Submission to Treasury Select Committee Inquiry on Regional Imbalances in the UK[1]

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August 2019

1. The research and evidence base

This submission draws upon research undertaken as part of an ESRC-funded project on 'Manufacturing renaissance in industrial regions? Investigating the potential of advanced manufacturing for sectoral and spatial rebalancing'. The project is examining the geographical, organisational and economic dynamics of advanced manufacturing industries across the UK, focusing on several sectors in particular: aerospace; pharmaceuticals; motor vehicles; and electronics. The research team is led by Peter Sunley (Southampton University) and includes Emil Evenhuis (Southampton University), Richard Harris (Durham University), Ron Martin (Cambridge University), John Moffat (Durham University) and Andy Pike (Newcastle University). For more information, see: www.manufacturing-regions.org.uk/

2. Context

We welcome the Treasury Committee's inquiry into this important issue of regional imbalances in the UK. The UK has had longstanding and persistent geographical disparities in economic and social conditions and national government has engaged in ongoing efforts to design and implement institutional arrangements and policies to address the problem for close to a century (Martin *et al.* 2015).

In the latest iteration of the UK government's recognition of the issue in July 2019, the new Prime Minister has restated a commitment to 'spatial rebalancing' and (re)announced earlier comments to the UK Shared Prosperity Fund, a Towns Fund, public expenditure on transport infrastructure in northern England and 'Growth Deals' in Northern Ireland, Scotland and Wales (Johnson 2019).

The UK has amongst the highest spatial disparities in economic conditions internationally (OECD 2016). Geographical disparities in economic and social conditions remain a public policy issue for the UK government for the several basic reasons including:

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- Economic: geographical over-concentration of economic activity generates agglomeration economies but also risks inefficiencies as excess localised demand for capital, land and labour generates rising costs and diseconomies and skews demand for infrastructure investment to offset these pressures (Pike *et al.* 2019). Places outside geographical concentrations risk the under-utilisation of their economic potential.
- Social: the spatially uneven distribution of economic activity across the nation generates unfairness and inequity in the life chances and opportunities for people and places.
- Environmental: geographical concentration of economic activities in too few places promotes the unsustainable use of scare resources.
- Political: lack of economic opportunities for so-called 'left behind' people and places and perceived unfairness has fuelled the discontent and political fragmentation and division in recent years across the UK.

Therefore, addressing geographical disparities is a key priority for the new government in the UK.

3. Differences in productivity levels across regions and LEPs in Great Britain[2]

Geographical disparities in economic conditions can be measured using different indicators and at different spatial levels. Productivity is one measure of the efficiency of the economy and is central to conventional models of economic growth, income and living standards. Geographical disparities in productivity in the UK are marked and increasing.

Table 1 shows average (logged) total factor productivity (TFP) across plants in both manufacturing and most services[3] operating in the administrative regions of Great Britain during 2010-2016. Regions are ranked from highest (London) to lowest (Wales). The gap between the highest and lowest regions is 0.28. This is mostly driven by the gap in the service sector (separate data for manufacturing and services is available on request but not presented here). The last row in Table 1 shows the gap between London and the next highest region, the South East, indicating that some 46 per cent of the top-to-bottom gap in logged TFP is accounted for by the gap between London and the South East; that is, productivity differences between London and everywhere else dominates with differences between the other regions being much smaller. The other major point regarding the results in Table 1 is that, aside from Scotland, productivity levels generally fall when moving towards the north and periphery of Great Britain (cf. McCann, 2016).

[2] The following uses results presented in Harris and Moffat (2019a).
[3] All market-based sectors covering manufacturing and most of services with the notable exception of utilities, construction and financial services (specifically included are the following Standard Industrial Classification 1992 sectors: SIC 15-37, 50-64, 70-74, 90-93). The accompanying appendix shows how TFP was calculated.

