

The Changing Shape of UK Manufacturing

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Abstract

The contribution of the manufacturing industry to the UK economy has changed markedly over the last 60 years. On average, output in the industry has grown by 1.4% a year since 1948, although it has contracted around the economic downturns in the 1970s and early 1990s, and most recently and notably during the 2008-9 economic downturn. But output growth has been at a slower rate than that for the whole economy, and as a consequence the proportion of whole economy Gross Value Added (GVA) accounted for by manufacturing has fallen since the early 1950s. The change in manufacturing output over the long term is determined primarily by changes in its principle factors of production: labour and capital. An increase in either of these factors will tend to lead to an increase in output – however higher manufacturing output has been achieved despite a steady fall in the number of jobs and broadly stable capital stock. Therefore over this period labour productivity, as measured by output per labour hour worked, has increased. In other words, the manufacturing industry has become more productive. This article will analyse several potential reasons for the increase in manufacturing productivity over the long term such as: a better quality workforce; an improvement in the information technology base; a change in the composition of the UK manufacturing industry; more investment in research and development; capital deepening; and a more integrated global economy. These factors are intended to inform and encourage the debate around changes in manufacturing productivity rather than provide a comprehensive and definitive explanation.

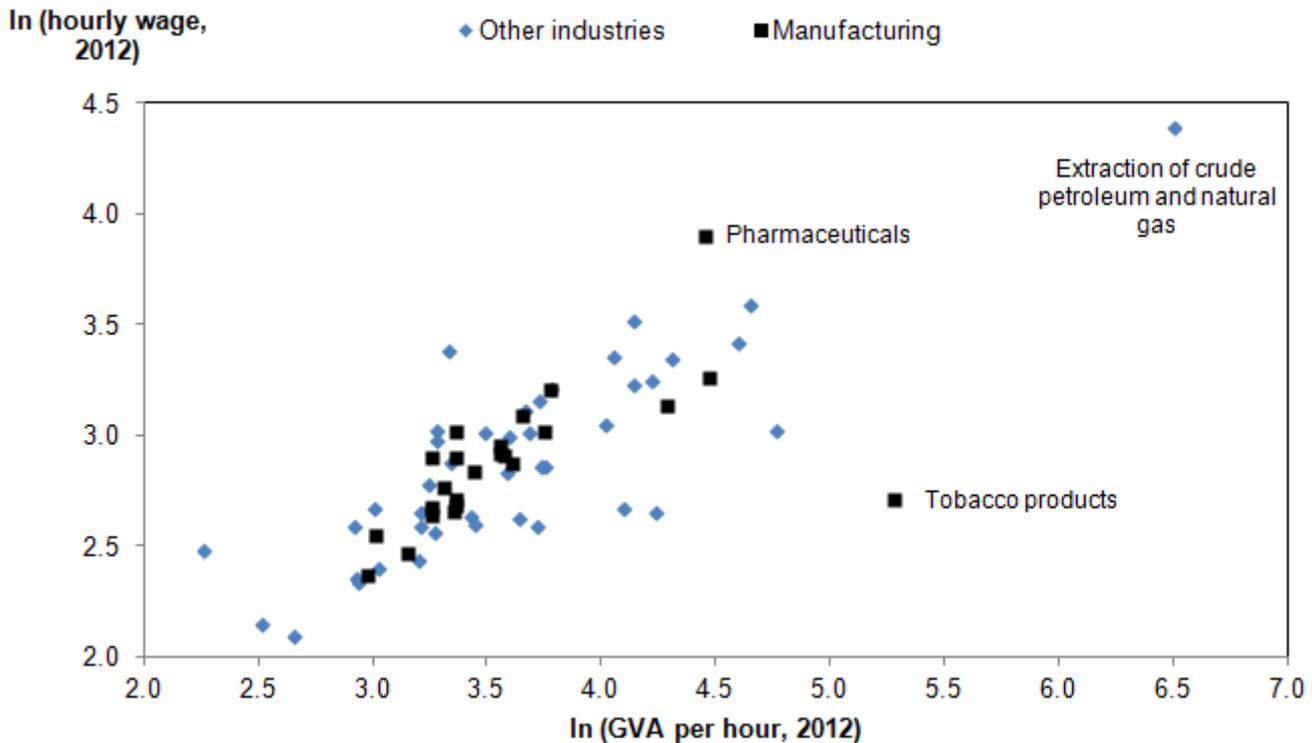
Acknowledgements

1. The authors would like to acknowledge input from Joseph Murphy, Ian Derrick, Phil Wales, Sophie Moir, Matthew Power, Heather Bovill and Chris Kevany.

Why is productivity important?

Productivity is important as it is generally associated with higher wages and therefore higher living standards, particularly over the long term. The relationship between these two variables can be seen when analysing the relationship between the level of Gross Value Added (GVA) per hour and hourly wages for a variety of manufacturing sub-industries. Manufacturing industries with a high GVA per hour and therefore high productivity generally pay a higher wage than those with low GVA per hour and low productivity. For example the pharmaceutical sub-industry is one of the most productive within manufacturing and pays the highest hourly wage. However, despite being more productive the tobacco industry pays a lower wage, although this is one of the few outliers.

Figure 1: Current price Gross Value Added per hour and hourly wage, 2012



Notes:

1. Source: Labour Productivity

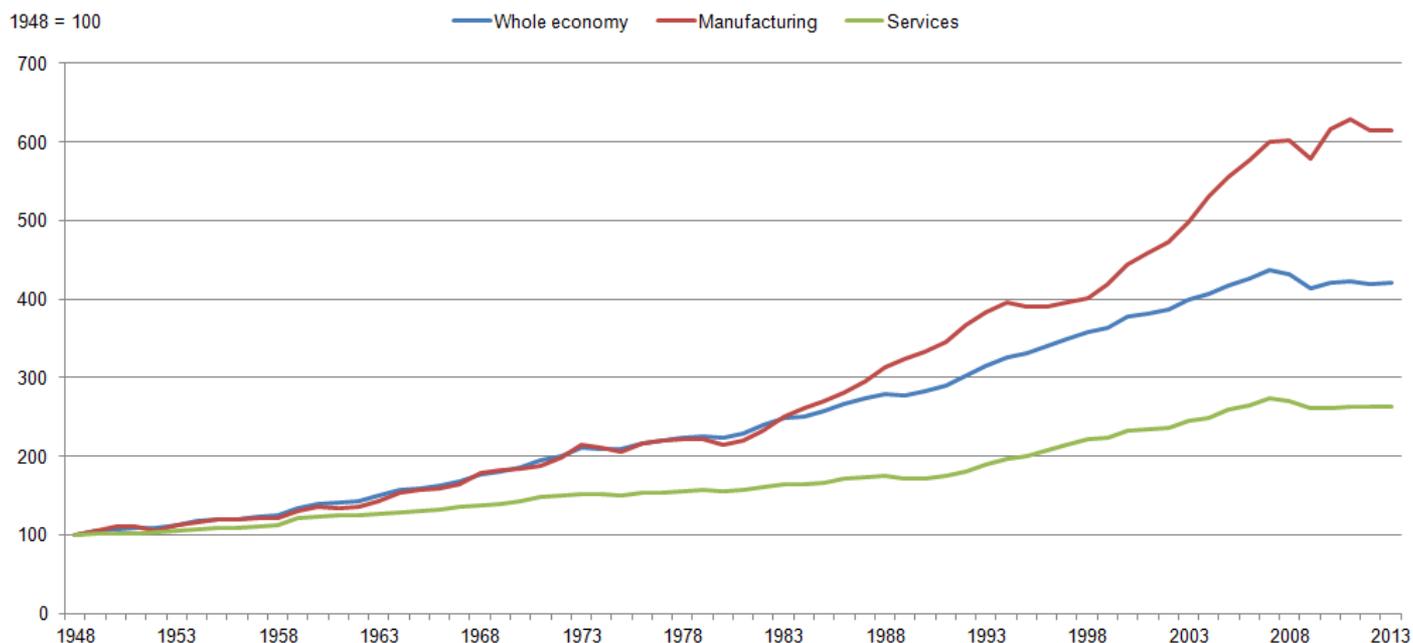
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Manufacturing productivity over the long term

