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The economic impact of Brexit on London and UK industrial sectors

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Introduction

In a nationwide referendum nearly ten years ago, the UK voted to leave the European Union (EU) after 43 years of membership in the EU and its predecessor, the European Economic Community (EEC). Various studies attempted to estimate the economic impact of this decision, with different methodologies, frames of reference and objectives. This analysis by GLA Economics revisits the subject while focusing on sectoral impacts as well as aggregate effects using the latest available data.

Key Points

- Recent studies on Brexit's economic impacts suggest that UK output levels have ended up 5%-10% lower than they would have been had Brexit not happened.
- Using an economic model that compares the UK's performance to that of the EU's six major economies (Germany, France, Italy, Spain, Netherlands and Poland; henceforth 'EU benchmark'), this study suggests that overall, in real terms, the UK's output ended up being 5.1% lower than that of the EU benchmark since 2016.
    - As an example, to illustrate the magnitude, a 5.1% shortfall would correspond to roughly £110 billion if UK real GVA were £2.1 trillion in 2015. This should be interpreted as a relative gap compared to EU economies rather than a precise estimate of the causal effect of Brexit alone. While this divergence is consistent with the effects of Brexit, it does not fully exclude other UK-specific factors over the same period.
    - Sectors that have historically employed more EU-national workers saw relatively flat output growth compared to the EU benchmark.
- While UK aggregate employment increased relative to the EU benchmark, employment in sectors with more EU-national workers dropped notably since 2016.
- On aggregate, real wage per employee in the UK decreased significantly compared to the EU, as has real gross value added (GVA) per employee (a proxy for productivity).
- If the post-2016 divergence were to continue at roughly the same annual pace through 2030 — a strong assumption made for illustration only — the UK–EU benchmark gap in real GVA, employment and wages would widen further.
    - If the UK's real GVA was £2.1 trillion in 2015, and so treating this as the starting point, then by 2030, the UK's real output would be approximately £250 billion lower than the EU benchmark.
    - Meanwhile, if we assume that the UK's average real wage per employee in 2030 is £40,000 per year, then the implied shortfall in the UK worker's average real wage compared to the EU benchmark would be approximately £10,000.

- While the analysis was performed at the national level, important insights could be derived for London, since the sectors that employ more EU-national workers comprise approximately half of the capital's total output and at least 60% of its workforce.
    - The results for these sectors include flat output growth, reduced job creation and limited capital deepening. Despite the capital's economic resilience and relative competitiveness in frontier-economy sectors such as Artificial Intelligence and professional services, these results indicate that London's performance since 2016 has been undermined, with that damage consistent with Brexit's effects.

Context

- Since the 2016 Brexit referendum, various studies attempted to measure the economic impacts of this decision on the UK while projecting future impacts and comparing the UK's performance to the EU's.
- In January 2026, GLA Economics performed a review of existing studies on Brexit's economic impacts[1]. This discussion reproduces parts of that note accordingly.
    - The run-up to the Brexit referendum in 2016 saw economic forecasters predict a large and persistent shock to UK economic performance – of around a 10% reduction in GDP – in the event of a 'leave' vote.
    - The following years saw many studies finding smaller impacts of around 2%-5% of GDP.
    - More recent studies, however, integrate the latest data on economic performance across both the UK and the EU. These point to a bigger drop in UK output (in the 5-10% range) than their previous counterparts.

Studies pre-Referendum

- Some of the first projections of Brexit impacts came from HM Treasury (HMT) in April 2016[2]. This produced estimates under three scenarios – membership of the European Economic Area (a 'Norway' scenario), a negotiated bilateral agreement (a 'Switzerland' scenario) and a World Trade Organisation (WTO) scenario.
    - These scenarios produced estimates of, respectively a 3.4%-4.3% impact on GDP by 2031, a 4.6%-7.8% impact and a 5.4%-9.5% impact. Although the UK does have the Trade and Cooperation Agreement (TCA) with the EU, the deal is somewhere between the Switzerland and WTO scenarios, meaning GDP is roughly 5%-9% lower than it would have been in staying in the EU.
- Dhingra et.al. (2016)[3] showed, with a different method and assumptions to HMT, that the impact of Brexit on lower productivity and foreign direct investment (FDI) would lead to a 6.3% to 9.5% lower long-run level of GDP.

Studies post-Referendum

- The Office for Budget Responsibility (OBR) suggested "a 4 per cent reduction in the potential productivity of the UK economy (relative to remaining in the EU), with the full effect felt after 15 years"[4]. UK in a Changing Europe, meanwhile, estimated a 2-3% hit to GDP[5].

[1] See Overview of recent studies on Brexit's economic impacts | London City Hall
[2] https://www.gov.uk/government/publications/hm-treasury-analysis-the-long-term-economic-impact-of-eu-membership-and-the-alternatives
[3] https://cep.lse.ac.uk/pubs/download/brexit02.pdf
[4] https://obr.uk/box/how-are-our-brexit-trade-forecast-assumptions-performing/
[5] https://ukandeu.ac.uk/brexit-and-the-economy-what-do-we-know/

- Born et. al. (2019)[6] estimated that the UK economy was 2.4% smaller than it would otherwise have been by the end of 2018, while Springford (2022)[7] estimated that the UK economy was 5.2% smaller by December 2021, and 5.5% smaller by June 2022.
- The National Institute of Economic and Social Research (NIESR)[8] published a report on Brexit's economic effects, which suggested that three years after the end of the transition period, the UK's real GDP is 2%-3% lower than it would have been had Brexit not happened, with that impact increasing to 6% by 2035.
- Fetzer and Wang (2020)[9] found that all countries and regions of the UK have reduced economic activity after the EU Referendum and prior to the UK leaving the EU. Across the UK, losses add up to £50 billion, or 2.3%-2.5% of GDP in 2019. The absolute loss was highest in London at £17 billion in 2018, or 3.8% of GDP, falling to £7 billion, or 1.6% in 2019.

