Office for National Statistics

Article

# Firm-level labour productivity measures from the Annual Business Survey, UK: 1998 to 2019

Labour productivity firm-level experimental statistics using the Annual Business Survey. Covering non-financial business economy for the UK, 1998 to 2019.

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## Table of contents

1. Main points

2. Changes to the productivity distribution

3. Productivity by business characteristics

4. Firm-level labour productivity measures from the Annual Business Survey, Great Britain: 1998 to 2019 data

5. Glossary

6. Data sources and quality

7. Related links

# 1 . Main points

- Labour productivity varies substantially across businesses; only 30% of this variation can be accounted for by factors such as age, size, location and industry sector.
- Older firms are more productive, as are firms that are mainly based in London and the South East, firms that are foreign owned, or that engage in international trade.
- Over half of the growth in mean labour productivity between 1998 and 2019 was because of the top 10% of workers by labour productivity.
- Labour productivity growth in the period 2010 to 2019 was slower than in the period 1999 to 2007; workers between the 50th and 90th percentiles by labour productivity are the largest contributors to this slowdown.
- Labour productivity in the manufacturing sector has grown faster than services between 1998 and 2019; mainly because of a fall in the workforce at lower productivity manufacturing businesses between 1998 and 2008, while in 2019 there is still a large share of services workers in lower productivity businesses.
- Data to compare the labour productivity of businesses from our experimental statistics can be extracted using the How productive is your business interactive tool.

# 2 . Changes to the productivity distribution

For the non-financial business economy, from 1998 to 2019, mean labour productivity increased 20% from £43,500 to £52,000 approximate gross value added (aGVA) per worker in 2019 prices, as shown in Table 1. Over the same period, the median barely grew, increasing 3.4% from £29,500 to £30,500 aGVA per worker in total. The average worker has experienced little growth in productivity over the same period, while the workers at the 90th percentile — with already higher aGVA — have seen an increase of 15%. Faster growth in productivity by the frontier has lead to an increase in dispersion of productivity across the workforce. Dispersion, measured by the ratio between the 90th percentile and the 50th percentile of the productivity distribution, increased from 3.19 in 1998 to 3.56 in 2019.

Figure 1 shows the distribution of workers by productivity in more detail.

Table 1: Slow growth in productivity and widening dispersion between 1998 and 2019
Changes in the distribution of aGVA per worker in the non-financial business economy, 1998 to 2019, 2019 constant prices, UK

