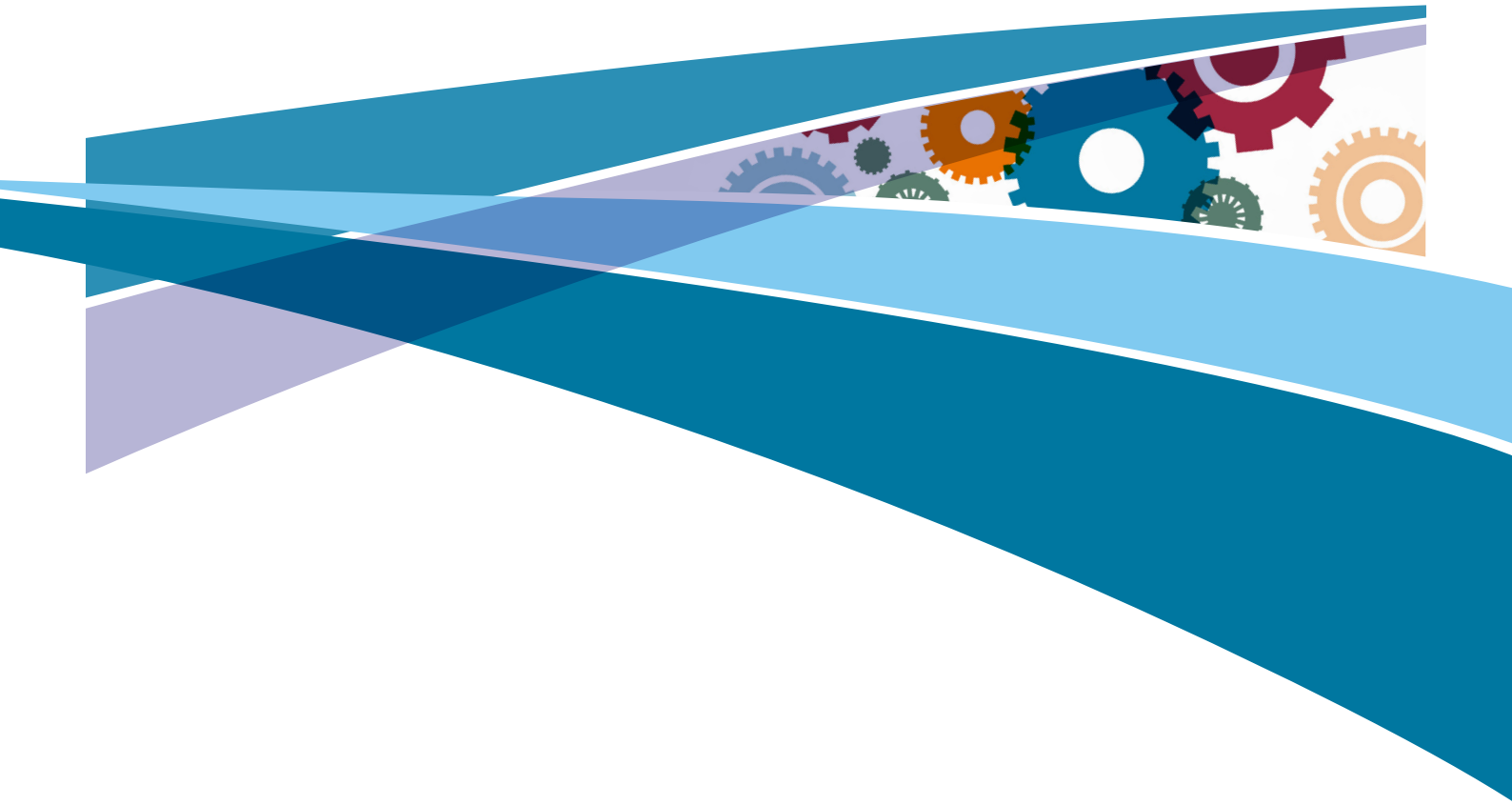
Intellectual Property Office

# Estimating UK investment in intangible assets and Intellectual Property Rights



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This is an independent report commissioned by the Intellectual Property Office (IPO). Findings and opinions are those of the researchers, not necessarily the views of the IPO or the Government.



