International Journal of the Economics of Business

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/cijb20

The UK Productivity Puzzle: A Survey of the Literature and Expert Views

Sam Williams, Anthony J. Glass, Madeleine Matos, Thomas Elder & David Arnett

To cite this article: Sam Williams, Anthony J. Glass, Madeleine Matos, Thomas Elder & David Arnett (02 Jul 2024): The UK Productivity Puzzle: A Survey of the Literature and Expert Views, International Journal of the Economics of Business, DOI: 10.1080/13571516.2024.2367818

To link to this article: https://doi.org/10.1080/13571516.2024.2367818

INTERNATIONAL JOURNAL OF THE ECONOMICS OF BUSINESS
https://doi.org/10.1080/13571516.2024.2367818

The UK Productivity Puzzle: A Survey of the Literature and Expert Views

Sam Williams[a], Anthony J. Glass[b], Madeleine Matos[a], Thomas Elder[a] and David Arnett[a]

[a]Economic Insight, London, UK; [b]Sheffield University Management School, University of Sheffield, Sheffield, UK

ABSTRACT

Since 2008, the UK's productivity has stagnated, leading to the widely debated "productivity puzzle". Understanding this phenomenon and its drivers is crucial for managers and policymakers. This article summarises theoretical and empirical literature on the determinants of productivity in general terms, as well as their relevance to the UK's productivity performance. It also discusses to what extent the findings from a survey of leading UK academic experts on productivity provide support for the existing theoretical and empirical evidence on this topic, and help identify and validate the most important factors explaining the UK's productivity slowdown since 2008. The combination of our literature review and survey findings suggests that key determinants of the UK's productivity slowdown include: insufficient investment; insufficient quality of infrastructure; limitations in human capital stock; and management quality issues.

ARTICLE HISTORY
Received 4 December 2023
Accepted 10 June 2024

KEYWORDS
UK productivity; literature review; questionnaire of experts; management quality; regional and sector inequality; future productivity outlooks

JEL CLASSIFICATION
D24; M21

1. Introduction

Since the 2008 financial crisis, UK productivity has flatlined in both levels and growth rates (Haldane 2018), as can be seen in Figure 1. The graph shows a general increase in productivity, with the growth rate flattening post-2007. There are three dips in the productivity growth rate shown on the graph: a more gradual decline in growth from 1988 to 1992 (owing to the early 1990s recession related to the US savings and loan crisis, and the UK's membership of the Exchange Rate Mechanism); and two much sharper dips between 2007 and 2009 (owing to the global financial crisis), and 2019 to 2020 (owing to the COVID-19 pandemic). According to ONS data, from 1970 to 2007 UK average annual multifactor productivity (MFP) growth was 1.3% (pre-2008),

CONTACT Anthony J. Glass a.j.glass@sheffield.ac.uk Sheffield University Management School, University of Sheffield, Sheffield, UK; Sam Williams sam.williams@economic-insight.com Economic Insight, 125 Old Broad St., London, EC2N 1AR, UK

Supplemental data for this article can be accessed online at https://doi.org/10.1080/13571516.2024.2367818.

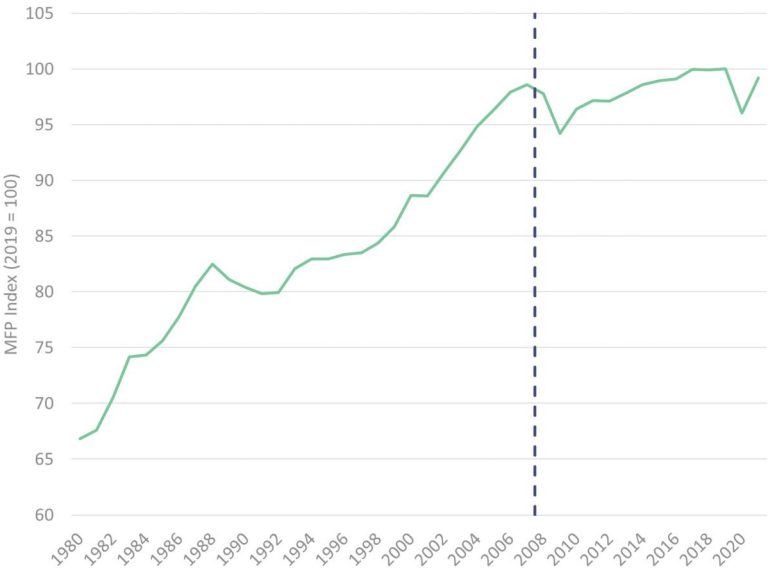

Figure 1. Annual UK multifactor productivity index (2019 = 100), 1980–2021.
Notes: ONS MFP dataset ID: MFP01, 7 April 2022 release

while from 2008 to 2021 (post-2007) it has been just 0.1%.[1] This slowdown in productivity growth has been well documented across many countries in the Western world, but the UK stands out in terms of the persistence of low-to-stagnant productivity (Aznar et al. 2015; Harris and Moffat 2017; Haldane 2018; Riley, Rincon-Aznar, and Samek 2018; Schneider 2018; Goodridge, Haskel, and Wallis 2018; Crafts and Mills 2020; The UK Productivity Commission 2022). Several theoretical and empirical studies have investigated the issue and identify a wide range of possible factors that may contribute to the observed slowdown. However, there is no consensus on *why* UK productivity growth has flatlined post-2007, which has led to it being described as a puzzle.[2]

It is likely that a range of reasons contribute to the UK's productivity puzzle. A broad overview of the phenomenon can be found in Haldane (2018), Mason, O'Mahony, and Riley (2018), Riley, Rincon-Aznar, and Samek (2018), Zymek and Jones (2020), Van Ark and Venables (2020) and Goldin et al. (2024). While there is no consensus on the key reasons contributing to the UK's productivity puzzle, the productivity slowdown is observed across most sectors of the UK economy (as well as most regions in the UK) as documented in various studies (Bughin et al. 2018; Riley, Rincon-Aznar, and Samek 2018; Goldin et al. 2021). This suggests that the causal factors may primarily be economy-wide, rather than industry- or region-specific.

It is challenging to identify from the existing literature and research the factors most likely contributing to the productivity growth decline in the UK. This is because: (i) it is a vast subject, with a large number of relevant publications; (ii) theoretical literature, by definition, can only provide the intuition as to why certain factors may affect productivity but does not provide direct evidence that they have; and (iii) while empirical studies may provide better evidence on the relationship between possible

factors and productivity growth, not every study considers the same scope of causal factors, so a meta-analysis of the empirical evidence would suffer from selection bias.

Therefore, to make best use of the existing literature and evidence to identify the most likely factors driving the UK's productivity slowdown post-2007, in this paper, we present a review of the literature, alongside a survey of 26 leading UK academic experts on productivity.[3] We have used this survey to provide a view on which of the possible factors identified in the literature are likely to be the most important ones in explaining the UK's productivity puzzle. This is because: (i) undertaking a literature review provides us with a comprehensive understanding of, and allows us to identify, the possible factors driving productivity performance; (ii) undertaking a survey of leading UK academic experts helps us identify and validate which of the possible factors are most relevant to the UK productivity slowdown; and (iii) combining the literature review with our survey of leading UK academic experts provides a more focused perspective on the UK productivity slowdown and the factors most likely to contribute to it. While existing papers, such as Naoum (2016), have used expert surveys to determine factors driving productivity growth in specific sectors, our paper adopts a new approach by surveying: (i) expert views on UK-wide productivity; and (ii) asking experts to estimate the magnitude of productivity growth.

Our review of the existing literature identifies a range of factors contributing to productivity growth in general. For example, various studies (Schmookler 1954; Griliches 1963, 1964; De Long and Summers 1991; Lichtenberg 1992) identify private investment as a key determinant of productivity growth, while others (Guellec and van Pottelsberghe De La Potterie 2002; Coccia 2010) also find public investment to be important. Duggal, Saltzman, and Klein (1999) identify quality of infrastructure as a key factor, and Abowd et al. (2005) identify human capital as an important factor. Recent evidence from Bloom, Van Reenen, and Sadun (2016, 2019a) highlights the importance of firm-level management quality, showing that it accounts for a substantial proportion of productivity variation both across countries and between (or within) firms. Other studies (Disney, Haskel, and Heden 2003; Barnett et al. 2014a; Dai et al. 2022) consider the role of the allocation of capital and labour resources in determining productivity growth, while others such as Melitz (2003) and Syverson (2011) consider the impact of openness to trade. Finally, others consider the importance of government policy (Rizov, Croucher, and Lange 2016; Aghion and Schankerman 2004; Buccirossi et al. 2013), while some also investigate the effect of the ownership structure of firms (Dunning 1977, 1980, 1988; Arnold, Mattoo, and Narciso 2008; Beltrán 2019; Benfratello and Sembenelli 2006; Takii 2004; Ullah, Wei, and Xie 2014)., 20

To help us identify and validate which of the above potential factors are most likely to have contributed to the UK's productivity slowdown in practice, we have surveyed leading UK academic experts in the subject matter. Table 1 shows the number of experts that thought each factor contributed towards the UK's aggregate MFP growth slowdown, and their view on its importance.[4]

We find that most experts agree that the following factors are important.

- **Private and public investment.** Experts select this factor most frequently, because they believe it also influences other factors. They think poor investment affects the

Table 1. Factors driving lower UK MFP growth post-2007.

	Ranked most important factor by expert	Ranked second most important factor by expert	Ranked third most important factor by expert	Ranked fourth most important factor by expert	Ranked fifth most important factor by expert	Total mentions as one of the five most important factors	Total mentions as a factor explaining UK MFP growth
Private investment	11	1	4	0	1	17	17
Quality of infrastructure	1	5	2	6	1	15	17
Public investment	1	6	2	3	2	14	15
Human capital stock	4	2	2	1	2	11	14
Firm management quality	2	4	2	1	2	11	13
Capital allocation across industries	2	3	1	1	2	9	9
Openness to trade	0	1	1	4	1	7	7
Labour allocation across industries	3	0	2	1	0	6	8
Regulatory and competition policy	0	2	2	0	0	4	4
Other factors	0	1	2	0	0	3	3
Government fiscal policy	1	0	0	1	0	2	3
Mix of firm ownership structures	0	0	2	0	0	2	3
Government monetary policy	0	0	0	0	0	0	0

Source: Economic Insight survey of academic experts, N = 26.

UK's infrastructure quality and its uptake and utilisation of technological change, and is symptomatic of poor confidence in the UK economy.

- **Quality of infrastructure.** While experts note this factor's relationship to investment, they think the UK's deteriorating infrastructure results in resources (particularly labour) being utilised on tasks that could have been completed more efficiently, if infrastructure was better.
- **Human capital stock.** Experts believe that the skills shortage and changing demographics of the labour force have contributed to declining MFP growth.
- **Firm management quality.** Experts agree that the quality of firm management has led to an ineffective use of labour and capital stocks. They consider that poor management training leads to an unmotivated and under-utilised workforce.

The innovation of this study is that, by combining the literature review with the survey of leading UK academic experts, we provide a more focused perspective on the UK's productivity performance. This is because it allows us to validate findings on the key determining factors of the productivity slowdown from the theoretical and empirical literature with the practical experiences and opinions of experts. This provides a robust foundation for understanding and addressing productivity issues in the UK.

The remainder of this paper is structured as follows. For each factor explaining the UK's productivity puzzle, we review and set out: (i) the theoretical and empirical evidence from the literature; (ii) direct links identified in the literature specifically relating to the UK productivity puzzle; and (iii) insights from our survey of leading academic experts. We do this for each of the following factors, following the order of importance as determined by our survey results: investment (private and public), infrastructure, human capital stock, management quality, allocation of resources (capital and labour), openness to trade, government policy (including both fiscal and monetary policy, and regulation and competition policy) and ownership structures of firms. This is then followed by the concluding section. In the attached (online) supplement to this review, we provide details of our survey methodology, including the survey design and choice of experts.

2. Investment (private and public)

Investment is a factor that has long been associated with productivity growth. Economists have linked greater R&D investment with improved productivity growth as far back as the 1950s and 1960s (Schmookler 1954; Griliches 1963, 1964; Griliches and Jorgenson 1966; Jorgenson and Griliches 1967; Griffith and Simpson 1998). More recent literature still considers investment to be an important determinant of productivity. For example, Syverson (2011) highlights the large body of research evidencing this. Existing research covers: (i) the effect of private investment on productivity growth at both the economy-wide, industry and firm level; and (ii) the influence of public investment on aggregate productivity growth. We cover each of these topics in turn below, before discussing the research on investment in the context of the UK's productivity puzzle and any insights gained from our survey of leading academic experts.

2.1. Extent of private investment

There is clear empirical evidence demonstrating that increased private investment can improve productivity growth at an economy-wide level. For example, De Long and Summers (1991) find a significant, positive relationship between national rates of machinery and equipment investment, and productivity growth using cross-country data. They also note that investment in equipment has the highest explanatory power for national productivity growth out of all investment components. Lichtenberg (1992) finds similar results for private R&D investment, using cross-country data to show that greater private investment in R&D can lead to higher productivity growth. This result is consistent with later research across OECD countries by Guellec and van Pottelsberghe De La Potterie (2002) and Griffith, Redding, and Van Reenen (2004). Lower IT investment in the EU has also been shown to largely explain the relatively slow productivity growth of the EU compared to the USA from 1995 to 2006 (Van Ark, O'Mahony, and Timmer 2008).

