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ECONOMICS PAPER NO. 10B

Manufacturing in the UK: Supplementary analysis

DECEMBER 2010

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Introduction

Manufacturing is currently the third largest sector in the UK economy, after business services and wholesale/retail in terms of share of UK GDP. In 2009, manufacturing contributed around £140 billion in gross value added to the economy and employed some 2.6 million people.

UK manufacturing is an established leading manufacturer in the world, being the sixth largest manufacturer globally by output, and a leading exporter of technology intensive manufacturing goods. However, the performance and success of the UK sector has not always been well communicated.

The economics paper published alongside the Coalition Government's *Growth Review Framework for Advanced Manufacturing* examines the changing nature of today's manufacturing sector. It analyses evidence underpinning global drivers for manufacturing growth, considers barriers that might hinder further innovation and growth and the role of Government in the new global economic and financial environment.

This statistical report, which is published alongside both documents aims to provide a broader insight into the performance and trends of the UK manufacturing sectors and analyse how UK compares to its international competitors. The paper analyses the information contained in UK official statistics, trade association data as well as statistics from international organisations such as OECD[1], Eurostat and UNCTAD[2] to present a picture of current and past performance of UK manufacturing. It analyses sector's contribution the UK economy, highlighting strengths and challenges and key enablers for future growth, including trends in exports, Foreign Direct Investment, research and development, innovation, the skills base, market environment and business confidence.

The analysis and measures presented in this publication - and follow-on updates when new data becomes available - will also assist in future reviews and updates of the Manufacturing Framework.

[1] Organisation for Economic Co-operation and Development
[2] United Nations Conference on Trade and Development

Gross Value Added and Employment

The manufacturing industry is of vital economic importance to the UK, making a significant contribution in terms of the value of goods and services the industry produces and employment

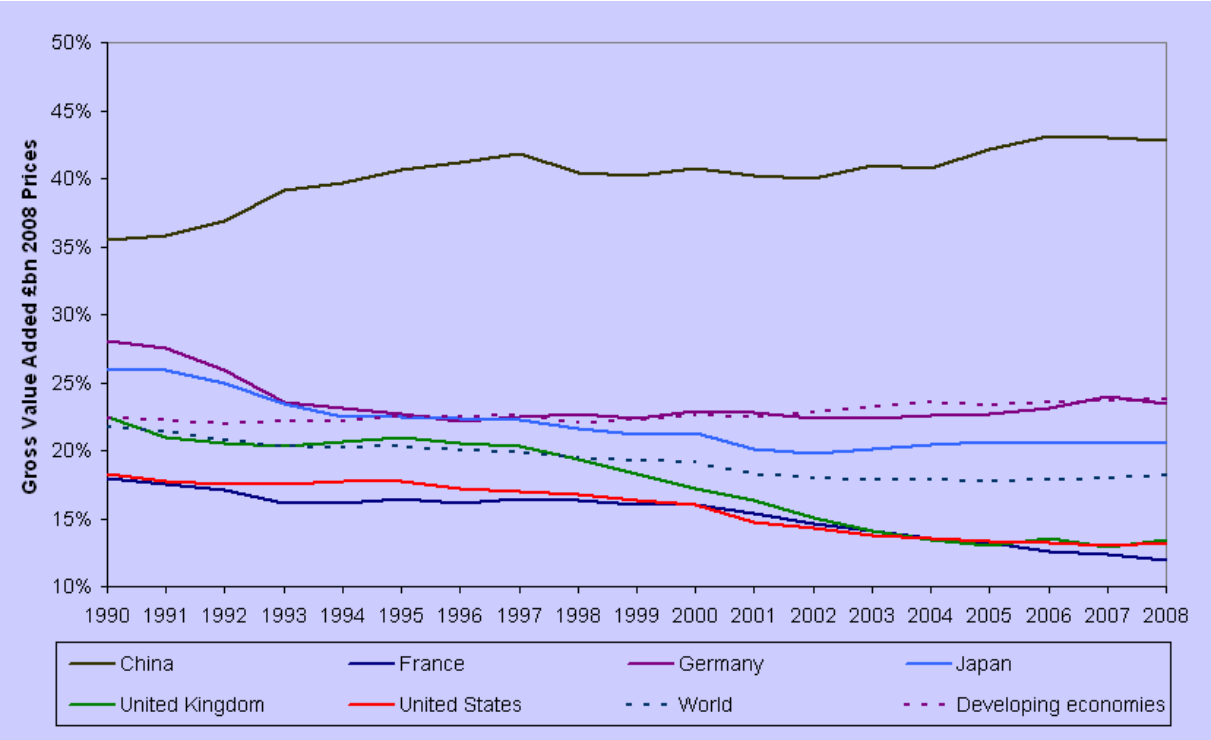
Its contribution to Gross Domestic Product (GDP) and employment is likely to be greatly underestimated by official statistics because statistical classifications are slow to catch up with dynamic changes in manufacturing, in particular the fact that the boundary between manufacturing and services is becoming increasingly blurred. Official statistics also do not capture the indirect contribution that manufacturing makes to productivity and growth through innovation.

Gross Value Added

Gross value added (GVA) measures the contribution to the economy of each individual producer, industry or sector. Manufacturing is the third largest sector in the UK economy, after Business Services and the Wholesale/Retail sector in terms of share of UK GDP.

In 2009, the UK manufacturing sector generated some £140bn in gross value added, however over the period 1990 to 2009, manufacturing as a share of UK GDP has fallen steadily from 22% to just over 11%. This trend has been more pronounced in the UK than other leading industrialised nations (see Figure 1 below)

Figure 1: Manufacturing as a percentage of GDP globally and across comparator countries



Source: UNCTAD Handbook of Statistics

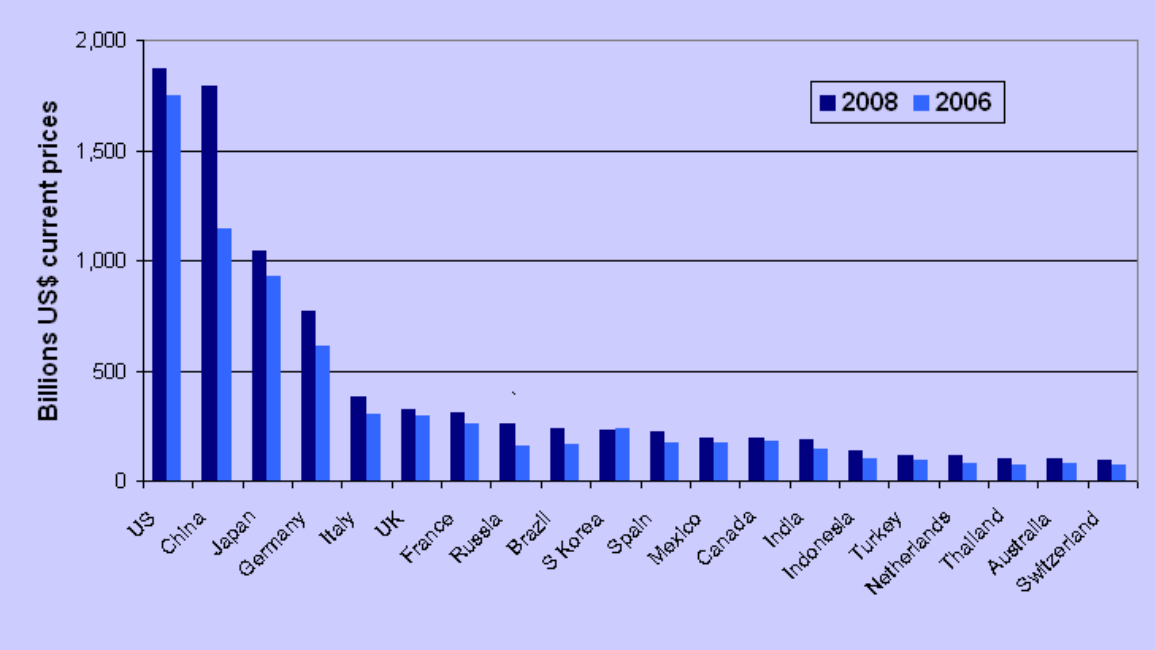
The steady fall in the contribution of manufacturing to UK GDP can be attributed in larger part to the following two factors:

- the fragmentation of global value chains with lower skilled lower value modules being outsourced to lower wage cost countries.
- significant technological progress, which has served to drive down prices more rapidly in manufacturing than services[3].

China, one of the world's two largest manufacturers alongside the US, is a notable exception to this global trend with manufacturing making up 42.7% of its GDP in 2008, up from 35.5% in 1990. This reflects in part the offshoring and outsourcing by developed countries of low value high volume manufacturing activities such as production to lower costs and gain access to new emerging markets.

Figure 2 below shows that the UK continues to be the sixth largest manufacturer in the world, ahead of France, Brazil, Russia, India and Canada. However, the difference in manufacturing output between the UK and the two leading manufacturing countries – the US and China – has increased further.

Figure 2: Manufacturing output, US$ in current prices



Source: UNCTAD Handbook of Statistics (2009)

[3] Investment and technological change tends to have greater capacity to increase productivity in manufacturing (consider the scope for automation in a car factory compared to an orchestra or hairdresser), with competition driving down global prices of manufactured goods faster than services. If capital and labour are mobile across sectors, wages rise across all sectors as a result of the new technology. In response, prices rise by relatively more in service sectors compared to the manufacturing sectors where the technology originated. Under the assumption of inelastic demand for goods and services, the relative decline in manufacturing prices leads to a less than proportionate increase in sales, reducing total expenditure and the manufacturing sectors share of total economy output (this is often referred to as the Baumol effect).

Gross Value Added in higher technology manufacturing

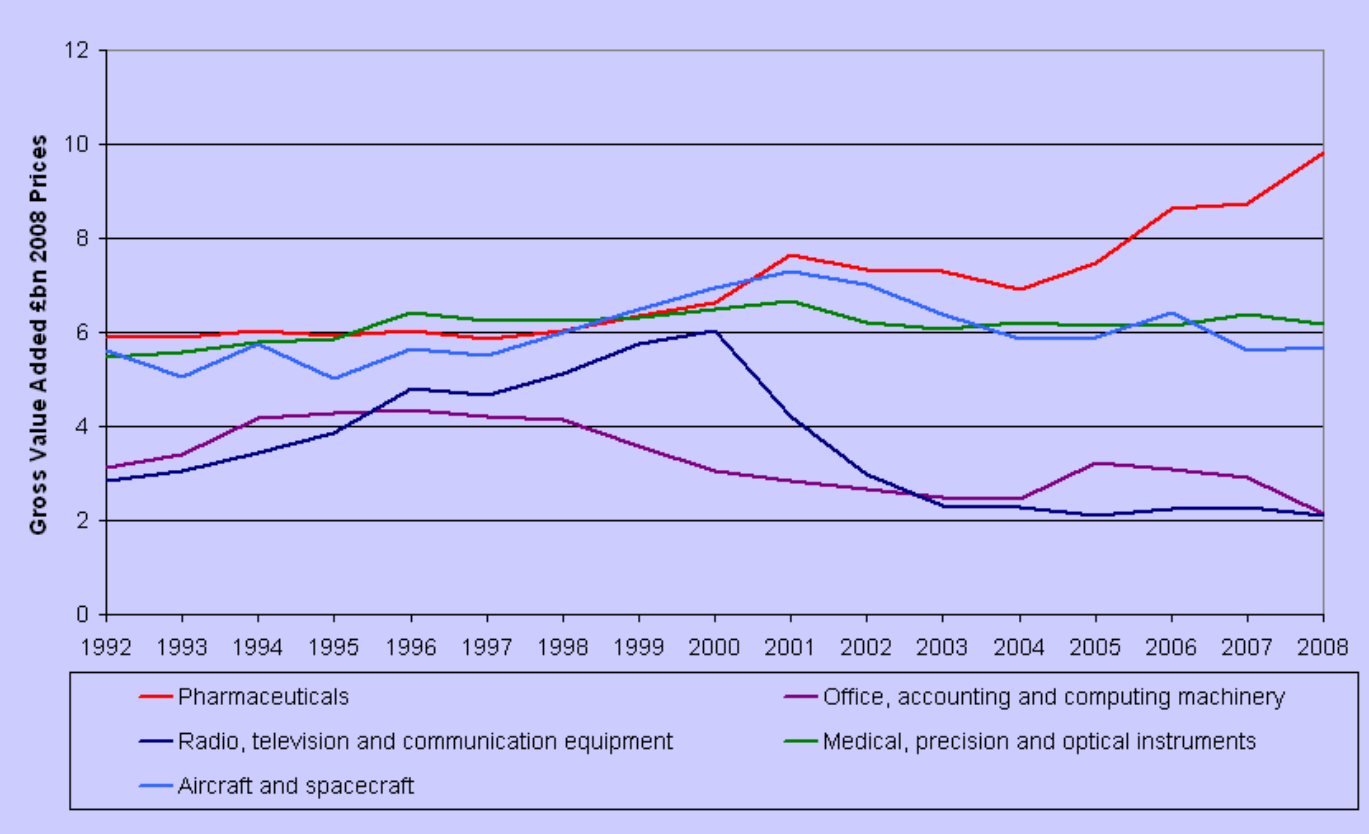
Some aspects of manufacturing activity involve relatively higher levels of knowledge, skills, investment and innovation. Various terms have been used to describe manufacturing activity with these characteristics including high-tech manufacturing, high-value manufacturing, advanced manufacturing and modern manufacturing. The OECD subdivides manufacturing into four technology classes based on the relative research and development intensity of manufactured products (see Table 1 below).

Table 1: Technology levels of manufacturing sub-sectors

High technology	**Medium High Technology**
Pharmaceuticals	Chemicals (excluding Pharmaceuticals)
Office, Accounting and Computing Machinery	Machinery and Equipment n.e.c.
Radio, Television and Communication Equipment	Electrical Machinery and Apparatus n.e.c.
Medical, Precision and Optical Instruments	Motor Vehicles, Trailers and Semi-trailers
Aircraft and Spacecraft	Railroad Equipment and Other Transport Equipment n.e.c.
Medium Low Technology	**Low Technology**
Coke, Refined Petroleum Products and Nuclear Fuel	Food Products, Beverages and Tobacco
Rubber and Plastic Products	Textiles, Textile Products, Leather and Footwear
Other Non-metallic Mineral Products	Wood, Products of Wood and Cork
Basic Metals and Fabricated Metal Products	Pulp, Paper, Paper Products, Printing and Publishing
Building and Repairing of Ships and Boats	Manufacturing n.e.c.

In real terms the value added by the high technology sectors as a whole increased by 13% over the period 1992-2008, to total almost £26bn in 2008, this growth being chiefly driven by the Pharmaceuticals sector with 67% real terms growth over this period. Gross Value Added from the manufacture of Radio, Television and Communication Equipment and Office, Accounting and Computing Machinery industries fell by 26% and 31% respectively over the same period (see Figure 3).

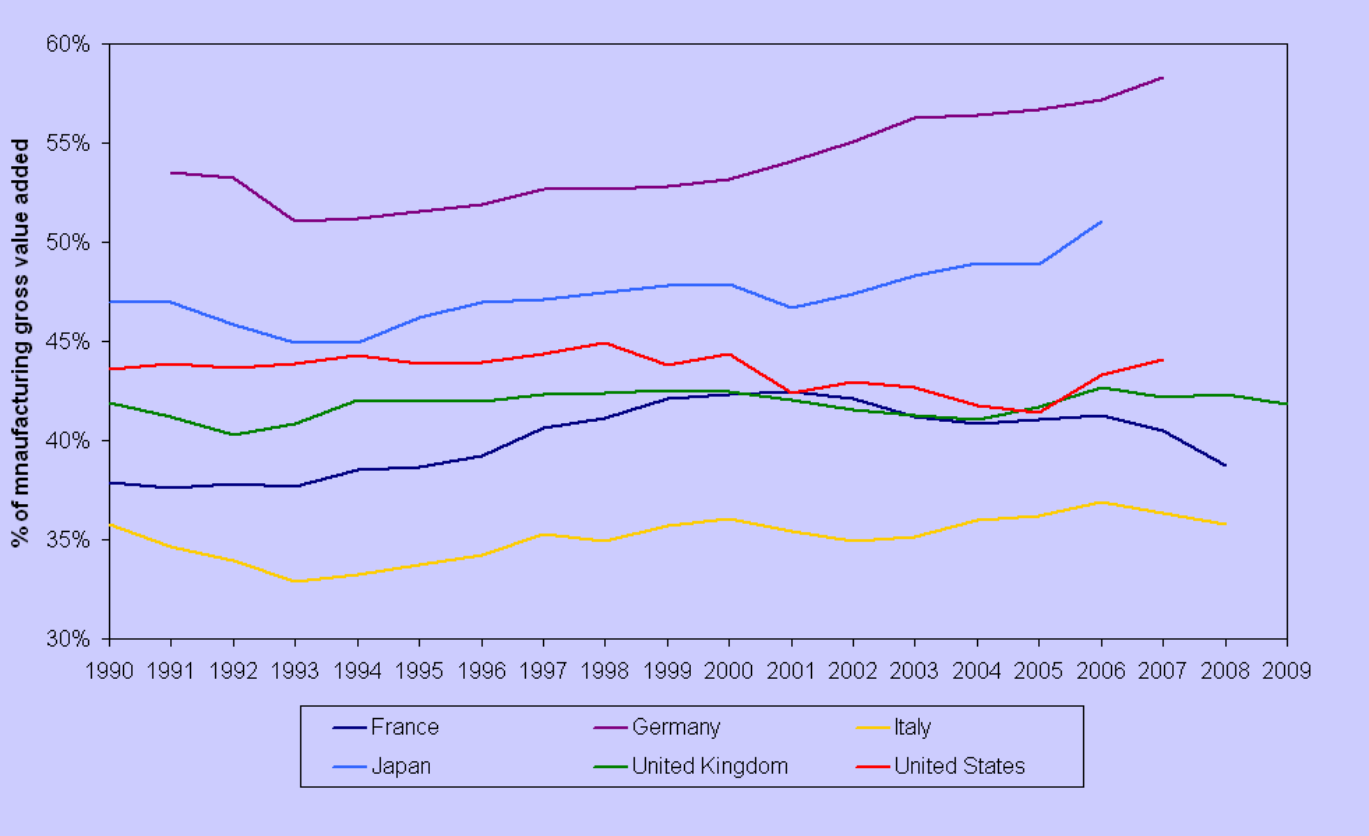
Figure 3: Gross Value Added of UK high technology sectors (£bn 2008 constant prices)



Source: ONS National Accounts

In most developed economies, most notably in Germany and Japan, there is a gradual long-term trend within manufacturing towards high and medium-high technology manufactured goods with lower technology and generally lower value added manufacturing being taken up by developing economies. In 2008, the latest year for which there is comparable data, these industries contributed just over 42% to total manufacturing gross value added in the UK. This figure is similar to the US but significantly behind Germany and Japan (see Figure 4 below).

