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Testing the Automation-Migration Interface: A Mechanism Synthesis and Research Agenda for Migration Studies

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Abstract
Technological change, particularly automation and artificial intelligence (AI), is reshaping labour demand and influencing migration dynamics. This article introduces the Automation-Migration Interface Approach as a conceptually driven mechanism synthesis that updates labour-market segmentation theory for the age of automation and AI. Focusing on the European Union, with comparative references to the United States, China, and OECD or global evidence, we argue that automation tends to intensify labour market polarisation by reducing routine middle-skill jobs while expanding demand for high-skill work and sustaining parts of the low-skill service economy. Although some low-skilled roles remain difficult to automate, others face displacement or degradation through reorganised workflows and digital management, raising risks for migrants who are often concentrated in secondary labour-market segments. We conduct a systematic review of academic and grey literature using an LLM-assisted screening pipeline with human validation. The synthesis traces a pathway from automation and AI adoption to task restructuring and occupational shifts, then to migrant sorting and matching, and finally to barriers and mediators that shape outcomes such as wages, employment stability, mobility, segregation, and skill utilisation. The reviewed evidence suggests that skilled migrants can benefit from growing demand in AI-related and green-transition sectors, while many low-skilled migrants remain concentrated in precarious work with limited upward mobility. Key mediators include constrained access to training, difficulties in credential recognition, and gatekeeping risks linked to algorithmic screening and workplace management tools. The article concludes with policy implications for inclusive labour-market governance, including targeted upskilling and transition supports, safeguards against algorithmic bias in hiring and employment services, improved mobility and matching infrastructure, and streamlined recognition of migrant skills. It also sets out a migration-studies research agenda with testable

propositions on how these mechanisms vary across institutional contexts, and priorities for harmonised exposure measures, migrant-specific causal designs, and evaluation of institutional moderators.

Pitch: A conceptually driven mechanism synthesis that updates labour-market segmentation theory for the age of automation/AI, with EU institutional mediation and a research agenda that makes migration effects testable.

Keywords: automation, labour migration, labour market polarisation, AI, reskilling, Automation-Migration Interface Approach.

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Introduction
Technological advancements, particularly automation and artificial intelligence, are reshaping global labour markets, altering employment structures, and influencing labour migration patterns and migrant positionalities in the labour market. As AI-enabled technologies replace some routine tasks while increasing demand for specialized expertise, labour market polarization can intensify, creating both opportunities and challenges for migrant workers. Migrants often fill critical gaps in high-demand sectors, yet they may also face displacement from some middle-skill and selected low-skill roles, as well as barriers to entry and progression in technology-intensive industries. Understanding how automation and AI interact with migrant labour is therefore essential for anticipating future dynamics in labour migration.

Building on Dual Labour Market Theory of Migration (Piore, 1979), this article develops a mechanism-based synthesis of how automation reshapes migrant labour demand and labour-market segmentation. In Piore's framework, advanced economies exhibit a primary sector with stable, well-paid employment and a secondary sector characterized by low-wage and precarious work. This review examines how automation can amplify segmentation by restructuring task content within occupations, reducing demand for some routine middle-skill work, and shifting employment toward high-skill roles and some difficult-to-automate essential services. Because migrant workers are often concentrated in secondary-sector jobs, they are particularly exposed to changes in job availability, job quality, and mobility prospects as technologies diffuse across sectors. At the same time, skilled migration may become more important in filling occupations that are resilient to automation and that require technological proficiency.

Drawing on a systematic review of academic research and grey literature, the study provides an initial comparative analysis of how automation and AI affect migrant labour in the European Union, with reference to the United States and China. It identifies key trends, highlights gaps in existing evidence, and offers policy-relevant insights. Specifically, it examines when automation acts as a complement to migrant labour and when it functions as a substitute, and it considers barriers that shape migrant participation in AI-affected industries, including barriers related to skills recognition, access to training, and hiring and workplace practices.

The central research question guiding this analysis is: how do automation and AI interact with migrant labour in the European Union, and through which mechanisms do these interactions shape labour-market segmentation and migrant outcomes? Supporting questions examine how technological change restructures tasks and occupations, how migrants sort into evolving job and regional opportunity structures, and which barriers and institutional mediators

condition outcomes for wages, stability, mobility, segregation, and skill utilisation. The review synthesises evidence on rising demand for high-skilled labour in AI-related and green-transition sectors, adjustment pressures associated with routine task displacement and occupational restructuring, and the structural constraints that limit transitions into more secure and automation-resilient work, including training access, credential recognition, and algorithmic gatekeeping. Using a comparative frame to interpret EU patterns alongside evidence from the United States, China, and OECD or global sources, the article treats cross-regional contrasts as indicative rather than directly comparable given institutional differences. It concludes with policy implications aimed at strengthening inclusive adjustment, with interventions mapped to the barriers that most strongly mediate migrant outcomes during technological transformation.

Definitions and Scope

In this article, automation refers to the broad process through which machines, software, and redesigned workflows substitute for, complement, or reorganize specific work tasks. Robotics or industrial automation is a narrower category focused on physical equipment that replaces routine manual tasks in sectors such as manufacturing and warehousing, for example automated sorting systems or robotic picking. Artificial intelligence, including machine learning, is treated as a distinct subset of digital technologies that automate or augment mainly cognitive functions such as prediction, classification, and language processing, and it often affects hiring and workplace management through tools such as CV screening, predictive scheduling, and performance monitoring. Data science refers to the wider set of practices used to analyse data for forecasting and decision support, sometimes using machine learning and sometimes not, while generative AI is a type of AI that produces new content such as text or code and can reshape tasks in customer service and professional work. Keeping these concepts separate matters because they influence migrant workers through different channels, with robotics and industrial automation more directly altering demand for routine manual labour, and AI also shaping access to jobs and job quality through screening, credential evaluation, and algorithmic management.

Theory: Automation-Migration Interface Approach

For decades labour markets have been polarised into high and low skills tiers, particularly for migrants. In this article we propose 'Automation-Migration Interface Approach' which explores the dynamic relationship between technological advancements in automation and labour migration patterns, emphasizing their joint impact on labour markets and economic structures. It also develops a mechanism-based synthesis of how automation reshapes migrant labour demand and labour-market segmentation.

