Productivity Growth and Employment Dynamics

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Executive Summary

Introduction

This briefing report examines the relationship between productivity and employment growth using a UK-wide industry–region dataset covering twelve UK regions, including the devolved administrations, over the period 1998–2023. The analysis distinguishes between:

- **Direct effects**: the impact of productivity growth within the same sector; and
- **Indirect (spillover) effects**: the wider employment effects arising across other sectors through supply chains, lower costs, stronger demand and increased economic activity.

The analysis allows the relationship between productivity growth and employment to vary across sectors and regions, providing long-run estimates for both the UK as a whole and Northern Ireland specifically.

Main Findings

Productivity growth has uneven direct employment effects across sectors

The analysis shows that productivity growth does not affect all sectors in the same way. Focusing on the direct within-sector effects, the strongest labour-saving impacts are observed in Primary industries, Manufacturing and Administrative Services. In these sectors, productivity growth is associated with lower employment within the sector where the productivity gains occur, reflecting automation, mechanisation and organisational efficiency improvements that reduce labour requirements. These estimates capture only the direct employment effects and do not take account of the positive spillover effects that productivity growth may generate elsewhere in the economy.

By contrast Knowledge-Intensive Business Services show little evidence of substantial labour displacement, suggesting stronger complementarities between technology and high-skilled labour. In addition, Consumer and Local Market Services display relatively modest negative direct employment effects, reflecting the continued importance of interpersonal interaction and locally delivered services.

Positive spillover effects offset labour-saving effects

The analysis finds strong evidence of positive spillover effects across all sectors. Productivity growth in one part of the economy generates wider benefits through supply-chain links and income effects. Combining the direct and indirect (spillover) effects, the findings suggest that productivity growth primarily contributes to the reallocation of employment across sectors rather than uniform job destruction across the economy.

Results align with task-based theories of technological change

The findings are closely aligned with the task-based literature which emphasises that technological change affects tasks rather than occupations as a whole. Sectors characterised by routine, codifiable and automatable activities display stronger labour-saving effects, while sectors involving non-routine cognitive work, creativity, problem-solving and interpersonal interaction display weaker labour displacement and greater complementarity between labour and technology.

The findings are also broadly consistent with aspects of the job polarisation hypothesis, whereby technological change disproportionately affects routine middle-skill employment while increasing demand for some high-skill and locally delivered service roles.

Policy Implications

The findings suggest that productivity policy should focus not only on maximising productivity gains, but also on addressing how technological change affects employment outcomes. Since employment effects differ substantially across sectors, **sector-focused interventions** are likely to exert a strong influence on long-run employment outcomes. Key priorities include:

- Workforce transition planning and reskilling in sectors exposed to automation;
- Strengthening digital, AI, STEM and management capability in technology-complementary sectors;
- Improving management quality and progression opportunities in local service sectors;
- Addressing skills shortages and supply constraints in sectors with strong spillover effects, particularly Construction; and
- Strengthening the export capacity and competitiveness of tradable sectors.

Place-based policies are also important because regions differ significantly in terms of industrial structure, workforce characteristics, infrastructure and exposure to technological change. Relevant **place-based priorities** include:

- Supporting regional diversification;
- Aligning local skills provision with changing sectoral demand;
- Investing in transport and digital connectivity; and
- Support supply-chain development, innovation networks and SME engagement programmes that strengthen linkages between sectors and improve the competitiveness of firms upstream and downstream of industries with strong spillover effects.

1. Introduction

With persistently weak productivity growth acting as a constraint on economic performance in the UK, there is a strong policy focus on improving productivity across the economy. At the same time, the emergence of new technologies, particularly robotics, digitalisation and artificial intelligence (AI), offers significant potential to enhance efficiency and support faster economic growth. However, the implications of higher productivity for employment are unclear due to offsetting effects. While technological advances are sometimes associated with job displacement and labour-saving change[1], research evidence shows that productivity growth can support job creation and rising economic activity. The overall employment impact of productivity growth depends on how these effects operate both within individual industries and through wider interactions across the economy.

Against this backdrop, this study provides empirical evidence on the relationship between productivity and employment using an industry–region panel dataset covering twelve regions within the UK, including devolved administrations. By distinguishing between direct (within-sector) and indirect (spillover) effects operating across the wider economy, the analysis provides insight on how productivity gains translate into employment outcomes across different industries and regions. The study examines these relationships at both the aggregate UK level and across individual regions, allowing consideration of how the relationship between productivity and employment varies across regions. Particular attention is given to the implications for Northern Ireland throughout this briefing report.

The remainder of the report is structured as follows. Section 2 reviews the key findings in the literature, Section 3 presents the empirical analysis and Section 4 discusses the key findings and their implications for policy.

2. Insights From Other Studies

The relationship between productivity growth and employment is complex, with evidence pointing to a range of diverse and sometimes opposing effects. Productivity growth can simultaneously displace workers, create new jobs and lead to changes in the composition of employment. An important distinction in the literature is between direct and indirect effects. The former refers to the impact of productivity growth within the industries where it originates, while the latter captures the impact of spillover effects across the economy.

[1] Labour-saving technological change refers to productivity improvements that reduce the amount of labour required to produce a given level of output, often through automation, mechanisation or more efficient production processes.

Direct Effects: Within Industry Effects

Within industries, productivity growth may influence employment through several distinct channels (Figure 1). On the one hand, technological progress can reduce labour demand through labour-saving effects, where firms are able to produce the same level of output with fewer workers. On the other hand, productivity growth may also support employment through complementary effects, where technology enhances worker capabilities and raises demand for labour, and through scale effects, where lower production costs and improved competitiveness stimulate output growth and expand employment.

Many studies show that productivity growth reduces the demand for labour within the industries where it originates. Using cross-country industry data covering OECD countries, Autor and Salomons (2017) found negative own-industry employment effects, consistent with labour-saving technological change such as automation. This finding is closely linked to the task-based framework developed by Autor (2013), which treats production as a set of tasks rather than occupations. Technological change tends to substitute for workers performing routine and codifiable tasks, such as clerical work or repetitive manufacturing processes, leading to job displacement in these roles. More recent contributions emphasise that technological change can also reshape the role of expertise within organisations, allowing workers to perform more complex tasks with technological assistance and altering the composition of labour demand (Autor and Thompson, 2025). These mechanisms help explain the long-term decline in middle-skill jobs in sectors such as Manufacturing and Administrative Services.