Manufacturing productivity has grown by 2.8% on average per annum since 1948 – compared with 1.5% in the services industry. The 2008-09 economic downturn resulted in heavy declines in productivity in both manufacturing and services, neither of which have recovered to pre-crisis trend growth rates. Figure 2 shows the impact is greater for manufacturing, but nevertheless, over the long term, manufacturing productivity continues to compare favourably to that in the services industry and the economy as a whole.

Figure 2: Labour productivity 1948-2013**Notes:**

1. Source: Labour Productivity (ONS)

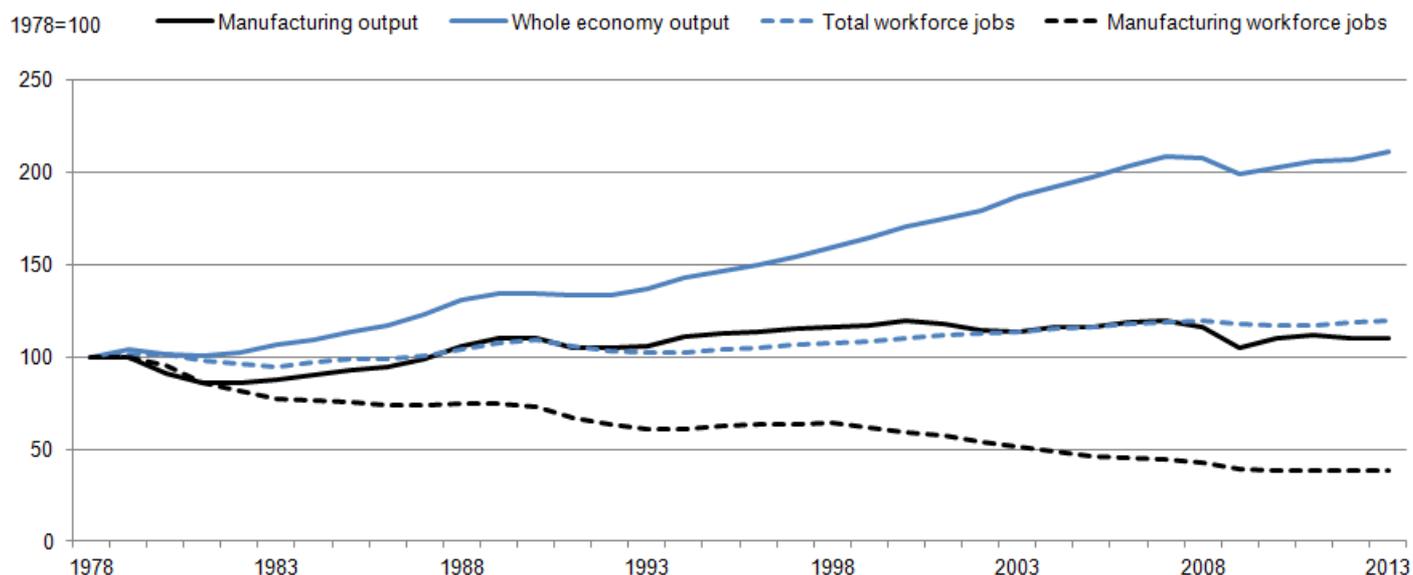
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Figure 3 shows that gains in manufacturing productivity can be decomposed into two aspects: fairly consistent but slow output growth coinciding with a sharp reduction in jobs. In contrast, output growth in the whole economy has been stronger but jobs have also grown over the period, resulting in productivity growth being more subdued.

Figure 3: Whole economy and manufacturing output, employment and productivity, 1978 - 2013



Notes:

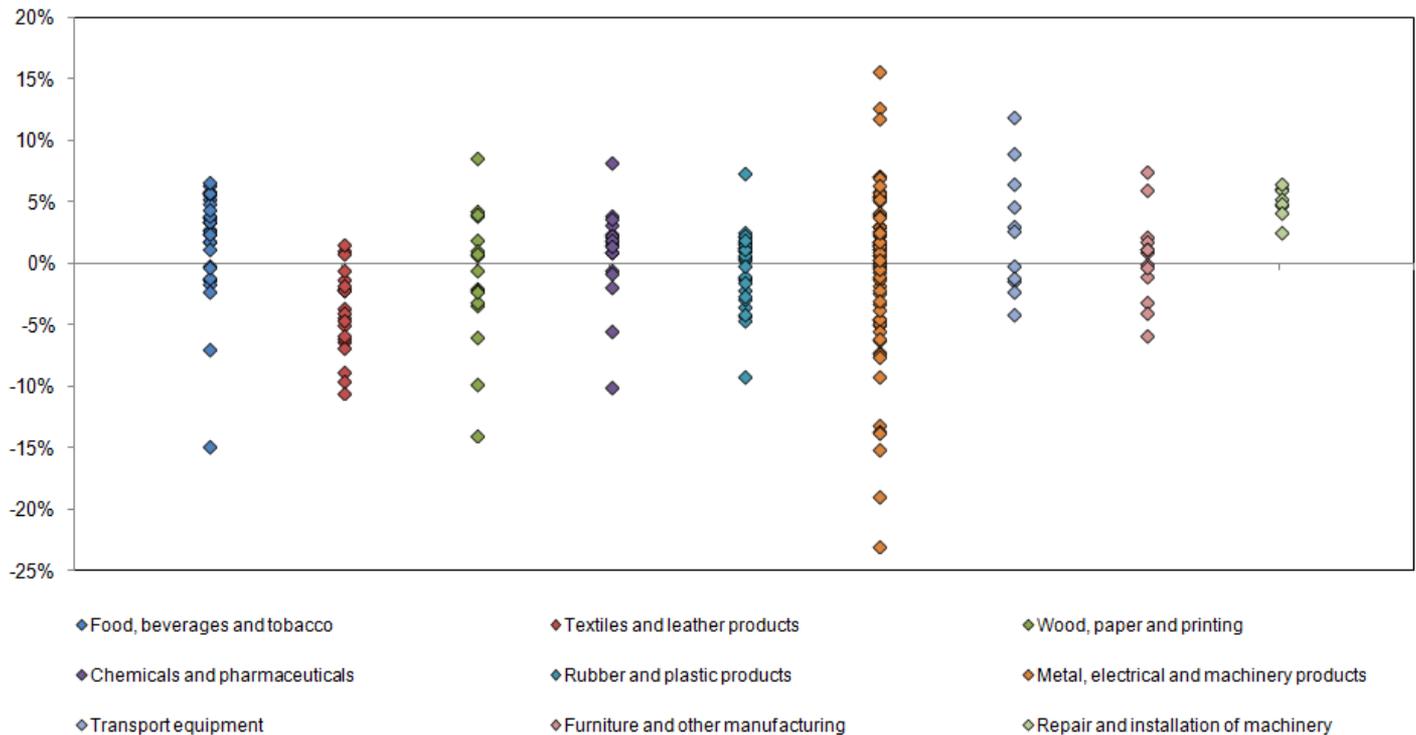
1. Source: Index of Production (ONS), Gross Domestic Product (ONS) & Labour Market Statistics (ONS)