More recent studies

- Bloom et. al. (2025) use both macroeconomic simulations and microeconomic survey data from UK firms to estimate the effects. They conclude that "by 2025, Brexit had reduced UK GDP by 6% to 8%, with the impact accumulating gradually over time"[10].
  - They also estimate that "investment was reduced by between 12% and 18%, employment by 3% to 4% and productivity by 3% to 4%"[11].
  - These impacts are attributed to post-Brexit uncertainty deterring both investment and demand, inefficiencies in firm management and allocation of resources as UK-EU negotiations dragged on.
- Another study by Millard et. al. (2025)[12] used a macroeconomic model of trade that accounts for firm heterogeneity and labour-market frictions to analyse Brexit's effects on productivity and growth.
  - They concluded that under the TCA, UK GDP would be 7.5% lower than it would have been otherwise in 2021, before increasing towards a long-term situation of GDP being around 4% lower than where it would have been.
  - They attribute this drop to higher trading costs preventing high-productivity UK firms from exporting as much as they would have otherwise, while low-productivity firms face lower competition from EU rivals due to trade barriers.
- Analysis by Goldman Sachs in 2024 demonstrated that 'structural and cyclical costs of Brexit' were responsible for the UK growing 5% less between 2016 and 2024 than other comparable countries[13].
  - The Bank further noted that the actual hit to the UK economy could reach 8% of real GDP. This effect is a result of reduced trade with the EU, low business investment and labour-market shortages due to the end of freedom of movement.

[6] Born B et al (2019), The Costs of Economic Nationalism: evidence from the Brexit experiment, Economic Journal, volume 129, pp2722-2744
[7] Springford J (2022), What can we know about the cost of Brexit so far?, Centre for European Reform, 9 June: https://www.cer.eu/publications/archive/policy-brief/2022/cost-brexit-so-far
[8] Kaya A et al (2023), Revisiting the Effect of Brexit, NIESR: https://niesr.ac.uk/publications/revisiting-effect-brexit?type=global-economic-outlook-topical-feature
[9] Fetzer T and Wang S (2020), Measuring the Regional Economic Cost of Brexit: evidence up to 2019, CAGE working paper no 486: https://warwick.ac.uk/fac/soc/economics/research/centres/cage/manage/publications/wp486.2020.pdf
[10] https://www.nber.org/papers/w34459
[11] Ibid.
[12] https://www.cambridge.org/core/journals/national-institute-economic-review/article/abs/understanding-the-effects-of-brexit-on-uk-productivity/76F7F6C0F4CE98CD5300C0EBBBEC2F3A
[13] https://www.cnbc.com/2024/02/14/brexit-has-sliced-5percent-off-uk-economic-growth-goldman-sachs-says.html?utm_source=chatgpt.com

Issues this analysis seeks to address

- Previous studies tended to utilise input-output models, synthetic control methodologies or comprehensive general equilibrium models to estimate the total impact of Brexit on the London and UK economies, looking specifically at gross value added (GVA) and employment.
  - Many of these studies used data that has recently been updated.
- The majority of these studies did not delve into the sectoral impacts of Brexit (i.e., impacts on different industrial sectors), especially how the end of freedom of movement of EU workers impacted output, employment and incomes by sector.
- This analysis uses the most recent data on GVA, employment and wages for both the UK and the EU's six largest economies (Germany, France, Italy, Spain, Netherlands and Poland, which collectively comprise nearly 75% of the EU's total output).
  - Moreover, it supplements analysis of impacts on the national economies with impacts at the sectoral level, looking at sectors that typically employed a greater fraction of EU-national workers and seeing how they have performed since Brexit.
- While the analysis is not replicated at the London (i.e., regional or city) level due to data limitations, the sectors that employ relatively more EU-national workers (henceforth 'high-exposure' sectors) represent approximately 50% of London's GVA and 60% of its workforce. As a result, important insights relevant to London could be derived by looking at outcomes for these sectors.

Methodology

- The question the model attempts to answer is: "How did the UK evolve relative to similar EU economies after 2016?"
- The analysis used in this exercise employs what is called a 'triple difference-in-difference' econometric model**.** What this means is that it attempts to isolate the economic impacts of Brexit specifically since the 2016 Referendum by controlling for:
  - Country-fixed effects (i.e., removes the effects of differences in institutions and geography between the UK and the EU benchmark countries)
  - Year-fixed effects (i.e., removes the effects of global shocks that affect all countries in the sample, such as the COVID-19 pandemic, cyclical financial factors and global inflation), and
  - Sector-fixed effects (i.e., removes the effects of structural differences across the 20 industrial sectors examined)
- It also attempts to filter out sector-specific trends (i.e., pre-2016 trends within sectors, so that differences in sectors prior to Brexit aren't misattributed to the Referendum and subsequent events).
- For EU countries, data on real GVA, employment, real total wages, real wage per employee and real GVA per employee (a proxy for productivity) for the years 2000 to 2023 was collected from Eurostat.
- For the UK, the same data was collected from the Office for National Statistics.
- To isolate the sectors that employ a relatively higher share of EU-national workers (i.e., 'higher-exposure' sectors), ONS Census data was used with 'country of birth' as a proxy for nationality.
- UK wage series (real total wages and real wages/employee) are expressed in constant 2025 pounds. EU wage series are deflated to constant 2025 euros and converted into pound equivalents using a constant exchange rate. This ensures consistency of scaling over time, although the converted EU values should be interpreted as fixed-rate pound equivalents rather than literal 2025 £ price measures.

Industrial sectors

- For both the UK and the EU benchmark, the analysis uses the UK Standard Industrial Classification to categorise economic activity into 20 broad categories (A-T); Eurostat also provides breakdowns for these 20 categories (see table below).