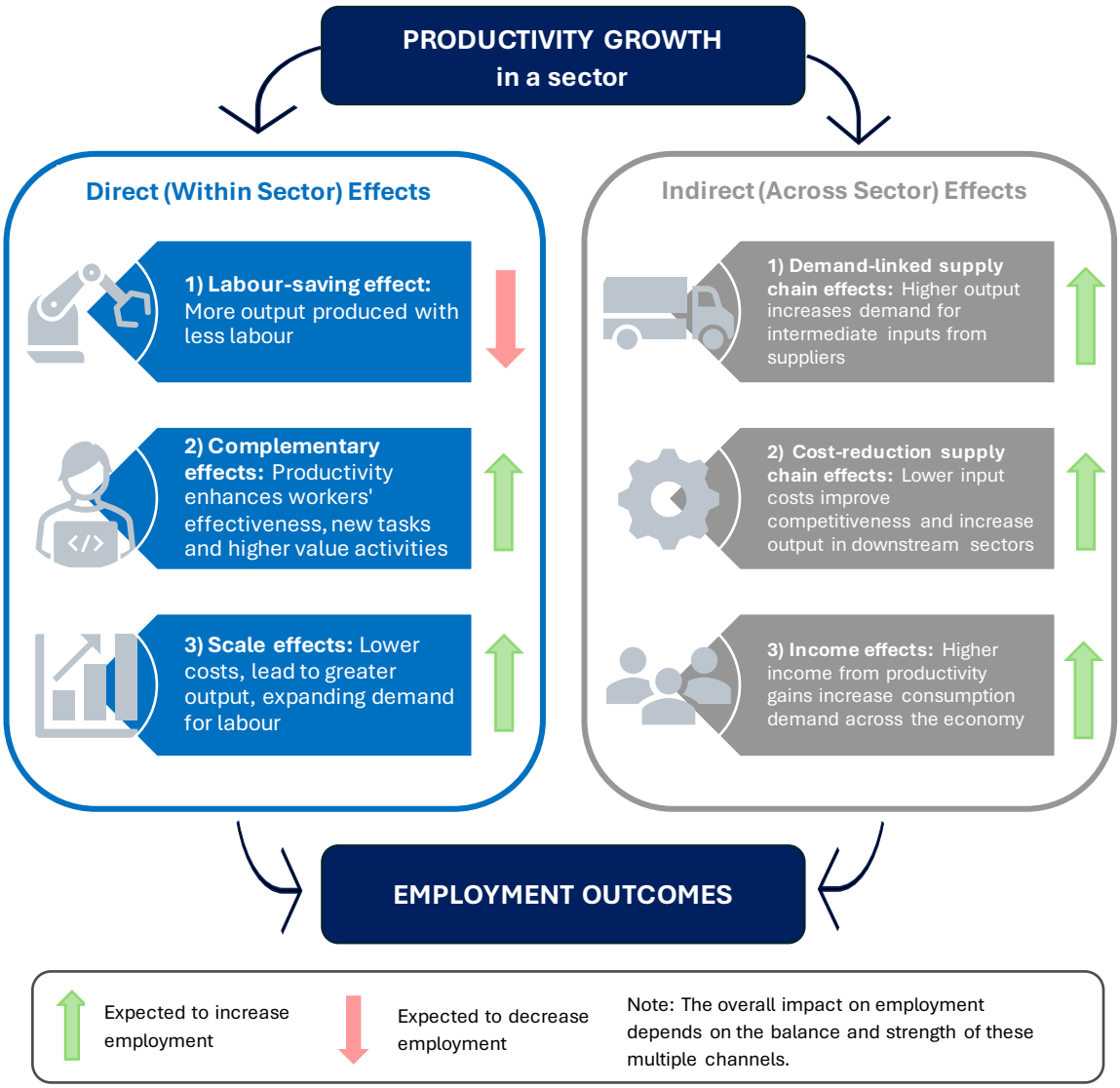
Further evidence supports this displacement pattern. Acemoglu and Restrepo (2020) show that the adoption of industrial robots in the United States reduced employment and wages in affected regions, while Graetz and Michaels (2018) find that although automation raises productivity, it often reduces labour input within directly affected industries.

However, the direct effects of productivity growth are not uniformly negative. The task based literature also emphasises that technology may complement rather than displace labour, particularly in non-routine, cognitive tasks (e.g. problem-solving, management) and interpersonal tasks (e.g. personal services). In this context, technological progress may enhance worker productivity and increase the demand for labour.

In addition, productivity gains can generate scale effects. In a competitive market, productivity growth may lead to a reduction in production costs, which exerts a downward impact on prices and raises real incomes, which in turn increases consumption. Furthermore, technological progress may improve product quality, customisation and speed of delivery, which also contribute to increasing demand (Bessen, 2019). If the increase in demand is sufficient enough, this will offset the labour saving effects, leading to a total increase in employment within the sector.

Overall, the evidence suggests that the direct impact of productivity growth on employment is ambiguous and sector-specific, depending on the balance between substitution, complementary and demand (scale) effects.

Figure 1: Channels in which productivity growth may affect employment



Indirect Effects: Spillover Effect

Beyond individual industries, productivity growth generates important spillover effects that influence employment across the wider economy. These spillover effects occur through multiple channels (Figure 1).

One key channel operates through supply chains. Direct productivity gains can stimulate output expansion in the originating sector, increasing demand for intermediate inputs and generating employment spillovers across connected industries. In addition, when productivity improves in upstream industries, production costs fall, lowering prices for downstream firms. This stimulates output expansion and increases labour demand in those sectors. For example, productivity gains in semiconductor manufacturing have enabled growth in industries such as consumer electronics and software services.

Another important channel is through income and demand effects. Productivity growth stimulates increases in income through lower prices, which leads to increased spending across the whole economy. This demand-driven effect can generate employment growth across a wide range of sectors, particularly in service sectors where demand is closely linked to household spending, e.g. retail and hospitality.

These indirect effects can be substantial and, in some sectors, may offset or even outweigh negative direct effects. As shown by Autor and Salomons (2017), the net impact of productivity growth on employment depends critically on these economy-wide spillovers.

Labour Market Adjustment

Even where overall employment is stable, productivity growth can lead to significant structural changes in the labour market. The task-based literature highlights a long-term trend of job polarisation in advanced economies, with growth in high-skill and low-skill jobs alongside a decline in middle-skill roles (Autor, 2013; Autor, 2019).

This reflects the fact that routine tasks, often concentrated in middle-skill occupations, are more easily automated. Workers displaced from these roles may move to lower-paid service jobs, contributing to shifts in the composition of employment and, in some cases, widening income inequality. As a result, productivity growth may be associated with reallocation rather than net job loss, but with important distributional consequences. While this evidence is largely based on earlier waves of technological change, emerging technologies such as AI have the potential to affect a broader range of cognitive and professional tasks, suggesting that future patterns of labour-market adjustment may differ in some respects from those observed historically.

Institutional and Policy Contexts

The employment effects of productivity growth are shaped not only by technology itself, but also by the institutional and policy environment within which technological change occurs. Autor (2022) emphasises that the impacts of technologies, such as automation and digital, are not predetermined. Rather, labour market outcomes depend on how technological change is developed, adopted and managed through education systems, labour market institutions, training frameworks and wider public policy. In this context, policy plays an important role in shaping whether productivity gains complement labour, support job creation and improve job quality, or instead contribute to labour displacement and inequality.

Key factors influencing employment outcomes include:

- Skill complementarities: The extent to which workers can adapt to and work alongside new technologies.
- Labour market institutions: Wage-setting mechanisms, training systems and employment protections that influence how the gains from productivity growth are distributed.
- Adjustment frictions: The ease with which workers can move between sectors, occupations and regions in response to structural change.

While previous waves of technological progress ultimately supported long-run employment growth, the speed and breadth of current technological change, particularly advances in artificial intelligence, raise important questions about whether labour market adjustment mechanisms will operate as effectively in the future. This highlights the importance of complementary policies that actively shape the direction and diffusion of technological change, including investment in skills, retraining, workforce adaptability and support for worker mobility. Such measures can help ensure that productivity gains translate into broad-based and inclusive employment outcomes rather than uneven labour outcomes.