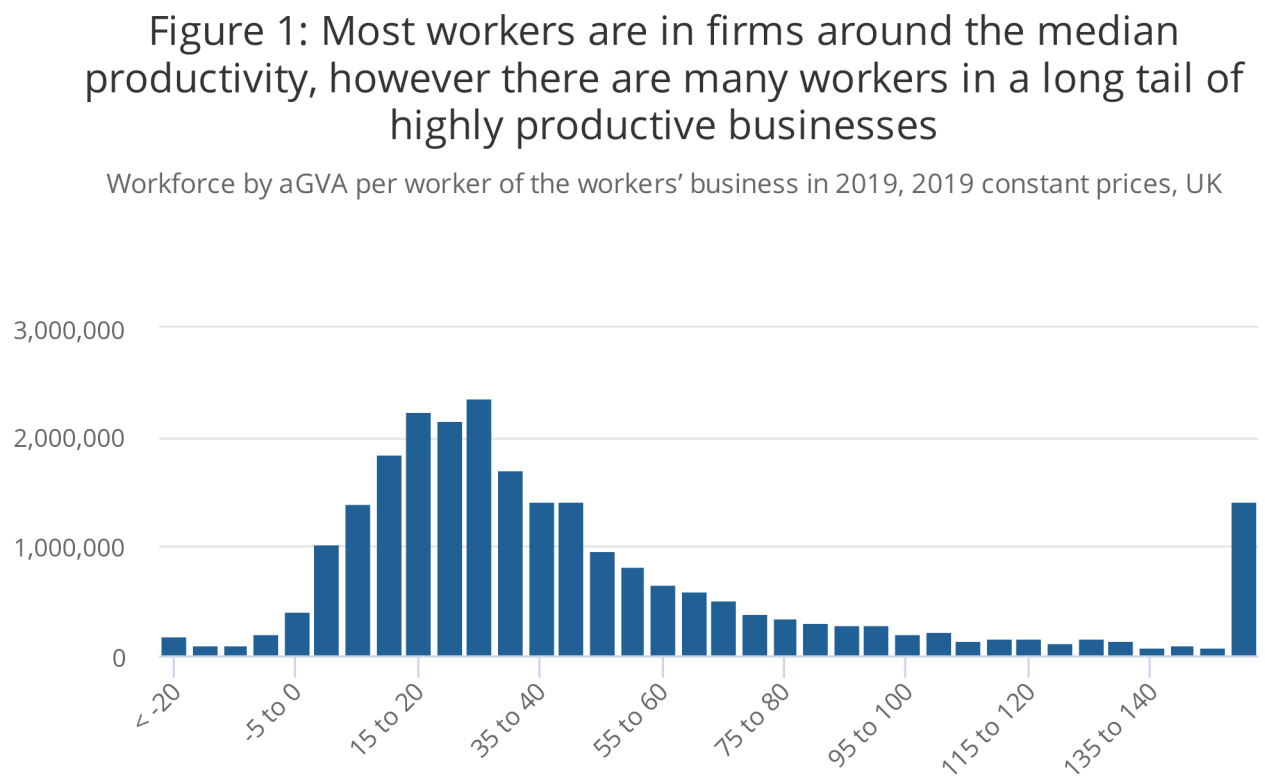
**aGVA per worker (£000)**

| Year | Mean | Median | Dispersion p90/p50 |
|---|---|---|---|
| **1998** | 43.5 | 29.5 | 3.19 |
| **2004** | 44.0 | 32.5 | 2.83 |
| **2008** | 47.0 | 29.0 | 3.48 |
| **2012** | 48.5 | 30.0 | 3.38 |
| **2015** | 52.0 | 32.0 | 3.39 |
| **2019** | 52.0 | 30.5 | 3.56 |

Source: Office for National Statistics – Annual Business Inquiry and Annual Business Survey. Northern Ireland Statistics and Research Agency – Northern Ireland Annual Business Inquiry

**Figure 1: Most workers are in firms around the median productivity, however there are many workers in a long tail of highly productive businesses**