There is also evidence that investment and R&D are linked with productivity growth at the industry level. Research shows that certain industry characteristics are associated with higher investment, and thus productivity growth. One such characteristic is technical opportunities, which is understood to be the ease of achievement of innovation and technical improvements within an industry (Nelson and Wolff 2004). The degree of technical opportunity varies between industries, as it is an intrinsic characteristic of an industry, where certain industries (such as those related to the fields of pharmaceuticals and computers) naturally have more scope for technological improvement than others (Nelson and Wolff 1997). Industries with a larger scope to utilise technology are shown to experience higher productivity growth, as they can continually benefit from R&D investment and improvements in technology over time (Nelson and Wolff 1997).

There are also several studies demonstrating that increased investment leads to higher productivity at the firm level. For example, Lichtenberg and Siegel (1991) show that R&D investment has positive returns to firm-level productivity using a panel study of over 2,000 US firms. Similarly, Hall and Mairesse (1995) find that R&D expenditure is important in predicting the productivity growth of firms in their study of 350 French manufacturing companies. Consistent with this, Aw, Roberts, and Yi Xu (2008) show that Taiwanese electronics firms that select into exporting tend to already be more productive than their domestic counterparts but where the export decision is often accompanied by large R&D investments. These investments further raise exporters' productivity, in turn reinforcing this circularity between R&D, trade and productivity. Further evidence for the link between investment and productivity is found by Doraszelski and Jaumandreu (2013) who show that the R&D expenditures of Spanish firms explain significant amounts of productivity growth, and Hall, Lotti, and Mairesse (2013) who find that R&D and ICT investment are both strongly associated with innovation and productivity in their study of Italian firms. They also show that R&D is more important for innovation, and ICT investment is more important for productivity growth. Data from publicly traded US firms also support the association between greater investment and greater productivity growth (İmrohoroğlu and Tüzel 2014).

The incentives for firms to invest in R&D and thus improve productivity can be linked back to appropriability, which is the extent to which the innovating firm itself benefits from the new knowledge it creates (Ngai and Samaniego 2011). The link between appropriability and R&D intensity (and thus productivity) is evidenced by several studies, including Cohen and Levinthal (1990), Klevorick et al. (1995) and Nelson and Wolff (1997). Cohen and Levinthal (1990) use cross-sectional survey data on technological opportunity and appropriability conditions in the American manufacturing industry to test the extent to which a firm's R&D spending is determined by technological opportunity, appropriability and/or demand conditions. Their results support the importance of appropriability in encouraging R&D spending, and by corollary, increasing productivity. Using data from the Yale Survey on Industrial Research and Development, Klevorick et al. (1995) find that technological change varies across industries, and that industries vary in the amounts they invest in R&D. They note that, usually, firms in industries with rapid productivity growth tend to engage intensively in R&D. In particular, they explore the effects of appropriability conditions on R&D and find that stronger appropriability increases the probability of engaging in R&D, whereas weaker appropriability does the opposite. Nelson and Wolff (1997) provide both theoretical and empirical evidence in relation to the relationship between appropriability and R&D intensity. Theoretically, they point to the longstanding awareness of major differences in rates of technical progress across industries (Terleckyj 1960). Empirically, also using data from the Yale Survey on Industrial Research and Development, they find that both technological opportunity and appropriability positively affect industry R&D intensity.

2.2. Extent of public investment

Findings from the literature on the relationship between public investment and productivity growth are more varied, with some authors pointing to a potential crowding out effect on private investment, where it could harm future productivity growth if undertaken by relatively inefficient public enterprises in sectors with high rates of effective protection (Lustig 2000; Ramirez 1998a). In line with this, an empirical study by Lichtenberg (1992) finds that the effect of public R&D investment on productivity was insignificantly different from zero across most models he employed, with one model even showing a negative effect, although he does caution that these results may be the consequence of problems with the data.

There are also several studies that find a positive relationship between public investment and productivity growth. Barro (1989) identifies that public investment is positively correlated with productivity growth but suggests this is due to reverse causation (where low productivity growth causes low public investment, rather than the other way around). However, Aschauer (1989a) offers evidence against this reverse causation hypothesis. He points out that the public capital stock measures used by Barro (1989) are, by the author's own admission, subject to large measurement errors. Then, using more robust data, Aschauer (1989a) shows that public investment is a key determinant of productivity growth across the G7 industrial economies. A number of subsequent empirical studies have found similar evidence that public investment

increases productivity growth. For example, Ramirez (1998a, 1998b) shows that public, as well as private, investment had significant positive effects on the rate of productivity growth in his studies of Mexico and Chile. Guellec and van Pottelsberghe De La Potterie (2002) also find that public R&D expenditure generates productivity growth, and that the effect is larger in countries where the share of public research conducted in universities (relative to government laboratories) is higher, the share of public R&D funding going to defence is lower, and the level of business R&D is more intense (i.e. the proportion of business R&D to business GDP is higher). Coccia (2010) similarly determines that both public and private investment in R&D are important for productivity growth. He highlights that these investments can be complementary but notes that private investment must be higher than public investment to be a determinant of productivity growth of countries.

2.3. Investment and the UK's productivity puzzle

Underinvestment is considered a key factor in explaining the slowdown in productivity growth in the Western world more generally, and not just the UK (e.g. Furman 2015; Herzog-Stein and Horn 2018). Notwithstanding this, it is one of the factors that has been most strongly linked to the UK's poor productivity growth post-2007 in the literature (Besley, Coelho, and Van Reenen 2013; Goodridge, Haskel, and Wallis 2013; Pryce 2015; Jones 2016; Chadha 2017a; Mason, O'Mahony, and Riley 2018; Bughin et al. 2018; Van Ark and Venables 2020). This view is supported by facts such as the UK being in the lowest third of OECD countries for the proportion of output going to R&D spending (Mason, O'Mahony, and Riley 2018; Van Ark and Venables 2020), lagging significantly behind other countries such as the US, France and South Korea (Pryce 2015).[5] Indeed, Goldin et al. (2021) point to the pattern of falling public investment (as a share of GDP) seen across most OECD countries since the financial crisis as a likely contributor to the problem. As a result, increasing private and public investment is widely proposed as one of the key steps in solving the productivity puzzle (Jones 2016; Herzog-Stein and Horn 2018; Chadha 2017a; The UK Productivity Commission 2022). However, Chadha (2017a) notes that it must be investment that firms would choose as part of their production set.

The volume of research highlighting the significance of investment is reflected in the results of our survey, which, as set out in the Introduction, suggest that investment (particularly private investment) is the most important factor in explaining the UK's productivity slowdown. Specifically, 17 (15) experts (out of 26 surveyed) believe private (public) investment is a factor behind the UK's lower level of productivity growth, post-2007. Of these experts, 17 (14) consider that private (public) investment is one of the five most important factors and, notably, 11 believe private investment is the single most important factor. The consensus between the experts on the importance of investment is largely because they believe it also influences other factors. In particular, they think poor investment affects the UK's infrastructure quality and its uptake and utilisation of technological change, and is symptomatic of poor confidence in the UK economy. Experts note a lack of public investment in the UK, particularly in infrastructure, which worsened since austerity and adversely affected other drivers of

productivity (private investment, capital and labour stocks). They also note that it has not been targeted at the right sectors. Most experts think that the UK suffers from underinvestment, except for one who notes that the UK has overinvested in the financial industry. One expert notes the following: "This is an area where the UK is lagging behind peer countries, who have been investing higher percentages of GDP. Private capital increases would reflect confidence in demand and embody technological progress". Another expert believes that the "[l]ack of investment, especially in SMEs, is a long-standing problem in key sectors in the UK". Similarly, another expert suggests that investment is "much too low – [because of a] combination of short term thinking, labour market policies that encourage low productivity and just terrible inconsistency in policy rendering the UK almost uninvestable". The experts also believe that investment is a key driver of productivity growth at the regional and sectoral levels in the UK, with one expert suggesting that "[i]n general, the industries with the biggest negative swings [in productivity growth] are also the ones that require significant capital and infrastructure investment (e.g. utilities, healthcare) but the investment simply has not happened at the scale ultimately required, with significant knock on effects for other industries dependent on these ones as a foundation of their own productivity".

3. Infrastructure

There is a large body of literature researching the association between infrastructure and productivity growth. Theoretical models have been developed, which show that higher-quality infrastructure can lead to increased productivity growth, such as Findlay and Wilson (1987) and Clarida and Findlay (1992). More recent theoretical research is consistent with this. For example, Agénor (2010) demonstrates conceptually that increases in the share of spending on infrastructure can lead to a higher productivity equilibrium. Empirical research has also been conducted into the link between infrastructure and productivity growth, with contrasting results. One of the first studies on this matter, Aschauer (1989b), identifies a decline in infrastructure investment as an important factor underlying the 1970s and 1980s productivity slowdown in the US, and emphasises the importance of infrastructure's relationship to productivity. However, the results of this study have been widely debated, owing to its modelling approach and specification (Deng 2013). The problems raised generally relate to difficulties encountered when estimating production functions using macro-economic time-series methods, such as spurious correlation and missing variables (Deng 2013). Subsequent studies designed to rectify these issues have provided mixed results, with some supporting the original conclusions including Aschauer (1990), Munnell (1990), Berndt and Hansson (1992), Nadiri and Mamuneas (1994), Morrison and Schwartz (1996), and Duggal, Saltzman, and Klein (1999), while others have found contrasting evidence that infrastructure had a negligible effect, including Holtz-Eakin (1994), Hulten and Schwab (1984, 1991), and Garcia-Milà and McGuire (1992).

Following these studies, research has been conducted for other countries and time periods, which generally show that infrastructure has a positive influence on productivity. One such paper, Yeaple and Golub (2007), studies 18 developed and developing

countries and controls for the endogeneity of infrastructure provision (relating to the idea that more productive countries can afford higher-quality infrastructure) using a three-stage least-squares estimation strategy. It finds that, even once controlling for the endogeneity of infrastructure provision and unobserved heterogeneity across countries, infrastructure still has a statistically significant, positive effect on productivity. Other recent cross-country empirical studies by Sotelsek and Laborda (2019) and Arif, Javid, and Khan (2021) find similar results that show infrastructure has a positive effect on productivity.

Infrastructure quality has also been highlighted in the context of the UK's productivity puzzle. Many papers identify the poor state of the country's infrastructure as a key factor in explaining the flatlining of productivity growth post-2007 (Chadha, Yeşil, and Pabst 2021; Van Ark and Venables 2020; Haldane 2018; Besley, Coelho, and Van Reenen 2013; The UK Productivity Commission 2022). Proponents of this idea especially point to the inadequacy of the country's transport system for the growing demands placed on it (Chadha, Yeşil, and Pabst 2021) and the fact that the UK is in the lowest third of OECD countries in terms of the proportion of output going to hard and soft infrastructure investment (Mason, O'Mahony, and Riley 2018; Van Ark and Venables 2020). Arbabi, Mayfield, and McCann (2020) also show that the English and Welsh urban infrastructure networks allow less adequate mobility, relative to their Dutch and German equivalents.

As discussed previously, the experts responding to our survey largely believe the quality of infrastructure in the UK is one of the key factors explaining the UK's slow productivity growth, post-2007. Specifically, 17 (out of 26) experts believe the quality of infrastructure in the UK is a factor behind the slowdown, and 15 of these 17 experts also consider that it is one of the top five most important factors. While experts note this factor's relationship to investment, they think that the UK's deteriorating infrastructure results in resources (particularly labour) being utilised upon tasks that could have been completed more efficiently, if infrastructure was better. Experts agree that the UK's infrastructure is in a poor state. For example, one identifies the following limitations: "[h]ousing shortage, ageing transport networks, connectivity limitations"; another expert considers that "[t]he lack of world class infrastructure is such that many working hours are spent by employees and managers alike engaged in energy sapping journeys that all-too frequently leave them exhausted, on a cumulative basis, with a mix of early starts and large chunks of the working week taken out with significant delays". Several of the experts also argue that differences in the quality of infrastructure are a key factor explaining variations in regional productivity performance, with one expert noting that "non-London regions have poorer infrastructure and inherited (locked-in) spatial disadvantages".

4. Human capital stock

The OECD defines human capital as "the stock of knowledge, skills and other personal characteristics embodied in people that helps them to be productive" (OECD), which includes formal education, as well as informal and on-the-job learning. The importance of education and skills as drivers of economic growth and productivity dates back to

Solow's growth model (1957). Education and skills raise productivity through both direct and indirect mechanisms. They directly expand an individual's capabilities to accomplish more difficult tasks and address more complex problems, and they indirectly facilitate technological diffusion and innovation (Aznar et al. 2015). For example, with regard to the former, direct effects, empirically, a positive relationship between labour productivity and level of education is expected (Schultz 1962). This positive relationship arises both by raising total factor productivity (TFP) and by fostering physical capital accumulation. Thus, with regard to the latter, indirect effects, Acemoglu (1996) finds that where the workforce's education and skills levels are raised, firms are more willing to invest in physical capital. Lucas (1990) argues that capital inflow in poor countries is restricted owing to lower human capital stocks, while Barro (1991) explores whether upskilling leads to higher rates of investment, both in human and in physical capital, where human capital has positive spillover effects (as in Lucas 1988).

There is also a wide body of empirical evidence linking improvements in human capital (through increased education or experience) to greater productivity, including Abowd et al. (2005), Abowd and Kramarz (2005), Fox and Smeets (2011), Ilmakunnas, Maliranta, and Vainiomäki (2004), and Syverson (2011). For example, Ilmakunnas, Maliranta, and Vainiomäki (2004) use Finnish matched worker-plant data, which shows productivity increases with both a worker's education and age. On the other hand, Fox and Smeets (2011) use Danish matched employee–employer data to understand the impacts of education, gender, experience and tenure on productivity. While these factors affecting human capital have significant coefficients, they find that their contribution to overall productivity is more limited.