3. Analysis

3.1 Approach

This analysis examines the relationship between productivity growth and employment growth using an industry–region panel dataset covering industries across regions over time. The dataset is constructed using ONS Regional Gross Value Added (GVA) by industry, together with workforce jobs data. Productivity is expressed as Real GVA per job, aligning with the specification used in the UUEPC outlook model and enabling the outputs to inform modelling scenarios. The dataset covers twelve UK regions (nine English regions, plus Scotland, Wales and Northern Ireland), seven broad industry groupings and the period 1998 to 2023.

In particular, the approach examines how changes in productivity affect employment within each industry, distinguishing between direct and indirect effects:

- Direct effects: How productivity growth within an industry affects employment in that same industry.
- Indirect (spillover) effects: How productivity growth in other industries affects employment, reflecting connections across the wider economy (for example through supply chains or changes in demand).

The analysis also allows for effects to occur over time by including one and two-year lags. This reflects the fact that productivity improvements often take time to influence employment as firms adopt new technologies, reorganise production and adjust workforce levels, while labour market frictions may delay these responses. Including lagged effects therefore captures both the immediate and delayed employment consequences of productivity growth. Further technical details on how the productivity-employment relationships are estimated are provided in Appendix A.

The analysis groups industries into seven broad sectors to reflect the fact that different parts of the economy behave differently[2]:

- Primary: Agriculture, mining and quarrying, utilities and water supply and waste management
- Manufacturing
- Construction
- Consumer and Local Market Services (CLMS): Wholesale and retail, transport, hospitality, arts and other personal services
- Knowledge-Intensive Business Services (KIBS): Finance, ICT and professional, scientific and technical services
- Administrative and Support Services
- Public Services: Public administration, education and health

This grouping reflects shared characteristics, including role of technology and exposure to trade, which may have a bearing on employment response to productivity growth. Sectors vary in several key respects:

[2] The Real Estate sector is excluded from the analysis due to difficulties in measuring GVA in this sector due to the need to include imputed rents on owner-occupied dwellings.

- Use of technology and automation: Manufacturing and administrative services are more exposed to automation, while many service roles rely more on human interaction.
- Capital intensity: Some sectors rely heavily on machinery and equipment, while others depend more on labour.
- Demand patterns: Consumer-facing services are closely tied to household spending, whereas knowledge-based services are often driven by business demand.
- Supply chain linkages: Productivity improvements in one sector (e.g. manufacturing) can create demand in others (e.g. logistics, business services).
- Exposure to competition and trade: Tradable sectors may respond differently to productivity gains than locally oriented services.

These characteristics often interact in practice. The employment response to productivity growth therefore reflects the combined influence of factors such as technology, capital intensity, trade exposure, demand conditions and supply-chain integration, rather than any single characteristic in isolation.

Additionally, it is important to distinguish between different types of services. For example:

- Administrative and support services tend to be more cyclical and demand-driven, often expanding and contracting with overall economic activity.
- Knowledge-intensive business services (KIBS) are more likely to be innovation-driven and complementary to technology, meaning productivity growth may increase demand for skilled labour.
- Consumer services (CLMS) often depend on local demand and face-to-face interaction, making them less susceptible to automation and more likely to absorb workers from other sectors.

By accounting for these differences, the analysis provides a means of assessing how productivity growth affects employment across the economy.

3.2 Results

Main Results

The estimated direct and indirect long-run impact of productivity growth on industry employment growth at both the UK-wide and Northern Ireland levels derived from the Bayesian estimation are shown in Tables 1 and 2. The Bayesian hierarchical model exhibited strong convergence diagnostics, providing reassurance regarding the statistical robustness of the estimated elasticities.[3] The results provide strong evidence that the employment effects of productivity growth vary substantially across sectors and operate through both direct (within-sector) and indirect (spillover) channels.

The estimated long-run effects for Northern Ireland are broadly similar to those for the UK as a whole. More generally, across all the regions the results suggest that differences across sectors are considerably more important than differences across regions in explaining variation in the

[3] All estimates use 4 chains x 1,000 post-warmup draws (4,000 total) on a UK-wide panel of 12 NUTS1 regions x 7 sectors x 1998-2023. All Rhats = 1.00; bulk ESS > 600 for every parameter; 0 divergent transitions.

productivity–employment relationship. Variance decomposition of the estimated coefficients indicates that approximately 70% of the variation in the direct effects reflects differences between sectors, while around 30% reflects regional differences. The dominance of sectoral factors is even more pronounced for spillover effects, where approximately 85% of the variation is attributable to differences between sectors and only 15% to differences across regions.

Table 1: Estimated direct long-run elasticities for the UK and Northern Ireland

SECTOR	LR DIRECT UK (95% CrI)	LR DIRECT NI (95% CrI)	P(NI labour-saving)
Primary	-0.44 [-0.68, -0.19]	-0.43 [-0.69, -0.18]	100%
Manufacturing	-0.39 [-0.65, -0.14]	-0.39 [-0.65, -0.12]	100%
Construction	-0.18 [-0.51, 0.16]	-0.18 [-0.52, 0.16]	85%
CLMS	-0.19 [-0.40, 0.04]	-0.18 [-0.41, 0.05]	93%
KIBS	-0.04 [-0.23, 0.15]	-0.03 [-0.23, 0.16]	63%
Admin services	-0.25 [-0.62, 0.13]	-0.24 [-0.62, 0.14]	90%
Public Services	-0.22 [-0.46, 0.00]	-0.22 [-0.47, 0.02]	96%

Note: Estimates are long-run elasticities. For example, a value of -0.44 indicates that a 1% increase in productivity is associated with a 0.44% decrease in employment within the same sector, holding other modelled factors constant. Long-run effects combine contemporaneous, one-year lagged and two-year lagged effects. CrI denotes Bayesian credible interval. Reported probabilities indicate the likelihood that the estimated direct effect is negative.

Table 2: Estimated indirect (spillover) long-run elasticities for the UK and Northern Ireland

SECTOR	LR INDIRECT UK (95% CrI)	LR INDIRECT NI (95% CrI)	P(NI positive spill)
Primary	0.41 [0.12, 0.71]	0.43 [0.13, 0.76]	100%
Manufacturing	0.56 [0.19, 0.91]	0.58 [0.21, 0.96]	100%
Construction	0.69 [0.33, 1.08]	0.71 [0.33, 1.13]	100%
CLMS	0.71 [0.39, 1.02]	0.73 [0.41, 1.08]	100%
KIBS	0.54 [0.25, 0.83]	0.56 [0.26, 0.87]	100%
Admin services	0.68 [0.30, 1.07]	0.70 [0.31, 1.11]	100%
Public Services	0.49 [0.13, 0.80]	0.51 [0.16, 0.85]	100%

Note: Estimates are long-run elasticities. With regards to indirect effects, a value of 0.41indicates that a 1% increase in the average productivity growth of other sectors within the regional economy is associated with a 0.41% increase in employment in the sector concerned, holding other modelled factors constant. Long-run effects combine contemporaneous, one-year lagged and two-year lagged effects. CrI denotes Bayesian credible interval. Reported probabilities indicate the likelihood that the estimated indirect (spillover) effect is positive.