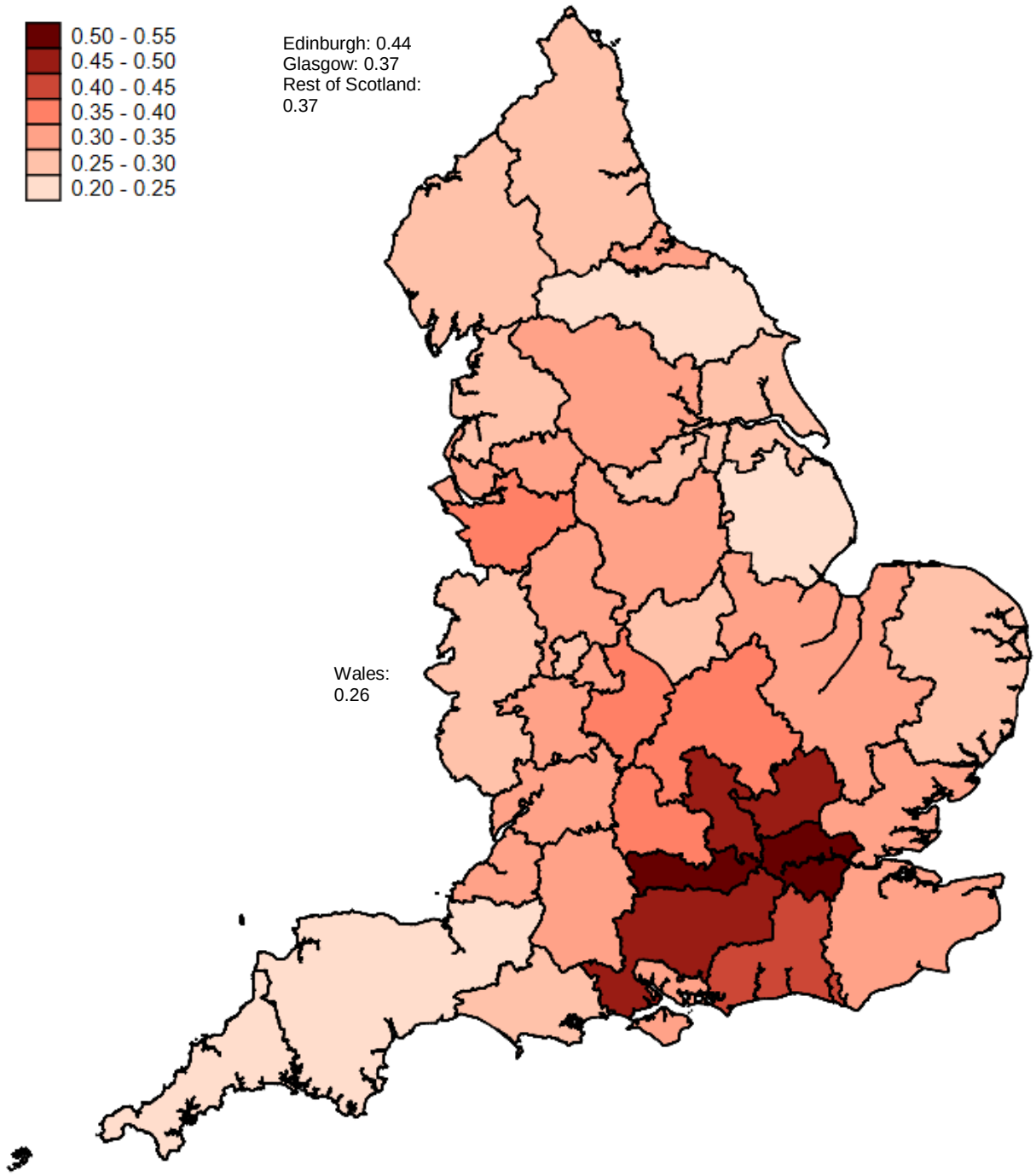
Table 1: (weighted) means of *ln* TFP 2010-16 by administrative region