**Workforce by aGVA per worker of the workers' business in 2019, 2019 constant prices, UK**



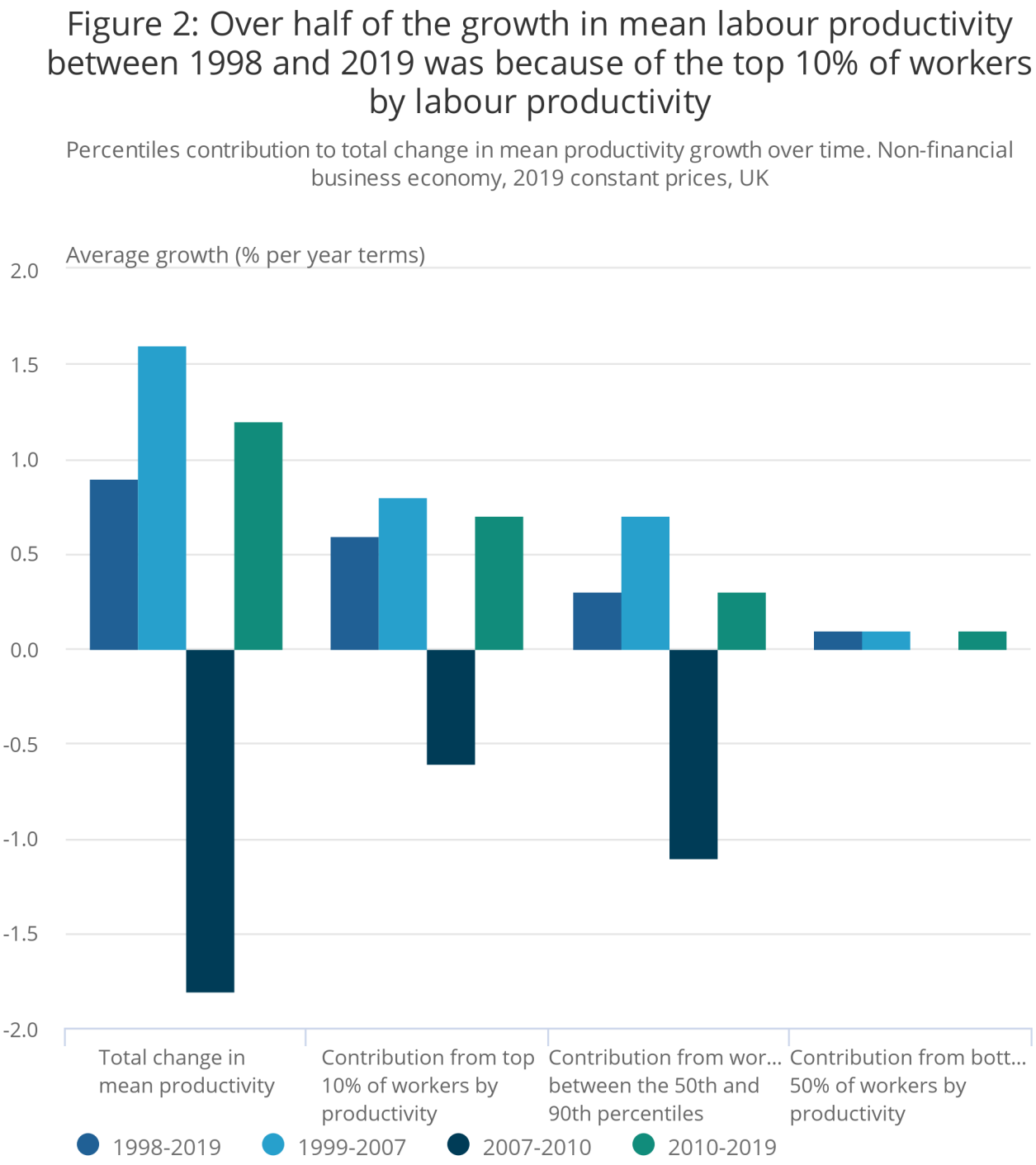

**Source: Office for National Statistics – Annual Business Inquiry and Annual Business Survey. Northern Ireland Statistics and Research Agency – Northern Ireland Annual Business Inquiry**

Figure 2 shows the contribution to growth from different parts of the productivity distribution. The group of bars on the left show total change in mean productivity, broken down across different time periods. The group of bars on the right show the contributions from the top 10% of workers by productivity, the middle 40%, and the bottom 50% of workers, in each time period.

Workers in the top 10% of the productivity distribution contributed 61% of the total growth in productivity between 1998 and 2019. For 1999 to 2007, the top 10% of workers contributed the same amount to total growth as the bottom 90% contributed. For 2010 to 2019, the contribution of the top 10% of workers increased to 63% and the bottom 90% contribution fell to 37%, mainly because of the 40% of workers between the 50th and 90th percentiles.

**Figure 2: Over half of the growth in mean labour productivity between 1998 and 2019 was because of the top 10% of workers by labour productivity**

**Percentiles contribution to total change in mean productivity growth over time. Non-financial business economy, 2019 constant prices, UK**




**Source: Office for National Statistics – Annual Business Inquiry and Annual Business Survey. Northern Ireland Statistics and Research Agency – Northern Ireland Annual Business Inquiry**

**Notes:**

1. Figure 2 represents the average of the annual growth rates of the different periods
2. Figure 2 percentages may not sum up due to rounding

Table 2 disaggregates the total Annual Business Survey (ABS) distribution by high-level industry classification to illustrate the changes of the industry composition during the last 22 years. Figure 3 shows more detail about the workers in manufacturing and non-financial market services specifically, for different levels of productivity.

