

**International sectoral R&D trends  
after the global financial crisis:  
What can we learn for current  
policy?**

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# **International sectoral R&D trends after the global financial crisis: What can we learn for current policy?**

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## TABLE OF CONTENTS

<b>EXECUTIVE SUMMARY.....</b>	<b>4</b>
<b>1. BACKGROUND.....</b>	<b>9</b>
<b>2. POST-RECESSION R&amp;D TRENDS IN THE UK.....</b>	<b>10</b>
<b>3. NATIONAL PERSPECTIVES ON SECTORAL REAL R&amp;D SPENDING ....</b>	<b>12</b>
<b>4. COMPARING SECTORAL PATTERNS OF RECOVERY .....</b>	<b>18</b>
<b>5. POLICY FOR A BALANCED RECOVERY?.....</b>	<b>19</b>
<b>ANNEX A: COUNTRY TABLES .....</b>	<b>22</b>

## **EXECUTIVE SUMMARY**

In this Insight paper we review international evidence drawn from OECD databases which provide comparable time-series on sectoral R&D trends for the period 2008-2016. Our central focus is how R&D trends in UK sectors in the UK differed from those in other countries in the aftermath of the great financial crisis.

### **UK trends in sectoral R&D spending**

Total business R&D spending in the UK fell marginally from 2008-10 before recovering consistently to reach a level 23 per cent higher than that in the recession by 2016. R&D spending in services recovered significantly more quickly than that in manufacturing sectors, some of which have never regained the volume of R&D investment which they had in the recession.

In manufacturing, the poorer performing sectors have tended to be more traditional foundation industries. In services, poor performing sectors have tended to be those which grew rapidly in the pre-recession period – information and communication and financial services.

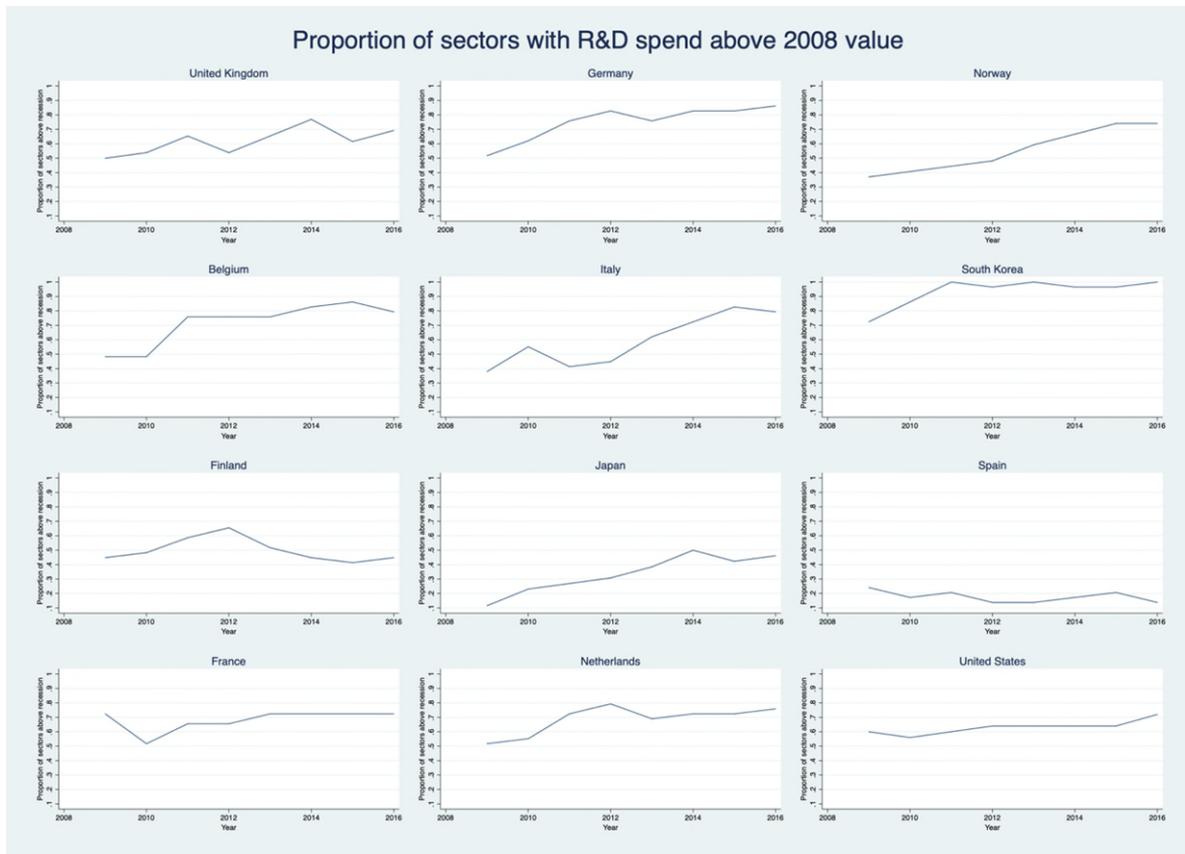
**Table 1: Real business R&D spending 2008=100: UK**

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total BERD	100	97	98	104	101	107	113	118	123
Agriculture forestry and fishing (a)	100	38	64	58	64	46	59	67	93
Mining and quarrying (b)	100	121	181	226	220	240	226	196	201
Manufacture of food products; beverages and tobacco	100	99	87	102	99	116	115	89	106
Manufacture of textiles, wearing apparel, leather	100	58	59	137	170	115	115	98	106
Manufacture of wood, paper, printing and reproduction	100	51	54	44	63	101	112	122	133
Manufacture of coke and refined petroleum products	100	142	21			29		133	61
Manufacture of chemicals and chemical products	100	107	123	107	98	132	131	111	168
Manufacture of basic pharmaceutical products	100	114	125	141	133	118	102	98	95
Manufacture of rubber and plastic products	100	79	70	84	100	95	109	131	124
Manufacture of other non-metallic mineral products	100	52	51	49	37	39	55	48	58
Manufacture of basic metals	100	69	73	126	90	62	97	81	87
Manufacture of fabricated metal products, other	100	114	107	97	86	88	89	80	75
Manufacture of computer, electronic and optical products	100	80	67	77	76	78	76	74	80
Manufacture of electrical equipment	100	143	168	153	169	156	174	181	163
Manufacture of machinery, vehicles and OTE	100	88	89	97	111	117	127	141	160
Manufacture of furniture	100	373	440	660	471	649	489	497	529
Other manufacturing	100	194	318	255	222	265	256	356	313
Electricity, gas, steam, water supply (d,e)	100	123	116	126	313	418	395	500	446
Construction (f)	100	192	132	128	202	230	340	287	399
Wholesale and retail trade; motor vehicles (g)	100	93	118	117	106	102	102	132	121
Transportation and storage (h)	100	182	177	179	58	179	265	326	239
Accommodation and food service activities (i)	100	97	211	281	318	172	307	400	638
Information and communication (j)	100	85	77	85	86	92	101	99	107
Financial and insurance activities (k)	100	84	76	65	56	69	76	80	80
Real estate activities (l)	100	120	110	107	119	172	223	207	145
Professional, scientific, and technical activities (m)	100	102	107	114	98	104	111	115	111
Administrative and support service activities (n)	100	69	111	156	229	214	342	352	346
Public administration and defence (o, p)	100	319	169	148	358	608	280	184	169
Human health and social work activities (q)	100	123	1018	693	655	1206	1499	1979	2252
Other service activities (s, t, u)	100	450	811	712	704	897	715	804	826

### Slow recovery internationally – except in South Korea

Recovery in R&D spend in sectors across a number of countries after the great financial crisis was slow. Many sectors only recovered their pre-recession levels of real R&D

spending 4-6 years after the recession. The Figure below illustrates the proportion of sectors at or above their pre-recession R&D spending level.



In almost every country with the exception of South Korea a significant proportion of sectors had still not regained their levels of real R&D spending by 2016 – eight years after the recession. This is true of around a third of sectors in the UK, France, Belgium and Norway and around 10 per cent of sectors in Germany.

### Key contrasts with the UK

In general terms, sectors' post-recession profile of real R&D spending in the UK was more varied than that in most other countries. Countries such as Belgium, Germany and South Korea achieved a more uniform recovery across sectors. Germany is particularly interesting in this respect as the increase in total real R&D was only marginally above that in the UK; Belgium and South Korea had significantly higher overall growth rates in real R&D spending.

There is a starker distinction between patterns of R&D spend post-recession in manufacturing and services in the UK than in most other economies. Manufacturing R&D has performed poorly in many sectors relative to services in the UK. Other countries achieved a more balanced recovery.

The UK recovery in R&D spending within manufacturing was more clearly divided between low tech sectors and medium- or high- tech sectors than that in other countries where a wider range of manufacturing sectors typically recovered.

Agricultural R&D in the UK has declined and remained consistently below 2008 levels in real terms. This is a marked contrast to most other countries.

Real R&D spending in information and communications and financial services in the UK has remained below its 2008 level. Again, this is a marked contrast to almost all other countries.

### **Explaining unbalanced recovery in the UK**

There are three significant differences between innovation policy in the UK and that in Germany and Belgium which may help to explain their more balanced recovery post-recession.

First, in both Belgium and Germany innovation policy is the subject of compromise between agencies and government at regional and federal levels. Arguably, this leads to more equitable division of funding with some support targeted at regionally important but not necessarily world-leading companies. This differs from the policy approach in the UK which focuses support on leading-edge innovations and firms wherever they may be located.

A second key difference between the innovation systems of Germany and Belgium on the one hand and the UK on the other, has been the traditional strength of intermediate institutions in Germany and Belgium and their relative weakness in the UK. Fraunhofer Institutes in Germany and industry R&D centres in Belgium have traditionally played an important role in linking university and business sectors. The development of the Catapult Centre network in the UK over the last few years has done much to remedy this historical discrepancy in the UK innovation system.

Third, in some senses UK innovation policy has actually targeted an unbalanced outcome. The focus of Innovate UK policy support on a number of strategically important sectors, particularly in manufacturing, may have had the unintended consequence of reducing funding to research and development in sectors not supported.

## 1. BACKGROUND

R&D provides a crucial input to nations' innovation and technological development activity. It also represents a risky and uncertain investment for firms and other related organisations. In periods of uncertainty in the macro-economy, such as the global financial crisis, firms may have been inclined to reduce R&D investments in favour of investments with more predictable outcomes.

In this note we review international evidence drawn from OECD databases which provide comparable time-series on sectoral R&D trends for the period 2008-2016. We consider data for a number of countries as well as the United Kingdom. Our central focus is how the experience of sectors in the UK differed from that in other countries in the aftermath of the great financial crisis. It turns out that trends differ markedly, both within and across countries, reflecting national policy initiatives, economic conditions and the state of the broader global economy.

Data is taken directly from the OECD Science and Technology Indicators database and represents the OECD's effort to create internationally comparable and measurable time-series<sup>1</sup>. In particular, we focus on data for the post-2008 period for which data on consistent sectoral definitions is available. We also focus on one single indicator for each sector-real R&D spend by businesses at 2010 prices and constant purchasing power parity (PPP). This indicator provides an indication of the overall volume of R&D investment. It does not provide any indication of comparable R&D intensity across countries or across sectors. Instead the intention is to see how different sectors recovered from the 2008-2010 recession and how such recoveries differed between economies. Note that in some countries R&D surveys have rather sectoral coverage and do not cover elements of public services. In other cases, sectoral definitions differ and this is reflected in the tables included later.

In the main text we focus on trends in the post-2008 period, indexing each sectoral series at 100 in 2008. Values greater than 100 in later years, indicated in green, suggest a level of real R&D spend which is above that in the recession, i.e. 2008. Figures in red, indicating the value is lower than 100, suggest a level of real R&D spending below that

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<sup>1</sup> OECD (2020), "Research and Development Statistics: Business enterprise R-D expenditure by industry and by type of cost - ISIC Rev 4", *OECD Science, Technology and R&D Statistics* (database), <https://doi.org/10.1787/05a9850a-en> (accessed on 14 May 2020).

in the recession in 2008. The data provides a detailed perspective on sectoral patterns of R&D investment over the 2008-2016 period both for a range of manufacturing sectors and also for a number of broad service sectors. In some sectors, the timeseries exhibit some volatility and this is typically associated with those sectors which have relatively low levels of real R&D spending in both the recession and subsequent periods.

