Cracking the Productivity Code: An International Comparison of UK Productivity

John Van Reenen
LSE and *MIT*
Xuyi Yang
University of Cambridge and *POID*[1]

Abstract

We examine the growth and level of UK productivity compared to France, Germany and the United States. There has been a marked slowdown in labour productivity growth: comparing the dozen years before and after the Global Financial Crisis. The average annual growth of the UK's real value added per hour in the market economy has fallen from 2.5 per cent to 0.5 per cent. Just over half of this two percentage point slowdown is due to slower TFP growth, which is broadly similar in magnitude across countries. Britain experienced a much larger slowdown in the growth of capital intensity than other countries and it is this (alongside a smaller contribution from slow skills growth) which accounts for the particularly severe 'productivity puzzle'. The level of UK labour productivity is also low compared to peers, especially the United States. In 2019, lower tangible and intangible capital intensity accounted for about half of this gap. These findings suggest that UK policy should focus on the problem of chronic under-investment

Since the Global Financial Crisis (GFC), the United Kingdom has been struggling with slow productivity growth. Total economy annual GDP per hour growth between 2007Q4 and 2023Q3 was about 0.4 per cent. Focusing on the market economy,[2] the average growth rate of output per hour between 2007 and 2019 was about the same at 0.5 per cent per year, showing that this pattern is not simply due to the turmoil

1 John Van Reenen is a Ronald Coase Chair in Economics and Professor at the London School of Economics. Xuyi Yang is a PhD student at University of Cambridge and an Occasional Research Assistant at the Centre for Economic Performance (CEP). We thank the ESRC and UKRI for financial support through Programme on Innovation and Diffusion (POID). Helpful comments have come from seminar presentations in Manchester, LSE and at the 2023 Royal Economic Society in Glasgow, especially from Bart Van Ark, David Miles, Carol Propper, and Anna Valero.

2 The market economy excludes hard-to-measure government-related sectors like health and education. Specifically, it excludes real estate (industrial division L), public administration and defence (O), education (P), human health and social work (Q), the self-employed (T), and activities of extraterritorial organizations (U).

over the COVID pandemic and Russia's invasion of Ukraine. Moreover, although just about every country experienced a post-crisis slowdown, the United Kingdom was hit particularly severely. In the dozen years before the financial crisis, UK productivity growth was over 2.5 per cent per year, so this implies a huge two percentage point fall post versus pre-crisis. In contrast, the slowdown in the United States, France and Germany over the same period was only 1.6, 1.5 and 1.0 percentage points respectively.

The consequences of low productivity growth are profound. Real wage growth relies on productivity growth in the long run. So it is not surprising that average UK real wages today are similar to their level in 2005. On some measures, this is the longest stagnation for centuries and the cause of a host of political and social problems.

In this article, we investigate productivity from an international perspective, comparing the United Kingdom to the United States, France, and Germany. We use the most recent comparable data (primarily from KLEMS) to examine the UK's market economy productivity growth compared to its peers. We also look at Britain's relative productivity level. We focus on decomposing the components of productivity into different capital inputs and the unexplained residual component (Total Factor Productivity, TFP). We look at various types of capital: human capital (skills) and fixed capital (e.g. equipment and buildings); tangible versus intangible capital (such as software and Research and Development, R&D); and Information and Communication Technology (ICT) capital vs. non-ICT capital.

Our conclusions can be succinctly summarized. Britain's substantial post-crisis fall in productivity growth relative to other countries is primarily due to a large fall in capital accumulation rate. All countries experienced a broadly similar fall in TFP growth after the GFC, but the slowdown in capital intensity was particularly severe in the United Kingdom. In terms of productivity levels, both low investment in capital and TFP contribute significantly to the gap with other countries. The exact magnitudes on levels are more sensitive to assumptions than growth accounting, but in 2019, roughly half of the overall UK productivity gap was due to lower tangible and intangible capital.

The article is structured as follows. Section one briefly summarizes the data and methods employed. Section two compares productivity growth, focusing on the dozen years before and after the financial crisis. Section three analyses productivity levels. This section offers some extensions that looks at alternative labour composition measures, industry breakdowns, post-2019 performance, the role of hours worked, labour markets, and alternative decomposition methods. Section four concludes with policy discussions. The online appendix deals with data (Appendix A) and provide some further results (Appendix B).[3]

3 The Appendix is found at https://csls.ca/ipm/46/Van_Reenen_Online_Appendix.pdf.

Data and Methods

To ensure valid comparisons, we require consistent volume measures of input and output across countries. Although there has been some harmonization in recent decades, it is still the case that different National Statistics Institutes (NSIs) use different methods to construct their national accounts. The variation in data construction across countries presents a challenge for productivity level comparisons, although it is less of an issue for our growth analysis due to its internal consistency over time. To address this concern, we employ two primary data sources: EUKLEMS & INTANProd 2023 (Bontadini *et al.*, 2023) and OECD productivity statistics (OECD, 2014). For output and capital input data, we rely on EUKLEMS & INTANProd 2023, which reconstructs the capital stock data in national accounts using a consistent approach across countries. This harmonized capital data is available only through the most recent 2023 release.

For labour input data, we have substituted the data on hours worked in national accounts with the hours data from the OECD productivity statistics (OECD, 2014), which harmonizes the methodology for constructing the working hours data. This is particularly important for comparing productivity levels because UK hours are calculated in a different way to those in other countries.[4] The difference in methods causes aggregate UK hours to appear artificially higher and, in turn, UK output per hour to appear artificially lower. Unless these are corrected, the UK's TFP gap in levels is overstated (although we show it makes little difference to growth rates).

As the main interest of this article is in understanding UK productivity performance relative to its international counterparts, we normalize the level accounting such that UK=100. However, alternative comparisons employing different base countries can be made by substituting the United Kingdom with any country of interest.

We follow a standard production function approach, decomposing country i's labour productivity as:

$$\ln\left(\frac{Y_i}{H_i}\right) = \ln A_i + \alpha_i \ln LC_i + (1-\alpha_i)\ln\left(\frac{K_i}{H_i}\right) \quad (1)$$

where Y_i is real gross value added (GVA), K_i is the capital stock, H_i is total hours worked, LC_i is labour composition ("skills" - the labour quality of the workforce, [5] and A_i is Total Factor Productivity (TFP). The

4 This is detailed in the Appendix. Essentially, the United Kingdom relies on employee surveys of hours worked from the Labour Force Survey whereas the other countries primarily use adjusted administrative data.

5 Detailed methods for constructing labour composition measures are discussed in section 3. In short, KLEMS uses age-education-gender-industry cells which are tracked from different surveys such as the Labour Force Survey. Average hourly wages are used to proxy productivity, and the fractions of labour compensation allocated to each cellular division are tracked over time. For example, if the fraction of labour compensation for middle-aged men with college degrees increases relative to middle-aged men with only high school qualifications, this will imply an improvement in average skills or labour composition.

6 We are implicitly assuming constant returns to scale in the production function.

parameter α_i is measured as the share of labour costs in value added, and $1-\alpha_i$ is the capital share.[6] We can then express a country's labour productivity relative to the United Kingdom:

$$\ln \frac{(Y_i/H_i)}{(Y_{uk}/H_{uk})} = \ln \frac{A_i}{A_{uk}} + \tilde{\alpha_i} \ln \frac{LC_i}{LC_{uk}} + (1-\tilde{\alpha_i}) \ln \frac{(K_i/H_i)}{(K_{uk}/H_{uk})} \quad (2)$$

To conduct a cross-sectional multilateral comparison of labour productivity, we take the average of the country i's labour share and a base invariant labour share, denoted by $\tilde{\alpha_i}$. The base invariant labour share is the average labour share over all possible country choices.

To analyse the drivers of labour productivity growth, we follow the growth accounting method by Solow (1957). This approach decomposes labour productivity growth into contributions from factor inputs and TFP:

$$\Delta \ln \left(\frac{Y_{i,t}}{H_{i,t}}\right) = \Delta \ln A_{i,t} + \alpha_{i,t} \Delta \ln LC_{i,t} + (1-\alpha_{i,t}) \Delta \ln \left(\frac{K_{i,t}}{H_{i,t}}\right) \quad (3)$$

where $\Delta \ln X_{i,t} = \ln X_{i,t} - \ln X_{i,t-1}$ denotes the growth rate of variable X in country i and year t.[7] Labour shares and capital shares of value added (i.e. $\bar{\alpha_{i,t}}$ and $1-\bar{\alpha_{i,t}}$) are averaged over periods t and $t-1$ for each country i.

