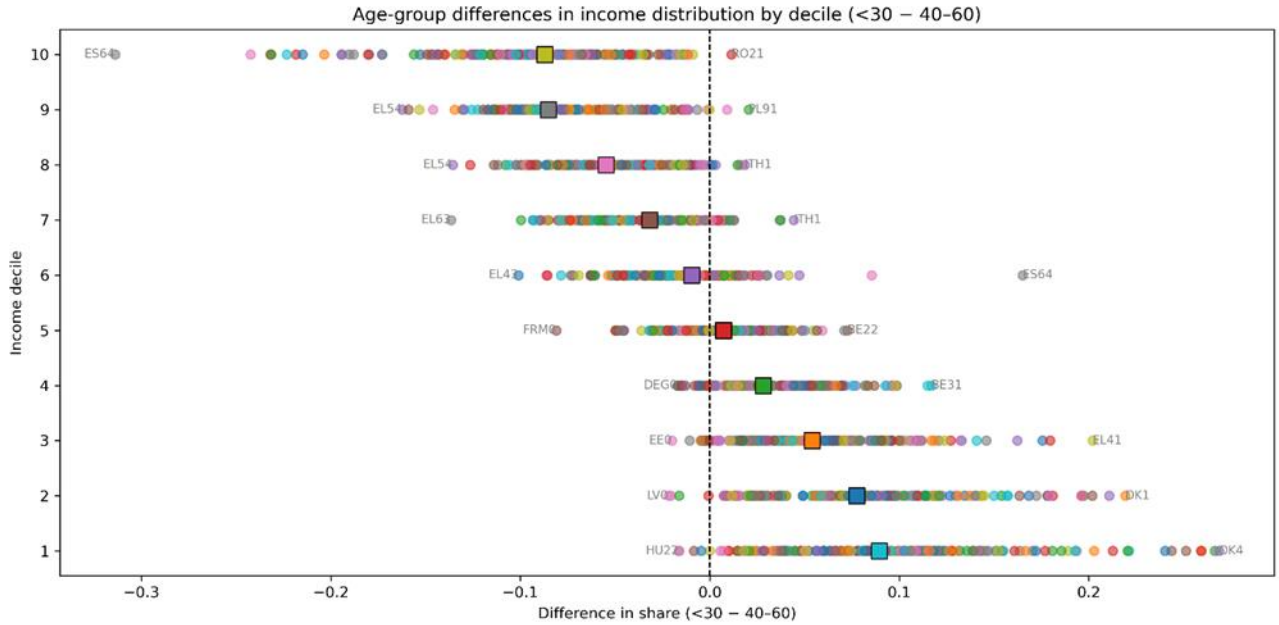


Figure 10. Young vs older worker differences in income distribution by decile (regions)

Figure 10 compares the income distribution of younger workers (under 30) and middle-aged workers (40–60) across income deciles. The x-axis shows the difference in shares (<30 − 40–60), meaning positive values indicate a higher relative concentration of young workers in a given decile, while negative values reflect a stronger presence of middle-aged workers.

The distribution reveals a clear age-related segmentation. Young workers are relatively more represented in the bottom deciles, particularly in the first and second, highlighting their greater likelihood of entering the labour market in lower-paid or entry-level positions. Middle-aged workers, on the other hand, dominate the upper-middle and top deciles, consistent with their higher accumulated experience, stronger bargaining power, and career progression. Around the middle of the distribution (deciles 4–6), the differences approach zero, indicating more balance between the two groups.

The concentration of younger workers at the bottom of the distribution also reflects structural characteristics of early labour market participation, such as the prevalence of temporary contracts,

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

internships, or jobs with limited career progression opportunities. Conversely, middle-aged workers' concentration in the higher deciles signals the role of seniority, skill accumulation, and occupational stability in shaping access to higher incomes.

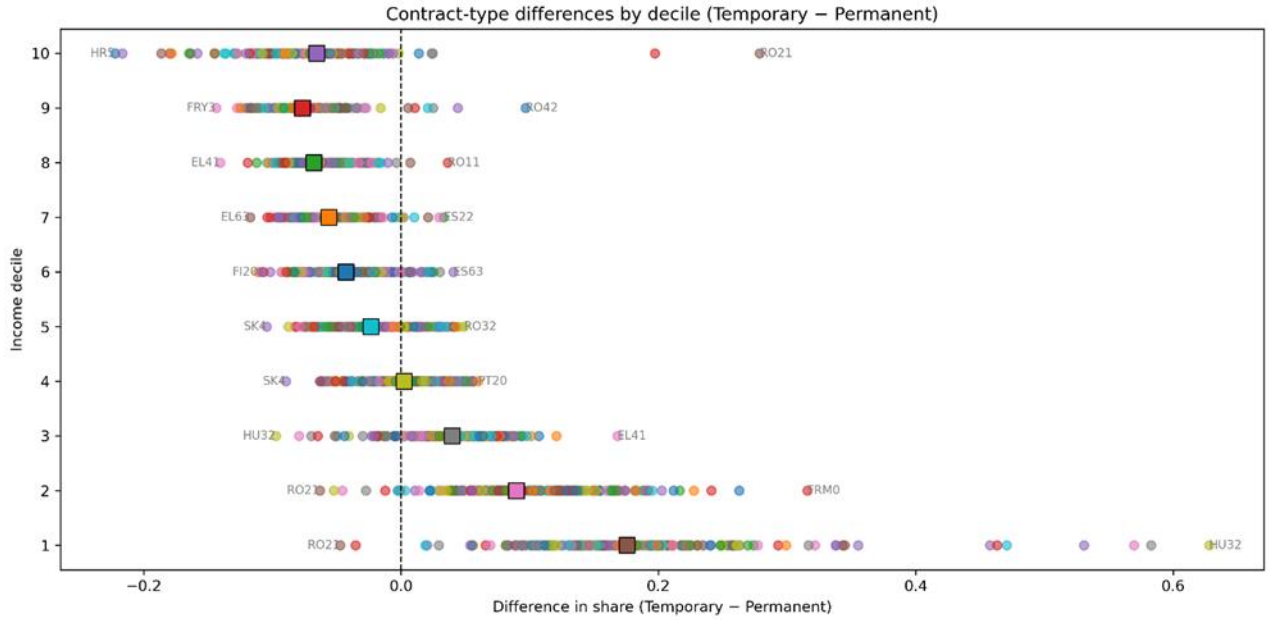


Figure 11. Temporary vs permanent worker differences in income distribution by decile (regions)

Figure 11 shows the income distribution differences between workers on temporary and permanent contracts across income deciles. The x-axis represents the difference in shares (Temporary − Permanent). In this case, positive values indicate that temporary workers are relatively more concentrated in a given decile, while negative values imply that permanent workers are more prevalent.

The results reveal a sort of segmentation. Temporary workers are strongly overrepresented in the bottom deciles, especially the first and second, which highlights the precarious nature of such contracts and their association with low-income positions. That is, these jobs are fixed term and characterised by a low salary. By contrast, permanent workers dominate the upper deciles, where the presence of temporary workers is minimal. This pattern reflects the cumulative advantages of stable employment, such as access to higher wages, seniority premiums, and greater bargaining power, which are largely absent in temporary positions.

Interestingly, the middle of the distribution (deciles 4–6) shows more mixed outcomes, suggesting that some temporary workers may access intermediate income positions, but they remain systematically underrepresented in the higher deciles. The results underline the dualism of European labour markets, where contract type plays a decisive role in shaping income inequality. Workers with temporary contracts face structural disadvantages that not only limit upward mobility but also lock them disproportionately into the lower tiers of the income distribution.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