Labour-market segmentation has long shaped migrant incorporation in destination economies, with migrants disproportionately concentrated in secondary-sector work characterised by lower wages, weaker protections, and limited progression (Piore, 1979). The Automation-Migration Interface Approach extends this tradition by specifying how task-based technological change alters the opportunity structure that migrants enter, and which institutional mediators determine whether migrants experience upgrading, exclusion, or persistent segmentation. The approach is mechanism-based rather than purely correlational: it treats automation and AI not as uniform shocks, but as technologies that reorganise tasks, reshape occupational demand, and introduce new gatekeeping points in recruitment and workplace management.

The Interface approach traces a sequential pathway. First, automation and AI adoption changes the composition of tasks within jobs through substitution, augmentation, and reorganisation. Second, these task shifts aggregate into occupational and sectoral restructuring, often consistent with labour-market polarisation, with contraction of routinised middle-skill

work and growth in high-skill roles alongside continued demand for some low-skill services. Third, migrants sort into the resulting job and regional opportunity structure through recruitment channels, networks, and legal constraints on mobility. Fourth, realised outcomes depend on mediators that shape transitions and job quality, including credential recognition, access to training, language and digital skills, welfare and employment protections, and algorithmic gatekeeping in hiring and workplace monitoring. The central theoretical claim is that technology affects migrant outcomes largely through sorting and mediation processes, which vary systematically across institutional contexts.

This approach updates Dual Labour Market Theory in two ways. It treats segmentation as a dynamic outcome of task restructuring, not a fixed property of sectors. Automation can shift work that was previously secondary into more tightly managed service regimes and reorganised workflows, potentially degrading job quality even where employment persists. It also recognises that AI introduces institutionalised gatekeeping through screening, prediction, scheduling, and performance management tools, creating new mechanisms of exclusion that operate before wages and employment outcomes are observed. Migrants may therefore face a double exposure: concentration in segments where automation can reduce progression ladders and intensify work, alongside heightened filtering where automated decision systems embed or amplify disadvantage.

The Automation-Migration Interface Approach treats cross-context differences as differences in mediating institutions rather than like-for-like contrasts. Training systems, credential-recognition regimes, welfare eligibility and portability, employment protection, collective bargaining coverage, and migration-status rules influence whether migrants can convert task change into upgrading or become locked into low-mobility segments. Similarly, the governance of algorithmic systems in employment, including transparency, auditing, and contestability, shapes whether AI adoption increases efficiency while protecting equal access, or deepens segmentation through opaque screening and management practices. These institutional moderators are central to explaining why comparable task shocks can yield different migrant outcomes across the EU, the United States, China, and other advanced economies.

From a macroeconomic perspective, the interaction between automation and labour migration has broader implications for economic growth, wage distribution, and employment structures. General equilibrium models suggest that skilled migration can enhance economic performance by complementing automation-driven labour demand (Mandelman & Zlate, 2022), whereas unskilled migration may help sustain essential but difficult-to-automate occupations (Mann & Pozzoli, 2022). Additionally, the degree of a country's openness to trade and migration influences the extent to which automation reshapes its labour market. In highly open economies, automation-induced job displacement may be offset by an influx of skilled migrants who contribute to innovation and technological development (Giesing & Rude, 2022). Conversely, in more restrictive economies, automation could lead to more pronounced job losses and social dislocation, particularly for workers with lower adaptability (Javed, 2023).

The approach generates testable propositions for migration studies. In contexts with high routine-task exposure, automation adoption is expected to be associated with contraction in routine middle-skill work and relative expansion in high-skill roles and selected low-skill services, reshaping the distribution of jobs available to migrants. Where migrants are concentrated in secondary-sector roles with limited progression ladders, task reorganisation is more likely to translate into job-quality degradation and constrained upward mobility than into upgrading. Migrant sorting into expanding occupations and regions is expected to be shaped strongly by legal mobility constraints, recruitment intermediaries, and network access, especially during periods of restructuring. The link between automation exposure and migrant upgrading should be stronger where credential recognition is faster and where training access

is inclusive, affordable, and compatible with low-wage work schedules. AI-enabled screening and workplace management is expected to increase disparities in access and progression for migrants when systems lack auditing, transparency, and contestability, and when migrant status correlates with predicted 'risk' or 'fit'. Stronger employment protections and portable welfare and transition supports should weaken the link between automation exposure and migrant precarity by reducing the costs of occupational and geographic transitions. Finally, effects should differ across migrant categories, with temporary workers and migrants with restricted status showing stronger concentration in shrinking or degraded segments and weaker mobility responses than migrants with more portable rights.

Taken together, the Automation-Migration Interface Approach shifts the analytical focus from whether automation substitutes for or complements migrant labour in the aggregate to identifying the mechanisms and institutional conditions that determine migrant incorporation trajectories under technological change. It also clarifies how evidence can cumulate across studies by locating findings at specific links in the mechanism chain and testing how institutional moderators shape those links across settings.

Geography of Automation-Migration Interface Approach

The influence of automation and AI on labour migration and migrants varies significantly across regions, shaped by characteristics of their labour markets. For instance, the European Union (EU) and European Economic Area (EEA), face distinct challenges and opportunities compared to the United States, China, and other global economies. These differences arise from variations in demographic trends, economic structures, labour market policies, and technological adoption rates.

In the EU, the labour market is heavily influenced by demographic aging and population shrinking, creating a growing reliance on migrant workers to fill labour shortages, particularly in sectors such as healthcare, construction, and agriculture. Automation and AI are expected to further reshape the demand for migrant labour. In the EU, technology adoption is gradual and often guided by regulatory frameworks aimed at balancing innovation with worker protection. This creates in the EU, as mentioned above, a dual effect: while automation may displace workers in certain low-skilled jobs traditionally filled by migrants, it also drives demand for skilled migrants in high-tech industries and AI-related fields and essential workers in low-skilled service and care jobs.

In contrast, the United States labour market is characterized by greater flexibility and faster technological adoption, which intensifies both the displacement effects of automation and the creation of high-skill job opportunities (Javed, 2023). Migrants in the U.S. have traditionally played a vital role in filling both high- and low-skilled roles. However, the rapid implementation of AI in industries such as manufacturing, logistics, and services could disproportionately affect low-skilled migrant workers (Javed, 2023). At the same time, the U.S. remains a hub for global talent in AI and technology, attracting skilled migrants and offering competitive opportunities for innovation-driven roles (Giesing & Rude, 2022).