Labour Productivity Growth

To analyze productivity growth over time, we focus on the 1995 to 2019 period, a dozen years before and after the financial crisis (i.e. 1995-2007 versus 2007-2019). There are two reasons for this time frame. First, our primary data source, EUKLEMS & INTANProd 2023 KLEMS23 only goes back to 1995. Second, we conclude our analysis in 2019, just before the outbreak of the COVID-19 pandemic, which severely disrupted economic activities.[8]

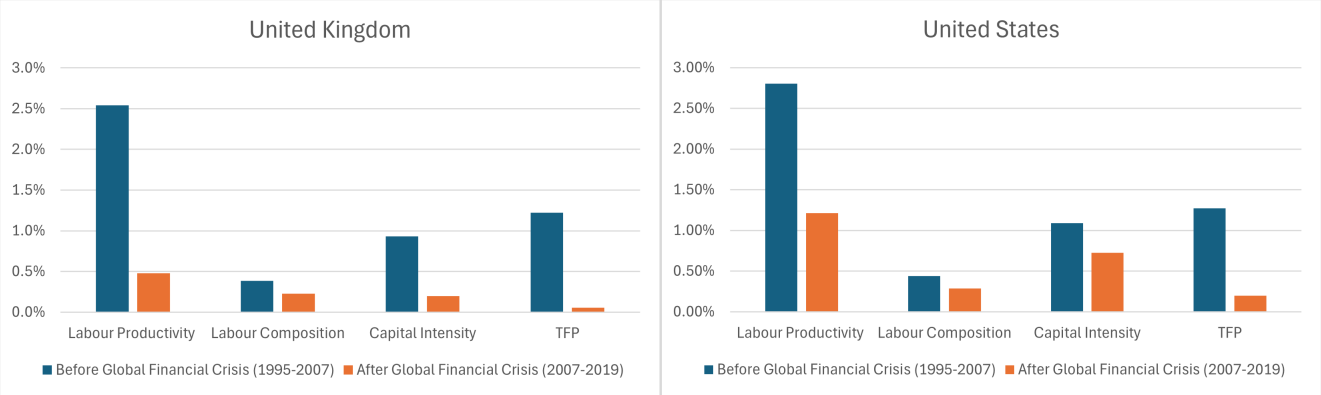
Chart 1 compares labour productivity growth rates before and after the financial crisis (with underlying numbers in Appendix Table C11). Beginning with the UK panel, we see that the UK labour productivity was growing at 2.5 per cent per year pre-crisis but fell to 0.5 per cent p.a. afterwards. This was a worse collapse than in the other countries. The UK productivity was growing faster pre-crisis than France (2.0 per cent) and Germany (1.9 per cent) and only slightly worse than the United States during its "productivity miracle" period (2.8 per cent). Post-crisis, all four economies experienced slowdowns, but the United Kingdom fared the worst, with a 2.1 per cent slowdown compared to 1.6 per cent in the United States, 1.5 per cent in

7 In our main analysis, TFP growth is defined based on Equation 3, which is the aggregate value added growth not explained by the revenue-share-weighted input growth. In section 3, we explored an alternative growth accounting model.

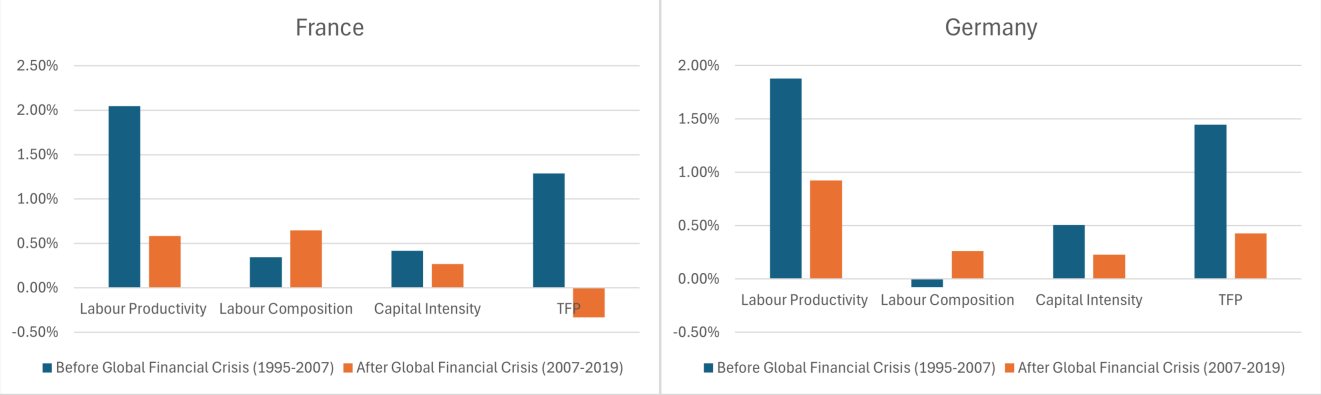
8 Section 4 looks at other years. For example, Appendix Table C13 has alternative cutoff years for the pre-GFC and post-GFC periods - these yield similar results.

Chart 1: Growth Accounting Before and After the Global Financial Crisis, SNA Market Economy, Per cent or Percentage Point Contributions per Year

Panel A: United Kingdom and United States



Panel B: France and Germany



Note: Growth accounting is estimated based on Equation 3. The left bar of each variable (labour productivity, labour composition,capital intensity and TFP) is the average weighted annual growth rate in the pre-GFC period (1995-2007), and the corresponding right bar is the average weighted annual growth rate in the post-GFC period (2007-2019). For the United States, the pre-GFC period starts in 1996 due to data limitations. See Appendix Table C11 for growth accounting results. Source: EUKLEMS & INTANProd 2023 (Bontadini *et al.*, 2023); OECD productivity statistics (OECD, 2014).

France, and 1.0 per cent in Germany.

We decompose labour productivity growth into the contributions from capital deepening, skills and TFP in Chart 1 and Chart 2. Chart 2, Panel A indicates that there was a general slowdown in TFP growth with the United Kingdom no worse than other countries. Britain's TFP growth slowed by 1.2 percentage points, accounting for over half of the overall labour productivity slowdown. The TFP slowdown was 1.1 percentage points in the United States, 1.6 percentage points in France and 1.0 percentage points in Germany.

Of the (roughly) other half of the UK labour productivity slowdown (0.9 percentage points), four-fifths was due to slower capital deepening (0.73 percentage points) with a smaller fraction ascribed to labour composition (0.16 percentage points). This slowdown in capital intensity growth was particularly large, both in absolute terms Chart 1 and relative to other countries Chart 2. The weighted decline in capital intensity growth is only -0.36 percent-

age points in the United States (half of that in the United Kingdom), -0.28 in Germany and -0.15 in France. In addition, the United Kingdom had the largest fall in labour composition growth (-0.16 per cent versus -0.15 per cent in the United States). In contrast,labour composition growth actually improved in France and Germany.

In Chart 2, Panel B we break down the deceleration of capital deepening into three subcategories: ICT tangible capital , non-ICT tangible capital , and intangible capital . Across these asset classes, tangible capital emerges as the primary driver of the overall decline in capital deepening across all countries. Specifically, the slowdown in ICT tangible capital deepening was the most significant contributor in the United Kingdom and United States, whereas non-ICT tangible capital deepening mattered more in Europe. The United Kingdom has the largest slowdown in ICT capital and intangibles deepening, whereas its slowdown in non-ICT capital deepening is more comparable to other EU countries.

We also looked at the broader notion of intangibles (Appendix Chart B7 and Chart B9). Broadly, in Chart 3, the conclusions do not change that much. The UK's labour productivity slowdown remains at almost 2 percentage points with TFP contributing 1.2 percentage points, and this TFP slowdown is similar across countries. The contribution of intangibles is -0.11 percentage points in the United Kingdom, slightly less than the -0.17 percentage points under the SNA framework. But the main differentiating factor is still lower capital investment. In summary, the United Kingdom had the worst contraction in labour productivity growth across the four countries we study after the financial crisis. Britain's fall in TFP growth was similar to that experienced across other nations. What stands out is the sharper drop in capital accumulation and (to a lesser extent) a slowdown in skill accumulation. Thus the picture in growth rates is qualitatively similar to that in levels: the UK's productivity problem is related to lower investment levels in fixed and human capital.