## 2. POST-RECESSION R&D TRENDS IN THE UK

This section provides an overview of trends in real R&D spending in UK sectors for the 2008-16 period (Table 1)<sup>2</sup>. As noted earlier, we index each series at 100 in 2008: values greater than 100 (green) indicate a rise in R&D spend relative to the recession period; values less than 100 (red) indicate a fall in real R&D spend relative to the recession period.

Total business R&D spending in the UK fell marginally from 2008-10 before recovering consistently to reach a level 23 per cent higher than that in the recession by 2016. The steady rise in real aggregate spending in the UK hides significant sectoral volatility and disparity. In general terms, R&D spending in services recovered significantly more quickly than that in a range of manufacturing sectors, some of which have never regained the volume of R&D investment which they had in recession. A few key sectors stand out:

- Real R&D spend in agriculture, forestry and fishing has remained consistently below its level at the time of the recession. By 2016, real R&D spending in the sector remained 7 per cent below that of 2008.
- A number of manufacturing sectors, particularly those in the foundation industries, had levels of real R&D spend in 2016 below those of 2008. This includes pharmaceuticals, non-metallic minerals, basic metals, metal products, and computer and electronic products.
- Some manufacturing sectors had levels of R&D spend in 2016 significantly above that of the recession period. These sectors include electrical equipment, vehicles, furniture, and chemicals.
- Almost all of the service sectors covered by the OECD data had levels of real R&D spending in 2016 above that in 2008. Two exceptions are notable. First, real R&D spending in the information and communication only rose above its 2008 level in 2016. Second, levels of R&D in financial services and insurance remain around the fifth below those in 2008.

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<sup>2</sup> Annex 1 contains tables including the absolute values for each time series.

In aggregate, UK trends since the recession suggest a sharp divide between manufacturing and service sectors. However, within each group there have been winners and losers. In manufacturing, the poorer performing sectors have tended to be more traditional foundation industries. In services, poor performing sectors have tended to be those which grew rapidly in the pre-recession period. Other studies have noted that these sectors also increased their productivity sharply before the recession but have been responsible for a disproportionate share of the productivity slowdown in the UK in the post-recession period<sup>3</sup>.

**Table 1: Real business R&D spending 2008=100: UK**

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total BERD	100	97	98	104	101	107	113	118	123
Agriculture forestry and fishing (a)	100	38	64	58	64	46	59	67	93
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Manufacture of textiles, wearing apparel, leather	100	58	59	137	170	115	115	98	106
Manufacture of wood, paper, printing and reproduction	100	51	54	44	63	101	112	122	133
Manufacture of coke and refined petroleum products	100	142	21			29		133	61
Manufacture of chemicals and chemical products	100	107	123	107	98	132	131	111	168
Manufacture of basic pharmaceutical products	100	114	125	141	133	118	102	98	95
Manufacture of rubber and plastic products	100	79	70	84	100	95	109	131	124
Manufacture of other non-metallic mineral products	100	52	51	49	37	39	55	48	58
Manufacture of basic metals	100	69	73	126	90	62	97	81	87
Manufacture of fabricated metal products,	100	114	107	97	86	88	89	80	75
Manufacture of computer, electronic and optical products	100	80	67	77	76	78	76	74	80
Manufacture of electrical equipment	100	143	168	153	169	156	174	181	163
Manufacture of machinery, vehicles and OTE	100	88	89	97	111	117	127	141	160
Manufacture of furniture	100	373	440	660	471	649	489	497	529
Other manufacturing	100	194	318	255	222	265	256	356	313
Electricity, gas, steam, water supply (d,e)	100	123	116	126	313	418	395	500	446
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Financial and insurance activities (k)	100	84	76	65	56	69	76	80	80
Real estate activities (l)	100	120	110	107	119	172	223	207	145
Professional, scientific, and technical activities (m)	100	102	107	114	98	104	111	115	111
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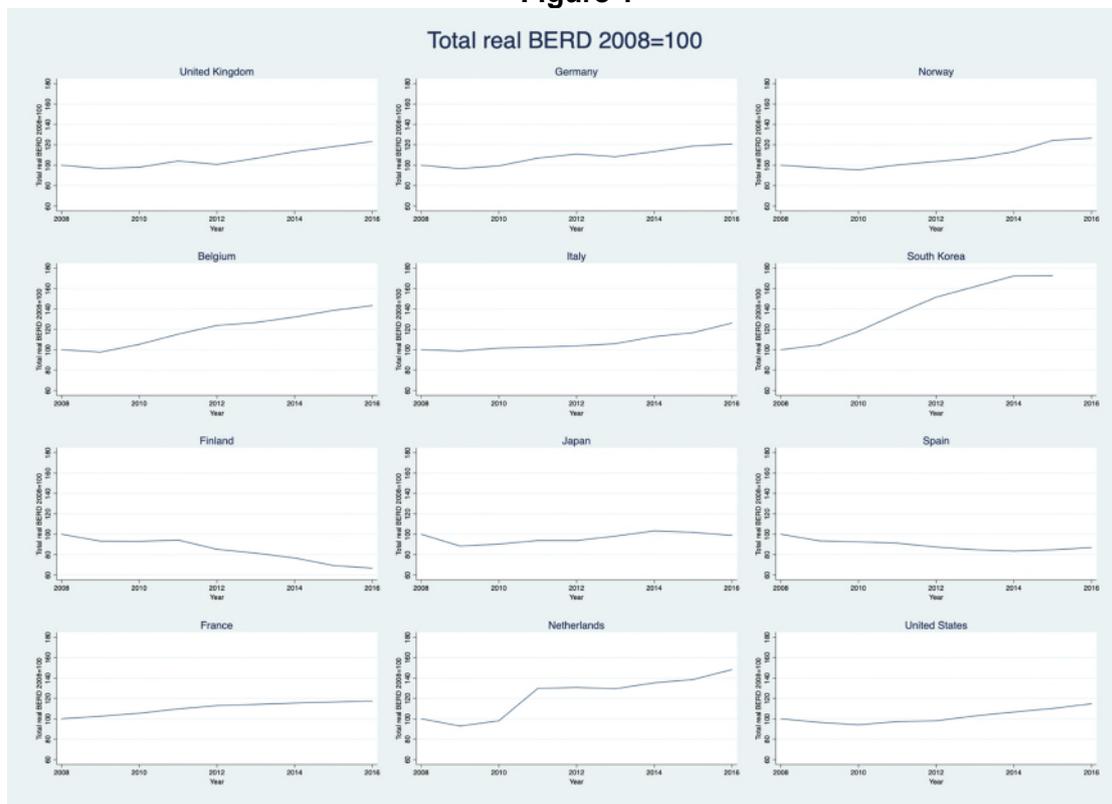
<sup>3</sup> Riley, R Rincon-Aznar, A and Samek, L (2018) 'Below the aggregate; A sectoral account of the UK productivity puzzle', ESCoE Discussion Paper 2018-06.

Source: OECD (2020), "Research and Development Statistics: Business enterprise R-D expenditure by industry and by type of cost - ISIC Rev 4", *OECD Science, Technology and R&D Statistics* (database), <https://doi.org/10.1787/05a9850a-en> (accessed on 14 May 2020).

### 3. NATIONAL PERSPECTIVES ON SECTORAL REAL R&D SPENDING

Trends in aggregate real R&D spend by nation have varied strongly since the 2008-10 recession as Figure 1 illustrates and are reflected in the sectoral changes discussed later. Real R&D spending in the larger European economies (the UK, France, Germany, Italy) typically fell marginally post-2008 before recovering and growing to a level 20-30 per cent higher than the 2008 level by 2016. Some smaller European economies (the Netherlands, Belgium) achieved faster growth increasing real R&D spend by 40-60 per cent<sup>4</sup>. Both lag South Korea, however, where real R&D spend rose around 70 per cent between 2008 and 2016. Real R&D spending in Finland and Spain remained below their 2008 level for the whole of the post-recession period.

**Figure 1**



Source: See Table 1.

<sup>4</sup> Austria also falls into this group but is excluded from the analysis due to a lack of data for 2008.

As in the UK the trend in total real BERD in each country hides significant sectoral variation and, in some countries, disparities. These are as follows:

- **Belgium** - national real R&D spending in Belgium increased more rapidly than that in the UK, reaching a level 58 per cent above its recession level in 2017 (Table A1). Growth in real R&D spending in the post-recession period was evidence in almost all sectors with the exception of agriculture, and the manufacture of computers and electronic equipment.
- **Finland** – real R&D spending in Finland has declined consistently in volume since 2008 reaching 68 per cent of its 2008 level in 2017 (Table A2). This decline is evident across almost all manufacturing sectors, particularly computers and electronic products where R&D spend is only a third of its 2008 level. R&D spend has risen rapidly in agriculture (2017=579), utilities (2017=157) and has increased by around a third in information and communications and financial services.
- **France** – aggregate real business R&D spend in France has increased broadly in line with that in the UK since the recession, growing 17 per cent in real terms by 2016 (Table A3). Levels of real R&D spend are higher than those in 2008 in all service sectors but remain below their 2008 recession levels in some traditional manufacturing sectors (textiles, wood and paper, chemicals and metals). Unlike the UK there has been no increase in real R&D spend in vehicle manufacture.
- **Germany** – aggregate real R&D has grown similarly to that in the UK, increasing 30 per cent between 2008 and 2017 (Table 2). Increases in R&D spend are generally more widespread and even across the economy than in the UK for both services and manufacturing sectors. Textiles, furniture and transport equipment are the only manufacturing sectors in which real R&D has fallen (Table 2).
- **Italy** – levels of aggregate real R&D have grown at a broadly similar pace to that in the UK (Table A4). Recovery from recession was slower than in many countries in a number of manufacturing and services sectors. By 2016 almost all sectors had higher levels of R&D spend than in 2008 including a sharp rise in real R&D spending in agriculture.
- **Japan** – real business R&D spending remained below that in 2008 until 2014 and even in 2017 was only 3 per cent above its 2008 level (Table A5). Recovery was very slow across a range of sectors and notably slower in manufacturing where a number of sectors still have levels of real R&D spend below that in 2008. Foundation and traditional industries have performed poorly with few if any recovering levels of real R&D as of 2008.
- **South Korea** – by 2015 aggregate real R&D spending was 73 per cent above its recessionary level (Table 3). Recovery was very rapid in almost all sectors with levels of R&D spend markedly above recession levels almost universally. Levels of real R&D spend have declined post-recession in some sectors: transportation and the arts, entertainment.

- **Netherlands** – total real business R&D spending has grown significantly faster than that in the UK to be 48 per cent higher than the recession level in 2016 (Table A6). As in the UK, there is significant sectoral disparity with R&D investment in financial services remaining below recession levels. This is also the case for chemicals, pharmaceuticals and the manufacture of electronic equipment. Some volatility is evident in other sectors where levels of R&D are limited.
- **Norway** – aggregate real business R&D spend has grown marginally faster than that in the UK as a whole (2017=134). Recovery post-recession was uneven and in some sectors was slow, particularly in manufacturing with a number of sectors not regaining recession levels of real R&D spending – pharmaceuticals, vehicles, computers (Table A7). Financial services R&D grew marginally more rapidly than that in the economy as a whole.
- **Spain** – aggregate business R&D remains below the 2008 level a pattern common to most sectors across manufacturing and services (Table 4). Notable exceptions in manufacturing relate to motor vehicles and other transport equipment.
- **USA** – real aggregate business R&D spending regained its 2008 level in 2013 and has increased steadily since reaching 15 per cent up on 2008 by 2016 (Table A8). Significant diversity in sectors' experience is evidence with manufacturing sectors in particular experiencing persistent falls in real R&D spending relative to 2008. Services R&D – particularly in financial services – has risen sharply.