Sector Letter	Sector Definition
A	Agriculture, forestry and fishing
B	Mining and quarrying
C	Manufacturing
D	Electricity, gas, steam and air conditioning supply
E	Water supply; sewerage, waste management and remediation activities
F	Construction
G	Wholesale and retail trade; repair of motor vehicles and motorcycles
H	Transportation and storage
I	Accommodation and food service activities
J	Information and communication
K	Financial and insurance activities
L	Real estate activities
M	Professional, scientific and technical activities
N	Administrative and support service activities
O	Public administration and defence; compulsory social security
P	Education
Q	Human health and social work activities
R	Arts, entertainment and recreation
S	Other service activities
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use

Identifying sectors disproportionately reliant on EU-national workers

- Looking at data for 2014 and 2015 (i.e., just before the Brexit referendum), in the UK, the percentage of employed individuals in each sector who were born in EU countries could be determined; while not perfect, it serves as a functional proxy for EU-national workers. The percentages for each sector (average for 2014 and 2015) are as follows:

Sector	Percentage of EU-born workers
A	19.7%
B	3.6%
C	9.3%
D	2.2%
E	6.4%
F	4.2%
G	5.1%
H	7.1%
I	16.2%
J	5.8%
K	4.9%
L	4.0%
M	6.9%
N	15.8%
O	1.1%
P	3.6%
Q	4.2%
R	4.4%
S	5.0%
T	6.4%

- The median across the 20 sectors is 5%. Any sector that has a percentage higher than 5% is considered 'high-exposure', and vice-versa for 'low-exposure'. High-exposure sectors are highlighted in red in the above table.

Model specification

- Real GVA, employment, real wages, real wage per employee, and real GVA per employee represent the five dependent variables in the series of econometric equations. Generally, the equations take the following specification:

$$\log(Emp_{cst}) = \beta^1 * (UK_c * Post2016_t) + \beta^2 * (UK_c * Exposure_s) + \beta^3 * (Post2016_t * Exposure_s) + B^4 * (UK_c * Post2016_t * Exposure_s) + \alpha_c + \delta_s + \lambda_t + \tau_s + \epsilon_{cst}$$

Where:

- Emp_{cst} is employment in country *c*, sector *s* and year *t* (that is also replaced by GVA, productivity, real wages, etc.) so it's the dependent variable. This would be replaced by real GVA, real wages, real wage per employee and real GVA per employee for the other specifications, and in each case would take a natural logarithm form.
- UK_c = 1 if country is UK, 0 otherwise
- $Post2016_t$= 1 for years ≥ 2016, 0 otherwise
- $Exposure_s$ = sector-level exposure to EU-national workers (where $Exposure_s$ =1 for high exposure sectors and 0 otherwise)
- α_c= country fixed effects
- δ_s = sector fixed effects
- λ_t = year fixed effects
- τ_s = sector-specific linear time trends (to eliminate pre-2016 differences between sectors)
- ϵ_{cst}= error term

Results

Real GVA

- The results of the econometric modelling for Real GVA are in *Appendix 1 Table 1*. They show that overall, the UK has grown more slowly than the EU economies since 2016.
  - The model estimates the average difference in real GVA between the UK and the EU benchmark in the post-2016 period. The estimates suggest that UK real output is 5.1% lower relative to EU economies in the post-2016 period, compared to the pre-2016 baseline.
- The deterioration in UK real output relative to the EU's continues post-2021 (i.e., the Trade and Cooperation Agreement (TCA) comes into force and freedom of movement ends), implying this is not a one-off economic shock in response to the Referendum result (see *Appendix 1 Table 1* for post-2021 results).
- That said, this effect does not differ by whether a sector had a bigger or smaller share of EU workers working in it. The absence of a significant triple-interaction effect suggests that sectors with greater reliance on EU workers did not experience materially different output trajectories from less exposed sectors. This implies that the aggregate UK output divergence relative to the EU benchmark is unlikely to be driven primarily by the labour-supply channel associated with the end of free movement.
- The estimate does not mean the UK economy shrank by 5.1% each year. Rather, it indicates that, over the post-2016 period, the UK economy appears to have settled onto a level about 5% below the path implied by the EU economies.

- For example, to illustrate the magnitude, a 5.1% shortfall would correspond to roughly £110 billion if the UK's real GVA were £2.1 trillion in 2015. This should be interpreted as a relative gap compared to EU economies rather than a precise estimate of the causal effect of Brexit alone.
  - While this divergence is consistent with the effects of Brexit, it does not fully filter out other UK-specific factors over the same period (e.g., UK political uncertainty, UK-specific COVID responses, UK energy price exposure).
  - Even though it feels large, note that over 7–8 years:
    - Small annual growth differences compound
    - Structural shocks accumulate
    - Level gaps can become large
- The key point is that this aggregate picture is consistent with Brexit having played a negative role, but it would be too strong a statement to say Brexit alone explains the entire divergence. What the regressions support is that, after 2016, the UK underperformed comparable EU countries on real GVA, and that this occurred in a period when Brexit was the major UK-specific structural shock.

Employment

- In terms of employment, the model shows that overall employment in the UK has grown post-2016 (see *Appendix 1 Table 2*). This could reflect the increase in net migration to the UK following the introduction of the post-Brexit points-based system.
- That said, in sectors with higher structural reliance on EU workers, there has been a significant reduction in employment in the UK relative to the EU, with employment in these sectors being approximately 20% lower in the UK relative to EU economies compared to pre-2016. This effect is persistent and continues beyond 2021 with the TCA coming into force (see *Appendix 1 Table 2*).
  - This would suggest that Brexit contributed to a sector-specific labour contraction and reallocation from sectors that tend to rely more on EU workers to those that structurally relied less on them.
- Meanwhile, in EU economies, high-exposure sectors experienced a significant increase in employment relative to low-exposure sectors (of approximately 5%).