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A more detailed analysis of manufacturing output can be undertaken by using PRODCOM sales data, which are available for 240 sub-industries and closely relate to output data. Figure 4 presents the growth in PRODCOM sales for a range of manufacturing sub-industries – for example the orange cluster of dots represents average annual PRODCOM sales growth in the 73 sub-industries of the manufacture of metal, electrical and machinery products between 2002 and 2013. Within the industry the casting of steel has grown by 15.7% between 2002 and 2013, while the casting of other non-ferrous metals has fallen by 22.9%. This range of growth in the manufacture of metal products is indicative of other manufacturing sub-industries, and highlights large disparities in manufacturing sales performance across sub-industries. Despite manufacturing growth being fairly consistent but slow at an aggregate level – certain areas of the manufacturing industry have experienced strong average annual growth between 2002 and 2013, and others have not.

Figure 4: PRODUCTION COMMUNAUTAIRE (PRODCOM) sales growth, average annual growth, 2002 - 2013



Notes:

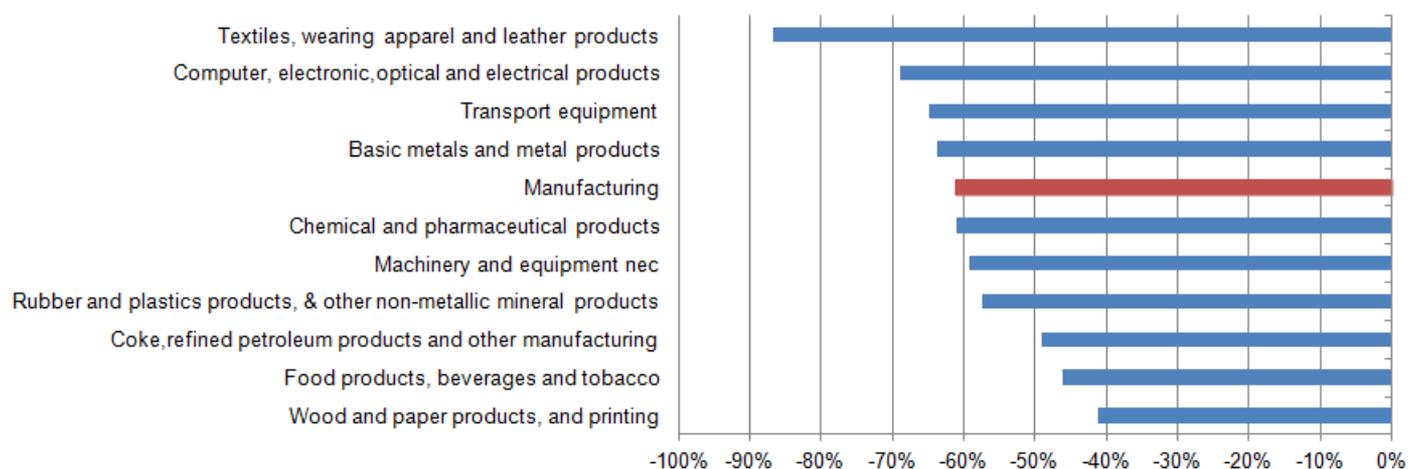
1. Source: UK Manufacturers' Sales by product PRODCOM

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Jobs have reduced markedly across all manufacturing sub-industries since 1978. The falls in jobs in textiles have been particularly strong – with a reduction of over 80% in jobs between 1979 and 2013 (Figure 5). Jobs in the ‘wood and paper’ sub-industry has been the most resilient of the manufacturing sub-industries, falling 40%, although this is still large when compared to most services sub-industries, which have mainly increased jobs over the period.

Figure 5: Reduction in jobs between 1979 and 2013 (%)**Notes:**

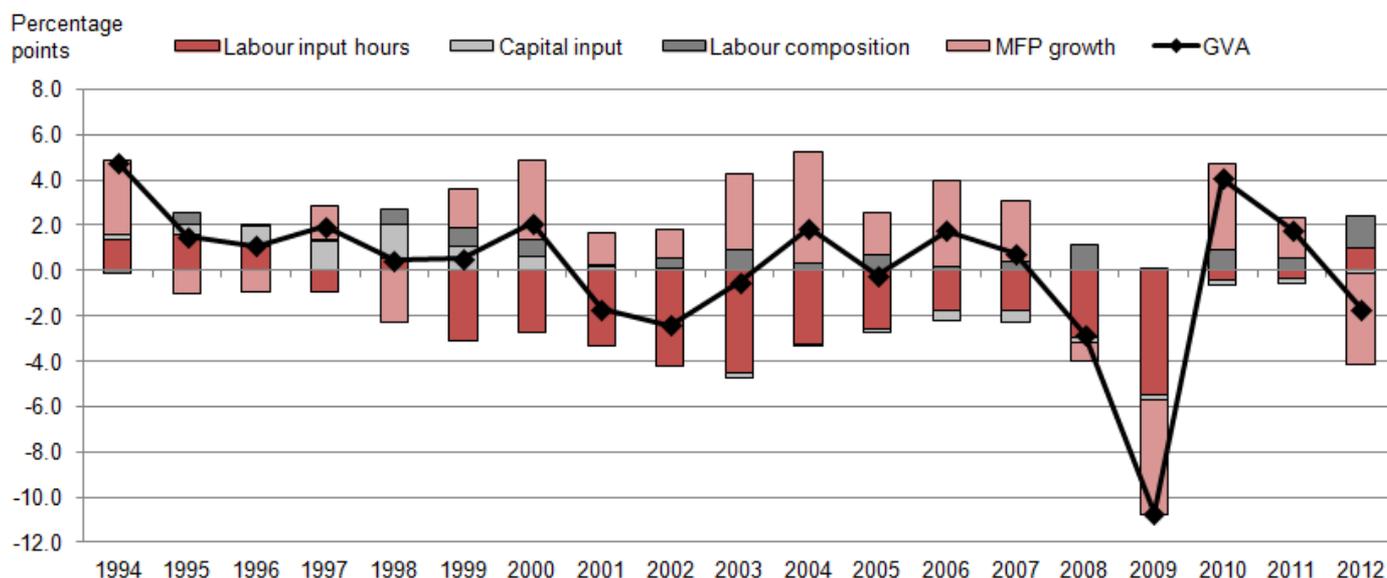
1. Source: Labour Productivity Statistics (ONS)

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Changes in labour input have consistently acted as a drag on manufacturing output growth due to the falling number of hours worked within the industry – this can be seen by the dark red bars in Figure 6. This partly reflects the changing composition of the UK manufacturing industry – a more capital intensive and efficient production process, and outsourcing of low technical manufacturing to developing economies may both have impacted the number of people employed in the industry. In contrast, changes in capital input – generally shows a small but positive contribution to output growth. However, a range of other factors can affect manufacturing output: these are split into labour composition (improvements to the skill set and experience of the workforce) and multifactor productivity (increases in productivity that cannot be attributed to either changes in capital or labour input – for example improvements in the underlying production technology, or the way in which the combined factors of production are used in the production process).