China, on the other hand, is undergoing a rapid transformation due to its large-scale automation and AI integration in manufacturing and service industries. While China is a net exporter of migrants, it also faces domestic labour market shifts. Automation is reducing the demand for low-skilled labour in traditional industries, potentially affecting internal migrants who move from rural to urban areas for work. However, China's focus on becoming a global leader in AI opens opportunities for high-skilled roles and innovation-driven jobs (Bian & Zhou, 2024).

While automation and AI are global phenomena, their impacts on labour migration and migrants differ across regions. The EU's demographic shifts and regulatory focus create a mixed landscape of risks and opportunities for migrants. The U.S. continues to attract high-

skilled migrants while presenting challenges for low-skilled workers. China's rapid technological progress reshapes its domestic and international labour market dynamics. Other regions vary in their response to technological advancements based on their development stages and economic priorities. Understanding these regional distinctions is crucial for crafting targeted policies that address the intersection of AI, automation, and migration.

Any EU–U.S. (and EU-China) comparison in this review should be read as suggestive rather than 'like-for-like'. The regions differ fundamentally in labour-market institutions and policy architectures that mediate how automation translates into migrant outcomes: employment protection and collective bargaining coverage; welfare-state design and access to social protection; the scale and structure of active labour-market policies; vocational education and training systems; and the design of migration regimes (e.g., intra-EU free movement and heterogeneous national rules in the EU versus more unified federal frameworks in the U.S., and distinct internal-migration institutions in China). These institutional differences can change both the speed of technology adoption and the distribution of adjustment costs and opportunities for migrants. Accordingly, we use the regional contrast to highlight mechanisms and policy-relevant patterns, not to claim directly comparable magnitudes across settings.

Methods: LLM + human validation + geographic coding + limitations

This literature review used in this paper employed a generative AI assisted methodology, leveraging the capabilities of large language models to streamline and enhance the process. Specifically, we combined established systematic review techniques with capabilities of large language models to improve efficiency and comprehensiveness in literature search and screening. The final stage of both articles checking and analysing was done by humans.

Given the rapid expansion of scholarship on automation, AI, and migration, we used large language models (LLMs) to make evidence mapping feasible at scale. The LLMs supported two bounded tasks: (i) expanding and refining database search strings by generating synonyms and related terms, and (ii) triaging the large set of retrieved abstracts using explicit, rule-based prompts aligned to our inclusion criteria. Human reviewers then validated the LLM outputs, resolved borderline cases, and conducted full-text screening of shortlisted studies, ensuring that inclusion decisions ultimately rested with researchers. To support transparency and replication, we document the decision rules, report screening counts at each stage, and make the prompts and implementation notes available.

We employed a thorough, scoping, due to the novelty of the topic, systematic approach to identify studies examining the impact of automation and AI on employment. Furthermore, our search strategy was expanded to cover migration-related topics by incorporating keywords like 'migration', 'migrants', 'labour migration', 'Third-Country Nationals (TCNs)', and related terms alongside those for automation and AI. This approach ensured a comprehensive coverage of literature concerning the impact of automation and AI on both employment and labour migration.

An AI agent based on GPT4o specifically created for systematic review studies helped generate synonyms and related terms for key concepts and writing search strings for academic databases. Search was run entirely by researchers.

Following established recommendations for comprehensive literature reviews (DeSimone et al., 2021; Gusenbauer & Haddaway, 2020; Martín-Martín et al., 2021; Mongeon & Paul-Hus, 2016), our search spanned Scopus, EBSCOhost, and Web of Science. In addition to database queries, we conducted manual searches in Google Scholar, Semantic Scholar, and Google to capture additional publications and grey literature. We also examined the reference lists of identified studies and other key publications to ensure no relevant work was overlooked.

Large language models played a crucial role in streamlining the otherwise time-consuming screening process, impossible for a human mind in such a big volume. We

implemented a hierarchical LLM-based screening method that prioritized criteria such as thematic fit and study design. For each criterion, highly specific prompts guided the LLM's classification of abstracts using Boolean decisions and data extraction techniques, such as identifying study location or time-period. These prompts were iteratively tested on a sample of abstracts, with the AI's classifications compared against those made by human reviewers to ensure accuracy. Given the substantial number of abstract of 9,717 papers initially identified, we leveraged API calls to OpenAI's GPT-4o and GPT-4o mini models to efficiently process the data and minimize costs.

A three-level screening process was employed, similar to the employment-focused meta-analysis (cf. Sowa et al. 2024), but tailored to the migration research context:

- Level 1 Screening: Abstracts were screened using OpenAI's GPT-4o model, focusing on thematic fit, causal study design, and quantitative methodology. Thematic fit was defined by studies discussing automation and AI's impact on migrants, migration patterns, or labour migration within the EU or comparable contexts. This stage reduced the initial set to 35 papers.
- Level 2 Screening: LLM-based extraction of migration-specific criteria included location, inclusion of migration factors and economic indicators. Human reviewers validated the data and filtered studies further, resulting in 24 papers.
- Level 3 Screening: Two independent human reviewers conducted a rigorous assessment of full texts to ensure inclusion criteria were met. This stage emphasized studies examining automation and AI's impact on migrants at a macro level, causal inference, and econometric measures. The final set included 10 studies.

Manual searches identified migration-specific grey literature from relevant institutions and organizational reports. As with the employment-focused study, identical screening criteria were applied, resulting in the inclusion of additional sources.

Database reduction:

- Initial Dataset: 120 papers (manual search + migration-specific filter on 9,717 meta-analysis corpus) and 65 grey literature reports.
- Post-Level 1: 35 papers and 65 grey literature reports.
- Post-Level 2: 24 papers and 15 grey literature reports.
- Post-Level 3: 5 papers and 4 grey literature reports.

This tailored process ensured a focused and high-quality selection of studies examining the intersection of automation, AI, and migration dynamics.