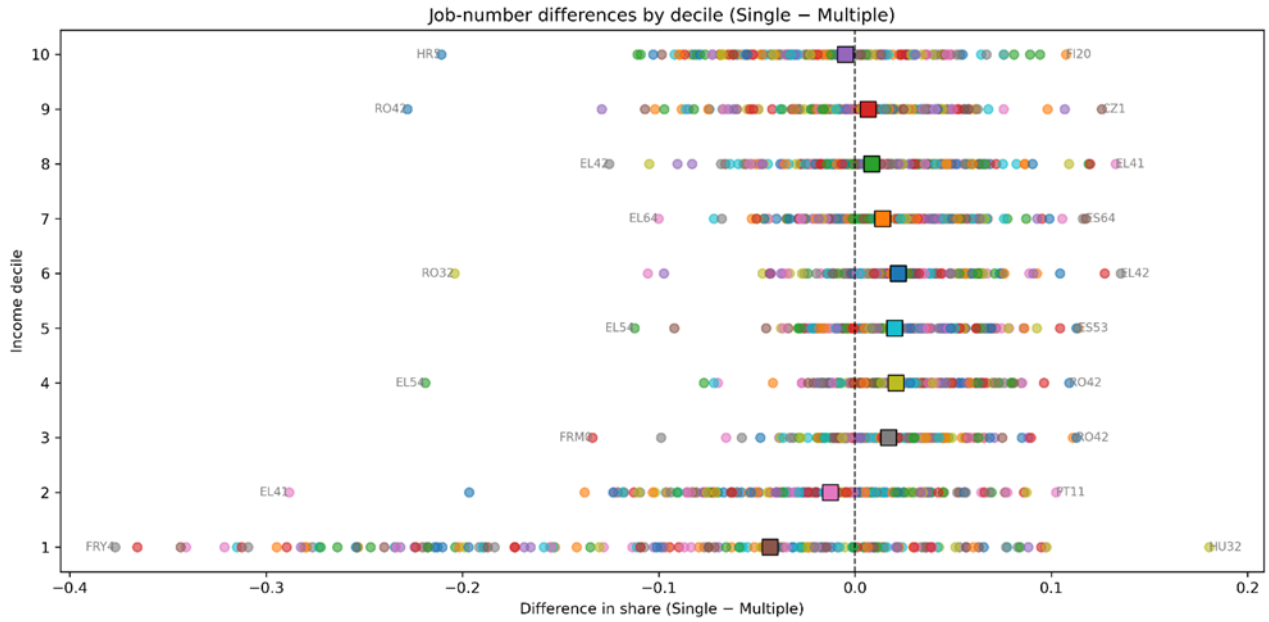


Figure 12. Single vs multiple job-holder differences in income distribution by decile (regions)

Figure 12 shows the income distribution differences between workers holding a single job and those with multiple jobs across income deciles. The x-axis reports the difference in shares (Single − Multiple), so negative values indicate that multiple job holders are overrepresented in a given decile, while positive values mean that single job holders are more prevalent.

The results highlight that differences in the share of workers within regions in the same decile are very limited for the vast majority of the EU regions. Multiple job holders are slightly more present in the lowest deciles, suggesting that taking on more than one job often reflects a strategy to compensate for low primary earnings.

Overall, however, the figure shows that the bulk of the differences in the shares remains closer to zero, meaning that the differences between single- and multiple-job holders are less pronounced compared to other labour market dimensions, such as contract type.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

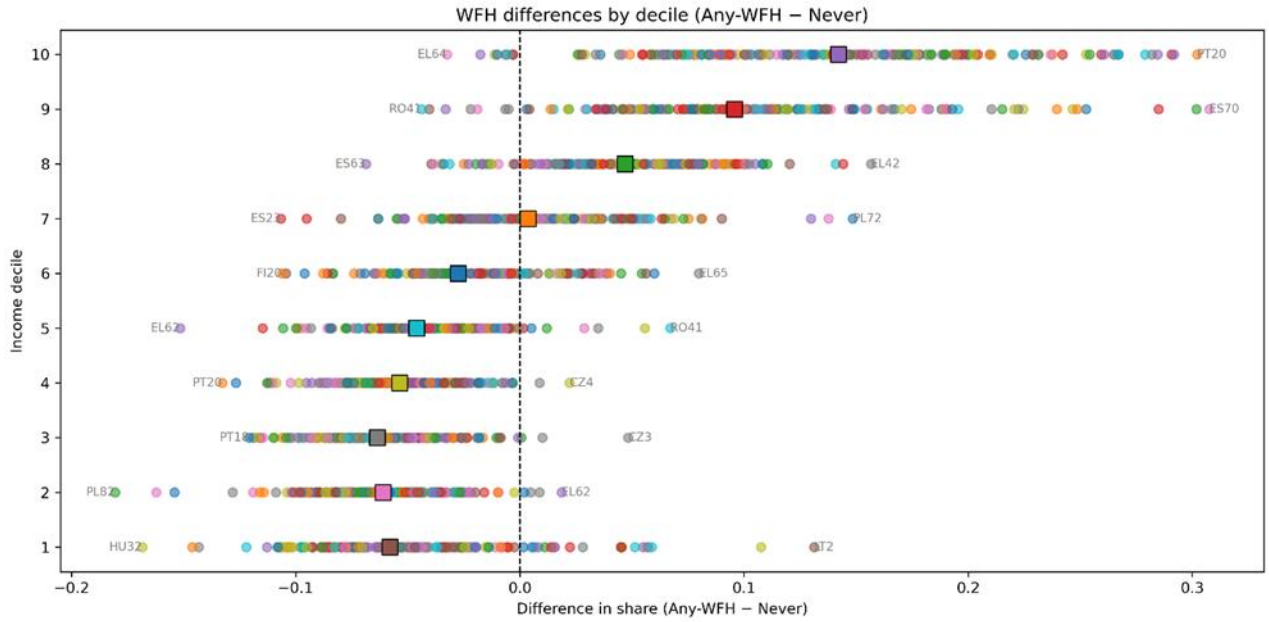


Figure 13. Work-from-home differences in income distribution by decile (Any-WFH vs Never, regions)

Figure 13 reports the differences in income distribution between workers who report any possibility of working from home (WFH) and those who never do, across income deciles. The x-axis measures the difference in shares (Any-WFH − Never), meaning positive values indicate a higher presence of workers with WFH possibilities, while negative values indicate an overrepresentation of those without WFH access.

The results clearly indicate that the possibility to work from home is strongly skewed towards the upper deciles of the income distribution. Workers with any form of WFH access are overrepresented in the top income brackets, particularly from the 7th decile onwards, with the effect especially pronounced in the 9th and 10th deciles. This pattern reflects the concentration of WFH opportunities in high-skilled, high-paying occupations such as managerial, professional, and technical jobs, which can more easily be adapted to remote modalities.

By contrast, workers without WFH access are relatively more present in the lower deciles. These positions typically correspond to occupations requiring physical presence, often in routine or manual jobs, such as retail, hospitality, manufacturing, and care work. This creates a clear inequality dimension: WFH not only reflects job quality and security but also reinforces the income gradient, privileging those already higher in the distribution.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

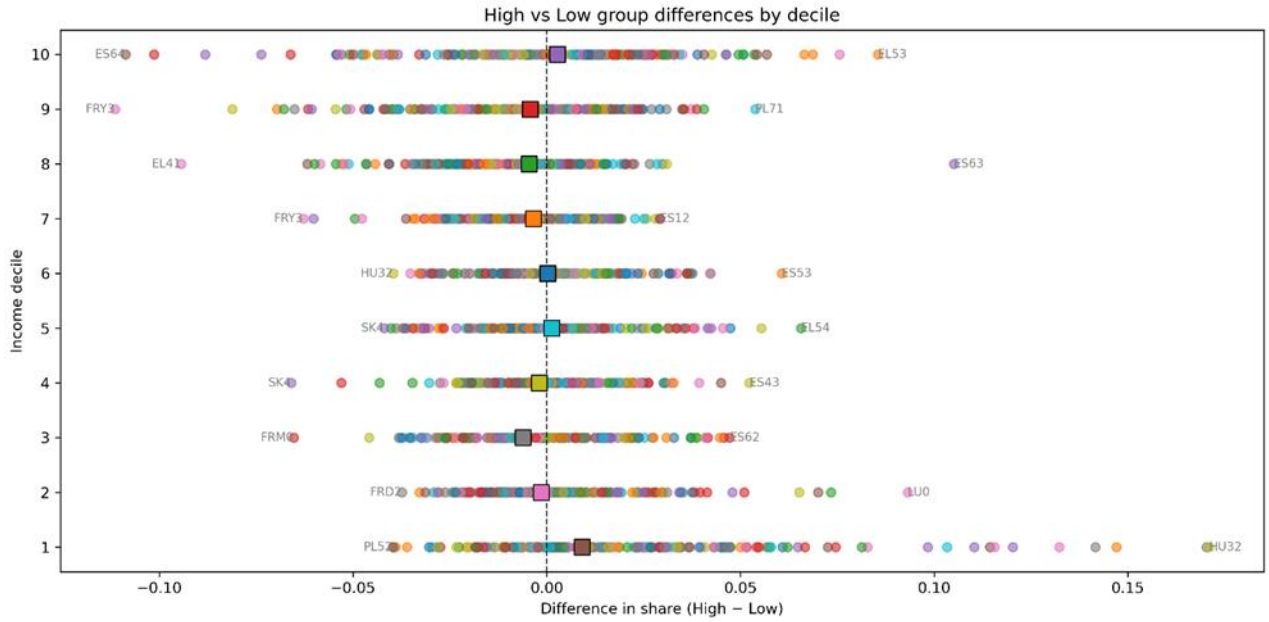


Figure 14. Differences in income distribution between high- and low-green exposure occupations by decile (regions)

Figure 14 illustrates the differences in income distribution between workers in high- and low-exposure green occupations, plotted across income deciles. The x-axis reports the difference in shares (High − Low), meaning positive values reflect a stronger presence of high-exposure workers in a given decile, while negative values indicate an overrepresentation of low-exposure workers.