	Mean[a]
London	0.533
South East	0.407
Scotland	0.384
Eastern	0.336
West Midlands	0.320
North East	0.308
North West	0.305
East Midlands	0.299
Yorkshire-Humberside	0.295
South West	0.286
Wales	0.257
Gap (highest-to-lowest)	0.276
Gap (London with South East)	0.126

[a] mean values are all significantly less (at the 1% level) than that of the South East except London (which is significantly larger at 1% level)

As to productivity across the LEPs, Figure 1 summarises the mean values, showing significantly higher TFP for the London and adjacent LEPs mostly north and south of London (viz., Thames Valley, Enterprise M3, Hertfordshire and Coast-to-Capital). The correlation between the means of TFP across LEP's for manufacturing and services (not shown) is 0.86, indicating that rankings are very similar across sectors. As with larger administrative regions (Table 1), aside from Scotland, productivity levels generally fall when moving towards the north and periphery of Great Britain.

Figure 1: (weighted) mean *ln* TFP 2010-16 by English LEPS and Scotland and Wales



4. The potential for advanced manufacturing to contribute to spatial rebalancing

Advanced manufacturing is defined as production activities that use a high level of technology and are relatively knowledge intensive. Advanced manufacturing may potentially play a key role in redressing some of these sharp geographical differences in productivity across the UK – and more widely in 'spatial rebalancing' the economy – due to several characteristics:

- Higher value and higher productivity economic activities based upon a high intensity of knowledge and capital
- Driving innovation and knowledge creation, especially through the development and application of advanced information and communication technologies and artificial intelligence (described as 'Industry 4.0' or the '4th Industrial Revolution').
- Upgrading potential for products and processes towards higher value-added content through the incorporation of tangibles such as technology and integration with intangible services such as branding, product support, after-care and disposal – described as 'manu-services' or 'servitization').
- Tradeable activities and exports generating earnings from overseas sales, contributing positively to the national balance of payments, helping to manage inflation through reducing reliance upon imports and sustaining exchange rate values.
- Higher quality, more productive and better paid jobs and training and skills development opportunities.

In our project we are taking a closer look at the potential for advanced manufacturing to play a key role in spatial rebalancing. Below we briefly discuss the three main findings so far.

Firstly, the potential for substantial future growth in advanced manufacturing is limited to only some segments, mainly aerospace, motor vehicles, defence-related manufacturing (i.e. military vehicles and weapons and ammunition), and perhaps pharmaceuticals. Moreover, historically the development of advanced manufacturing sectors is marked by strong ups and downs. Figure 2 shows the indexed development of advanced manufacturing sectors (in accordance to the Eurostat definition[4]) since the early 1990s. Figure 3 shows (using plant-level data) the cumulative distribution of TFP for these sectors (taken from Figure 4 in Harris et. al., 2019); plants belonging to the office machinery and data processing sector (SIC33) had the highest levels of TFP, followed by aerospace (SIC364), pharmaceuticals (SIC257), motor vehicles (SIC35) and instrumental engineering (SIC37). Plants in electrical & electronic engineering (SIC34) were clearly the least productive.

[4] https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:High-tech_classification_of_manufacturing_industries

Figure 2: Indexed development of GVA of advanced manufacturing sectors in Great Britain from 1991 until 2015, based on 5 year moving averages. With share in total GVA of each sector in 2011-2015 in brackets.