In this part we apply the systematic literature review (SLR) to the set of academic articles and a set of grey literature considering ‘the influence of automation, AI on labour migration and migrants’ which came out as a result of AI-assisted meta-analysis presented above. It follows a structured approach to synthesize and evaluate research findings on the interplay between artificial intelligence (AI), labour market dynamics, and migration and migrants. A systematic literature review is a structured, comprehensive, and methodical process for identifying, evaluating, and synthesizing the existing body of completed and recorded work produced by researchers, scholars, and practitioners. It aims to provide a clear and exhaustive summary of the current evidence on a clearly defined research question.

To support the comparative synthesis, each included study was coded by primary geographic focus using information reported in the abstract/full text (study setting, sample, data source, and policy context). We used five mutually exclusive categories aligned with the review’s comparative aim (EU/EEA vs major non-EU poles and multi-country evidence): (1) EU/EEA (studies focusing on the European Union, the European Economic Area, or specific EU/EEA member states); (2) United States (U.S.-only studies or analyses centred on U.S. labour markets and migration); (3) China (China-only studies, including internal migration where explicitly analysed as migration/mobility); (4) OECD/Global (multi-country studies

drawing on OECD datasets or broad cross-country/global evidence where no single country/region dominates); and (5) Other non-EU (single-country studies outside the EU/EEA, U.S., and China, e.g., UK-centred analyses).

When studies covered multiple settings, we applied the following decision rules: (i) if results were reported separately for one of the focal regions (EU/EEA, U.S., China), we coded to that region; (ii) if evidence was pooled across multiple countries without region-specific estimates, we coded as OECD/Global; (iii) where the empirical setting was ambiguous, we coded based on the data source and institutional context discussed most centrally in the paper. This coding was used for descriptive mapping and narrative comparison rather than for 'like-for-like' effect-size benchmarking across regions.

In order to make this literature review possible we created an extra ChatGPT model disconnected from the Internet and Dalle with internal knowledge base. It is an advanced assistant designed to support systematic literature reviews (SLRs) by streamlining the process and enhancing its quality. It helps organize and screen studies based on inclusion and exclusion criteria, extract key findings, and synthesize themes or trends to highlight insights and research gaps. It also aids in assessing the quality and credibility of sources, creating visual tools like PRISMA diagrams or conceptual maps, and structuring the review in alignment with standard guidelines like PRISMA or Cochrane. By facilitating analysis, synthesis, and iterative refinement, it aims to save time while ensuring methodological rigor and clarity throughout the review process.

We have encountered also limitations. LLM-assisted screening can introduce systematic classification bias (e.g., missing migration-relevant studies that use atypical terminology, or overweighting keyword cues), which may yield false exclusions despite structured prompting. Coverage is also constrained by database and search-engine scope and by the dominance of English-language indexing, potentially underrepresenting non-English or regionally published evidence. We mitigated these risks through multi-database searching, manual and grey-literature searches, iterative prompt testing against human judgements, and final human full-text screening; nevertheless, replications using additional databases, languages, or alternative models could identify somewhat different eligible studies.

Datasets: Academic articles and grey literature

In the first step of this systematic literature review we present an overview of the final set of academic articles selected by AI-assisted scoping metanalysis (one set of data) regarding the influence of automation, AI on labour migration and migrants (Table 1).

Table 1. Set of academic articles selected according to the methodology

Article	Key Focus	Methodology
1. Wang et al., 2024	AI and intergenerational mobility	Empirical analysis of CGSS (China General Social Survey) data
2. Chen et al., 2024	Worker mobility and machine learning adoption	Natural experiment (non-compete laws)
3. Niu et al., 2024	Workplace automation and energy poverty	Quantitative analysis, IV approach
4. Ross et al., 2024	System-wide labour effects of technological change	CGE (Computable General Equilibrium) modelling
5. Zhao, 2020	Long-term unemployment prediction	Machine learning (SHAP analysis)
6. Medici et al., 2023	Tech self-efficacy and mobility intentions	Survey and moderation analysis
7. del Rio-Chanona et al., 2021	Occupational mobility and automation	Network modelling, agent-based approach
8. Alabdulkareem et al., 2018	Skill polarization and occupational mobility	Network science and skill topology

9. Rajkumar et al., 2022	Weak ties and job mobility	Randomized experiments on LinkedIn
10. Mandelman & Zlate, 2022	Offshoring, immigration, and polarization	Stochastic growth model

Several included studies operationalise 'mobility' as a mechanism (occupational, geographic, or network mobility) rather than directly measuring migrant status; we therefore use them primarily to substantiate pathway mechanisms, and we distinguish these from migration-explicit evidence in the comparative synthesis.

In the second step, we select the pool of articles regarding AI, automation, labour market and migration and research location in order to make comparisons between EU/EEA and non-EU countries. This will be the dataset suitable for the following analysis and presentation of findings in the set of academic articles literature (Table 2).

Table 2. Set of academic articles selected for geographical migration/mobility

Article	Key Focus	Type of Migration	Location
1. Mandelman & Zlate, 2022	Offshoring, immigration, and polarization	International migration (low-skill immigration)	Non-EU (USA)
2. Ross et al., 2024	Labour effects of technological change	International migration (context variable)	EU (Germany)
3. del Rio-Chanona et al., 2021	Occupational mobility and automation	Geographical labour reallocation	Non-EU (UK-cantered)
4. Alabdulkareem et al., 2018	Skill polarization and occupational mobility	Urban migration	Non-EU (USA)
5. Niu et al., 2024	Automation and energy poverty	Rural-to-urban migration	Non-EU (China)

In the third step, we selected grey literature on AI, automation, labour market and migration (Table 3).

Table 3. Set of grey literature selected manually

Article	Key Focus	Methodology	Location
Borgonovi et al. 2023 (OECD)	AI skill migration across countries.	Analysis of OECD Digital Economy data.	Global (OECD member countries).
Lane et al. (2023) (OECD)	Impacts of AI adoption on workplace perceptions.	OECD surveys with descriptive and inferential analysis.	Manufacturing and finance sectors in seven countries, including U.S., Canada, and EU members.
Seiger et al. (2024) (Joint Research Center)	Role of Third-Country Nationals (TCNs) in digital and green transitions in the EU.	Analysis of EU labour market and migration data.	European Union.
Mandelman and Zlate (2022), Federal Reserve of Atlanta Working Paper (2021)	Effects of offshoring and low-skilled immigration on labour market polarization.	Stochastic growth modelling.	United States (and international data for trade and migration).