The UK Productivity Gap in Levels

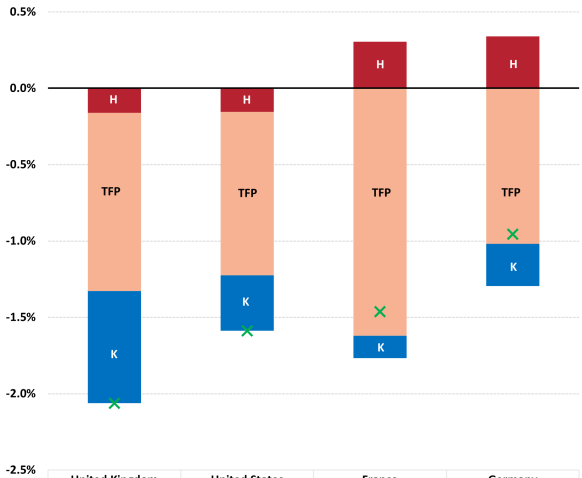
Basic Results

We now turn from productivity growth to level analysis. Chart 4 illustrates the UK labour productivity gap with its counterparts for 2019, adjusted for differences in capital intensity and labour composition. The first and darkest green bar shows that the United Kingdom lags behind all three countries. Specifically, US labour productivity is 30 per cent higher than that of the United Kingdom, while France and Germany lead by 14 per cent and 22 per cent respectively.

The next two bars in Chart 4 show the impact of adjusting for capital and labour quality. The middle green bar accounts for differences in capital intensity, considering both tangible and intangible capital in national accounts. This adjustment explains 6 percentage points of the gap with the United States, 5 percentage points with France and 8 percentage points with Germany. Hence, approximately one-fifth to over one-third of labour productivity gaps stem from lower investment in physical cap-

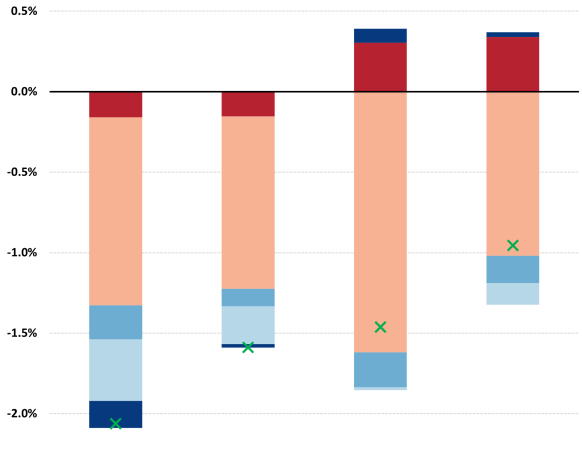
Chart 2: Productivity Growth Slowdown After the Global Financial Crisis, SNA Market Economy, Percentage point contribution per year

Panel A: Breakdown by Total Capital



	United Kingdom	United States	France	Germany
Total Capital (K)	-0.73%	-0.36%	-0.15%	-0.28%
TFP	-1.17%	-1.07%	-1.62%	-1.02%
Labour Composition (H)	-0.16%	-0.15%	0.30%	0.34%
Labour Productivity	-2.06%	-1.59%	-1.46%	-0.96%

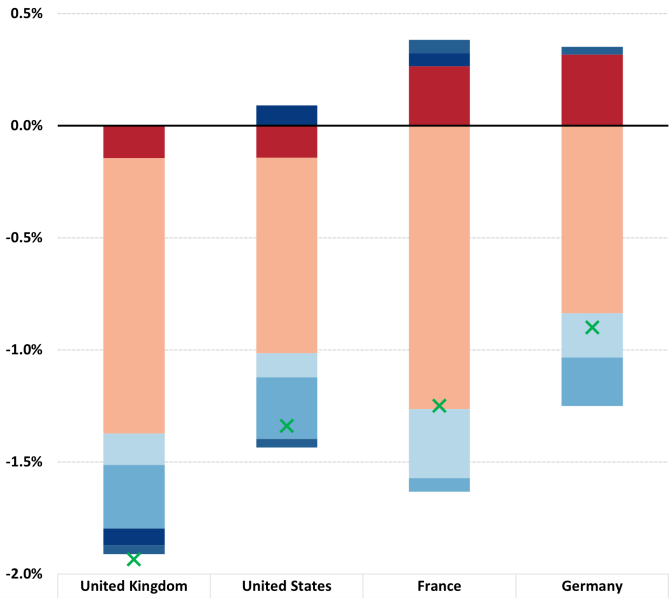
Panel B: Employment



	United Kingdom	United States	France	Germany
Intangible Capital	-0.17%	-0.02%	0.09%	0.03%
Tangible ICT Capital	-0.38%	-0.24%	-0.02%	-0.14%
Tangible NICT Capital	-0.21%	-0.11%	-0.22%	-0.17%
TFP	-1.17%	-1.07%	-1.62%	-1.02%
Labour Composition (H)	-0.16%	-0.15%	0.30%	0.34%
Labour Productivity	-2.06%	-1.59%	-1.46%	-0.96%

Note: This shows the difference in labour productivity growth in the dozen years before (1995-2007) and after (2007-2019) the financial crisis. The green cross denotes the overall fall in labour productivity growth. Panel A has the overall decomposition and Panel B breaks down the capital contribution into tangible Information and Communication Technology (ICT), tangible non-ICT capital (NICT) and intangible capital (SNA boundaries). Source: See Chart 1 for data sources and Chart notes.

Chart 3: Productivity Growth Slowdown After the Global Financial Crisis, CHS Market Economy, Percentage Contribution per Year



	United Kingdom	United States	France	Germany
Intangible Capital NatAcc	-0.04%	-0.04%	0.06%	0.03%
Intangible Capital Non-NatAcc	-0.07%	0.09%	0.06%	0.00%
Tangible ICT Capital	-0.28%	-0.28%	-0.06%	-0.22%
Tangible NICT Capital	-0.14%	-0.11%	-0.31%	-0.20%
TFP	-1.23%	-0.87%	-1.26%	-0.84%
Labour Composition (H)	-0.14%	-0.14%	0.26%	0.32%
Labour Productivity	-1.94%	-1.34%	-1.25%	-0.90%

Note: This shows the difference in labour productivity growth in the dozen years before (1995-2007) and after (2007-2019) the financial crisis in the CHS market economy. We decompose this into labour composition, TFP, and capital per hour growth (tangible ICT, tangible non-ICT, SNA intangible capital and non-SNA intangible capital). The green cross denotes the overall fall in labour productivity growth.
Source: See Chart 1 for data sources and Chart notes.

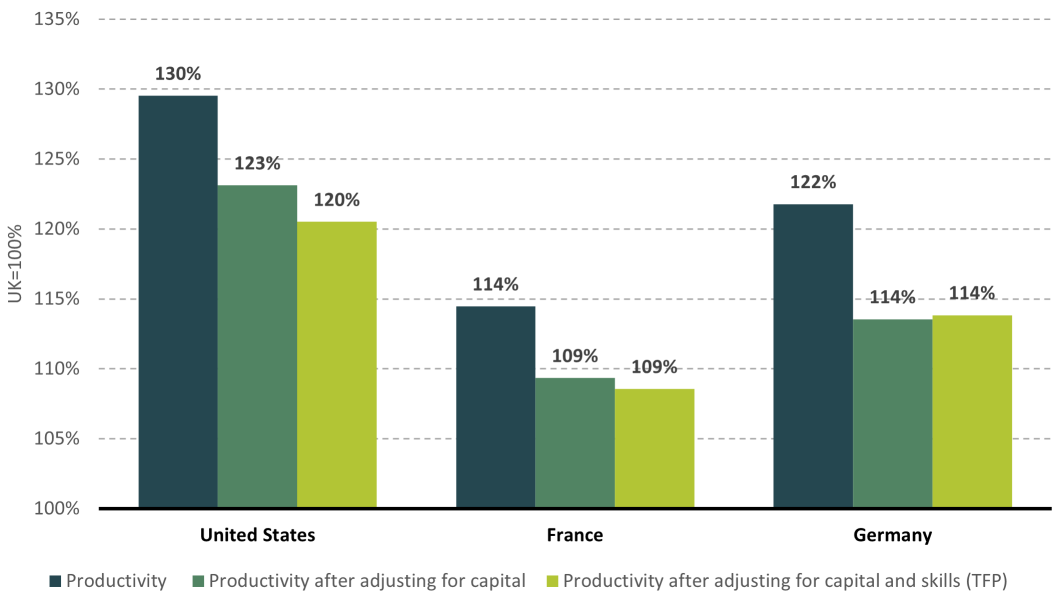
ital.

The last and lightest green bar in Chart 4 also takes into account labour quality differences and serves as our measure of TFP. Labour quality has little impact on the UK's productivity gap with Germany and France, but accounts for about 3 percentage points of its gap with the United States. After controlling for input differences, the UK TFP gap is 20 per cent with the United States, 9 per cent with France and 14 per cent with Germany. Hence, differences in observable capital and labour inputs have accounted for 31 per cent, 41 per cent and 36 per cent of the productivity gap with the United States, France and Germany respectively.[9]

Such productivity-level accounting comes with many caveats, such as imperfect measurement of labour composition and the different choices of purchasing power parity (PPP). We employ an alternative labour composition measure and conducted more robustness checks in Appendix B, which show these qualitative findings to be robust.