Relatedly, McGowan and Andrews (2015) and Zira (2016) find a negative relationship between underskilling and firm-level productivity. Similar results are obtained for underqualification, using linked employer–employee panel data (Kampelmann and Rycx 2012; Grunau 2016). Using UK data, Gardiner, Fingleton, and Martin (2020) find that, as human capital rises, capital stock per worker has less of an impact.

Other studies have shown that human capital is also associated with productivity growth at the regional level. For example, Zymek and Jones (2020) show that more productive regions in the UK, such as London and the South East, usually have a healthier and better educated workforce. Sunley et al. (2020) identify skills as an important driver of faster employment growth, in particular highlighting the relationship between the growth of more skilled occupations and total employment. They consider that this provides support to the recursive relationship between skilled labour accumulations and city economic growth (Storper and Scott 2008).

In the context of the UK's productivity puzzle, there are mixed views on whether the quality of human capital is a key factor. Although the UK appears to be close to the OECD average in terms of childhood education, primary and secondary schooling, and higher education, there are clear and large disparities between socio-economic groups (Van Ark 2021). There is also a long tail of poor performing schools and pupils relative to comparator countries (Besley, Coelho, and Van Reenen 2013). Van Ark (2021) notes that underperformance for a high proportion of the population, even at the level of early childhood and primary education, can damage the future productivity performance of those individuals and the businesses they work for later in life. This

skills problem also appears to have been compounded by the UK's widely known underperformance in both further education and adult skills (Van Ark 2021). Indeed, Aznar et al. (2015) and Van Ark and Venables (2020) also point out that, although the UK labour market is strong in high-end skills, it is weak in vocational skills and has a comparatively low level of base skills, such as numeracy and literacy. They believe this is symptomatic of the UK education system placing greater value on academic attainment than on vocational skills, relative to comparator countries like France or Germany. Chadha (2017b) similarly points to labour quality as a factor behind the UK's productivity slowdown, identifying that labour quality has shown no improvement since the middle of 2012. Human capital was also highlighted by multiple respondents in the call for evidence by The UK Productivity Commission (2022), with many pointing to a lack of basic skills consistent with the evidence above. However, Goldin et al. (2021) suggest that the supply of skills is not a significant explanation of the productivity growth slowdown. They find that, empirically, it cannot explain a significant proportion of the slowdown and note that their study shows that labour composition actually improved during the period they reviewed. Similarly, Goodridge, Haskel, and Wallis (2018) argue that human capital cannot explain the puzzle, providing evidence that upskilling has actually gained in pace post-2007.

In line with most of the literature set out above, our survey of experts suggests that human capital stock is an important factor in explaining the UK's lower level of productivity growth, post-2007. Specifically, 14 (out of 26) experts think that human capital stock has contributed, and 11 of these 14 experts consider it to be one of the five most important factors. These experts believe that skills shortages and changing demographics of the labour force have contributed to declining MFP growth. For example, one expert suggests that "[w]e have dysfunctional labour markets and huge skill shortages", and another expert points to an "[a]bsence of a coherent life-long learning and retraining infrastructure in the UK". We explore how skills shortages impact productivity growth in more depth in Section 6. The experts also agree that the scope for human capital gains may explain why some industries have experienced lower productivity growth than others, with one expert stating that "ICT clearly has most scope for human capital gains, whereas construction, at least in the UK, would seem to have one of the least". Other experts also argue that variations in human capital explain differences in regional productivity growth; for example, one expert notes that between regions, there are "[d]ifferences in human and financial capital stock/quality", while another points to "a bundle of factors in the lower performing regions e.g. labour force qualification and participation problems".

5. Management quality

Management quality has been found to affect overall firm-level productivity growth. In the UK, this is measured by the ONS's management practice scores, which rank performance between 0 (firms do not respond to ongoing problems, base promotion decisions on factors other than merit and do not track performance) and 1 (firms continuously review processes and performance, train employees and base promotion decisions on merit). This measure of management performance was first introduced in

2016, with the increase in this measure from 0.55 to 0.61 between 2020 and 2023 (ONS 2024) driven by an improvement in the performance of the worst-performing firms. For example, Syverson (2011) identifies that managers influence firm productivity by coordinating the application of inputs. This idea originates from Walker (1887), who put forward that differences in surplus across businesses are rooted in managerial ability. Thus, though a longstanding theoretical driver of productivity, empirical evidence of management quality's effect on productivity has only recently emerged.

Bloom and Van Reenen (2007) show that firms that score higher on measures of managerial quality experience greater improvements in productivity. This is based on a survey of over 700 plant managers of medium-sized firms in the US, UK, France, and Germany probing 18 specific management practices in four broad areas: (i) operations (e.g. documenting process improvements); (ii) monitoring (e.g. regular appraisals); (iii) targets (e.g. operational or financial); and (iv) incentives (e.g. promotion criteria). Subsequently, Bloom and Van Reenen have expanded their management practice survey to include additional countries, where Bloom and Van Reenen (2010) and Bloom et al. (2010) extended their survey programme to nearly 6,000 firms in 17 countries, including China, India and Brazil, echoing previous results.

Additionally, Bushnell and Wolfram (2009) find that power plant operators can affect the thermal efficiency of power plants in the US, where the best operators can improve fuel efficiency by over 3%. This leads to savings of millions of dollars of fuel costs per year for the fuel plants, suggesting that management quality drives productivity. Similarly, a randomised field experiment by Bloom et al. (2013) demonstrates that adopting better management practices led to growth in productivity in India. Bloom, Van Reenen, and Sadun (2016) show that management practices explain 30% of the productivity differences both between countries and across firms (within the same country), while Bloom et al. (2019a) demonstrate that even *within* the same firm, management can account for 40% of the productivity differences across plants.

Management quality is also commonly mentioned as a contributing factor to the UK's slowdown in productivity growth post-2007 (Mason, O'Mahony, and Riley 2018; Haldane 2018; Goldin et al. 2021; Van Ark 2021). Indeed, Haldane (2018) identifies that the UK has a much larger degree of dispersion in measures of management skills than comparator countries. He notes that the UK has double the amount of firms with low management scores, when compared to the US and Germany. Haldane (2018) also points to a study by Bloom and Van Reenen (2007), which shows that the management skills of UK firms were about half a standard deviation lower than comparator countries, and that these management skills are statistically significant determinants of productivity. Linking back to investment likely determining most factors contributing to the productivity puzzle, Goldin et al. (2021) suggest that increasing short-termism across top managers may also have resulted in declining investment rates. They point to evidence that, since the pay of top managers is linked to firm performance on the stock market, managers spend an increasing amount of resources on stock buybacks instead of long-term investment, which would improve productivity. Mason (2020) argues that top management teams are critical to helping small firms scale up, owing to UK short-termism or costs.

Our survey of experts supports the importance of firm management quality as a key factor in the UK's productivity puzzle. Specifically, half (13 out of 26) of the surveyed experts believe that firm management quality is a factor contributing to the UK's slow productivity growth post-2007, and 11 of these 13 experts consider it to be one of the five most important factors. Experts agree, in line with findings from the literature, that the quality of firm management has led to an ineffective use of labour and capital stocks. They consider that poor management training leads to an unmotivated and under-utilised workforce. Multiple experts agree that managers in the UK have insufficient training or skills. For example, one expert notes that "[t]he UK has a long running history of poorly trained and selected leaders and managers, and it is still the case that the vast majority do not undertake high-quality training and development before or during their periods of tenure. Not surprisingly, poor management and leadership results in an unmotivated and under-utilised workforce". Another expert suggests that the "evidence points to a deficit in L&M [leadership and management] skills in UK private sector and where they are enhanced through certain L&M programmes productivity does rise with a lag of about 3–5 years".

6. Allocation of resources (capital and labour)

Economic theory suggests that more productive firms have a greater incentive to, and are more able to, attract inputs, such as capital or labour, relative to firms that are less efficient. Over time, less productive firms are forced to become more efficient or go out of business, thus bringing about capital and labour reallocation.

A wide body of literature demonstrates the importance of resource allocation in driving productivity (Disney, Haskel, and Heden 2003; Barnett et al. 2014a; Dai et al. 2022). Moreover, several empirical studies show that there are large and persistent gaps in productivity across firms, even *within* industries, stemming from the misallocation of resources (Hsieh and Klenow 2009; Syverson 2011; Restuccia and Rogerson 2013). For example, Hsieh and Klenow (2009) suggest that resources in the US and around the world are not allocated efficiently, as there are large differences in capital and labour productivity across plants in these economies. Foster, Haltiwanger, and Krizan (2001) and Foster, Haltiwanger, and Syverson (2008) suggest that up to one half of productivity gaps in the US manufacturing industry are due to inefficient allocation of resources. Misallocation of resources has further been identified in the literature as a substantial source of productivity differences across countries (Restuccia and Rogerson 2008, 2013, 2017; Hsieh and Klenow 2009).

In the following subsections, we explore how the allocation of capital determines productivity growth, followed by how the allocation of labour determines it.

6.1. Allocation of resources: capital

There can be various impediments to efficient capital allocation, which in turn affect productivity growth. Barnett et al. (2014b) suggest that following the financial crisis, financial market frictions and weak and uncertain demand conditions are the greatest impediments to capital allocation. On one hand, weak demand can lead to

underutilisation of existing resources, leading (even highly productive) companies to delay expansion plans (Dixit and Pindyck 1994). On the other hand, uncertainty can lead to delays in investment decisions, as capital choices are (partially) irreversible (Caballero and Pindyck 1996). However, financial market frictions are frequently cited as affecting the allocation of capital (Banjeree and Duflo 2005; Erosa and Hidalgo Cabrillana 2008; Midrigan and Yi Xu 2014).

Asker, Collard-Wexler, and De Loecker (2014) show how risk and adjustment costs in capital accumulation can explain dispersion of firm-level revenue productivity. They also argue that private firms' management is less prone to short-termism and that those firms thus have substantially higher capital expenditures and are more responsive to investment opportunities.

Southern European countries provide for an interesting case study on declining productivity growth and capital misallocation (Blanchard 2007). For example, Reis (2013) finds that large capital inflows may have been misallocated to inefficient firms in Portugal in the 2000s, whereas Benigno and Fornaro (2014) suggest that the slowdown in aggregate productivity growth results from a shift in resources from the traded sector to the non-traded sector.

Capital misallocation has also been linked to productivity growth at the regional level. For example, Zymek and Jones (2020) highlight that variations in the existence and quality of productivity assets (i.e. capital stock) between UK regions may explain differences in productivity growth. They consider that capital stock includes factors such as public infrastructure, physical investments in factories and investments in intangibles. The authors also note that there is a lack of high-quality data with regard to stocks of capital per worker across UK regions, hindering a detailed analysis of this factor on regional productivity growth. Notwithstanding this, a study by Derbyshire, Gardiner, and Waights (2013) based on experimental estimates of regional capital stocks per worker shows that London, the South East and parts of Scotland had the highest capital stock per worker in the UK, with the West Coast and the North of England having the lowest.

Capital misallocation is not frequently mentioned in the literature as a key explanatory factor of the UK's productivity puzzle. Nonetheless, Pessoa and Van Reenen (2014) put forward suggestive evidence that the misallocation of capital has increased and contributes to explaining the UK's productivity growth slowdown, namely: (i) the rate of bankruptcies and liquidations appears low; (ii) the cross-sectional variance of employment, output and prices has increased across sectors; and (iii) there is an increased variance of productivity across firms *within* sectors (Field and Franklin 2013). They point to the main issue being bank forbearance, where banks are reluctant to call in underperforming loans to firms and projects that can no longer make their interest payments. Thus, low-productivity projects/firms that would have exited the market in "normal" times continue to contribute to the market and in doing so pull down aggregate productivity. These findings are consistent with Broadbent (2013), who finds that the substantial changes in sectoral rates of return on capital investment post-2007 have not led to movements in capital stocks across sectors. He concludes that this is not consistent with a dynamic and efficient economy where capital should move to the sectors with higher returns, as they are more profitable (Siddiqui 2020).

Relatedly, several studies point to capital shallowing as a factor in explaining the UK's productivity puzzle (Chadha 2017b; Riley, Rincon-Aznar, and Samek 2018; Van Ark and Venables 2020; Goldin et al. 2021). Chadha (2017b) identifies evidence such as the fall in the proportion of new investment spent on capital, and that the capital-to-output ratio has likely declined. Goldin et al. (2021) also provide empirical evidence that a decline in capital deepening has contributed to the slowdown and argue that this observed decline is a result of: (i) weak aggregate demand and financial constraints following the financial crisis; and (ii) structural issues such as a change in the composition of capital towards riskier intangibles, lower competition, short-termism and the moving of physical investment abroad. However, these results are contradicted by Goodridge, Haskel, and Wallis (2018), whose empirical results suggest that even with aggressive assumptions on depreciation rates, capital shallowing cannot explain the productivity slowdown in the UK.