Real total wages and real wages per employee

- With respect to real total wages, the model shows that on aggregate, they are almost flat in the UK relative to EU countries in the post-2016 period compared to the pre-2016 baseline (see *Appendix 1 Table 3*).
- However, in high-exposure sectors, there has been a significant reduction in real total wages in the UK relative to the EU benchmark, with real wages in these sectors being approximately 12–13% lower. This effect continues beyond the 2021 entry of the TCA into force (see *Appendix 1 Table 3*).
- Meanwhile, in EU economies, there is some evidence that high-exposure sectors experienced an increase in real wages relative to low-exposure sectors (of approximately 6%).
- On aggregate, real wages per employee in the UK are approximately 11% lower than they are in the EU benchmark in the post-2016 period compared to the pre-2016 baseline (see *Appendix 1 Table 4*).
  - There is no significant difference between the UK and EU in terms of real wage per employee in high-exposure sectors.

Real GVA per employee

- On aggregate, real GVA per employee (a proxy for productivity) in the UK is approximately 20% lower relative to EU countries in the post-2016 period compared to the pre-2016 baseline (see *Appendix 1 Table 5*).
- That said, the results show that in high-exposure sectors, real GVA per employee increased in the UK.

  - This should not be misinterpreted as a sustainable and structural increase in productivity in these sectors due to capital deepening or investment in technological enhancements that improve economic outcomes for businesses and their employees.
  - The increase in output per worker appears to be driven by reductions in employment and hours worked in these sectors, while output remained broadly unchanged. The absence of corresponding increases in real wages and capital deepening is consistent with the idea that this is unlikely to reflect underlying structural gains in efficiency (for a discussion of this, see *Appendix 2*).
- In contrast, the overall decline in productivity across the UK reflects a combination of weaker output performance alongside increases in total employment and hours worked. This implies that the economy is utilising more labour input while generating relatively less output, a pattern more consistent with a deterioration in underlying efficiency or adverse structural changes. The relative decrease in real wage per employee lends credence to this notion.

Modelling potential future outcomes

If the UK and EU continue along the same post-2016 trajectory in terms of real output growth, by how much would the UK's overall output be worse off in 2030 than the EU's, and how would London be impacted?

- The model estimates that UK real output is 5.1% lower relative to EU economies in the post-2016 period, compared to the pre-2016 baseline. If the post-2016 divergence were to continue at roughly the same annual pace through 2030 — **a strong assumption made for illustration only** — the UK–EU benchmark gap in real GVA would widen further.
- According to data from Eurostat and the ONS, real GVA in the EU benchmark countries grew by 1.9% on average every year between 2016 and 2023, compared to 1.2% in the UK. This represents a 0.7 percentage-point annual difference.
  - If that exact differential continued for another 7 years, then the UK/EU gap ratio in 2030 would equal (1/(1-0.051)) * (1.007)^7. This would imply that UK real output would be around 9.5% below the EU benchmark in 2030.
  - To put that in money terms, we know that the UK's real GVA was nearly £2.1 trillion in 2015. Treating this as the starting point, then by 2030, the UK's real output would be approximately £250 billion lower than the EU benchmark's.
- Two things to note, however:
  - **This is not a forecast**. It is a mechanical extrapolation of the model.
  - The £250 billion figure strongly depends on the assumed growth paths holding.
- Since the modelling was done at the UK level and not the regional/city level due to data limitations, it is difficult to arrive at an exact figure of how much worse off London would be compared to major EU cities such as Paris and Berlin.
  - Nonetheless, we know that London accounts for 25% of UK national output and the high-exposure sectors tend to concentrate in the capital. A simple proportional extrapolation would imply that London's economy could be around £50 billion smaller than comparable EU benchmark cities by 2030 if similar relative trends were to persist.

If the UK and EU continue along the same post-2016 trajectory in terms of growth in real wages earned per employee, by how much would the UK's real wage per employee be worse off in 2030 than the EU's, and how would London be impacted?

- The model estimates that real wage per employee in the UK is 11.7% lower relative to EU economies in the post-2016 period, compared to the pre-2016 baseline. If the post-2016 divergence were to continue

at roughly the same annual pace through 2030 — **a strong assumption made for illustration only** — the UK–EU benchmark gap in real wage per employee would widen further.

- Then, if the UK real wage per employee is at 88.3% of the EU benchmark in 2023, then the UK's real wage per employee has been growing about 1.54% per year more slowly than the EU benchmark. Carrying that same relative divergence forward for another 7 years: $0.883 \times 0.9846^{7} \approx 0.795$
- So, by 2030, the UK would be at about 79.5% of the EU benchmark. That means the gap would be: 1–0.795=0.205. So, the UK real wage per employee would be about 20.5% below the EU benchmark in 2030.
- If we assume that the UK's average real wage per employee in 2030 is £40,000, and that is 79.5% of the EU benchmark, then the EU benchmark would be: £40,000/0.795 ≈ £50,300. So, the implied gap is: £50,300– £40,000≈ £10,300.
- Therefore, if the post-2016 divergence in real wages per employee continued at the same pace through 2030 — **a strong assumption used purely for illustration** — the UK would be about 20.5% below the EU benchmark by 2030. If UK real wages per employee were £40,000 in 2030, this would imply an EU benchmark of roughly £50,300, or a gap of approximately £10,000 per worker.
- While wage per employee is higher in London than it is in other parts of the UK, it is probable that the city would find its real wage per employee in 2030 being thousands of pounds lower than levels in comparable cities within the EU.
    - In fact, other studies have already shown that London's productivity is lower than other EU cities such as Paris and Stockholm[14], and since real wages correlate strongly with productivity over time, it is likely that real wages in London continued to deteriorate vis-à-vis levels in major EU cities post-Brexit.