9 The proportion of the productivity gap explained by differences in observable capital and labour inputs = 1 – (TFP gap/ total labour productivity gap). For example, this proportion in the United States is 67 per cent = 1 - (20.5/29.5))

Chart 4: Labour Productivity Level in the United States, France and Germany Relative to the United Kingdom, SNA Market Economy, 2019



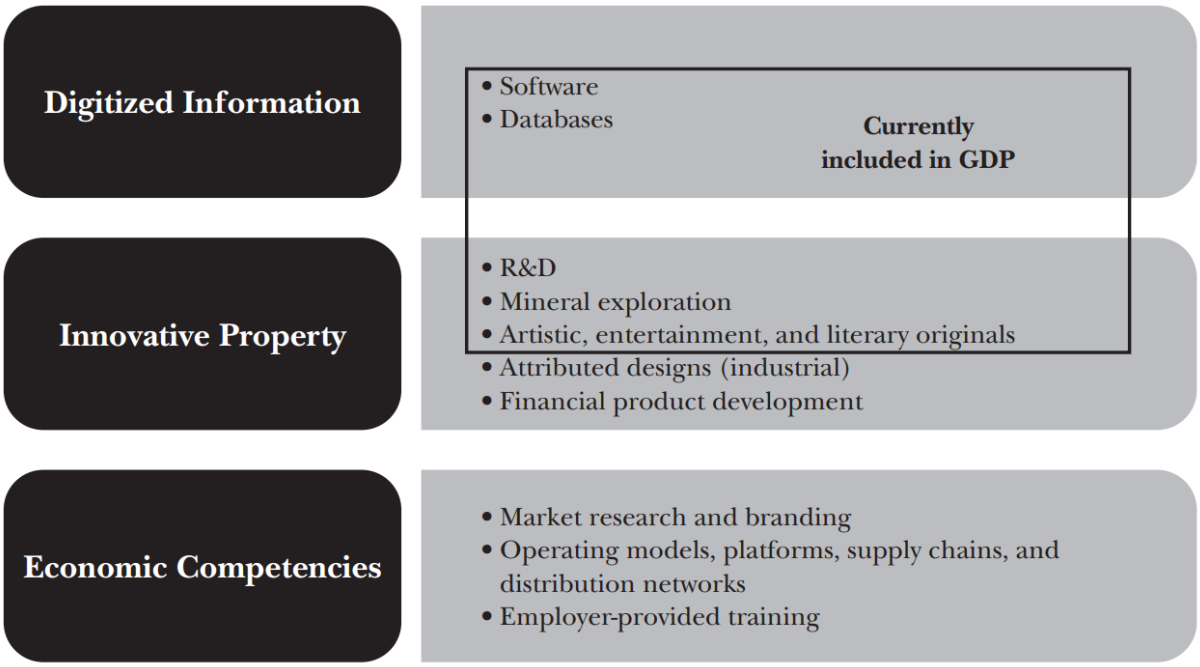
Note: The chart shows labour productivity levels adjusted for different factor inputs, normalized to the United Kingdom in 2019=100 per cent. The labour productivity level is in 2015 PPP prices. Capital intensity and labour composition are estimated by level accounting based on Equation 2, which are weighted by capital and labour shares respectively. See Appendix Table C1 for level accounting results. Because of data availability in EUKLEMS, unweighted labour composition is assumed to be the same for market and non-market sectors in the United States. See Appendix A for further details.
Source: EUKLEMS & INTANProd 2023. (Bontadini *et al.*, 2023); OECD productivity statistics (OECD, 2014); PPP (OECD, 2023c);Average years of schooling (Barro and Lee, 2013)

Extended Intangible Capital Measures

Intangible capital has become an increasingly important component of firm assets in the modern economy (Haskel and Westlake, 2017). However, the System of National Accounts (SNA) asset boundary only takes a rather narrow approach to incorporating intangibles, specifically digitized information (software and databases) and specific innovative property (R&D, mineral exploration, and arts originals). This fails to capture the more comprehensive value of intangibles such as marketing to enhance brand capital and company training to build human capital. For countries that invest heavily in intangible assets beyond the SNA boundary, output and capital stocks in national accounts will not accurately reflect productivity and the contribution of capital. To address this concern, Corrado, Hulten and Sichel (2009) proposed an expanded asset boundary (the "CHS" boundary) that encompasses a broader concept as illustrated in Figure 1. We can use the analytical module in EUKLEMS & INTANProd 2023 (Bontadini *et al.*, 2023), which complements national accounts data with information on intangibles using the CHS framework.

The capitalization of intangible assets outside national accounts could impact labour productivity through three chan-

Figure 1: Intangible Capital: Broad Categories and Types of Investment



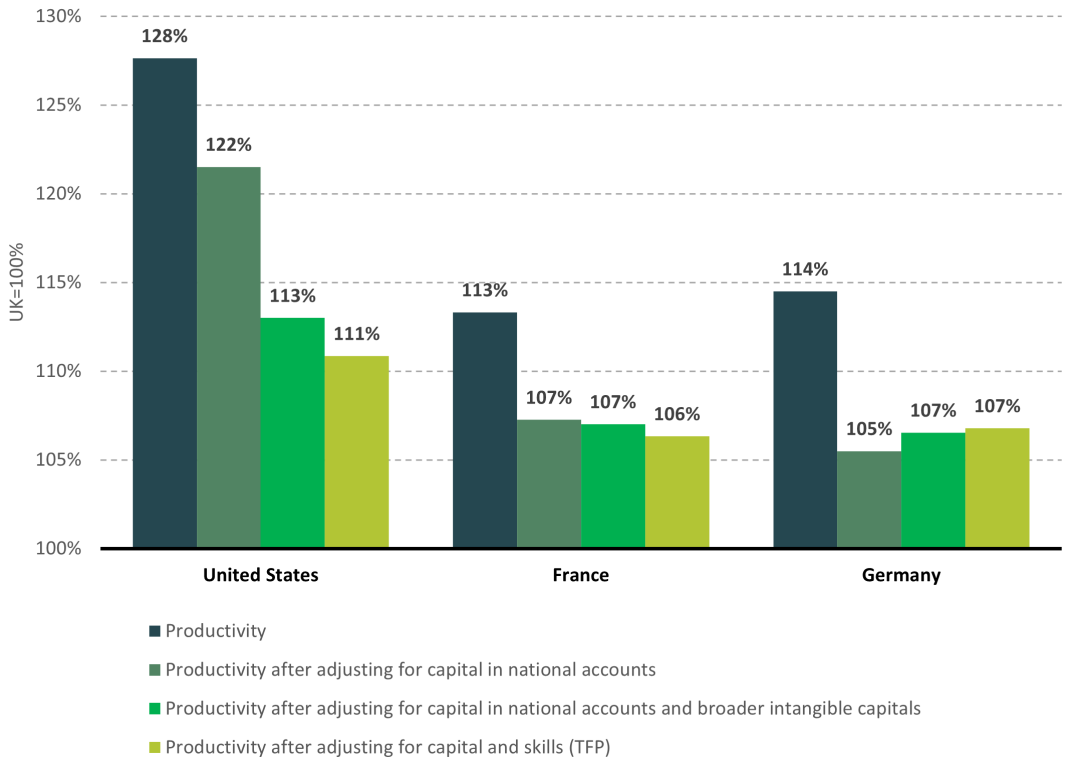
Source: Figure by Corrado *et al.* (2022).

nels. First, it increases the volume of the capital stock. Second, the capitalization of additional intangibles increases value-added, as these intangible assets are no longer considered intermediate inputs but rather part of final output. Third, it changes the capital and labour shares as capital compensation will be higher. How large these adjustments are is an empirical question.

We show the effect of incorporating broader intangibles on productivity gaps in Chart 5. The leftmost bar for each country represents the relative levels of labour productivity under the CHS boundary. Compared to Chart 4, the UK productivity gaps with the United States and France remain largely unchanged. However, the gap with Germany narrows considerably from 21.8 per cent to 14.5 per cent. This suggests that German intangible capital stock is relatively lower, flattering its productivity performance.

The second bar of Chart 5 shows the impacts of adjusting for capital intensity in national accounts, as in Chart 4. The third bar reflects the adjustment for the wider notion of intangible capital. While this adjustment has minimal impact on France and Germany, it significantly reduces UK's productivity gap with the United States by 8 per cent, indicating that the United States is much more intangible capital-intensive. Lastly, the fourth and lightest bar gives the new relative TFP levels. The incorporation of broader intangibles has reduced the UK TFP gaps further to 11 per cent with the United States and approximately 6 per cent with France and Germany. Thus, the difference in physical

Chart 5: Labour productivity Level Relative to the UK, CHS Market Economy, 2019



See sources and notes in Chart 4. See Appendix Table C2 for decomposition estimates.

and human capital inputs explains 60 per cent of the UK's productivity gap with the United States and over 50 per cent with France and Germany

In conclusion, the United Kingdom has lower value added per hour than France and Germany and much lower labour productivity than the United States. From two-fifths to one-third of these differences are accounted for by lower capital intensity, with the remaining gaps largely due to TFP. Using a broad measure of intangible capital, lower capital intensity emerges as the most important contributor to the productivity gap between the United Kingdom and its peers, with TFP playing a slightly smaller but still substantial role. Therefore, a key issue of the UK productivity problem lies in low investment both for growth and levels.