The results suggest that the distribution of green exposure across income deciles is relatively balanced, with differences clustering around zero for most of the distribution. There is no strong or systematic bias pushing high-exposure workers either towards the bottom or the top of the income distribution.

This pattern reflects the heterogeneous nature of green occupations. On the one hand, green exposure may be associated with high-skilled, higher-paid jobs in engineering, R&D, or environmental technologies, which place workers in upper deciles. On the other hand, many green-related roles also include medium- and low-skilled occupations, such as waste management, construction, or basic maintenance, which are concentrated in the middle or lower segments of the distribution. The coexistence of these dynamics helps explain why no uniform gradient emerges across the income scale.

In sum, the figure highlights that green exposure does not follow a straightforward inequality pattern but rather reflects the dual character of the green transition, spanning both highly skilled and manual-intensive segments of the labour market. This underlines the importance of disaggregating green jobs further by task and skill intensity when analysing their implications for inequality.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

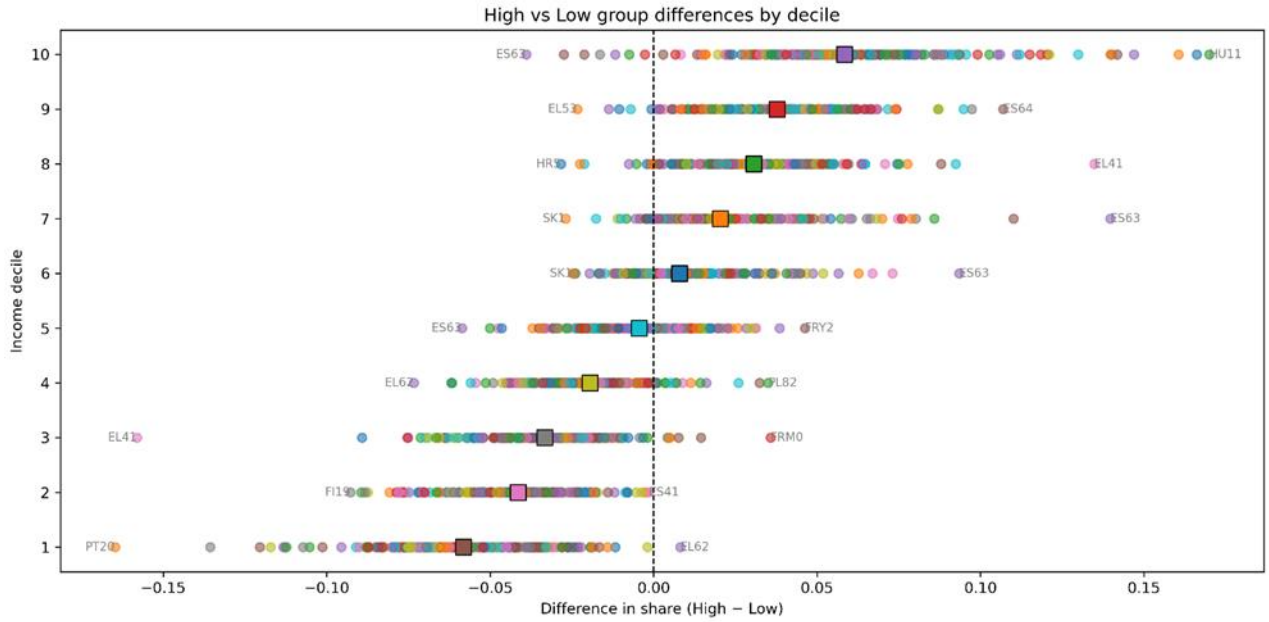


Figure 15. Differences in income distribution between high- and low-digital exposure occupations by decile (regions)

Figure 15 presents the same pattern with respect to high- and low-exposure digital occupations, measured across deciles at the regional level.

The results suggest a clearer polarisation pattern compared to green exposure. High-exposure digital workers are relatively more concentrated in the upper deciles of the income distribution, particularly from the 7th decile upwards, while low-exposure digital workers dominate the lower to middle deciles. This indicates that digital-intensive occupations tend to be associated with higher earnings, consistent with the hypothesis of skill-biased technological change, whereby digitalisation disproportionately benefits high-skilled workers.

Overall, the figure indicates that digital exposure may be more systematically linked to income inequality than green exposure. High-exposure digital occupations pull workers towards the higher end of the distribution, reinforcing stratification along technological lines. This stands in contrast to the dual character of green jobs, which span both high- and low-income activities.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

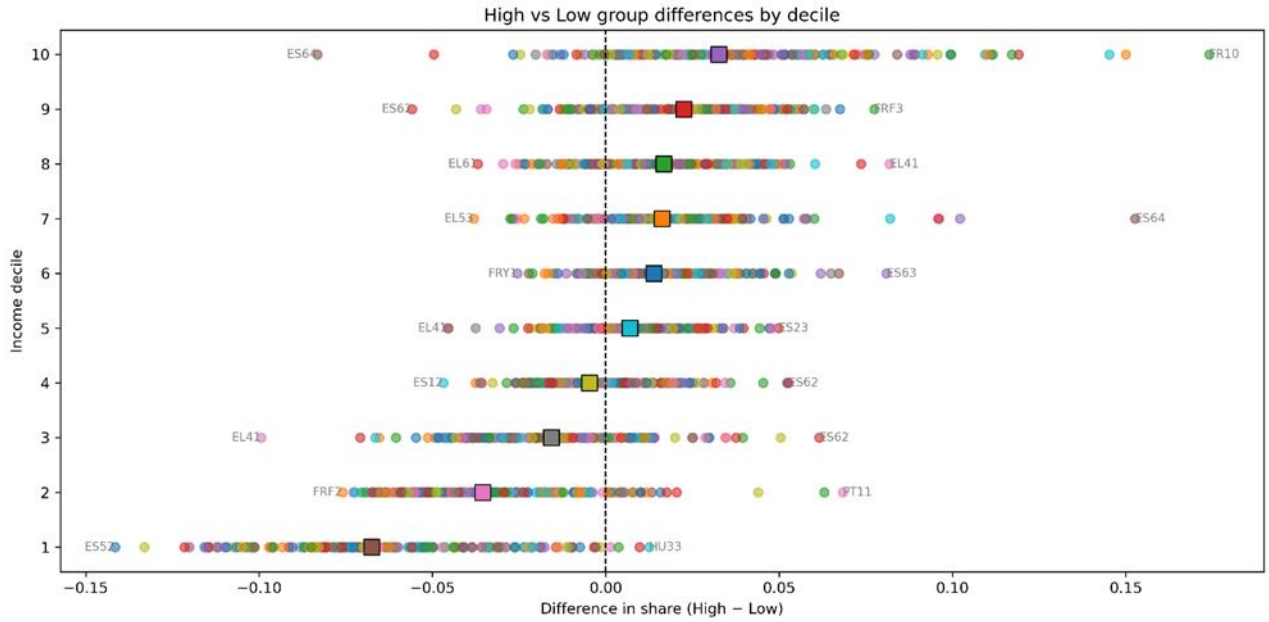


Figure 16. Differences in income distribution between high- and low-twin exposure occupations by decile (regions)

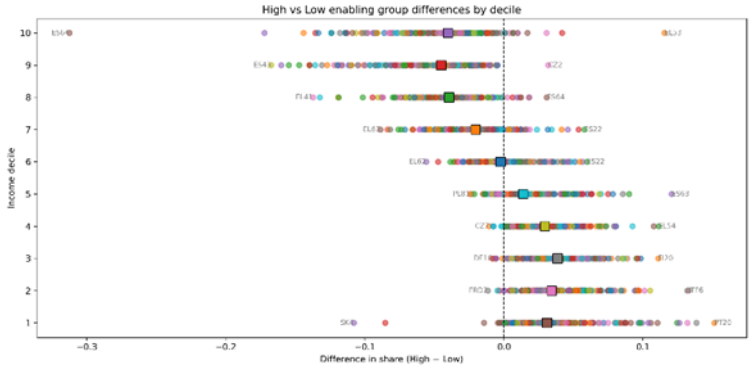
Figure 16 replicates the same exercise for the twin occupations. The x-axis reports the difference in shares (High − Low), where positive values indicate that high-exposure twin workers are overrepresented in that decile, and negative values indicate the opposite.