If the UK and EU continue along the same post-2016 trajectory in terms of employment creation in sectors with high exposure to EU-born workers, by how much would employment levels in these sectors in the UK be worse off in 2030 than those levels in the EU, and how would London be impacted?

- According to the model, by 2023, UK employment in high-exposure sectors is 17.8% below the EU benchmark. If the UK is at 82.2% of the EU benchmark in 2023, the implied annual relative shortfall over 8 years is: $0.822 \wedge (1/8) \approx 0.97580$
    - So, the UK high-exposure sectors' employment has been growing about 2.4% per year more slowly than that for the EU benchmark.
- Carrying that same divergence forward for another 7 years: $0.822 \times 0.9758^{(7)} \approx 0.6930$
    - By 2030, UK employment in high-exposure sectors would be about 69.3% that of the EU benchmark. That means the gap would be: 1–0.693= 0.307
    - Employment in the UK's high-exposure sectors would be about 30.7% below that of the EU benchmark in 2030.
- If we assume that UK employment in high-exposure sectors in 2030 is 17 million, and that is 69.3% of the EU benchmark, then the EU benchmark would be: 17/0.693 ≈ 24.517. The implied difference is: 24.5million –17million = 7.5million
- It is important to note that this 7.5 million figure depends heavily on the assumed 17 million baseline and strong assumptions regarding the evolution of employment trends in the UK and EU exactly in line with what happened from 2016 to 2023.
- As London is responsible for 60% of UK employee jobs in these high-exposure sectors, it is likely that much of this modelled 7.5 million job shortfall vis-à-vis the EU would transpire in London, meaning the city could find itself creating hundreds of thousands of jobs fewer in these sectors than comparable EU cities.

[14] https://www.centreforcities.org/press/londons-productivity-lags-well-behind-global-competitors/

Robustness checks

- To validate the results of this modelling exercise, various robustness checks were performed, such that the modelling was re-run to test for impacts:
  - Post-2021 entry of the TCA into force (in addition to impacts post-2016).
  - When including provisional data for 2024 (where available)
  - When treating the exposure variable as a continuous variable as opposed to a binary discrete one
- In all cases, the results by dependent variable were relatively unchanged.
- To delve more deeply into the employment and productivity (GVA/employee) trends, another regression was run using 'total hours worked' as a dependent variable. Normally, total employment and hours worked would correlate positively (i.e., move in the same direction).
  - On aggregate, total hours worked in the UK are approximately 10% higher in the UK relative to EU countries in the post-2016 period compared to the pre-2016 baseline. That said, in sectors with higher reliance on EU workers, total hours worked decreased in the UK relative to low-exposure sectors, by approximately 12-13% (see *Appendix 1 Table 6*).
  - This confirms the expected parallel relationship between total employment and total hours worked.
- Checks were also made to assess whether a linear regression represents a better fit than various non-linear specifications. The linear regression outperformed the other specifications in these checks.

Conclusions and implications for the UK and London

Aggregate performance

- The UK experienced weaker output performance relative to EU economies following Brexit, with the effect materialising in the years after the Referendum rather than just after the coming into effect of the TCA in 2021.
- The UK's real GVA was 5.1% lower than the EU benchmark path, equivalent to roughly £110–£115 billion when applied to a £2.1 trillion economy, which is an economically meaningful decline.
  - However, this aggregate underperformance does not vary systematically across sectors with different levels of exposure to EU labour.
- The labour market evidence paints a clearer picture. UK employment increased relative to the EU, while real total wages remained broadly unchanged. At the same time, real wages per employee declined by around 11%, and real GVA per employee (a proxy for productivity) declined by roughly 18%. Real output stayed relatively flat while aggregate employment and hours worked increased.
  - These results suggest that the UK used more labour input to generate slightly less output, and that the average worker was less well-paid in real terms compared to their EU counterpart.
- Overall, since the 2016 Referendum, EU benchmark countries:
  - Had stronger overall output performance than the UK,
  - Had stronger wage per employee performance on aggregate, and
  - Had stronger overall productivity performance
- While these aggregate outcomes cannot be attributed solely to Brexit, they are consistent with Brexit acting as a negative structural shock to the UK economy, contributing to weaker productivity and wage performance relative to comparable EU economies in the post-2016 period.

Performance in high-exposure sectors important for London

- The most direct evidence of Brexit-related effects emerges in sectors with a higher pre-2016 reliance on EU labour. Sectors more reliant on EU labour experienced significant and persistent reductions in both employment and total hours worked relative to the EU, beginning after the 2016 referendum and continuing after the entry into effect of the TCA in 2021.
  - In these sectors, UK employment declined by approximately 18% relative to the EU benchmark, while comparable sectors in EU economies experienced employment growth.

  - Real total wages in these sectors also declined in the UK relative to the EU.
- Yet output in those sectors did not fall proportionately. As a result, measured real GVA per employee rose in those sectors.
  - That rise in sectoral productivity should not be interpreted as sustainable and a by-product of structural processes that boost capital deepening and technological progress. A substantial body of economic theory and empirical evidence establishes a close relationship between labour productivity and real wages. In standard growth models and across OECD countries, increases in productivity are typically associated with increases in real wages (see Bosworth et al., 1994 and Cruz et al., 2023 for examples). At the firm level, more productive firms consistently pay higher wages, and productivity gains tend to translate into higher worker compensation (see Wallskog, 2026 for example).
  - While short-run deviations may occur, the long-run co-movement between productivity and wages remains an empirical regularity. In this context, the absence of a corresponding increase in real wages in high-exposure sectors suggests that the observed increase in output per worker is more consistent with labour reallocation and compositional effects arising from reductions in employment.
- High-exposure sectors in EU countries did not experience the same disruption seen in the UK. These sectors in EU economies experienced rises in employment and hours worked, and in some cases exhibited modest improvements in wage outcomes. This suggests that sectors reliant on mobile EU labour remained more stable within the EU than in the UK following Brexit.
- The results suggest that Brexit induced a reallocation of economic activity away from sectors reliant on EU labour, with adjustment in these sectors occurring primarily through reductions in labour rather than notable increases in output or real wages.
- Taken together, these findings indicate that Brexit likely had a negative impact on UK sectors most reliant on EU labour, reducing employment and wage outcomes relative to comparable EU sectors.