Extensions

In this section, we present several extensions and robustness tests of our analysis.

Alternative Labour Composition Measures

In addition to our previous labour composition measure, another common approach in the literature to control for the quality of the workers in level accounting is to estimate a human capital index based on worker's average years of schooling, assuming a rate of return to education (e.g. Caselli, 2005). In this section, we adopt this alternative following Hall and Jones (1999) in our level accounting:

$$h = e^{\phi(s)} \tag{4}$$

where s denotes the average years of schooling. The function $\phi(s)$ is piecewise linear with slope 0.13 for $s \leq 4$, 0.10 for $4 < s \leq 8$, and 0.07 for $8 < s$, following the specification in Caselli (2005).

One widely used data source for years of schooling s is the data on education attainment for the total population by Barro and Lee (BL, 2013) (e.g. the Penn World Table). However, directly using this data as a proxy for years of schooling in estimating the human capital index poses a challenge due to the differences in years of schooling between workers and the total population. To overcome this issue, we employ BL's average years of schooling for different education levels, weighted by the share of hours worked by each skill level in EUKLEMS data. As BL's data is available only every five years up to 2015, we extrapolate the average years of schooling to 2019 based on the growth rates observed between 2010 and 2015. Details are provided in the appendix.

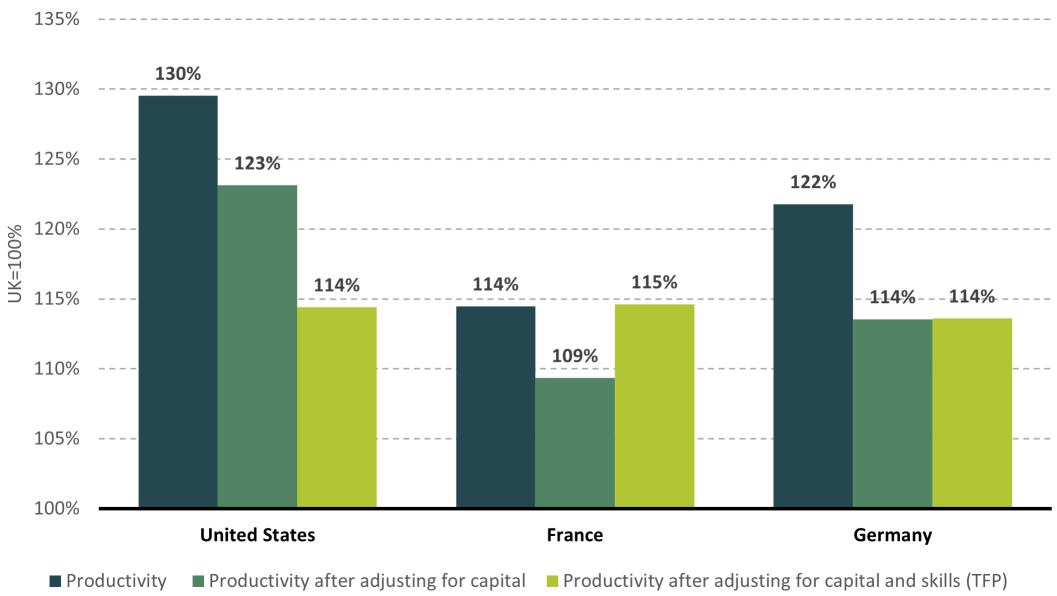
The alternative labour composition measure results in a significantly higher skills level in the United States relative to the United Kindgdom and a much lower relative skills level for France, while Germany's skills level remains largely unchanged. Chart 6 illustrates the level accounting results using these alternative measures, with the first two bars from the right remaining consistent with our previous analysis. However, the UK's TFP gap with the United States decreased significantly by 6 percentage points, while its gap with France increased by the same margin when employing the alternative labor composition measures. Considering broader intangibles in Chart 7, the UK's productivity gap further decreased to 6 percentage points with the United States, 12 percentage points with France, and 7 percentage points with Germany.

Productivity Breakdowns Across Industries

Is poor UK labour productivity growth after 2007 economy-wide or sector-specific? Chart 8 shows the sectoral decomposition of the productivity slowdown, weighted by industry size in terms of nominal GVA. Four things stand out: First, there was a substantial slowdown in the manufacturing sector across all countries after 2007. In particular, the United Kingdom had a more severe slowdown in manufacturing (0.98 per cent) than the other European countries (0.60 per cent for France and 0.65 per cent for Germany). Second, the manufacturing sector alone does not fully explain why the United Kingdom experienced a worse slowdown than other countries. When excluding the manufacturing sector from the market economy, as shown in Appendix Chart B17, our previous conclusions remain unchanged. Third, the wholesale and retail sector also saw a notable slowdown across all countries, but the United Kingdom was doing relatively well compared to other countries. Fourth, the United Kingdom performed significantly worse than other countries in Information and Communication (IC), finance and professional/scientific/technical services.

Chart B16 in the online Appendix

Chart 6: Labour Productivity Level Relative to the United Kingdom Using Alternative Labour Composition Measures, SNA Market Economy, 2019



Note: The Chart illustrates labour productivity levels adjusted for different factor inputs, as depicted in Chart 4. 'Skills" refers to the relative human capital levels calculated using Equation 4, which are weighted by labour shares. For detailed accounting results at the level, please refer to Appendix Table C7.
Source: EUKLEMS & INTANProd 2023. (Bontadini *et al.*, 2023); OECD productivity statistics (OECD, 2014); PPP (OECD, 2023c); Average years of schooling (Barro and Lee, 2013).

presents the growth accounting results for the four sectors that contributed the most to the UK's slowdown.[10] In manufacturing and professional services, the decline in TFP growth accounts for over three-fifths of the slowdown. However, in the IC and finance sectors, the most critical contributor is the collapse of capital deepening.

Performance after 2019

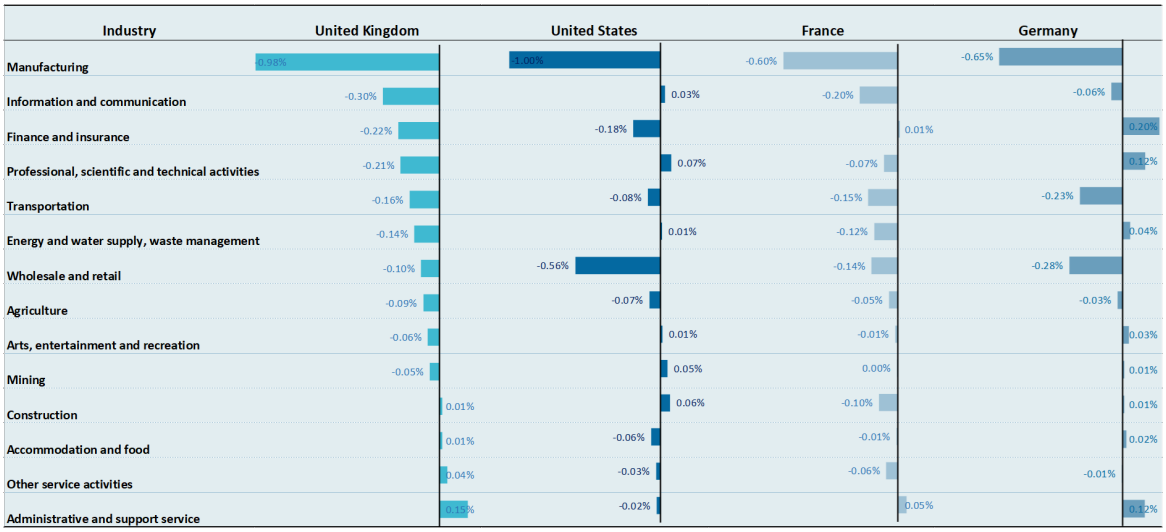
Our main analysis concludes in 2019 due to data availability and the onset of the COVID-19 pandemic. But we can use less comparable data to see whether the trajectory of labour productivity has substantially changed since then. Chart 9 plots labour productivity through 2023Q1. Despite the large swings observed during the pandemic (highlighted by the shaded area) in Chart 9, the post-pandemic trajectory of labour productivity in the UK continued the slow growth observed in the 2007-2019 period. There was a "heartbeat shape" in the lock-down period, but after 2001 productivity looks – if anything – even slower than the pre-Covid period. Germany looks similar to the UK. The United States seemed to weather the storm relatively well and France rather poorly. These most recent years are likely to be subject to the most data revisions across all countries, so we should be cautious about reading too much into them.