Figure 6: Contributions to change in Gross Value Added, 1994-2012**Notes:**

1. Source: Multi-factor Productivity (ONS)

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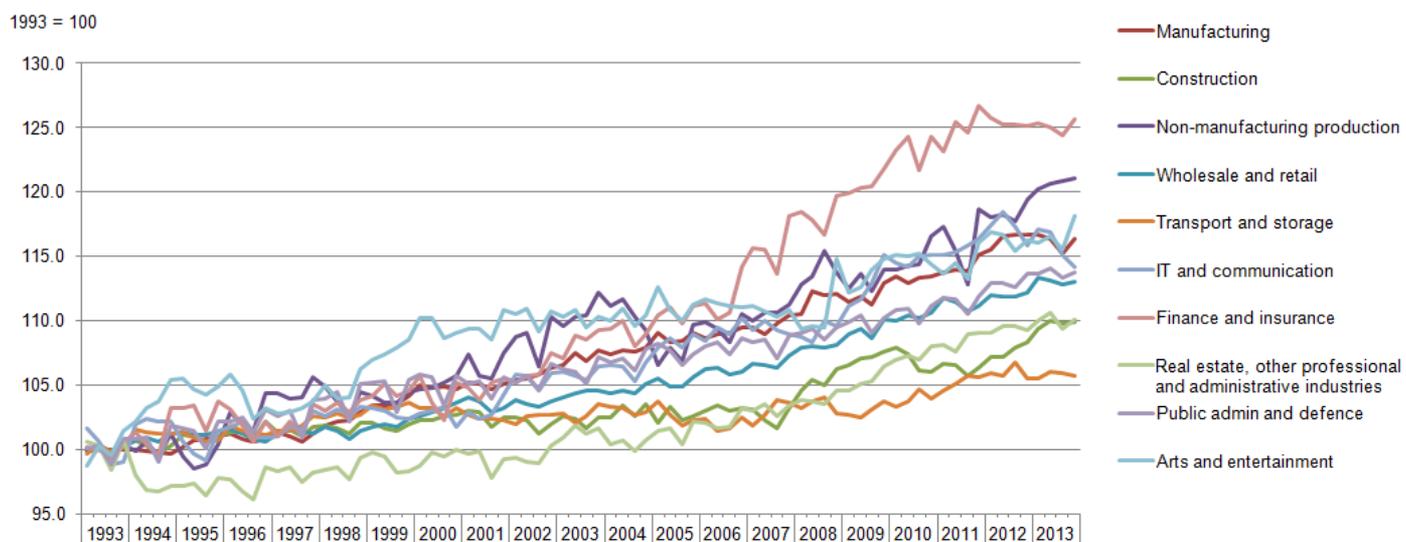
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Potential factors that have impacted manufacturing productivity

The strength in manufacturing productivity in the United Kingdom can possibly be explained by a number of factors. The factors discussed in this article are intended to inform and encourage the debate around manufacturing productivity, rather than provide a comprehensive and definitive explanation. Many of these are as a result of a more globalised and integrated world economy and are evident in other developed economies that are similar to the United Kingdom.

Labour Quality

Labour quality is captured in ONS published Quality Adjusted Labour Input (QALI) data – and includes qualifications attained by workers in the industry and their experience, age is used as a proxy for the latter. Despite falling employment in the manufacturing industry, the quality of labour utilised has improved, which is likely to have had a positive impact on productivity growth, as a more experienced and qualified workforce are likely to be more productive. Although QALI has improved for the economy as a whole, the skills and experience base has increased at a faster pace in manufacturing industry than most other industries, with the exception of financial services and non-manufacturing production (which includes oil and gas extraction). Changes in labour quality have been used to derive an index, referenced to 1993, and this is shown in Figure 7.

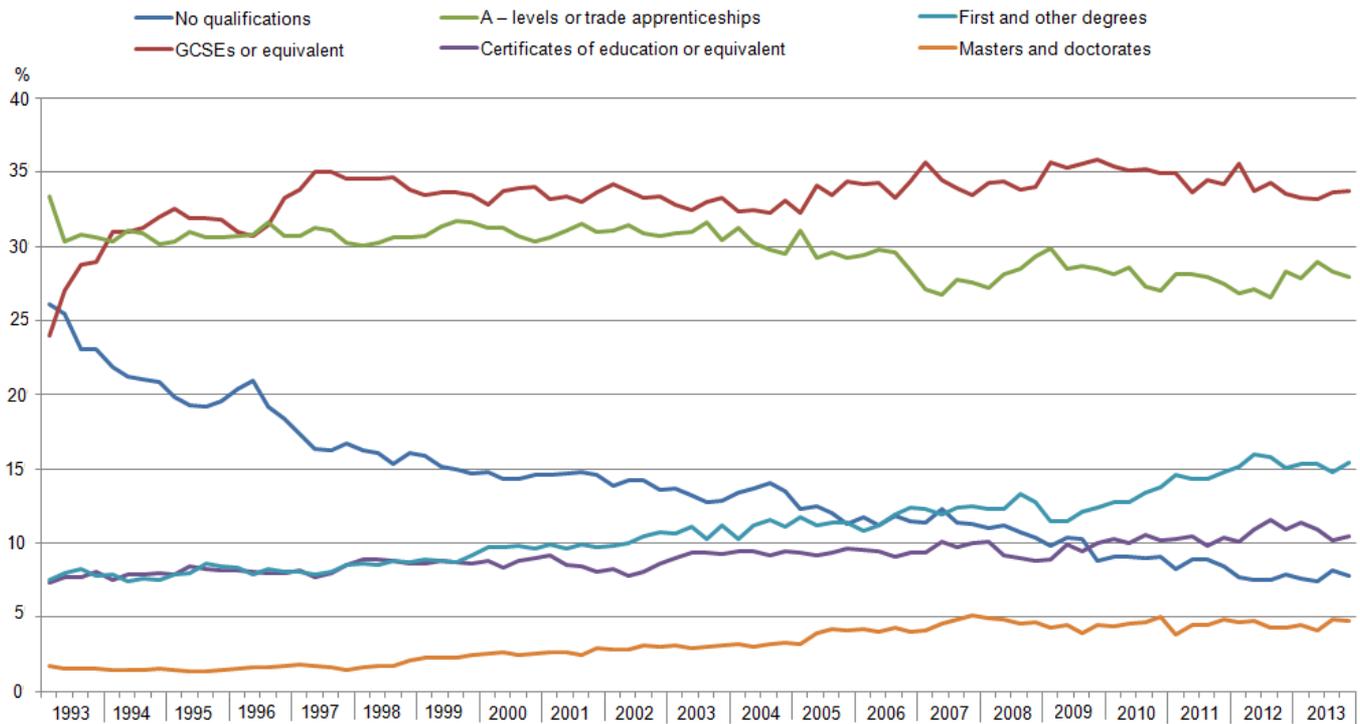
Figure 7: Labour quality by industry, 1993 - 2013**Notes:**

1. Source: Quality Adjusted Labour Input (QALI)
2. Click on the image to enlarge

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Figure 8 shows that the proportion of hours worked in the manufacturing industry accounted for by workers with no qualifications has fallen significantly from just over 26% to 8% since 1993, offset to an extent by a noticeable increase in graduates. The same trend is visible across the wider economy, but to a lesser extent (especially trends in hours accounted for by workers with no qualifications).