Results

Rather than repeating a region-by-region description of polarization and migrant disadvantage, we synthesise the evidence using the mechanism pathway of Automation-Migration Interface presented in Table 4. This pathway traces how automation/AI adoption drives task restructuring and occupational shifts, which in turn shape migrant sorting and the barriers that mediate outcomes (wages, stability, mobility, segregation, and skill utilisation). We then compare patterns across EU/EEA, U.S., China, and multi-country evidence, noting that institutional and migration-regime differences make these comparisons indicative rather than directly comparable.

Table 4. Mechanism pathway of Automation-Migration Interface: Automation/AI adoption → task restructuring → occupational shifts → migrant sorting → barriers → outcomes (wages, mobility, segregation)

Stage (ordered)	**Core mechanism**	**Typical indicators / operationalisation (examples)**	**Where institutions intervene most**
1	Automation/AI adoption	Robot density; AI/software diffusion; firm tech adoption; routine-task intensity; capital-labour substitution	Innovation policy; sectoral structure; regulation of tech deployment
2	Task restructuring	Changes in task content (routine ↓, non-routine/cognitive ↑); augmentation vs substitution; digital task growth	Training systems; employer incentives; workplace standards
3	Occupational shifts	Job polarization; sectoral reallocation; upgrading/downgrading; job quality changes	Employment protection; collective bargaining; wage-setting; ALMPs
4	Migrant sorting & matching	Entry into specific occupations/regions; recruitment channels; network-based matching; occupational segregation	Migration regime rules; recognition of credentials; anti-discrimination enforcement
5	Barriers & mediators	Credential recognition; training access; language/digital skills; algorithmic screening bias; legal status; welfare/work protections	Welfare eligibility; status-linked rights; enforcement capacity; platform/AI governance
6	Outcomes	Wages; employment stability; occupational mobility; geographic mobility; segregation; skill utilisation	Redistribution; social protection; integration policy; labour standards

Comment: Institutional context (EU vs US vs China), labour-market regulation, welfare-state design, training systems, and migration regimes, moderates links at every stage, especially sorting, barriers, and final outcomes.

The findings are synthesised to minimise repetition and to make clear where the evidence is strongest across a diverse set of designs, regions, and outcome measures. Rather than restating a region-by-region narrative of job polarization and migrant disadvantage, we organise the results using the mechanism pathway summarised in Table 4, which links automation and AI adoption to task restructuring, occupational shifts, migrant sorting and matching, and the barriers that mediate downstream outcomes. This structure allows us to compare studies that measure migrants directly with studies that inform key mechanisms through related indicators such as occupational mobility, geographic mobility, or matching processes.

Table 4 also shows that the included studies cluster in different parts of the pathway. Evidence is most developed for upstream links, namely how automation and AI reshape tasks and occupational demand, while fewer studies observe migrant outcomes directly or measure institutional mediators in a comparable way. We therefore present results in sequence along the pathway, moving from adoption and task change to sorting, barriers, and outcomes, and we then interpret regional differences through institutional context. Comparisons across EU/EEA, the United States, China, and multi-country evidence are treated as indicative rather than directly

comparable, because labour-market institutions, welfare and training systems, and migration regimes shape how the same technological shock translates into migrant outcomes.

Evidence on adoption, task restructuring, and occupational shifts (Stages 1 to 3)

Across the included studies, the strongest and most consistent evidence concerns the upstream part of the mechanism pathway, namely how automation and AI adoption changes task demand and reshapes occupational structures. At this stage, studies typically operationalise exposure through measures of technological change or adoption at the sector, firm, or macro level, and then trace implications for labour demand across skill groups. For example, system-wide modelling for Germany links labour augmenting technological change to shifts in labour demand that increase the importance of higher-skill profiles in technology intensive sectors (Ross et al., 2024). Complementary evidence from firm and labour market settings connects adoption conditions to workforce reallocation pressures, highlighting that technology diffusion is not simply a technical process but one that is shaped by labour market frictions and mobility (Chen et al., 2024; del Rio-Chanona et al., 2021).

A central finding at Stage 3 is that occupational change under automation tends to be asymmetric across the skill distribution. Several studies describe this as occupational polarization, with contraction in routinised middle-skill work and expansion in high-skill roles alongside persistent demand for low-skill service work (Mandelman and Zlate, 2022; Alabdulkareem et al., 2018). In the United States, modelling of offshoring and automation shows reduced demand for middle-skill jobs and a rise in high-skill and low-skill service demand, with downstream implications for who fills those service roles (Mandelman and Zlate, 2022). Evidence on skill structures and urban labour markets similarly highlights how occupational systems can polarise around skill profiles, reinforcing uneven access to upgrading pathways (Alabdulkareem et al., 2018). Network and mobility-oriented studies add that these shifts restructure feasible transition pathways between occupations, which matters for later stages of sorting and barriers even when migrant status is not the primary unit of analysis (del Rio-Chanona et al., 2021; Rajkumar et al., 2022) .

Taken together, the Stage 1 to Stage 3 evidence provides the enabling conditions for the migration-focused links later in the pathway. Automation and AI adoption changes what tasks are valued, and those task changes aggregate into occupational and sectoral shifts that expand some job ladders while narrowing others (Ross et al., 2024; Mandelman and Zlate, 2022) . The next subsections therefore move from these upstream changes to the downstream mechanisms, focusing on how migrants sort into the evolving opportunity structure and how barriers such as credential recognition, training access, and algorithmic screening shape observed outcomes (Zhao, 2020; Medici et al., 2023).

Migrant sorting and matching (Stage 4)

At Stage 4, the reviewed literature highlights that migrants do not enter a neutral labour market. They sort into jobs and places shaped by prior task and occupational restructuring, and matching is mediated by recruitment channels, networks, and mobility constraints. In the United States, Mandelman and Zlate (2022) show how automation and offshoring contribute to a dual structure in which rising demand for local services is met largely by low-skilled immigrants, while limited mobility and oversupply keep these workers concentrated in low-wage, low-mobility occupations. This pattern is consistent with the broader synthesis in your findings section that links technology-driven polarization to occupational segregation and uneven access to upgrading pathways.