**Table 2: Real business R&D spending 2008=100: Germany**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	100	97	99	107	111	108	113	119	121	130
Agriculture forestry and fishing (a)	100	130	140	123	133	135	127	136	142	149
Mining and quarrying (b)	100	47	43	34	36	51	40	67	65	77
Manufacture of food ,beverages and tobacco products	100	114	117	108	109	107	106	104	101	101
Manufacture of textiles, wearing apparel, leather	100	92	90	86	87	78	78	61	62	66
Manufacture of wood, paper, printing and reproduction	100	95	112	97	90	117	113	106	112	119
Manufacture of coke and refined petroleum products	100	104	99	103	104	99	124	138	142	143
Manufacture of chemicals and chemical products	100	97	94	99	103	97	103	105	107	110
Manufacture of pharmaceuticals	100	112	107	115	114	111	108	104	117	118
Manufacture of rubber and plastic products	100	94	92	103	103	102	105	110	118	113
Manufacture of other non-metallic mineral products	100	106	105	102	102	102	104	105	110	105
Manufacture of basic metals	100	122	121	125	129	124	123	120	120	127
Manufacture of fabricated metal products	100	94	94	94	96	93	93	100	101	108
Manufacture of computer, electronic products	100	88	90	98	108	106	106	105	105	104
Manufacture of electrical equipment	100	88	88	103	110	133	133	135	136	157
Manufacture of machinery and equipment n.e.c.	100	95	96	101	105	108	111	105	107	133
Manufacture of motor vehicles, trailers	100	89	95	103	108	105	118	126	127	146
Manufacture of other transport equipment	100	87	105	108	109	81	81	77	77	66
Manufacture of furniture	100	51	52	41	39	36	37	32	30	30
Other manufacturing	100	112	112	139	131	148	155	147	135	184
Repair and installation of machinery and equipment	100	126	125	140	130	137	145	267	237	41
Electricity, water (d,e)	100	165	149	148	138	151	139	113	107	120
Construction (f)	100	122	134	114	121	134	132	121	128	133
Wholesale and retail motor trades (g)	100	121	132	153	163	146	142	144	126	235
Transportation and storage (h)	100	92	101	170	189	139	141	195	158	167
Accommodation and food services (i)	100	98	130							
Information and communication (j)	100	132	135	151	157	154	154	149	154	154
Financial and insurance (k)	100	149	103	114	115	123	132	116	117	99
Real estate (l)	100									
Professional, scientific, technical (m)	100	119	123	131	124	124	119	175	184	203
Administrative and support services (n)	100	16	17	17	17	13	12	20	18	21
Public administration and defence; (o, p)	100									
Human health and social work (q)	100									
Arts, entertainment and recreation (r)	100									
Other services (s, t, u)	100									

Source: See Table 1.

**Table 3: Real business R&D spending 2008=100: Korea**

	2008	2009	2010	2011	2012	2013	2014	2015
TOTAL BERD	100	105	118	135	152	162	172	173
Agriculture forestry and fishing (a)	100	96	119	163	118	116	126	134
Mining and quarrying (b)	100	227	288	330	524	374	298	336
Manufacture of food ,beverages and tobacco products	100	103	81	106	123	120	126	252
Manufacture of textiles, wearing apparel, leather	100	104	102	172	192	216	217	233
Manufacture of wood, paper, printing and reproduction	100	135	144	190	249	213	222	273
Manufacture of coke and refined petroleum products	100	114	186	269	214	227	185	191
Manufacture of chemicals and chemical products	100	108	125	165	160	184	164	181
Manufacture of pharmaceuticals	100	105	109	125	150	154	159	187
Manufacture of rubber and plastic products	100	80	109	114	114	151	159	165
Manufacture of other non-metallic mineral products	100	159	136	152	206	199	149	139
Manufacture of basic metals	100	104	102	111	131	109	114	112
Manufacture of fabricated metal products	100	120	103	211	195	212	195	230
Manufacture of computer, electronic products	100	102	122	136	155	172	188	178
Manufacture of electrical equipment	100	109	115	124	145	137	147	179
Manufacture of machinery and equipment n.e.c.	100	99	110	121	158	154	162	159
Manufacture of motor vehicles, trailers	100	99	109	121	130	139	153	165
Manufacture of other transport equipment	100	92	100	105	127	122	125	140
Manufacture of furniture	100	243	242	289	303	344	456	443
Other manufacturing	100	89	99	172	147	146	167	216
Repair and installation of machinery and equipment	100							
Electricity, water (d,e)	100	101	105	135	141	114	118	122
Construction (f)	100	127	108	130	140	135	138	102
Wholesale and retail motor trades (g)	100	330	372	417	452	471	495	400
Transportation and storage (h)	100	60	126	207	116	182	65	64
Accommodation and food services (i)	100	330	32	258	45	332	292	515
Information and communication (j)	100	98	111	121	144	137	149	144
Financial and insurance (k)	100	1403	1072	791	1447	1336	3523	4257
Real estate (l)	100	4590	3097	513	273	230	549	965
Professional, scientific, technical (m)	100	135	126	149	156	180	181	201
Administrative and support services (n)	100	194	208	204	231	260	264	248
Public administration and defence; (o, p)	100	153	154	194	146	167	163	194
Human health and social work (q)	100							
Arts, entertainment and recreation (r)	100	120	119	94	91	88	63	97
Other services (s, t, u)	100	350	451	735	687	547	653	505

Source: See Table 1.

**Table 4: Real business R&D spending 2008=100: Spain**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	100	93	93	91	87	85	83	85	87	93
Agriculture forestry and fishing (a)	100	76	76	73	73	72	79	81	93	113
Mining and quarrying (b)	100	82	91	96	82	67	59	63	67	80
Manufacture of food ,beverages and tobacco products	100	91	86	85	81	81	80	78	89	99
Manufacture of textiles, wearing apparel, leather	100	80	73	71	81	87	120	120	90	76
Manufacture of wood, paper, printing and reproduction	100	79	75	79	63	54	58	57	67	69
Manufacture of coke and refined petroleum products	100	83	95	109	109	109	110	107	96	79
Manufacture of chemicals and chemical products	100	83	87	85	82	83	81	80	83	92
Manufacture of pharmaceuticals	100	102	97	98	90	87	89	91	96	105
Manufacture of rubber and plastic products	100	93	86	85	89	86	79	80	84	84
Manufacture of other non-metallic mineral products	100	86	77	76	62	66	59	53	51	50
Manufacture of basic metals	100	88	93	116	82	69	65	57	55	89
Manufacture of fabricated metal products	100	85	80	81	76	71	69	68	65	73
Manufacture of computer, electronic products	100	88	85	76	66	64	62	59	61	69
Manufacture of electrical equipment	100	91	88	84	89	81	82	90	93	79
Manufacture of machinery and equipment n.e.c.	100	103	91	95	96	92	89	93	96	100
Manufacture of motor vehicles, trailers	100	118	129	121	115	110	126	123	147	168
Manufacture of other transport equipment	100	111	136	159	141	134	120	129	133	140
Manufacture of furniture	100	94	76	73	61	59	69	57	57	54
Other manufacturing	100	98	80	87	82	86	77	79	93	97
Repair and installation of machinery and equipment	100	69	50	47	46	45	47	36	48	52
Electricity, water (d,e)	100	123	134	147	160	133	118	122	121	129
Construction (f)	100	78	65	64	56	50	53	42	39	45
Wholesale and retail motor trades (g)	100	67	56	54	53	50	43	50	61	70
Transportation and storage (h)	100	75	98	64	63	47	49	37	59	71
Accommodation and food services (i)	100	74	46	16	61	36	30	31	21	39
Information and communication (j)	100	92	88	87	84	84	85	78	82	79
Financial and insurance (k)	100	146	154	121	75	71	67	108	122	183
Real estate (l)	100	125	110	87	83	29	73	68	72	147
Professional, scientific, technical (m)	100	94	95	90	90	90	86	90	88	94
Administrative and support services (n)	100	94	82	72	101	99	83	81	76	80
Public administration and defence; (o, p)	100	99	64	66	63	47	51	32	29	32
Human health and social work (q)	100	71	69	61	69	75	77	74	64	64
Arts, entertainment and recreation (r)	100	50	43	47	44	59	62	74	68	80
Other services (s, t, u)	100	77	60	75	58	52	50	50	33	36

Source: See Table 1.

## 4. COMPARING SECTORAL PATTERNS OF RECOVERY

The breadth of recovery of R&D spending and the speed of recovery varies widely between countries. Figure 2 provides a visual profile for each country reporting the proportion of sectors in each country which were at or above their recession level of real R&D spending in each year. In South Korea for, example, as Table 3 shows, recovery was rapid with almost all sectors having levels of real R&D spend above the recession level by 2010. In Spain by contrast (Table 4) only around a fifth of sectors recovered levels of real R&D spend post-recession. Two key observations follow from Figure 2:

- First, recovery in R&D spend in sectors across a number of countries was slow. Many sectors only recovered their pre-recession levels of real R&D spending 4-6 years after the recession.
- Second, in almost every country with the exception of South Korea a significant proportion of sectors had still not regained their levels of real R&D spending by 2016 – eight years after the recession. This is true of around a third of sectors in the UK, France, Belgium and Norway and around 10 per cent of sectors in Germany.

Lagging sectors varied somewhat between countries and in Table 5 we summarise the key sectoral differences between the profile of each country and the UK. The UK stands out from other countries in a number of respects:

- In general terms, sectors' post-recession profile of real R&D spending in the UK was more varied than that in most other countries. Countries such as Belgium, Germany and South Korea achieved a more uniform recovery across sectors. Germany is particularly interesting in this respect as the increase in total real R&D was only marginally above that in the UK; Belgium and South Korea had significantly higher overall growth rates in real R&D spending.
- There is a starker distinction between patterns of R&D spend post-recession in manufacturing and services in the UK than in most other economies. Manufacturing R&D has performed poorly in many sectors relative to services in the UK. Other countries achieved a more balanced recovery.
- The UK recovery in R&D spending within manufacturing was more clearly divided between low tech sectors and medium- or high- tech sectors than that in other countries where a wider range of manufacturing sectors typically recovered.
- Agricultural R&D in the UK has declined and remained consistently below 2008 levels in real terms. This is a marked contrast to most other countries.
- Real R&D spending in information and communications and financial services in the UK has remained below its 2008 level. Again, this is a marked contrast to almost all other countries.

These contrasting trends suggest a range of policy questions. Perhaps central to this is to consider how Germany and Belgium achieved a more balanced recovery after the global financial crisis than that in the UK.

## **5. POLICY FOR A BALANCED RECOVERY?**

Differences in the post-recession development of R&D spending reflect a variety of influences including countries' economic history, labour market structures, and capital market. Innovation policy will also play a role in shaping the development of individual sectors and the balance between.

There are perhaps three significant differences between innovation policy in the UK and that in Germany and Belgium which may help to explain their more balanced recovery post-recession. First, in both Belgium and Germany innovation policy is the subject of compromise between agencies and government at regional and federal levels. Arguably, this leads to more equitable division of funding with some support targeted at regionally important but not necessarily world-leading companies. This differs from the policy approach in the UK which focuses support on leading-edge innovations and firms wherever they may be located. The UK focus on excellence has a tendency to concentrate support among larger, frontier firms and away from smaller and medium-size firms which may characterise the more traditional sectors, particularly in manufacturing.