Figure 8: Percentage of manufacturing hours accounted for by qualification, 1993 - 2013**Notes:**

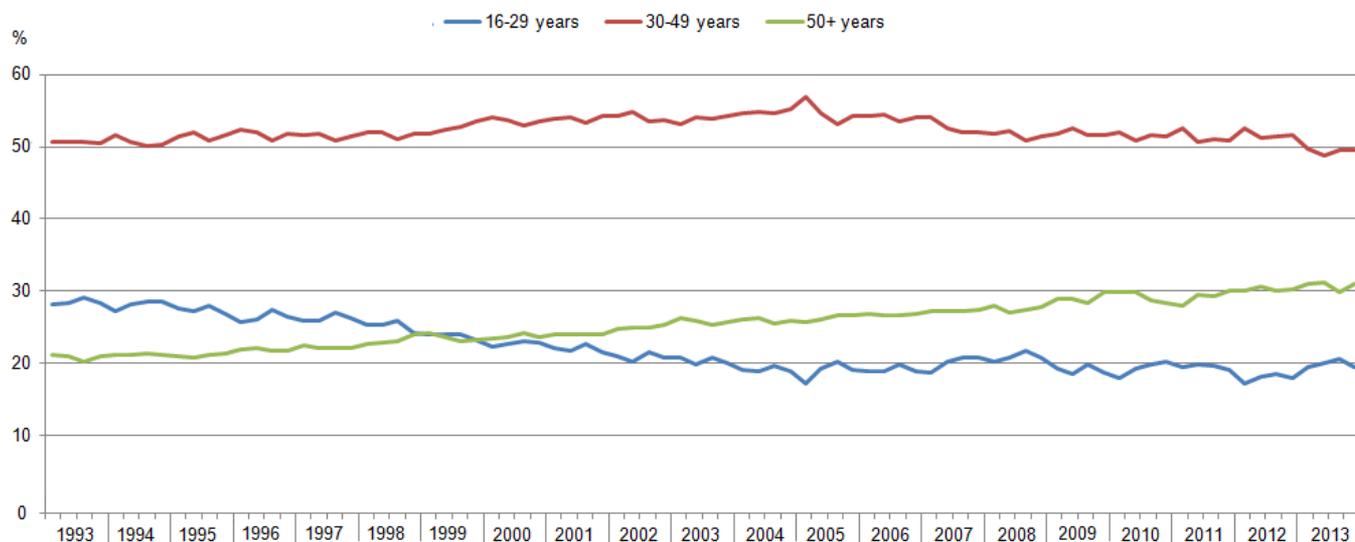
1. Source: Quality Adjusted Labour Inputs (QALI)

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There has also been an increase in experience within manufacturing – Figure 9 shows that the proportion of people aged 50+ working in the industry has risen from 20% to 30%, offset by a fall in the proportion of workers aged 16-29. This may partly be driven by changing demographics in the United Kingdom – nevertheless it has resulted in a more experienced workforce. More experience is generally associated with higher productivity – as workers have a greater wealth of knowledge to draw from and are therefore more familiar with the manufacturing production process and the associated challenges.

Figure 9: Percentage of manufacturing hours accounted for by age, 1993 - 2013**Notes:**

1. Source: Quality Adjusted Labour Input (QALI)

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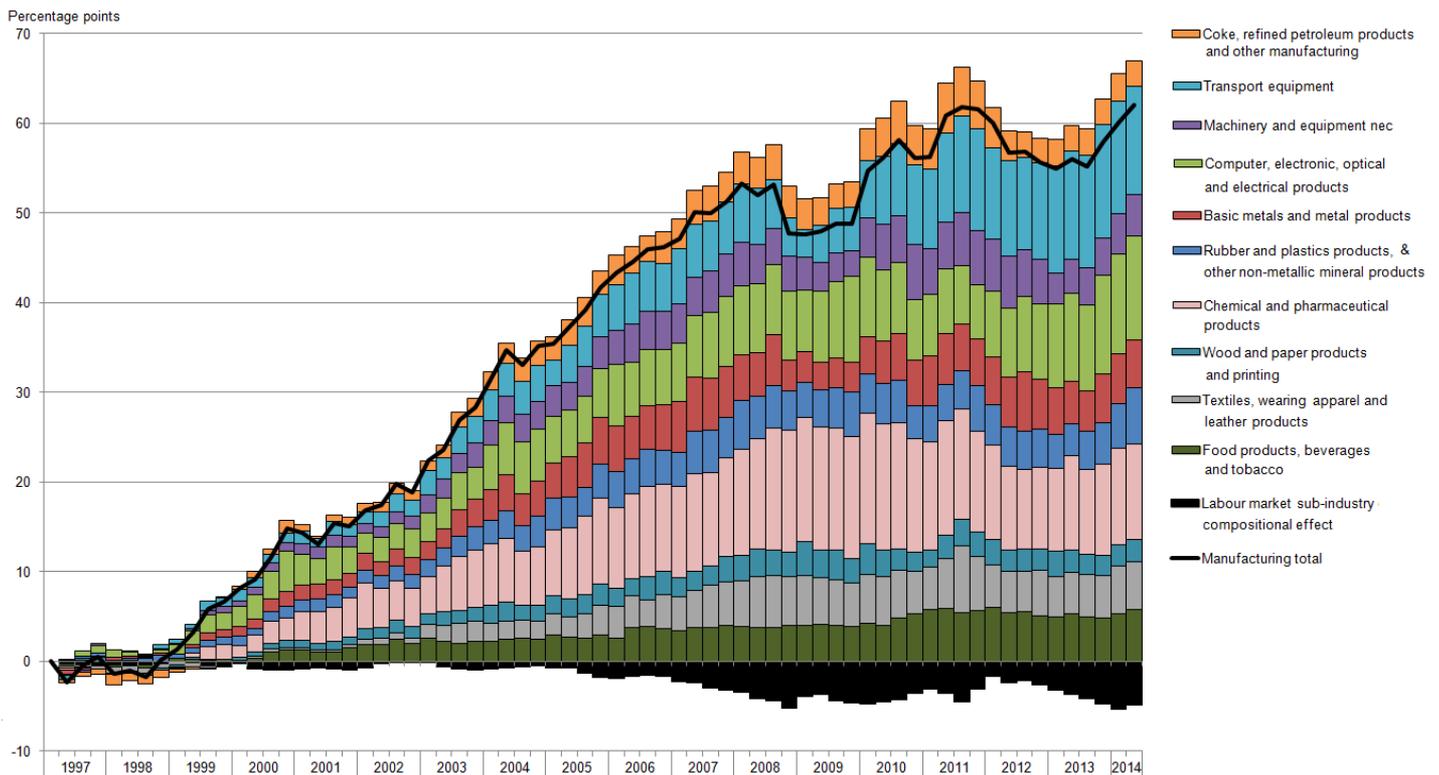
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A broad based increase in productivity across sub-industries

The increase in manufacturing productivity since the early 1990s has been broad based and each manufacturing sub-industry has contributed – with chemical and pharmaceutical products making the largest and coke and refined petroleum the smallest contribution over the period. This productivity measure also captures the labour compositional effect – employees moving between sub-industries that have different levels of productivity. For example if there was a movement of workers from a low to a high productivity industry – this would have a positive impact on productivity and would be captured as a positive ‘compositional effect’. Capital may have also moved between industries although data are not available to analyse this. Figure 10 illustrates that the impact of shifting labour between sub-industries, as shown by the black bars, has had a negligible impact on manufacturing productivity growth since the early 1990s. The impact is largest (and is negative) between 2008 and 2011, although remains low compared to changes in the productivity of each sub-industry.