Figure 4: Value added in higher technology[4] manufacturing as a percentage of total manufacturing value added



Source: OECD STAN database

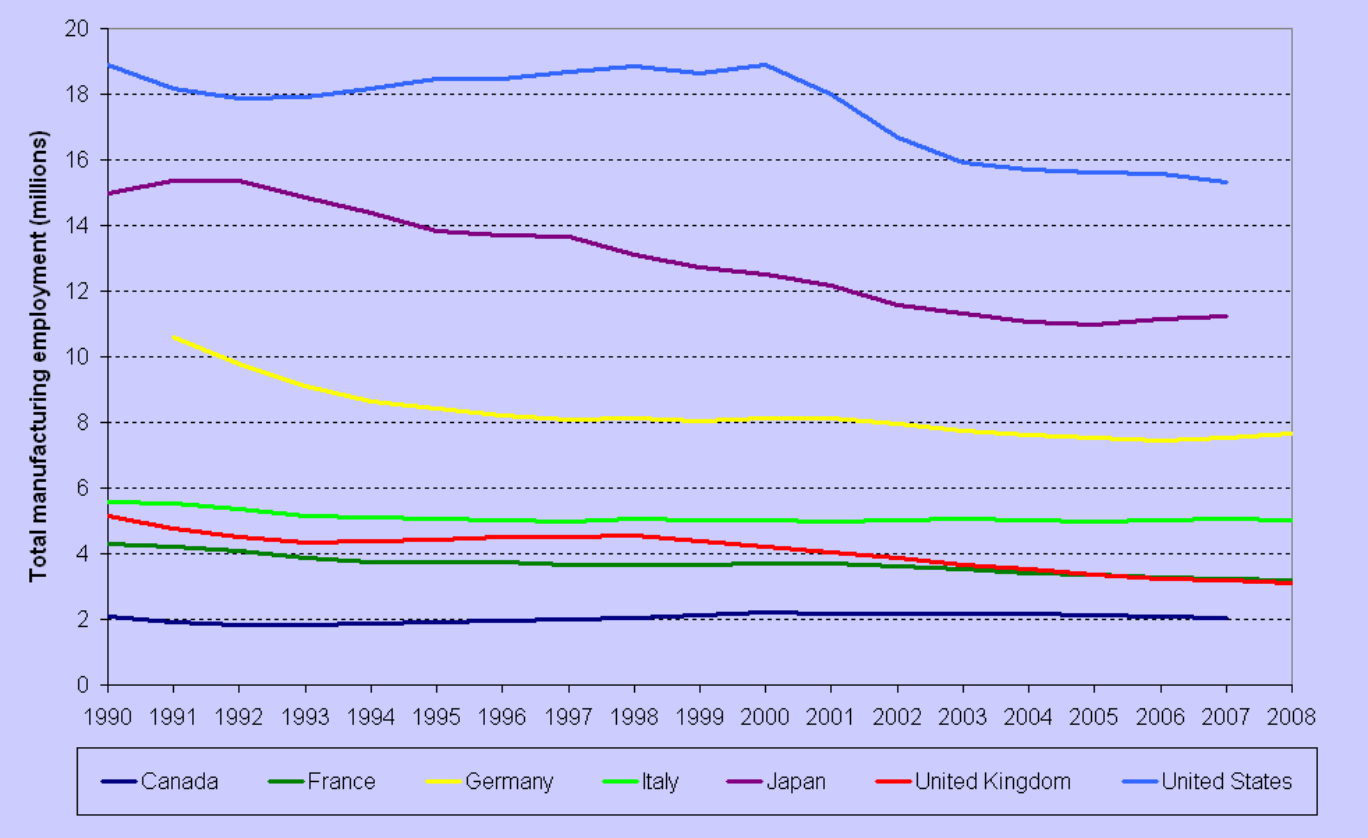
[4] Higher technology here is the OECD definition of high and medium high technology manufacturing. This consists of chemicals, machinery and equipment and transport equipment.

Employment

In 2009, the UK manufacturing sector employed some 2.6 million people, representing around 8.5% of total UK employment.

In the UK, employment levels in the manufacturing continue to fall, from some 5.2 million to 3.1 million between 1990 and 2008. This trend is also evident in most other developed economies, particularly France and Japan and the US (see Figure 5 below).

Figure 5: Manufacturing employment in selected developed countries, 1990-2009



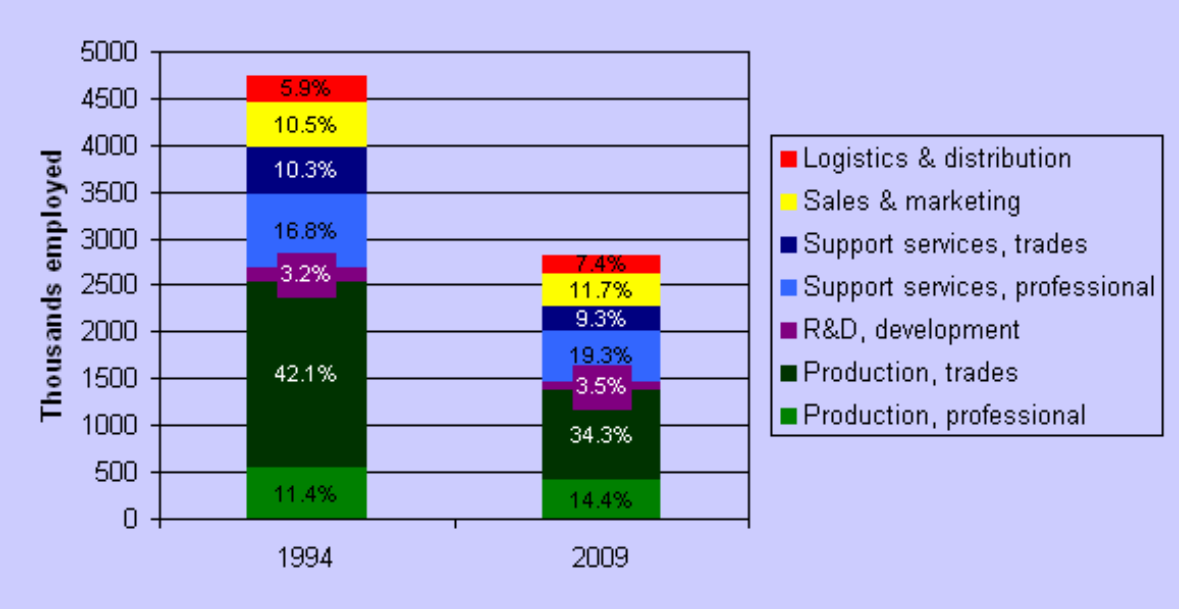
Source: OECD STAN Database

Structure of manufacturing employment by occupation

The UK's manufacturing labour force has responded to the changing demands of the global economy. Overall employment in UK manufacturing has fallen from 4.7 million in 1994 to 2.6 million in 2009.

However, in addition, the distribution of different types of employment has changed also with the proportions of employees in production and support service trade occupations falling over the period while the professional occupations have increased their share of manufacturing employment. The fall in employment has affected all occupations but focused on the traditional, less skilled production jobs. This is illustrated in Figure 6 below.

Figure 6: Total manufacturing employment and structure by occupation 1994 and 2009

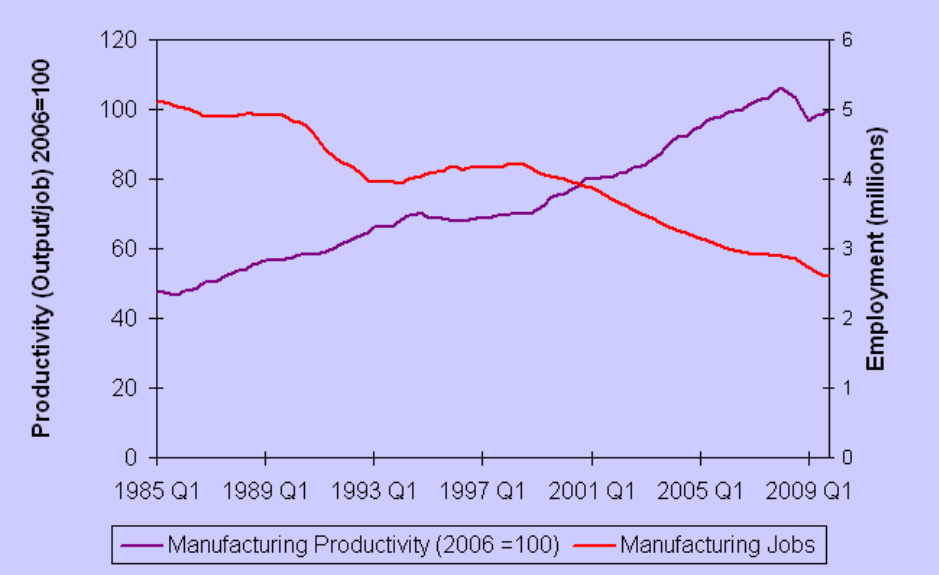


Source: BIS calculations based on ONS Labour Force Survey data

Productivity

Productivity is a measure of the efficiency by which the economy turns inputs, such as labour and capital, into value added. As Figure 7 shows, the productivity performance of manufacturing – defined here as output per employee – more than doubled between 1985 and 2009. This trend has tended to be driven more by growth in manufacturing output than a decline in employment levels.

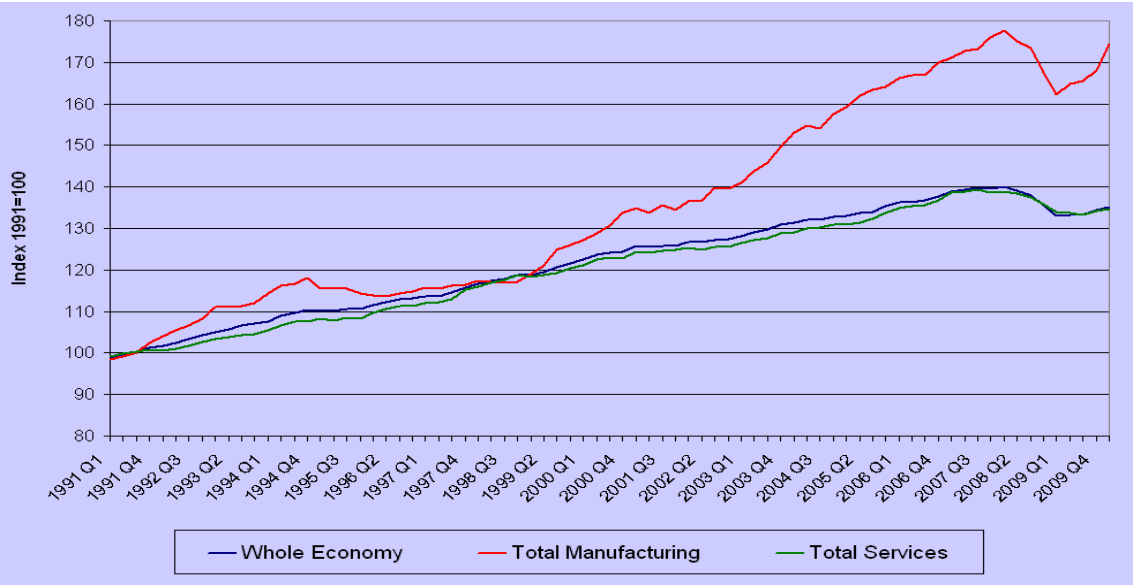
Figure 7: UK manufacturing productivity and employment (quarterly data)



Source: ONS productivity and employment data

As Figure 8 below shows, the manufacturing sector has recorded greater rates of improvement in productivity performance than the services sector and the UK economy as a whole.

Figure 8: Relative productivity performance of UK manufacturing sector, 1991-2009

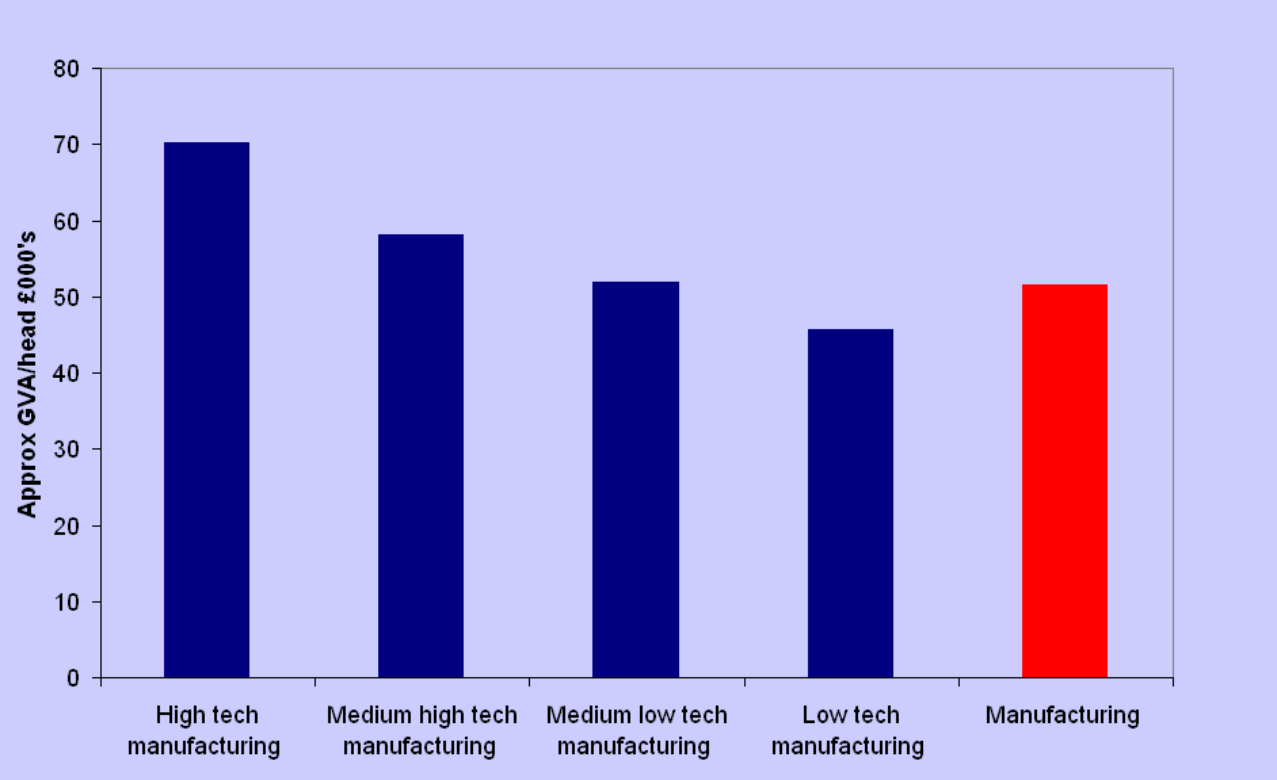


Source: ONS productivity data

Productivity in higher technology manufacturing

Figure 9 below illustrates the differences in productivity – measured as Gross Value Added per head – between the different technology levels of manufacturing in the UK[5]. The higher the technology of the manufactured goods being produced – the greater the Value Added per head of employment.

Figure 9: Estimated productivity - Gross Value Added per head - by technology level 2007

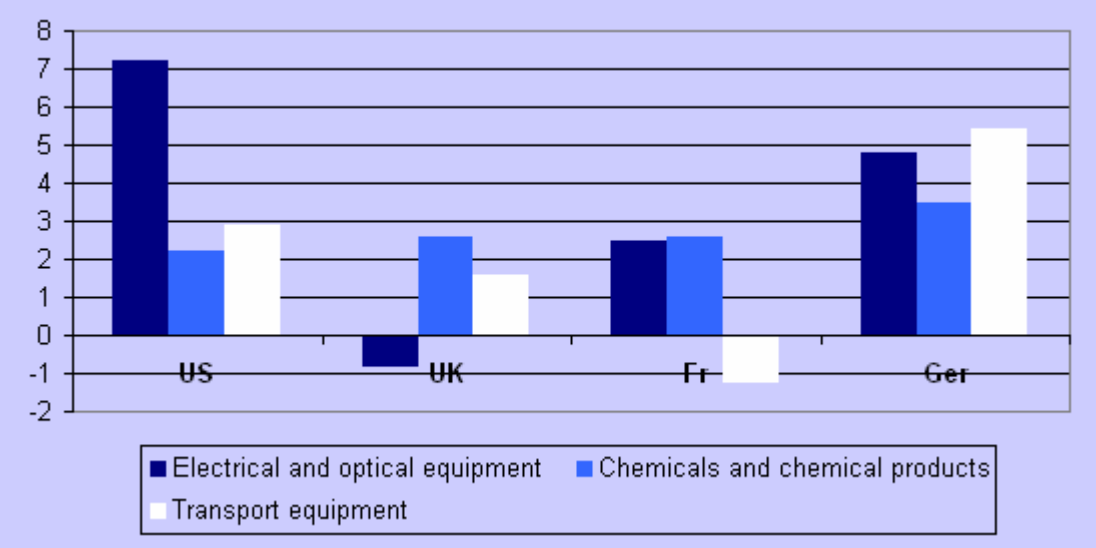


Source: BIS calculations based on ONS Annual Business Inquiry 2007

In recent years gross value added growth in high technology sectors has been rather mixed. The Electrical and Optical Machinery sector has declined where UK's competitors, particularly the US, have shown growth. This decrease is attributable to the Radio, Television and Communication Equipment and Office, Machinery and Computing sectors. The UK Chemical sector has grown in line with France and the US but has not kept pace with substantial growth in Germany and the UK Transport Equipment sector, while growing, is lagging behind the US and Germany (see Figure 10).

[5] Note that these are approximate figures as they do not take into account different balances of full and part-time employment across the different sectors of manufacturing

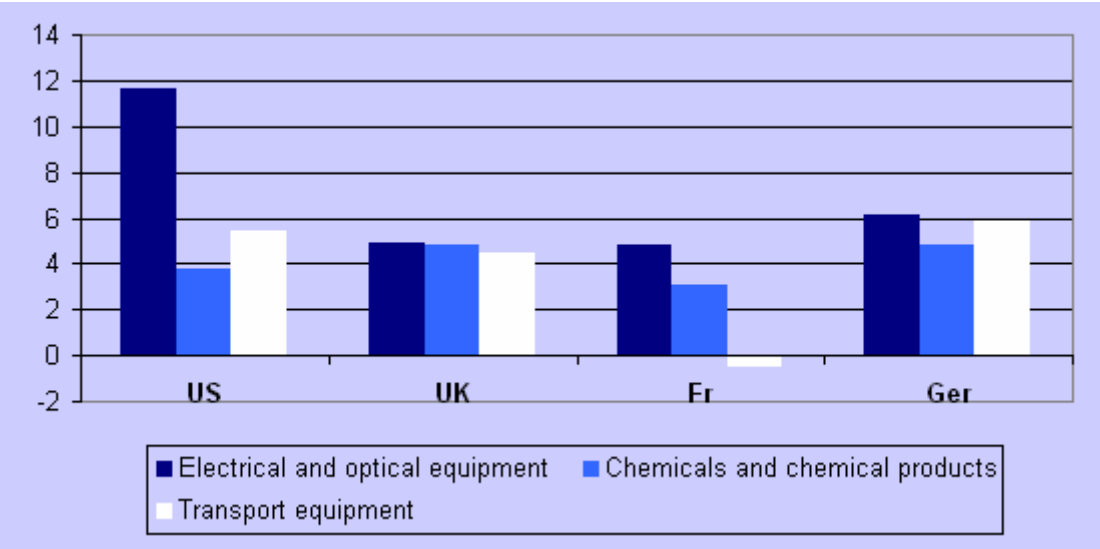
Figure 10: Value Added growth in selected high-tech manufacturing sectors (Annual average growth rate), 2000-2007



Source: BIS calculations based on EU Klems productivity database

In terms of labour productivity the UK has seen all three sectors grow in line with each other and those of France, Germany and the US with the exception of Electrical and Optical Equipment in the US and Transport Equipment in France which has declined slightly over the period (see Figure 11).