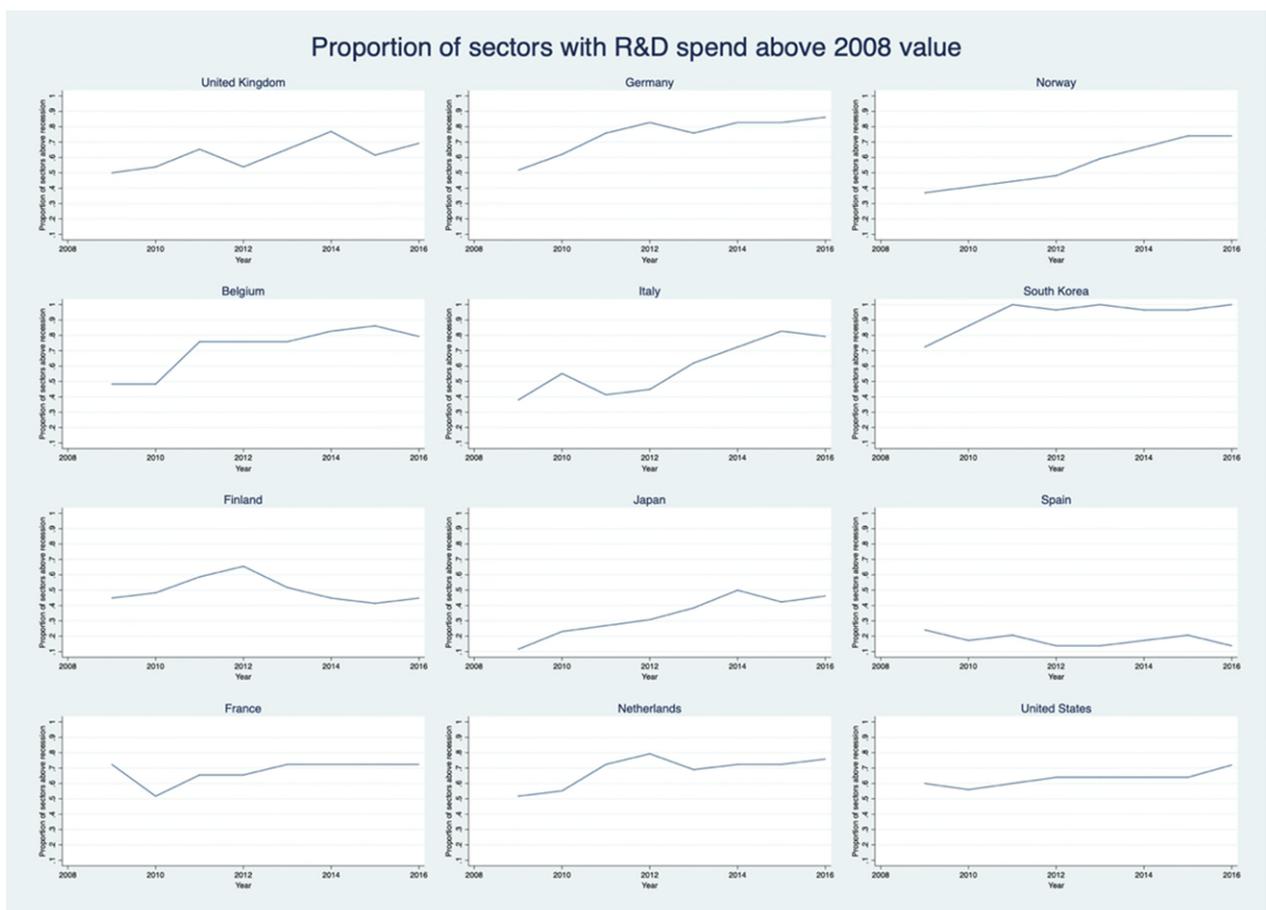
A second key difference between the innovation systems of Germany and Belgium on the one hand and the UK on the other, has been the traditional strength of intermediate institutions in Germany and Belgium and their relative weakness in the UK. Fraunhofer Institutes in Germany and industry R&D centres in Belgium have traditionally played an important role in linking university and business sectors. The development of the Catapult Centre network in the UK over the last few years has done much to remedy this historical discrepancy in the UK innovation system. However, in the immediate post-recession period the Catapult Centre network was significantly less well-developed than it is now.

Third, in some senses UK innovation policy has actually targeted an unbalanced outcome. The focus of Innovate UK policy support on a number of strategically important

sectors, particularly in manufacturing, may have had the unintended consequence of reducing funding to research and development in sectors not supported. This raises the question about the extent to which a balanced recovery from recession is desirable in the long-term.

Current policy in the UK is to focus innovation support on international excellence with awards guided by the novelty of innovation projects. The tendency is for this to concentrate support in stronger businesses and away from new younger or weaker businesses. The implication is that the support may increase the gap between Frontier and non-Frontier firms within a particular sector. The evidence considered here also suggests this policy approach may also be driving a wedge between some sectors heavily backed by government and others which have received less policy support.

**Figure 2**



Source: See Table 1.

**Table 5: Summary of sectoral trends in real R&D spend relative to the UK**

	National picture	Similarities to the UK	Differences from the UK
Belgium	Faster growth than the UK – 2017=158	Falls in real R&D spend in agriculture, computers and electrical equipment	Increases in real R&D spend in almost all sectors including traditional manufacturing, information and communications and financial services
Finland	Consistent decline since 2008 - 2017=68	Declines in spending in most manufacturing sectors. As in the UK rise in real R&D spend in vehicles.	Sharp increases in real R&D spend in agriculture, utilities, information and communications and financial services
France	Similar growth to that in the UK 2016=117	Falls in real R&D spend in some traditional manufacturing sectors	Less sectoral disparity than the UK. Growth in real R&D spend in all service sectors and in agriculture. No increase in real R&D in vehicles.
Germany	Similar growth to that in the UK 2017=130	R&D growth even across almost all manufacturing and service sectors	Less sectoral disparity than the UK. Falls in real R&D spending in other transport equipment and furniture. Increased R&D spend in agriculture. Increases in information and communications and stable R&D spend in financial services
Italy	Similar growth to that in the UK 2016=126	Slow recovery from recession spend levels in many sectors. Like Germany by 2016 real R&D growth was evident in almost all sectors	Less sectoral disparity than in the UK. Increases in real R&D spending in most sectors with a particularly sharp increase in agricultural R&D.
Japan	Little growth in real R&D spend since 2008, 2017=103	Falls in real R&D spend in a number of traditional manufacturing sectors. Agricultural R&D has fallen.	Very slow recovery across a range of manufacturing and services sectors. Faster in services. Flat real R&D spend in information and communications, rising sharply in financial services.
South Korea	By 2015 aggregate real R&D spending was 73 per cent above its recessionary level.	None.	Rapid recovery in almost all sectors and most characterised by sharp increases in real R&D spend since the recession.
Netherlands	Real R&D spend has grown at around twice the UK rate – 2016=148	Significant sectoral diversity is evident in R&D trends in both manufacturing and services. R&D in financial services remains below recession levels	Agricultural R&D has increased sharply. Manufacturing sectors which have seen declining R&D spend differ from those in the UK – chemicals and pharmaceuticals.
Norway	Growth marginally faster than the UK post-recession.	As in the UK significant sectoral diversity and slow recovery in some manufacturing sectors.	Agricultural R&D has grown sharply, financial services R&D also increased but at a relatively slow pace. Weaker manufacturing sectors have been pharma, computers.
Spain	Real R&D spend in 2017 remains below 2008 levels – 2017=93	R&D in motor vehicles has increased sharply – one of few sectors where this is evident in Spain	Decline across most sectors both manufacturing and services.
USA	Slower national recovery and growth than the UK – 2016=115	Diversity in sectoral R&D trends with a weaker recovery in manufacturing sectors.	A number of manufacturing sectors remain below their real R&D level in 2008 including both traditional and non-traditional sectors. R&D in financial services has risen sharply and consistently.

## ANNEX A: COUNTRY TABLES

**Table A1: Real business R&D spending 2008=100: Belgium**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	100	98	105	115	124	127	132	139	143	158
Agriculture forestry and fishing (a)	100	100	90	92	53	57	21	37	21	25
Mining and quarrying (b)	100	97	289	362	69	99	259	337	68	80
Manufacture of food ,beverages and tobacco products	100	107	115	122					177	187
Manufacture of textiles, wearing apparel, leather	100	99	106	117	99	109			100	119
Manufacture of wood, paper, printing and reproduction	100	107	90	106	142	155	130	126	114	130
Manufacture of coke and refined petroleum products	100	104	46	52	73	75				
Manufacture of chemicals and chemical products	100	93	96	113	119	116	110	113	94	105
Manufacture of pharmaceuticals	100	100	98	120	125	127	126	127	161	172
Manufacture of rubber and plastic products	100	95	98	102	101	99	111	121	103	129
Manufacture of other non-metallic mineral products	100	119	115	120	103	100	111	116	94	100
Manufacture of basic metals	100	96	113	137	135	118			127	145
Manufacture of fabricated metal products	100	109	145	150	173	175			142	160
Manufacture of computer, electronic products	100	95	84	86	91	94	86	89	93	99
Manufacture of electrical equipment	100	89	90	97	60	58	62	61	46	46
Manufacture of machinery and equipment n.e.c.	100	89	98	107	129	131	111	121	131	142
Manufacture of motor vehicles, trailers	100	95	98	123	134	156	120	135	138	155
Manufacture of other transport equipment	100	105	119	142			132	154	131	121
Manufacture of furniture	100	110	96	100	117	114	86	92	147	176
Other manufacturing	100	124	112	125	158	182	152	181	142	192
Repair and installation of machinery and equipment	100	99	82	90	161	180	112	139	197	191
Electricity, water (d,e)	100	65	196	217	328	378	297	314	280	223
Construction (f)	100	110	139	120	76	81	82	106	130	146
Wholesale and retail motor trades (g)	100	97	122	116	235	237	268	278	300	312
Transportation and storage (h)	100	131	94	114			185	205	165	162
Accommodation and food services (i)	100	107	2	2						
Information and communication (j)	100	100	130	144	137	136	153	160	183	212
Financial and insurance (k)	100	100	95	97	160	158	219	223	222	288
Real estate (l)	100									
Professional, scientific, technical (m)	100	99	129	126	146	155	172	184	172	194
Administrative and support services (n)	100	83	22	23			81	82	26	30
Public administration and defence; (o, p)	100	105	85	93			28	69	35	40
Human health and social work (q)	100	100	169	215	71	67	287	414	450	507
Arts, entertainment and recreation (r)	100									
Other services (s, t, u)	100	164	205	228					80	97

**Table A2: Real business R&D spending 2008=100: Finland**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	100	93	93	94	85	81	77	69	67	68
Agriculture forestry and fishing (a)	100	158	535	733	265	408	207	218	231	579
Mining and quarrying (b)	100	143	79	78	90	76	55	58	80	142
Manufacture of food ,beverages and tobacco products	100	89	100	97	88	98	100	84	67	79
Manufacture of textiles, wearing apparel, leather	100	135	68	52	37	46	63	78	53	42
Manufacture of wood, paper, printing and reproduction	100	82	99	75	80	75	70	79	76	77
Manufacture of coke and refined petroleum products	100									
Manufacture of chemicals and chemical products	100	76	80	82	66	78	63	71	75	69
Manufacture of pharmaceuticals	100	96	93	100	114	97	107	102	112	115
Manufacture of rubber and plastic products	100	90	82	83	84	85	80	85	88	124
Manufacture of other non-metallic mineral products	100	87	107	105	115	90	95	90	94	86
Manufacture of basic metals	100	99	104	85	77	64	50	57	56	48
Manufacture of fabricated metal products	100	117	111	114	101	102	96	82	79	110
Manufacture of computer, electronic products	100	95	93	88	65	59	57	44	37	35
Manufacture of electrical equipment	100	99	108	118	127	129	128	97	93	91
Manufacture of machinery and equipment n.e.c.	100	85	85	95	109	114	98	93	90	95
Manufacture of motor vehicles, trailers	100	116	97	101	100	117	117	179	181	191
Manufacture of other transport equipment	100	147	117	195	237	152	57	69	116	132
Manufacture of furniture	100	90	80	104	116	87	78	60	46	86
Other manufacturing	100	78	75	70	90	63	65	60	83	57
Repair and installation of machinery and equipment	100									
Electricity, water (d,e)	100	112	118	144	154	128	96	103	166	157
Construction (f)	100	131	172	144	145	125	215	268	270	309
Wholesale and retail motor trades (g)	100	103	101	124	155	109	91	109	111	92
Transportation and storage (h)	100	87	51	74	82	70	64	73	66	51
Accommodation and food services (i)	100									
Information and communication (j)	100	86	95	100	101	115	106	112	118	139
Financial and insurance (k)	100	89	88	89	105	81	110	145	110	132
Real estate (l)	100									
Professional, scientific, technical (m)	100	89	79	107	121	120	108	90	97	93
Administrative and support services (n)	100									
Public administration and defence; (o, p)	100									
Human health and social work (q)	100									
Arts, entertainment and recreation (r)	100									
Other services (s, t, u)	100									