Figure 10: Contribution to manufacturing sub-industries productivity growth, percentage points since Q1 1997



Notes:

1. Source: Labour Productivity (ONS) and Labour Market Statistics (LMS)
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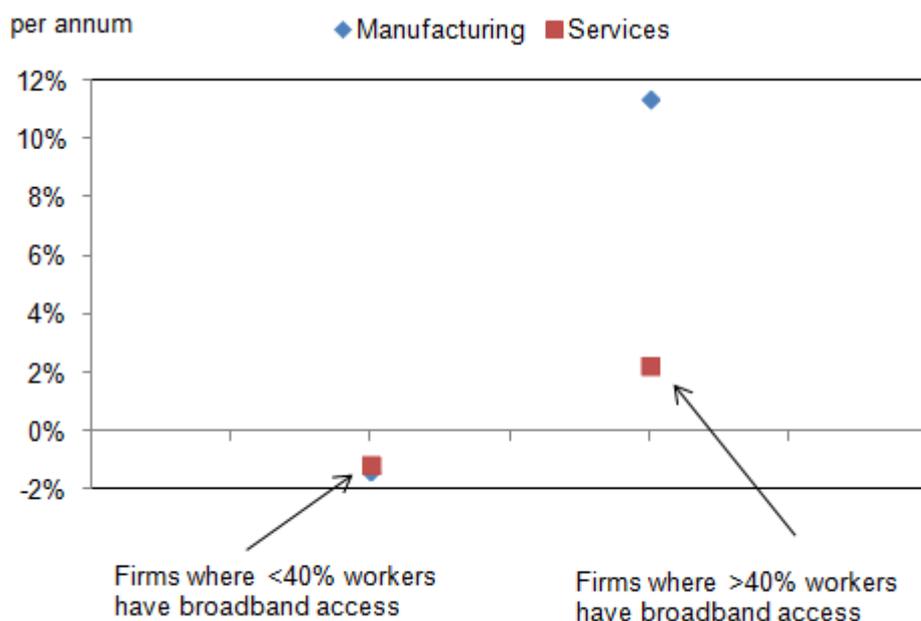
Changes in manufacturing productivity shown in Figure 10 suggest that there has been limited impact on productivity from activity switching between manufacturing sub-industries. All manufacturing industries have become more productive since 1997.

The importance of the improvement in the ICT base

Due to technological progression firms now have access to more efficient and innovative ways to communicate, as they have developed their Information, Communication and Technology (ICT) base. Adopting a micro-data based approach using the Annual Respondents Database (ARD) data, analysis suggests that this progression seems to have been more important in the manufacturing industry than services. Firms can be classified in terms of the maturity of their ICT base, which is proxied as the proportion of the firm's employees who have access to a broadband internet connection in their workplace. Figure 11 shows that productivity growth tends to be higher in firms with higher levels of ICT maturity, but the relationship is far stronger in manufacturing than services. Manufacturing firms that have a low ICT maturity have seen productivity fall by around 1% per

annum, while manufacturing firms that have high ICT maturity have seen productivity growth of just over 11% per annum.

Figure 11: Average annual labour productivity growth by ICT maturity (% per annum, 2001 to 2007)



Notes:

1. Source: Annual Respondents Database (ARD): Annual Business Survey (ABS), E-commerce survey, and Community Innovation Survey (CIS)

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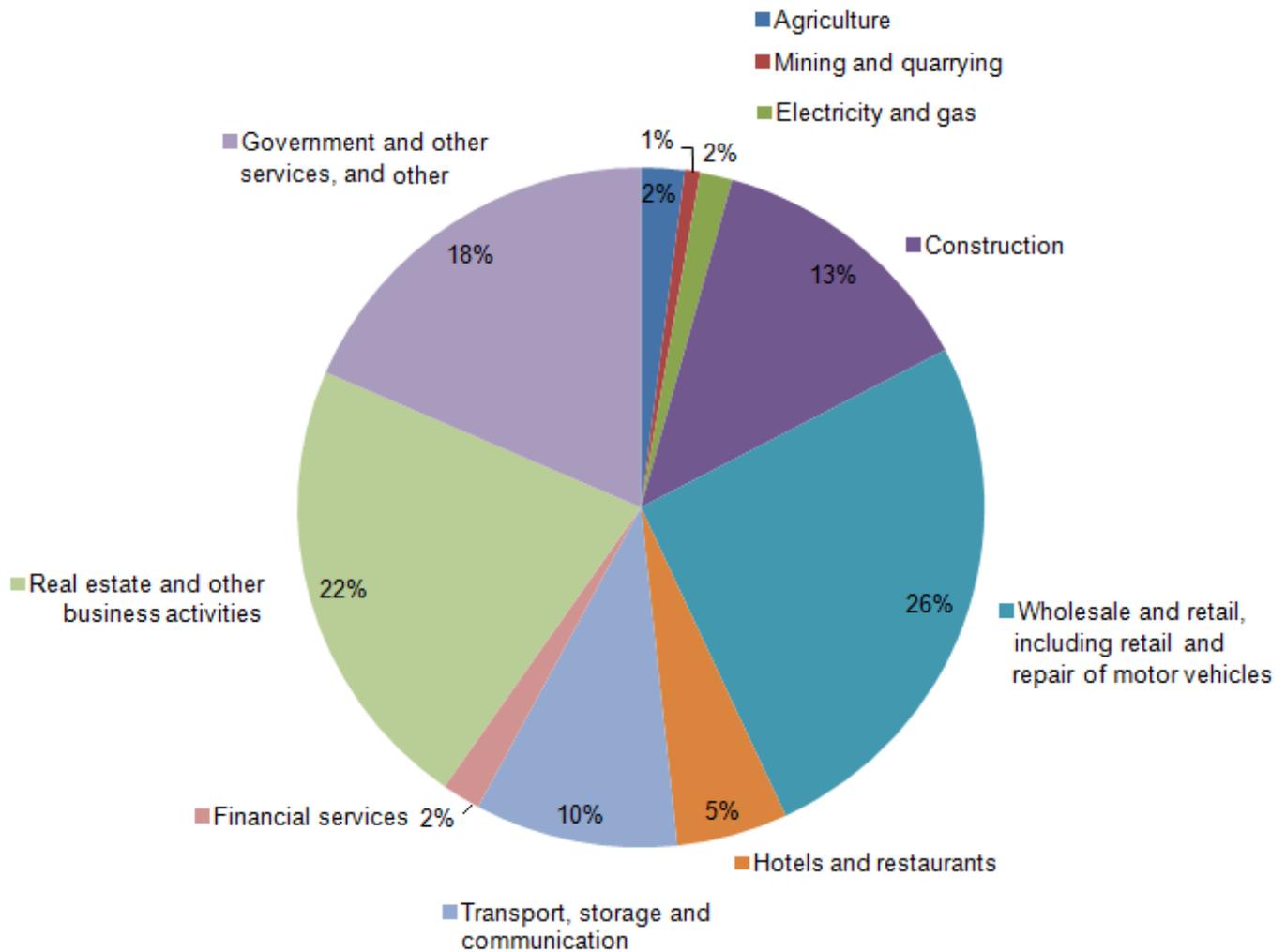
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Changing composition of the UK manufacturing industry