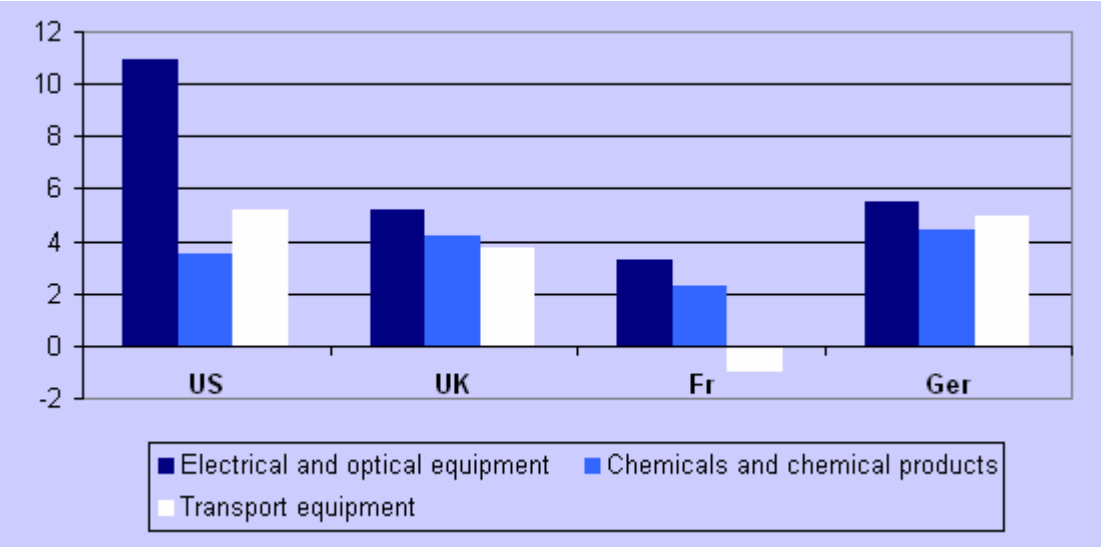
Figure 11: Labour productivity growth in selected high-tech manufacturing sectors (Annual average growth rate), 2000-2007



Source: BIS calculations based on EU Klems productivity database

Total Factor Productivity (TFP) is often defined as a measure which accounts for effects on total output not captured by the contribution of labour or capital inputs. The picture for TFP growth is almost identical to that of labour productivity growth except that in the UK there is more difference between the growth rates of the three sectors (see Figure 12).

Figure 12: Total Factor Productivity growth[6] in selected high-tech manufacturing sectors (Annual average growth rate), 2000-2007



Source: BIS calculations based on EU Klems productivity database

[6] Total Factor Productivity (TFP) growth represents that part of growth in value added which cannot be explained by increases in labour or capital inputs. TFP would include technological and non-technological innovation, as well as knowledge accumulation and other forms of intangible investment.

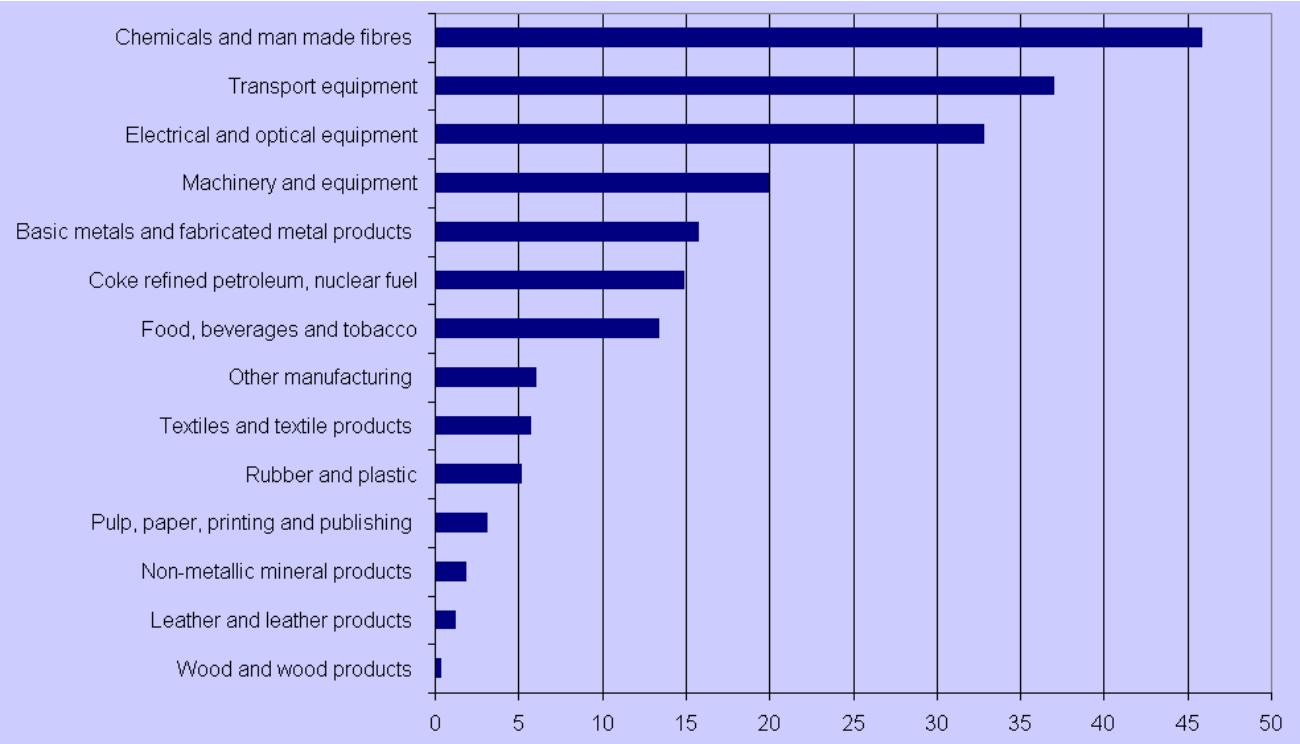
Export and Foreign Direct Investment Performance

Importance of manufacturing exports

The level of exports – measured in volume or value terms – is also a measure of the ability of companies from a particular country to compete on world markets, as exporting firms tend on average to be more productive and more innovative than non-exporters.

In 2009, UK exports of goods produced by the manufacturing sector totalled some £205bn in 2009[7], representing around 53% of total UK export by value. The majority of UK manufacturing exports were of Chemicals and Chemical Products (including Pharmaceuticals), Transport Equipment (including Aerospace) and Electrical and Optical Equipment (e.g. Medical Instrumentation) as shown in Figure 13 below.

Figure 13: UK exports of manufactured goods (£m), 2009

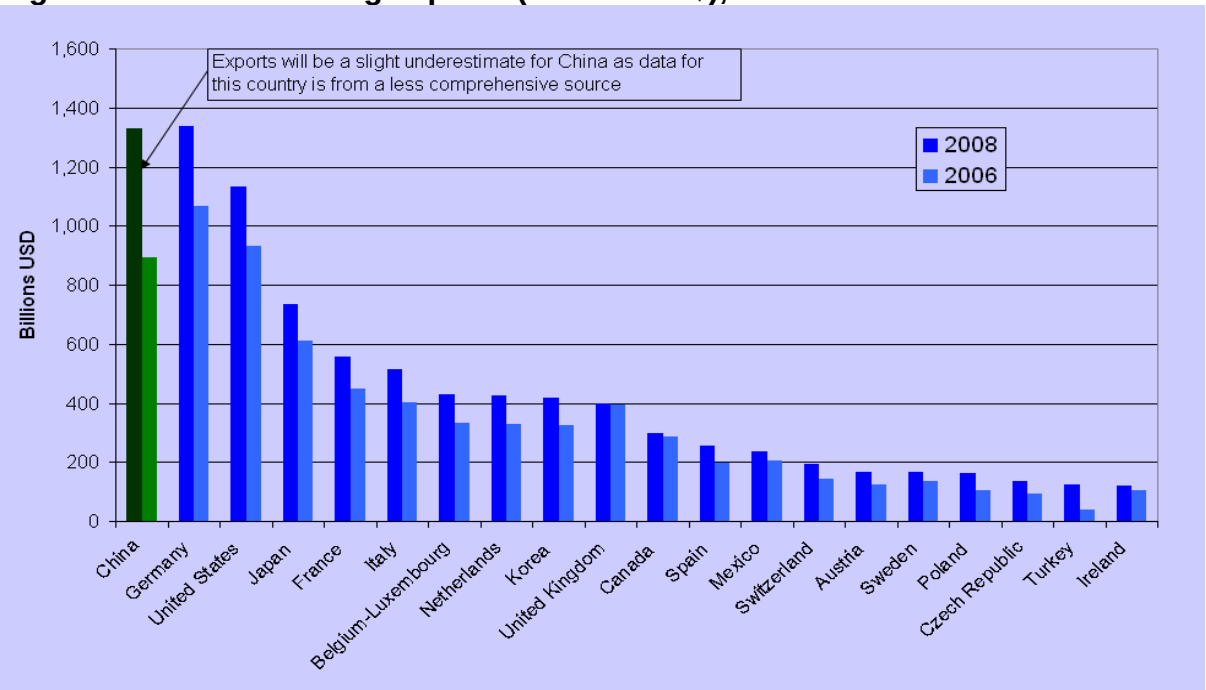


Source: ONS, MQ10, 2010

Manufactured goods form the majority of global exports and in the case of developed economies the majority of these manufactured exports are high or medium-high technology. Latest available data shows that the UK is the tenth largest exporter of manufactured goods, behind countries including China, Germany, the US, Japan and France exporting $398bn in 2008 (see Figure 14 overleaf).

[7] ONS (2010) MQ10, *UK Trade in Goods Analysed in Terms of Industries Quarter 2, 2010.*

Figure 14: Manufacturing exports (current US$), 2006 and 2008

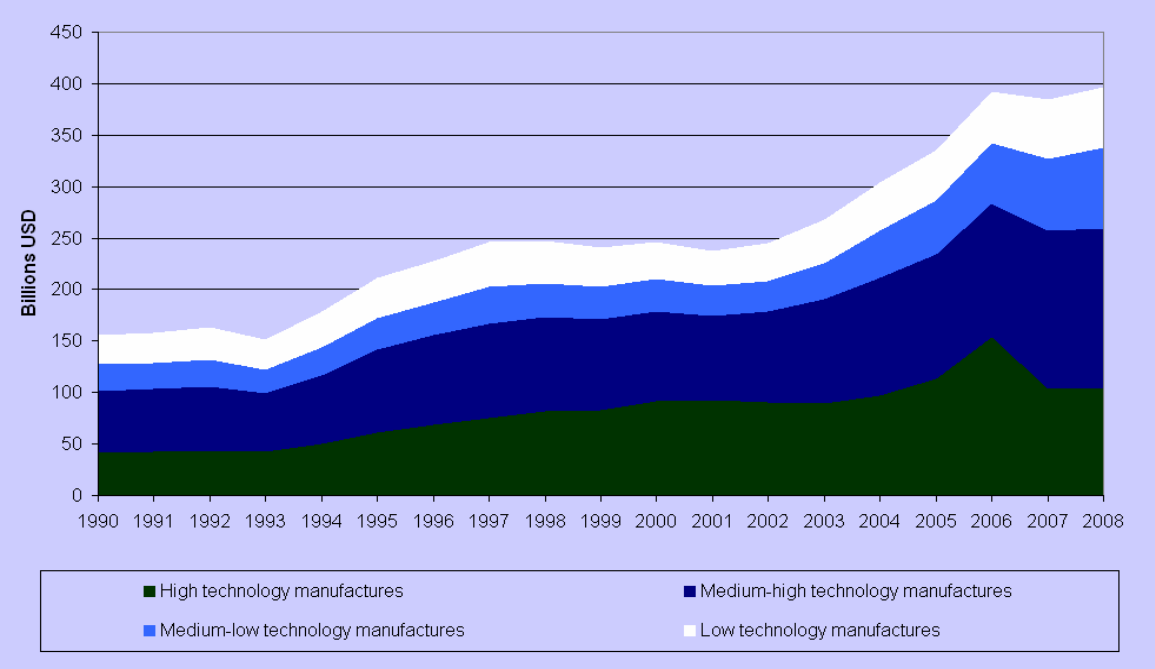


Source: OECD STAN Bilateral Trade Database
Figure for China taken from UNCTAD Handbook of Statistics 2009 and not directly comparable with OECD data

Importance *of higher technology* manufacturing *exports*

Figure 15 below shows that UK manufacturing exports have increased significantly in value terms since 1990, the majority of which are in goods produced by the high and medium-high technology industries.

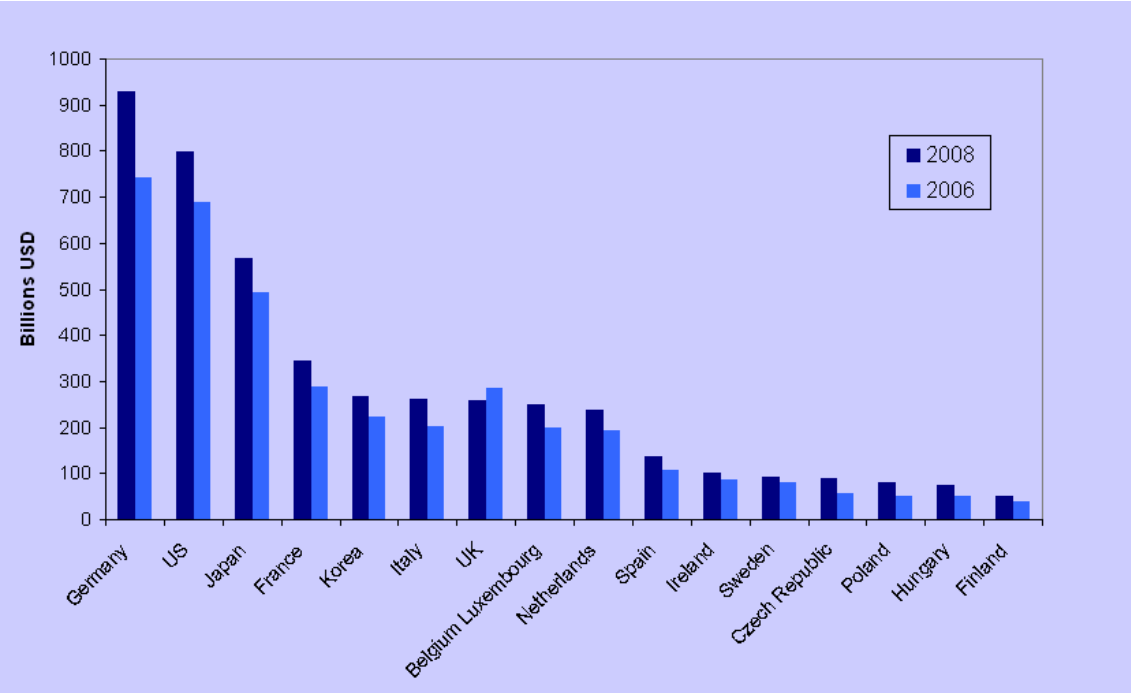
Figure 15: UK manufacturing exports, by technology, 1990-2008



Source: OECD Bilateral Trade Database

In the UK, in 2008 65% (or $260bn US dollars) of manufactured exports were of high or medium-high technology. This meant the UK was the seventh largest OECD exporter of these goods in 2008 compared to fourth largest in 2006 (see Figure 16 below)[8].

Figure 16: Exports of high and medium-high technology manufacturing goods by value in UK and comparator countries

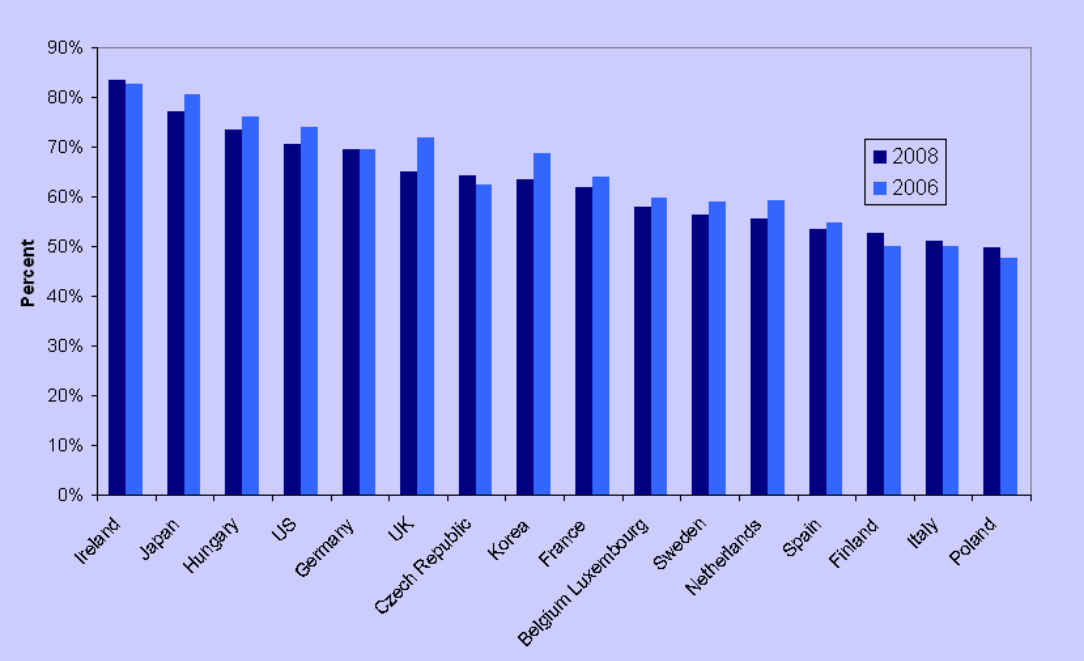


Source OECD STAN Bilateral Trade Data

Figure 17 shows that in the UK, the share of high or medium-high technology manufacturing exports in total manufacturing exports was lower in 2008 compared to 2006. The importance of high and medium-high technology exports in total manufacturing also fell back in a number of other leading manufacturing countries including Japan, the United States and France.