Compared to the green and digital cases, the twin exposure distribution is more uneven and polarised. High-exposure twin workers are disproportionately present in both the highest deciles, with a less marked concentration compared to digital occupations.

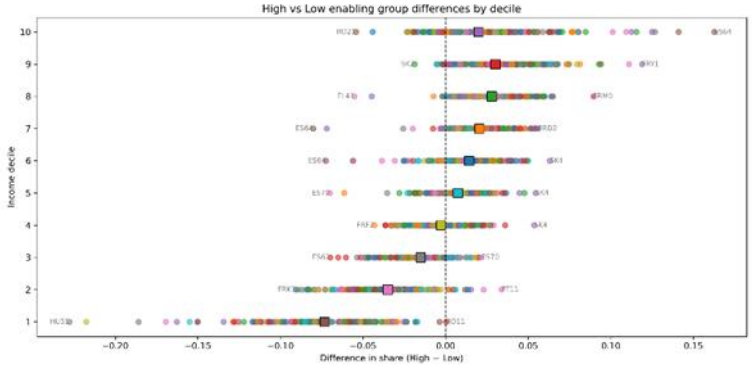
By contrast, low-exposure twin workers are more concentrated in the middle of the income distribution, particularly between the 3rd and 6th deciles. This indicates that low-exposure occupations tend to provide more "average" positions in the income hierarchy, while high-exposure occupations exhibit a much stronger polarisation dynamic.

Taken together, the figure points to the complex inequality implications of the twin transition. Unlike digital exposure alone, which is strongly upward biased, or green exposure, which is more balanced, twin exposure generates a U-shaped distribution: some workers benefit from very high rewards, while others face lower and potentially unstable earnings. This confirms the need to interpret twin transition effects as multidimensional and context-dependent.

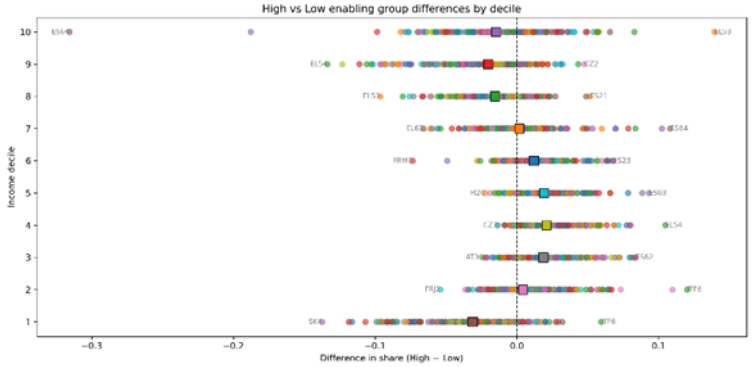
This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.



a) Green enabling occupations



b) Digital enabling occupations



c) Twin enabling occupations

Figure 17. Differences in income distribution between high- and low-enabling occupations by decile (regions)

The analysis of enabling exposures-covering enabling green, digital, and twin occupations-sheds light on how complementary skill sets associated with the twin transition are distributed across the income distribution. Unlike direct exposure, enabling roles capture occupations that support or facilitate transformative technologies without being directly characterized by them, offering a broader perspective on the structural changes in labour markets.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

The distribution of enabling green occupations across income deciles reveals relatively contained differences between high- and low-exposure groups. However, some nuances emerge. In the lower deciles, the differences tend to be slightly positive, indicating that workers in enabling green occupations are more represented in the bottom of the distribution. Conversely, modest positive differentials are visible in the middle and upper deciles, especially from decile 6 onwards, pointing to a lower concentration of enabling green roles in better-paid segments of the labour market.

The distribution of enabling digital occupations shows somewhat stronger asymmetries compared to enabling green roles. Differences between high- and low-exposure groups are closer to zero in the lower deciles (except for the lowest decile) but become increasingly positive in the middle and upper part of the distribution. This indicates that workers in enabling digital occupations-those that facilitate the diffusion of digital competences without directly applying digital tasks-are relatively more concentrated in higher-income categories. The positive gaps are particularly noticeable from deciles 6 to 10, where enabling digital roles appear overrepresented.

The distribution of enabling twin occupations presents a more polarised pattern compared to enabling green and digital roles. Differences between high- and low-exposure groups remain clustered around zero in middle deciles, indicating relatively balanced shares. However, in the highest and lowest deciles a slight negative skew is observed, suggesting that enabling twin occupations are somewhat more concentrated among middle than in upper or lower-income deciles.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

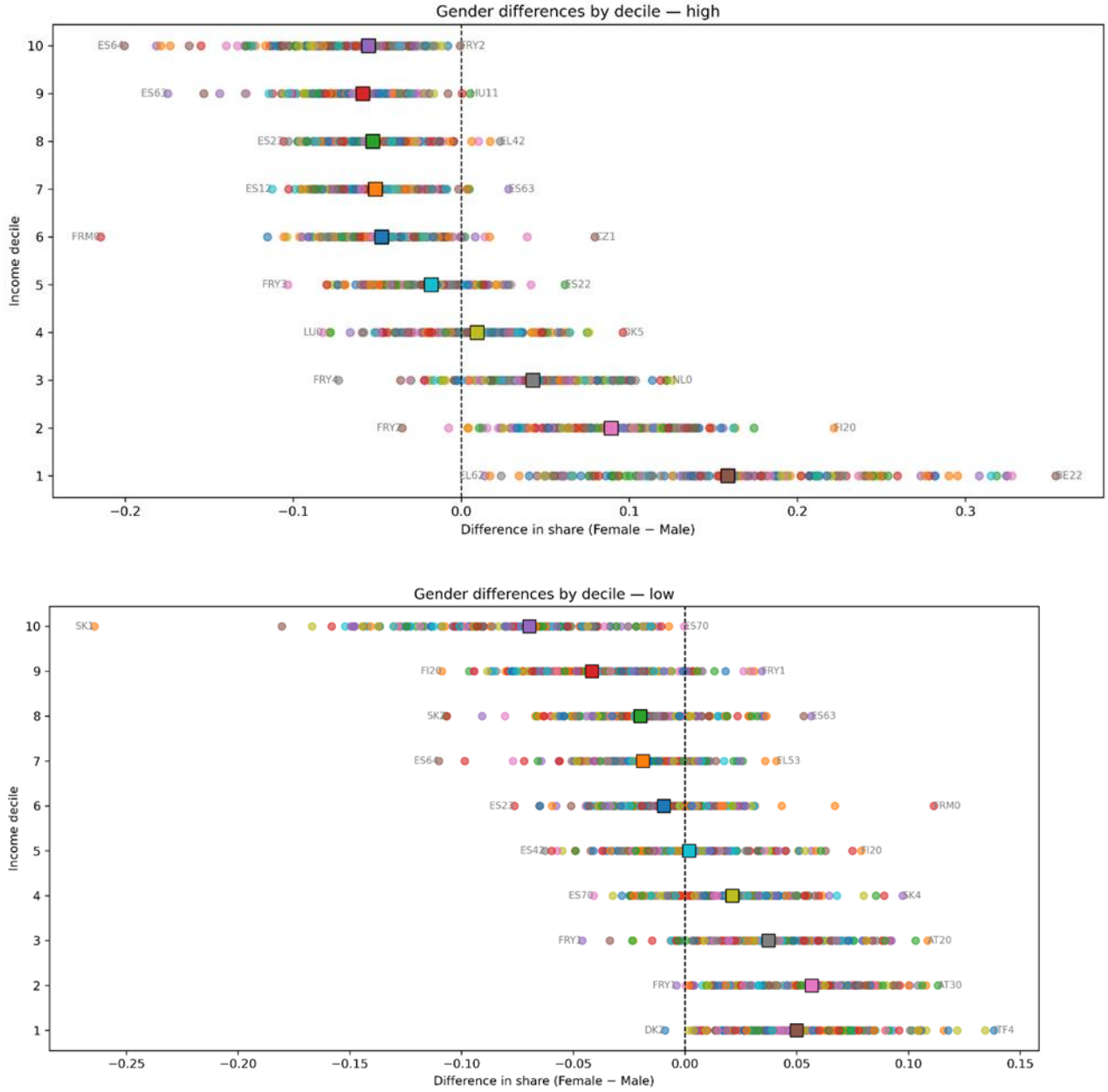


Figure 18. Gender differences in income distribution by decile for high- and low-exposure green occupations (Female – Male share)

Figure 18 illustrates gender differences across the income distribution when distinguishing between workers with high and low exposure to green occupations.