Heterogeneous Direct Effects

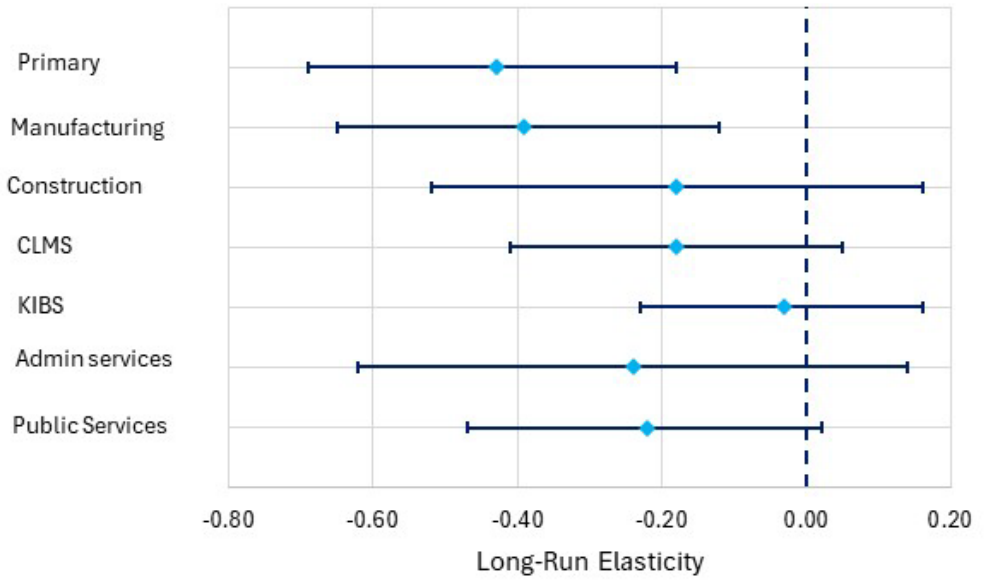
Focusing on the Northern Ireland results, the long-run direct elasticities shown in Table 1 and Figure 2 indicate that productivity growth tends to have labour-saving effects in most sectors, although the magnitude of these effects varies considerably across industries.

The strongest negative direct effects are observed in the **Primary** and **Manufacturing** sectors. The estimated long-run elasticity for Manufacturing implies that a 1% increase in productivity

reduces employment within the sector by approximately 0.39%, while the corresponding effect for the Primary sector is slightly larger at minus 0.43%. In both cases, the probability that productivity growth is labour-saving exceeds 99%.

These findings are consistent with the task-based and automation literature, which emphasises that technological progress in tradable and capital-intensive sectors is often associated with labour-saving technological change and automation (Autor, 2013; Acemoglu and Restrepo, 2020). In these sectors, productivity gains commonly arise due to mechanisation, robotics and efficiency improvements that reduce labour requirements. The labour-displacing effects of automation may be intensified by the tradable nature of these sectors, particularly in manufacturing, as firms are exposed to strong national and international competitive pressures that increase the incentive to improve efficiency and reduce labour costs. While productivity improvements may support output growth in the manufacturing sector, the results suggest that the productivity gains were not sufficiently large, or sufficiently widespread across manufacturing subsectors, to generate output and export growth strong enough to fully offset labour-saving technological change.

Figure 2: Direct NI long-run elasticities, with 95% credible intervals



The **Construction** sector displays only a relatively modest negative direct effect (minus 0.18), with wider uncertainty around the estimate. This suggests that while mechanisation and efficiency improvements are important, these are partly offset by demand-side effects associated with investment cycles and project delivery requirements. During periods of strong investment activity, productivity improvements may enable firms to expand output by undertaking more projects or completing projects more quickly, thereby limiting the extent to which labour-saving effects translate into lower employment.

With regard to the service sectors, **Administrative Services** displays the largest negative direct effect (minus 0.24), with a high probability (90%) that productivity growth reduces labour

demand. This aligns with the routine nature of many administrative and support roles, which are more susceptible to automation, digitalisation and organisational efficiencies.

In contrast, the estimated long-run elasticity for **Knowledge-Intensive Business Services (KIBS)** is close to zero (minus 0.03), indicating that productivity growth in this sector is broadly employment-neutral rather than labour-replacing. This finding is consistent with the task-based literature, which emphasises complementarities between technology and high-skilled labour in non-routine cognitive occupations (Autor, 2013; Autor, 2019). In sectors such as ICT, professional services and finance, productivity-enhancing technologies may augment worker capabilities rather than directly substitute for labour. Consequently, technological change in these sectors may alter the composition and nature of work more than the overall level of employment.

The long-run direct elasticity for **Consumer and Local Market Services (CLMS)** is moderately negative (-0.18), although the credible interval includes zero. The relatively limited labour-displacing impact is consistent with the labour-intensive and locally delivered nature of many consumer-facing services. These activities often rely heavily on interpersonal interaction and are therefore less exposed to automation and labour-saving technological substitution. Productivity improvements in these sectors are more likely to arise through incremental improvements in organisation, logistics and service delivery rather than large-scale labour replacement. In addition, productivity gains may stimulate demand through lower prices, improved service quality and higher real incomes, partly offsetting substitution effects.

Public Services exhibit an elasticity of minus 0.22, suggesting that productivity gains may reduce labour inputs, although the overall effect remains relatively limited. This modest employment response is consistent with the institutional and policy-constrained nature of many public and non-market activities, where employment levels are influenced by public budgets, service obligations and governance structures rather than purely market-based adjustments (Autor, Mindell and Reynolds, 2020). The estimated probability that productivity growth is labour-saving in Public Services (approximately 96%) is in fact marginally higher than in Administrative Services; the more muted interpretation here reflects institutional and budgetary constraints on public-sector employment adjustment rather than a smaller or less certain estimated effect.

Overall, the results highlight the importance of sectoral heterogeneity. Productivity growth appears most labour-saving in tradable and routine-intensive sectors, while employment effects are more muted in knowledge-intensive and consumer-facing services where complementarities between labour and technology are stronger.