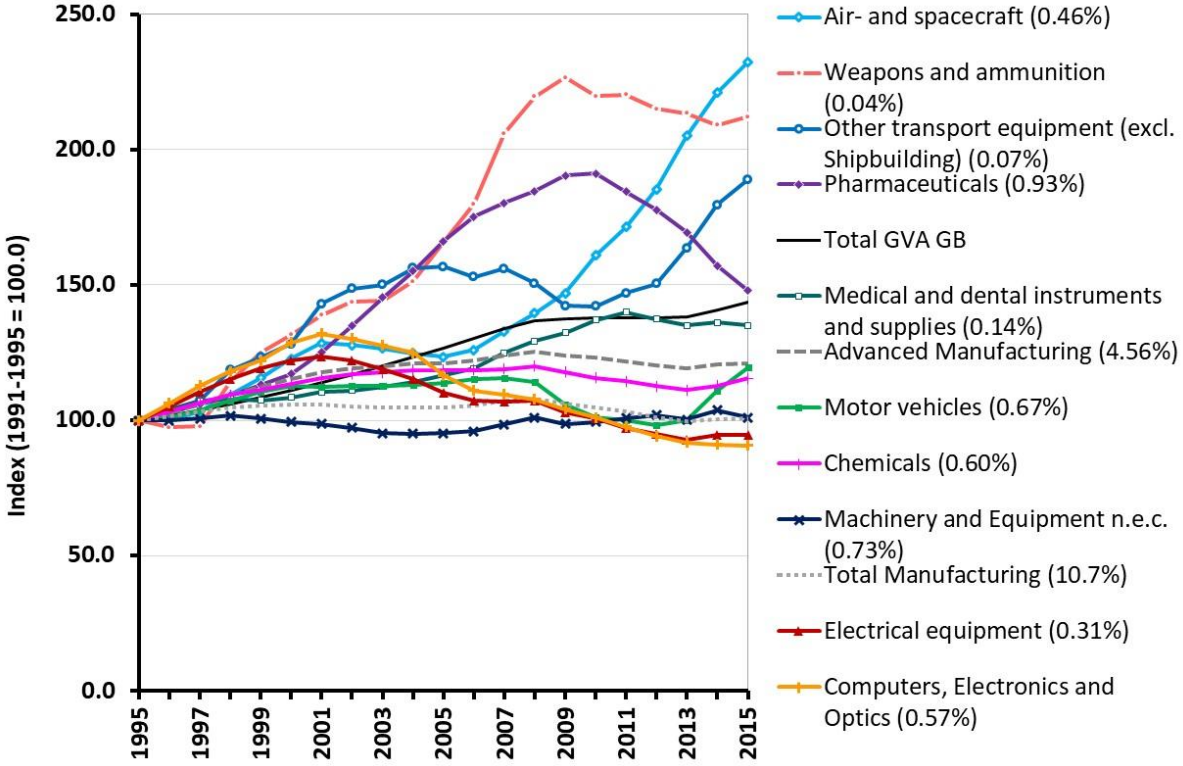
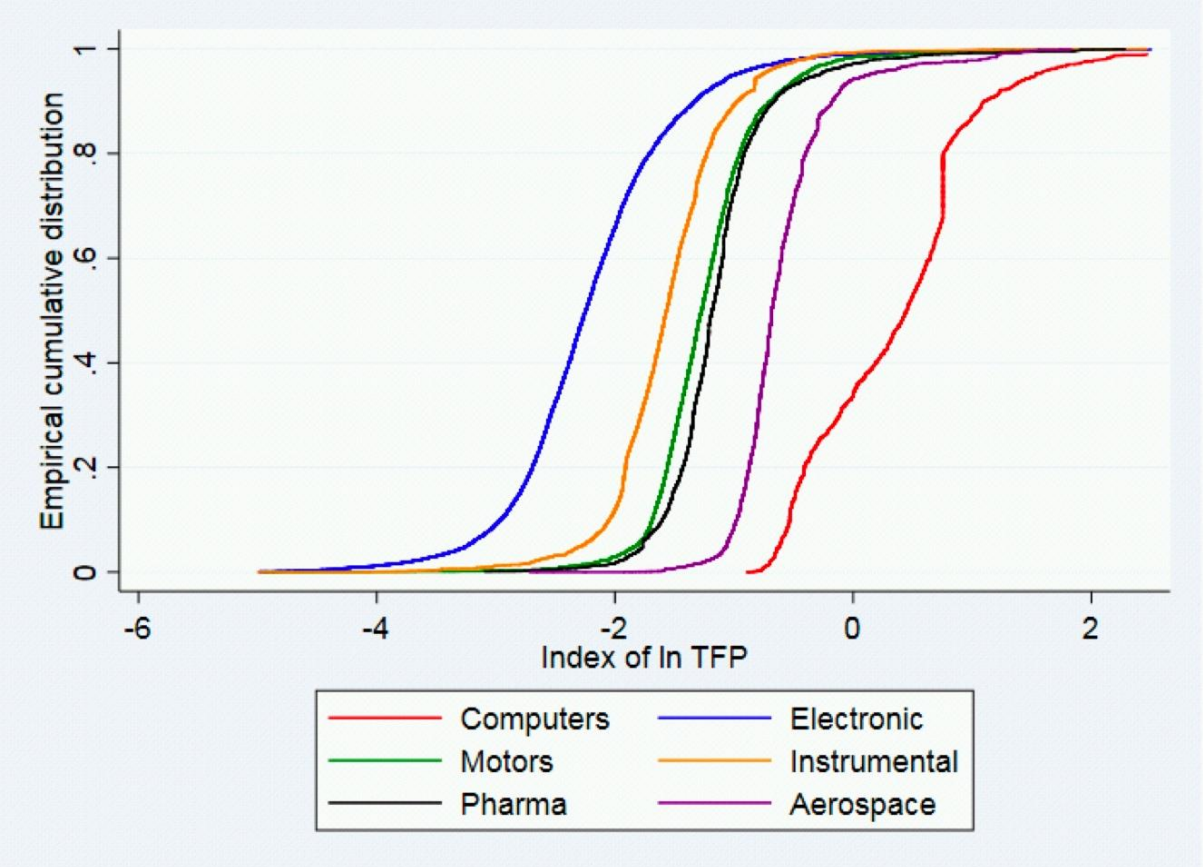