Table 2: Manufacturing has experienced the largest improvement in productivity
Changes in the distribution of aGVA per worker in the non-financial business economy – high level industry sectors, 2019 constant prices, UK

**aGVA per worker (£000)**

| | **Manufacturing** | | | **Construction** | | |
|---|---|---|---|---|---|---|
| **Year** | **Mean** | **Median** | **Dispersion(p90/p50)** | **Mean** | **Median** | **Dispersion(p90/p50)** |
| **1998** | 37.0 | 25.0 | 3.2 | 77.5 | 57.5 | 2.7 |
| **2005** | 54.0 | 39.5 | 2.8 | 70.5 | 51.5 | 2.6 |
| **2012** | 64.0 | 47.5 | 2.9 | 71.0 | 50.0 | 2.7 |
| **2019** | 66.0 | 50.5 | 2.6 | 73.5 | 46.5 | 2.7 |
| | Non-Financial Market Services | | | Non-Market Services | | |
| **Year** | Mean | Median | Dispersion(p90/p50) | Mean | Median | Dispersion(p90/p50) |
| **1998** | 42.5 | 30.5 | 3.0 | 28.5 | 23.0 | 2.9 |
| **2005** | 43.0 | 30.0 | 3.0 | 24.0 | 19.5 | 3.2 |
| **2012** | 47.5 | 29.5 | 3.4 | 21.5 | 19.0 | 2.5 |
| **2019** | 51.5 | 30.0 | 3.7 | 23.5 | 20.5 | 2.3 |

Source: Office for National Statistics – Annual Business Inquiry and Annual Business Survey. Northern Ireland Statistics and Research Agency – Northern Ireland Annual Business Inquiry

Manufacturing has evolved in the opposite direction to services. The sector has shrunk from approximately 4 million workers to 2.5 million workers between 1998 and 2019. These workers were mainly in lower productivity businesses, causing mean and median labour productivity to strongly increase for the manufacturing sector. This decline is a trend that started well before our dataset starts in 1998, however even after 1998, the decline is still substantial. The decline in workforce bottoms out in 2008, after which productivity grew more slowly.

The mean labour productivity of non-financial market services industry increased 21% from £42,500 to £51,500 of output per worker since 1998, while the mean of the non-market services decreased 17.5%. These two services sectors, combined, dominate the whole economy, but have differed in productivity growth since 1998. The number of workers in the non-financial market services sector has increased strongly since 1998. As shown in Figure 3, the increase is mainly in lower productivity firms, such that the median labour productivity has seen no growth from 1998 to 2019.

## Figure 3: Declining number of workers in manufacturing, rise in number of workers for services but in lower productivity firms

Workers by aGVA per worker of the workers' business, 1998 and 2019. Non-financial business economy, 2019 constant prices, UK

**Download the data**

.xlsx

# 3 . Productivity by business characteristics

Larger and older firms are more productive, as are firms mainly located in London and the South East, and firms that have international links in terms of foreign ownership or engagement in international trade.

We use regression analysis to control for composition effects, such as older firms also being larger, and different regions having different industry mixes. Table 3 and Figures 4 and 5, show regressions of labour productivity based on a firm's characteristics, controlling for year and industry fixed effects.

Many large firms have workers spread across the UK, and even if the modal region for their workforce is London, the South East or another region, most of their workforce is distributed more evenly. Comparing model 1 with model 2, we group firms that are effectively "inter-regional" separately, using a criterion of having more than 40% of its workforce outside of its largest region or country. Inter-regional firms account for 28% of the workforce in our data, on this measure.

With the region groupings in model 2, the productivity advantage of London relative to the control region of the East Midlands, is slightly higher at 33%, rather than 25% when classifying the inter-regional firms separately. While less productive than predominantly London firms, inter-regional firms are still highly productive. The regressions control for the size of the firm. Even accounting for (usually) being a larger firm, being inter-regional is associated with a 17% premium in labour productivity.