[8] Data is available for the UK in 2009 where the export share increased to 66%. This is during the height of the recession and is a result of total manufacturing exports falling faster than high and medium-high technology exports

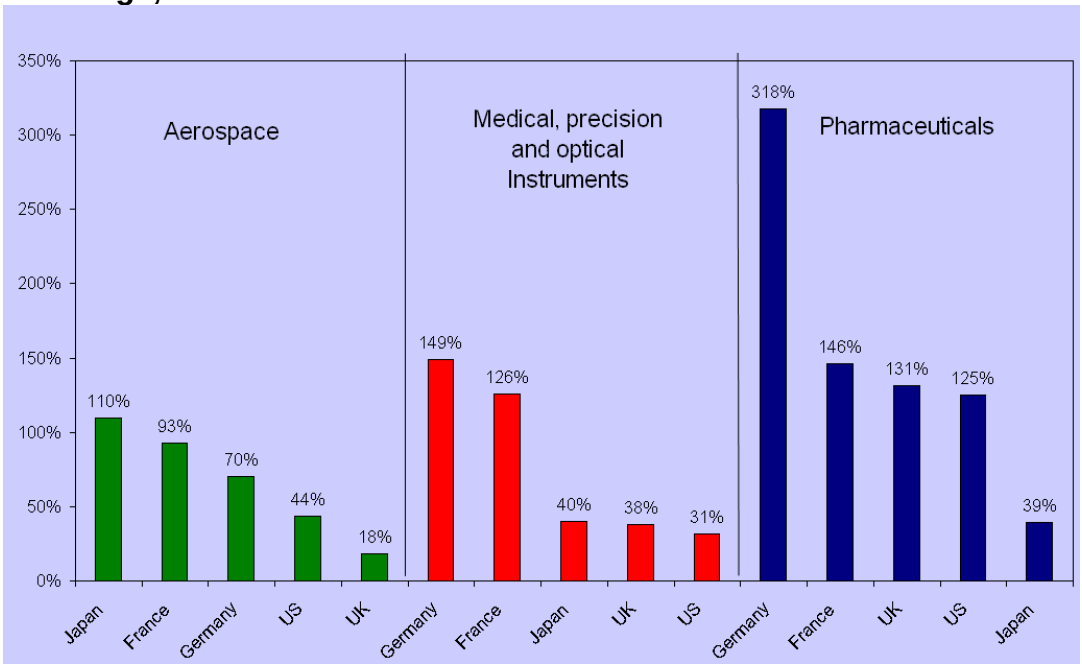
Figure 17: Exports of high and medium-high technology manufacturing goods as a percentage of total manufactured goods exports



Source OECD STAN Bilateral Trade Data

Within the high technology industries the UK has increased its exports in real terms in Aerospace, Precision Instruments and Pharmaceuticals since 2000. However, in many cases, this has been at a slower rate compared to other leading manufacturing countries. In Pharmaceuticals, the UK has kept pace with France the US although has been outstripped by Germany which has seen growth exceeding 300% over this period (see Figure 18).

Figure 18: Growth in high technology exports by sector where the UK has a comparative advantage, 2000-2008



Source: BIS calculations based on OECD STAN Bilateral Trade Database

Figures 19 through 27 show the main exporters of the following high-tech products: Aerospace, Armaments, Chemistry, Computer and Office Machinery, Electrical Machinery, Electronic Telecommunications, Non-electrical Machinery, Pharmacy and Scientific Instruments[9]. The data reveals that:

1. The UK is one of the leading exporters in the areas of Aerospace, Chemistry, Pharmaceutical Products and Scientific Instruments

2. In many of these high-tech industries our main competitors continue to be developed countries including France, Germany, US and Japan.

3. China has already emerged as a leading competitor in the areas of Chemistry, Computer, Office and Electrical Machinery and Electronic Telecommunications Equipment.

Figure 19: Aerospace exports, 2008

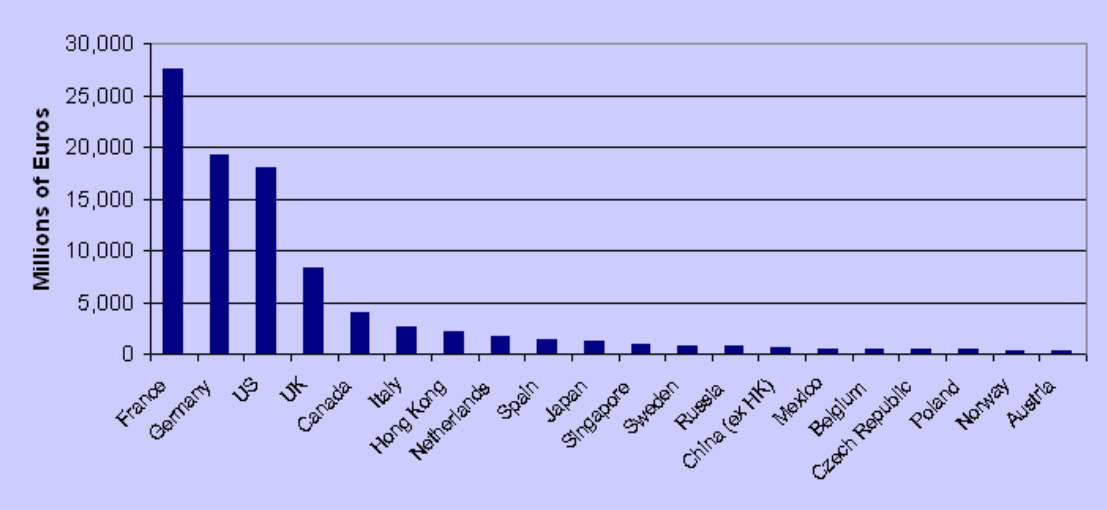
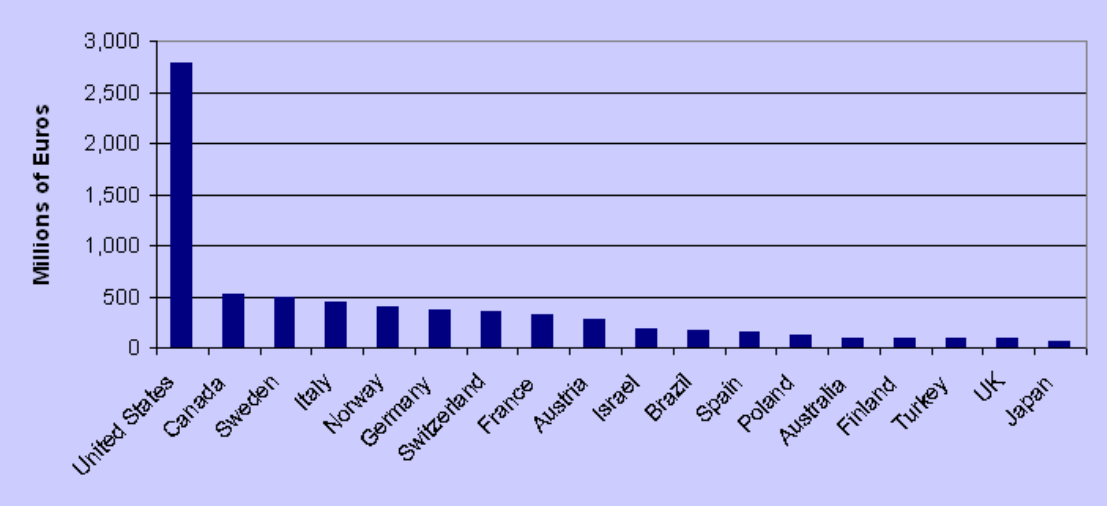


Figure 20: Armament exports, 2008



[9] These are the different categories of high-tech exports used by Eurostat.

Figure 21: Chemistry exports, 2008

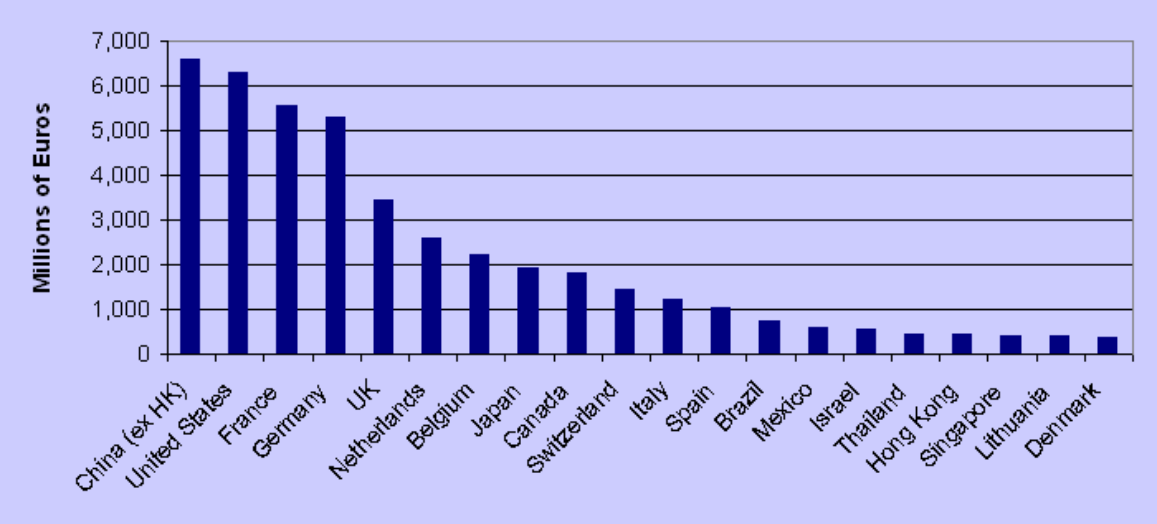


Figure 22: Computer and Office Machinery exports, 2008

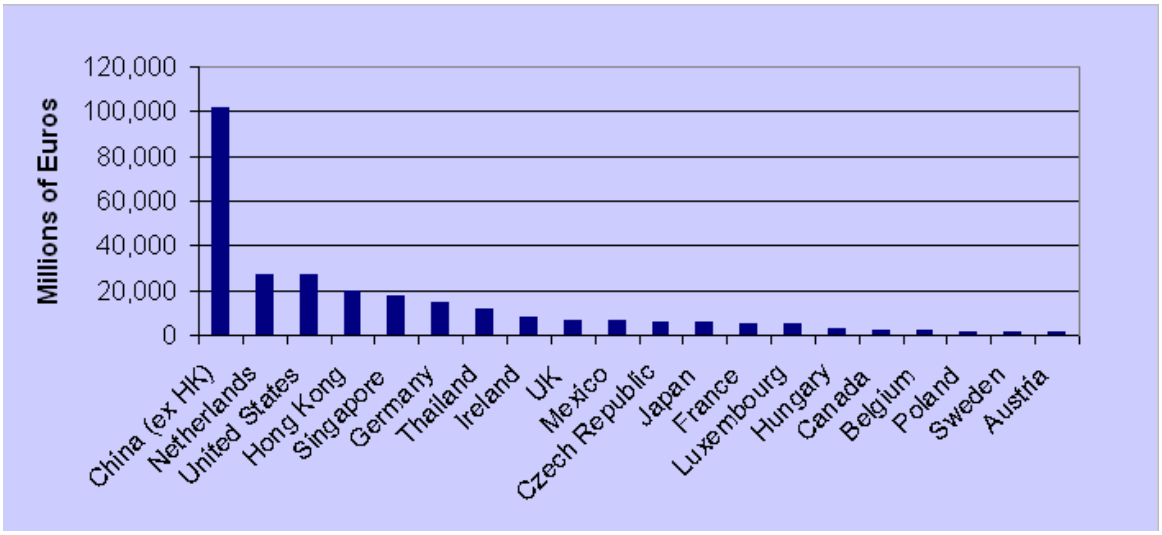


Figure 23: Electrical Machinery exports, 2008

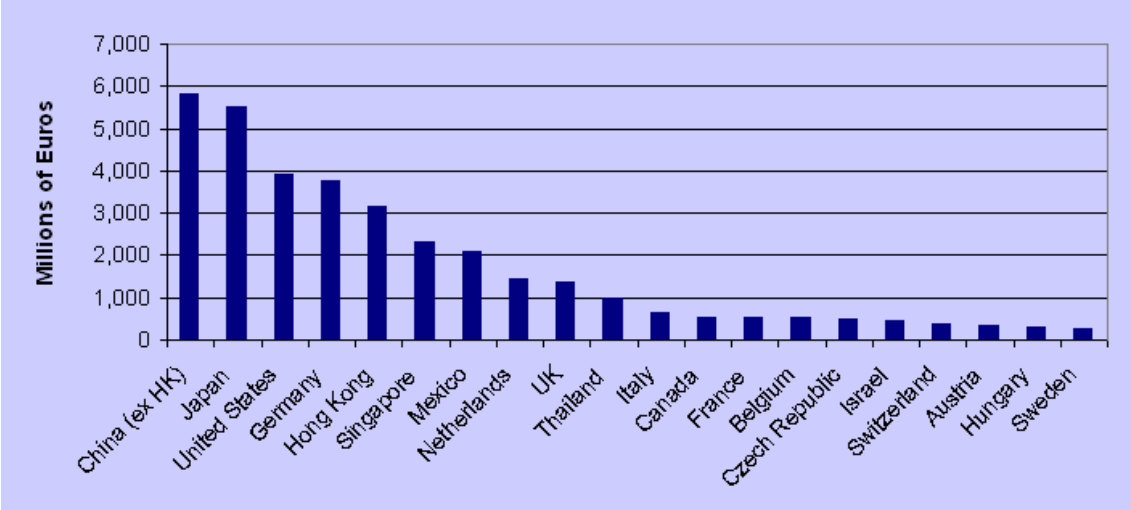


Figure 24: Electronic Telecommunications exports, 2008

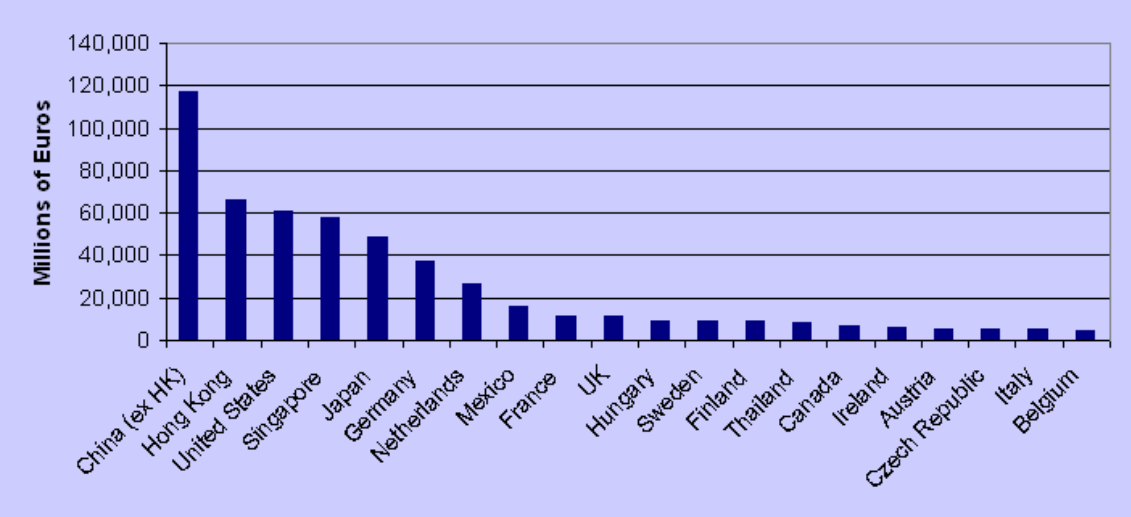


Figure 25: Non-electrical Machinery exports, 2008

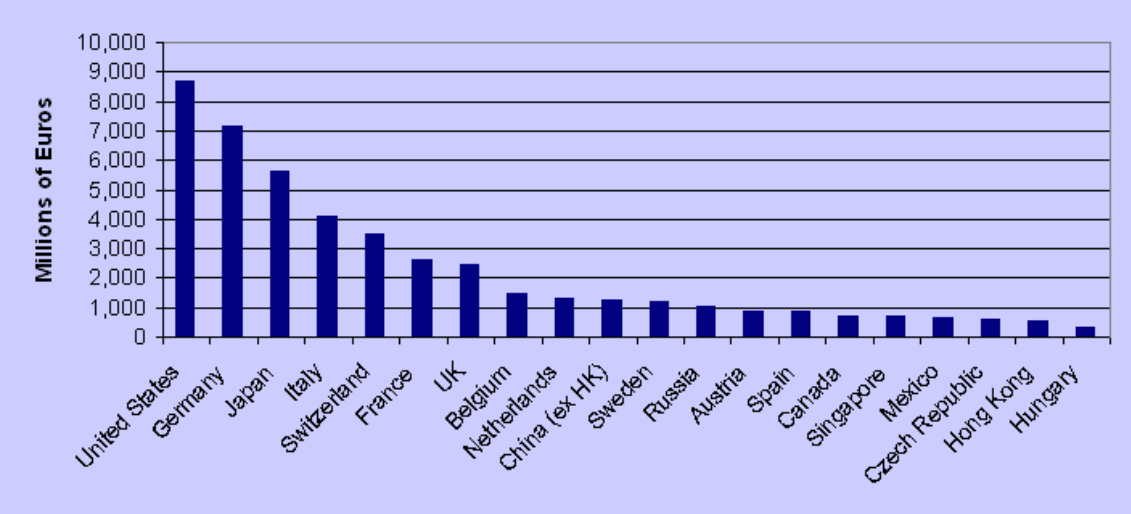


Figure 26: Pharmaceutical exports, 2008

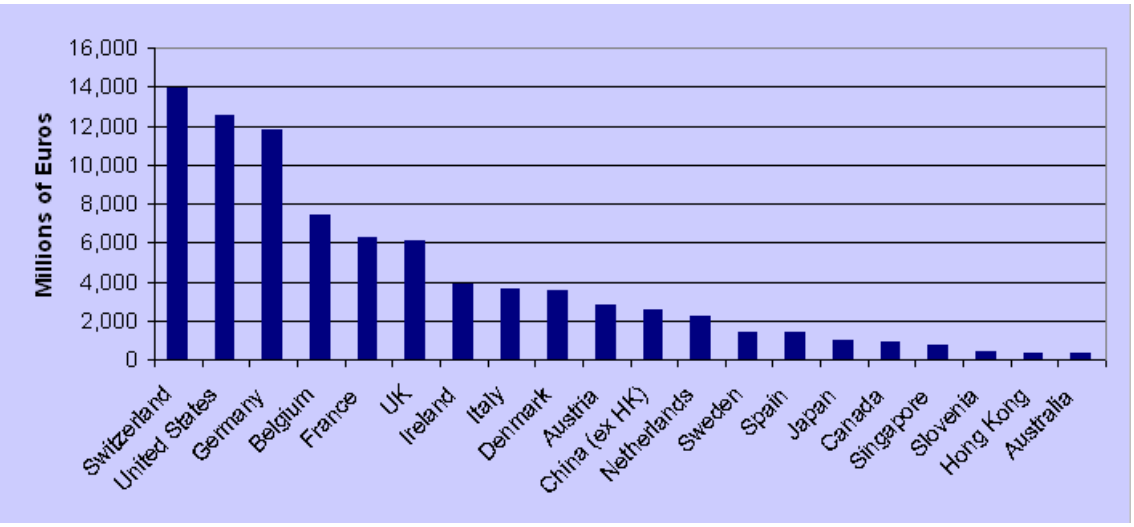
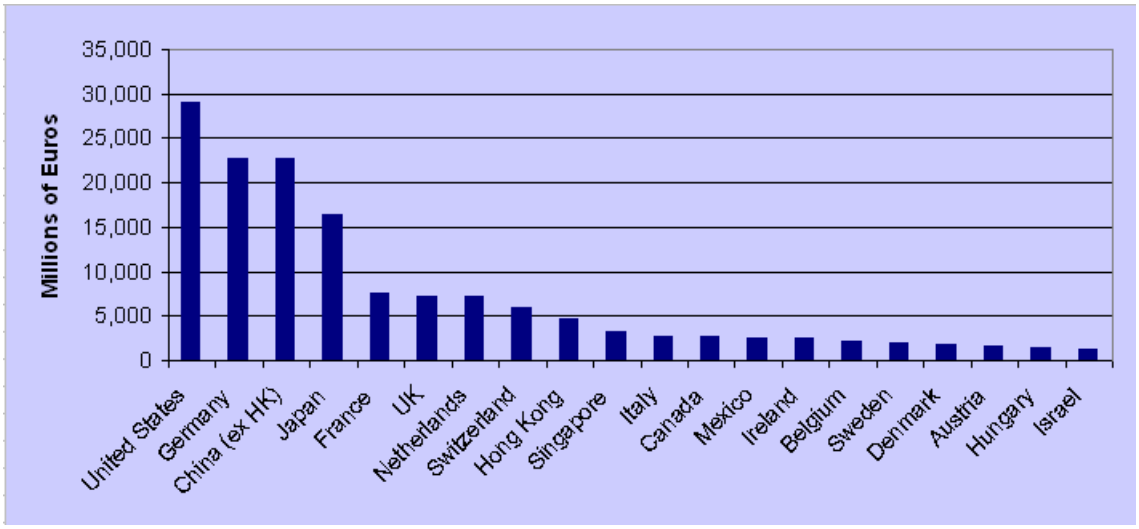