In the case of high exposure, the overall pattern suggests that women are relatively more represented in the lower income deciles, with positive gender gaps in decile 1, while men dominate in several of the middle to upper deciles, where the difference often shifts towards negative values. This asymmetry signals that even in high-green exposure jobs, women tend to be concentrated in the lower part of the wage distribution, whereas men capture a larger share in the upper tiers.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

Conversely, for low exposure occupations the picture is less balanced. Differences are more pronounced. Some regions show small female advantages in the bottom and middle parts of the distribution, and some male advantages in the upper deciles.

Taken together, the evidence points to the presence of structural gender inequalities associated with the greening of jobs. Women are not absent from green occupations, but their relative concentration in the lower income deciles indicates that the transition may reinforce existing gender hierarchies unless specific policies are designed to support women's access to better-paid green opportunities.

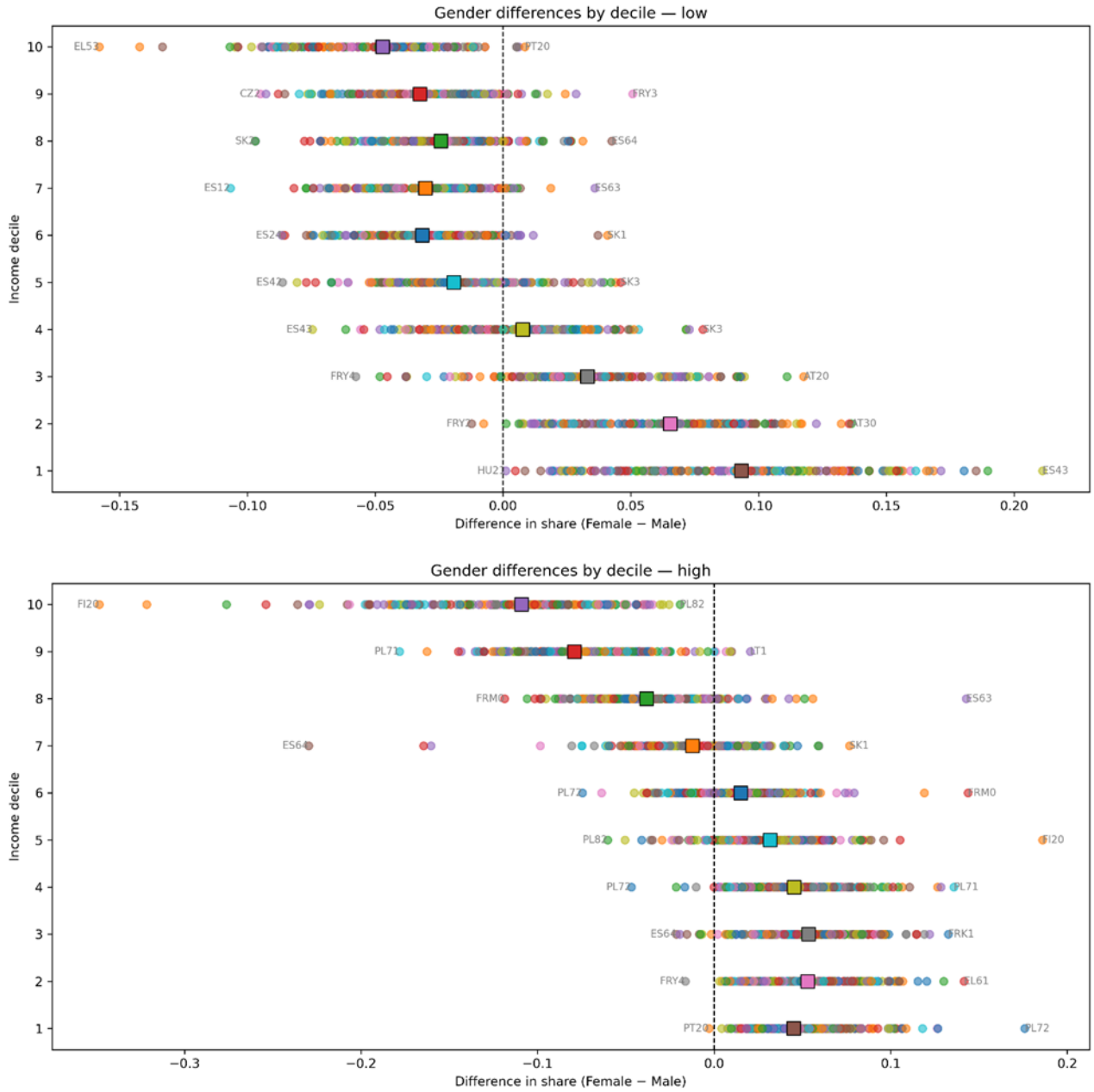


Figure 19. Gender differences in income distribution by decile for high- and low-exposure digital occupations (Female – Male share)

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

Figure 19 combines gender differences with digital exposure and shows a pattern that is somewhat different from the one observed for green exposure.

For high digital exposure, the distribution of gender differences tends to be more polarized. Women appear to be relatively more concentrated in the lower income deciles, while men dominate more clearly in the higher income deciles.

In contrast, for low digital exposure occupations the distribution of gender differences is flatter, with values clustering closer to zero across most income deciles. There are both positive and negative gaps depending on the region and decile, but the overall magnitude of disparities is smaller than in the high-exposure case.

This suggests that digitalisation does not automatically create equal opportunities but may reinforce existing disparities, particularly in terms of access to higher-paying positions. The findings resonate with broader evidence on the underrepresentation of women in advanced digital roles and highlight the importance of policies that promote equal participation and career progression in digital-intensive sectors.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

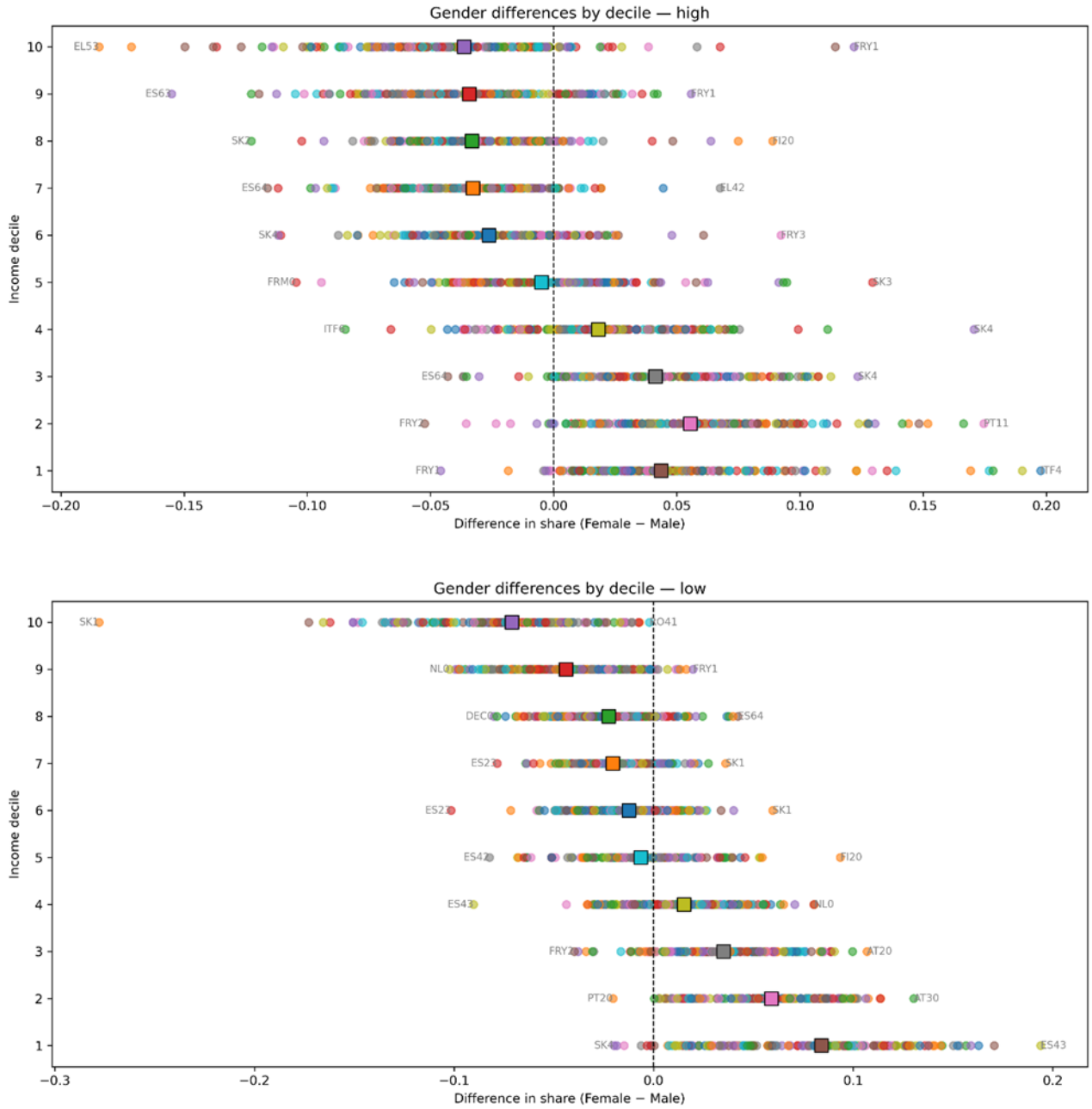


Figure 20. Gender differences in income distribution by decile for high- and low-exposure twin occupations (Female – Male share)

Figure 20 on twin exposure (green and digital combined) provides a more integrated view of gender inequalities across the income distribution.