Offsetting Spillover Effects Across the Regional Economy

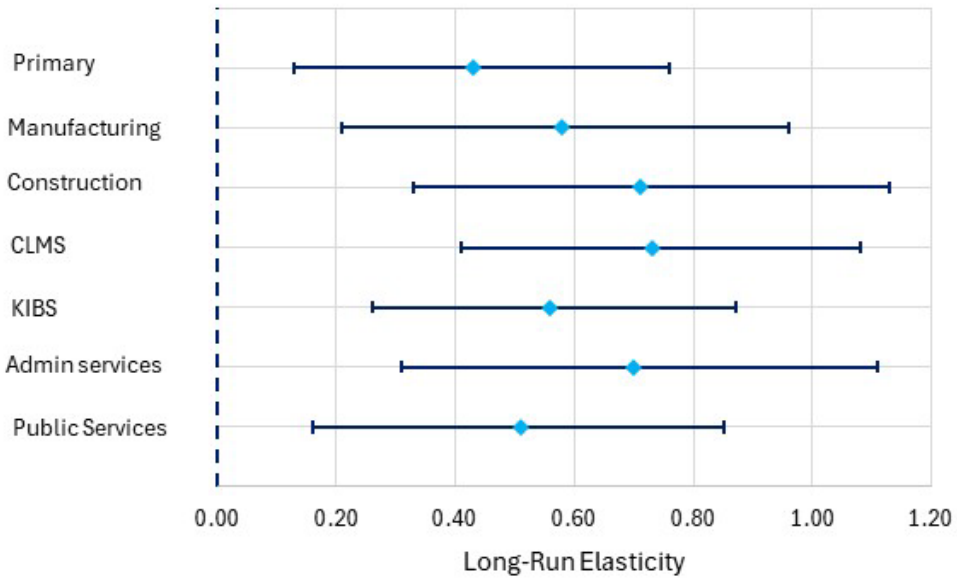
The long-run spillover elasticities shown in Table 2 and Figure 3 indicate that productivity growth in one part of the regional economy tends to support employment growth in other sectors through channels such as supply-chain linkages and income effects. Unlike the direct effects, which vary considerably across industries, the spillover effects are positive across all sectors and relatively similar in magnitude. The estimated spillover elasticities range from approximately 0.4 to 0.7 across sectors, with all probabilities indicating near certainty that

spillover effects are positive. This suggests that the indirect benefits of productivity growth operate broadly across the whole economy, even where own-sector productivity growth may be labour-saving. Because the long-run spillover elasticities are estimated with uncertainty and their credible intervals overlap substantially across sectors, the most robust reading is that spillovers are positive and broadly similar in magnitude across the economy, rather than representing a precise ranking of individual sectors. This points to the presence of a broadly shared regional multiplier operating across industries.. Accordingly, the sector-specific comparisons with the NISRA Input-Output multipliers below should be read as broadly illustrative corroboration rather than confirmation of a precise sectoral ordering.

Construction and **Administrative Services** exhibit some of the largest spillover elasticities, with long-run effects of approximately 0.7. This likely reflects the cross-cutting nature of these sectors within regional economies. Construction activity is closely linked to investment and business expansion across the wider economy, as growth in other industries often generates demand for new buildings, infrastructure and commercial premises. Similarly, Administrative Services provide supporting functions across a wide range of industries, including logistics, facilities management and business support services..

CLMS displays a sizeable positive spillover elasticity (0.71), implying that productivity growth elsewhere in the regional economy tends to support employment growth in locally oriented consumer services. This positive impact is consistent with local multiplier mechanisms identified in the regional economics literature (Moretti, 2010). Productivity growth in higher-productivity sectors can increase regional incomes and spending power, thereby generating additional demand for retail, hospitality and other locally delivered services. The results therefore suggest that positive income and demand effects exceed any potential crowding-out pressures at the aggregate sectoral level.

Figure 3: Indirect NI long-run elasticities, with 95% credible intervals



Manufacturing, Primary, KIBS and Public Services also exhibit sizeable positive spillover elasticities (although more moderate compared with the above sectors), indicating that productivity gains elsewhere in the economy support employment growth within these sectors. In Manufacturing and Primary industries, this may partly reflect supply-chain linkages and lower input costs, while in KIBS it likely reflects increased demand for professional, technical and digital services as economic activity expands.

The spillover results are broadly consistent with evidence from NI's Input-Output Accounts (NISRA, 2026). Sectors identified in the econometric analysis as exhibiting relatively strong indirect effects also display comparatively large output multipliers in the NISRA Input-Output Tables. For example, Construction has one of the largest Type I output multipliers in the economy, indicating extensive supply-chain linkages, providing support for the finding that productivity improvements in Construction can have important spillover effects beyond the sector itself.

The results for CLMS are also consistent with the Input-Output evidence, although through a different channel. While the Input-Output tables indicate several consumer-facing industries exhibit only moderate indirect supply-chain effects, they display relatively large induced effects within the Type II multipliers. This suggests that increases in household income and expenditure generate substantial demand for retail, hospitality, transport and other locally delivered services. Such findings are consistent with the interpretation that positive income and demand effects contribute to the sizeable spillover elasticities estimated for CLMS.

Nevertheless, the econometric estimates should not be interpreted as directly equivalent to input-output multipliers. The input-output framework primarily captures supply-chain linkages and household expenditure effects associated with changes in economic activity, whereas the econometric model identifies the historical employment response to productivity growth. As a result, the estimated spillover elasticities capture a broader range of mechanisms, including supply-chain effects, income effects, cost reductions and wider demand responses operating across the economy.

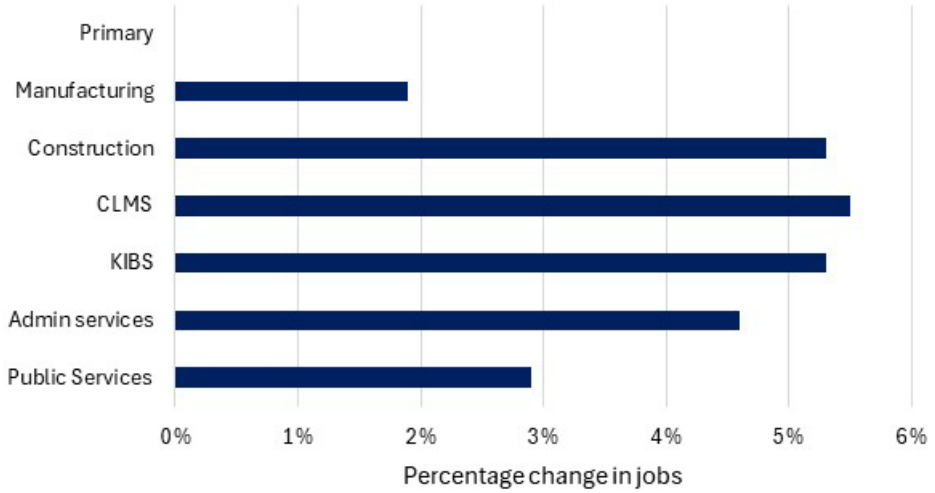
Overall, the spillover results indicate that productivity growth generates important economy-wide employment benefits that partially offset direct labour-saving effects within individual sectors.

3.3 Scenario Analysis

To illustrate the implications of the econometric results, the estimated Bayesian long-run elasticities were used to simulate the effects of an economy-wide productivity increase. The scenario considers a 10% increase in productivity across all sectors simultaneously. This should be interpreted as a stylised medium to long-run increase, occurring gradually over a number of years, rather than a single year increase in productivity growth.

Figure 4 shows the estimated percentage change in employment within each sector resulting from the economy-wide 10% productivity increase. The scenario generates positive employment effects across most sectors, highlighting the importance of indirect spillover effects within the wider economy. While productivity growth may reduce labour demand directly within some sectors through automation, efficiency improvements and labour-saving technological change, these effects are fully offset by positive spillovers arising through stronger aggregate demand, lower production costs, supply-chain linkages and increased economic activity across connected industries.