Figure 3: Cumulative distribution of *ln* TFP for plants in certain sectors



Secondly, with regard to the question of whether these advanced manufacturing sectors can potentially prosper in the Traditional Industrial Regions of Britain[5], the answer is also rather differentiated. Some sectors are clearly moving out of Traditional Industrial Regions altogether (especially pharmaceuticals, and computers, electronics and optics). The reason for this seems to be that these regions do not provide a conducive context for research & development activities and science-based innovations, on which these sectors rely. But in other sectors these emphasis is more on efficient assembly and engineering-based know-how. And these sectors – such as aerospace, motor vehicles and some defence-related manufacturing – are generally doing well and expanding in some Traditional Industrial Regions. But it should be emphasised that this is true for only some of these regions (most notably the East Midlands, and to a lesser extent in West Midlands and Wales); while there is as yet little expansion in other Traditional Industrial Regions (e.g. Yorkshire, South Western Scotland, and North East). Table 2 presents a summary.

Table 2: Trends in the geography of advanced manufacturing in Britain

	Growth sectors, expanding into new regions	*Slower growth sectors, flourishing in select regions*
Emphasis on efficient assembly and engineering-based know-how (doing well in some Traditional Industrial Regions)	• Aerospace • Automotive • Other transport equipment (excl. shipbuilding and aerospace) • Medical and dental instruments and supplies	• Machinery and equipment • Electrical equipment • Chemicals
Emphasis on research & development activities and science-based innovations (in general, moving out of Traditional Industrial Regions)	• Pharmaceuticals • Weapons and ammunition	• Computers, Electronics and Optics

Thirdly, to realise the potential that some of advanced manufacturing sectors have to contribute to spatial rebalancing, place-specific support for these sectors will be required. A key element in the approach that the government has adopted in its recent industrial strategy, is the strengthening of existing clusters and connecting these clusters to evidence presented in the extant literature. However, our research indicates that this approach needs to be qualified.