Figure 27: Scientific Instruments exports, 2008



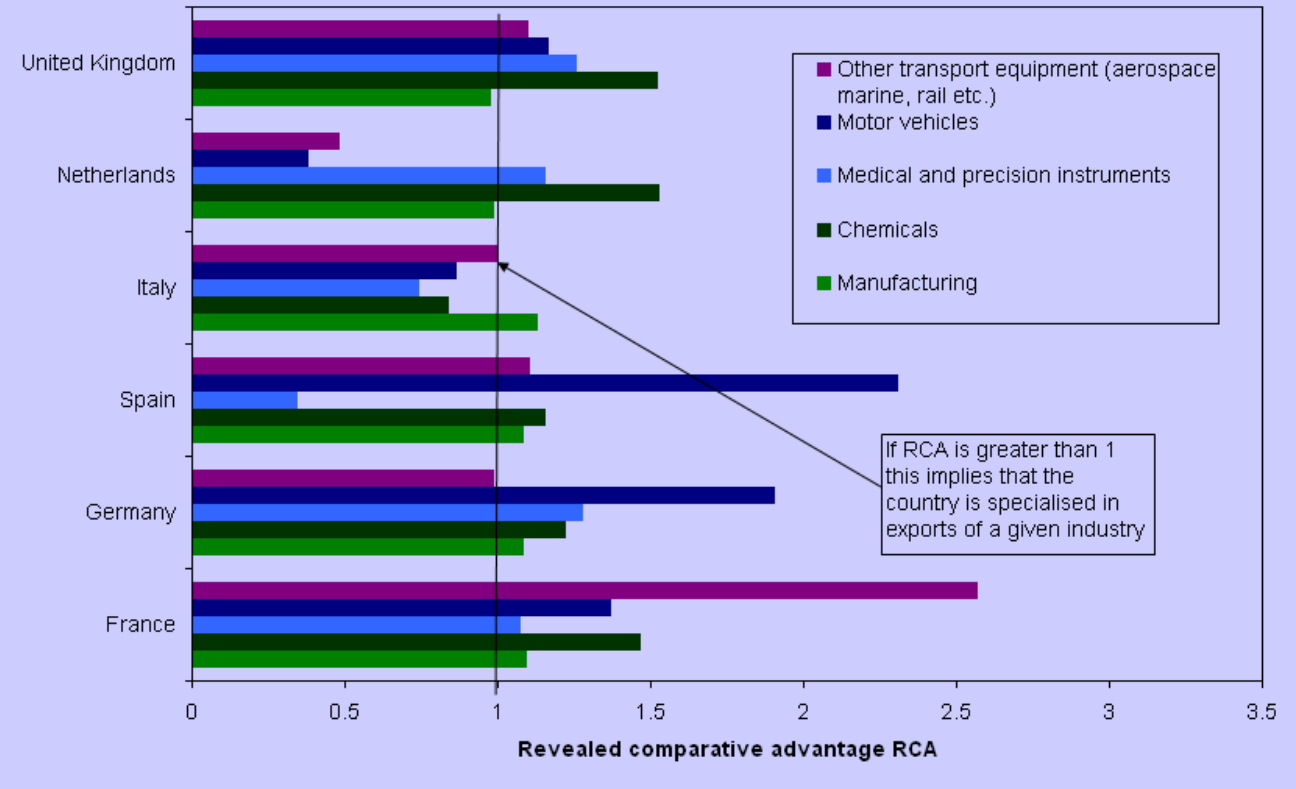
Sources for figures 19-27: Eurostat High-tech statistics

Comparative Advantage

Comparative advantage/disadvantage in export terms means that a country exports more/less of a certain product than would be suggested by its share of total world exports. It does not necessarily mean that a particular industry is in decline or ascendancy but is simply measure of a country's export specialisation during the reference period.

As can be seen in Figure 28 the UK has a comparative advantage in all the higher technology sub sectors displayed here with the most notable strengths in Chemicals and Medical, Precision and Optical Instruments.

Figure 28 Comparative advantage in high and medium-high technology manufacturing exports broken down by industry for UK and comparator countries



Source: Based on OECD Micro Trade Indicators Data

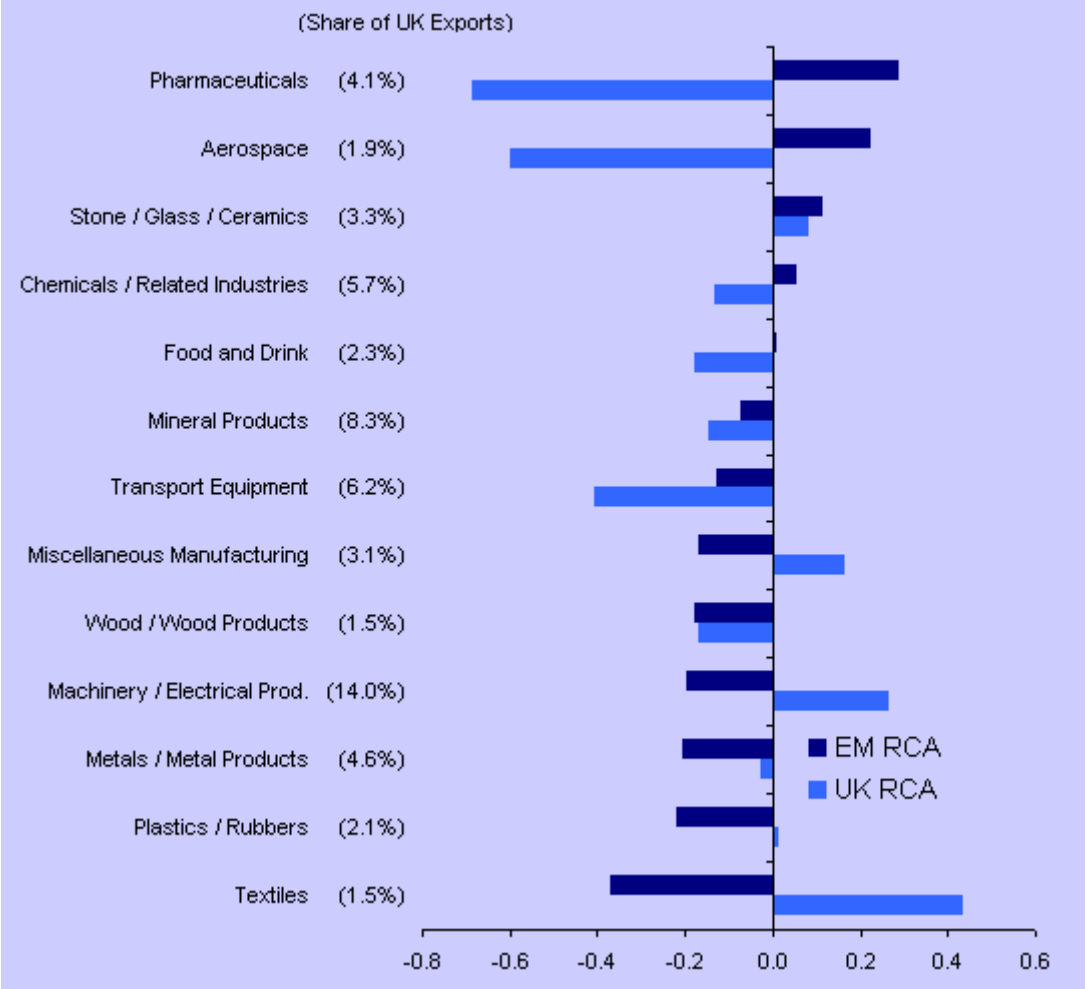
Available OECD data is not sufficiently detailed to illustrate the UK's particular specialisations in Pharmaceuticals (within Chemicals) and Aerospace (within Other Transport Equipment) but does show that UK specialisations do exist in the higher technology manufacturing industries in common with other developed economies.

Figure 29 overleaf compares the comparative advantages/disadvantages of the UK to those of emerging markets[10] (based on trade data); illustrating manufacturing sectors where the UK (and generally other developed economies) tends to specialise versus those where emerging market are concentrating.

The UK has the largest comparative advantage in high-technology sectors such as Aerospace and Pharmaceuticals, areas where emerging markets are comparatively weak. At the other end of the scale are areas of comparative disadvantage for the UK such as Textiles (where emerging markets are particularly strong), Plastics and Rubber, Metals and Machinery.

[10] Emerging markets are defined here as being China, Hong Kong, India, Indonesia, Malaysia, the Philippines, Singapore and Thailand.

Figure 29: Revealed Comparative Advantage in manufacturing sectors – UK and emerging markets 2008



Source: IMF BoP Database, UN COMTRADE (HS 2002)

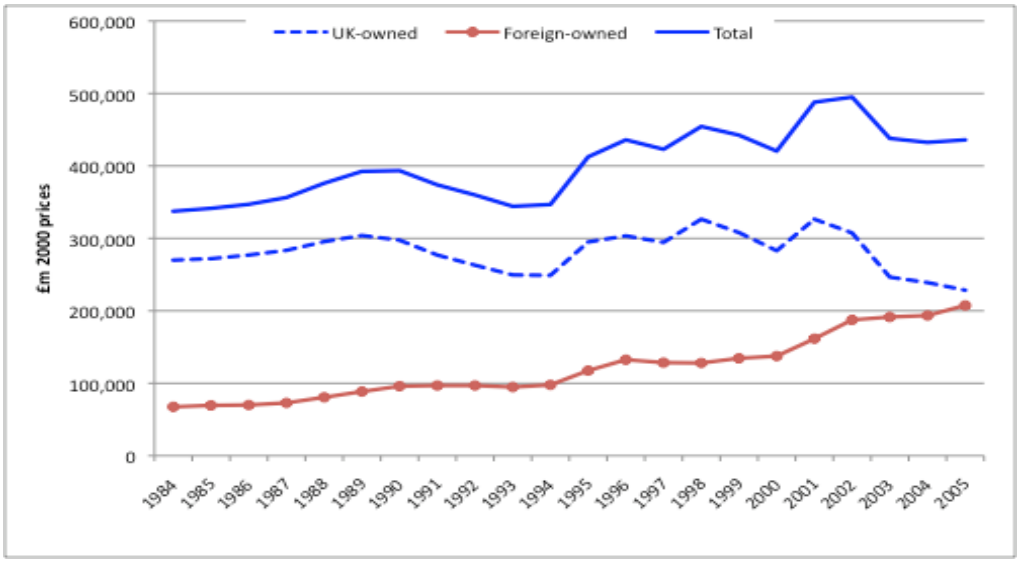
Note: Blue bars to the right indicate UK strengths; red bars to the right indicate emerging market strengths

Foreign Direct Investment (FDI)

According to data from UKTI's Inward Investment Report in 2009/10 inward FDI projects in the areas of advanced manufacturing, Life Sciences, ICT and Environmental Technology accounted for around a third of the 1,619 UK inward investment projects in 2009/10. A similar percentage of projects related to R&D and manufacturing.

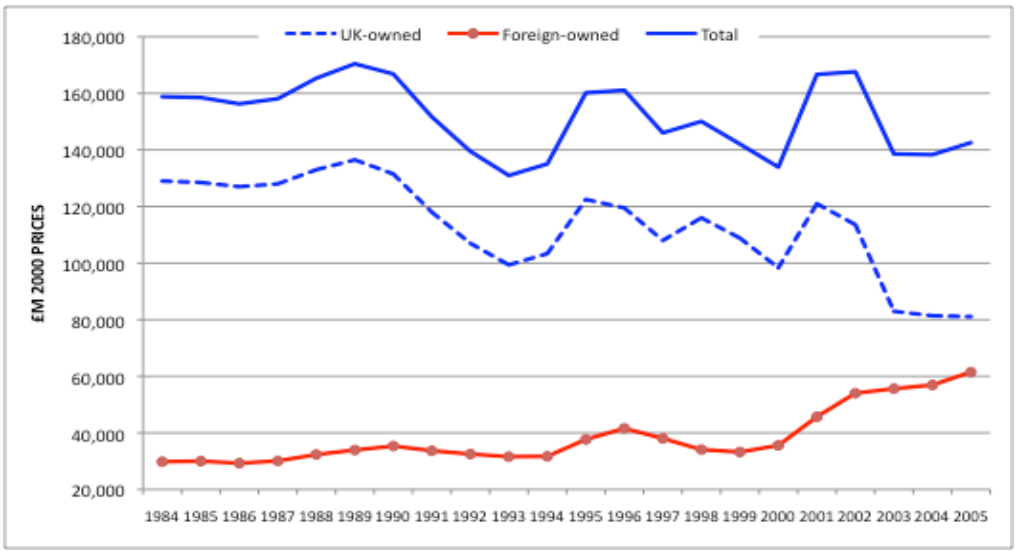
The contribution made by foreign-owned firms to output and total GVA in the manufacturing sector in Great Britain has been steadily rising since the mid 1980s, while that made by UK firms has declined (see Figures 29 and 30 overleaf). This trend reflects the UK Government's policy of promoting open and competitive markets.

Figure 30: Manufacturing Gross Output, Great Britain, 1984-2005



Source: Harris (2009) The Effect of Foreign Mergers and Acquisitions on UK Productivity and Employment. Report Submitted to UKTI October 2009

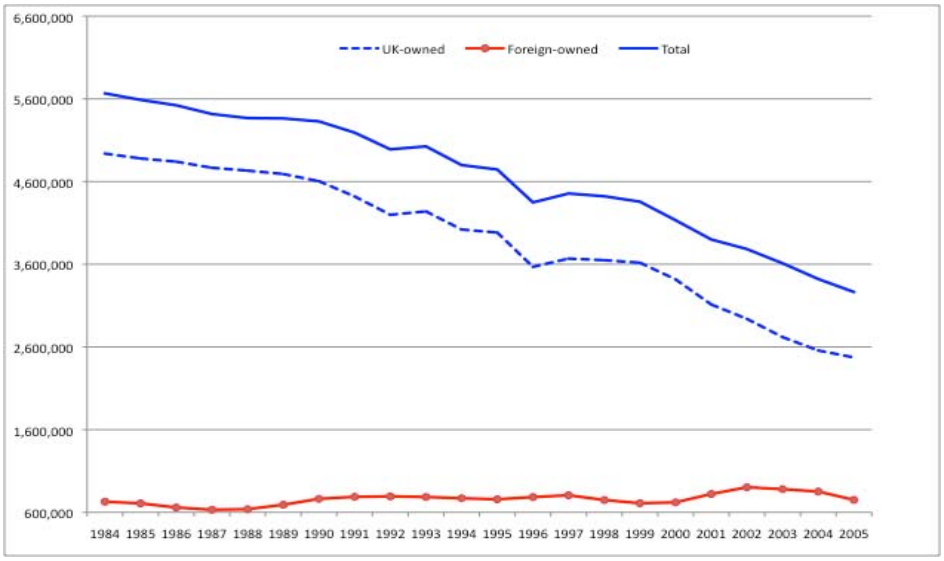
Figure 31: Manufacturing Value Added, Great Britain, 1984-2005



Source: Harris (2009) The Effect of Foreign Mergers and Acquisitions on UK Productivity and Employment. Report Submitted to UKTI October 2009

In terms of manufacturing employment, the long-term trend for foreign-owned establishments is that of steady or even slightly increasing employment, though there has been a decline since 2002. This is in sharp contrast to the clear downward trajectory of UK-owned manufacturing employment. However this is due to foreign ownership gaining a gradually greater share of manufacturing as is evidenced by foreign ownership shares of output and GVA and not necessarily attributable to any propensity of foreign owners to recruit and retain more staff than UK owners (see Figure 32).

Figure 32: Manufacturing employment, Great Britain, 1984-2005



Source: Harris (2009) The Effect of Foreign Mergers and Acquisitions on UK Productivity and Employment. Report Submitted to UKTI October 2009

Skill levels and salaries

Skills base

There has been an improvement in the education levels of manufacturing workers with 17.1% holding a degree in 2009 compared with only 9.7% in 1994 – almost double. Educational attainment was already considerably higher among production and support service professional, R&D development and sales & marketing workers and this is still the case – 31.7% of these employees held a degree in 2009 compared with only 3.1% of the remaining manufacturing workforce.

The upskilling of individuals across all occupational groups coupled with a shift in employment towards more highly skilled occupations has resulted in an overall rise in educational attainment in UK manufacturing (see Table 3).