Figure 4: Economy-wide productivity growth scenario: Percentage change in jobs



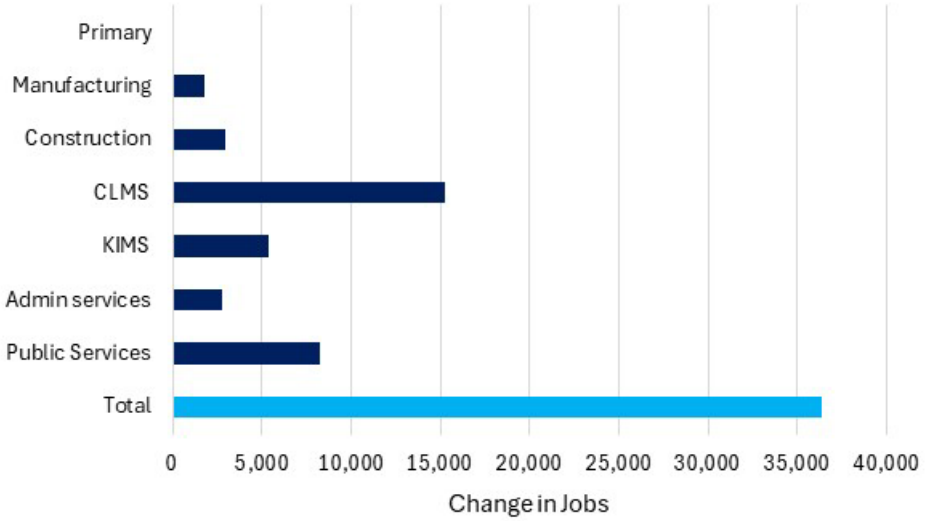
Note: Figure illustrates the estimated long-run percentage change in sectoral employment associated with a stylised 10% increase in productivity across all sectors simultaneously. Effects are derived from the estimated Bayesian long-run elasticities and combine both direct within-sector effects and indirect spillover effects operating through the wider economy. In the Primary sector, the overall net employment effect is close to zero because negative direct labour-saving effects are broadly offset by positive spillover effects from productivity growth elsewhere in the economy.

The largest employment gains are observed in CLMS (+5.5%), followed by Construction (+5.3%) and KIBS (+5.3%). Administrative Services and Public Services also record sizeable positive employment increases (+4.6% and +2.9% respectively). These findings suggest that sectors characterised by relatively limited direct labour displacement, combined with strong integration with the wider economy, benefit most from economy-wide productivity growth. In these sectors, the positive spillover and demand effects outweigh any direct labour-saving impacts.

Manufacturing employment increases more modestly (+1.9%). While the sector benefits from positive spillover effects associated with stronger economy-wide growth, these gains are partially offset by direct labour-saving effects linked to automation and efficiency improvements within the sector itself. The Primary sector shows little overall employment response (0.0%), reflecting strong labour-saving effects fully offsetting moderately positive spillover effects.

Figure 5 translates the percentage changes shown in Figure 4 into estimated changes in the number of jobs, taking account of the current size of each sector in NI. While KIBS records one of the strongest percentage employment responses to productivity growth, its contribution to overall job creation is more modest because it starts from a relatively small employment base. By contrast, a large share of the employment gains occur within CLMS, reflecting both its positive employment response and its substantially larger share of total employment. This illustrates that the aggregate employment consequences of productivity growth depend not only on sectoral elasticities, but also on the existing industrial structure of the economy.

Figure 5: Economy-wide productivity growth scenario: Change in absolute number of jobs



Overall, the scenario analysis highlights the coexistence of direct labour-saving effects and positive spillover effects arising from productivity growth. Rather than leading to uniform job destruction, productivity growth appears to contribute to the reallocation of employment across sectors, with employment expanding in some parts of the economy while growing more slowly in others.

It is important to bear in mind that the scenario represents a stylised economy-wide productivity shock. In practice, productivity growth is unlikely to occur evenly across all sectors and instead tends to vary over time according to differences in technological change, market conditions and sector-specific investment patterns. Knowledge-intensive sectors may experience faster productivity growth than many consumer-facing services, particularly where digital technologies and AI are more readily adopted. As a result, the actual pattern of employment reallocation may differ from that illustrated here. Nevertheless, the scenario illustrates how productivity gains arising elsewhere in the economy may generate spillovers that

support employment in lower-productivity service activities. In this respect, the findings are consistent with the job-polarisation literature, which emphasises employment growth in high-skill and some lower-skill service occupations.

4. Discussion

Uneven effects across sectors

The results highlight that the employment effects of productivity growth are uneven across sectors and operate through a combination of direct labour-saving effects and broader positive spillover effects across the economy. Rather than exerting a uniform impact on employment, productivity growth appears to contribute to the reallocation of employment across sectors, with the balance between displacement and expansion depending on the characteristics of individual industries.

Importantly, the estimated direct effects within sectors are not equivalent to the total employment effects across the wider economy. A sector may experience direct labour-saving effects from productivity growth within the sector itself, while still benefiting indirectly from productivity growth elsewhere in the economy through spillover and demand effects.

The results are closely aligned with the task-based literature associated with Autor (2013, 2019), which emphasises that the employment consequences of technological change depend on the nature of tasks performed within industries. Sectors characterised by routine, codifiable and automatable activities display the strongest evidence of labour-saving effects. In contrast, sectors involving non-routine, cognitive oriented work, interpersonal interaction or locally delivered services exhibit weaker labour displacement and, in some cases, broadly employment-neutral outcomes.

The strongest direct labour-saving effects are observed in Primary industries (such as Agriculture), Manufacturing and Administrative Services. These sectors are more exposed to mechanisation and automation, reflecting the routine-intensive and, in many cases, tradable nature of production. By contrast, KIBS display little evidence of substantial labour displacement. This is consistent with the argument that technology may complement rather than substitute for high-skilled labour engaged in problem-solving, management, analytical and creative tasks. Similarly, the direct estimate for CLMS is moderately negative, with a credible interval that includes zero. The limited labour-displacing impact in CLMS reflects the importance of interpersonal interaction and the more limited scope for automation in many locally delivered services.

Job reallocation

The results also provide strong evidence of positive spillover effects across all sectors. Productivity growth in one part of the economy generates wider benefits through supply-chain linkages, lower production costs, increased incomes and stronger aggregate demand. These spillovers help offset direct labour-saving effects and suggest that productivity growth primarily drives employment reallocation across sectors rather than aggregate job destruction. The scenario analysis indicates that this reallocation is likely to favour sectors that benefit most from indirect demand and spillover effects, particularly consumer-facing local market services, construction and knowledge-intensive business services, although the precise pattern will depend on where productivity growth occurs within the economy.

Nevertheless, the process of adjustment may not be immediate in practice. Workers displaced from labour-saving sectors may face transition challenges before new employment opportunities emerge elsewhere in the economy. This highlights the importance of policies that

support labour market adjustment and facilitate worker transitions across sectors. While the results indicate that productivity growth is associated with the reallocation of employment across sectors, the analysis does not imply that workers displaced from labour-saving sectors automatically transition into expanding sectors. The adjustment process may involve retraining requirements, occupational mismatch, geographic mobility constraints and differences in wage levels or job quality. As a result, the policy challenge is not only whether employment opportunities emerge elsewhere in the economy, but whether workers can realistically access these opportunities.

The results are broadly consistent with elements of the job polarisation hypothesis identified in the task-based literature, which argues that technological change disproportionately displaces routine middle-skill work while increasing demand for both high-skill cognitive occupations and some lower-skill service roles. Evidence of job polarisation has been particularly pronounced in the United States, where technological change and automation have been associated with a long-term decline in routine middle-skill employment alongside growth at both the upper and lower ends of the occupational distribution (Autor and Dorn, 2013).