Implications for London

- Broadly speaking, London remains the UK's most productive economic region by a considerable margin, with its contribution to national output increasing over the past decade to reach nearly 25%. The capital continues to outperform national and global cities in important categories such as foreign direct investment (FDI) attraction and specialisation in frontier-economy sectors such as AI and Fintech.
  - Nevertheless, this modelling exercise shows that Brexit has curtailed London's potential to perform even better, in particular when it comes to productivity and nominal wage growth.
  - The capital is acutely reliant on high-exposure sectors. With these sectors accounting for 50% of London's GVA and 60% of its employee jobs, the adverse effects on employment creation, productivity and output in London should not be underestimated.

Appendix 1: Modelling Results

Table 1: Real GVA

	(1)	(2)
	Post-2016 Referendum	*Post-2021 TCA*
UK × Post	–0.053	–0.044
	(0.044)	(0.053)
UK × Trade exposure	–0.486*	–0.474*
	(0.245)	(0.238)
Post × Trade exposure	0.012	0.043
	(0.027)	(0.034)
UK × Post × Trade exposure	0.025	–0.033
	(0.073)	(0.086)
Observations	3,360	3,360
Country fixed effects	✓	✓
Sector fixed effects	✓	✓
Year fixed effects	✓	✓
Sector–year trends	✓	✓

*Notes: OLS estimation. Dependent variable: log(Real GVA). All specifications include country, sector and year fixed effects, and sector-specific year trends. Standard errors clustered by country × sector in parentheses. *** p < 0.001, ** p < 0.01, * p < 0.05.*

Table 2: Employment

	(1)	(2)
	Post-2016 Referendum	*Post-2021 TCA*
UK × Post	0.151***	0.119*
	(0.044)	(0.046)
UK × Trade exposure	–0.496*	–0.533*
	(0.217)	(0.219)
Post × Trade exposure	0.055**	0.026
	(0.018)	(0.025)
UK × Post × Trade exposure	–0.196***	–0.219***
	(0.052)	(0.063)
Observations	3,360	3,360
Country fixed effects	✓	✓
Sector fixed effects	✓	✓
Year fixed effects	✓	✓
Sector–year trends	✓	✓

*Notes: OLS estimation. Dependent variable: log(Employment). All specifications include country, sector and year fixed effects, and sector-specific year trends. Standard errors clustered by country × sector in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.*

Table 3: Real Total Compensation

	(1)	**(2)**
	Post-2016 Referendum	*Post-2021 TCA*
UK × Post	0.033	0.001
	(0.033)	(0.034)
UK × Trade exposure	–0.037	–0.067
	(0.157)	(0.156)
Post × Trade exposure	0.062**	0.017
	(0.021)	(0.020)
UK × Post × Trade exposure	–0.135**	–0.116*
	(0.049)	(0.051)
Observations	3,360	3,360
Country fixed effects	✓	✓
Sector fixed effects	✓	✓
Year fixed effects	✓	✓
Sector–year trends	✓	✓

*Notes: OLS estimation. Dependent variable: log(Real Total Compensation). All specifications include country, sector and year fixed effects, and sector-specific year trends. Standard errors clustered by country × sector in parentheses. *** p < 0.001, ** p < 0.01, * p < 0.05.*

Table 4: Real Compensation per Employee

Post-2016 Referendum	*log(Real Compensation per Employee)*
UK × Post-Referendum	–0.118***
	(0.032)
UK × Trade exposure	0.459**
	(0.167)
Post-Referendum × Trade exposure	0.007
	(0.019)
UK × Post-Referendum × Trade exposure	0.061
	(0.048)
Observations	3,360
Country fixed effects	✓
Sector fixed effects	✓
Year fixed effects	✓
Sector–year trends	✓

*Notes: OLS estimation. Dependent variable: log(Real Compensation per Employee). Specification includes country, sector and year fixed effects, and sector-specific year trends. Standard errors clustered by country × sector in parentheses. *** p < 0.001, ** p < 0.01, * p < 0.05.*

Table 5: Real GVA per Employee

Post-2016 Referendum	*log(Real GVA per Employee)*
UK × Post-Referendum	–0.203**
	(0.069)
UK × Trade exposure	0.009
	(0.208)
Post-Referendum × Trade exposure	–0.042
	(0.033)
UK × Post-Referendum × Trade exposure	0.221*
	(0.085)
Observations	3,360
Country fixed effects	✓
Sector fixed effects	✓
Year fixed effects	✓
Sector–year trends	✓

*Notes: OLS estimation. Dependent variable: log(Real GVA per Employee). Specification includes country, sector and year fixed effects, and sector-specific year trends. Standard errors clustered by country × sector in parentheses. *** p < 0.001, ** p < 0.01, * p < 0.05.*

Table 6: Total Hours Worked

Post-2016 Referendum	*log(Total Hours Worked)*
UK × Post-Referendum	0.098**
	(0.036)
UK × Trade exposure	–0.145
	(0.180)
Post-Referendum × Trade exposure	0.052**
	(0.017)
UK × Post-Referendum × Trade exposure	–0.133**
	(0.049)
Observations	3,360
Country fixed effects	✓
Sector fixed effects	✓
Year fixed effects	✓
Sector–year trends	✓

*Notes: OLS estimation. Dependent variable: log(Total Hours Worked). Specification includes country, sector and year fixed effects, and sector-specific year trends. Standard errors clustered by country × sector in parentheses. *** p < 0.001, ** p < 0.01, * p < 0.05.*

Appendix 2: Interpreting the Model's Aggregate and Sectoral Productivity Results

This appendix interprets two core findings from the modelling exercise. First, at the aggregate level, the UK shows a modest post-2016 real-GVA shortfall relative to comparable EU economies (5.1%), but a much larger fall in real GVA per employee (just under 20%) alongside a considerable rise in employment. Second, in high-exposure sectors—that is, sectors with above-median reliance on EU-born workers before Brexit—the UK shows sharp falls in employment, hours worked and real total wages relative to the EU benchmark, yet a rise in real GVA per employee, while the direct output effect in real GVA itself is relatively small.