In line with the limited and mixed evidence on the contribution of the allocation of capital to the UK's productivity puzzle, around a third (9 out of 26) of the surveyed experts believe it to be a factor in explaining the UK's slowdown in MFP post-2007 (all nine of these experts also believe it is one of the five most important factors). Specifically, in line with what the literature reveals, experts mention that investment is not sufficiently targeted or targeted towards industries with lower productivity growth potential. One of the experts we surveyed states that "investment in fixed capital in the UK economy is patchy at best. The sectoral mix (and the importance of services) doesn't help, nor does the importance of the property sector in generating returns on capital". Another expert believes that "there has been underinvestment in capital for industries where potential for productivity growth is higher, relative to industries with low productivity/lower potential for growth". Other experts also argue that the allocation of resources, including capital, is a key factor in explaining differences between regional productivity growth rates, with one expert noting these are "strongly correlated with capital investment" and another stating the reason for differences in regional growth rates is "resource allocation and relative prices".

6.2. Allocation of resources: labour

Hsieh and Klenow (2009) find that misallocation of labour resources substantially lowers aggregate productivity. Allocation of labour resources contributes to productivity growth mostly through different levels of mismatch between available skills and those required to undertake the jobs, leading to a decline in productivity. Vandeplas and Thum-Thysen (2019) consider there are three different levels of skills mismatch: (i) "macro-economic skills mismatch", which arises when the skills distribution differs between the available workers and those that get hired; (ii) "skills shortages", which arise when employers encounter difficulties to fill their vacancies; and (iii) "on-the-job skills mismatch" (overqualification or underqualification), which refers to a discrepancy between the qualification level of a jobholder and the requirements for that particular job.

In their empirical study, Vandeplas and Thum-Thysen (2019) find that theoretical predictions on the relationship between skills mismatch and productivity depend on

the dimension of skills mismatch considered. For example, they find a negative relationship between macro-economic skills mismatch and labour productivity, and a positive relationship between skills shortages and labour productivity. From a theoretical perspective, one would expect skills shortages to be negatively related with productivity, as they may lead to loss of production owing to unfilled jobs for a certain period of time, or to the recruitment of workers with lower skills or qualifications than what their vacancies would ideally require, resulting in underskilling and underqualification (Bennett and McGuinness 2009). Another argument that is commonly made is that skills shortages inhibit investment and the adoption of new technologies, reducing productivity growth (Foley and Watts 1994). This is supported by evidence that skilled workers are more capable of using new technologies (Katz and Autor 1999; Acemoglu 2002; Link and Siegel 2003). For example, Acemoglu and Zilibotti (2001) find that in less-developed countries, tasks that are carried out by skilled workers in developed countries are performed by unskilled workers, leading to a decline in productivity. There is also an argument that low-wage immigration could potentially act as a drag on productivity. In terms of the evidence, Kangasniemi et al. (2012) observe a positive and significant relationship between high levels of immigration and poor labour productivity in Spain. This relationship is positive but not significant for the UK. The main reason for these different results is that migration only affects the UK's quantity of labour, whereas it affects both Spain's quantity and quality effect to a greater degree. This suggests that Spanish productivity is affected by immigration, but in the UK, we cannot determine if this is the case. This difference between the countries is likely due to differences between the sectoral make-up of the two economies.

By raising labour costs (e.g. because firms need to spend more on training, recruitment or wages), skills shortages could distort the optimal allocation of resources. Some scholars have also argued that they put workers in a better bargaining position, allowing them to demand an easier pace at work (Haskel and Martin 1993). However, empirical evidence on the magnitude of these relationships is mixed. On the one hand, Forth and Mason (2004) and McGuinness and Bennett (2006) do not identify a clear link between productivity and unfilled vacancies, based on their analysis of firm-level data. On the other hand, Haskel and Martin (1993) find that skills shortages have reduced productivity growth in the UK by around 0.7 percentage-points per year over the period 1983–1986. Nickell and Nicolatsis (1997) argue that a 10% increase in the number of firms reporting a skills shortage leads to a (permanent) 10% reduction in fixed capital investment and a (temporary) 4% reduction in spending on R&D. Tang and Wang (2005) find a negative impact on the performance of small- and medium-sized enterprises, while Bennett and McGuinness (2009) find that skills shortages have a substantial impact on firm-level productivity.

Regarding on-the-job skills mismatch, Vandeplas and Thum-Thysen's (2019) data confirm earlier findings from the economic literature: when comparing a mismatched with a well-matched worker within the same occupation, overqualification raises productivity, while underqualification reduces it. When comparing a mismatched with a well-matched worker within the same qualification level, overqualification (underqualification) reduces (increases) productivity. This is because overqualification can reduce job satisfaction and motivation, and increase turnover, reducing productivity.

McGowan and Andrews (2015) argue that, while firm-level productivity may indeed increase with overqualification, there may still be a negative association between the aggregate productivity of an economy and overqualification as a result of a suboptimal allocation of resources. Their main argument is that if (less productive) firms recruit highly qualified workers for jobs that do not require such qualifications, while other firms face a shortage of or have difficulties accessing highly qualified workers for the (more productive) jobs they offer, such misallocation of resources constrains entry and expansion of more productive firms and as such reduces aggregate productivity.

In relation to the UK's productivity puzzle, the evidence is mixed. Some consider that a poor allocation of labour resources is a contributing factor to the slowdown in productivity growth (Dimson et al. 2016; Mason, O'Mahony, and Riley 2018; Van Ark 2021; The UK Productivity Commission 2022), while others argue it is insignificant (Goodridge, Haskel, and Wallis 2018). Evidence from Dimson et al. (2016) shows that compared to comparator OECD countries, the UK has a higher rate of mismatch between existing worker skills and those required for their job. Similarly, Patterson et al. (2016) show, empirically, that labour reallocation to low-productivity occupations can account for a substantial proportion of the slowdown. However, this is contradicted by empirical studies by Goodridge, Haskel, and Wallis (2018) and Goldin et al. (2021), which find that the reallocation of labour between industries is more likely to deepen than explain the UK's productivity puzzle. Goldin et al. (2021) note that this may be due to differences in the granularity of the data used between the studies. Goodridge, Haskel, and Wallis (2018) and Goldin et al. (2021) look at broad industry groups, whereas Patterson et al. (2016) use individual occupations. Therefore, Patterson et al. (2016) could have been measuring a reallocation between jobs within the broader industry groups that Goodridge, Haskel, and Wallis (2018) and Goldin et al. (2021) studied.

Turrell et al. (2021) show that the effects of occupation mismatch on productivity and output are small using naturally occurring vacancy data, mapped onto official occupational classifications. Thus, they find that this does not help explain the UK productivity puzzle. Additionally, Blundell et al. (2014), using individual data on employment and wages, show that the supply of workers in the 2008 recession is higher than in previous ones (e.g. late 1970s/early 1980s and early 1990s). However, they find strong evidence against the composition or quality-of-labour hypothesis as a potential explanation for the reduction in wages and hence observed productivity.

A final complication in measuring UK productivity arises owing to the high importance of services in its economy. Djellal and Gallouj (2012) state that it is difficult to measure service productivity because the products: (i) are intangible, so it is hard to measure their quantity; (ii) are interactive, resulting in the customer participating in their production and affecting their value; (iii) are time-sensitive, so effects differ over the short and long-term; and (iv) have subjective value, which therefore differs between users. These features make it difficult to define the value and quantity of services to formulate an index-based productivity measure. As the importance of the service sector to the UK has been growing over the last three decades, this has become an increasingly important issue.

Consistent with the above, experts responding to our survey had mixed views on the allocation of labour as a factor behind the UK's slowdown in productivity growth, with only around a third (8 out of 26) of the surveyed experts considering that the allocation of labour across industries is a factor explaining historical average UK MFP growth (and just six of these eight considering it to be one of the five most important factors). These experts suggest that there is a mismatch between skills, jobs and a disproportionate growth of financial services. For example, one expert states that "there is reasonable evidence that the growth of financial services has hollowed out highly qualified workers from other sectors/firms. The service economy also employs many, many people with mid-high level skills in low productivity jobs". Similarly, another expert notes that "[t]he difficulty in recruiting staff to jobs has been a major issue in many UK cities. There is a mismatch in the skill sets required with the jobs created especially with high levels of IT and numerate skills".

7. Openness to trade

Openness to trade has been linked to improved productivity growth in theoretical studies. These include Melitz (2003) and Syverson (2011), who note that productivity gains come from the increased competition induced by trade. Grossman and Helpman (1991) explore the implications for dynamic performance based on the hypothesis that international trade in tangible commodities facilitates the exchange of intangible ideas, where they model endogenous technological progress. This link is also evidenced by empirical studies, such as Pavcnik (2002) and Blundell, Griffith, and Van Reenen (1999).

Pavcnik (2002) investigates the effects of liberalised trade on plant productivity in Chile. This is because, during the late 1970s and early 1980s, Chile underwent trade liberalisation, significantly exposing its plants to competition from abroad. Thus, using plant-level data on Chilean manufacturers, the author finds that *within* plant productivity improvements can be attributed to liberalised trade for the plants in the import-competing sector. However, aggregate productivity improvements tend to stem from the reshuffling of resources and output from less to more efficient producers. This is consistent with findings from Blundell, Griffith, and Van Reenen (1999), who study a panel of British manufacturing firms and find that companies innovate more in industries facing more import competition and lower domestic concentration ratios. They also find that *within* each industry, firms with bigger market shares innovate more. These firms have a stronger incentive to innovate, as it allows them to shield their profits from additional entry or the expansion of smaller firms. Tsionas and Tzeremes (2022) find similar results, showing that a firm becoming more international has a significant effect on its productivity.

Having openness to trade as an explanatory factor for the UK's productivity puzzle is not self-evident. This is because, on one hand, external openness is considered an important driver of productivity (Haldane 2018), whereas on the other hand, the UK scores highly on all external openness metrics in 2014 – thus further adding to the "puzzle". Notwithstanding this, figures from the ONS (2018b) suggest that in 2016, businesses that declare international trade in goods were around 70% more

productive on average than non-traders. This suggests that these firms were more vulnerable to the negative impact from the barriers to trade that the UK's exit from the European Union introduced, which is consistent with Bloom et al.'s (2019b) finding that the 2016 Brexit referendum led to a fall in UK private investment and productivity. Academic respondents expect that the UK's move away from the EU and closure of its market to internal competition will be transient, and future governments will be obliged to adopt a more open approach to trade. This expectation of increased future openness to trade could be contributing to their more optimist long-term UK productivity growth forecasts.

Our surveyed experts had mixed views on whether openness to trade is an important factor explaining historical average UK MFP growth, with only seven of the 26 experts sharing this view. All of those seven experts consider it to be one of the five most important factors in explaining the productivity slowdown, and they suggest this is due to the increase in competitiveness of markets.

8. Government policy

Another factor that has been shown to influence productivity growth is government policy. This includes specific policy choices, such as raising the minimum wage, which Rizov, Croucher, and Lange (2016) show enhances productivity in low-paying sectors. More broadly, multiple different types of government policy have also been shown to influence productivity. For example, Aghion and Schankerman (2004) create a theoretical framework demonstrating that competition-enhancing policy can improve productivity, and Buccirossi et al. (2013) provide empirical evidence of this effect. Similarly, Knittel (2002) and Fabrizio, Rose, and Wolfram (2007) demonstrate the substantial effects of regulation or deregulation, and the effects of different regulatory regimes on productivity growth in different industries. Monetary policy is also associated with productivity because of its effect on R&D, as Moran and Queralto (2018) demonstrate with a theoretical model. Colciago and Silvestrini (2022) provide further support of the influence of monetary policy on productivity, but their model shows this happens through the impact of monetary policy on competition and firm concentration. Further research finds a link between fiscal policy and productivity growth, including Cassou and Lansing (1999) who show that tax policies and public capital may have contributed to productivity slowdowns in the past.20

In the specific context of the UK's slowdown in productivity growth since 2008, previous research on the contribution of government policy is limited and is thus an area where further work is needed (Pabst and Westwood 2021). Although some papers have discussed this issue, they have not provided quantitative evidence of the contribution of government policy to the productivity puzzle. For example, Jones (2016) argues that over-centralisation and short-termism in government policy have hindered its long-term approach, which is key for innovation. Westwood (2018) also questions whether the large amount of institutional reinvention in policymaking is related to the UK's poor productivity performance, while Van Ark and Venables (2020) point to the poor coordination of productivity-enhancing policies, including competition policy, labour market policy and industrial policy. Pabst and Westwood (2021) largely agree

with the research outlined above, describing the country's poor productivity performance within a dysfunctional wider governance system and pointing to four stylised facts to support their argument: (i) over-centralisation; (ii) weak, ineffective institutions and policy churn; (iii) institutional and policy silos; (iv) short-termism and poor policy coordination.

More generally, there is evidence that a country's overall institutional development impacts productivity. For example, Beck, Demirgüç-Kunt, and Maksimovic (2005), D'Souza, Megginson, and Nash (2005) and Yasar, Paul, and Ward (2011) find an empirical link between institutional development and firm performance because of the removal of financing obstacles and greater perceived property rights protection. Empirical studies by Boubakri, Cosset, and Saffar (2013), John, Litov, and Yeung (2008) and Xiao (2013) show that institutional development is associated with greater risk-taking and R&D investment because of greater investor protection. A further related study by Chen et al. (2017) also finds that institutional development is associated with a rise in investment efficiency.

Reflecting the limited existing literature, few of our surveyed experts believe government policy is important in explaining the UK's productivity slowdown. No experts select government monetary policy as a factor behind the UK's recent productivity performance, while only four experts select regulatory and competition policy, and just three experts select fiscal policy. Of the experts who believe fiscal policy is a factor, two rank it within their top five most important factors while all four of the experts who selected regulatory and competition policy believe it to be one of the top five most important factors, but the experts disagreed on the reasons for this. A couple of the experts believe this is the result of planning and competition regulations, which are too stringent, e.g. one expert argues that "planning rules makes new infrastructure and capital investment difficult and expensive", whereas other experts view regulators as "lack[ing] the power to correct market imperfections".