**Table A3: Real business R&D spending 2008=100: France**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	100	103	105	110	113	114	115	116	117	
Agriculture forestry and fishing (a)	100	122	130	144	147	165			186	
Mining and quarrying (b)	100	264	261	204	251	253			233	
Manufacture of food ,beverages and tobacco products	100	106	126	110	114	117			119	
Manufacture of textiles, wearing apparel, leather	100	72	74	58	58	64			75	
Manufacture of wood, paper, printing and reproduction	100	96	78	89	99	100			80	
Manufacture of coke and refined petroleum products	100									
Manufacture of chemicals and chemical products	100	91	94	72	77	80			82	
Manufacture of pharmaceuticals	100	81	78	78	74	74			76	
Manufacture of rubber and plastic products	100	100	98	102	115	109			108	
Manufacture of other non-metallic mineral products	100	108	89	98	98	100			112	
Manufacture of basic metals	100	88	38	75	74	75			43	
Manufacture of fabricated metal products	100	202	207	215	221	223			227	
Manufacture of computer, electronic products	100	103	93	95	100	107			110	
Manufacture of electrical equipment	100	118	88	89	91	89			92	
Manufacture of machinery and equipment n.e.c.	100	116	118	125	132	124			129	
Manufacture of motor vehicles, trailers	100	73	78	82	81	80			95	
Manufacture of other transport equipment	100	81	88	93	100	106			96	
Manufacture of furniture	100	315	299	283	280	293			186	
Other manufacturing	100	97	99	121	126	131			127	
Repair and installation of machinery and equipment	100	142	95	130	148	141			163	
Electricity, water (d,e)	100	118	123	132	131	137			171	
Construction (f)	100	180	185	143	160	160			133	
Wholesale and retail motor trades (g)	100	167	200	240	247	262			316	
Transportation and storage (h)	100	155	74	100	96	93			314	
Accommodation and food services (i)	100									
Information and communication (j)	100	109	123	123	134	146			154	
Financial and insurance (k)	100	103	139	163	157	155			177	
Real estate (l)	100									
Professional, scientific, technical (m)	100	104	116	122	121	115			112	
Administrative and support services (n)	100	944	266	329	383	470			373	
Public administration and defence; (o, p)	100	84	57	47	45	56			166	
Human health and social work (q)	100	217	447	610	645	846			1426	
Arts, entertainment and recreation (r)	100	55	33	94	156	176			450	
Other services (s, t, u)	100	130	130	132	125	135			202	

**Table A4: Real business R&D spending 2008=100: Italy**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	100	99	102	103	104	106	113	117	126	
Agriculture forestry and fishing (a)	100	104	201	187	190	243	382	504	595	
Mining and quarrying (b)	100	92	42	34	34	31	28	24	32	
Manufacture of food ,beverages and tobacco products	100	98	102	92	104	113	118	131	146	
Manufacture of textiles, wearing apparel, leather	100	107	124	125	129	135	142	151	162	
Manufacture of wood, paper, printing and reproduction	100	113	105	108	96	109	113	134	156	
Manufacture of coke and refined petroleum products	100	41	70	95	91	99	126	117	74	
Manufacture of chemicals and chemical products	100	93	100	92	94	96	101	108	122	
Manufacture of pharmaceuticals	100	109	113	116	114	106	99	103	112	
Manufacture of rubber and plastic products	100	87	99	96	113	109	130	120	132	
Manufacture of other non-metallic mineral products	100	92	93	77	92	91	101	122	138	
Manufacture of basic metals	100	86	86	93	88	80	69	74	106	
Manufacture of fabricated metal products	100	83	87	86	88	102	97	110	119	
Manufacture of computer, electronic products	100	104	113	116	108	102	102	105	74	
Manufacture of electrical equipment	100	98	112	117	118	120	114	123	142	
Manufacture of machinery and equipment n.e.c.	100	100	98	106	116	121	128	131	140	
Manufacture of motor vehicles, trailers	100	84	91	108	113	118	140	135	141	
Manufacture of other transport equipment	100	96	102	99	97	86	82	81	122	
Manufacture of furniture	100	94	83	86	91	90	105	114	137	
Other manufacturing	100	100	118	116	139	119	135	141	204	
Repair and installation of machinery and equipment	100	113	107	81	92	103	104	101	98	
Electricity, water (d,e)	100	24	21	25	33	37	180	116	73	
Construction (f)	100	111	97	73	82	94	83	230	210	
Wholesale and retail motor trades (g)	100	100	105	87	92	106	117	131	163	
Transportation and storage (h)	100	56	55	47	30	67	62	64	66	
Accommodation and food services (i)	100	127	196	164	134		122	108	164	
Information and communication (j)	100	115	110	99	98	111	104	114	125	
Financial and insurance (k)	100	114	119	86	102	110	131	135	145	
Real estate (l)	100	788	347	176	252	71	94	35	127	
Professional, scientific, technical (m)	100	99	102	109	97	100	124	123	131	
Administrative and support services (n)	100	68	61	59	89	50	182	336	520	
Public administration and defence; (o, p)	100	92	156	141	89	106	102	768	249	
Human health and social work (q)	100	128	119	143	228	310	318	335	383	
Arts, entertainment and recreation (r)	100									
Other services (s, t, u)	100	243	254	305	285	334	323	284	464	

**Table A5: Real business R&D spending 2008=100: Japan**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	100	88	90	94	94	98	103	102	99	103
Agriculture forestry and fishing (a)	100	93	140	92	58	67	58	64	77	61
Mining and quarrying (b)	100	124	81	27	25	36	31	33	32	28
Manufacture of food ,beverages and tobacco products	100	91	91	88	87	92	81	83	86	105
Manufacture of textiles, wearing apparel, leather	100	84	89	98	99	101	98	97	100	126
Manufacture of wood, paper, printing and reproduction	100	87	91	85	76	64	65	61	66	69
Manufacture of coke and refined petroleum products	100	86	90	84	81	83	73	75	77	80
Manufacture of chemicals and chemical products	100	92	92	94	95	96	95	100	104	105
Manufacture of pharmaceuticals	100	93	101	99	106	117	120	114	106	115
Manufacture of rubber and plastic products	100	93	93	98	97	105	118	117	119	121
Manufacture of other non-metallic mineral products	100	83	85	91	91	91	92	82	85	93
Manufacture of basic metals	100	90	94	101	91	92	100	95	91	91
Manufacture of fabricated metal products	100	101	110	110	105	102	107	94	97	116
Manufacture of computer, electronic products	100	84	80	87	83	82	79	78	71	72
Manufacture of electrical equipment	100	86	97	90	89	92	91	90	91	95
Manufacture of machinery and equipment n.e.c.	100	96	96	100	100	115	116	116	119	119
Manufacture of motor vehicles, trailers	100	87	94	100	104	113	125	126	125	128
Manufacture of other transport equipment	100	80	107	112	126	159	182	218	221	254
Manufacture of furniture	100	64	51	57	51	49	55	53	69	63
Other manufacturing	100	96	109	107	112	126	114	90	85	94
Electricity, water (d,e)	100	89	95	79	77	76	69	68	57	83
Construction (f)	100	97	98	96	98	95	85	91	105	105
Wholesale and retail motor trades (g)	100	106	98	83	120	124	162	180	181	176
Transportation and storage (h)	100	96	89	93	118	141	152	117	118	141
Information and communication (i)	100	90	93	99	95	82	120	110	100	103
Financial and insurance (k)	100	92	106	139	78	94	138	153	125	191
Professional, scientific, technical (m)	100	85	87	82	81	85	104	104	101	104
Administrative and support services (n)	100	100	105	95	94	86	94	127	130	117

**Table A6: Real business R&D spending 2008=100: Netherlands**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	100	93	98	130	131	129	135	138	148	
Agriculture forestry and fishing (a)	100	103	127	272	218	210	257	320	359	
Mining and quarrying (b)	100									
Manufacture of food ,beverages and tobacco products	100	110	131	151	155	150	144	121	141	
Manufacture of textiles, wearing apparel, leather	100	93	92	84	134	130	123	150	151	
Manufacture of wood, paper, printing and reproduction	100	103	72	73	82	77	104	137	210	
Manufacture of coke and refined petroleum products	100	20	92	709	1511	1510	1608	1437	1055	
Manufacture of chemicals and chemical products	100	100	81	66	60	60	61	59	61	
Manufacture of pharmaceuticals	100	91	84	71	57	52	55	55	50	
Manufacture of rubber and plastic products	100	102	91	242	205	205	172	193	215	
Manufacture of other non-metallic mineral products	100	95	79	124	117	92	80	88	87	
Manufacture of basic metals	100									
Manufacture of fabricated metal products	100	94	100	115	100	121	119	155	186	
Manufacture of computer, electronic products	100	93	129	134	139	146	153	137	143	
Manufacture of electrical equipment	100	97	74	83	81	87	78	76	81	
Manufacture of machinery and equipment n.e.c.	100	81	114	128	144	145	182	188	205	
Manufacture of motor vehicles, trailers	100	85	96	192	185	192	198	216	216	
Manufacture of other transport equipment	100	97	175	273	281	282	277	275	312	
Manufacture of furniture	100	91	90	790	107	56	99	98	159	
Other manufacturing	100	107		11	15	13	12	14	19	
Repair and installation of machinery and equipment	100									
Electricity, water (d,e)	100									
Construction (f)	100	143	232	445	554	445	466	437	469	
Wholesale and retail motor trades (g)	100	98	175	203	218	201	212	256	303	
Transportation and storage (h)	100	195	84	580	570	468	503	605	524	
Accommodation and food services (i)	100									
Information and communication (j)	100	111	181	248	237	226	246	275	316	
Financial and insurance (k)	100	8	10	78	104	97	74	94	95	
Real estate (l)	100		0	35	21	24	30	11	11	
Professional, scientific, technical (m)	100	104	102	200	188	188	187	192	201	
Administrative and support services (n)	100		176	1062	929	1268	1257	688	738	
Public administration and defence; (o, p)	100									
Human health and social work (q)	100									
Arts, entertainment and recreation (r)	100									
Other services (s, t, u)	100									

**Table A7: Real business R&D spending 2008=100: Norway**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	100	97	95	100	104	107	113	124	126	134
Agriculture forestry and fishing (a)	100	92	104	85	83	87	139	192	197	268
Mining and quarrying (b)	100	94	97	89	114	143	131	116	121	110
Manufacture of food ,beverages and tobacco products	100	109	86	86	94	88	100	142	166	163
Manufacture of textiles, wearing apparel, leather	100	85	87	98	88	73	81	89	99	135
Manufacture of wood, paper, printing and reproduction	100	101	89	110	86	80	82	92	110	133
Manufacture of coke and refined petroleum products	100									
Manufacture of chemicals and chemical products	100									
Manufacture of pharmaceuticals	100	89	93	132	70	67	58	55	58	65
Manufacture of rubber and plastic products	100	81	117	97	133	135	144	152	155	186
Manufacture of other non-metallic mineral products	100	97	104	129	119	119	109	100	113	120
Manufacture of basic metals	100	85	75	51	66	66	64	106	93	96
Manufacture of fabricated metal products	100	120	133	161	180	175	193	216	211	194
Manufacture of computer, electronic products	100	97	76	81	78	76	82	86	82	81
Manufacture of electrical equipment	100	105	89	91	98	108	126	117	116	115
Manufacture of machinery and equipment n.e.c.	100	73	67	78	85	102	112	106	102	101
Manufacture of motor vehicles, trailers	100	94	42	70	71	75	87	52	57	69
Manufacture of other transport equipment	100	111	90	85	115	110	122			
Manufacture of furniture	100	100	126	118	130	144	147	132	145	161
Other manufacturing	100	81	76	72	83	71	79	98	96	116
Repair and installation of machinery and equipment	100	91	73	76	91	92	85	128	129	129
Electricity, water (d,e)	100	123	147	132	147	138	137	179	223	214
Construction (f)	100	76	72	57	56	83	97	111	116	150
Wholesale and retail motor trades (g)	100	111	79	98	88	112	121	123	157	140
Transportation and storage (h)	100	95	127	115	147	135	148	274	253	285
Information and communication (i)	100	98	106	110	119	126	134	158	176	193
Financial and insurance (k)	100	97	94	119	110	116	115	114	89	124
Professional, scientific, technical (m)	100	99	106	109	110	107	115	124	122	126
Administrative and support services (n)	100	67	96	120	95	88	39	57	58	71