In the low twin-exposure group, the differences between women and men are slightly more evident than in the high-exposure group. Women are relatively better represented in the lowest income deciles, while men are consistently more present in the upper deciles. The distribution shows both positive and negative deviations, but the pattern highlights how women, although engaged in twin-transition occupations, remain underrepresented at the top of the wage distribution. This suggests

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

that barriers found separately in green and digital jobs cumulate when the two dimensions are combined, reinforcing the structural imbalance.

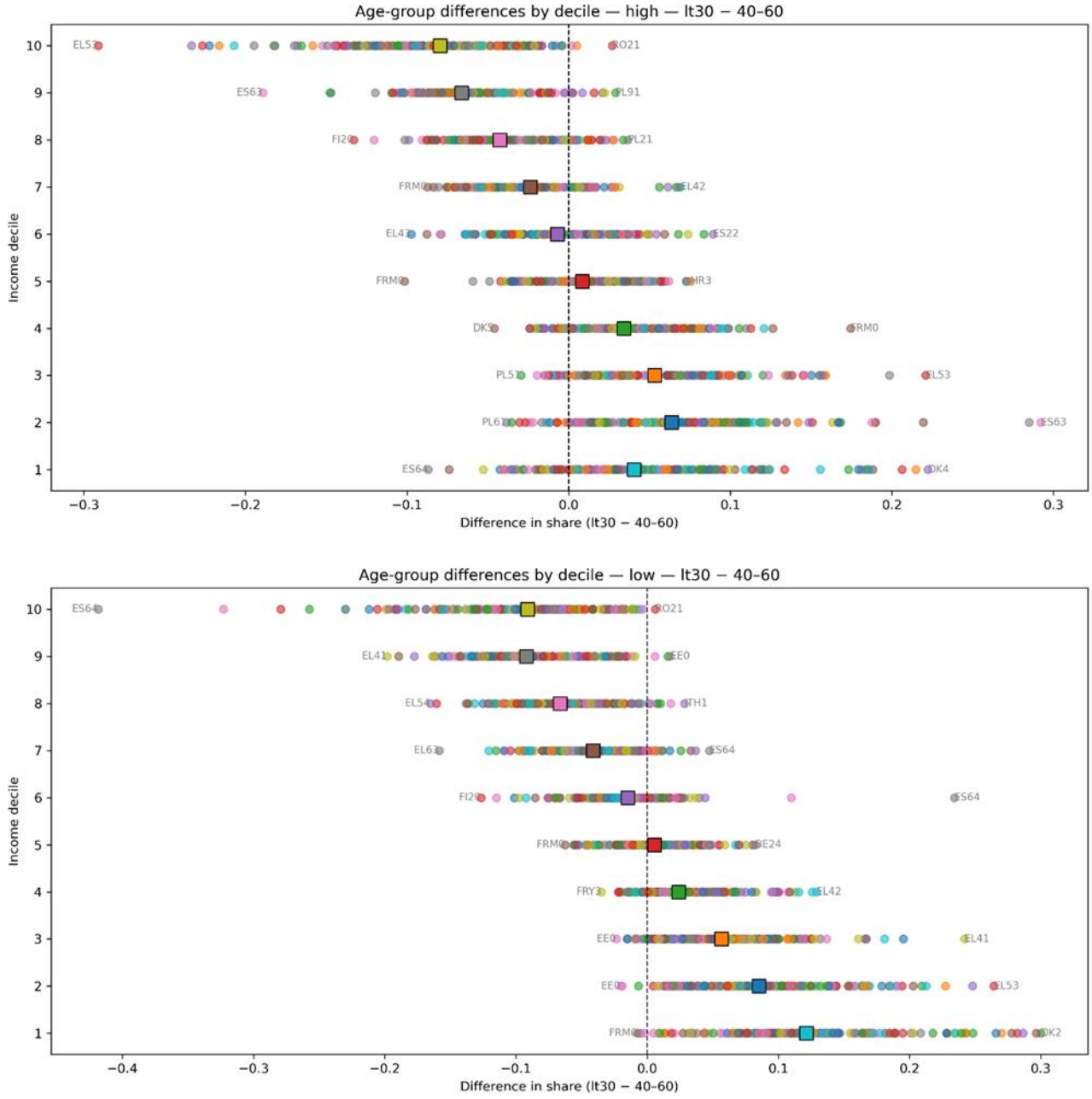


Figure 21. Age-group differences in income distribution by decile for high- and low-exposure green occupations (share of workers under 30 minus share of workers aged 40–60)

Figure 21 shows differences between younger workers (under 30) and prime-age workers (40–60) in terms of their relative position across the income distribution, distinguishing between high and low exposure to green occupations.

In the case of high green exposure, the gaps between age groups are generally modest and fluctuate closely around zero across deciles. Some regions display small positive gaps in the lower deciles,

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

meaning a relatively higher presence of younger workers, while others show advantages for the older group in the middle and upper deciles. However, no systematic trend emerges, suggesting that within green-intensive occupations, younger and prime-age workers are more evenly distributed across the wage spectrum.

For low green exposure, the dispersion is more pronounced. In some regions, younger workers are clearly more concentrated in the lower deciles, while older workers dominate the middle and upper ranges of the distribution. The negative values are also wider in magnitude than in the high-exposure case, pointing to a more structural disadvantage for younger cohorts in non-green occupations.