Several studies contribute mechanism evidence on how sorting and matching occurs even when migrant status is not the primary outcome. del Rio-Chanona et al. (2021) model occupational mobility under automation as a network of feasible job-to-job transitions, showing

that displacement risk depends not only on which jobs decline but also on whether workers can realistically move into expanding occupations. Alabdulkareem et al. (2018) similarly emphasise that skill structures and urban labour markets can reinforce polarized opportunity sets and constrain transitions from low- to high-skill roles, which helps explain why migrant concentration can persist in certain sectors and cities. Rajkumar et al. (2022) adds complementary evidence from job-matching networks, showing that access to weak-tie connections can causally increase job mobility, which is directly relevant to understanding how migrants may gain or lose access to better matches as labour markets restructure.

Finally, the evidence suggests that individual adaptability can influence sorting outcomes, but that it interacts with opportunity structures rather than replacing them. Medici et al. (2023) finds that technological self-efficacy is associated with stronger mobility intentions in the face of technological advancement, indicating one micro-level channel through which workers may pursue better matches when tasks change. Taken together, Stage 4 findings support the interpretation that technology shocks shape migrant outcomes partly through sorting and matching processes that depend on mobility pathways, network access, and the structure of local labour demand, setting up the next stage on barriers and mediators that can block or enable these transitions.

Barriers and mediators (Stage 5)

Across the reviewed literature, Stage 5 mediators explain why similar technology shocks can produce very different outcomes for migrants. A recurring barrier is restricted access to mobility and upgrading pathways, including limited opportunities to retrain, weak portability of skills across sectors, and constraints on geographic or occupational movement. For example, migrant concentration in low wage service work is reinforced by limited mobility and thin progression ladders in sectors that expand under polarization dynamics (Mandelman and Zlate, 2022). Related evidence on occupational transition structures shows that adjustment depends on whether workers can realistically move into expanding occupations, not only on whether those occupations exist (del Rio-Chanona et al., 2021) .

A second cluster of mediators concerns human capital translation and access to training, especially credential recognition and digital preparedness. Grey literature and EU focused evidence underline that many migrants, including Third Country Nationals, face persistent barriers due to unrecognised qualifications and limited access to upskilling, even as digital and green transitions raise demand for higher skill profiles (Seiger et al., 2024; Lane et al., 2023). Micro-level evidence further suggests that technological self-efficacy is associated with stronger mobility intentions under technological change, indicating that digital confidence and perceived ability to adapt can shape whether individuals pursue transitions when tasks shift (Medici et al., 2023).

A third mediator is institutional and algorithmic filtering in labour market access. The literature highlights risks that AI-enabled decision tools in employment services or hiring can disadvantage low-skilled migrants through biased classification and screening, which can compound existing segmentation (Zhao, 2020). More broadly, institutional context shapes the strength of these barriers through welfare eligibility, employment protections, and the availability of transition supports. For example, discussions of policy responses in both EU and non-EU contexts emphasise that displaced workers, including migrants, often require unemployment support, retraining assistance, and mobility or housing support to translate labour demand shifts into stable employment, particularly under rapid structural change (Ross et al., 2024; Niu et al., 2024).

Together, Stage 5 findings indicate that migrant outcomes are not determined by automation exposure alone. They are mediated by whether migrants can convert skills into recognised credentials, access training and digital capability building, navigate algorithmic

gatekeeping, and rely on institutional protections that reduce the costs of occupational and geographic transitions (Seiger et al., 2024; Zhao, 2020; Medici et al., 2023).

Outcomes for migrants and mobility (Stage 6)

At Stage 6, the reviewed literature links technology-driven restructuring to heterogeneous outcomes for migrants across wages, employment stability, mobility, segregation, and skill utilisation. Where migrant outcomes are measured directly, the most consistent pattern is that polarization dynamics can widen gaps between higher- and lower-skilled migrants, particularly through occupational concentration in lower-wage service work and limited upward mobility. In the United States, Mandelman and Zlate (2022) show that automation and offshoring contribute to labour-market polarization in ways that increase demand for local services and draw low-skilled immigrants into those sectors, with implications for wage dispersion and persistent concentration in low-wage jobs (Mandelman and Zlate, 2022).

Evidence from China highlights mobility outcomes that are closely tied to stability and vulnerability. Niu et al. (2024) links automation-related shocks to intensified rural-to-urban migration pressures, suggesting that labour demand shifts can translate into mobility but not necessarily into secure, upward transitions for lower-skilled movers, especially when shocks are regionally uneven (Niu et al., 2024). This complements the broader mechanism evidence that occupational and geographic transitions are constrained by the structure of feasible pathways, which shapes who can move into expanding jobs and who remains exposed to instability (del Rio-Chanona et al., 2021).

Several studies also point to outcomes that operate through access and gatekeeping. Zhao (2020) highlights that AI-enabled classification and screening tools can disadvantage low-skilled and migrant groups through biased risk prediction or decision rules, which can reduce access to opportunities and reinforce segregation effects even when labour demand exists (Zhao, 2020) . In contrast, evidence on mobility and matching mechanisms indicates potential channels for improving outcomes. Rajkumar et al. (2022) shows that expanding weak-tie connections can causally increase job mobility, which is relevant for understanding how migrants may access better matches in restructuring labour markets (Rajkumar et al., 2022). Medici et al. (2023) similarly finds that technological self-efficacy is associated with stronger mobility intentions, pointing to a channel through which digital confidence and perceived adaptability can shape whether workers pursue occupational or geographic moves under technological change (Medici et al., 2023).

Taken together, Stage 6 outcomes are best understood as the product of the full pathway. Task and occupational change create new opportunity structures, but realised outcomes for migrants depend on whether sorting leads to good matches and whether barriers, including training access, credential recognition, legal status constraints, and algorithmic gatekeeping, allow migrants to convert mobility into stable and well-matched employment (Mandelman and Zlate, 2022; Zhao, 2020; Medici et al., 2023)

Regional patterns and institutional interpretation (EU/EEA, U.S., China, OECD or global)

The mechanism pathway summarised in Table 4 plays out across all regions, but the reviewed studies suggest that outcomes differ because labour-market institutions, welfare and training systems, and migration regimes shape sorting, barriers, and the distribution of adjustment costs. For this reason, the regional synthesis below interprets differences primarily as differences in mediating institutions and constraints, not as directly comparable magnitudes.