9. Ownership structure of firms

The ownership of firms has also been found to be a determinant of aggregate productivity. For example, Dunning (1977, 1980, 1988) puts forward a framework where multinational enterprises (MNEs) have valuable intangible assets (such as technological know-how, superior management practices, coordination with suppliers and customers, and overseas contacts), which lead to them being more competitive and productive than domestic firms. Consistent with this, empirical studies show that MNEs are more productive than domestic firms (Arnold, Mattoo, and Narciso 2008; Beltrán 2019; Benfratello and Sembenelli 2006; Griffith 1999; Harris and Robinson 2002; Le, Pieri, and Zaninotto 2019; Takii 2004; Ullah, Wei, and Xie 2014). Focusing on the interaction between MNEs and domestic firms, Driffield, Love, and Yang (2014) identify how: (i) foreign-owned MNEs operating domestically can create productivity spillovers benefiting domestic firms; and (ii) domestic-owned MNEs operating abroad can benefit from the productivity of firms in the home country, by bringing back knowledge and technology. Xu, Liu, and Abdoh (2022) also find strong evidence that foreign ownership positively affects firm productivity. They put forward that there are two channels

through which foreign ownership affects productivity: innovation and finance (Beck et al. 2006; Ayyagari, Demirgüç-Kunt, and Maksimovic 2011; Luong et al. 2017). This is because foreign ownership is linked to firms with higher innovation, while both innovation and access to finance lead to higher firm performance and productivity (Beck, Demirgüç-Kunt, and Maksimovic 2005; Eberhart, Maxwell, and Siddique 2004). Similarly, Hill and Snell (1989) show that a firm's ownership structure affects its propensity to invest in R&D, which in turn influences productivity.

Firm ownership structures have been less frequently mentioned as a key explanatory factor for the UK's productivity puzzle. Notwithstanding this, some industry reports have noted that UK manufacturing firms with foreign ownership have higher management scores than UK-owned ones. These articles have identified a relationship between foreign-owned firms in the UK and higher productivity levels (Make UK 2019). These reports further note that compared to other countries with a similar proportion of foreign-owned manufacturing companies (such as Germany), the productivity gap between the foreign- and domestic-owned manufacturing companies is diverging in the UK, whereas it is converging in Germany. Relatedly, the ONS (2019) finds that between 2006 and 2017, on average, foreign-owned firms were around 18% more productive than equivalent, domestically owned firms. Similarly, Haldane (2018) states that the productivity of foreign-owned firms is twice as high as domestically owned ones, and The UK Productivity Commission (2022) quotes evidence provided by Nicholas Oulton, stating that US-owned firms operating in the UK are about 20% more productive than equivalent domestically owned ones.

In line with less agreement evidenced in the literature above, in the survey of experts, firm ownership structure featured less frequently as a key explanatory factor of historical average UK MFP growth post-2007. Only 3 (out of 26) experts select the average mix of firm ownership structures for the UK as an important factor, with two of those three listing it as one of the top five factors. Those who select this factor as being important mention ownership structures encouraging short-termism, poor managerial compensation and firms' mixed goals. For example, one expert argued that "[t]oo many ownership structures encourage short term thinking, and a lack of R&D and investment in both human and physical capital".

10. Conclusion

This literature review, guided by our survey of leading academic experts, has identified several factors that have an impact on UK productivity growth. Of the factors set out in this review, surveyed experts consistently find that investment (private and public), infrastructure, human capital stock and management quality are the most important factors contributing to aggregate UK productivity growth (and specifically to the slowdown in the UK's productivity performance post-2007). In summary:

- **Investment (private and public).** Economists have linked investment, in particular R&D investment, with improved productivity since the 1950s (Schmookler 1954; Griliches 1963, 1964; Griliches and Jorgenson 1966; Jorgenson and Griliches 1967; Griffith and Simpson 1998; Syverson 2011). This is supported by empirical evidence

linking private R&D investment and higher productivity growth (Lichtenberg 1992; Guellec and van Pottelsberghe De La Potterie 2002; Griffith, Redding, and Van Reenen 2004). Moreover, underinvestment is one of the factors most frequently cited as the key reason for the UK's productivity growth slowdown (Besley, Coelho, and Van Reenen 2013; Goodridge, Haskel, and Wallis 2013; Pryce 2015; Jones 2016; Chadha 2017a; Mason, O'Mahony, and Riley 2018; Bughin et al. 2018; Van Ark and Venables 2020).

- **Infrastructure.** There is a wide body of research on the link between infrastructure and productivity growth (Findlay and Wilson 1987; Clarida and Findlay 1992). Empirical evidence with regard to this positive relationship has been mixed, but in general the literature finds that infrastructure investments and productivity growth are linked (Aschauer 1989b; Aschauer 1990; Munnell 1990; Berndt and Hansson 1992; Nadiri and Mamuneas 1994; Morrison and Schwartz 1996; Duggal, Saltzman, and Klein 1999). Additionally, many scholars consider that the UK's poor state of infrastructure is a key explanatory factor of low productivity growth since 2008 (Chadha, Yeşil, and Pabst 2021; Van Ark and Venables 2020; Haldane 2018; Besley, Coelho, and Van Reenen 2013; The UK Productivity Commission 2022).
- **Human capital stock.** The importance of education and skills in driving productivity performance has likewise been put forward by economists since the 1950s (Solow 1957). The relationship between human capital and productivity growth has also been demonstrated empirically (Schultz 1962; Lucas 1988, 1990; Barro 1991; Abowd et al. 2005; Abowd and Kramarz 2005; Fox and Smeets 2011; Ilmakunnas, Maliranta, and Vainiomäki 2004; Syverson 2011). Whether human capital is a key contributor to the UK's productivity puzzle attracts mixed views. Van Ark (2021) notes that the UK's skills problem appears to have been compounded by the UK's widely known underperformance in both further education and adult skills, compared to other countries such as France or Germany, whereas Goldin et al. (2021) and Goodridge, Haskel, and Wallis (2018) suggest that the supply of skills is not a significant explanation for the productivity-growth slowdown.
- **Management quality.** Management quality has been found to affect overall firm productivity growth (Walker 1887; Syverson 2011). In particular, recent empirical evidence suggests that management quality is linked to productivity growth (Bloom and Van Reenen 2007, 2010; Bloom et al. 2013; Bloom, Van Reenen, and Sadun 2016, 2019a; Bushnell and Wolfram 2009). Management quality has also frequently been considered a contributing factor to the UK's slowdown in productivity growth since 2008 (Mason, O'Mahony, and Riley 2018; Haldane 2018; Goldin et al. 2021; Van Ark 2021).

In line with the persistence of low-to-stagnant productivity growth in the UK post-2007, and the most important factors applying economy-wide, we further asked the surveyed experts about their expectations for future UK MFP growth, as well as the underlying reasons for their predictions. These are consistent with the reasons found in the literature and in their prior survey responses regarding the factors most likely influencing the UK productivity slowdown post-2007. Specifically, we find that the surveyed experts expect that future UK MFP growth will not improve over the next 5 years but

Table 2. Prospects for future UK MFP growth.

	Next 12 months (2024)	Next 5 years (2024–2028)	Next 10 years (2024–2033)
<0.00%	4	1	1
0.00–0.10%	13	7	1
0.11–0.50%	6	10	9
0.51–1.00%	0	5	8
1.01–1.50%	0	0	2
>1.50%	0	0	0
Not sure	3	3	5

Source: Economic Insight survey of academic experts, N = 26.

may improve slightly over the next 10 years. Most estimate MFP growth to be 0.0–0.1% over the next year (2024), 0.1–0.5% over the next 5 years (2024-2028) and either 0.1–0.5% or 0.5–1.0% over the next 10 years (2024–2033), as illustrated in Table 2.

Key reasons given by the experts for a potential improvement over the longer term include: increased investment levels (owing to greater certainty in the UK economy, after its trading relationships have been finalised), and potentially a new government with a higher desire for state intervention. In addition, a possible improvement in human capital stock was highlighted by the experts as younger people who have more skills and with more STEM training as part of their education enter the workforce. These are consistent with the underlying reasons uncovered in this review regarding the main causes of the UK's productivity puzzle, both from the literature and from the experts' views on the prevailing reasons for the low-to-stagnant productivity growth in the UK.

Overall, the findings, both from the reviewed literature and from our survey of leading UK academic experts, suggest that solving the UK's productivity puzzle relies on investing in high-productivity firms while also improving the UK's infrastructure and addressing the UK's skills shortages. While we expect this area will continue to be widely researched and expect future research into the underlying causes of the UK's productivity puzzle to continue to explore a range of factors, this literature review highlights the most important ones.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes

1. This is based on an analysis of data sourced from the ONS (2022).
2. As is common in the productivity literature, in this paper we focus on MFP, where it follows that our coverage also relates to its growth from changes in its levels. Further, in this paper, we elaborate on the motivation for focusing on MFP (see, for example, endnote 4). There are, however, a number of ways of measuring MFP and its growth. For instance, growth accounting is commonly used to measure MFP at the national level. If one were to use this framework to explain changes in MFP, this would reduce to technological progress, capital deepening or increases in the number of workers (where there are increasing returns to scale), as TFP (i.e. the Solow residual) is "backed out" of the production function. Intuitively, and as is also highlighted theoretically in the survey by Glass et al. (2019) of the issues in performance measurement of national economies, growth accounting overlooks drivers of

MFP and its growth. To guard against overlooking drivers in this paper, we consider a wide set of drivers and not only those that a particular theoretical approach to the measurement of MFP (or its growth) points to.

3. We consider UK academic experts on productivity to be the most suitable sample frame for this study. Unlike policymakers and business people whose knowledge of productivity may focus on specific business areas, we surveyed academic experts, as they would be expected to have a broader knowledge of UK productivity.
4. We note that there are different measures of productivity. One such measure is MFP, which is defined as the amount of change in output that cannot be accounted for by changes in inputs of quality-adjusted labour and capital (ONS 2018a). Another measure is labour productivity, which is defined as the "output per unit of labour input" (ONS 2023). Our preferred measure is MFP, because it accounts for both labour and capital (and changes in quality of each), and so we consider it the most complete measure of productivity. Our survey therefore focuses on MFP when referring to UK average productivity growth, or productivity growth by sector. Owing to data limitations, labour productivity growth is used when referring to regional productivity growth. The two measures are not directly comparable.
5. We note that in recent ONS releases since 2020, the UK's R&D expenditure has been above the EU and OECD average. Given that there is a time lag between investment increasing and it having an effect on productivity, we would not expect this higher investment to have an immediate effect on productivity in the short term but would expect the UK's productivity rate to rise if it is sustained, ceteris paribus.

References

Abowd, J. M., and F. Kramarz. 2005. Human Capital and Worker Productivity: Direct Evidence from Linked Employer-Employee Data. *Annales d'Économie et de Statistique* (79/80): 323–338. https://doi.org/10.2307/20777580.

Abowd, J. M., J. Haltiwanger, R. Jarmin, J. Lane, P. Lengermann, K. McCue, and K. Sandusky. 2005. The Relation among Human Capital, Productivity, and Market Value: Building Up from Micro Evidence. In Carol Corrado, John Haltiwanger and Dan Sichel (eds). *Measuring Capital in the New Economy*, 153–204. Chicago: University of Chicago Press.

Acemoglu, D. 1996. A Microfoundation for Social Increasing Returns in Human Capital Accumulation. *The Quarterly Journal of Economics* 111 (3): 779–804. https://doi.org/10.2307/2946672.

Acemoglu, D. 2002. Technical Change, Inequality, and the Labour Market. *Journal of Economic Literature* 40 (1): 7–72. https://doi.org/10.1257/jel.40.1.7.

Acemoglu, D., and F. Zilibotti. 2001. Productivity Differences. *The Quarterly Journal of Economics* 116 (2): 563–606. https://doi.org/10.1162/00335530151144104.

Agénor, P.-R. 2010. A Theory of Infrastructure-Led Development. *Journal of Economic Dynamics and Control* 34 (5): 932–950. https://doi.org/10.1016/j.jedc.2010.01.009.

Aghion, P., and M. Schankerman. 2004. On the Welfare Effects and Political Economy of Competition-Enhancing Policies. *The Economic Journal* 114 (498): 800–824. https://doi.org/10.1111/j.1468-0297.2004.00244.x.

Arbabi, H., M. Mayfield, and P. McCann. 2020. Productivity, Infrastructure and Urban Density – An Allometric Comparison of Three European City Regions across Scales. *Journal of the Royal Statistical Society Series A: Statistics in Society* 183 (1): 211–228. https://doi.org/10.1111/rssa.12490.

Arif, U., M. Javid, and F. N. Khan. 2021. Productivity Impacts of Infrastructure Development in Asia. *Economic Systems* 45 (1): 100851. https://doi.org/10.1016/j.ecosys.2020.100851.

Arnold, J. M., A. Mattoo, and G. Narciso. 2008. Services Inputs and Firm Productivity in Sub-Saharan Africa: Evidence from Firm-Level Data. *Journal of African Economies* 17 (4): 578–599. https://doi.org/10.1093/jae/ejm042.

Aschauer, D. A. 1989a. Public Investment and Productivity Growth in the Group of Seven. *Economic Perspectives* 13: 17–25.