Table 2: Educational attainment of individuals according to broad occupational group

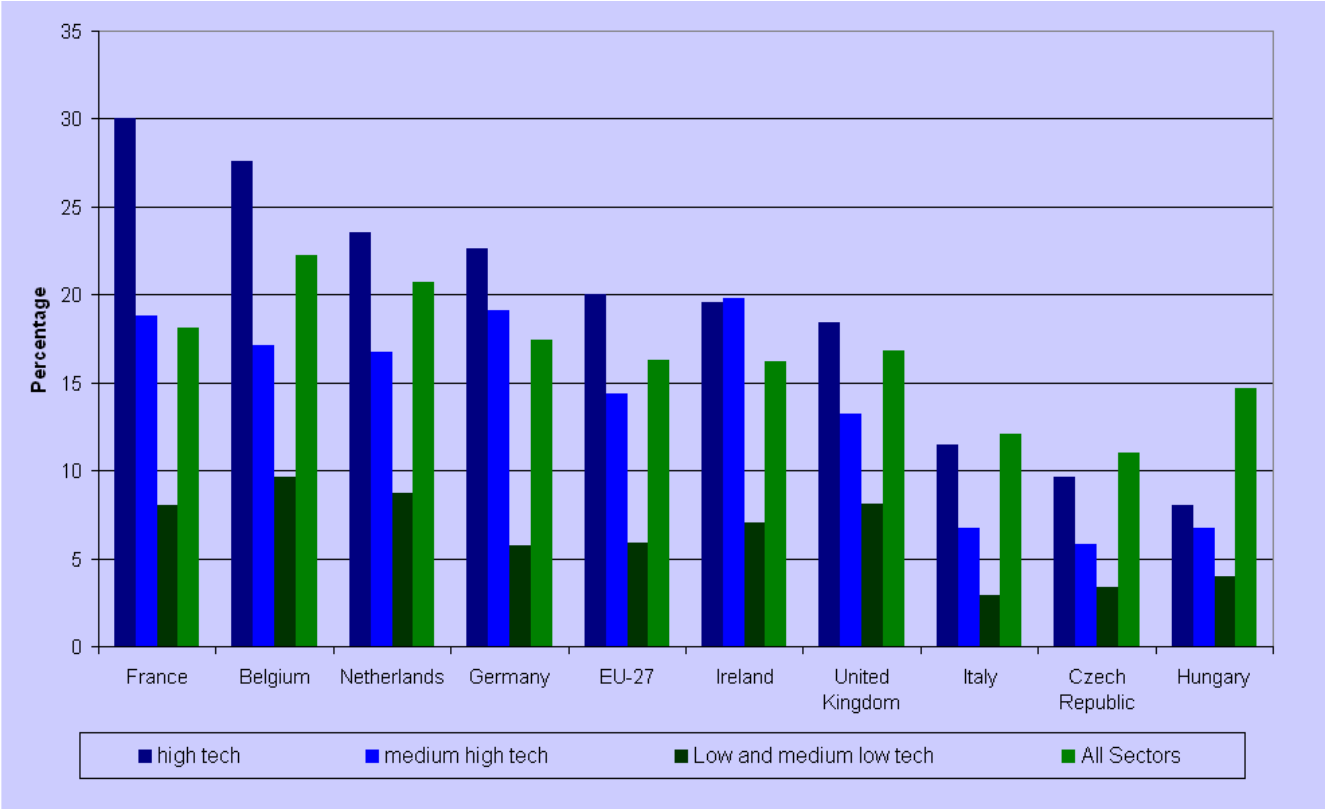
	Employment share (%)		Proportion with NVQ level 3 and above (%)		Proportion with degree or equivalent (%)	
Occupation	**1994**	**2009**	**1994**	**2009**	**1994**	**2009**
Production, trades; Support services, trades; Logistics & distribution	58.3	51.0	35.0	37.7	1.6	3.1
Production, professional; R&D, development; Support services, professional; Sales & marketing	41.8	49.0	63.2	69.8	22.8	31.7
All manufacturing	**100**	**100**	**45.8**	**53.5**	**9.7**	**17.1**

Source: BIS calculations based on ONS Labour Force Survey data

Across all countries (with the slight exception of Ireland) the percentage of professionals and technicians with tertiary level education is highest in the high technology manufacturing sectors and lowest in the lower technology sectors.

The UK appears to lag behind most of its European competitors, including the EU average, though this measure should be viewed with some circumspection. Tertiary education will differ across countries it terms of quality and level as well as take-up in the population. Long-term cultural and structural factors will influence the general involvement in tertiary education so comparisons with some countries (particularly Scandinavian countries but also perhaps Belgium and the Netherland) might be misleading (see Figure 33).

Figure 33: Persons employed as professionals or technicians with tertiary level education as a percentage of total employment in the manufacturing sector by technology intensity in the UK and comparator countries



Source: Eurostat, Science, Technology and Innovation in Europe (2010); Table 4.20 page 111; 2007 data

Interestingly, while across all sectors the proportion of professionals with tertiary education in the UK is comparable or higher than other member states; the proportion in high and medium-high technology manufacturing is lower. This is most apparent in the case of France where UK's overall percentage trails by just over one percentage point but in high tech manufacturing 30% of professionals in France have had tertiary education compared to 18.4% in the UK. In general this data does suggest that UK graduates and other tertiary qualified professionals are less likely to work in manufacturing (particularly high-technology manufacturing) than the UK's European competitors

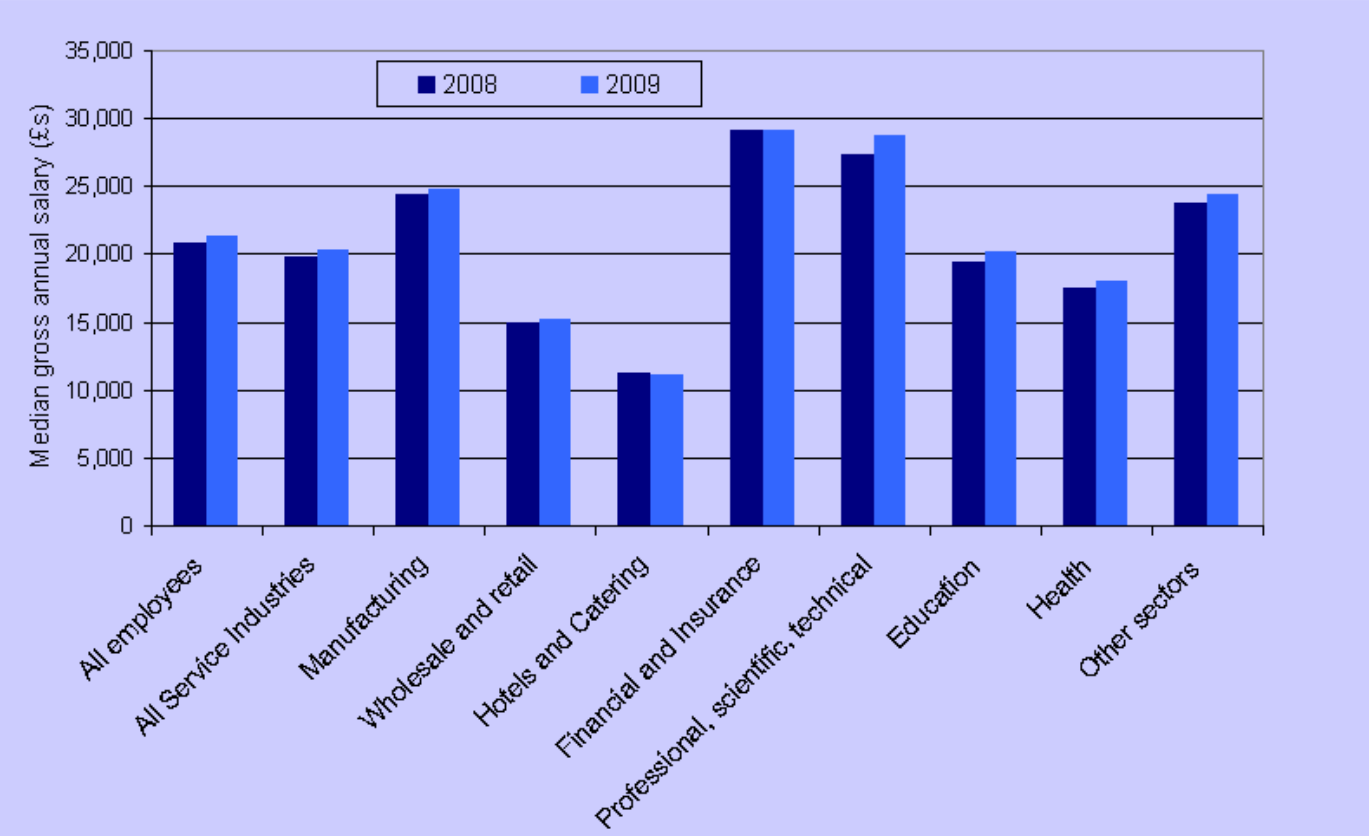
The same is not true however for low/medium-low technology manufacturing where UK's percentage of tertiary qualified professionals is over two percentage points greater than the EU average. The differential between high and low technology, in terms of proportions of third tier qualified professionals in UK is one of the lowest in Europe.

Salaries

Median salaries in the manufacturing industries are greater than overall median salaries in the UK economy and the median across all services industries. While there are several industrial sectors with median salaries greater than manufacturing (the larger ones including the financial and insurance sector and the professional, scientific and technical sectors) on average salaries in the UK manufacturing sector are comparable to other industries.

It is important to note that salaries vary across all industrial sectors including the manufacturing sector. Industry median annual salaries at the manufacturing subsector level can vary between £20,000 in the food manufacturing industry to £50,000 in the petroleum refining industry (see Figure 34). Medians are used here to give an average measure of salaries that will not be skewed by a small number of very high earners (a common problem when looking at mean salary data).

Figure 34: Median gross annual salary (£) selected industries in the UK economy.



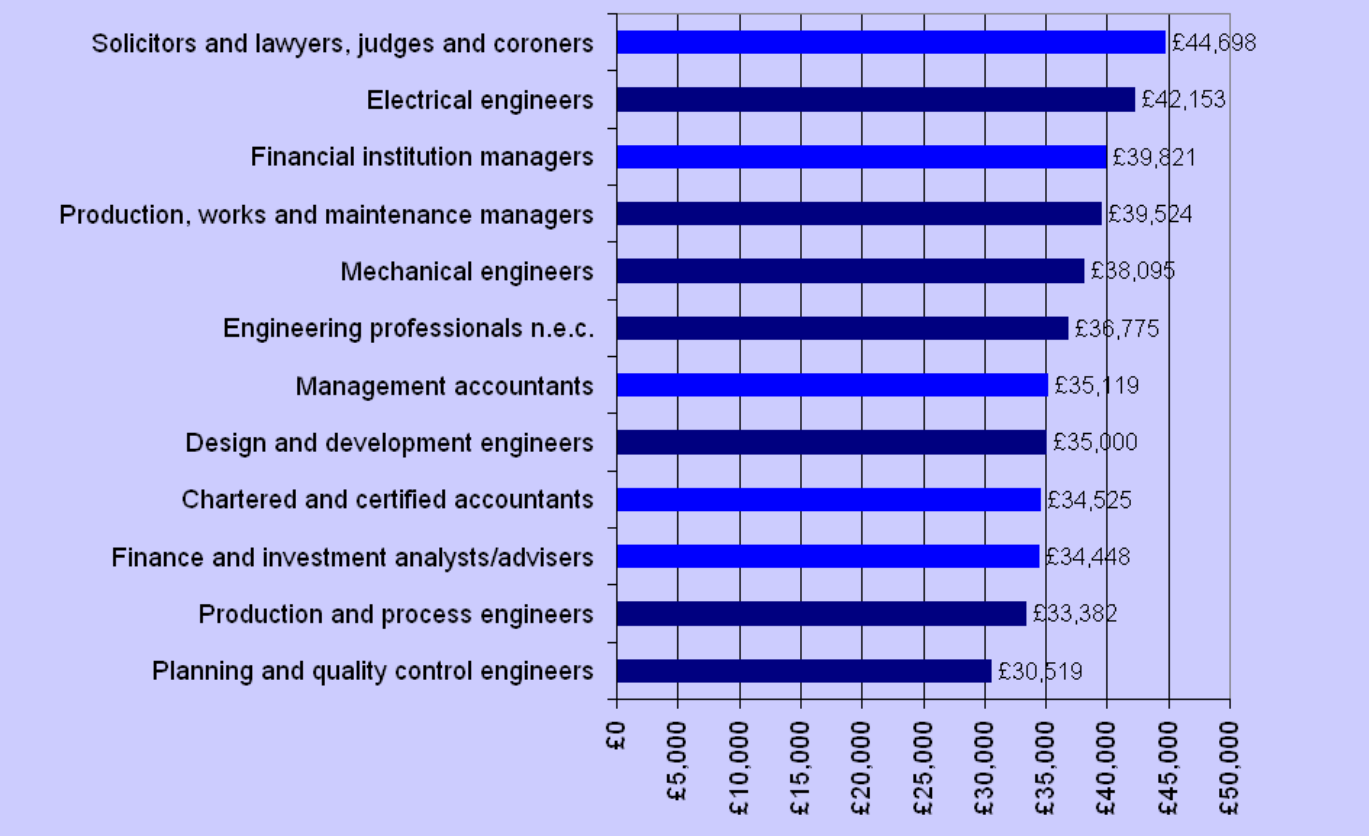
Source: BIS analysis based on Annual Survey of Hours and Earning, ONS

Occupational comparisons

As there are a wide range of professions within industries it may be more useful to look at the higher paid professions as these are where the most qualified and most in-demand employees will engage themselves.

Within manufacturing the key highly qualified jobs concern engineering. There ONS Annual Survey of Hours and Earnings collects data on an occupational basis as well as an industrial one. As can be seen in Figure 35 the median salaries in engineering occupations are comparable if not higher than those of many financial, legal and accounting occupations with electrical engineers almost as well remunerated as lawyers and solicitors.

Figure 35: Median gross annual salaries of selected engineering and non-engineering occupations 2009



Source: Annual Survey of Hours and Earning, ONS

A separate study by the Engineering and Technology Board reports salaries for incorporated and chartered engineers. This illustrates median salaries for progressive levels of qualified engineers as reported by a survey of registered engineers (see Table 4). These figures should not be compared directly with data in the charts above as they reflect levels of experience within engineering while Figure 35 reflects overall medians of professions.

Table 3: Registered engineers salaries

	Median Gross Salary 2007
Chartered Engineer	£50,000
Incorporated Engineer	£41,000
Engineering Technician	£33,000

Source: Engineering and Technology Board 2007 Survey of Registered Engineers

Innovation activity

The presence and persistence of high technology manufacturing requires innovation to continue the progression of technology. Research and development and other forms of innovation can increase productivity and expand the range and complexity of products available. This will be essential as the UK positions itself increasingly as an exporter of higher technology manufactured goods and developing nations continue to increase their dominance over low technology manufacturing.

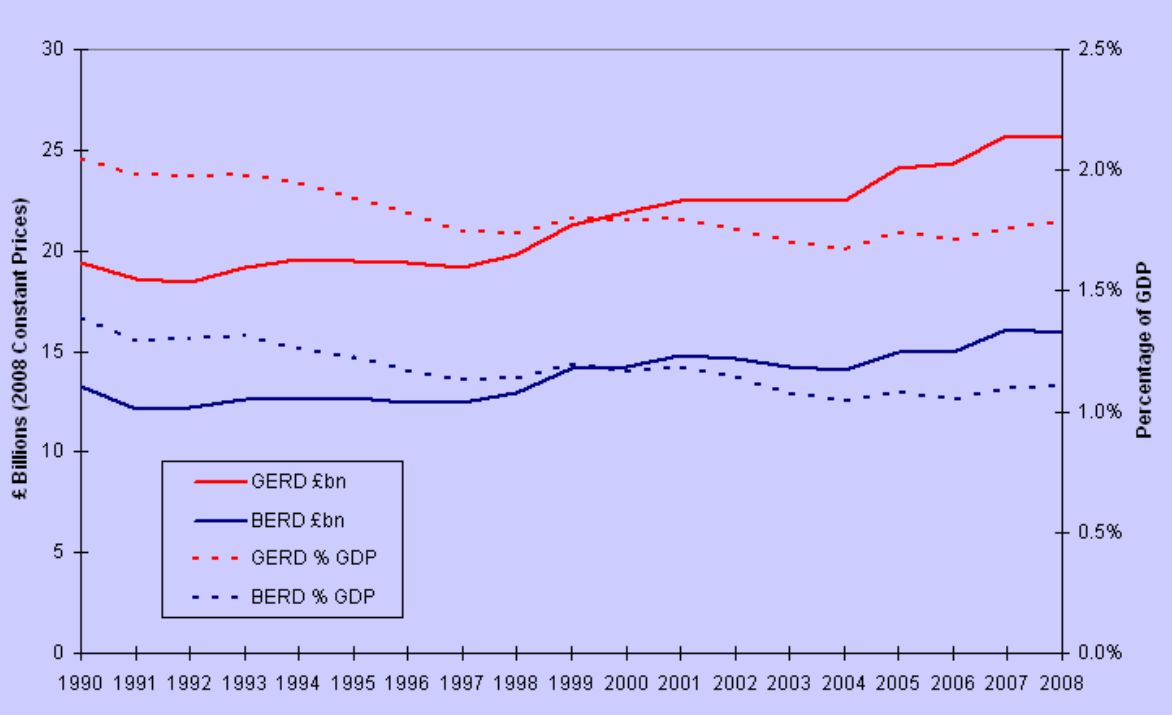
Research and development, particularly business enterprise research and development, is a well measured concept within international statistics and there is a large amount of data available both on a total and sectoral basis. However R&D spend in itself does not capture the full value of innovation activities, or indeed even R&D therefore other indicators of the science base are included.

Research and Development

The majority of business enterprise research and development has been focused in the manufacturing sector and the majority of that within high and medium-high technology industries.

As can be seen below in Figure 36, Gross Expenditure on Research and Development (GERD) and Business Enterprise Research and Development (BERD) in the UK has increased in real terms since 1990. However when compared with the growth of the economy the relative sizes of R&D expenditures have declined

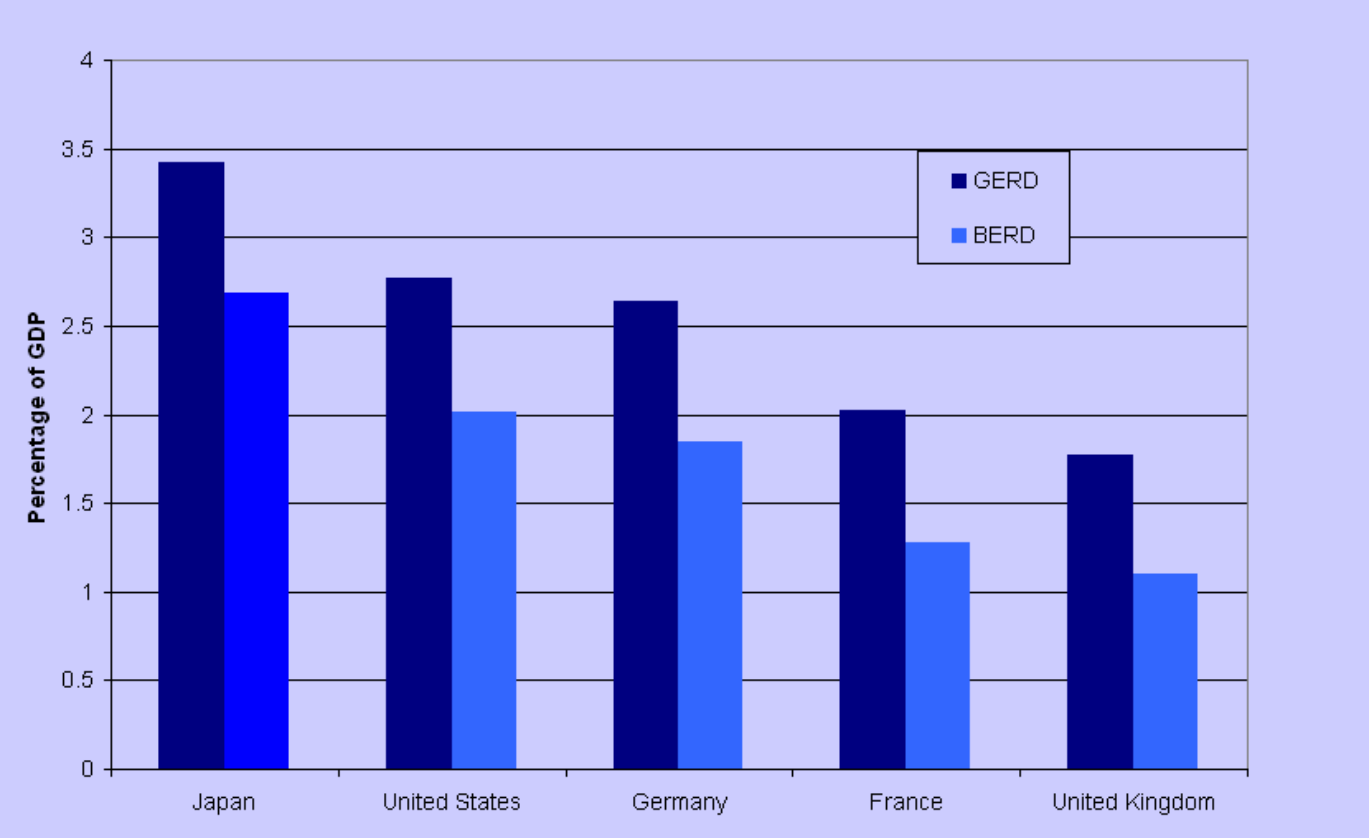
Figure 36: Gross expenditure and business enterprise research and development



Source: ONS BERD and GERD

When taken as a proportion of GDP both GERD and BERD are the lowest among selected leading manufacturing countries. This has been the case since 1990 and since then the gap between the UK and Germany, Japan and the US has widened, with these countries increasing their R&D expenditure as a proportion of GDP (often called R&D intensity). France, while still larger proportional investor than the UK has also been declining in R&D intensity (see Figure 37).