10 Alternative starting years for the pre-GFC period (1995 versus 1997) result in different rankings of weighted sector slowdown. However, the top four contributors remain unchanged. See Appendix B for further analysis.

Chart 7: Labour Productivity Level Relative to the United Kingdom Using Alternative Labour Composition Measures, CHS Market Economy, 2019

See sources and notes in Chart 7. See Appendix Table C8 for decomposition estimates.

Chart 8: Weighted Slowdown of Labour Productivity Growth After GFC Across Industries, SNA Market Economy, Percentage Point Contribution Per Year



Note: The productivity slowdown is the change in average labour productivity growth rates in 1995-2007 vs. 2007-2019. The slowdown by industry is weighted by the output share of each sector in the market economy.
Source: EUKLEMS & INTANProd 2023 (Bontadini *et al.*, 2023); OECD productivity statistics (OECD, 2014)

Overall, the impact of COVID-19 on labour productivity appears to be a one-time shock that has not fundamentally changed the long-term trends. Our sense is that nothing major has changed in the data to alter our analysis.

Output Growth Decomposition

Productivity is a ratio of output (value added) to labour input (hours). An alternative decomposition is to focus on explaining total value-added growth as a function of overall inputs including hours. The interpretation of this approach is less clear than our main decomposition as hours can grow for many reasons such as higher population (e.g. from immigration), demographic change, lower unemployment and less leisure (fewer holidays and longer working weeks).

Nevertheless, to investigate whether the UK's position is all due to more hours growth rather than lower output growth, we decompose value-added growth as:

$$\Delta \ln Y_{i,t} = (1-\bar{\alpha}_{i,t})\Delta \ln K_{i,t} + \bar{\alpha}_{i,t}\Delta \ln LC_{i,t} + \bar{\alpha}_{i,t}\Delta \ln Hours_{i,t} + \ln A_{i,t} \quad (5)$$

Chart 10 shows the decomposition results derived from Equation 5. The first bar on the left illustrates the slowdown in value-added growth. The magnitude of deceleration is similar for the United Kingdom, United States, and France, but notably smaller for Germany. Despite the slowdown in output growth, both the United Kingdom and Germany increased hours growth compared to their pre-crisis trends (the second, red bar). In contrast, hours growth slowed in the United States and France.

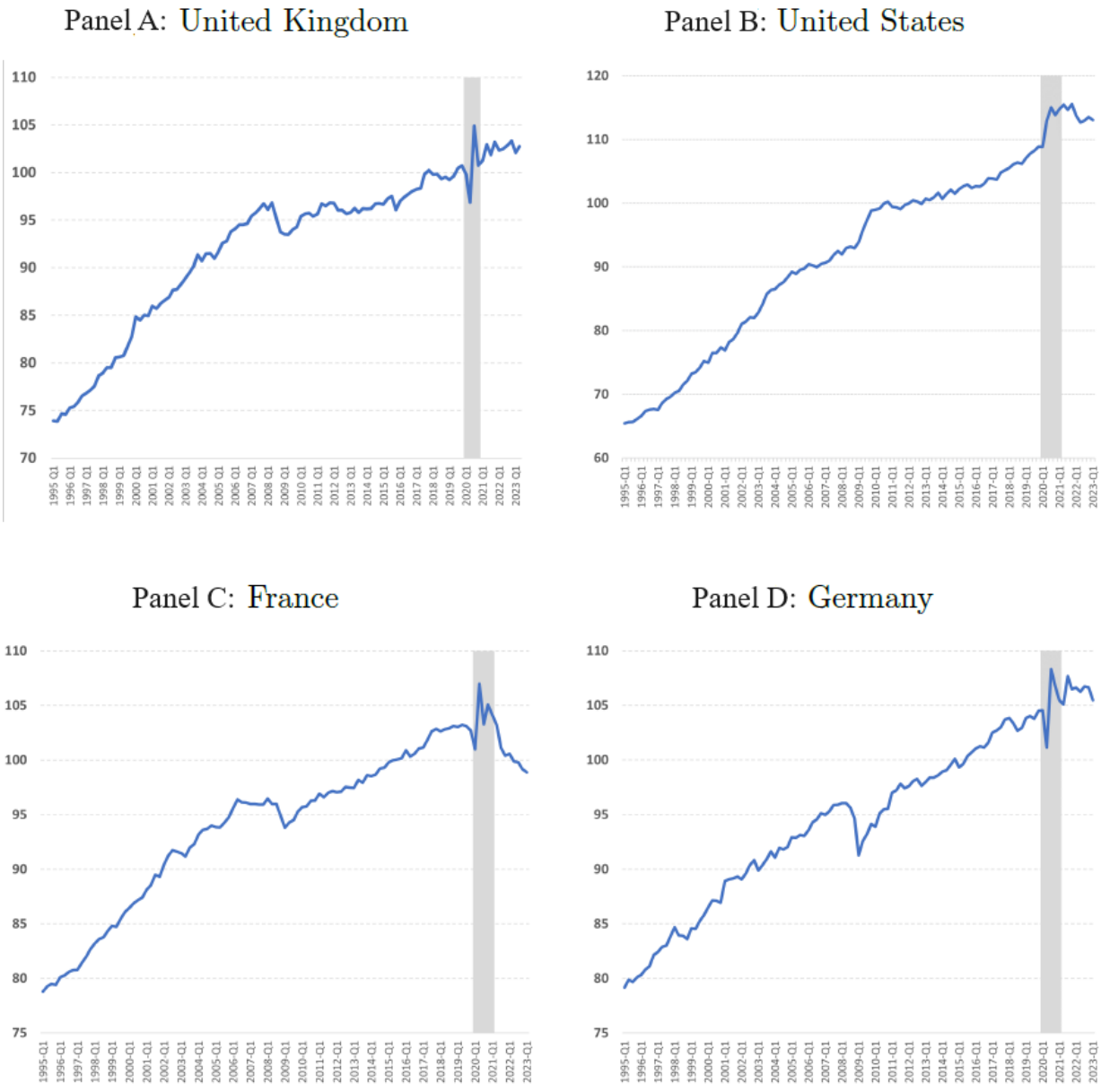
Regarding capital, it is still clear that Britain experienced the most severe slowdown in capital growth, being approximately three times as large as the EU countries and about one-sixth larger than the United States. TFP remains the most important contributor to the output growth slowdown across all countries.

Is the hours story more of a success for the UK? The problem is that the increase in hours worked post crisis does not seem to translate into better output growth. Given the extra hours, we would expect output growth to have been stronger than it was in the United States and France, not more or less the same. And Germany, which had a faster increase in hours growth than the United Kingdom, seems to have had a far superior productivity performance.

Labour Market Response after the Global Financial Crisis

The hours analysis of the previous subsection prompts a more in-depth look at labour markets. Chart 11 shows the employment rate of the working-age population by quarter between 1995 and 2023. Going into the financial crisis, the employment rate was highest in the United Kingdom (about 72 per cent), slightly lower in Germany and the United States (about 70 per cent) and much lower in France (about 66 per cent). All countries experienced falls in the employment rate during the financial crisis, with some recovery afterwards. Germany was particularly quick to recover,

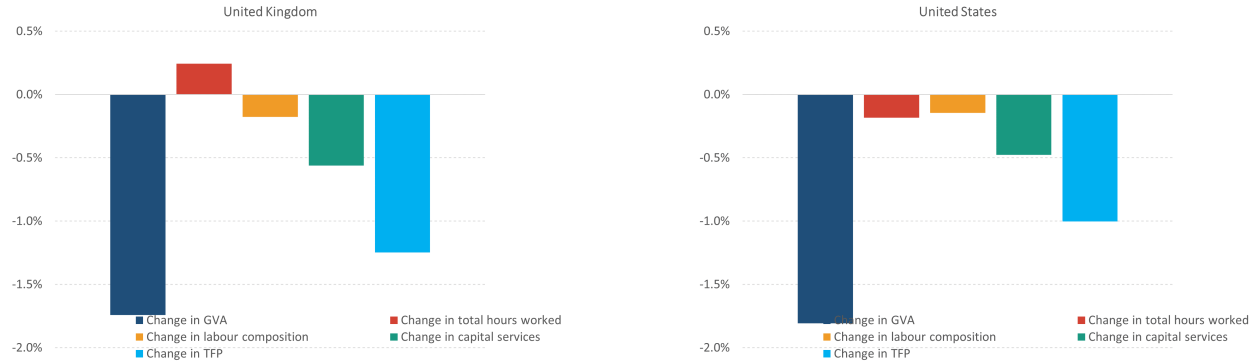
Chart 9: Quarterly Labour Productivity Trend, 1995Q1-2023Q1