Aschauer, D. A. 1989b. Is Public Expenditure Productive? *Journal of Monetary Economics* 23 (2): 177–200. https://doi.org/10.1016/0304-3932(89)90047-0.

Aschauer, D. A. 1990. Why Is Infrastructure Important?. In *Is There a Shortfall in Public Capital Investment?*, edited by A. Munnell, 21–50. Boston, MA: Federal Reserve Bank of Boston.

Asker, J., A. Collard-Wexler, and J. De Loecker. 2014. Dynamic Inputs and Resource (Mis)Allocation. *Journal of Political Economy* 122 (5): 1013–1063. https://doi.org/10.1086/677072.

Aw, B. Y., M. J. Roberts, and D. Yi Xu. 2008. R&D Investments, Exporting, and the Evolution of Firm Productivity. *American Economic Review* 98 (2): 451–456. https://doi.org/10.1257/aer.98.2.451.

Ayyagari, M., A. Demirgüç-Kunt, and V. Maksimovic. 2011. Firm Innovation in Emerging Markets: The Role of Finance, Governance, and Competition. *Journal of Financial and Quantitative Analysis* 46 (6): 1545–1580. https://doi.org/10.1017/S0022109011000378.

Aznar, A. R., J. Forth, G. Mason, M. O'Mahony, and M. Bernini. 2015. *UK Skills and Productivity in an International Context*. Department for Business Innovation & Skills. London, UK: BIS Research Paper Number 262.

Banjeree, A., and E. Duflo. 2005. Growth Theory through the Lens of Development Economics. *Handbook of Economic Growth* 1: 473–552.

Barnett, A., M. Barriel, A. Chiu, and J. Franklin. 2014a. *The Productivity Puzzle: A Firm-Level Investigation into Employment Behaviour and Resource Allocation over the Crisis*. London, UK: Bank of England. Working Paper No. 495.

Barnett, A., B. Broadbent, A. Chiu, J. Franklin, and H. Miller. 2014b. Impaired Capital Reallocation and Productivity. *National Institute Economic Review* 228: R35–R48. https://doi.org/10.1177/002795011422800104.

Barro, R. 1989. A Cross-Country Study of Growth, Saving, and Government. In B. Douglas Bernheimand and John Shoven. Eds. *National Saving and Economic Performance*, 271–304. University of Chicago Press.

Barro, R. J. 1991. Economic Growth in a Cross Section of Countries. *The Quarterly Journal of Economics* 106 (2): 407–443. https://doi.org/10.2307/2937943.

Beck, T., A. Demirgüç-Kunt, L. Laeven, and V. Maksimovic. 2006. The Determinants of Financing Obstacles. *Journal of International Money and Finance* 25 (6): 932–952. https://doi.org/10.1016/j.jimonfin.2006.07.005.

Beck, T., A. Demirgüç-Kunt, and V. Maksimovic. 2005. Financial and Legal Constraints on Growth: Does Firm Size Matter? *The Journal of Finance* 60 (1): 137–177. https://doi.org/10.1111/j.1540-6261.2005.00727.x.

Beltrán, A. 2019. Informal Sector Competition and Firms Productivity. *Applied Economics Letters* 27 (15): 1243–1246. https://doi.org/10.1080/13504851.2019.1676383.

Benfratello, L., and A. Sembenelli. 2006. Foreign Ownership and Productivity: Is the Direction of Causality So Obvious? *International Journal of Industrial Organization* 24 (4): 733–751. https://doi.org/10.1016/j.ijindorg.2005.07.012.

Benigno, G., and L. Fornaro. 2014. The Financial Resource Curse. *Scandinavian Journal of Economics* 116: 58–86.

Bennett, J., and S. McGuinness. 2009. Assessing the Impact of Skill Shortages on the Productivity Performance of High-Tech Firms in Northern Ireland. *Applied Economics* 41 (6): 727–737. https://doi.org/10.1080/00036840601007450.

Berndt, E. R., and B. Hansson. 1992. Measuring the Contribution of Public Infrastructure Capital in Sweden. *The Scandinavian Journal of Economics* 94: S151–S68. https://doi.org/10.2307/3440255.

Besley, T., M. Coelho, and J. Van Reenen. 2013. Investing for Prosperity: Skills, Infrastructure and Innovation. *National Institute Economic Review* 224: R1–R13. https://doi.org/10.1177/002795011322400101.

Blanchard, O. 2007. Adjustment Within the Euro. The Difficult Case of Portugal. *Portuguese Economic Journal* 6 (1): 1–21. https://doi.org/10.1007/s10258-006-0015-4.

Bloom, N., E. Brynjolfsson, L. Foster, R. Jarmin, M. Patnaik, I. Saporta-Eksten, and J. Van Reenen. 2019a. What Drives Differences in Management Practices? *American Economic Review* 109 (5): 1648–1683. https://doi.org/10.1257/aer.20170491.

Bloom, N., P. Bunn, S. Chen, P. Mizen, P. Smietanka, and G. Thaiwates. 2019b. *The Impact of Brexit on UK Firms*. Cambridge, MA: National Bureau of Economic Research. No. w26218.

Bloom, N., B. Eifert, A. Mahajan, D. McKenzie, and J. Roberts. 2013. Does Management Matter? Evidence from India. *The Quarterly Journal of Economics* 128 (1): 1–51. https://doi.org/10.1093/qje/qjs044.

Bloom, N., C. Genakos, R. Sadun, and J. Van Reenen. 2010. *Does Management Matter: New Empirics and Old Theories*. Cambridge, MA: Mimeo.

Bloom, N., and J. Van Reenen. 2007. Measuring and Explaining Management Practices across Firms and Countries. *The Quarterly Journal of Economics* 122 (4): 1351–1408. https://doi.org/10.1162/qjec.2007.122.4.1351.

Bloom, N., and J. Van Reenen. 2010. Why Do Management Practices Differ across Firms and Countries? *Journal of Economic Perspectives* 24 (1): 203–224. https://doi.org/10.1257/jep.24.1.203.

Bloom, N., J. Van Reenen, and R. Sadun. 2016. *Management as a Technology?*. Cambridge, MA: National Bureau of Economic Research. No. w22327.

Blundell, R., Crawford, C. and Jin, W., 2014. What can wages and employment tell us about the UK's productivity puzzle?. *The Economic Journal* 124 (576): 377–407.

Blundell, R., R. Griffith, and J. Van Reenen. 1999. Market Share, Market Value and Innovation in a Panel of British Manufacturing. *Review of Economic Studies* 66 (3): 529–554. https://doi.org/10.1111/1467-937X.00097.

Boubakri, N., J. Cosset, and W. Saffar. 2013. The Role of State and Foreign Owners in Corporate Risk-Taking: Evidence from Privatization. *Journal of Financial Economics* 108 (3): 641–658. https://doi.org/10.1016/j.jfineco.2012.12.007.

Broadbent, B. 2013. Conditional Guidance as a Response to Supply Uncertainty. Speech given at Londond Business School by Ben Broadbent, External member of the Monetary Policty Committee, September 23rd. https://www.bankofengland.co.uk/-/media/boe/files/speech/2013/conditional-guidance-as-a-response-to-supply-uncertainty.pdf

Buccirossi, P., L. Ciari, T. Duso, G. Spagnolo, and C. Vitale. 2013. Competition policy and productivity growth: An empirical assessment. Review of Economics and Statistics, 95 (4): 1324–1336.

Bughin, J., J. Dimson, V. Hunt, T. Allas, M. Krishnan, J. Mischke, and M. Canal. 2018. *Solving the United Kingdom's Productivity Puzzle in a Digital Age*. McKinsey Global Institute Discussion Paper. https://www.mckinsey.com/featured-insights/regions-in-focus/solving-the-united-kingdoms-productivity-puzzle-in-a-digital-age

Bushnell, J. B., and C. Wolfram. 2009. The Guy at the Controls: Labor Quality and Power Plant Efficiency. In *International Differences in the Business Practices and Productivity of Firms*, 79–102. Chicago: University of Chicago Press.

Caballero, R., and R. Pindyck. 1996. Uncertainty, Investment, and Industry Evolution. *International Economic Review* 37 (3): 641–662. https://doi.org/10.2307/2527445.

Cassou, S. P., and K. J. Lansing. 1999. Fiscal Policy and Productivity Growth in the OECD. *The Canadian Journal of Economics* 32 (5): 1215–1226. https://doi.org/10.2307/136478.

Chadha, J. S. 2017a. *The UK's Productivity Puzzle: Labour, Investment and Finance*. National Institute of Economic and Social Research, London: General Election Briefing.

Chadha, J. S. 2017b. *The Productivity Puzzle*, 21. London: Gresham College Lecture.

Chadha, J., H. K. Yeşil, and A. Pabst. 2021. *Designing a New Fiscal Framework: Understanding and Confronting Uncertainty*. London: National Institute of Economic and Social Research. Occasional Paper, no. 61.

Chen, R., S. El Ghoul, O. Guedhami, and H. Wang. 2017. Do State and Foreign Ownership Affect Investment Efficiency? Evidence from Privatizations. *Journal of Corporate Finance* 42: 408–421. https://doi.org/10.1016/j.jcorpfin.2014.09.001.

Clarida, R. H., and R. Findlay. 1992. Government, Trade, and Comparative Advantage. *American Economic Review* 82: 122–127.

Coccia, M. 2010. Public and Private R&D Investments as Complementary Inputs for Productivity Growth. *International Journal of Technology, Policy and Management* 10 (1/2): 73–91. https://doi.org/10.1504/IJTPM.2010.032855.

Cohen, W. M., and D. A. Levinthal. 1990. Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly* 35 (1): 128–152. https://doi.org/10.2307/2393553.

Colciago, A., and R. Silvestrini. 2022. Monetary Policy, Productivity, and Market Concentration. *European Economic Review* 142: 103999. https://doi.org/10.1016/j.euroecorev.2021.103999.

Crafts, N., and T. C. Mills. 2020. Is the UK Productivity Slowdown Unprecedented? *National Institute Economic Review* 251: R47–R53. https://doi.org/10.1017/nie.2020.6.

Dai, S., N. Kuosmanen, T. Kuosmanen, T. Kuusi, J. Liesiö, and T. Maczulskij. 2022. *Misallocation of Labor and Capital in Finland's Business Sector*. Finnish Government: Publications of the Government's Analysis, Assessment and Research Activities.

De Long, J. B., and L. H. Summers. 1991. Equipment Investment and Economic Growth. *The Quarterly Journal of Economics* 106 (2): 445–502. https://doi.org/10.2307/2937944.

Deng, T. 2013. Impacts of Transport Infrastructure on Productivity and Economic Growth: Recent Advances and Research Challenges. *Transport Reviews* 33 (6): 686–699. https://doi.org/10.1080/01441647.2013.851745.

Derbyshire, J., B. Gardiner, and S. Waights. 2013. Estimating the Capital Stock for the NUTS 2 Regions of the EU-27. *Applied Economics* 45 (9): 1133–1149. https://doi.org/10.1080/00036846.2011.613797.

Dimson, J., V. Hunt, D. Mikkelsen, J. Scanlan, and J. Solyom. 2016. Productivity: The Route to Brexit Success. https://www.mckinsey.com/featured-insights/europe/productivity-the-route-to-brexit-success#/

Disney, R., J. Haskel, and Y. Heden. 2003. Restructuring and Productivity Growth in UK Manufacturing. *The Economic Journal* 113 (489): 666–694. https://doi.org/10.1111/1468-0297.t01-1-00145.

Dixit, A., and R. Pindyck. 1994. *Investment Under Uncertainty*. Princeton: Princeton University Press.

Djellal, F., and F. Gallouj. 2012. The Productivity Challenge in Services: Measurement and Strategic Perspectives. *The Service Industries Journal* 33 (3-4): 282–299. https://doi.org/10.1080/02642069.2013.747519.

Doraszelski, U., and J. Jaumandreu. 2013. R&D and productivity: Estimating endogenous productivity. *Review of economic studies* 80 (4): 1338–1383.

Driffield, N., J. H. Love, and Y. Yang. 2014. Technology Sourcing and Reverse Productivity Spillovers in the Multinational Enterprise: Global or Regional Phenomenon? *British Journal of Management* 25 (S1): S24–S41. https://doi.org/10.1111/1467-8551.12009.

Drupp, M. A., M. C. Freeman, B. Groom, and N. Frikk. 2018. Discounting Disentangled. *American Economic Journal: Economic Policy* 10 (4): 109–134. https://doi.org/10.1257/pol.20160240.

D'Souza, J., W. Megginson, and R. Nash. 2005. Effect of Institutional and Firm-Specific Characteristics on Post-Privatization Performance: Evidence from Developed Countries. *Journal of Corporate Finance* 11 (5): 747–766. https://doi.org/10.1016/j.jcorpfin.2004.12.001.

Duggal, V. G., C. Saltzman, and L. R. Klein. 1999. Infrastructure and Productivity: A Nonlinear Approach. *Journal of Econometrics* 92 (1): 47–74. https://doi.org/10.1016/S0304-4076(98)00085-2.

Dunning, J. H. 1977. Trade, Location of Economic Activity and the MNE: A Search for an Eclectic Approach. In Bertil Ohlin, Per-Ove Hesselborn, Per Magnus Wijkman (Eds).,*The International Allocation of Economic Activity: Proceedings of a Nobel Symposium Held at Stockholm*, 395–418. London: Palgrave Macmillan UK.

Dunning, J. H. 1980. Toward an Eclectic Theory of International Production: Some Empirical Tests. *Journal of International Business Studies* 11 (1): 9–31. https://doi.org/10.1057/palgrave.jibs.8490593.