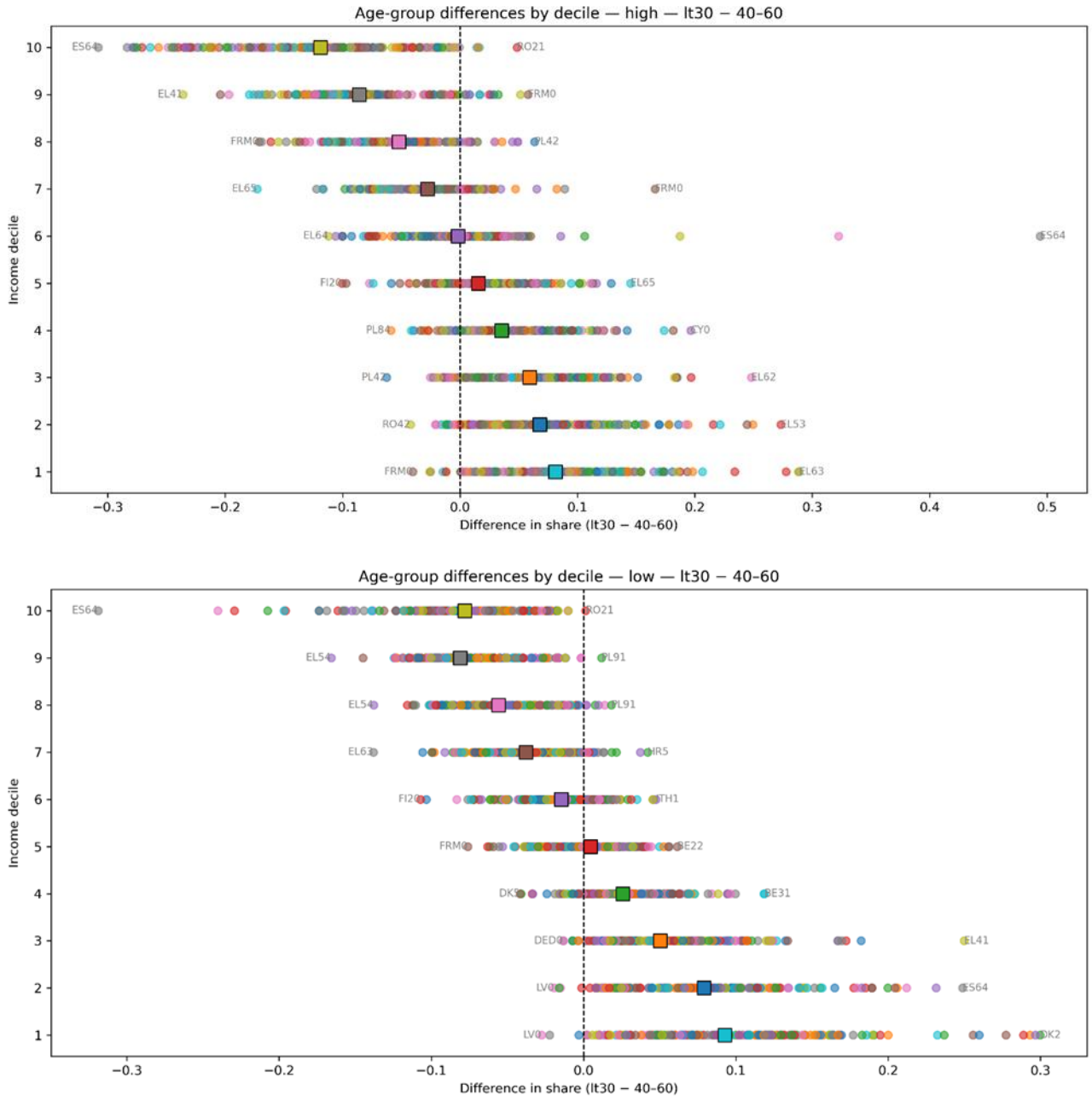


Figure 22. Age-group differences in income distribution by decile for high- and low-exposure digital occupations (share of workers under 30 minus share of workers aged 40–60)

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

In Figure 22 we show that even for age differences in digital exposure no important contrasts between high- and low-exposure occupations exists.

In high digital exposure jobs, younger workers (under 30) are relatively more present in the lower deciles, with positive differences at the bottom of the income distribution. In the middle and higher deciles, however, the balance shifts toward prime-age workers (40–60), who tend to dominate in the upper part of the wage distribution.

For low digital exposure occupations, the distribution of differences appears very similar. This indicates that age-related inequalities affect traditional, low-digital occupations as well as digital-intensive ones.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

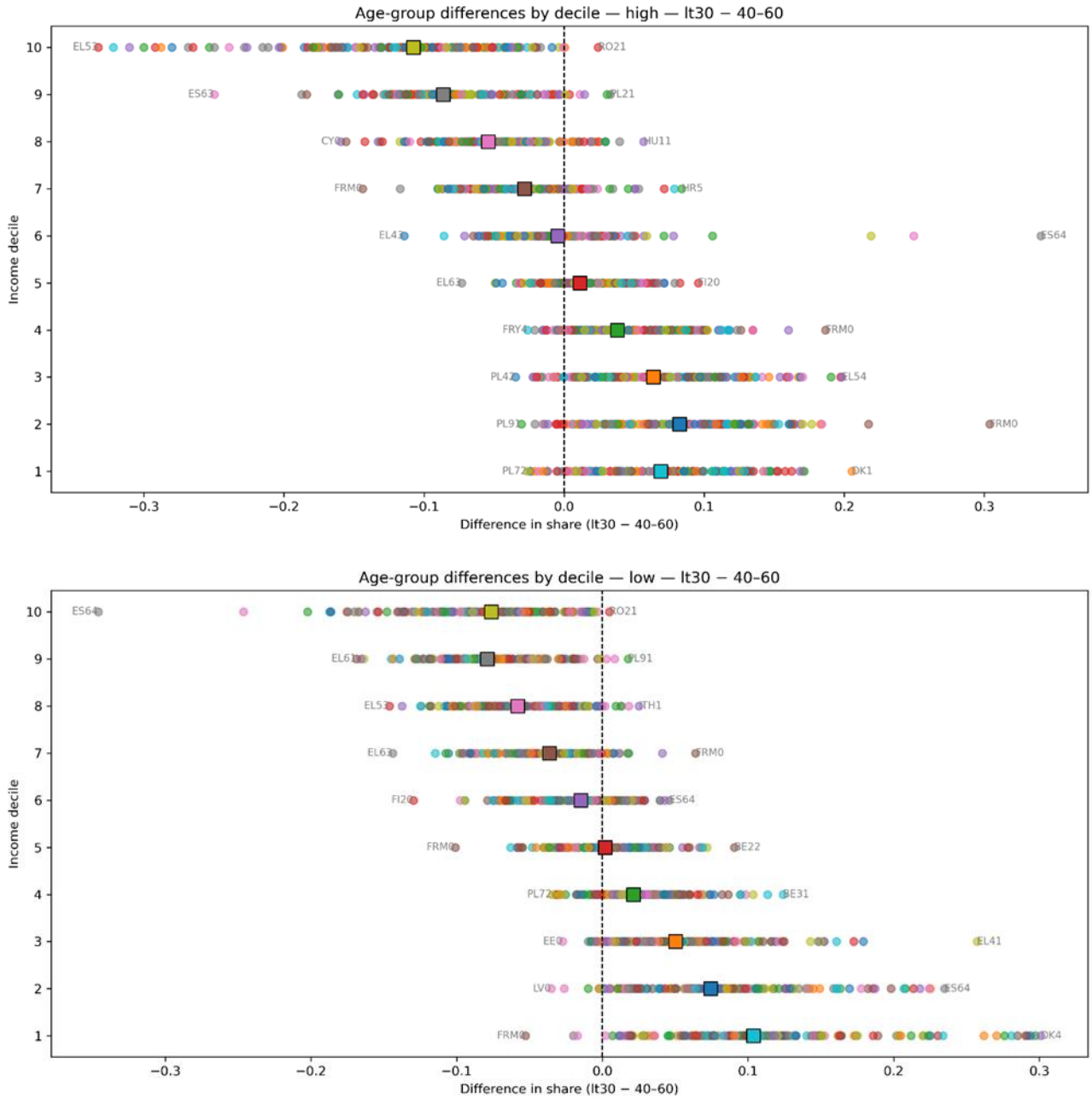


Figure 23. Age-group differences in income distribution by decile for high- and low-exposure twin occupations (share of workers under 30 minus share of workers aged 40–60)

Finally, in Figure 23, age differences in twin-exposure (green and digital combined) occupations provide a comprehensive view of how the transition affects younger and prime-age workers across the income distribution.

In high twin-exposure occupations, younger workers (under 30) appear somewhat more present in the lower income deciles, while prime-age workers (40–60) dominate in the middle and upper deciles.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

In low twin-exposure occupations, the gaps are similarly modest, though in some regions the negative values are wider, showing a stronger concentration of older workers in the middle and upper deciles. Younger workers do not appear systematically disadvantaged, but their presence is clearly limited in the upper end of the wage distribution.

Takeaway #10.
Gender inequality persists across transitions: Women remain disproportionately concentrated in the lower income deciles, particularly in high-exposure sectors, highlighting barriers to upward mobility and career advancement.

Takeaway #11.
Generational divides are significant: Younger workers are more often found in the bottom deciles, while middle-aged workers dominate higher deciles, suggesting that digitalization and green transitions may reinforce intergenerational inequality.

Takeaway #12.
High exposure to the green transition is connected to less clear and evident patterns of systematic differences over the income distribution.

Takeaway #13.
Targeted policy responses are needed: Inclusive training, reskilling opportunities, and active labor market policies are essential to ensure women and younger workers can access high-quality jobs and share in the benefits of structural change.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

8. Conclusions

The analysis explored the distributive implications of the twin transition, focusing on how the diffusion of green, digital, and combined occupations interacts with existing structures of inequality in Europe. By combining national and regional perspectives, the analysis has highlighted the persistence of cross-country heterogeneity, the uneven pace of labour market transformation, and the differentiated impacts on gender and age groups.

At the national level, inequality, as measured by the Gini index, has proved remarkably persistent between 2016 and 2022. Countries are clustered into high-inequality and low-inequality groups, with little evidence of convergence. These patterns are shaped primarily by structural and institutional factors rather than by short-term shocks. Against this backdrop, the expansion of green and digital labour has been uneven: digital occupations have grown steadily, particularly in Northern and Western Europe, while green occupations have shown mixed trajectories, and twin jobs remain a niche but slowly emerging category. Enabling occupations provide a broader base for diffusion, but their prevalence varies systematically across member states, reinforcing the idea that national labour market structures mediate the distributional consequences of the transition.