[5] Defined as regions with a share of employment in manufacturing and mining above 33.8% (i.e. more than a half standard deviation above the national average of 30.1%) in 1971. These regions (at NUTS2-level) are: Tees Valley and Durham; Greater Manchester; Lancashire; South Yorkshire; West Yorkshire; Derbyshire and Nottinghamshire; Leicestershire, Rutland and Northamptonshire; Shropshire and Staffordshire; West Midlands; West Wales and the Valleys; and South Western Scotland.

Most of the extant empirical evidence on spatial concentration in the United Kingdom has employed measures that suffer from areal unit problems. Using plant-level indices of spatial proximity derived from postcode district data, Harris et. al. (2019) investigate the extent of spatial concentration and its impact on total factor productivity in advanced manufacturing sectors in Great Britain. Separate indices of spatial concentration are calculated to take account of distances to plants in the same industry and distances to plants in 'related' industries as well as different distance decay factors. The extent to which, and where, clustering occurs is shown to vary considerably across advanced manufacturing sectors. The results from estimation of production functions indicate that, in most advanced manufacturing sectors, spatial concentration has a negative impact on productivity in small plants and a positive effect in larger plants. Large plants likely benefit more from knowledge spillovers due to their higher levels of absorptive capacity.

Appendix 1: Data and model estimated in calculating TFP

Using plant level panel data covering 2010-16 from the Annual Business Survey (ABS) conducted by the Office for National Statistics (ONS), and the methodology used by Harris and Moffat (2012, 2015a,b, 2017), estimates of total factor productivity (TFP) are obtained from estimation of log-linear Cobb-Douglas production functions (including fixed-effects) using system-GMM (Blundell and Bond, 1998) to address the issues of endogeneity inherent to production function estimation. The model is:

$$y_{it} = \alpha_i + \alpha_E e_{it} + \alpha_M m_{it} + \alpha_K k_{it} + \alpha_X X_{it} + \alpha_T t + \epsilon_{it} \quad (1)$$

where y_{it}, e_{it}, m_{it} and k_{it} refer to the natural logarithms of real gross output, employment, intermediate inputs and capital stock in plant *i* in time *t* (*i* = 1,…, *N*; *t*=1,…*T*) respectively, X_{it} is a vector of variables determining TFP (as set out in Table A.1 below) and t is a time trend. The factor inputs e_{it}, m_{it}, and k_{it} are treated as endogenous. In order to calculate TFP, equation (1) is estimated providing values of the elasticities of output with respect to factor inputs (α_E, α_M, and α_K). Logged TFP can be calculated as follows:

$$\widehat{lnTFP_{it}} = y_{it}^s - \hat{\alpha}_E e_{it} - \hat{\alpha}_M m_{it} - \hat{\alpha}_K k_{it} = \hat{\alpha}_i + \hat{\alpha}_X X_{it} + \hat{\alpha}_T t + \hat{\epsilon}_{it}^s \quad (2)$$

However, Equation (2) is not a proper TFP index, because the measure of input growth ($\hat{\alpha}_E e_{it} + \hat{\alpha}_M m_{it} + \hat{\alpha}_K k_{it}$) does not satisfy axiom X5 (proportionality) in O'Donnell (2016), except in the case of constant returns-to-scale. Proportionality is therefore restored by using a special case of the Färe-Primont (1995) input index:

$$\widehat{lnTFP_{it}^{FP}} = y_{it}^s - \frac{1}{\hat{\alpha}_E + \hat{\alpha}_M + \hat{\alpha}_K}(\hat{\alpha}_E e_{it} + \hat{\alpha}_M m_{it} + \hat{\alpha}_K k_{it}) \quad (2a)$$

Equation (1) was estimated separately for 12 industry sub-groups defined according to their technology. Industries were classified using OECD and Eurostat definitions,[6] although with some minor amendments. Table A.2 sets out the sub-groups to which industries were assigned (Electricity, Gas and Water supply, SIC40-41, and Construction, SIC45, are omitted due to a lack of data on capital stocks). All data were weighted to ensure that the samples are representative of the population of GB plants. The detailed results from estimating equation (1) are available on request and in Harris and Moffat (2019a).