Most of the differences in labour productivity between the other region groupings are small, with either no statistical significance or only a small degree. The exceptions are Wales and the North East. However, in the final specifications in models 3 and 4, which take into account more detailed international links, these effects are also smaller.

Table 3a: Businesses that are larger, older, mainly located in London and the South East, foreign owned and trade internationally are more productive on average

Conditional analysis of the relationship between aGVA per worker productivity and business characteristics, 2019 constant prices, UK

| | (1) | |
|---|---|---|
| **Employment polynomial** | (figure 4) | |
| **Age polynomial** | (figure 5) | |
| **Modal location:** | | |
| **North East** | -0.05 | (0.03) |
| **North West** | 0.01 | (0.02) |
| **Yorkshire & Humber** | -0.02 | (0.02) |
| **West Midlands** | -0.01 | (0.03) |
| **East England** | 0.04* | (0.02) |
| **London** | 0.25*** | (0.03) |
| **South East** | 0.16*** | (0.02) |
| **South West** | -0.02 | (0.02) |
| **Wales** | -0.08*** | (0.02) |
| **Scotland** | 0.01 | (0.02) |
| **Northern Ireland** | -0.02 | (0.02) |
| **Foreign owned** | 0.19*** | (0.02) |
| **Fixed effects:** | | |
| **Year** | Yes | |
| **2-digit industry** | Yes | |
| **N** | 995,189 | |
| **R^2** | 0.242 | |

Source: Office for National Statistics – Annual Business Inquiry and Annual Business Survey. Northern Ireland Statistics and Research Agency – Northern Ireland Annual Business Inquiry

Table 3b: Businesses that are larger, older, mainly located in London and the South East, foreign owned and trade internationally are more productive on average

Conditional analysis of the relationship between aGVA per worker productivity and business characteristics, 2019 constant prices, UK

| | (2) | | (3) | | (4) | |
|---|---|---|---|---|---|---|
| **Employment polynomial** | **(figure 4)** | | **(figure 4)** | | **(figure 4)** | |
| **Age polynomial** | **(figure 5)** | | **(figure 5)** | | **(figure 5)** | |
| **Location singly or predominantly:** | | | | | | |
| **North East** | -0.06** | (0.02) | -0.02 | (0.03) | -0.02 | (0.03) |
| **North West** | 0.01 | (0.02) | 0.03 | (0.02) | 0.03 | (0.02) |
| **Yorkshire & Humber** | -0.03* | (0.02) | -0.02 | (0.02) | -0.02 | (0.02) |
| **West Midlands** | -0.02 | (0.02) | 0.00 | (0.02) | 0.00 | (0.02) |
| **East England** | 0.04* | (0.02) | 0.03 | (0.02) | 0.03 | (0.02) |
| **London** | 0.33*** | (0.02) | 0.31*** | (0.02) | 0.31*** | (0.02) |
| **South East** | 0.12*** | (0.01) | 0.12*** | (0.02) | 0.12*** | (0.02) |
| **South West** | -0.01 | (0.02) | -0.02 | (0.02) | -0.02 | (0.02) |
| **Wales** | -0.09*** | (0.02) | -0.06* | (0.02) | -0.06* | (0.02) |
| **Scotland** | 0.02 | (0.02) | 0.04* | (0.02) | 0.04* | (0.02) |
| **Northern Ireland** | -0.00 | (0.02) | | | | |
| **Inter-regional** | 0.17*** | (0.03) | 0.08** | (0.03) | 0.09** | (0.03) |
| **Foreign owned** | 0.18*** | (0.02) | | | | |
| **Foreign owned - EU** | | | 0.13*** | (0.04) | 0.13** | (0.04) |
| **Foreign owned - non-EU** | | | 0.20*** | (0.03) | 0.18*** | (0.03) |
| **Goods importer and/or exporter** | | | 0.18*** | (0.02) | | |
| **Services importer and/or exporter** | | | 0.25*** | (0.02) | | |
| **Goods exporter** | | | | | 0.08** | (0.03) |
| **Goods importer** | | | | | 0.14*** | (0.03) |
| **Services exporter** | | | | | 0.22*** | (0.02) |
| **Services importer** | | | | | 0.10*** | (0.02) |
| **Fixed effects:** | | | | | | |
| **Year** | Yes | | Yes | | Yes | |
| **2-digit industry** | Yes | | Yes | | Yes | |
| **N** | 995,189 | | 250,788 | | 250,210 | |
| **R^2** | 0.243 | | 0.294 | | 0.295 | |