The connection between inequality and labour markets reveals important asymmetries. Green employment tends to be more prevalent in relatively unequal economies, reflecting structural reliance on sectors such as agriculture, construction, and energy. Digital employment, by contrast, is more concentrated in egalitarian economies with stronger redistributive systems and higher skill intensity. Twin jobs show no systematic relationship with inequality, underlining their incipient character and dependence on specific industrial trajectories. Enabling occupations echo these findings: enabling digital competences are more widespread in egalitarian contexts, while enabling green competences are more prominent in more unequal economies.

At the regional and micro level, the analysis has uncovered significant sources of inequality across gender, age, and employment quality. Women remain disproportionately concentrated in the lower income deciles, with men more present in the upper tiers. These gender gaps are particularly pronounced in high-exposure occupations, especially in digital- and twin-intensive sectors, suggesting that structural barriers to advancement persist even where women are present in transition-related jobs. Age divides are also evident, with younger workers overrepresented in lower deciles and prime-age workers dominating higher segments. However, generational gaps are less systematic than gender inequalities, pointing to barriers in progression rather than outright exclusion.

Beyond wages, non-wage job characteristics also display inequality gradients. Temporary workers are concentrated in the bottom deciles, underscoring the precarious nature of their employment. Access to remote work is skewed towards the top of the distribution, reflecting its association with higher-skilled and higher-paid roles. By contrast, differences between single and multiple job holders are modest, suggesting that holding several jobs reflects compensation strategies but does not constitute a systematic driver of inequality.

Interesting, whereas those workers with high exposure to the green transition show an even distribution across income deciles, high-exposed digital and twin occupations workers tend to be over-represented at the top of the income distribution. This insight seems to suggest that the green transition per-se does not fuels income inequalities and disparities via a wage premium.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

Taken together, the findings demonstrate that the twin transition is not distributionally neutral. Inequalities are sharper in transition-intensive occupations, particularly with respect to gender, and risks of polarisation emerge precisely in the sectors most central to Europe's future economic development. Left unmanaged, the digital and green transformations risk reinforcing existing divides, stratifying labour markets along lines of gender, age, and employment quality.

The policy implications are therefore clear. For gender, targeted measures are required to ensure women's access to high-value segments of green and digital employment, dismantling barriers to advancement and promoting work-life balance. For age, investments in training, re-skilling, and career progression are necessary to support younger workers' upward mobility while safeguarding older cohorts. More broadly, active labour market policies, redistributive systems, and skills strategies must be aligned with the twin transition to ensure that its opportunities are shared inclusively.

The transition to a digital and sustainable economy represents both a challenge and an opportunity. Managed inclusively, it can generate high-quality employment and reinforce social cohesion. If neglected, however, it risks entrenching existing disparities. The evidence presented in this report underscores the importance of integrating equity considerations into the core of transition policies, ensuring that the future of work in Europe is not only greener and more digital, but also fairer.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

References

Acemoglu, Daron. "Technical change, inequality, and the labor market." Journal of economic literature 40, no. 1 (2002): 7-72.

Aghion, P., Akcigit, U., Bergeaud, A., Blundell, R., & Hemous, D. (2019). Innovation and top income inequality. Review of Economic Studies, 86(1)

Antonioli, D., Ghisetti, C., Mazzanti, M., Nicolli, F., & Quatrosi, M. (2025). “Twin transition” and HRM practices: empirical evidence from Italian firms. Industry and Innovation, 1-20.

Arntz, M., Gregory, T., & Zierahn, U. (2016). The risk of automation for jobs in OECD countries: A comparative analysis.

Autor, D. H., Katz, L. F., & Krueger, A. B. (1998). Computing inequality: Have computers changed the labor market? Quarterly Journal of Economics, 113(4), 1169–1213.

Autor, David H. "Why are there still so many jobs? The history and future of workplace automation." Journal of economic perspectives 29, no. 3 (2015): 3-30.

Autor, D. H., & Dorn, D. (2013). The growth of low-skill service jobs and the polarization of the US labor market. American Economic Review, 103(5), 1553–1597.

Brynjolfsson, E., & Hitt, L. M. (1996). Paradox lost? Firm-level evidence on the returns to information systems spending. Management Science, 42(4), 541–558.

Cardona, M., Kretschmer, T., & Strobel, T. (2013). ICT and productivity: Conclusions from the empirical literature. Information Economics and Policy, 25(3), 109–125.

Castells-Quintana, D., Ramos, R., & Royuela, V. (2015). Income inequality in European regions: Recent trends and determinants. Review of Regional Research, 35(2), 123–146.

Consoli, D., Castellacci, F. and Santoalha, A., 2023. E-skills and income inequality within European regions. Industry and Innovation, 30(7), pp.919-946.

Curtis, E. M., O’Kane, L., & Park, R. J. (2024). Workers and the green-energy transition: Evidence from 300 million job transitions. Environmental and Energy Policy and the Economy, 5(1), 127-161.

Dibiaggio, L., Nesta, L., & Vannuccini, S. (2024). European sovereignty in artificial intelligence: A competence-based perspective (Doctoral dissertation, SKEMA Business School; Université Côte D'Azur; GREDEG CNRS).

European Commission (2022). Strategic Foresight Report. Twinning the Green and Digital Transitions in the New Geopolitical Context. COM(2022) 289 final. Bruselas, 29.6.2022. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0289&qid=1658824364827.

Fallah, B. N., & Partridge, M. D. (2007). The elusive inequality–economic growth relationship: Are there differences between cities and the countryside? Annals of Regional Science, 41(2), 375–400.

Frank, M. W. (2008). Inequality and growth in the United States: Evidence from a new state-level panel of income inequality measures. Economic Inquiry, 47(1), 55–68

This project has received funding from the European Union’s Horizon Europe under grant agreement No 101132559.

Frey, C.B. and Osborne, M.A., 2017. The future of employment: How susceptible are jobs to computerisation?. Technological forecasting and social change, 114, pp.254-280.

Furceri, D., & Ostry, J. D. (2019). Robust determinants of income inequality. Oxford Review of Economic Policy, 35(3), 490–517

Galbraith, J. K., & Garcilazo, E. (2005). Pay inequality in Europe 1995–2000: Convergence between countries and divergence within. European Journal of Comparative Economics, 2(2), 139–175.

Goos, Maarten, Alan Manning, and Anna Salomons. "Explaining job polarization: Routine-biased technological change and offshoring." American economic review 104, no. 8 (2014): 2509-2526.

Iacono, R., & Ranaldi, M. (2022). Income inequality in advanced economies: A review of the evidence. Oxford Open Economics, 1(1)

Karabarbounis, L., & Neiman, B. (2014). The global decline of the labor share. Quarterly Journal of Economics, 129(1), 61–103.

Kretschmer, T. (2012). Information and communication technologies and productivity growth: A survey of the literature. OECD Digital Economy Papers, No. 195

Muench, S., Stoermer, E., Jensen, K., Asikainen, T., Salvi, M. And Scapolo, F., Towards a green and digital future, Publications Office of the European Union, Luxembourg, 2022, https://data.europa.eu/doi/10.2760/977331, JRC129319.

Panizza, U. (2002). Income inequality and economic growth: Evidence from American data. Journal of Economic Growth, 7(1), 25–41.

Partridge, M. D., Rickman, D. S., & Levernier, W. (1996). Trends in U.S. income inequality: Evidence from a panel of states. Quarterly Review of Economics and Finance, 36(1).

Perugini, C., & Martino, G. (2008). Income inequality within European regions: Determinants and effects on growth. Review of Income and Wealth, 54(3), 373–406

Rodríguez-Pose, A., & Tselios, V. (2009). Education and income inequality in the regions of the European Union. Journal of Regional Science, 49(3), 411–437

Royuela, V., Veneri, P., & Ramos, R. (2019). Inequality and urban growth in Europe. Regional Studies, 53(6), 779–789.

Santoalha, A., Consoli, D. and Castellacci, F., 2021. Digital skills, relatedness and green diversification: A study of European regions. Research Policy, 50(9), p.104340.

Tselios, V. (2008). Income and educational inequality in the regions of the European Union. Journal of Policy Modeling, 30(2), 225–242.

Tselios, V. (2014). Education and inequality in the regions of the European Union. Journal of Development Studies, 50(3), 330–347

Vona, F., Marin, G., Consoli, D., & Popp, D. (2018). Environmental regulation and green skills: an empirical exploration. Journal of the Association of Environmental and Resource Economists, 5(4), 713-753.

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.