The plant-level TFP estimates from equation (2a) were aggregated to provide (weighted) means[7] at three levels of geography: (i) the 11 administrative regions of Great Britain; (ii) 12 leading cities and their non-city hinterlands; and (iii) 39 English

[6] E.g. http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/Annexes/htec_esms_an3.pdf; https://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an2.pdf; and https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Knowledge-intensive_services_(KIS).

[7] Note, these are means of the plant-level estimates of TFP (weighted to ensure the ABS data is representative of the population of plants in operation in Great Britain); estimates have not been additionally weighted by each plant's share in total gross output. Doing the latter would result in an aggregate estimate of TFP (for the sub-group being considered) that also takes into account how much (gross output) each plant contributes to overall sales. In principle, it is possible that the relative values obtained could differ significantly (e.g., plants with highest TFP are also the smallest), but in reality we do not find this occurs.

LEPs (with Glasgow, Edinburgh, the rest of Scotland, and Wales added to ensure coverage of Great Britain).

Table A.1 Definitions of variables used (weighted) all sectors, 2010-2016

Variable	Definition	Mean	Std. Dev.	Source
ln gross output	*ln* real gross output (£m 2000 prices)	5.336	1.967	ABS
ln Intermediate Inputs	*ln* intermediate inputs (gross output - GVA) (£m 2000 prices)	4.361	2.356	ABS
ln Employment	*ln* numbers employed in plant	1.594	1.320	ABS
ln Capital	*ln* plant and machinery capital stock (£m 1995 prices) plus real value of plant & machinery hires. Source Harris and Drinkwater (2000, updated)	-3.568	4.033	ABS
ln Age	*ln* number of years since year of opening	1.925	0.938	ABS
Single-Plant Enterprise	Dummy coded 1 if plant comprises a single-plant enterprise	0.685	0.465	ABS
Multi-Region Enterprise	Dummy coded 1 if plant belongs to an enterprise operating plants in more than one UK region	0.291	0.454	ABS
Outward FDI	Dummy coded 1 if plant belongs to a GB or GB-registered foreign-owned firm involved in outward FDI	0.114	0.318	AFDI
GB outward FDI	Dummy coded 1 if plant belongs to a GB foreign-owned firm involved in outward FDI	0.099	0.299	AFDI
Brown-USA	Dummy coded 1 if plant is US-owned and not newly opened during 2010-2016	0.018	0.132	ABS
Brown-EU	Dummy coded 1 if plant is EU-owned and not newly opened during 2010-2016	0.032	0.177	ABS
Brown-OFO	Dummy coded 1 if plant is other country foreign-owned and not newly opened during 2010-2016	0.017	0.128	ABS
Green-USA	Dummy coded 1 if plant is US-owned and newly opened during 2010-2016	0.007	0.081	ABS
Green-EU	Dummy coded 1 if plant is EU-owned and newly opened during 2010-2016	0.014	0.117	ABS
Green-OFO	Dummy coded 1 if plant is other country foreign-owned and newly opened during 2010-2016	0.006	0.076	ABS
R&D	Dummy coded 1 if plant has positive R&D stock[a]	0.019	0.137	BERD
R&D rest enterprise	Dummy coded 1 for rest of enterprise which owns a plant with positive R&D stock	0.065	0.247	BERD
Export only	Dummy coded 1 if plant exports goods and/or services but does not import	0.049	0.217	ABS
Import only	Dummy coded 1 if plant imports goods and/or services but does not export	0.076	0.266	ABS
Export & import	Dummy coded 1 if plan t both exports and imports	0.172	0.377	ABS
Assisted area	Dummy coded 1 if plant is located in an area eligible for EU structural funds assistance	0.272	0.445	ABS
Subsidy	Dummy coded 1 if plant received a subsidy - see Harris and Moffat (2019b) for definitions	0.193	0.395	ABS
Urbanisation	Percentage of 5-digit industries located in travel-to-work (TTWA) area in which plant is located – Jacobian spillovers	-0.227	2.283	ABS
Agglomeration	Percentage of industry output (at 5-digit SIC level) located in TTWA in which plant is located – MAR spillovers	-0.462	0.223	ABS
Herfindahl Index	Herfindahl index of industry concentration (3-digit level)	-2.939	0.866	ABS
Cities	Dummy coded 1 if plant is located in major city (defined by NUTS3 code)[b]	0.244	0.429	ABS
Local Enterprise Partnership	Dummies coded 1 if plant is located in particular Local Enterprise Partnership			
Industry	Dummies coded 1 if plant is in particular 4-digit industry			
Unweighted N		1,681,652		