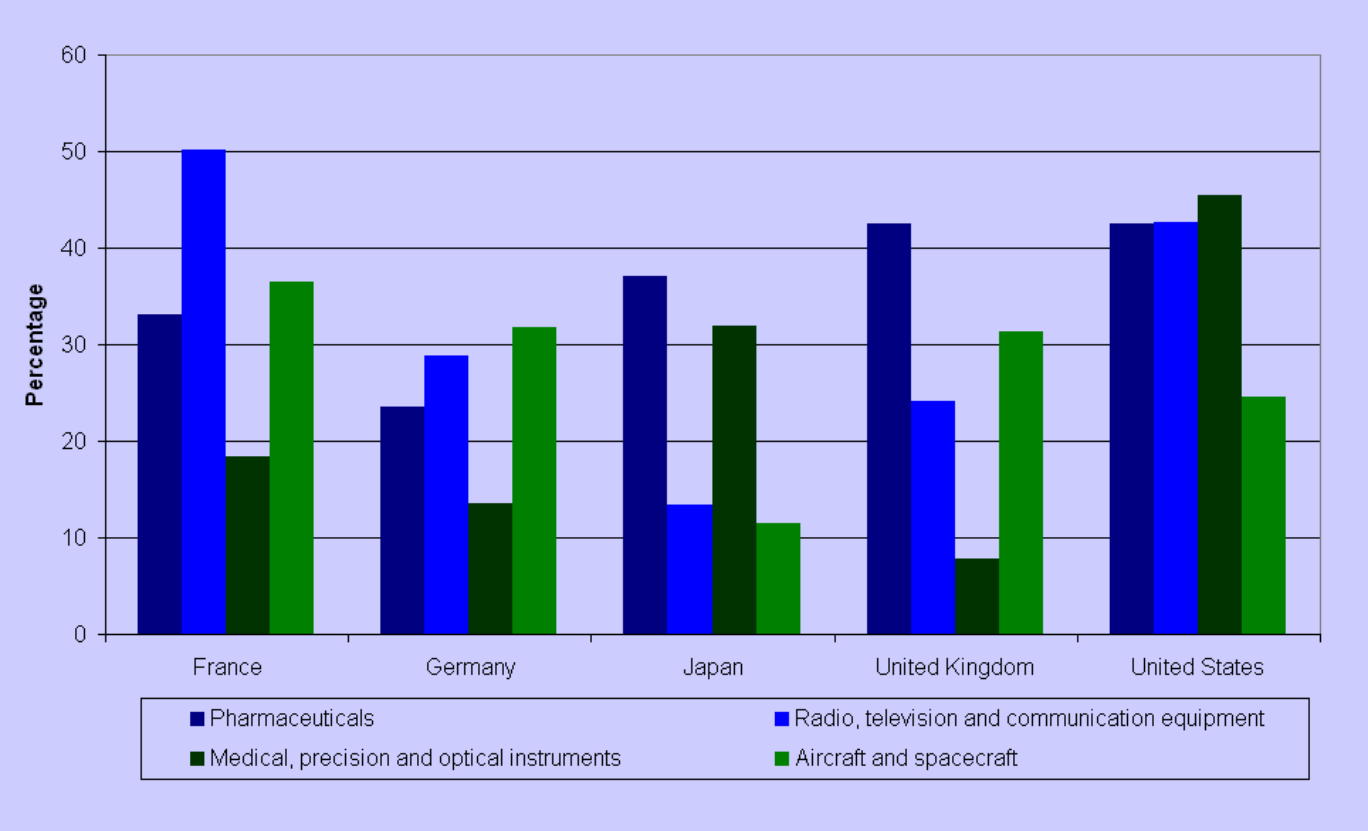
Figure 37: R&D expenditure as a percentage of GDP in 2008



Source: OECD Main Science and Technology Indicators

In the 2006, the latest year for which internationals comparisons are available across G5 countries the UK had the greatest R&D intensity (BERD as a percentage of value added) in the Pharmaceuticals sector which, alongside the US, is the highest in the World. Aircraft and Spacecraft are also a strength in UK R&D (see Figure 38).

Figure 38: High technology R&D expenditure as a percentage of GDP, 2006



Source: OECD STAN Indicators

Patent activity

Research and development is not the only measure of innovation activity. Having conducted research and created new products or processes, firms in many sectors seek to protect their investment from competitors through patenting.

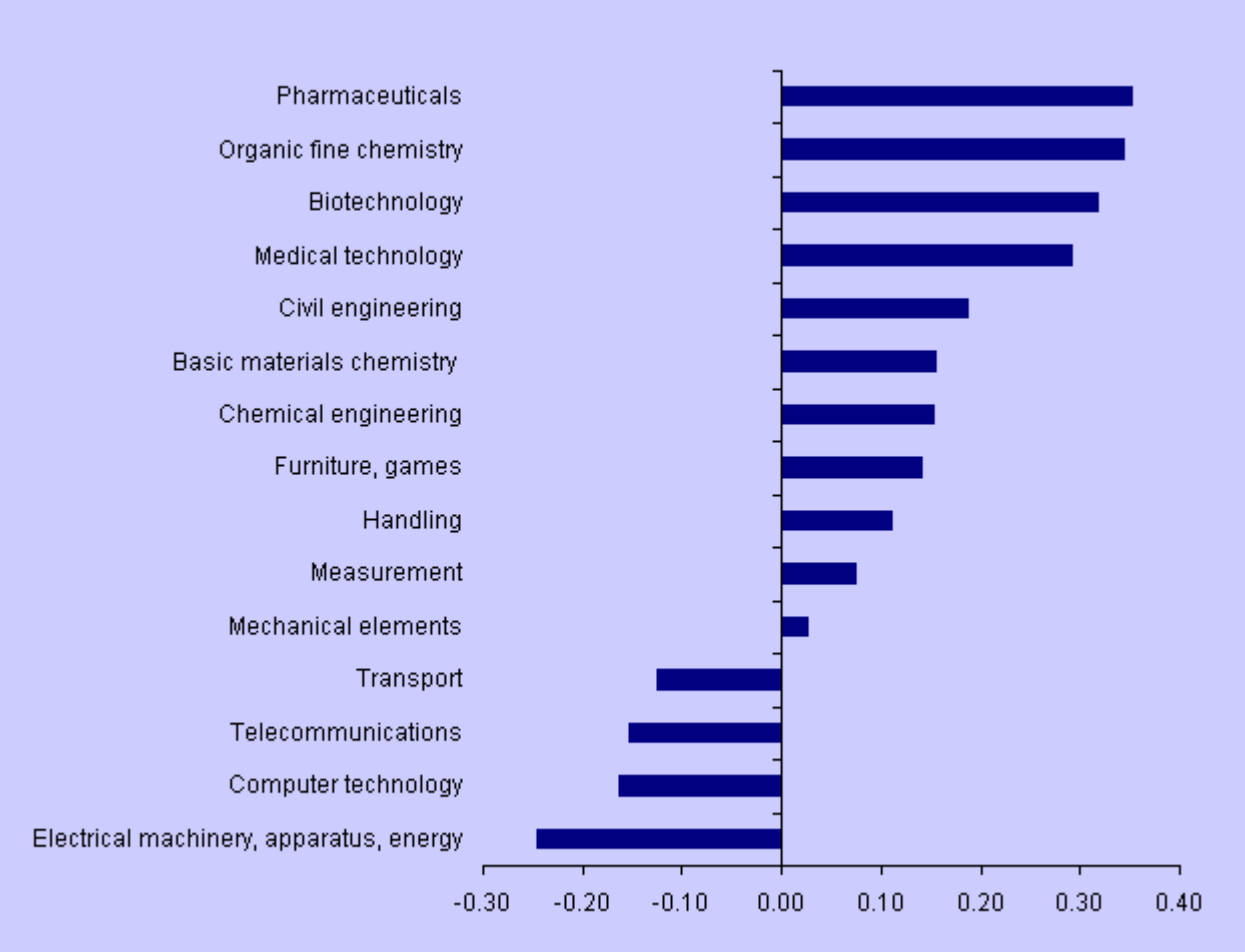
Figure 39 shows the ratio of UK patenting activity in selected technologies to what we would expect given global technological patterns and the UK's overall number of patents.[11] The chart shows that the UK has particular strengths around Organic Chemistry, Biotechnology and Medical Technologies, but are generally less strong in technologies such as Telecommunications, Computer Technology and Electrical Machinery (although anecdotal evidence points to strengths in particular niches that cannot be separately identified in the statistics, such as Plastic Electronics).

However the information in this chart should be viewed with some caution. While propensity to use patents as a method of intellectual property protection is likely to be consistent within industries across different countries the size of businesses is also likely to be an important

[11] Clearly, many firm and sectors will not use patents as their sole or even primary means of Intellectual Property protection. But we might expect that any under-use of patents would be consistent for a given industry across countries. Patent data therefore provides an initial indication of some technological strength.

factor. Large firms are more likely to utilise patents and have the resources and patience to go through the patent process. Smaller business may simply choose to use secrecy and bring products to market as quickly as possible before competitors can copy their designs. Also smaller companies may not have the resources to use the patenting system as efficiently as larger companies.

Figure 39: Comparative technological advantage in particular technologies based on number of patents for UK and emerging economies



Source: WIPO Statistics Database, July 2009.

Collaboration

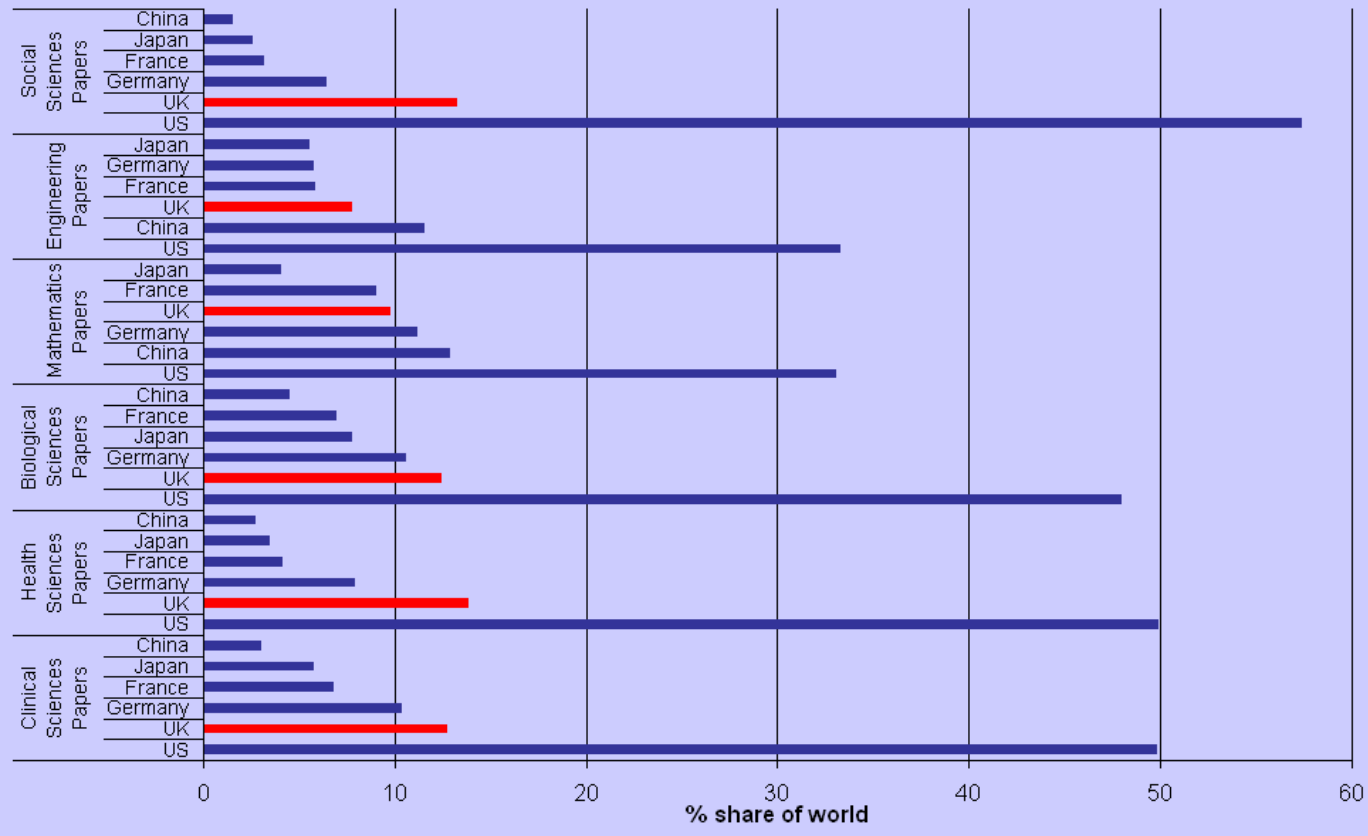
Co-authorship of research publications provides a direct measure of collaboration in science. International co-authorship has been growing fast, facilitated by the growing dominance of English as a common language in scientific institutions and advances in communication technologies. In 2007, almost 22% of scientific articles involved international co-authorship, a figure three times higher than in 1985. Increases in domestic and international co-authorship point to the crucial role of interaction among researchers as a way to diversify their sources of knowledge.

Nearly 50% of all scientific articles published in the UK were internationally co-authored in 2007, over twice the World average and exceeded only by fellow large European countries, France

(51%) and Germany (53%). In contrast the proportion of international co-authorship in the US and Japan was 30% and 25% respectively (see Figure 40).

With between 30% and 57% of all scientific citations, depending on subject, the US is the clear leader in scientific citations, which is not entirely surprising given the sheer size of the US science base. However UK scientific articles are the second most cited in clinical, health biological and social science papers. The dominance of the English language may be an influencing factor here (though despite this China performs very well in mathematics and engineering papers) but this does show the high regard the products of the UK science base are held in internationally.

Figure 40: Share of world citations by discipline, 2008



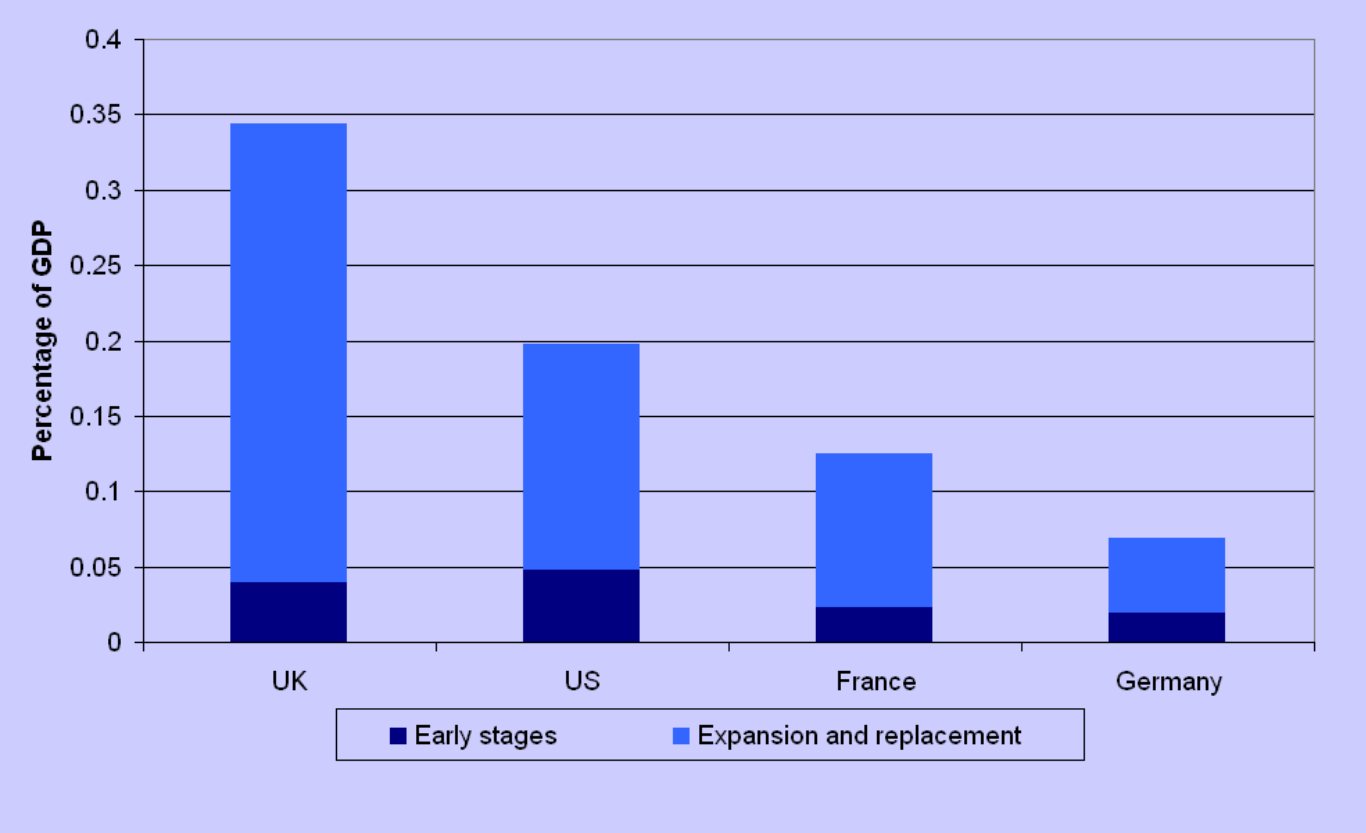
Source: DIUS (2009)

Access to Finance

According to Eurostat data, UK businesses have enjoyed greater access to early stage venture capital than their European neighbours. Also later stage venture capital and business angel finance appears to be relatively plentiful.