Source: Office for National Statistics – Annual Business Inquiry and Annual Business Survey. Northern Ireland Statistics and Research Agency – Northern Ireland Annual Business Inquiry

Notes

1. Standard errors in parentheses, * p < 0.1, ** p < 0.05, *** p < 0.01

2. Location is based on share of a firm's workforce across regions. "Modal East Midlands" and "singly or predominantly in the East Midlands" are the baseline regions.

3. Models 3 and 4 only include 2013 to 2019, and exclude Northern Ireland. Data on trade in goods is only available from 2013 in Great Britain, while the Northern Ireland ABI does not survey trade.

4. Employment and age are controlled for in the regression models, however the effects are modelled as a non-linear effect and show in Figure 4. The effects were modelled using a fractional polynomial

5. The regressions are weighted by survey sample weights and by business employment, to be representative of the workforce

The relationship between labour productivity and age is non-linear, as shown in Figure 4. Productivity increases as a new firm grows older, up to about aged seven years, when the average effect tends to plateau.

Similarly, while an average worker at a medium or large firm is more productive than an average worker at a small firm, beyond a certain size, on average, there are small or no differences in productivity.

### Figure 4: The effect of age on productivity is non-linear, with the greatest effect occurring in the first five years

**Effect of age from model 2 in Table 3, 2019 constant prices, UK**

**Source: Office for National Statistics – Annual Business Survey Northern Ireland Statistics – Annual Business Inquiry**

**Notes:**

1. Non-linear effect calculated using a fractional polynomial. The effect is qualitatively similar across the models in Table 3.

### Figure 5: The effect of number of workers on productivity is non-linear

**Effect of number of workers from model 2 in Table 3, 2019 constant prices, UK**

**Source: Office for National Statistics – Annual Business Survey Northern Ireland Statistics – Annual Business Inquiry**

**Notes:**

1. Non-linear effect calculated using a fractional polynomial. The effect is qualitatively similar across the models in Table 3.

While Figure 5 shows the average effect for the dataset as a whole, the relationship between size and productivity varies depending on the industry sector. Figure 6 repeats model 2 for individual industry sections. Manufacturing has more visible economies of scale, and the relationship between firm size and productivity holds even between large and larger firms. Some services industry sections have weaker relationships, and for professional, scientific and technical services there is little difference in productivity between small and large firms, only a negative effect for firms with fewer than 10 workers.

**Figure 6: Effect of number of workers on productivity are non-linear. Manufacturing has more visible economies of scale**

**Effect of number of workers on productivity, selected industry sections, 2019 constant prices, UK**

**Source: Office for National Statistics – Annual Business Survey Northern Ireland Statistics – Annual**

**Notes:**

1. Non-linear effect calculated using a fractional polynomial. The specification from model 2 in Table 3 was repeated, restricting data to each industry section. The effects are qualitatively similar for the different model specifications.

This regression analysis can only show correlations and not causal effects. A very motivated entrepreneur might found their business in the South East, in order to benefit from knowledge spillover from other local firms. The entrepreneur may still end up with a high productivity firm even if they were to choose a different region, because, being motivated, they are likely to take other steps to improve productivity regardless of location. Researchers are able to find causal effects working in both directions. Spillovers that occur to a firm by accident can still raise productivity (examples can be found in Greenstone and others, 2010, Identifying Agglomeration Spillovers: Evidence from Winner and Losers of Large Plant Openings). The higher productivity of international traders is well established, for example in Wales and others (2018), UK Trade in Goods and Productivity: New Findings. However, De Loecker (2013) Detecting Learning by Exporting also presents evidence that firms learn from the experience of exporting and increase productivity because of being a trader.