Evidence for the EU/EEA is dominated by Germany-focused modelling and EU policy analysis. Ross et al. (2024) suggests that labour-augmenting technological change increases demand for higher-skill profiles in technology-intensive sectors, reinforcing a stronger pull for skilled migrants in advanced EU economies. At the same time, EU-focused grey literature

highlights persistent segmentation for Third-Country Nationals, who remain underrepresented in high-skilled digital roles and overrepresented in essential but lower-paid sectors, often because of credential non-recognition and limited access to upskilling. The EU context is also characterised by a stronger policy emphasis on equity and worker protection, including attention to bias risks in algorithmic decision-making, although implementation and integration outcomes remain heterogeneous across member states.

The U.S. evidence emphasises faster technology adoption and a more flexible labour market, which can intensify both displacement pressures and the creation of high-skill opportunities (Javed, 2023). Mandelman and Zlate (2022) show how offshoring and automation contribute to occupational polarization and a dual structure in which high-skilled workers benefit while low-skilled immigrants become concentrated in low-wage service work with limited mobility, partly due to oversupply and constrained progression ladders. In parallel, the U.S. remains a major destination for global AI talent, reinforcing the high-skill channel of the pathway, while raising distributional concerns for low-skilled migrants as automation diffuses across services and logistics (Giesing and Rude, 2022; Javed, 2023).

China is represented mainly through studies on rapid automation and domestic mobility dynamics. The reviewed synthesis highlights that automation can reduce demand for low-skilled labour in traditional industries and interact with internal migration from rural to urban areas. Niu et al. (2024) links automation-related shocks to increased rural-to-urban migration pressures, with unskilled movers often struggling to secure stable work, which can reinforce regional disparities. Complementary China evidence in the reference set also points to automation effects on internal migration patterns more broadly (Bian and Zhou, 2024). Taken together, China's regional pattern is distinctive in that migration is frequently internal mobility, and institutional mediators include urban absorption capacity and the availability of relocation supports and basic protections during transitions.

Multi-country and OECD-oriented grey literature mainly strengthens the interpretation of global skill demand and institutional mediation. Borgonovi et al. (2023) documents rising demand for AI-related skills across OECD countries and shows how highly skilled migrants help meet this demand, while also raising concerns about unequal talent distribution and potential brain drain. Lane et al. (2023) highlights that low- and mid-skilled roles, where migrants are often overrepresented, are perceived as more exposed to automation in sectors such as manufacturing and finance, and it emphasises digital preparedness and training access as key mediators. These cross-country sources reinforce the pathway interpretation: adoption and restructuring are widespread, but whether migrants experience upgrading, stagnation, or displacement depends heavily on training systems, credential recognition, and the inclusiveness of transition supports.

Across settings, the reviewed studies are consistent with the Automation–Migration Interface claim that technological change can deepen segmentation by skill and migrant status, but the institutional filter differs. In the EU/EEA, regulatory frameworks and integration policies feature more prominently, and barriers such as credential recognition and equitable access to upskilling shape whether migrants can move into expanding digital and green roles. In the U.S., flexibility and rapid adoption can accelerate both opportunity creation and displacement, with polarization dynamics contributing to persistent concentration of low-skilled immigrants in low-wage services. In China, rapid automation interacts strongly with internal mobility and uneven regional development, making relocation supports and stable urban absorption key to whether mobility translates into improved outcomes.

Policy implications mapped to barriers

The mechanism pathway and literature map suggest that automation and AI do not determine migrant outcomes directly. Outcomes depend on whether migrants can access upgrading

pathways and whether institutional supports reduce the costs of transition. Policy implications therefore map most clearly to Stage 5 barriers and mediators, because these are the points where interventions can convert task and occupational change into inclusive mobility rather than segmentation.

Table 5. Policy implications mapped to pathway barriers and mediators in the Automation-Migration Interface

Barrier or mediator	What it does in the pathway	Policy implications and actionable levers
Credential recognition and skills portability	Blocks movement from declining jobs into expanding digital and higher-quality roles, even when labour demand exists	Speed up recognition processes; expand bridging programmes and sector-specific conversion courses; fund competency-based assessments; mutual recognition and standardised frameworks; reduce licensing bottlenecks in high-demand occupations
Training access and time to retrain	Limits adjustment capacity, especially for low-wage migrants facing time, cost, and childcare constraints	Targeted training vouchers and paid training leave; employer co-funding tied to quality outcomes; modular and stackable micro-credentials; on-the-job training pathways in expanding sectors; outreach through trusted migrant organisations
Language and digital skills gaps	Reduces ability to perform new digital tasks and access training and job search tools	Integrated language-plus-vocation programmes; baseline digital literacy as an integration service; subsidised access to devices and connectivity; work-based language training in key sectors
Legal status and rights constraints	Restricts job mobility and bargaining power, increases exposure to exploitation, and discourages training investment	Expand portability of work permits across employers and sectors; reduce processing times; strengthen enforcement against labour abuses; ensure access to complaint mechanisms; clarify rights in platform and subcontracted work
Algorithmic screening and automated decision bias	Creates new gatekeeping points in hiring, scheduling, and employment services that can compound existing discrimination	Require transparency and auditing for high-impact employment systems; bias testing with migrant-relevant subgroups; contestability and human review; documentation of model purpose and limits; procurement standards for public employment services
Weak job-matching channels and limited networks	Constrains access to "good matches" as the labour market restructures	Strengthen public employment services for migrants; mentoring and referral programmes; employer partnerships; local mobility hubs; credential and skills signalling tools; recognition of prior experience and informal skills
Mobility constraints such as housing, transport, regional mismatch	Prevents movement to regions or firms where new tasks and jobs concentrate	Relocation grants; housing support tied to training or job offers; transport subsidies; place-based transition packages in regions facing automation shocks; support for circular and seasonal mobility where relevant
Welfare and transition supports	Determines whether displaced workers can take the risk of retraining and job search	Ensure eligibility and portability of benefits; integrate training with unemployment support; rapid-response services for displaced workers; counselling and job search assistance targeted to migrants
Workplace standards and job quality	Shapes whether expanding sectors provide stable pathways or reproduce low-wage traps	Enforce minimum standards in high-migrant sectors; address subcontracting and platform practices; promote career ladders; link subsidies to job quality, training provision, and progression outcomes.