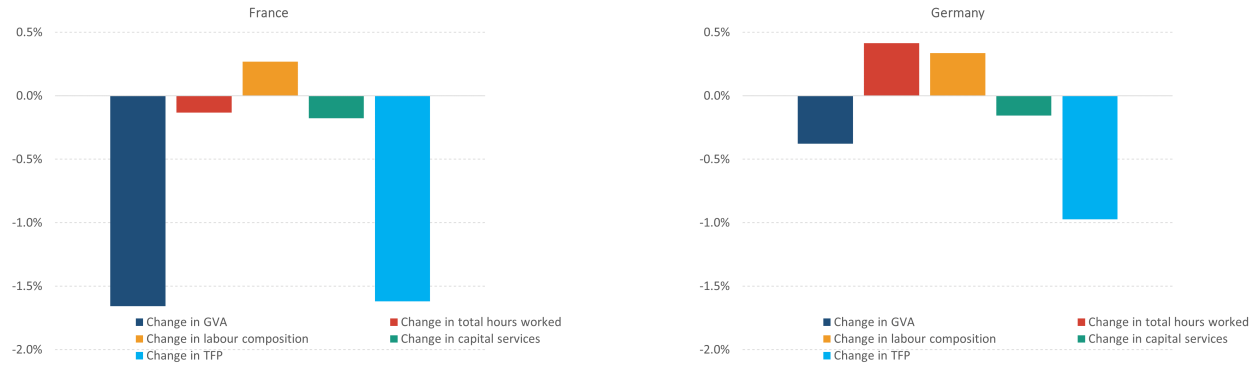
Note: Labour productivity indicator for the United Kingdom, France and Germany is calculated based on the whole economy. The labour productivity indicator for the United States is based on the business sector. Labour productivity is indexed with a base year of 2019=100 in the United Kingdom, 2012=100 in the United States, and 2015=100 in France and Germany.
Source: Labour productivity indicator (ONS, 2023); Labour productivity for all workers (U.S. Bureau of Labor Statistics, 2023); Labour productivity indicator (Eurostat, 2023).

Chart 10: Decomposition of Output Growth Slowdown, SNA Market Economy

Panel A: United Kingdom and United States



Panel B: France and Germany



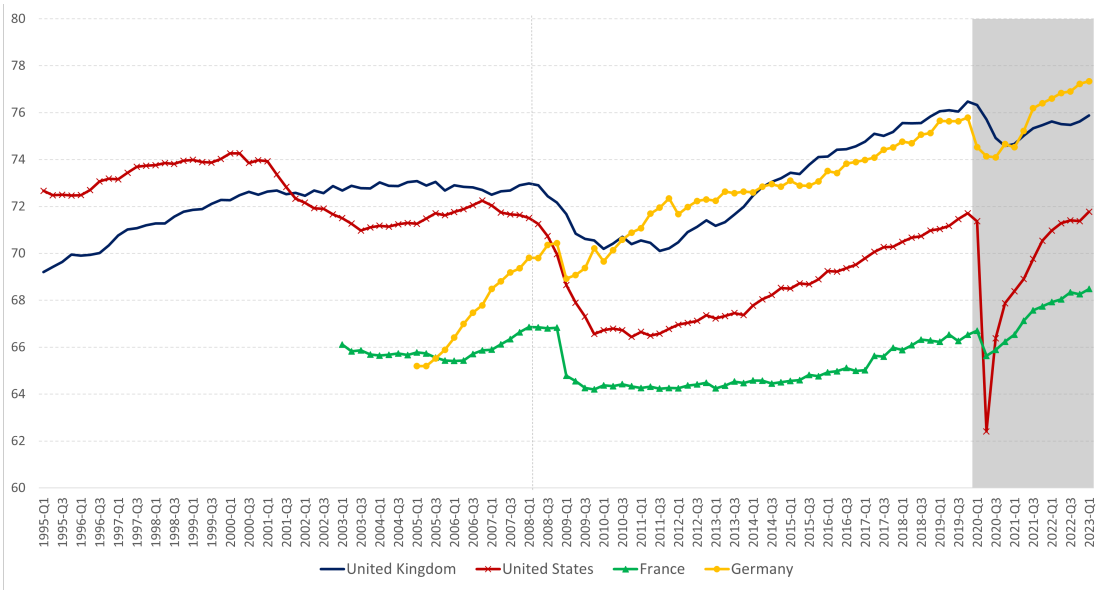
Note: The change in GVA or other factors of production is the difference in their average annual growth rates between 1995-2007 and 2007-2019. See Table C15 for detailed decomposition results.
Source: EUKLEMS & INTANProd 2023(Bontadini *et al.*, 2023); OECD productivity statistics (OECD, 2014).

and by 2019 both the United Kingdom and Germany now had an employment rate of around 74 per cent. In 2023, the German employment rate was actually higher than the United Kingdom at around 76 per cent. The United States rate fell by more in the crisis and was very slow to recover, with levels that are still below those in 2007. France had the slowest recovery of all and has only just managed to reach its pre-crisis levels. [11]

Could the poorer productivity performance in the United Kingdom be due to successfully getting more low-skilled people into jobs than these other countries? Under this interpretation, low UK productivity growth is a sign of a successful labour market, rather than a weak business sector. The controls for labour composition are meant to deal with this issue. If more low-

11 Table C16 and Table C17 in the online appendix, we compare the cumulative (beginning-to-end) change in the employment rate and employment/population ratio for pre-GFC and post-GFC periods across countries. From 2007 to 2019, the employment rate grew by 3.47 percentage points in the United Kingdom whereas it only grew by 1.65 and -0.42 percentage points in France and the United States respectively. Note that these are for the whole economy rather than the market economy as reported in earlier tables, as the market economy employment rate is not a well-defined concept (population is intrinsically a whole economy concept).

Chart 11: Quarterly Employment Rate of Working-age Population, SNA Total Economy



Note: The working-age population refers to people aged 15-64. The quarterly employment rates of the working-age population for France and Germany start in 2003Q1 and 2005Q1 respectively, due to data availability.
Source: Employment rate indicator (OECD, 2023a).

educated workers are now employed, this should be reflected in a fall in labour quality (skills) and picked up in the decomposition. But this control is only across age-education-gender-industry groups. Maybe the young and less educated unemployed individuals are particularly less productive and the standard labour quality controls fail to reflect this.

Two observations cause us to doubt this more hopeful reading of the United Kingdom position. First, Germany has been more successful than the United Kingdom in raising the employment rate - a full 6.68 percentage points (see Table C16). Despite its employment rate growth being twice as large as that in the United Kingdom, Germany's productivity growth was in fact better than Britain's. Second, there was a similar large increase in the employment rate in the United Kingdom in the 1995-2007 period as there was in the post-2007 period (indeed it was larger than any of the other three countries). But productivity growth did not seem held back by this at all in the pre-GFC period.

In summary, although our labour quality controls are imperfect, it is unclear how much in principle they bias the UK's relative position if at all. The analysis here suggests that poor productivity performance cannot be explained by a relatively resilient labour market.

Alternative Labour Productivity Growth Decomposition

One potential concern for interpreting the growth accounting results in section two is the endogeneity of capital deepening. Fernald *et al.* (2017) argues that the weak capital intensity growth is induced by a slowdown in the TFP growth, and proposed an alternative decomposition in

terms of the capital-output ratio. Specifically, labour productivity can be decomposed as:

$$\Delta \ln \left(\frac{Y_{i,t}}{H_{i,t}} \right) = \frac{1 - \overline{\alpha_{i,t}}}{\overline{\alpha_{i,t}}} \Delta \ln \left(\frac{K_{i,t}}{\overline{Y_{i,t}}} \right) + \Delta \ln LC_{i,t} + \frac{\Delta \ln A}{\overline{\alpha_{i,t}}} \quad (6)$$

Chart 12 decomposes the labour productivity growth before and after the GFC using Equation 6. Both labour composition and TFP growth rates make up a larger share of the productivity slowdown. In contrast, the contribution of capital intensity decreases substantially. Capital over output growth was almost zero in Germany throughout the two periods, while the United States and France observed an increase in capital-output ratio growth after the GFC. The United Kingdom is the only one amongst all that experienced a decline in capital intensity, although the decline is quantitatively much smaller than our previous decomposition results. The capital story remains to be a key differentiating factor between the United Kingdom and other countries, which is qualitatively consistent with our findings in section two.[12]

Alternative Hours Calculations

As noted above, among our four countries, only the United Kingdom adopts the direct method (surveying employees) to calculate hours, which tends to overestimate the actual hours worked. Labour productivity estimated using the direct method is consistently lower than that estimated using component method (CM) hours.[13] Since labour input data in EUKLEMS is sourced from national accounts, using hours data in EUKLEMS underestimates the UK productivity level and overestimates the UK productivity gap with other countries. Although the method used by OECD (2014) to construct the harmonized working hours data that we use in this article is not perfect, it offers a consistent estimate across countries, mitigating biases in international comparisons.