[a] R&D stocks are computed using the perpetual inventory method comprising adding together 1/3rd gross stock (assuming length of life of an R&D investment is 5 years) and 2/3rd net stock (assuming 20% straight-line depreciation rate)

[b] These are London, Manchester, Birmingham, Glasgow, Edinburgh, Cardiff, Tyneside, Liverpool, Bristol, Nottingham, Leicester and Coventry. Note in estimated model, separate dummies were entered for each city.

Source: Office for National Statistics (2018a, b, c)

Table A.2: Technology definitions (1992 SIC codes):

Sector	SIC code
Hi-tech manufacturing	Pharmaceuticals (SIC244); Office machinery & computers (SIC30); Radio, TV & communications equipment (SIC32); Medical & precision instruments (SIC33); Aircraft & spacecraft (SIC353).
Medium high-tech manufacturing	Chemicals (SIC24 exc. Pharmaceuticals, SIC244); Machinery & equipment (SIC29); Electrical machinery (SIC31); Motor vehicles (SIC34); Other transport equipment (SIC 35 exc. Ships & boats, SIC351, and Aircraft & spacecraft, SIC353)
Medium low-tech manufacturing	Coke & petroleum (SIC23); Rubber & plastics (SIC25); Other non-metallic (SIC26); Basic metals (SIC 27); Fabricated metals (SIC28); Ships & boats (SIC351)
Low-tech manufacturing	Food & beverages (SIC15); Tobacco (SIC16); Textiles (SIC17); Clothing (SIC18); Leather goods (SIC 19); Wood products (SIC 20); Paper products (SIC21); Publishing, printing (SIC22); Furniture and other manufacturing (SIC36); recycling (SIC37)
Hi-tech knowledge intensive (KI) services	Telecoms (SIC642); Computer & related (SIC72 exc. Maintenance & repair, SIC725); R&D (SIC73); Photographic activities (SIC7481); Motion pictures (SIC 921); Radio & TV activities (SIC922); Artistic & literary creation (SIC9231)
KI services	Water transport (SIC61); Air transport (SIC62); Legal, accountancy & consultancy (SIC741 exc. Management activities of holding companies, SIC7415); Architecture & engineering (SIC742); Technical testing (SIC 743); Advertising (SIC744)
Low KI services	Repairs (SIC50); Land transport (SIC60); Support for transport (SIC63); real estate (SIC70); Renting machinery (SIC 71); Maintenance & repair of office machines (SIC725); Management activities of holding companies (SIC7415); Labour recruitment (SIC745); Investigation services (SIC746); Industrial cleaning (SIC747); Packaging (SIC7482); Secretarial services (SIC7483); Other business services (SIC7484); Sewage & refuse (SIC90)
Other low KI services	Postal services (SIC641); Membership organisations (SIC91); Other entertainment services (SIC923 exc. Artistic & literary creation, SIC9231); News agencies (SIC924); Sporting activities (SIC926); Other recreational activities (SIC927); Other services (SIC93).
Wholesale[a]	SIC51
Specialist retail[a]	SIC522-4
Retail (part)[a]	Rest of 52 excluding specialist retail
Hotels & restaurants[a]	SIC55

[a] Usually included in 'low KI services' but estimates of equation (5) uses these separate sub-groups as the numbers of observations is otherwise very large and estimation is problematic.

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