Because EU/EEA, U.S., and China differ in welfare institutions, employment protection, training systems, and migration regimes, the same barrier will require different instruments. In EU/EEA settings, integration services, credential recognition, and coordinated training systems can be central levers. In the U.S., portability of status, enforcement in low-

wage sectors, and employer-led upskilling may matter more given labour-market flexibility. In China, where mobility is often internal, relocation supports, urban absorption capacity, and regional transition policies are likely to be more salient. Across all settings, transparency and accountability for AI-enabled employment decision tools is a cross-cutting implication.

These policy levers are most effective when packaged as transition supports that combine skills, matching, and protections, because the evidence indicates that migrant outcomes reflect the interaction of opportunity structures with barriers rather than exposure to automation alone.

Conclusion + scope limits + research agenda

This article proposed the Automation-Migration Interface Approach to synthesise how automation and AI reshape labour demand and, through labour-market segmentation, influence migrant outcomes in the European Union. Across the reviewed evidence, the upstream mechanisms are clearest: technology adoption changes task content and contributes to occupational restructuring that is often consistent with labour-market polarisation, with expansion in high-skill roles and persistence of some low-skill services alongside contraction in routinised middle-skill work (Ross et al., 2024; Mandelman and Zlate, 2022; Alabdulkareem et al., 2018). Within this opportunity structure, migrants' realised outcomes depend less on exposure alone than on sorting and mediators, including access to mobility pathways, training, credential recognition, and gatekeeping through automated decision systems (del Rio-Chanona et al., 2021; Medici et al., 2023; Zhao, 2020). EU-focused grey literature reinforces that Third-Country Nationals can contribute to the digital and green transitions, but persistent barriers in skills recognition and upskilling access risk reproducing segmentation and under-utilisation, even as demand for AI-related skills rises across advanced economies (Seiger et al., 2024; Borgonovi et al., 2023; Lane et al., 2023). Framed through Dual Labour Market Theory, the synthesis therefore supports the claim that technological change can amplify primary-secondary sector divides unless institutions and policies actively convert restructuring into inclusive mobility (Piore, 1979).

Several limits condition interpretation of these findings. First, the academic evidence base captured by the review is small relative to the breadth of the topic and is uneven across regions, with EU/EEA evidence dominated by Germany-centred modelling and policy analysis, and comparatively fewer studies directly estimating migrant outcomes using harmonised measures (Ross et al., 2024; Seiger et al., 2024). Second, many included studies operationalise mobility or matching mechanisms without measuring migrant status directly, which is analytically useful for mechanism tracing but restricts migrant-specific inference (del Rio-Chanona et al., 2021; Rajkumar et al., 2022). Third, cross-regional contrasts are indicative rather than like-for-like because institutional context differs across settings in ways that shape adoption speeds, adjustment pathways, and protections (Javed, 2023; Bian and Zhou, 2024). Fourth, despite multi-database searching and human validation, screening and coverage constraints remain, including database scope, English-language dominance, and potential LLM-assisted classification bias as described in the method part. Finally, the review is designed for mechanism-based synthesis rather than meta-analysis, so it does not provide pooled effect sizes or causal magnitudes comparable across regions and study designs.

The review points to a focused migration studies' agenda for generating higher-value, evidence, organised along the mechanism pathway.

1. Measure exposure consistently (Stages 1 to 2). Future studies should harmonise automation and AI exposure measures for migrants across sectors and places, distinguishing robotics, AI-enabled management, and generative AI task reconfiguration, and linking these to occupational task profiles and firm adoption data (Chen et al., 2024; Lane et al., 2023).

2. Identify causal pathways from restructuring to migrant outcomes (Stages 3 to 6). There is a need for designs that connect task and occupational shifts to migrant wages, stability, mobility, segregation, and skill utilisation using credible identification strategies and comparable migrant definitions. The current evidence demonstrates plausible mechanisms but less direct causal tracing for migrants across EU contexts (Mandelman and Zlate, 2022; del Rio-Chanona et al., 2021).
3. Make sorting and matching empirically visible (Stage 4). Researchers should quantify how migrants enter expanding occupations and regions, including the role of recruitment intermediaries, networks, and platform-mediated hiring. Evidence on mobility pathways and weak-tie access suggests measurable levers, but these need migrant-specific application in EU settings (Rajkumar et al., 2022; Medici et al., 2023).
4. Audit algorithmic gatekeeping and workplace AI (Stage 5). Given the potential for automated screening and risk prediction to compound disadvantage, a priority is evaluating bias, transparency, contestability, and disparate impact for migrants in hiring, scheduling, and employment-service tools (Zhao, 2020). EU-relevant studies should connect these mechanisms to observed transitions and job quality.
5. Institutional moderators and policy evaluation (Stages 5 to 6). Comparative work should test how training systems, credential recognition regimes, welfare eligibility, and employment protections shape adjustment. EU-level priorities include evaluating whether upskilling and recognition reforms increase migrants' transitions into digital and green roles and reduce under-utilisation (Seiger et al., 2024; Borgonovi et al., 2023).
6. Differentiate migration types and heterogeneity. Future evidence should distinguish intra-EU mobility, Third-Country Nationals, refugees, and temporary workers, and examine heterogeneity by gender, age, sector, and legal status. This is essential for identifying which groups face shrinking opportunities and which can capture upgrading pathways as adoption diffuses (Seiger et al., 2024; Lane et al., 2023).
7. Link internal migration dynamics where relevant for comparison. China-focused studies show that automation interacts strongly with internal mobility and regional disparities; incorporating comparable internal mobility measures can improve mechanism understanding without treating regions as directly comparable (Bian and Zhou, 2024; Niu et al., 2024).

Overall, the evidence supports a clear implication for future scholarship and policy: the central question is not only whether automation substitutes for or complements migrant labour, but which institutions and mediators determine whether migrants are channelled into upgrading pathways or remain concentrated in precarious segments of the labour market (Piore, 1979; Ross et al., 2024; Mandelman and Zlate, 2022).

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