# 4 . Firm-level labour productivity measures from the Annual Business Survey, Great Britain: 1998 to 2019 data

# 5 . Glossary

## Labour productivity

Labour productivity is calculated by dividing output by labour input.

## Non-financial market services

Businesses within the sectors of retail, administrative support and services, transport and storage, accommodation and food, information and communication, real estate and professional, scientific and technical.

## Approximate gross value added (aGVA)

The Annual Business Survey (ABS) provides information on turnover and intermediate purchases, which can be used to estimate businesses' approximate gross value added (aGVA). It is a measure of the income generated by those surveyed, less their intermediate consumption of goods and services used up in order to produce their output.

# 6 . Data sources and quality

## Data sources

We combine data from the Annual Business Inquiry (1998 to 2008), Annual Business Survey (2008 to 2019) and Northern Ireland Annual Business Inquiry (1998 to 2019). These are the UK's main structural business surveys — comprising 55,000 responses per year from a representative sample of businesses to cover approximately two-thirds of the UK economy. The structural business surveys are designed to feed into gross domestic products (GDP) and the National Accounts, alongside a variety of other data sources. These datasets also provide approximate gross value added (aGVA) at the business level labour productivity calculated as aGVA divided by the number of workers at the business. While this allows us to look at the distribution of productivity at a high level of granularity, this also introduces volatility as the statistics are based on a sample that partially rotates from year to year.

## Sample

The surveys are sampled using the Inter-Departmental Business Register (IDBR), from which we take business-level employment, industry code, age and foreign ownership information. The IDBR in turn is maintained using a variety of survey, tax, administrative and commercial data.

## Methodology

The data covers the business economy, excluding the public sector, finance, farms and the self-employed. Standard Industrial Classifications (SIC) 1992 and 2003 codes from before 2007 have been converted using a modal mapping at five-digit level. For large business non-responders, the Office for National Statistics (ONS) carries out ratio imputation in each survey year, as described in the Annual Business Survey Technical Report. For this article, the Annual Business Inquiry imputations have been recalculated using the history of the business now available retrospectively.

AGVA per worker is a ratio that often has a small denominator. This can magnify any errors in the gross value added (aGVA) data and distort the statistics. We remove the top and bottom 1% of responses by aGVA per worker within each year and grouping variable, before calculating means and distribution statistics.

Results in this article are presented on a constant prices basis, base year 2019. Following the implementation of double deflation on labour productivity: 1997 to 2018, industry volume estimates of GDP, and current price and volume estimates of GDP we use implicit price deflators calculated from the GDP output accounts. The price deflators were calculated at the lowest level of industry aggregation used in the national accounts, which is mostly the two-digit SIC level.

In this article results are weighted to be representative of workers in the business economy. First, the sample is weighted to be representative of the whole population of businesses, using survey design weights. Then each business is additionally weighted by its workforce size, for example a factory with 1,000 workers has 200 times more weight than a small workshop with five workers. In our dataset in 2019, approximately half of workers were in firms with 250 workers or more, even though there were only 9,200 firms of this size out of approximate 2.5 million businesses in total.

The Business Register Employment Survey collects data on the number of workers at each site of a business, across the UK. This provides different options for classifying a business by location. In model 1 in Table 3 we use the region or nation where the business has the most workers. However, many large businesses are effectively cross-UK. Often London or the South East are the largest region for the business, even if London or the South East each only make up less than 15% of the business's workforce. For the other models, we deem a business as "inter-regional" if more than 40% of a business's workforce was outside its largest region or nation.

Table 4 shows the distribution of businesses by their geographic footprint.