**Table A8: Real business R&D spending 2008=100: USA**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	100	96	94	97	98	103	107	110	115	
Mining and quarrying (b)	100		166	175	177	247	285	240	195	
Manufacture of food ,beverages and tobacco products	100	161				188	196	182		
Manufacture of textiles, wearing apparel, leather	100	52	59	75	65	75	70	83	127	
Manufacture of wood, paper, printing and reproduction	100	109	96	93	77	72	67	58	63	
Manufacture of coke and refined petroleum products	100	44			62	17	16	14	25	
Manufacture of chemicals and chemical products	100	82	84	89	85	85	87	85	79	
Manufacture of pharmaceuticals	100	93	101	92	94	101	107	110	120	
Manufacture of rubber and plastic products	100	135	115	121	182	186	179	126	184	
Manufacture of other non-metallic mineral products	100	70	80	73	80	79	84	73	74	
Manufacture of basic metals	100	120	92	91	101	83	89	81	76	
Manufacture of fabricated metal products	100	84	69	74	71	85	80	84	82	
Manufacture of computer, electronic products	100	93	97	100	101	103	111	107	114	
Manufacture of electrical equipment	100	105	104	110	93	122	126	124	135	
Manufacture of machinery and equipment n.e.c.	100	90	97	140	133	116	109	120	111	
Manufacture of motor vehicles, trailers	100					118	127	131	149	
Manufacture of other transport equipment	100					72	69	73		
Manufacture of furniture	100	82	77	64	69	73	71	85	68	
Other manufacturing	100	134				168	156	166		
Electricity, water (d,e)	100	108	184	164	145	121	125	191	138	
Construction (f)	100									
Wholesale and retail motor trades (g)	100									
Transportation and storage (h)	100	131	70	58	124		457	269	322	
Information and communication (i)	100	92	94	106	110	124	136	144	154	
Financial and insurance (k)	100	174	190	304	304	366	344	443	598	
Real estate (l)	100									
Professional, scientific, technical (m)	100	125	86	93	84	78	70	85	75	
Human health and social work (q)	100	41	92	54	48	37	35	52	57	

**Table A9: Real business R&D spending (\$m, 2010 prices and PPP): UK**

	2008	2009	2010	2011	2012	2013	2014	2015	2016
TOTAL BERD	2335 3	2258 8	2287 8	2432 1	2353 2	2491 2	2646 7	2760 8	2878 6
Agriculture forestry and fishing (a)	30	11	19	17	19	14	18	20	28
Mining and quarrying (b)	107	129	194	242	235	257	242	210	215
Manufacture of food products; beverages and tobacco	381	376	330	388	378	442	438	341	404
Manufacture of textiles, wearing apparel, leather	26	15	15	35	44	30	30	25	27
Manufacture of wood, paper, printing and reproduction	48	24	26	21	30	48	53	58	63
Manufacture of coke and refined petroleum products	89	126	19			26		118	55
Manufacture of chemicals and chemical products	370	394	457	397	362	487	486	412	623
Manufacture of basic pharmaceutical products	523	594	652	738	694	618	531	513	496
Manufacture of rubber and plastic products	135	107	95	114	135	128	147	178	168
Manufacture of other non-metallic mineral products	116	60	59	57	43	46	63	56	67
Manufacture of basic metals	97	67	70	122	87	60	94	78	85
Manufacture of fabricated metal products	792	905	846	770	681	693	704	632	597
Manufacture of computer, electronic and optical products	1765	1407	1177	1366	1343	1378	1336	1302	1412
Manufacture of electrical equipment	139	198	233	213	234	217	241	251	227
Manufacture of machinery vehicles and OT equipment	4540	3975	4038	4387	5037	5331	5781	6387	7243
Manufacture of furniture	11	39	47	70	50	69	52	53	56
Other manufacturing	64	124	204	164	143	170	164	229	201
Electricity, gas, and water supply (d,e)	37	45	43	46	114	153	144	183	163
Construction (f)	41	79	54	52	83	94	139	118	164
Wholesale and retail trade motor vehicles (g)	911	849	1073	1070	962	933	931	1206	1101
Transportation and storage (h)	23	42	41	41	13	41	61	75	55
Accommodation and food service activities (i)	13	12	27	35	40	22	39	50	81
Information and communication (j)	3857	3289	2975	3272	3330	3553	3897	3822	4138
Financial and insurance activities (k)	651	548	496	424	367	447	497	521	517
Real estate activities (l)	13	15	14	14	15	22	29	27	19
Professional, scientific, and technical activities (m)	8364	8523	8945	9522	8207	8701	9248	9586	9268
Administrative and support service activities (n)	175	121	194	272	399	373	597	615	605
Public administration and defence (o, p)	7	23	12	11	26	45	21	13	12
Human health and social work activities (q)	4	4	36	24	23	43	53	70	79
Other service activities (s, t, u)	5	22	39	35	34	43	35	39	40

**Table A10: Real business R&D spending (\$m, 2010 prices and PPP): Belgium**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	5707	5571	6009	6578	7066	7229	7538	7912	8176	9002
Agriculture forestry and fishing (a)	33	33	30	30	18	19	7	12	7	8
Mining and quarrying (b)	2	2	6	8	1	2	5	7	1	2
Manufacture of food ,beverages and tobacco products	116	124	134	143					207	218
Manufacture of textiles, wearing apparel, leather	57	56	60	66	56	62			57	68
Manufacture of wood, paper, printing and reproduction	22	23	19	23	31	33	28	27	25	28
Manufacture of coke and refined petroleum products	15	15	7	8	11	11				
Manufacture of chemicals and chemical products	363	337	348	410	433	422	400	410	341	380
Manufacture of pharmaceuticals	1398	1395	1366	1673	1753	1769	1761	1779	2245	2406
Manufacture of rubber and plastic products	105	100	103	107	106	104	117	127	108	135
Manufacture of other non-metallic mineral products	63	75	72	75	64	63	70	73	59	63
Manufacture of basic metals	120	115	136	165	162	142			153	174
Manufacture of fabricated metal products	70	76	101	104	121	122			99	111
Manufacture of computer, electronic products	579	551	489	499	525	544	497	517	536	572
Manufacture of electrical equipment	268	240	241	260	160	156	167	164	122	125
Manufacture of machinery and equipment n.e.c.	264	235	260	282	340	345	293	319	347	376
Manufacture of motor vehicles, trailers	108	103	106	133	145	168	130	146	149	167
Manufacture of other transport equipment	107	113	127	152			141	165	140	129
Manufacture of furniture	10	11	10	10	12	12	9	9	15	18
Other manufacturing	13	16	14	16	20	23	19	23	18	24
Repair and installation of machinery and equipment	16	16	13	14	25	28	18	22	31	30
Electricity, water (d,e)	31	20	61	67	101	117	92	97	87	69
Construction (f)	55	61	76	66	42	45	45	58	72	80
Wholesale and retail motor trades (g)	137	132	167	158	321	324	366	380	409	427
Transportation and storage (h)	15	20	14	18			29	32	26	25
Accommodation and food services (i)	1	1	0	0						
Information and communication (j)	455	456	591	654	623	617	695	727	834	966
Financial and insurance (k)	127	127	120	123	202	200	277	283	282	365
Real estate (l)			1	1	1	1			1	1
Professional, scientific, technical (m)	1005	991	1296	1268	1467	1559	1726	1848	1727	1952
Administrative and support services (n)	145	120	31	33			117	119	38	44
Public administration and defence; (o, p)	1	1	1	1			0	1	0	0
Human health and social work (q)	5	5	9	12	4	4	16	23	24	28
Arts, entertainment and recreation (r)			0	0			1	1	1	1
Other services (s, t, u)	1	1	1	1					1	1

**Table A11: Real business R&D spending (\$m, 2010 prices and PPP): Finland**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	5792	5401	5391	5464	4936	4719	4446	4013	3864	3952
Agriculture forestry and fishing (a)	1	1	4	5	2	3	2	2	2	4
Mining and quarrying (b)	12	16	9	9	10	9	6	7	9	16
Manufacture of food ,beverages and tobacco products	71	64	72	69	63	70	71	60	48	57
Manufacture of textiles, wearing apparel, leather	14	19	10	7	5	6	9	11	8	6
Manufacture of wood, paper, printing and reproduction	131	107	130	98	104	98	91	103	100	100
Manufacture of coke and refined petroleum products										
Manufacture of chemicals and chemical products	169	129	136	139	112	131	106	120	126	117
Manufacture of pharmaceuticals	126	122	117	126	143	123	136	129	142	145
Manufacture of rubber and plastic products	44	39	36	36	37	37	35	37	38	54
Manufacture of other non-metallic mineral products	31	27	33	33	36	28	30	28	29	27
Manufacture of basic metals	65	64	67	55	50	42	33	37	36	31
Manufacture of fabricated metal products	44	52	49	50	45	45	43	36	35	49
Manufacture of computer, electronic products	3095	2937	2870	2717	2004	1826	1753	1356	1150	1095
Manufacture of electrical equipment	239	236	258	281	304	308	306	233	221	218
Manufacture of machinery and equipment n.e.c.	455	389	385	432	495	517	446	424	411	430
Manufacture of motor vehicles, trailers	22	26	21	22	22	26	26	40	40	42
Manufacture of other transport equipment	26	39	31	51	63	40	15	18	30	35
Manufacture of furniture	8	7	6	8	9	7	6	5	4	7
Other manufacturing	21	17	16	15	19	14	14	13	18	12
Repair and installation of machinery and equipment										
Electricity, water (d,e)	39	43	46	56	60	50	37	40	64	61
Construction (f)	37	49	64	54	54	47	80	100	101	115
Wholesale and retail motor trades (g)	79	82	80	99	123	87	73	86	89	73
Transportation and storage (h)	23	20	12	17	19	16	15	17	15	12
Accommodation and food services (i)			1		1					
Information and communication (j)	485	417	460	487	491	559	515	544	573	674
Financial and insurance (k)	86	77	76	77	91	70	95	126	95	114
Real estate (l)			3	3	3					
Professional, scientific, technical (m)	405	359	319	434	488	484	438	366	391	378
Administrative and support services (n)			3	4	5	3	6	5	10	4
Public administration and defence; (o, p)				0	0					
Human health and social work (q)			3	3	4	5	2	3	3	4
Arts, entertainment and recreation (r)					16	15	21	24	28	