Dunning, J. H. 1988. The Eclectic Paradigm of International Production: A Restatement and Some Possible Extensions. *Journal of International Business Studies* 19 (1): 1–31. https://doi.org/10.1057/palgrave.jibs.8490372.

Eberhart, A. C., W. F. Maxwell, and A. R. Siddique. 2004. An Examination of Long-Term Abnormal Stock Returns and Operating Performance following R&D Increases. *The Journal of Finance* 59 (2): 623–650. https://doi.org/10.1111/j.1540-6261.2004.00644.x.

Erosa, A., and A. Hidalgo Cabrillana. 2008. On Finance as a Theory of TFP, Cross-Industry Productivity Differences, and Economic Rents. *International Economic Review* 49 (2): 437–473. https://doi.org/10.1111/j.1468-2354.2008.00486.x.

Fabrizio, K. R., N. L. Rose, and C. D. Wolfram. 2007. Do Markets Reduce Costs? Assessing the Impact of Regulatory Restructuring on US Electric Generation Efficiency. *American Economic Review* 97 (4): 1250–1277. https://doi.org/10.1257/aer.97.4.1250.

Field, S., and M. Franklin. 2013. Micro-Data Perspectives on the UK Productivity Conundrum. ONS. https://webarchive.nationalarchives.gov.uk/ukgwa/20160106202157/http://www.ons.gov.uk/ons/rel/icp/microdata-perspectives-on-the-uk-productivity-conundrum/january-2013/micro-data-perspectives-on-the-uk-productivity-conundrum.html

Findlay, R., and J. D. Wilson. 1987. The Political Economy of Leviathan. In Assaf Razin and Efraim Sadka (eds.,) *Economic Policy in Theory and Practice*, 289–306. London: Palgrave Macmillan UK.

Foley, P., and D. Watts. 1994. Skills Shortages and Training: A Forgotten Dimension in New Technology. *R&D Management* 24 (3): 279–289. https://doi.org/10.1111/j.1467-9310.1994.tb00879.x.

Forth, J., and G. Mason. 2004. *The Impact of High-Level Skill Shortages on Firm-Level Performance: Evidence from the UK Technical Graduates Employers Survey*. London: National Institute of Economic and Social Research. Discussion Paper No. 235.

Foster, L., J. Haltiwanger, and C. Krizan. 2001. Aggregate Productivity Growth: Lessons from Microeconomic Evidence. In *New Developments in Productivity Analysis*, 303–372. Chicago: University of Chicago Press.

Foster, L., J. Haltiwanger, and C. Syverson. 2008. Reallocation, Firm Turnover, and Efficiency: Selection on Productivity or Profitability? *American Economic Review* 98 (1): 394–425. https://doi.org/10.1257/aer.98.1.394.

Fox, J. T., and V. Smeets. 2011. Does Input Quality Drive Measured Differences in Firm Productivity? *International Economic Review* 52 (4): 961–989. https://doi.org/10.1111/j.1468-2354.2011.00656.x.

Furman, J. 2015. *Productivity Growth in the Advanced Economies: The Past, the Present, and Lessons for the Future*. Peterson Institute for International Economics.

Garcia-Milà, T., and T. J. McGuire. 1992. The Contribution of Publicly Provided Inputs to States' Economies. *Regional Science and Urban Economics* 22 (2): 229–241. https://doi.org/10.1016/0166-0462(92)90013-Q.

Gardiner, B., B. Fingleton, and R. Martin. 2020. Regional Disparities in Labour Productivity and the Role of Capital Stock. *National Institute Economic Review* 253: R29–R43. https://doi.org/10.1017/nie.2020.28.

Glass, A., K. Kenjegalieva, R. C. Sickles, and T. Weyman-Jones. 2019. An Overview of Issues in Measuring the Performance of National Economies. In *The Palgrave Handbook of Economic Performance Analysis*, edited by T. ten Raa and W. Greene, 659–705. Cham: Palgrave Macmillan. https://doi.org/10.1007/978-3-030-237271_17.

Goldin, I., P. Koutroumpis, F. Lafond, and J. Winkler. 2024. Why Is Productivity Slowing Down? *Journal of Economic Literature* 62 (1): 196–268.

Goodridge, P., J. Haskel, and G. Wallis. 2013. Can Intangible Investment Explain the UK Productivity Puzzle? *National Institute Economic Review* 224: R48–R58. https://doi.org/10.1177/002795011322400104.

Goodridge, P., J. Haskel, and G. Wallis. 2018. Accounting for the UK Productivity Puzzle: A Decomposition and Predictions. *Economica* 85 (339): 581–605. https://doi.org/10.1111/ecca.12219.

Griffith, R. 1999. Using the ARD Establishment Level Data to Look at Foreign Ownership and Productivity in the United Kingdom. *The Economic Journal* 109 (456): 416–442. https://doi.org/10.1111/1468-0297.00443.

Griffith, R., S. Redding, and J. Van Reenen. 2004. Mapping the Two Faces of R&D: Productivity Growth in a Panel of OECD Industries. *Review of Economics and Statistics* 86 (4): 883–895. https://doi.org/10.1162/0034653043125194.

Griffith, R., and H. Simpson. 1998. *Productivity and the Role of Government*. Institute for Fiscal Studies.

Griliches, Z. 1963. The Sources of Measured Productivity Growth: United States Agriculture, 1940-60. *Journal of Political Economy* 71 (4): 331–346. https://doi.org/10.1086/258782.

Griliches, Z. 1964. Research Expenditures, Education, and the Aggregate Agricultural Production Function. *American Economic Review* 54: 961–974.

Griliches, Z., and D. W. Jorgenson. 1966. Sources of Measured Productivity Change: Capital Input. *American Economic Review* 56: 50–61.

Grossman, G. M., and E. Helpman. 1991. Trade, Knowledge Spillovers, and Growth. *European Economic Review* 35 (2-3): 517–526. https://doi.org/10.1016/0014-2921(91)90153-A.

Grunau, P. 2016. The Impact of Overeducated and Undereducated Workers on Firm-Level Productivity: First Evidence from Germany. *International Journal of Manpower* 37: 258–283.

Guellec, D., and B. van Pottelsberghe De La Potterie. 2002. R&D and Productivity Growth: Panel Data Analysis of 16 OECD Countries. *OECD Economic Studies* 2001 (2): 103–126. https://doi.org/10.1787/eco_studies-v2001-art12-en.

Haldane, A. G. 2018. The UK's Productivity Problem: Hub No Spokes. Speech given by Andrew Haldane, Chief Economist at the Bank of England, the Academy of Social Sciences Annual Lecture, London, June 28th. https://www.bankofengland.co.uk/-/media/boe/files/speech/2018/the-uks-productivity-problem-hub-no-spokes-speech-by-andy-haldane#:~:text=The%20%E2%80%9CHub%2DNo%2DSpokes%E2%80%9D%20Model&text=This%20means%20UK%20productivity%20is,unclear%20will%20ever%20be%20closed

Hall, B. H., F. Lotti, and J. Mairesse. 2013. Evidence on the Impact of R&D and ICT Investments on Innovation and Productivity in Italian Firms. *Economics of Innovation and New Technology* 22 (3): 300–328. https://doi.org/10.1080/10438599.2012.708134.

Hall, B. H., and J. Mairesse. 1995. Exploring the Relationship between R&D and Productivity in French Manufacturing Firms. *Journal of Econometrics* 65 (1): 263–293. https://doi.org/10.1016/0304-4076(94)01604-X.

Harris, R., and J. Moffat. 2017. The UK Productivity Puzzle, 2008-2012: Evidence Using Plant-Level Estimates of Total Factor Productivity. *Oxford Economic Papers* 69: 529–549.

Harris, R., and C. Robinson. 2002. The Effect of Foreign Acquisitions on Total Factor Productivity: Plant-Level Evidence from UK Manufacturing, 1987-1992. *Review of Economics and Statistics* 84 (3): 562–568. https://doi.org/10.1162/003465302320259556.

Haskel, J., and C. Martin. 1993. Do Skill Shortages Reduce Productivity? Theory and Evidence from the United Kingdom. *The Economic Journal* 103 (417): 386–394. https://doi.org/10.2307/2234777.

Herzog-Stein, A., and G. A. Horn. 2018. The Productivity Puzzle: It's the Lack of Investment, Stupid!. *Intereconomics* 53 (2): 69–75. https://doi.org/10.1007/s10272-018-0724-9.

Hill, C. W., and S. A. Snell. 1989. Effects of Ownership Structure and Control on Corporate Productivity. *Academy of Management Journal* 32 (1): 25–46. https://doi.org/10.2307/256418.

Holtz-Eakin, D. 1994. Public Sector Capital and the Productivity Puzzle. *The Review of Economics and Statistics* 76 (1): 12–21. https://doi.org/10.2307/2109822.

Hsieh, C. T., and P. J. Klenow. 2009. Misallocation and Manufacturing TFP in China and India. *Quarterly Journal of Economics* 124 (4): 1403–1448. https://doi.org/10.1162/qjec.2009.124.4.1403.

Hulten, C. R., and R. M. Schwab. 1984. Regional Productivity Growth in US Manufacturing, 1951-78. *American Economic Review* 74: 152–156.

Hulten, C. R., and R. M. Schwab. 1991. Public Capital Formation and the Growth of Regional Manufacturing Industries. *National Tax Journal* 44 (4.1): 121–134. https://doi.org/10.1086/NTJ41788927.

Ilmakunnas, P., M. Maliranta, and J. Vainiomäki. 2004. The Roles of Employer and Employee Characteristics for Plant Productivity. *Journal of Productivity Analysis* 21 (3): 249–276. https://doi.org/10.1023/B:PROD.0000022093.59352.5e.

İmrohoroğlu, A., and Ş. Tüzel. 2014. Firm-Level Productivity, Risk, and Return. *Management Science* 60 (8): 2073–2090. https://doi.org/10.1287/mnsc.2013.1852.

John, K., L. Litov, and B. Yeung. 2008. Corporate Governance and Risk-Taking. *The Journal of Finance* 63 (4): 1679–1728. https://doi.org/10.1111/j.1540-6261.2008.01372.x.

Jones, R. 2016. *Innovation, Research and the UK's Productivity Crisis*. Sheffield: Sheffield Political Economy Research Insttute (SPERI). SPERI Paper No. 28.

Jorgenson, D. W., and Z. Griliches. 1967. The Explanation of Productivity Change. *The Review of Economic Studies* 34 (3): 249–283. https://doi.org/10.2307/2296675.

Kampelmann, S., and F. Rycx. 2012. The Impact of Educational Mismatch on Firm Productivity: Evidence from Linked Panel Data. *Economics of Education Review* 31 (6): 918–931. https://doi.org/10.1016/j.econedurev.2012.07.003.

Kangasniemi, M., M. Mas, C. Robinson, and L. Serrano. 2012. The Economic Impact of Migration: Productivity Analysis for Spain and the United Kingdom. *Journal of Productivity Analysis* 38 (3): 333–343. https://doi.org/10.1007/s11123-012-0280-4.

Katz, L., and D. Autor. 1999. Changes in the Wage Structure and Earnings Inequality. In *Handbook of Labour Economics*, edited by O. Ashenfelter and D. Card, Vol. 3A. Amsterdam: North Holland.

Klevorick, A. K., R. C. Levin, R. R. Nelson, and S. G. Winter. 1995. On the Sources and Significance of Interindustry Differences in Technological Opportunities. *Research Policy* 24 (2): 185–205. https://doi.org/10.1016/0048-7333(93)00762-I.

Knittel, C. R. 2002. Alternative Regulatory Methods and Firm Efficiency: Stochastic Frontier Evidence from the US Electricity Industry. *Review of Economics and Statistics* 84 (3): 530–540. https://doi.org/10.1162/003465302320259529.

Le, M., F. Pieri, and E. Zaninotto. 2019. From Central Planning towards a Market Economy: The Role of Ownership and Competition in Vietnamese Firms' Productivity. *Journal of Comparative Economics* 47 (3): 693–716. https://doi.org/10.1016/j.jce.2019.04.002.

Lichtenberg, F. R. 1992. *R&D Investment and International Productivity Differences*. Cambridge, MA: National Bureau of Economic Research. No. w4161.

Lichtenberg, F. R., and D. Siegel. 1991. The Impact of R&D Investment on Productivity–New Evidence Using Linked R&D–LRD Data. *Economic Inquiry* 29 (2): 203–229. https://doi.org/10.1111/j.1465-7295.1991.tb01267.x.

Link, A. N., and D. Siegel. 2003. *Technological Change and Economic Performance*. London: Routledge.

Lucas, J. R. 1990. Why Doesn't Capital Flow from Rich to Poor Countries? *American Economic Review* 80: 92–96.

Lucas, R. E. 1988. On the Mechanics of Economic Development. *Journal of Monetary Economics* 22 (1): 3–42. https://doi.org/10.1016/0304-3932(88)90168-7.

Luong, H., F. Moshirian, L. Nguyen, X. Tian, and B. Zhang. 2017. How Do Foreign Institutional Investors Enhance Firm Innovation? *Journal of Financial and Quantitative Analysis* 52 (4): 1449–1490. https://doi.org/10.1017/S0022109017000497.

Lustig, N. C. 2000. *Mexico: The Remaking of an Economy*. Brookings Institution Press.