If output per worker rises in the exposed sectors, does that not mean those sectors became more efficient? And if so, is it inconsistent to interpret the aggregate UK result as a deterioration in productivity? The answer is no, but only if one is precise about what labour productivity measures and about what the regressions do and do not identify.

The Office for National Statistics defines labour productivity as "output per unit of labour input" and explains that it is calculated by dividing output by labour input.[15] The OECD productivity manual makes a key conceptual distinction: labour productivity is **not** a pure technology measure. Rather, it "reflects how efficiently labour is combined with other factors of production" and also depends on "how many of these other inputs are available per worker"[16]. That is the crucial benchmark for interpreting the regressions.

Measured labour vs. structural (technology and investment-related) productivity

The modelling does show an increase in measured labour productivity in high-exposure sectors since real GVA per employee increased. A distinction should be made between:

1. **Measured labour-productivity change**: a change in output per worker, whatever its source; and
2. **Structural productivity change**: a durable improvement in capital deepening, investment, technology, or organisation that shifts the production possibility frontier.

The OECD manual is explicit that labour productivity bundles together several channels and therefore does not, by itself, identify a pure efficiency effect; for that, the OECD points the analyst toward multifactor productivity, which is designed to "disentangle the direct growth contributions of labour, capital, intermediate inputs and technology". This matters because the modelling exercise **does not** estimate multifactor productivity; it estimates changes in real GVA per employee.

The wage-productivity link

The wage–productivity link may not always hold in the short run, but the literature still treats wages as an important consistency check on genuine productivity change. OECD evidence finds that "wages increase with productivity" and that the relationship is "very tight" in both manufacturing and services[17]. Likewise, Teichgräber and Van Reenen note that, "in the long-run…the real pay of workers tends to follow labour

[15] Office for National Statistics (2024) *Labour productivity QMI*. Quote: "Labour productivity is defined as output per unit of labour input". Available at: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/labourproductivity/methodologies/labourproductivityqmi

[16] OECD (2001) *Measuring Productivity: OECD Manual*. Quote: "Labour productivity reflects how efficiently labour is combined with other factors of production" and depends on "how many of these other inputs are available per worker". Available at: https://unstats.un.org/unsd/nationalaccount/docs/OECD-Productivity-e.pdf

[17] OECD (2018) *The Productivity-Wage Premium*. Quote: "wages increase with productivity, and the relationship is very tight". Available at: https://www.oecd.org/content/dam/oecd/en/publications/reports/2018/06/the-productivity-wage-premium_c2c82bef/04e36c29-en.pdf

productivity."[18] The implication is not that wages mechanically prove or disprove productivity change, but that productivity gains unaccompanied by robust real-term wage gains should be interpreted cautiously.

Why sectoral results do not automatically point to structural efficiency gains

Consider the results for the high-exposure sectors. These show that since 2016, relative to their EU counterparts, the UK's high-exposure sectors experienced roughly:

- -17.8% change in employment
- -12.4% change in hours worked
- -12.6% change in total real wages
- +6.3% change in real wages per employee (small and statistically insignificant)
- +24.7% change in real GVA per employee
- +2.6% change in real GVA (small and statistically insignificant)

This pattern indicates a rise in measured labour productivity. The issue is whether the rise should be classified as a structural productivity gain. On the basis of these results, that claim does not follow. The reason is that UK evidence from the affected sectors points to several labour-saving and output-restructuring responses to the end of free movement in 2021 that could raise output per worker without generating a broad, sector-wide efficiency breakthrough.

For example, the Migration Observatory reports that some industries "used to rely heavily on EU workers" and that, once free movement ended, many of those jobs were no longer eligible for work visas[19]. Second, the same source records that "about half of employers" facing staff shortages said they were "unable to meet demands", which implies constrained growth rather than an unequivocal productivity boom[20].

The Revealing Reality / ReWAGE evidence states that employers may "reduce the labour-intensiveness of work" by "raising the productivity of workers, automating, or relocating activity" and may "ultimately produce less" if they cannot otherwise respond[21]. A rise in output per worker after a labour shock can arise through mechanisms other than a broad structural efficiency gain. Examples include:

- **Labour-saving process changes within existing operations**: For agriculture and the wider food chain (a high-exposure sector), the UK Parliament's food-and-farming labour shortages inquiry states that the sector was suffering from "acute labour shortages" due principally to Brexit and Covid[22], and the Migration Advisory Committee / Revealing Reality report also points to firms scaling back or changing production when labour could not be sourced[23], which is exactly the kind of mechanism that can raise output per worker without producing a broad structural efficiency gain.

[18] Teichgräber, A. and Van Reenen, J. (2021) *Have Productivity and Pay Decoupled in the UK?* Quote: "in the long-run at the macro level, the real pay of workers tends to follow labour productivity." Available at: https://cep.lse.ac.uk/pubs/download/dp1812.pdf

[19] Sumption, M. et al. (2022) *How is the End of Free Movement Affecting the Low-wage Labour Force in the UK?* Quote: jobs in some industries "used to rely heavily on EU workers". Available at: https://migrationobservatory.ox.ac.uk/wp-content/uploads/2022/08/MigObs-Report-How-is-the-End-of-Free-Movement-Affecting-the-Low-wage-Labour-Force-in-the-UK.pdf

[20] Ibid.