The changing composition of the UK manufacturing industry may also have an impact on productivity. It is possible that manufacturing firms previously provided support services such as transport and wholesale ‘in-house’ – but are now sub-contracting these functions. Therefore activities that would traditionally be classified as manufacturing and are generally associated with lower productivity are now classified in the services industry. In a given quarter, 97% of employees that leave a manufacturing firm are re-employed within the industry – with the remaining 3% employed elsewhere. Employees that become unemployed when leaving the manufacturing industry are not included in this analysis. Figure 12 shows the cumulative job flows out of the manufacturing industry since 2002 - a large proportion of which are now employed in what could be considered ‘support services’ such as wholesale (26%), transport (10%) and financial services (2%). If some manufacturing support services have been outsourced elsewhere in the economy, then this may have a positive impact on manufacturing productivity. This may also be partly responsible for a

very small proportion of the shift in measured output from manufacturing to services in the wider economy.

Figure 12: Job flows out of the manufacturing industry, 2001 to 2013



Notes:

1. Source: Labour Force Survey Microdata

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Research and Development

Another possible factor is the large investment in research and development (R&D) on manufactured products, which is often cited as a key determinant of multi-factor productivity. This accounted for just over 70% of all business R&D expenditure in 2012, despite the manufacturing

industry only accounting for 10% of the economy in GVA terms¹. R&D expenditure on manufactured products represented 3.4% of manufactured product sales in 2012. This compares with R&D expenditure on service products which represented 0.1% of turnover in the service sector in the same year. This is broadly comparable for 2010 and 2011. Manufacturing R&D investment is primarily driven by spend on pharmaceutical products (33.8% of product sales in 2012). Other products that are invested heavily in include computers & peripheral equipment (10.1%) and consumer electronics and communications equipment (27.6%), as shown in Table 1. Data on R&D investment in manufactured products have been available for many years, but R&D investment in service products as a share of turnover for the sector have only been available since 2010. Manufacturing R&D investment has increased from £9.7 billion in 2001 to £12.2 billion in 2012; this has resulted in an increase in expenditure as a proportion of manufactured product sales from 3.2% to 3.4% over the period. This increase in R&D investment may be a driver of manufacturing productivity growth.

Table 1: Research and development expenditure on products as a proportion of product sales

Sectors	2010	2011	2012
			%
Services¹	0.2	0.2	0.1
Manufacturing	3.3	3.6	3.4
Food products and beverages; Tobacco products	0.4	0.5	0.5
Textiles, clothing and leather products	0.1	0.1	0.1
Pulp, paper and paper products; Printing; Wood and straw products	0.1	0.1	0.1
Refined petroleum products and coke oven products	6	5.7	7.6
Chemicals and chemical products	3	2.2	2.6
Pharmaceuticals	31.7	35.5	33.8
Rubber and plastics	0.6	0.7	0.8
Other non-metallic mineral products	0.6	0.6	0.4
Casting of iron and steel	1.3	1.6	1.7
Non-ferrous metals	1.8	1.4	1.1
Fabricated metal products except machinery and equipment	0.4	0.5	0.5
Machinery and equipment	2.9	3.2	3.3
Computers and peripheral equipment	9.2	9.9	10.1
Electrical equipment	4.2	3.9	3.7
Consumer electronics and communication equipment	11.6	17.3	27.6

Sectors	2010	2011	2012
Precision instruments and optical products; photographic equipment	4.7	5.4	5.6
Motor vehicles and parts	3.4	4	4.4
Other transport equipment	1.1	1.1	1.1
Shipbuilding	4.6	5.6	4.7
Aerospace	8	7.7	7.5
Other manufactured goods	0.9	0.9	0.9

Table source: Office for National Statistics

Table notes:

1. R&D on service products is as a percentage of the turnover of the service sector rather than sales of service products.

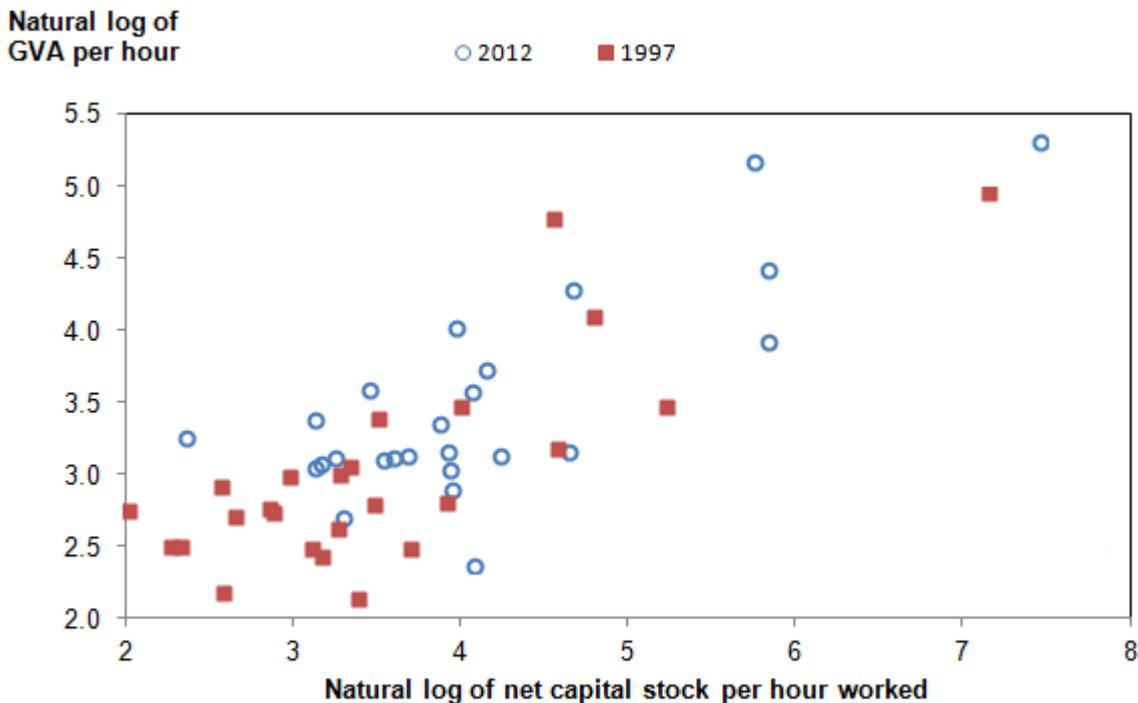
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Capital deepening

Capital deepening or capital intensity may also have played a part in manufacturing productivity growth; this is defined as an increase in the net capital stock per employee. Although the net capital stock has been broadly stable in manufacturing, due to falling employment capital deepening has occurred since 1997. Analysing output per hour against net capital stock per hour worked shows evidence that capital deepening has occurred for all manufacturing sub-industries i.e. workers have access to more capital and are therefore more productive in all sub-industries.