Make UK. 2019. *Piecing Together the Puzzle: Getting UK Manufacturing Productivity Growth Back on Trend*. MAKE UK – The Manufacturers' Organisation. https://www.makeuk.org/-/media/eef/files/reports/industry-reports/make-uk-productivity-report-2018.pdf

Mason, C. 2020. Productivity and the UK's Deficiency in Scale-Ups. In *Productivity Perspectives*, edited by P. McCann and T. Vorley, 147–173. Cheltenham: Edward Elgar Publishing Limited.

Mason, G., M. O'Mahony, and R. Riley. 2018. What Is Holding Back UK Productivity? Lessons from Decades of Measurement. *National Institute Economic Review* 246: R24–R35. https://doi.org/10.1177/002795011824600111.

McGowan, M. A., and D. Andrews. 2015. *Labour Market Mismatch and Labour Productivity: Evidence from PIAAC Data*. OECD. OECD Economics Department Working Papers No. 1209. https://www.oecd-ilibrary.org/economics/labour-market-mismatch-and-labour-productivity_5js1pzx1r2kb-en

McGuinness, S., and J. Bennett. 2006. Examining the Link between Skill Shortages, Training Composition and Productivity Levels in the Construction Industry: Evidence from Northern Ireland. *The International Journal of Human Resource Management* 17 (2): 265–279. https://doi.org/10.1080/09585190500405538.

Melitz, M. J. 2003. The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica* 71 (6): 1695–1725. https://doi.org/10.1111/1468-0262.00467.

Midrigan, V., and D. Yi Xu. 2014. Finance and Misallocation: Evidence from Plant-Level Data. *American Economic Review* 104 (2): 422–458. https://doi.org/10.1257/aer.104.2.422.

Moran, P., and A. Queralto. 2018. Innovation, Productivity, and Monetary Policy. *Journal of Monetary Economics* 93: 24–41. https://doi.org/10.1016/j.jmoneco.2017.10.006.

Morrison, C. J., and A. E. Schwartz. 1996. State Infrastructure and Productive Performance. *American Economic Review* 86: 1095–1111.

Munnell, A. H. 1990. Why Has Productivity Growth Declined? Productivity and Public Investment. *New England Economic Review* 3–22.

Nadiri, M. I., and T. P. Mamuneas. 1994. The Effects of Public Infrastructure and R&D Capital on Cost Structure and Performance of US Manufacturing Industries. *The Review of Economics and Statistics* 76 (1): 22–37. https://doi.org/10.2307/2109823.

Naoum, S. G. 2016. Factors Influencing Labor Productivity on Construction Sites: A State-of-the-Art Literature Review and a Survey. *International Journal of Productivity and Performance Management* 65 (3): 401–421. https://doi.org/10.1108/IJPPM-03-2015-0045.

Nelson, R. R., and E. N. Wolff. 1997. Factors behind Cross-Industry Differences in Technical Progress. *Structural Change and Economic Dynamics* 8 (2): 205–220. https://doi.org/10.1016/S0954-349X(96)00079-3.

Nelson, R. R., and E. N. Wolff. 2004. Technological Opportunity and Productivity of R&D Activities. *Journal of Productivity Analysis* 21 (2): 167–181. https://doi.org/10.1023/B:PROD.0000016871.95892.41.

Ngai, L. R., and R. M. Samaniego. 2011. Accounting for Research and Productivity Growth across Industries. *Review of Economic Dynamics* 14 (3): 475–495. https://doi.org/10.1016/j.red.2009.12.002.

Nickell, S., and D. Nicolatsis. 1997. *Human Capital, Investment and Innovation: What Are the Connections?*. London School of Economics. London, UK: Centre for Economic Performance Discussion Paper No. 20.

ONS. 2018a. A Simple Guide to Multi-Factor Productivity. https://www.ons.gov.uk/economy/economicoutputandproductivity/productivitymeasures/methodologies/asimpleguidetomultifactorproductivity

ONS. 2018b. UK Trade in Goods and Productivity: New Findings. https://www.ons.gov.uk/economy/economicoutputandproductivity/productivitymeasures/articles/uktradeingoodsandproductivitynewfindings/2018-07-06#:~:text=1.-,Main%20points,than%20non%2Dtraders%20in%202016.

ONS. 2019. Firm-level Labour Productivity Measures from the Annual Business Survey, Great Britain: 2017. https://www.ons.gov.uk/economy/economicoutputandproductivity/productivitymeasures/articles/firmlevellabourproductivitymeasuresfromtheannualbusinesssurveygreatbritain/2017

ONS. 2022. Multi-Factor Productivity Estimates. https://www.ons.gov.uk/economy/economicoutputandproductivity/productivitymeasures/datasets/multifactorproductivityexperimentalestimatesreferencetables

ONS. 2023. Labour Productivity QMI. https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/labourproductivity/methodologies/labourproductivityqmi
ONS. 2024. Management Practices in the UK: 2016 to 2023. https://www.ons.gov.uk/economy/economicoutputandproductivity/productivitymeasures/bulletins/managementpracticesintheuk/latest
Pabst, A., and A. Westwood. 2021. *The Politics of Productivity: Institutions, Governance and Policy*. The Productivity Institute. Working Paper No. 015.
Patterson, C., A. Şahin, G. Topa, and G. L. Violante. 2016. Working Hard in the Wrong Place: A Mismatch-Based Explanation to the UK Productivity Puzzle. *European Economic Review* 84: 42–56. https://doi.org/10.1016/j.euroecorev.2015.10.013.
Pavcnik, N. 2002. Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants. *The Review of Economic Studies* 69 (1): 245–276. https://doi.org/10.1111/1467-937X.00205.
Pessoa, J. P., and J. Van Reenen. 2014. The UK Productivity and Jobs Puzzle: Does the Answer Lie in Labour Market Flexibility? *The Economic Journal* 124 (576): 433–452. https://doi.org/10.1111/ecoj.12146.
Pryce, V. 2015. Why Should We Care about Productivity? *National Institute Economic Review* 231: R30–R35. https://doi.org/10.1177/002795011523100104.
Ramirez, M. D. 1998a. Does Public Investment Enhance Productivity Growth in Mexico? A Cointegration Analysis. *Eastern Economic Journal* 24: 63–82.
Ramirez, M. D. 1998b. Does Public Investment Enhance Labor Productivity Growth in Chile? A Cointegration Analysis. *The North American Journal of Economics and Finance* 9 (1): 45–65. https://doi.org/10.1016/S1062-9408(99)80080-1.
Reis, R. 2013. The Portuguese Slump and Crash and the Euro Crisis. *Brookings Papers on Economic Activity* 2013 (1): 143–210. https://doi.org/10.1353/eca.2013.0005.
Restuccia, D., and R. Rogerson. 2008. Policy Distortions and Aggregate Productivity with Heterogeneous Establishments. *Review of Economic Dynamics* 11 (4): 707–720. https://doi.org/10.1016/j.red.2008.05.002.
Restuccia, D., and R. Rogerson. 2013. Misallocation and Productivity. *Review of Economic Dynamics* 16 (1): 1–10. https://doi.org/10.1016/j.red.2012.11.003.
Restuccia, D., and R. Rogerson. 2017. The Causes and Costs of Misallocation. *Journal of Economic Perspectives* 31 (3): 151–174. https://doi.org/10.1257/jep.31.3.151.
Riley, R., A. Rincon-Aznar, and L. Samek. 2018. *Below the Aggregate: A Sectoral Account of the UK Productivity Puzzle.* London, UK: ESCoE Discussion Paper, No. 2018–06.
Rizov, M., R. Croucher, and T. Lange. 2016. The UK National Minimum Wage's Impact on Productivity. *British Journal of Management* 27 (4): 819–835. https://doi.org/10.1111/1467-8551.12171.
Schmookler, J. 1954. The Level of Inventive Activity. *The Review of Economics and Statistics* 36 (2): 183–190. https://doi.org/10.2307/1924669.
Schneider, P. 2018. The UK's Productivity Puzzle is in the Top Tail of the Distribution. *Bank Underground*. https://bankunderground.co.uk/2018/03/29/the-uks-productivity-puzzle-is-in-the-top-tail-of-the-distribution/
Schultz, T. 1962. Reflections on Investment in Man. *Journal of Political Economy* 70 (5, Part 2): 1–8. https://doi.org/10.1086/258723.
Siddiqui, K. 2020. A Perspective on Productivity Growth and Challenges for the UK Economy. *Journal of Economic Policy Researches* 7: 21–42.
Solow, R. M. 1957. Technical Change and the Aggregate Production Function. *The Review of Economics and Statistics* 39 (3): 312–320. https://doi.org/10.2307/1926047.
Sotelsek, D., and L. Laborda. 2019. Effects of Road Infrastructure on Employment, Productivity and Growth: An Empirical Analysis at Country Level. *Journal of Infrastructure Development* 11 (1-2): 81–120. https://doi.org/10.1177/0974930619879573.
Storper, M., and A. J. Scott. 2008. Rethinking Human Capital, Creativity and Urban Growth. *Journal of Economic Geography* 9 (2): 147–167. https://doi.org/10.1093/jeg/lbn052.

Sunley, P., R. Martin, B. Gardiner, and A. Pike. 2020. In Search of the Skilled City: Skills and The Occupational Evolution of British Cities. *Urban Studies* 57 (1): 109–133. https://doi.org/10.1177/0042098019834249.

Syverson, C. 2011. What Determines Productivity? *Journal of Economic Literature* 49 (2): 326–365. https://doi.org/10.1257/jel.49.2.326.

Takii, S. 2004. Productivity Differentials between Local and Foreign Plants in Indonesian Manufacturing, 1995. *World Development* 32 (11): 1957–1969. https://doi.org/10.1016/j.worlddev.2004.06.010.

Tang, J., and W. Wang. 2005. Product Market Competition, Skills Shortages and Productivity: Evidence from Canadian Manufacturing Firms. *Journal of Productivity Analysis* 23 (3): 317–339. https://doi.org/10.1007/s11123-005-2213-y.

Terleckyj, N. 1960. Sources of Productivity Advance: A Pilot Study of Manufacturing Industries, 1899-1953. PhD diss., Columbia University.

The UK Productivity Commission. 2022. *Productivity in the UK: Evidence Review. First Report of The UK Productivity Commission*. London, UK: National Institute of Economic and Social Research.

Tsionas, M. G., and N. G. Tzeremes. 2022. The Degree of Internationalization and Firm Productivity: Empirical Evidence from Large Multinationals. *British Journal of Management* 33 (4): 1969–1990. https://doi.org/10.1111/1467-8551.12560.

Turrell, A., Speigner, B., Copple, D., Djumalieva, J. and Thurgood, J., 2021. Is the UK's productivity puzzle mostly driven by occupational mismatch? An analysis using big data on job vacancies. Labour Economics, 71, p.102013.

Ullah, B., Z. Wei, and F. Xie. 2014. ISO Certification, Financial Constraints, and Firm Performance in Latin American and Caribbean Countries. *Global Finance Journal* 25 (3): 203–228. https://doi.org/10.1016/j.gfj.2014.10.003.

Van Ark, B. 2021. Putting Together the Pieces of the Productivity Puzzle: Review Article of Productivity Perspectives and Productivity and the Pandemic. *International Productivity Monitor* 40: 118–133.

Van Ark, B., and A. J. Venables. 2020. A Concerted Effort to Tackle the UK Productivity Puzzle. *International Productivity Monitor* 39: 3–15.

Van Ark, B., M. O'Mahony, and M. P. Timmer. 2008. The Productivity Gap between Europe and the United States: Trends and Causes. *Journal of Economic Perspectives* 22 (1): 25–44. https://doi.org/10.1257/jep.22.1.25.

Vandeplas, A., and A. Thum-Thysen. 2019. *Skills Mismatch & Productivity in the EU*. European Commission's Director-General for Economic and Financial Affairs. European Economy Discussion Papers No. 100. https://economy-finance.ec.europa.eu/system/files/2019-07/dp100_en.pdf

Walker, F. A. 1887. The Source of Business Profits. *The Quarterly Journal of Economics* 1 (3): 265–288. https://doi.org/10.2307/1882759.

Westwood, A. 2018. The Holy Grail of Industrial Strategy? England's Continuing Search for Specialist Technical Institutions. *Ekonomiaz, Revista vasca de Economía, Gobierno Vasco/Eusko Jaurlaritza/Basque Government* 94: 132–155.

Xiao, G. 2013. Legal Shareholder Protection and Corporate R&D Investment. *Journal of Corporate Finance* 23: 240–266. https://doi.org/10.1016/j.jcorpfin.2013.08.009.

Xu, J., J. Liu, and H. Abdoh. 2022. Foreign Ownership and Productivity. *International Review of Economics & Finance* 80: 624–642. https://doi.org/10.1016/j.iref.2022.02.079.

Yasar, M., C. Paul, and M. Ward. 2011. Property Rights Institutions and Firm Performance: A Cross-Country Analysis. *World Development* 39 (4): 648–661. https://doi.org/10.1016/j.worlddev.2010.09.009.

Yeaple, S. R., and S. S. Golub. 2007. International Productivity Differences, Infrastructure, and Comparative Advantage. *Review of International Economics* 15 (2): 223–242. https://doi.org/10.1111/j.1467-9396.2007.00667.x.

Zimmermann, C. 2007. *Academic Rankings with RePEc*. Department of Economics, Storrs, CT: University of Connecticut.

Zira, E. 2016. The Impact of Skill Mismatch on Aggregate Productivity: Cross-Country Analysis in OECD Economies. Master thes., KTH Industrial Engineering and Management.

Zymek, R., and B. Jones. 2020. *UK Regional Productivity Differences: An Evidence Review*. London, UK: Report for the Industrial Strategy Council.