The UK has performed well in comparison to France, Germany and the US on levels of venture capital investment as a proportion of GDP, suggesting that UK firms have had less difficulty accessing this kind of finance relative to firms in comparator economies. Regarding venture capital for early stage investment, 2008 data illustrates that the US has overtaken the UK by a small margin, but the UK still leads France and Germany. As regards venture capital for expansion and replacement, 2008 data shows that the UK still leads the US, France and Germany (see Figure 41).

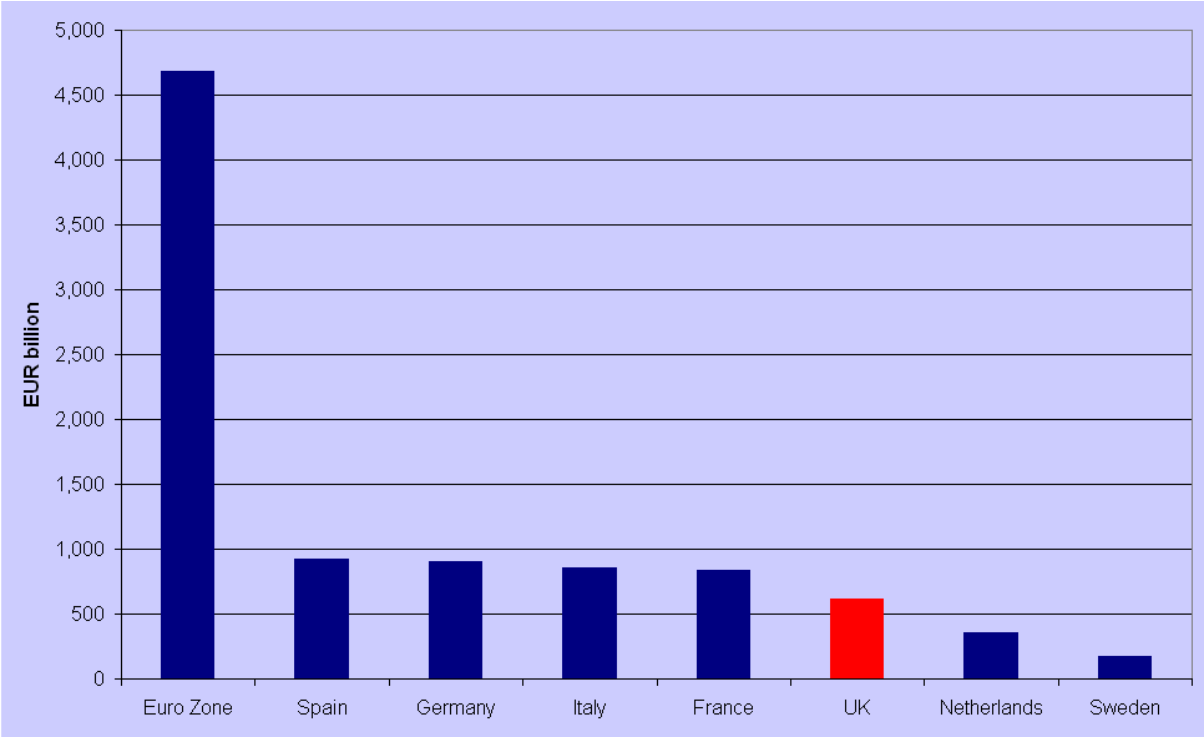
Figure 41: Venture capital investments at different financing stages as a percentage of national GDP, 2008



Source: Eurostat data

However UK businesses appear to have had less access to loan finance. In 2008, 614 billion Euros of loans were granted to enterprises in the UK, which was less than in Germany, France and smaller Euro Zone economies Spain and Italy (see Figure 42).

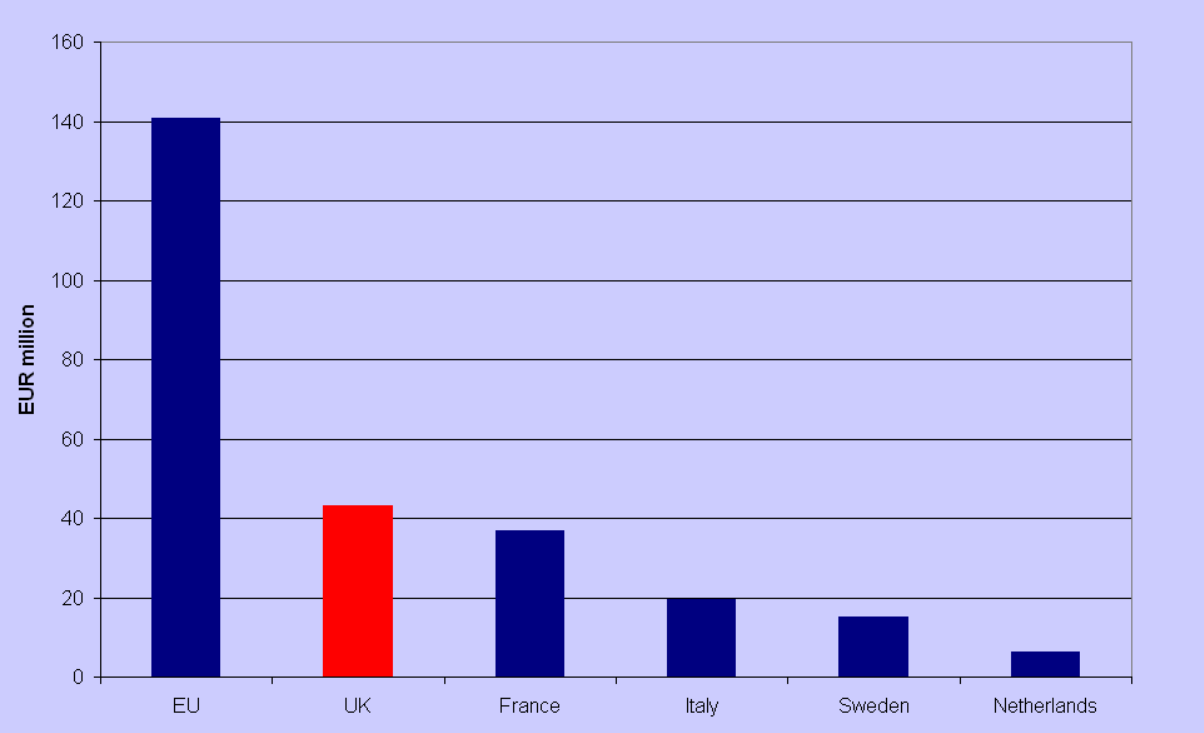
Figure 42: Loans granted to enterprises in 2008



Source: European Commission, Enterprise Finance Index statistics

In 2008 UK businesses enjoyed access to the largest amounts of business angel finance in the EU (see Figure 43).

Figure 43: Business angel finance in 2008



Source: European Commission, Enterprise Finance Index statistics

The Low Carbon Sector

The rapidly growing low carbon and environmental sector will drive demand for new and high technology manufactured goods from cars and other transport vehicles to the manufacture of wind turbines, tidal barrages and other energy generating machinery to name but a few.

These issues permeate a great many sectors of the economy both on the goods and the services side and due to its nature it is very difficult to measure. In 2009 BIS commissioned a study on the Low Carbon and Environmental Goods and Services (LCEGS) Industry. This study found that the UK LCEGS manufacturing sector had a market value (turnover) of around £33bn pounds in 2007/08 including supply chain activities. Particular areas where manufacturing generated the most value added included alternative fuels, geothermal and wind energy and low carbon building technologies (see Table 4).

The LCEGS sector was predicted to grow by 45% overall between 2007/8 and 2014/15.

Table 3: UK manufacturing market value of LCEGS sectors 2007/8

	Total £bn	Manufacturing £bn	Manufacturing %
Environmental	22.28	5.11	22.9
Renewable energy	31.10	12.00	38.6
Emerging low carbon	53.34	15.81	29.6
Total	**106.72**	**32.92**	**30.8**

Market Environment and Business Confidence

Appropriate, non-burdensome regulatory frameworks and minimal barriers to entrepreneurship can enable an open and competitive business environment that is key to business growth. Ensuring that the UK has such a business environment could help make it a more attractive place to do business.

World Bank Ease of Doing Business Index

This index measures the quality (usually simplicity) of regulations for businesses and the strength of protections on property rights. Empirical research funded by the World Bank claims that improving these regulations has a strong effect on economic growth. The latest data (2010) ranks the UK fifth in the World, behind Singapore, New Zealand, Hong Kong and the United States, having climbed one place since 2009.

Global Competitiveness Indicators

The Global Competitiveness Report's competitiveness ranking is based on the Global Competitiveness Index (GCI), developed for the World Economic Forum. The GCI is based on 12 pillars of competitiveness, providing a comprehensive picture of the competitiveness landscape in countries around the world at all stages of development. The pillars are: institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labour market efficiency, financial market development, technological readiness, market size, business sophistication, and innovation.

The rankings are calculated from both publicly available data and the Executive Opinion Survey, comprehensive annual survey conducted by the World Economic Forum together with its network of Partner Institutes (leading research institutes and business organizations) in the countries covered by the study. This year, over 13,500 business leaders were polled in 139 countries. The survey is designed to capture a broad range of factors affecting an economy's business climate. The report also includes comprehensive listings of the main strengths and weaknesses of countries, making it possible to identify key priorities for policy reform.

Table 4: World Economic Forum Global Competitiveness Indicators

Country	2010		2009	Change 2009 - 2010
	Rank	Score	Rank	
Switzerland	1	5.63	1	0
Sweden	2	5.56	4	2
Singapore	3	5.48	3	0
United States	4	5.43	2	-2
Germany	5	5.39	7	2
United Kingdom	12	5.25	13	1

Source: World Economic Forum

The World Economic Forum reports that:-

After having fallen four positions over the past two years, the United Kingdom moves up one spot to 12th place this year, with a stable performance. The country benefits from clear strengths, such as the efficiency of its labour market (8th), standing in contrast to the rigidity of many other European countries. The country continues to have sophisticated and innovative businesses that are highly adept at harnessing the latest technologies for productivity improvements and operating in a very large market (ranked 6th for market size). These are all characteristics that are important for spurring productivity enhancements. While somewhat improved since last year, the macroeconomic environment remains the country's greatest competitive weakness, with deficit spending that must be reined in to provide a more sustainable economic footing going into the future.

Table 5: Detailed Global Competitiveness Indicators for the UK

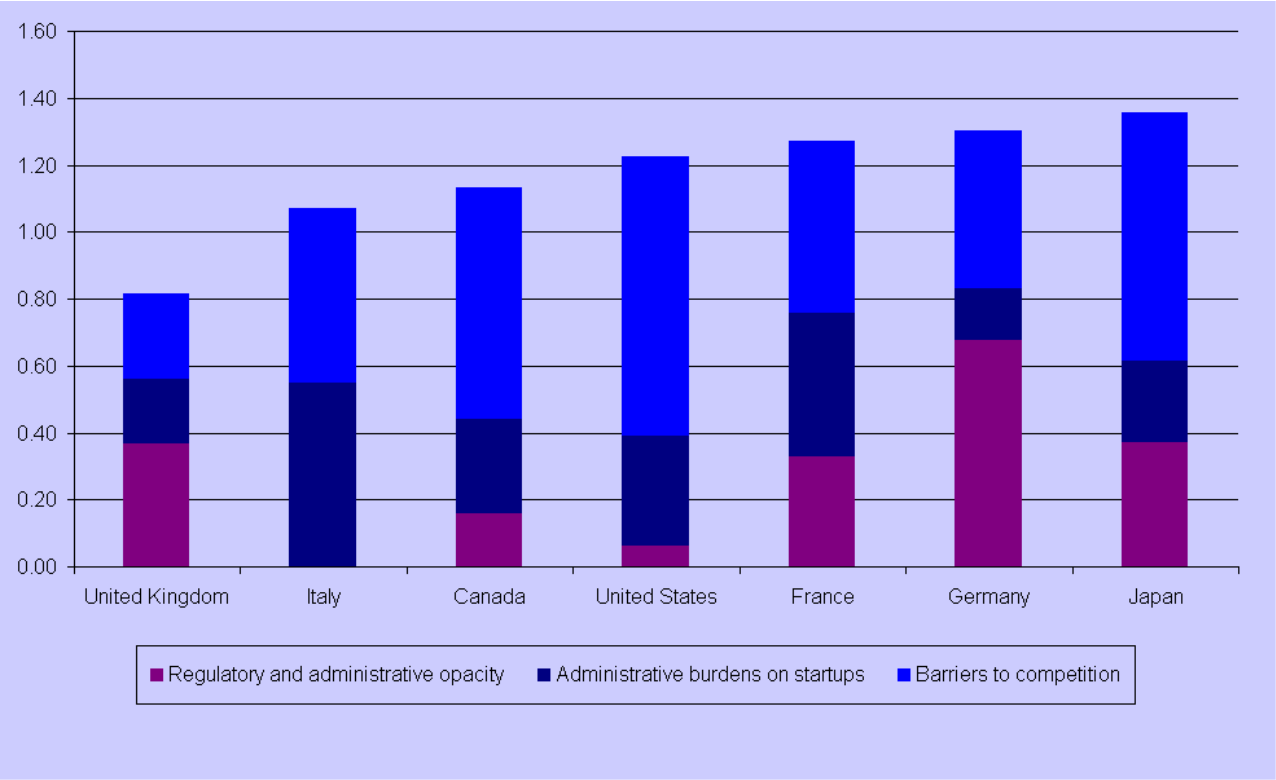
	Rank	Score
Overall	12	5.25
Individual Pillars		
Market size	6	5.8
Infrastructure	8	5.88
Labour market efficiency	8	5.29
Technological readiness	8	5.58
Business sophistication	9	5.32
Innovation	14	4.65
Institutions	17	5.28
Higher education and training	18	5.34
Health and primary education	19	6.4
Goods market efficiency	22	4.96
Financial market development	25	4.73
Macroeconomic environment	56	4.76

Source: World Economic Forum

OECD Barriers to Entrepreneurship Index

The *barriers to entrepreneurship* indicator measures regulations affecting entrepreneurship on a scale of zero to six; lower values suggest lower barriers. The index is composed of barriers to competition (legal barriers, antitrust exemptions, barriers in network sectors and in retail and professional services); regulatory and administrative opacity (licences, permits, simplicity of procedures); and administrative burdens for creating new firms. Under this measure the UK is deemed to have the least barriers to entrepreneurship in the World. Figure 44 overleaf compares the UK with other G7 economies.

Figure 44: Barriers to entrepreneurship, 2008



Industry Confidence

The Confederation of British Industry (CBI) conducts a quarterly survey of its members to gauge underlying trends and business confidence in UK manufacturing. The figures reported in Table 6 below are percentage balances – the difference between those replying positively or negatively.

As the number of respondents is small (less than 500) and they could be of very different sizes the trends here should be taken as reflecting impressions and perceptions of industry rather than describing actual events.

According to the CBI's latest (October 2010) quarterly survey of industrial trends manufacturers expect an increase in output over the next three months underpinned by predictions of a strong increase in export orders.

After of four quarters of increasing optimism about the situation for business and export prospects CBI members expectations for the year ahead were now in line with the previous three months (July - September).

Employment and investment trends were also positive with a positive balance of respondents reporting an increase in employee numbers (the highest positive balance reported by this survey since 1989) and an increasing balance of respondents planning to increase spending on plant and machinery and innovation (both product and process) over the next year.

Table 6: Selected results from the CBI Industrial Trends Survey October 2010

	2009		2010			
	Jul	Oct	Jan	Apr	Jul	Oct
Volume of activity (over past three months)						
Volume of total new orders	-29	-12	+1	+12	+18	+11
Volume of output	-31	-8	+11	+1	+24	+9
Numbers employed	-42	-34	-13	-12	-2	+6
Expectations for next three months						
Volume of new orders (up/down)	-15	+5	+9	+20	+5	+12
Volume of export orders (up/down)	-17	+9	+13	+18	-3	+15
Volume of output (up/down)	-14	+4	+4	+14	+6	+18
Optimism for the year ahead						
Optimism regarding business situation (more/less than three months ago)	-16	+10	+12	+24	+10	+2
Optimism regarding export prospects for the year ahead (more/less)	-5	+16	+19	+20	+10	+5
Twelve month forecast of expenditure authorisations compared to previous twelve months on:						
Product and process innovation (more/less)	-12	+16	+15	+12	+11	+20
Plant and machinery (more/less)	-38	-1	+1	+1	+2	+10

Source: CBI

Sources

- ONS National Accounts
- UNCTAD Handbook of Statistics
- OECD STAN Database
- ONS Productivity data
- ONS Employment data
- ONS Annual Business Inquiry
- EU KLEMS Productivity Database
- OECD STAN Bilateral Trade Database
- ONS MQ10 “UK Trade in Goods Analysed in Terms of Industries”
- EuroStat High-tech Statistics
- OECD Micro-trade Indicators
- UN Comtrade
- International Monetary Foundation Balance of Payments Database
- OECD STAN Foreign Direct Investment Database
- ONS Annual Survey of Hours and Earnings
- Engineering and Technology Board 2007 Survey of Registered Engineers
- ONS Labour Force Survey
- EuroStat “Science, Technology and Innovation in Europe”
- ONS Business Enterprise Research and Development
- ONS Gross Expenditure on Research and Development
- OECD Main Science and Technology Indicators
- OECD STAN Indicators
- World Intellectual Property Office Statistics Database

- European Commission Enterprise Finance Index Statistics
- Innovas Low Carbon and Environmental Goods and Services
- World Economic Forum Global Competitiveness Indicators
- OECD Barriers in Entrepreneurship Index
- CBI Industrial Trends Survey

BIS Economics Papers

BIS places analysis at the heart of policy-making. As part of this process the Department has decided to make its analysis and evidence base more publicly available through the publication of a series of BIS Economics Papers that set out the thinking underpinning policy development. The BIS Economics series is a continuation of the series of Economics papers, produced by the former Department for Business, Enterprise and Regulatory Reform (BERR) which analysed issues central to business and industry.

The main series is complemented by a series of shorter Occasional papers including literature reviews, appraisal and evaluation guidance, technical papers, economic essays and think pieces. These are listed below:

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8. **UK trade performance: Patterns in UK and global trade growth**, November 2010
7. **Understanding local growth**, October 2010
6. **Learning from some of Britain's successful sectors: An historical analysis of the role of government,** March 2010
5. **Internationalisation of innovative and high growth SMEs,** March 2010
4. **Supporting analysis for "Skills for Growth: The national skills strategy",** March 2010
3. **The space economy in the UK: An economic analysis of the sector and the role of policy,** February 2010
2. **Life Sciences in the UK - Economic analysis and evidence for 'life sciences 2010: Delivering the Blueprint',** January 2010
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6. **The globalization of value chains and industrial transformation in the UK,** February 2009
5. **China and India: Opportunities and Challenges for UK Business,** February 2009
4. **Regulation and Innovation: Evidence and Policy Implications,** December 2008

3. **High Growth Firms in the UK: Lessons from an analysis of comparative UK Performance,** November 2008

2. **Five Dynamics of change in Global Manufacturing**, September 2008

1. **BERR's Role in Raising Productivity: New Evidence**, February 2008

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