**Table A12: Real business R&D spending (\$m, 2010 prices and PPP): France**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	30483	31249	32122	33438	34419	34776	35190	35491	35780	
Agriculture forestry and fishing (a)	122	150	159	175	179	202			228	
Mining and quarrying (b)	7	18	18	14	17	17			16	
Manufacture of food ,beverages and tobacco products	352	374	443	386	401	411			419	
Manufacture of textiles, wearing apparel, leather	224	161	165	131	130	143			169	
Manufacture of wood, paper, printing and reproduction	85	82	66	76	85	85			68	
Manufacture of coke and refined petroleum products			127	125	89	114			61	
Manufacture of chemicals and chemical products	1344	1219	1264	966	1039	1074			1098	
Manufacture of pharmaceuticals	1245	1010	975	973	925	915			943	
Manufacture of rubber and plastic products	795	798	783	812	912	863			859	
Manufacture of other non-metallic mineral products	216	234	193	212	212	217			242	
Manufacture of basic metals	378	332	143	282	281	282			164	
Manufacture of fabricated metal products	356	719	736	765	788	794			810	
Manufacture of computer, electronic products	3890	3989	3616	3701	3877	4171			4273	
Manufacture of electrical equipment	841	991	742	752	765	751			770	
Manufacture of machinery and equipment n.e.c.	949	1102	1115	1189	1251	1177			1224	
Manufacture of motor vehicles, trailers	2700	1960	2112	2223	2178	2169			2566	
Manufacture of other transport equipment	3634	2954	3187	3388	3641	3854			3479	
Manufacture of furniture	7	23	21	20	20	21			13	
Other manufacturing	265	258	261	320	334	348			337	
Repair and installation of machinery and equipment	239	339	227	311	353	337			388	
Electricity, water (d,e)	477	563	587	628	627	653			816	
Construction (f)	104	188	193	150	168	167			139	
Wholesale and retail motor trades (g)	714	1191	1428	1714	1760	1866			2255	
Transportation and storage (h)	56	87	41	56	54	52			176	
Accommodation and food services (i)		3		0	4				2	
Information and communication (j)	2831	3087	3478	3492	3807	4133			4352	
Financial and insurance (k)	186	192	259	303	293	288			328	
Real estate (l)			3						6	
Professional, scientific, technical (m)	8266	8608	9597	10047	9978	9500			9265	
Administrative and support services (n)	48	455	128	159	184	226			180	
Public administration and defence; (o, p)	10	8	5	4	4	5			16	
Human health and social work (q)	3	6	12	16	17	23			39	
Arts, entertainment and recreation (r)	4	2	1	4	7	8			19	
Other services (s, t, u)	28	37	37	37	35	38			57	

**Table A13: Real business R&D spending (\$m, 2010 prices and PPP): Germany**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	58673	56661	58289	62770	65101	63580	66483	69717	70893	76449
Agriculture forestry and fishing (a)	126	164	177	155	167	171	160	172	179	188
Mining and quarrying (b)	36	17	15	12	13	18	14	24	23	28
Manufacture of food ,beverages and tobacco products	350	398	408	379	381	374	371	363	353	353
Manufacture of textiles, wearing apparel, leather	171	158	154	146	148	134	134	104	107	113
Manufacture of wood, paper, printing and reproduction	231	220	258	225	208	269	261	246	259	276
Manufacture of coke and refined petroleum products	112	116	111	116	116	111	139	154	159	161
Manufacture of chemicals and chemical products	4108	4002	3880	4051	4231	3972	4233	4330	4416	4518
Manufacture of pharmaceuticals	4348	4876	4641	5001	4952	4837	4706	4525	5098	5147
Manufacture of rubber and plastic products	1127	1060	1035	1159	1157	1151	1182	1244	1325	1277
Manufacture of other non-metallic mineral products	339	360	354	346	346	346	352	355	371	355
Manufacture of basic metals	507	619	612	634	656	629	624	607	609	642
Manufacture of fabricated metal products	945	891	885	892	911	882	875	942	951	1024
Manufacture of computer, electronic products	8245	7278	7446	8066	8946	8714	8756	8625	8618	8601
Manufacture of electrical equipment	1904	1669	1670	1968	2097	2528	2533	2572	2593	2992
Manufacture of machinery and equipment n.e.c.	5948	5630	5710	6025	6272	6396	6591	6244	6378	7909
Manufacture of motor vehicles, trailers	19464	17296	18397	20047	21011	20400	22941	24553	24700	28513
Manufacture of other transport equipment	2972	2574	3123	3198	3247	2395	2413	2296	2286	1973
Manufacture of furniture	124	64	65	51	48	44	45	40	37	37
Other manufacturing	487	547	548	676	636	723	754	716	657	894
Repair and installation of machinery and equipment	547	689	684	765	712	750	795	1458	1294	223
Electricity, water (d,e)	164	271	244	243	225	247	228	184	175	196
Construction (f)	71	86	95	81	85	95	93	86	91	94
Wholesale and retail motor trades (g)	210	255	278	321	343	307	299	302	264	493
Transportation and storage (h)	78	72	79	133	149	109	111	153	124	131
Accommodation and food services (i)	0	0	0							
Information and communication (j)	2440	3209	3294	3674	3843	3763	3767	3643	3759	3756
Financial and insurance (k)	280	419	289	321	321	345	370	325	329	276
Real estate (l)		1	1	1	1	1	1	1	1	2
Professional, scientific, technical (m)	3070	3655	3770	4009	3800	3799	3655	5359	5659	6217
Administrative and support services (n)	268	42	46	44	47	34	33	54	47	56
Public administration and defence; (o, p)	3	3	3	3	1	1	0			
Human health and social work (q)			4	4	4	7	7	9	8	0
Arts, entertainment and recreation (r)				2	2	4	4	2	2	0
Other services (s, t, u)	21	15	21	21	19	19	23	21	4	

**Table A14: Real business R&D spending (\$m, 2010 prices and PPP): Italy**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	1345 8	1328 4	1368 3	1379 8	1396 5	1426 1	1518 8	1570 9	1697 8	
Agriculture forestry and fishing (a)	2	2	5	4	4	5	9	11	13	
Mining and quarrying (b)	232	214	97	80	78	73	66	56	74	
Manufacture of food ,beverages and tobacco products	208	203	212	192	216	234	246	271	304	
Manufacture of textiles, wearing apparel, leather	444	474	548	554	575	597	630	671	719	
Manufacture of wood, paper, printing and reproduction	85	96	90	92	82	93	97	114	133	
Manufacture of coke and refined petroleum products	17	7	12	16	15	17	21	20	13	
Manufacture of chemicals and chemical products	471	439	470	432	444	453	474	509	574	
Manufacture of pharmaceuticals	635	692	721	737	725	676	630	657	711	
Manufacture of rubber and plastic products	311	271	307	299	353	339	404	375	411	
Manufacture of other non-metallic mineral products	132	122	122	102	121	120	134	161	182	
Manufacture of basic metals	144	124	125	134	126	115	100	107	153	
Manufacture of fabricated metal products	398	329	346	344	351	405	387	437	473	
Manufacture of computer, electronic products	1585	1651	1784	1840	1719	1610	1612	1672	1175	
Manufacture of electrical equipment	502	494	562	587	593	600	575	616	712	
Manufacture of machinery and equipment n.e.c.	1405	1402	1375	1489	1628	1704	1799	1839	1971	
Manufacture of motor vehicles, trailers	1533	1289	1391	1654	1734	1805	2150	2070	2159	
Manufacture of other transport equipment	1446	1395	1468	1436	1408	1244	1191	1177	1771	
Manufacture of furniture	78	74	65	67	71	71	82	89	107	
Other manufacturing	99	99	117	115	138	118	134	139	202	
Repair and installation of machinery and equipment	81	92	87	66	75	84	85	82	80	
Electricity, water (d,e)	107	26	23	27	35	40	193	125	79	
Construction (f)	56	62	54	41	46	52	46	128	117	
Wholesale and retail motor trades (g)	374	373	394	326	343	398	438	489	611	
Transportation and storage (h)	75	42	41	35	23	50	47	48	50	
Accommodation and food services (i)	2	3	4	4	3		3	2	4	
Information and communication (j)	1460	1672	1609	1441	1424	1616	1515	1663	1819	
Financial and insurance (k)	212	240	253	182	216	232	276	286	307	
Real estate (l)	4	30	13	7	10	3	4	1	5	
Professional, scientific, technical (m)	1268	1260	1287	1378	1233	1273	1574	1554	1657	
Administrative and support services (n)	20	13	12	12	17	10	36	66	102	
Public administration and defence; (o, p)	2	2	3	3	2	2	2	15	5	
Human health and social work (q)	64	82	76	91	146	199	204	215	245	
Arts, entertainment and recreation (r)		1	2		1	10	18	33	26	
Other services (s, t, u)	3	8	8	10	9	11	11	9	15	

**Table A15: Real business R&D spending (\$m, 2010 prices and PPP): Japan**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	119054	105284	107553	111768	111696	116871	122961	121259	117688	122204
Agriculture forestry and fishing (a)	29	27	41	27	17	20	17	19	23	18
Mining and quarrying (b)	111	138	90	30	28	40	34	36	36	31
Manufacture of food ,beverages and tobacco products	2331	2126	2127	2041	2023	2152	1897	1945	2003	2438
Manufacture of textiles, wearing apparel, leather	1259	1059	1125	1239	1249	1274	1231	1222	1260	1587
Manufacture of wood, paper, printing and reproduction	849	739	772	719	648	541	551	521	564	584
Manufacture of coke and refined petroleum products	521	447	468	438	421	431	381	392	401	418
Manufacture of chemicals and chemical products	7212	6635	6662	6777	6854	6924	6819	7235	7506	7550
Manufacture of pharmaceuticals	11313	10487	11427	11202	11987	13233	13533	12916	11943	12977
Manufacture of rubber and plastic products	2591	2413	2421	2539	2525	2721	3061	3034	3085	3147
Manufacture of other non-metallic mineral products	1496	1248	1267	1359	1355	1360	1378	1229	1264	1396
Manufacture of basic metals	2284	2057	2155	2310	2074	2105	2294	2175	2072	2082
Manufacture of fabricated metal products	449	453	494	495	470	458	481	424	438	523
Manufacture of computer, electronic products	32883	27729	26259	28621	27166	26819	26131	25558	23219	23641
Manufacture of electrical equipment	3498	3011	3409	3153	3127	3235	3197	3133	3187	3319
Manufacture of machinery and equipment n.e.c.	9964	9597	9534	9993	9967	11488	11603	11559	11875	11860
Manufacture of motor vehicles, trailers	24748	21574	23150	24867	25772	27980	30950	31143	30877	31709
Manufacture of other transport equipment	447	357	477	499	562	711	811	975	986	1134
Manufacture of furniture	184	117	93	105	94	91	102	98	127	117
Other manufacturing	1732	1660	1884	1855	1944	2176	1969	1560	1474	1629
Electricity, water (d,e)	630	558	595	495	482	478	433	429	358	521
Construction (f)	1047	1016	1023	1002	1021	990	887	949	1104	1101
Wholesale and retail motor trades (g)	369	391	361	306	443	456	598	663	666	650
Transportation and storage (h)	344	332	306	320	408	484	524	402	405	486
Information and communication (i)	5200	4666	4837	5126	4958	4280	6230	5718	5175	5368
Financial and insurance (k)	21	20	23	30	17	20	30	33	27	41
Professional, scientific, technical (m)	7483	6370	6493	6166	6031	6355	7767	7818	7539	7809
Administrative and support services (n)	57	57	61	55	54	49	54	73	74	67