[21] Revealing Reality (2023) *The impact of the end of Freedom of Movement*. Quotes: employers may "reduce the labour-intensiveness of work" by "raising the productivity of workers, automating, or relocating activity" and may "ultimately produce less". Available at: https://revealingreality.co.uk/wp-content/uploads/2023/07/The-impact-of-the-end-of-Freedom-of-Movement.pdf

[22] UK Parliament Environment, Food and Rural Affairs Committee (2022), 'Labour shortages in the food and farming sector'. https://committees.parliament.uk/publications/9580/documents/162177/default/

[23] Migration Advisory Committee (2023), 'The impact of the end of freedom of movement on the labour market'. https://assets.publishing.service.gov.uk/media/648983685f7bb7000c7faa13/RR_MAC_EndofFoM_Final.pdf

- **Relocation or offshoring of parts of production:** "There is evidence that UK firms have responded to increased trade frictions by restructuring supply chains and relocating parts of production to the EU."[24] In professional services (another high-exposure sector), there is some evidence that financial services firms have shifted assets, staff and operations to EU financial centres. MakeUK also reports that some firms reported moving parts of their operations to EU countries in response to Brexit-related changes in trading conditions[25]. This supports the idea that in high-exposure sectors, output per worker rose because low-value tasks were removed, production became fragmented, and some activity disappeared from the UK, not because firms in these sectors suddenly adopted transformative technological capacities or deepened their capital stock through greater investment. Tradeable services and advanced manufacturing firms were more likely to respond to Brexit by moving some operations overseas, in particular to EU countries[26].

- **Pruning of output or inability to meet demand**: For transportation and logistics (another high-exposure sector), the ONS documented that transport and storage businesses were among those struggling to fill jobs, explicitly linking this to HGV driver shortages[27]. The Migration Observatory reports that after the end of free movement, there was "early qualitative evidence of firms using practices that rely less on EU migrant workers"[28]. This included route changes, task consolidation, altered staffing patterns, and other operational changes to cope with fewer workers. For wholesale and retail trade as well as accommodation and food services (both being high-exposure sector), the UK Parliamentary Office of Science and Technology states that "Brexit-driven supply issues have prompted shortfalls in the transportation and storage, wholesale and retail, and accommodation and food industries"[29]. This supports the claim that labour shortages and inability to meet demand were material.

The wage evidence also matters here. The results show a small and statistically insignificant change in real wages per employee in the high-exposure sectors. That is not what one would expect if the 24.7% gain in output per worker were primarily driven by broad-based efficiency improvement. It is much easier to reconcile with a labour-scarcity adjustment in which firms cut headcount and hours, preserve core activity, but do not generate a commensurate surge in broad-based worker remuneration.

Last but not least, data on gross fixed capital formation (GFCF) from the UK and EU benchmark countries shows no evidence of a relative increase in investment in UK high-exposure sectors following 2016 that would point to productivity-inducing capital deepening. In fact, for high-exposure sectors, annual investment growth in the UK remained relatively stable, while the same sectors in the EU caught up with the UK after having lagged the UK from 2000 to 2015:

	Average Annual Change			
	2000-2015		2016-2023	
	High Exp	Low Exp	High Exp	Low Exp
EU benchmark	0.8%	-0.1%	2.1%	2.8%
UK	2.1%	2.5%	2.5%	1.8%

[24] https://www.makeuk.org/insights/reports
[25] Ibid.
[26] https://www.productivity.ac.uk/research/certainty-without-conviction-why-has-the-trade-and-cooperation-agreement-failed-to-reverse-brexit-relocations/
[27] 7. Office for National Statistics (2021), labour shortages data. https://www.ons.gov.uk/
[28] Migration Observatory (2022), 'How is the end of free movement affecting the low-wage labour force in the UK?'. https://migrationobservatory.ox.ac.uk/resources/reports/how-is-the-end-of-free-movement-affecting-the-low-wage-labour-force-in-the-uk/
[29] UK Parliamentary Office of Science and Technology (2023). https://post.parliament.uk/

These findings are also consistent with emerging firm-level evidence on the labour market effects of Brexit. Using a distinct identification strategy based on geographic exposure to the Irish border, Do et al. (2025)[30] show that Brexit-exposed firms reduced employment by up to 15.7% relative to less exposed firms while revising growth expectations downward. This provides independent evidence that Brexit exposure reduced labour demand and induced firms to adjust their production strategies. Importantly, the fact that exposed firms revised their growth expectations downward suggests that these adjustments are not associated with anticipated structural improvements in productivity, but rather reflect a response to a more constrained operating environment.

While firms may have attempted to adapt through innovation or process changes, these adjustments did not translate into broad-based capital deepening or technological upgrading over the period considered. Taken together, the evidence points to a pattern of constrained adjustment: firms reduced labour inputs and experimented with alternative production methods, but without the sustained investment or output growth typically associated with structural productivity improvements. As such, the observed increase in output per worker in high-exposure sectors is more plausibly interpreted as reflecting labour contraction and organisational adjustment.

In sum, while the sectoral results for the UK point to a rise in measured labour productivity, this should not be over-interpreted as proof of a structural and sustainable efficiency gain when the same sectors also show sharp labour contraction, lower total wages, lower hours, labour-saving reorganisation, relocation, and constrained demand.

[30] The Real effects of Brexit on labor demand: Evidence from firm-level data - ScienceDirect

For more information please contact Adam Yousef, GLA Economics
Greater London Authority, City Hall, Kamal Chunchie Way, London E16 1ZE
Tel: 020 7983 4000 e-mail: glaeconomics@london.gov.uk