Other Robustness Checks

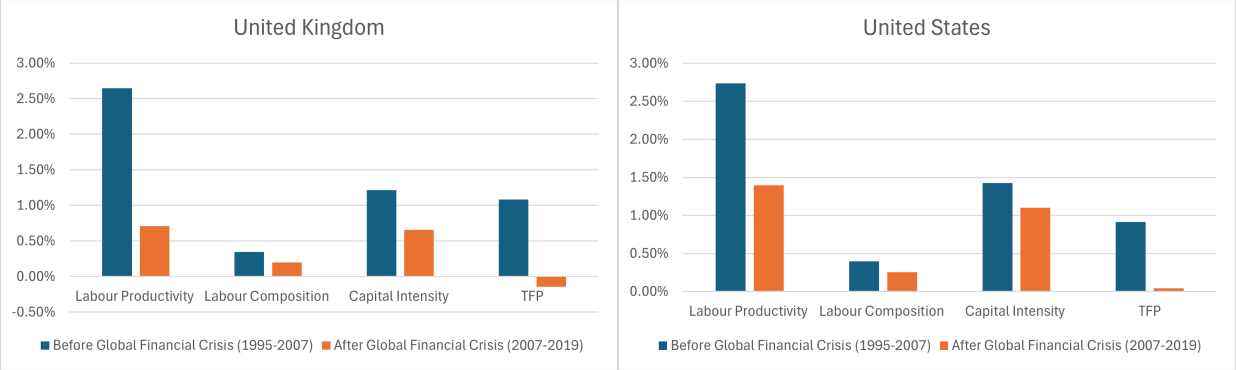
To ensure the robustness of our findings, we conducted many additional checks. First, we employ different PPP series in our productivity level analysis. In Appendix Table B2 and Chart B18 in the online appendix, we use both constant PPPs and current-year PPPs to convert productivity levels into international dollars. Both PPP series yield similar productivity level decomposition results, but

12 The key question regarding the two different decomposition methods revolves around what is really captured by TFP. Fernald *et al.* (2017) assume that TFP reflects the actual exogenous state of technology. In this case, TFP determines the return on investment and thus capital intensity. On the other hand, an alternative interpretation of TFP considers it as the residual due to mismeasurement and other factors omitted from the growth accounting model. In the latter case, TFP growth reflects the productivity change due to investment that is not well-reflected in existing measurements.

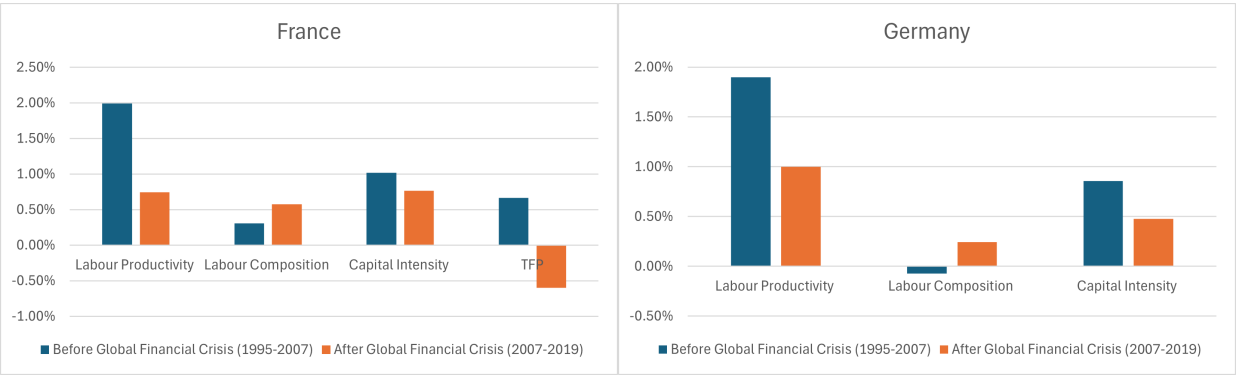
13 See Chart B2 in the online Appendix. We provide a more detailed comparison of different methods employed by each country for constructing labour input data in national accounts in Appendix A.

Chart 12: Growth Accounting Using an Alternative Decomposition Method

Panel A: United Kingdom and United States



Panel B: France and Germany



Source: EUKLEMS and INTANProd 2023 (Bontadini *et al.*, 2023). This implements the Fernald *et al.* (2017) approach.

lead to different rankings of relative labour productivity among countries in the earlier years. Second, we conduct growth accounting using alternative cut-off years for the pre-GFC and post-GFC periods in Appendix Table C13. Different choices of time frames have minimal impact on our main results. Third, we compare the double-deflated data from the Office for National Statistics (ONS) with the 2023 EUKLEMS data at the industry level. Although the United States and other European countries have long used double deflation for the calculation of real GVA, the ONS in the United Kingdom only introduced this method in 2021. Double deflation has little impact on labour productivity growth at the aggregate level but leads to significant revisions in labour productivity growth at the industry level.[14]

Conclusion and Policy Implications

We have examined UK productivity compared to the United States, France and

14 Table A5 in the online Appendix presents a comparison of the industrial labour productivity growth rates using the ONS and EUKLEMS data, confirming their overall consistency.

Germany using the latest comparable data for the market economy (i.e. dropping the hard-to-measure, public sector-related industries). We focused on the dozen years before and after the financial crisis that began in 2007, ending just before the COVID pandemic (although our findings do not much change if we go forward to 2023 or back to 1979).

The United Kingdom has a productivity problem in terms of growth and levels. British productivity growth in the market economy fell by over two percentage points (from 2.5 per cent to 0.5 per cent a year) post-crisis compared to pre-crisis, and this slowdown was worse than in other countries. Although the slowdown in TFP growth was fairly similar across countries, the United Kingdom had a particularly large slowdown in capital intensity growth and (to a lesser extent) in skills growth. In 2019, the level of output per hour worked was much lower than United States and significantly lower than in Germany and France. Just about half of these gaps are due to lower tangible and intangible capital per hour worked.

The conclusions from both looking at UK productivity in a comparative perspective are clear. Apart from the common TFP issue across most countries, the United Kingdom has weak productivity because it has chosen to make fewer investments.

What are the policy options for raising productivity? Our finding that both low capital inputs and TFP explain the productivity, suggests that the main problem in the United Kingdom is not misallocation or inefficiency, but rather investments in the broadest sense (including intangible investments). This is not to say that TFP-raising policies are unwelcome, but rather that attention may need to be focused on what is holding back investment.

We would point readers towards the Economy 2030 initiative (e.g. Brandily *et al.*, 2023) which builds on the work of the LSE Growth Commission (Aghion *et al.*, 2013). There are many practical recommendations, but we draw upon some broad themes.

First, the United Kingdom has indulged in a large number of policy mistakes, prevarications and reversals. The overly tough austerity of the early 2010s and the very hard Brexit in 2020 are two of the most obvious failures. Simply making fewer of these mistakes and having greater stability in policy would create a less uncertain environment for business investment. For example, keeping trade costs to Europe to a minimum through greater regulatory convergence.

Second, and related to the previous point, the United Kingdom lacks a credible Growth Plan and the institutions to deliver it. Having stronger institutions to promote growth in the heart of government to develop and deliver a long-term strategy based on Britain's comparative advantages (actual and latent) is vital (Valero and van Ark, 2023).

Third, create a better supply of finance for investment from Pension Funds. The United Kingdom stands out internationally by having low domestic investment from Pension Funds and a fragmented ownership base. Consolidating funds and changing regulations could increase business investment. Greater institutional involvement would also mean higher monitoring and en-

courage corporations to take a longer-term perspective (Aghion, Van Reenen and Zingales, 2013).

Fourth, higher education is a strong export industry in Britain (Costa *et al.* ,2023). But intermediate skills are weak for those who do not go to university. Reform of the system of Further Education, vocational and adult skills and apprenticeships could both raise skill levels and reduce inequality (Layard, McNally and Ventura, 2023).

Finally, it has long been recognized that the land-use planning system is not fit for purpose. It holds back development in some of our highest productivity clusters and industries, such a life sciences in the London-Cambridge-Oxford "golden triangle".

Without a way of returning to productivity growth, there is little hope of sustainable increases in living standards or gaining political consent for a just transition to a green economy. Policies helped deliver better productivity growth in the past as we have shown from the pre-2007 period. We need to do this again in the future.

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