**Table A16: Real business R&D spending (\$m, 2010 prices and PPP): Korea**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	33027	34554	39010	44700	50077	53487	56930	57028		
Agriculture forestry and fishing (a)	26	25	31	42	31	30	33	35		
Mining and quarrying (b)	8	18	22	26	41	29	23	26		
Manufacture of food ,beverages and tobacco products	444	455	361	472	546	531	558	1118		
Manufacture of textiles, wearing apparel, leather	194	201	199	334	372	418	421	451		
Manufacture of wood, paper, printing and reproduction	56	76	81	106	140	119	124	153		
Manufacture of coke and refined petroleum products	147	168	274	396	315	335	272	282		
Manufacture of chemicals and chemical products	1654	1785	2062	2730	2646	3052	2713	2998		
Manufacture of pharmaceuticals	806	846	878	1011	1210	1244	1281	1507		
Manufacture of rubber and plastic products	553	441	603	631	628	833	879	912		
Manufacture of other non-metallic mineral products	183	291	247	277	376	364	272	253		
Manufacture of basic metals	650	677	664	722	850	712	741	727		
Manufacture of fabricated metal products	297	357	307	625	578	630	579	683		
Manufacture of computer, electronic products	16083	16444	19624	21883	24997	27632	30269	28582		
Manufacture of electrical equipment	866	944	992	1077	1253	1186	1272	1551		
Manufacture of machinery and equipment n.e.c.	1992	1966	2184	2415	3154	3061	3225	3170		
Manufacture of motor vehicles, trailers	4373	4334	4757	5312	5669	6061	6710	7219		
Manufacture of other transport equipment	693	637	691	730	883	844	868	967		
Manufacture of furniture	22	53	52	63	66	75	99	96		
Other manufacturing	201	179	199	346	296	294	335	433		
Repair and installation of machinery and equipment										
Electricity, water (d,e)	358	360	374	481	504	409	421	436		
Construction (f)	819	1042	887	1064	1145	1103	1133	837		
Wholesale and retail motor trades (g)	173	570	642	720	781	813	854	690		
Transportation and storage (h)	70	42	88	145	81	127	46	44		
Accommodation and food services (i)	3	10	1	8	1	10	9	16		
Information and communication (j)	1641	1611	1826	1979	2356	2244	2447	2362		
Financial and insurance (k)	0	2	2	1	2	2	5	6		
Real estate (l)	1	31	21	3	2	2	4	7		
Professional, scientific, technical (m)	663	892	837	985	1034	1196	1203	1330		
Administrative and support services (n)	35	68	73	72	81	91	93	87		
Public administration and defence; (o, p)	10	15	15	19	14	17	16	19		
Human health and social work (q)		0	0	0	1	5	6	13		
Arts, entertainment and recreation (r)	3	4	4	3	3	3	2	3		
Other services (s, t, u)	3	10	13	21	19	15	18	14		

**Table A17: Real business R&D spending (\$m, 2010 prices and PPP): Netherlands**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	6234	5791	6109	8088	8153	8069	8433	8633	9239	
Agriculture forestry and fishing (a)	76	78	96	206	165	160	195	242	272	
Mining and quarrying (b)				34	67	66	78	16	12	
Manufacture of food ,beverages and tobacco products	296	326	388	446	459	445	427	359	418	
Manufacture of textiles, wearing apparel, leather	17	15	15	14	22	22	20	25	25	
Manufacture of wood, paper, printing and reproduction	34	35	25	25	28	26	36	47	72	
Manufacture of coke and refined petroleum products	18	4	16	126	268	268	286	255	187	
Manufacture of chemicals and chemical products	990	986	802	649	599	595	605	583	604	
Manufacture of pharmaceuticals	529	482	447	376	302	277	291	290	264	
Manufacture of rubber and plastic products	47	48	43	115	97	97	82	92	102	
Manufacture of other non-metallic mineral products	24	22	19	29	28	22	19	21	21	
Manufacture of basic metals				93	86	91	76	91	95	
Manufacture of fabricated metal products	79	74	80	92	79	96	95	123	148	
Manufacture of computer, electronic products	508	470	657	681	705	743	779	694	726	
Manufacture of electrical equipment	681	658	501	563	552	591	529	519	550	
Manufacture of machinery and equipment n.e.c.	749	609	854	957	1079	1086	1365	1405	1537	
Manufacture of motor vehicles, trailers	86	73	83	166	160	166	172	186	187	
Manufacture of other transport equipment	41	40	73	113	117	117	115	114	129	
Manufacture of furniture	13	12	12	103	14	7	13	13	21	
Other manufacturing	239	256		26	36	32	30	35	44	
Repair and installation of machinery and equipment			22	27	32	35	43	44	41	
Electricity, water (d,e)	48	36	25	47	54	50				
Construction (f)	27	39	63	121	151	121	127	119	128	
Wholesale and retail motor trades (g)	224	219	392	455	488	450	476	572	678	
Transportation and storage (h)	24	46	20	138	135	111	119	143	124	
Accommodation and food services (i)	0	0	0	13	3	2	1	2	2	
Information and communication (j)	372	414	673	923	882	840	914	1024	1175	
Financial and insurance (k)	301	24	29	235	312	292	223	282	286	
Real estate (l)	23		0	8	5	5	7	3	2	
Professional, scientific, technical (m)	592	616	602	1182	1112	1112	1107	1136	1193	
Administrative and support services (n)	11		19	113	99	135	134	73	79	

**Table A18: Real business R&D spending (\$m, 2010 prices and PPP): Norway**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	2508	2445	2394	2514	2598	2684	2840	3120	3173	3367
Agriculture forestry and fishing (a)	37	34	38	31	31	32	51	71	72	99
Mining and quarrying (b)	146	137	142	130	166	209	191	169	177	160
Manufacture of food ,beverages and tobacco products	72	79	62	62	68	63	72	102	119	117
Manufacture of textiles, wearing apparel, leather	8	7	7	8	7	6	7	8	8	11
Manufacture of wood, paper, printing and reproduction	26	27	24	29	23	21	22	24	29	35
Manufacture of coke and refined petroleum products								0	0	0
Manufacture of chemicals and chemical products			98					91	90	98
Manufacture of pharmaceuticals	58	52	54	76	41	39	34	32	33	37
Manufacture of rubber and plastic products	10	8	11	9	13	13	14	15	15	18
Manufacture of other non-metallic mineral products	10	9	10	12	11	11	10	10	11	12
Manufacture of basic metals	47	40	35	24	31	31	30	49	43	45
Manufacture of fabricated metal products	61	73	81	98	109	106	117	131	128	117
Manufacture of computer, electronic products	218	212	166	177	171	165	178	188	178	177
Manufacture of electrical equipment	44	46	39	40	43	47	55	51	51	50
Manufacture of machinery and equipment n.e.c.	123	89	82	96	105	126	137	130	125	124
Manufacture of motor vehicles, trailers	31	29	13	22	22	24	27	16	18	22
Manufacture of other transport equipment	46	51	41	39	53	51	56			
Manufacture of furniture	10	10	13	12	14	15	15	14	15	17
Other manufacturing	16	13	12	11	13	11	13	16	15	19
Repair and installation of machinery and equipment	21	19	15	16	19	20	18	27	28	28
Electricity, water (d,e)	16	20	24	21	24	22	22	29	36	35
Construction (f)	21	16	15	12	12	17	20	23	24	31
Wholesale and retail motor trades (g)	62	69	49	60	54	69	75	76	97	86
Transportation and storage (h)	13	13	17	16	20	18	20	37	34	38
Information and communication (j)	485	476	512	536	576	612	653	767	855	939
Financial and insurance (k)	118	114	111	141	129	138	136	135	105	147
Professional, scientific, technical (m)	669	665	707	727	738	716	766	833	816	843
Administrative and support services (n)	15	10	14	18	14	13	6	8	9	10

**Table A19: Real business R&D spending (\$m, 2010 prices and PPP): Spain**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	11151	10426	10325	10171	9749	9457	9308	9446	9699	10391
Agriculture forestry and fishing (a)	101	77	77	73	73	73	80	82	93	114
Mining and quarrying (b)	28	23	26	27	23	19	17	18	19	23
Manufacture of food ,beverages and tobacco products	316	287	273	267	257	255	254	247	280	312
Manufacture of textiles, wearing apparel, leather	158	126	115	112	129	138	189	190	142	119
Manufacture of wood, paper, printing and reproduction	82	65	62	65	51	45	48	46	55	57
Manufacture of coke and refined petroleum products	87	72	82	94	95	94	95	93	84	69
Manufacture of chemicals and chemical products	394	328	343	333	322	328	320	314	325	361
Manufacture of pharmaceuticals	894	915	865	874	806	778	793	809	859	938
Manufacture of rubber and plastic products	166	155	144	140	147	142	131	132	140	140
Manufacture of other non-metallic mineral products	127	109	98	97	79	84	75	67	65	64
Manufacture of basic metals	108	96	101	126	89	75	71	61	59	96
Manufacture of fabricated metal products	235	201	189	191	179	167	163	160	154	173
Manufacture of computer, electronic products	377	331	319	286	247	241	234	224	231	259
Manufacture of electrical equipment	322	291	283	269	288	260	263	289	298	253
Manufacture of machinery and equipment n.e.c.	325	336	297	309	312	299	290	303	312	325
Manufacture of motor vehicles, trailers	407	480	526	492	468	449	515	501	599	683
Manufacture of other transport equipment	581	645	788	926	821	777	697	749	773	815
Manufacture of furniture	36	34	27	26	22	21	25	20	20	19
Other manufacturing	90	89	72	79	74	77	69	71	84	88
Repair and installation of machinery and equipment	38	27	19	18	18	17	18	14	18	20
Electricity, water (d,e)	174	214	234	256	278	231	206	213	211	225
Construction (f)	334	262	219	214	189	169	178	141	130	150
Wholesale and retail motor trades (g)	557	373	312	304	295	278	241	278	342	388
Transportation and storage (h)	131	99	129	84	82	62	65	49	78	93
Accommodation and food services (i)	18	13	8	3	11	6	5	5	4	7
Information and communication (j)	1387	1276	1215	1207	1169	1158	1173	1085	1138	1092
Financial and insurance (k)	173	252	266	209	129	122	115	186	210	316
Real estate (l)	10	13	11	9	8	3	7	7	7	15
Professional, scientific, technical (m)	3179	2992	3009	2874	2858	2856	2747	2875	2782	2986
Administrative and support services (n)	66	62	54	48	66	65	54	53	50	53
Public administration and defence; (o, p)	30	29	19	20	19	14	15	10	9	10
Human health and social work (q)	167	119	115	102	115	125	129	123	106	106
Arts, entertainment and recreation (r)	11	6	5	5	5	7	7	8	7	9
Other services (s, t, u)	43	33	26	33	25	22	22	22	14	16

**Table A20: Real business R&D spending (\$m, 2010 prices and PPP): United States**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TOTAL BERD	296310	285684	278977	288074	290495	304637	315852	326354	339938	
Mining and quarrying (b)	1531		2542	2677	2706	3775	4360	3680	2990	
Manufacture of food ,beverages and tobacco products	2936	4723				5530	5758	5356		
Manufacture of textiles, wearing apparel, leather	831	433	489	621	538	625	585	686	1058	
Manufacture of wood, paper, printing and reproduction	1824	1979	1752	1697	1412	1315	1223	1061	1142	
Manufacture of coke and refined petroleum products	1384	613			859	229	217	196	346	
Manufacture of chemicals and chemical products	10315	8490	8623	9183	8727	8726	8981	8733	8117	
Manufacture of pharmaceuticals	49063	45460	49415	45009	46273	49518	52479	53816	58635	
Manufacture of rubber and plastic products	1852	2497	2121	2233	3373	3448	3313	2331	3404	
Manufacture of other non-metallic mineral products	1586	1113	1276	1155	1275	1255	1340	1155	1169	
Manufacture of basic metals	708	847	653	642	712	589	628	576	537	
Manufacture of fabricated metal products	2466	2064	1703	1815	1762	2089	1975	2074	2031	
Manufacture of computer, electronic products	61635	57093	59875	61421	62537	63477	68496	66138	70209	
Manufacture of electrical equipment	3204	3373	3320	3521	2967	3907	4046	3976	4329	
Manufacture of machinery and equipment n.e.c.	10300	9244	9956	14408	13700	11948	11243	12314	11418	
Manufacture of motor vehicles, trailers	13394					15801	17060	17498	19998	
Manufacture of other transport equipment	38137					27622	26273	27695		
Manufacture of furniture	486	401	373	312	334	353	346	415	332	
Other manufacturing	7581	10187				12760	11855	12556		
Electricity, water (d,e)	230	249	425	378	334	278	287	440	318	
Construction (f)		116	1079							
Wholesale and retail motor trades (g)	2563	3053	1781	1601	3028	1834				
Transportation and storage (h)	138	180	96	79	171		629	370	443	
Information and communication (i)	50806	46906	47902	53996	55798	62788	69332	73234	78474	
Financial and insurance (k)	1112	1933	2109	3386	3382	4069	3821	4922	6651	
Real estate (l)				70	20	87	192	214	407	
Professional, scientific, technical (m)	26308	32764	22640	24449	22161	20543	18499	22281	19822	
Human health and social work (q)	1338	543	1232	726	649	497	464	695	769	



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