Figure 13: Net capital stock and output per hour, 1997 and 2012**Notes:**

1. Source: Capital Stock and Labour Productivity

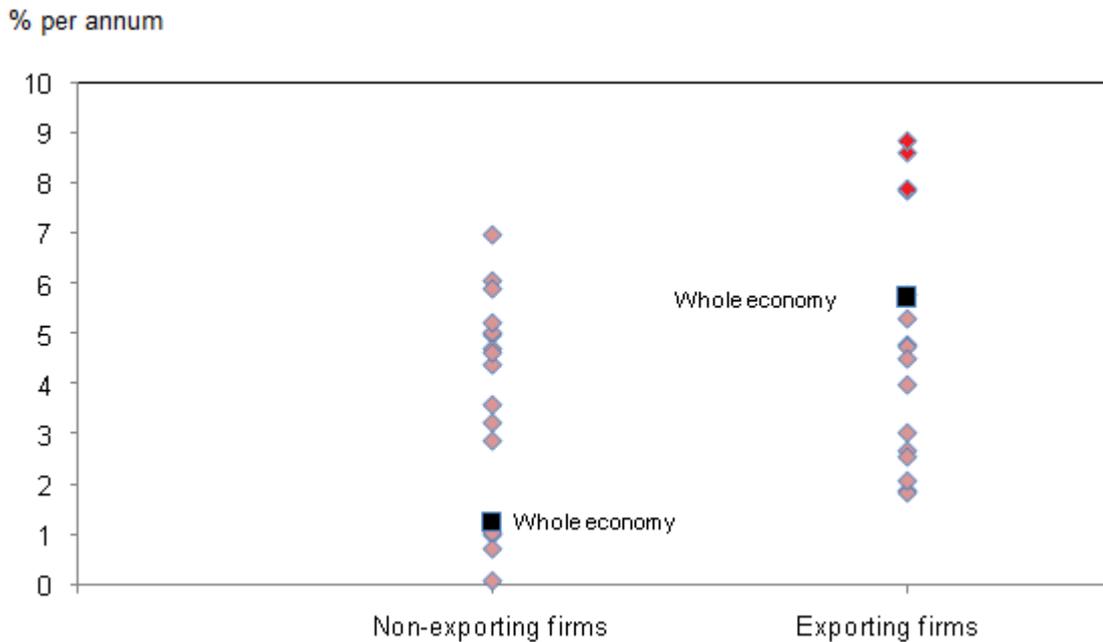
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A more integrated global economy

The global economy is continually becoming more integrated. According to economic theory, this allows the UK manufacturing industry to specialise in producing goods for which they have a lower opportunity cost and are therefore more efficient, which is likely to have a positive impact on productivity growth. A micro-data based approach using the Annual Respondents Database (ARD) data analyses productivity growth of firms with a specific set of characteristics. In Figure 15 each red dot represents productivity growth in a manufacturing sub-industry; but the industry level data have been categorised by firms that are export-oriented and those that are not (both types of firms can be present in a sub-industry). Figure 15 shows that exporting firms are generally associated with higher productivity growth; with particularly strong productivity growth exporting firms that manufacture basic metals, machinery, electrical equipment and motor vehicles, trailers & semi-trailers, highlighted in the chart in red.

Figure 14: Average annual labour productivity growth by exporting status, 2001 - 2010**Notes:**

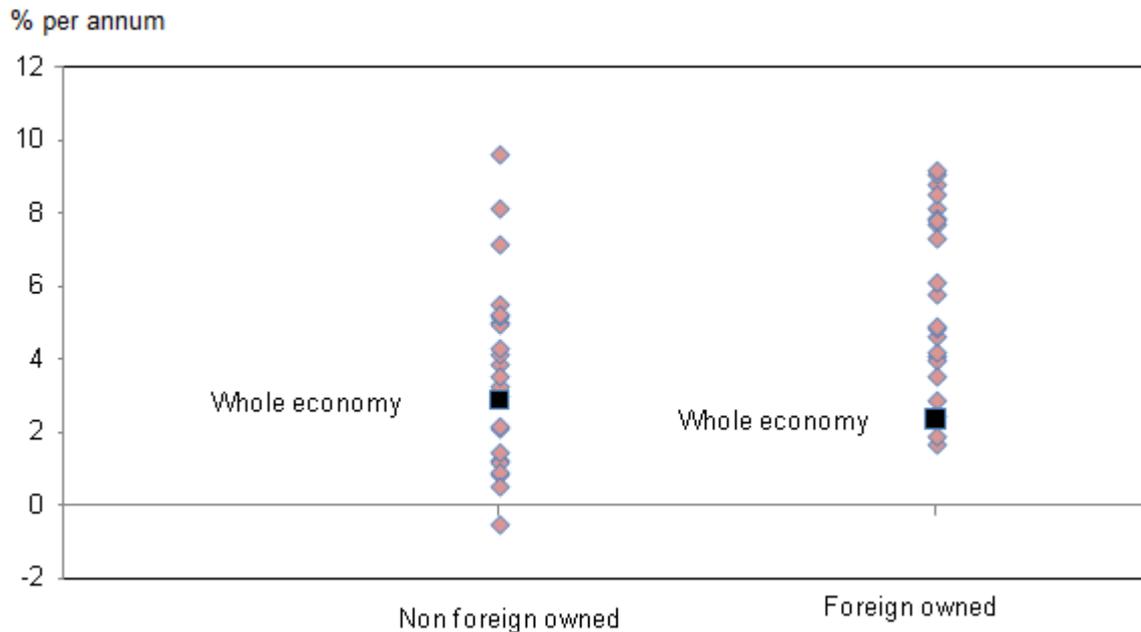
1. Annual Business Inquiry (ABI) are used for 'Whole Economy'
2. Source: Annual Respondents Database (ARD): Annual Business Survey (ABS)

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A more integrated global economy has also led to a number of foreign-owned companies setting up production in the UK – these are typically large multinational companies that may benefit from economies of scale. Figure 16 also uses data from the Annual Respondents Database (ARD) to show that foreign-owned firms generally experience higher productivity growth than UK domestic firms.

Figure 15: Average annual labour productivity growth by firm ownership, 2001 to 2010**Notes:**

1. Source: Annual Respondents Database (ARD): Annual Business Survey (ABS)

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Conclusion

This paper has presented a range of factors that may have had an impact on manufacturing productivity and is designed to inform and encourage the debate around manufacturing productivity – not provide a comprehensive and definitive explanation.

The key message from this analysis is that manufacturing productivity has risen across a broad range of sub-industries, from textiles to pharmaceuticals. This has been driven by a broad based reduction in jobs (a portion of which could be attributed to outsourcing) that has resulted in broad based capital deepening. The quality of labour has also improved relative to most other industries, with the manufacturing workforce shown to be better qualified and more experienced.

A number of other factors may have helped maintain a high rate of productivity growth. The manufacturing industry may have benefited more from technological and ICT advancements relative to services industries, as well as a more globalised economy, while the industry's high rate of manufacturing R&D investment relative to manufacturing sales may help explain some of the high rates of MFP growth experienced before the economic downturn.

Background notes

1. R&D expenditure on manufactured products can be made by businesses not classified to manufacturing so care should be taken when comparing with GVA.
2. Details of the policy governing the release of new data are available by visiting www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html or from the Media Relations Office email: media.relations@ons.gsi.gov.uk

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