However, the UK has experienced comparatively weaker productivity growth in recent years relative to the US, potentially limiting both the pace of labour-saving technological change and the scale of employment reallocation across sectors. Institutional differences, labour market structures and slower diffusion of frontier technologies may also have moderated polarisation dynamics relative to the US experience.

Artificial intelligence

Although the analysis is based on historical data and does not directly model AI adoption, the findings provide some insight into how different sectors have historically responded to productivity-enhancing technological change. However, the potential impact of AI may differ from earlier waves of productivity growth. Previous technological progress primarily affected routine production and clerical activities, whereas AI has the potential to influence a much broader range of cognitive, analytical and professional tasks across the economy.

The results suggest that sectors characterised by routine and standardised activities, particularly Manufacturing and Administrative Services, remain vulnerable to labour-saving technological change. In these sectors, AI may further automate repetitive production processes, clerical work and routine administrative tasks, potentially intensifying existing displacement pressures. At the same time, many firms and workers within these sectors have already undergone several decades of technological adjustment associated with earlier waves of technology change. As a result, they may be comparatively better prepared to adapt through workforce restructuring, task redesign, retraining and technology adoption.

However, the findings also suggest that AI exposure is likely to extend well beyond traditionally routine-intensive sectors. KIBS, including ICT, Finance and Professional Services, may experience substantial task restructuring as AI increasingly supports activities such as coding, data analysis, information processing and reporting. In these sectors, AI may augment worker productivity and alter the composition of work more than overall employment levels, although some routine cognitive and entry-level tasks may become increasingly automated.

Recent experimental evidence from professional services settings is consistent with this interpretation. Randomised controlled trials in knowledge-work settings find that AI adoption raises productivity substantially, with gains disproportionately concentrated among less-experienced workers (Brynjolfsson, Li and Raymond (2025) and Dell'Acqua *et al.* (2026)). This suggests that AI tends to complement rather than substitute for skilled labour in knowledge-intensive sectors, at least in the near term, reinforcing the broader pattern identified in the historical data, where KIBS exhibits broadly employment-neutral responses to productivity growth.

The analysis therefore suggests that the employment consequences of AI are unlikely to be uniform across sectors. While some occupations may face direct substitution risks, particularly where tasks are routine, codifiable and standardised, AI may complement labour in other activities by enhancing worker capabilities and supporting new forms of output and service delivery. The overall employment impact will depend not only on technological capability, but also on how firms, workers and institutions adapt through skills development, organisational change, management practices and labour-market policies.

It is also important to distinguish between measures of AI exposure and the employment effects of productivity growth. Recent evidence for Northern Ireland highlights that a relatively large share of employment is concentrated in sectors that are highly exposed to AI but currently exhibit below-average productivity levels (Donaldson *et al.*, 2026). This suggests that Northern Ireland may face above-average exposure to AI-driven workplace change. However, AI exposure and employment outcomes are not directly equivalent. Measures of AI exposure identify where technologies are most likely to affect tasks and occupations, whereas the analysis presented here estimates how employment has historically responded to technology changes over time. Moreover, the present framework incorporates economy-wide spillover effects, including demand, income and supply-chain linkages, which are not captured by exposure-based measures. As a result, high AI exposure does not necessarily imply proportionate employment losses, particularly where positive spillover effects offset direct labour-saving effects.

These findings reinforce the importance of AI policy responses. In addition to retraining displaced workers, there is likely to be growing importance attached to supporting AI adoption capabilities, management and organisational adaptation, workforce participation in technological change and the development of skills that complement rather than compete directly with AI technologies. Particular challenges may also emerge for entry-level and junior professional roles, where AI could alter traditional pathways through which workers acquire experience and progress within occupations.

Sectoral composition of the regional economy

The finding that the employment effects of productivity growth are primarily driven by differences between sectors, rather than by differences between regions suggests that the labour-market consequences of technological change depend more on the nature of economic activity (including task composition, tradability and the scope for automation) than on geography alone. In other words, a region's employment response to productivity growth is driven principally by the mix of industries located within the regional economy. This may partly reflect the fact that many of these institutional and policy settings are relatively similar across

UK regions. It is important to acknowledge, however, the regional estimates are inherently more uncertain given the relatively limited granularity of regional-industry data.

Nevertheless, the results imply that sectoral composition plays a critical role in determining how regions are affected by technological change and productivity growth. Regions that are more specialised in sectors with relatively strong labour-saving effects may be more exposed to employment displacement, while regions with a stronger presence in sectors benefiting from positive spillover and demand effects may experience more favourable employment outcomes.

This has important implications for Northern Ireland. Relative to the UK average, Northern Ireland has above-average employment concentrations in Agriculture, Manufacturing, Retail and Public Administration. The concentration in Manufacturing is especially important as the results suggest that sectors characterised by routine-intensive production processes are more exposed to labour-saving technological change and automation. That said, Northern Ireland's manufacturing base is more heavily weighted towards food processing and less concentrated in heavy industry than some other UK regions. This may imply somewhat weaker exposure to automation-related labour displacement than in more capital-intensive manufacturing regions.

In addition, Northern Ireland has relatively lower concentrations in several knowledge-intensive and high-productivity tradable service sectors, including ICT, Finance and Professional Services. The results suggest these sectors are characterised by relatively limited direct labour displacement and may benefit more strongly from positive spillover effects. Expanding the scale, productivity and export capacity of these sectors may therefore support more resilient long-run employment outcomes.

Interpretation caution

The findings should be interpreted as estimates of historical relationships between productivity growth and employment growth rather than forecasts of future technological change or AI adoption. In particular, the analysis identifies average sectoral and regional patterns observed over the period 1998–2023 and does not predict how future technologies will affect individual occupations, firms or workers. In addition, the workforce jobs measure used in the analysis captures jobs rather than individual workers, meaning that changes in employment do not necessarily correspond directly to changes in the number of people employed.

Policy implications

In terms of policy design, the findings suggest that productivity policy should not just focus on maximising productivity gains, but also on shaping how technological change affects labour-market outcomes. Since employment responses differ substantially across sectors, policy interventions are likely to be most effective when aligned with the specific characteristics of industries, occupations and regional economic structures. More generally, the results indicate that differences in employment responses to productivity growth are driven more by variation across sectors than across regions. Consequently, policies that consider sectoral development and industrial structure may exert a greater influence on long-run employment outcomes than place-based interventions aimed solely at increasing a region's overall responsiveness to productivity growth. This is because such place-based measures may be operating against a comparatively smaller share of the underlying variation identified in the analysis.

By contrast, sector-focused interventions are more closely aligned with the dominant sources of variation identified in the analysis and may exert a stronger influence on long-run employment outcomes. This includes policies that influence the sectoral composition of regional employment or raise productivity within sectors characterised by stronger employment resilience, positive spillover effects or greater complementarity between labour and technology. The scenario analysis also suggests that policy should not solely focus on sectors traditionally regarded as the principal drivers of productivity growth. Given that employment outcomes depend on both sectoral productivity responses and the existing industrial structure of the economy, there is also value in supporting productivity improvements within large employing sectors, where even modest productivity gains may generate substantial aggregate benefits.