Table 4: Businesses that are located predominantly in one region follow the typical regional productivity patterns. 2019 constant prices, UK

| Business location | Share of workers - 2019 | Mean a/GVA worker - 1998 | Mean a/GVA worker - 2019 |
|---|---|---|---|
| **Inter-regional:** | 28% | 45.5 | 46.5 |
| **Singly or predominantly:** | | | |
| **North East** | 2% | 36.0 | 43.5 |
| **North West** | 8% | 39.0 | 49.0 |
| **Yorkshire & Humber** | 5% | 36.5 | 39.5 |
| **East Midlands** | 5% | 39.0 | 40.5 |
| **West Midlands** | 6% | 36.0 | 50.0 |
| **East England** | 7% | 44.5 | 46.5 |
| **London** | 12% | 62.5 | 80.0 |
| **South East** | 10% | 50.5 | 56.5 |
| **South West** | 6% | 37.0 | 38.5 |
| **Wales** | 2% | 33.5 | 41.5 |
| **Scotland** | 5% | 38.5 | 48.5 |
| **Northern Ireland** | 3% | 32.5 | 44.0 |

Source: Office for National Statistics – Annual Business Inquiry and Annual Business Survey. Northern Ireland Statistics and Research Agency – Northern Ireland Annual Business Inquiry

Notes

1. This table shows statistics from groupings of businesses. This is not a substitute for regional productivity figures which are compiled to be consistent with National Accounts.

2. The dataset covers the non-financial business economy, so this analysis excludes the public sector, finance industry, farms and the self-employed.

It is possible to carry out more detailed analysis of the relationship between business productivity and geography, using the data on business sites ("local units"). Site, or local unit data, allows more comprehensive analysis on equivalised terms across businesses of different sizes, at a lower level. However, the cost of more granular analysis is that the survey data are still captured at the reporting unit level. Survey data values for a business must be apportioned to the business's local unit level, which adds an extra layer of statistical error.

For this article on general trends and correlates we use reporting unit-level data, and a high-level geographic classification.

The vast majority of enterprises are surveyed as whole enterprises. In our data, about 400 large enterprises are divided into "reporting units", which are the basis for the ONS' business survey sampling. These are usually divided into two or three parts (such as retail and non-retail, where the retail part receives retail-specific business surveys). In 2019, 5% of workers were in businesses split into multiple reporting units. As these are a small minority of enterprises, throughout, we refer to "firm" or "business" even though the unit of data is reporting unit.

# 7 . Related links

Productivity overview, UK: July to September 2021
Article | Released 11 January 2022
The main findings from the official statistics and analysis of UK productivity, presenting a summary of recent developments.

Firm-level labour productivity measures from the Annual Business Survey, Great Britain: 1998 to 2018
Article | Released 1 June 2020
Experimental Statistics on labour productivity at the firm level using the Annual Business Survey (ABS), by detailed combinations of firm characteristics. The statistics cover the non-financial business economy for Great Britain, 1998 to 2018.

Management practices and innovation, Great Britain
Article | Released 23 August 2021
Using firm-level survey data, we explore the repaltionship between management practices and innovative activity, including formal research and development.

UK trade in goods and productivity: New findings
Article | Released 6 July 2018
This research paper uses HM Revenue and Customs' administrative trade to analyse the link between productivity and trader status for British businesses.

Foreign direct investment (FDI) and labour productivity, a micro-data perspective: 2012 to 2015
Article | Released 6 October 2017
Examines the composition of firms with Foreign Direct Investment (FDI) in Great Britain between 2012 and 2015, and their productivity outcomes compared with firms with no FDI.

Understanding firms in the bottom 10% of the labour productivity distribution in Great Britain: "the laggards", 2003 to 2015
Article | Released 5 July 2017
This article uses firm-level data from the ABS to analyse the characteristics of firms in the bottom 10% of the labour productivity distribution in Great Britain between 2003 and 2015.

Annual Business Survey technical report: August 2018 Methodology | Released 24 August 2018
The technical report for the Annual Business Survey, providing detailed quality and methodology information.