Relevant **sector-based policy interventions** include:

- Supporting workforce transition planning in sectors exposed to automation and labour displacement. This includes reskilling, vocational training, lifelong learning, career guidance, early-warning systems and support for occupational transitions in routine-intensive sectors.
- Strengthening digital, AI, STEM, management and commercial skills in technology-complementary sectors, such as KIBS, where productivity growth may augment rather than replace labour. This includes building firms' capability to adopt and effectively integrate new technologies, strengthening management and organisational practices and supporting the effective deployment of AI within business processes (Cohen and Levinthal, (1990) and Bloom, Sadun and Van Reenen (2012)).
- Improving management capability, progression pathways and job quality in locally oriented service sectors that may benefit indirectly from wider productivity spillovers and rising demand.
- Supporting sectors with strong spillover effects by addressing supply-side constraints that may limit expansion, including skills shortages, apprenticeship pipelines, planning constraints, infrastructure bottlenecks and business connectivity. This may be particularly relevant in sectors such as Construction.
- Strengthening the export capacity, competitiveness and growth potential of tradable sectors to help productivity gains translate into output expansion, export growth and wider employment spillovers. This includes support for innovation, export market development, investment and firm scaling. Where productivity improvements generate stronger demand growth, the resulting scale effects may help offset labour-saving technological change and support wider employment across the regional economy.

While the analysis suggests that sectoral factors explain a larger share of variation in employment responses to productivity growth, this should not be interpreted as implying that **place-based policy** is of secondary importance. Rather, the two operate at different levels. Sector-based interventions influence how productivity growth affects employment within particular industries, whereas place-based policies help regions manage their particular sectoral composition and exposure to technological change, helping regions to adapt to structural economic change and capture the benefits of productivity growth. In practice, the most effective policy framework is likely to combine both approaches. In this context, relevant place-based measures include:

- Support regional economic diversification to reduce dependence on sectors that are highly exposed to labour-saving technological change and strengthen resilience to sector-specific shocks.
- Align local education, training and skills provision with evolving sectoral demand within regions.
- Invest in infrastructure, transport and digital connectivity that supports business connectivity and labour mobility.
- Support supply-chain development, innovation networks and SME engagement programmes that strengthen linkages between sectors and improve the competitiveness of firms upstream and downstream of industries with strong spillover effects.

The policy response is also likely to operate across different time horizons. In the **short term**, priorities include workforce transition support, employer engagement, AI adoption guidance and skills audits. Over the **medium term**, increased importance should be attached to sectoral skills pathways, management capability, digital adoption and innovation diffusion. **Longer-term** policy priorities include industrial diversification, infrastructure investment, innovation ecosystems and education reform that supports adaptability to ongoing technological change.

Overall message

The central message of the analysis is that productivity growth is essential for long-run economic growth and although employment effects are sector-specific, driven on the one hand by labour-saving technological change, the evidence also points to positive spillover effects across the wider economy. Productivity growth should not be presented as a simple trade-off between jobs-versus-efficiency.

As technological change accelerates, particularly with the diffusion of AI and digital technologies, these uneven effects are likely to become more pronounced. Policies that support labour market adjustment, skills development and sectoral transition will become increasingly important in ensuring that technological progress translates into both higher productivity and broad-based employment outcomes.

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Appendix A: Technical Details

The relationship between productivity and employment growth is estimated using an industry–region–time panel dataset. The dataset covers twelve UK regions (nine English regions, plus Scotland, Wales and Northern Ireland), seven broad sectors (defined in Section 3.1) and the period 1998 to 2023.

Empirical Specification

The analysis models employment growth within each sector and region as a function of both:

- Direct productivity growth (productivity growth within the same sector); and
- Indirect productivity growth (productivity growth spillovers from other sectors in the same region).

Lagged terms (one- and two-year lags) are included to capture adjustment dynamics over time.

The estimating equation is:

$$\text{Employment Growth}_{i,r,t} = \alpha + \beta_s \text{ Productivity Growth}_{i,r,t} + \gamma_s \text{ Spillover Growth}_{i,r,t} + \text{Fixed effects} + \varepsilon_{i,r,t}$$

where:

- *i* indexes sectors, *r* regions and *t* time
- Productivity Growth captures within-sector productivity changes
- Spillover Growth captures average productivity growth in other sectors
- β_s and γ_s vary by sector

The model includes a comprehensive set of fixed effects:

- Region fixed effects control for time-invariant regional characteristics (e.g. geography, industrial legacy)
- Year fixed effects capture economy-wide shocks (e.g. recessions, policy changes)
- Sector fixed effects control for persistent differences across industries

This ensures that the estimated relationships reflect within-region, within-sector variation over time.

Endogeneity

A key challenge is that productivity growth may be endogenous to employment outcomes as employment changes may influence productivity, or both may be driven by unobserved factors. If this issue is ignored, the estimated relationship between productivity growth and employment may be biased and potentially misleading. To address this issue, the analysis employs a Bartik shift-share instrumental variable approach designed to isolate plausibly exogenous variation in productivity growth.

The direct productivity instrument is constructed by combining:

- Initial sectoral employment shares in each region, and
- National sector-level productivity growth

The use of initial employment shares ensures that regional industrial structure is predetermined with respect to future productivity shocks. This approach exploits the fact that regions with different initial industrial structures are exposed differently to common national productivity shocks. A leave-one-out construction is used to ensure that a region's own performance does not mechanically influence the instrument. Separate instruments are constructed for direct productivity growth within sectors; and indirect spillover productivity growth across sectors.

This approach allows the analysis to isolate plausibly exogenous variation in productivity growth and estimate its impact on employment more reliably.

Bayesian hierarchical estimation

Estimating the productivity-employment relationship separately for each sector or region can produce unstable results, particularly where the underlying data are limited, volatile or affected by temporary fluctuations and outlier observations. This is especially relevant when working with regional sectoral-level productivity data, where estimates at this level of granularity may contain a degree of uncertainty. To address this issue, the analysis employs a Bayesian hierarchical estimation framework, which allows for differences across sectors and regions while avoiding excessively fragmented estimation.

The hierarchical structure estimates sectoral and regional effects jointly, while still allowing the productivity-employment relationship to vary systematically across industries and locations. This *partial pooling* approach means that estimates for individual sectors or regions are informed not only by their own data, but also by patterns observed across the wider dataset. As a result, estimates are more stable and less sensitive to noise or extreme observations. This produces more conservative and robust estimates of sectoral and regional differences, with extreme values moderated unless they are strongly supported by the data. The hierarchical model is estimated using the Bartik-instrumented productivity variation described above, so that the reported elasticities retain a causal interpretation rather than reflecting simple correlations.

The Bayesian framework estimates both the most likely employment effect and the uncertainty around it. This allows the analysis to estimate the probability that productivity growth is labour-saving (exerts a negative impact on employment) or employment-supporting (exerts a positive impact on employment) within each sector.

Uncertainty is summarised using credible intervals. A 95% credible interval represents the range within which the true employment effect is most likely to lie, given the observed data and the model assumptions. Narrower intervals indicate a greater degree of certainty, while wider intervals indicate greater uncertainty surrounding the estimated effect.