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# Abstract

This report represents an update on the estimates of UK Intangible investment we published at the end of March 2014. These revisions have been driven by methodological improvements centered on improved estimates of investment in human capital.

The report contains updated estimates of (a) the level of UK market sector investment in knowledge assets and (b) the proportions of those investments protected by Intellectual Property Rights (IPRs). Estimates for knowledge investment are produced as part of the UK Innovation Index. Our main findings are: 1) In 2011 the UK market sector invested £126.8bn in knowledge assets, compared to £88bn in tangible assets; 2) Since the recession of 2008-9, intangible investment has recovered and grew in 2010-11. In contrast investment in tangible assets has fallen; 3) In 2011, 50% (£63.5bn) of knowledge investment in the UK market sector was protected by IPRs 4) The majority of IPR investment is on assets protected by copyright (47%), trademarks (22%) and unregistered design rights (18%).

# 1. Introduction

This report builds on previous work which estimated UK market sector investment in knowledge capital (Goodridge, Haskel and Wallis (2012)) and the proportions of those investments protected by formal intellectual property rights (IPRs) (Farooqui, Goodridge and Haskel (2011)). Investment in knowledge, or intangible, capital adds to the stock of intellectual property (IP) in the economy. Not all of that investment is protected by formal Intellectual Property Rights (IPRs) such as copyright and patents: investments in software are protected, but investments in workforce training are not. Thus this report attempts to answer the following questions: (a) how much does the UK invest in knowledge assets? and (b) what proportion of UK knowledge investment is protected by formal IPRs?

To answer these questions we first estimate UK market sector[1] investment in knowledge or intangible assets, using the comprehensive framework outlined in Corrado, Hulten et al. (2005), hereafter CHS. Second, we apportion various knowledge investments to investments in IPRs. Improvements to the data and methodologies used to estimate investment in artistic originals in the national accounts, based on our previous work (Goodridge and Haskel 2011; Goodridge, Haskel et al. 2012), means that, when combined with official UK software investment data (Chamberlin, Clayton et al. 2007), we can offer a better estimate for UK investment in copyright-protected assets. As well as other categories of knowledge assets, our dataset includes estimates of investment in research and development ('R&D'), 'Branding' (made up of 'Advertising' and 'Market Research') and 'Architectural and Engineering Design' (AED), upon which we base our estimates for investment in 'Patents', 'Trademarks' and 'Design Rights' (both registered and unregistered). Of course, not all such investment is protected by IPRs, so

1 We define the market sector as sections A-K, MN, & RST according to the 2007 Standard Industrial Classification, thereby excluding Real Estate Activities (L), Public Administration & Defence (O), Education (P) and Health and Social Work (Q).

we use data from the Community Innovation Survey (CIS) to estimate the proportion that is protected. We estimate that: 38% of R&D is protected by patents and 3% by design registration; and 11% of AED is protected by design registration and 2% by patents.

It is worth noting that our estimates of IPR-protected investment are not measures of all UK spend on IPRs. Rather they are measures of all long-lived spending on creating knowledge assets, which contribute to the production of output over a period of greater than one year, and which is protected by formal IP mechanisms.

Our main findings are as follows:

1. In 2011, we estimate that the UK invested £126.8bn in intangible assets compared to £88bn in tangible assets;

2. Since the recession of 2008-9, intangible investment has recovered and grew in 2010-11. In contrast investment in tangible assets has fallen;

3. In 2011, we estimate that approximately 50% of UK market sector investment in knowledge was protected by formal IPRs;

4. Of that investment in IPRs in 2011, we estimate that: 10% was in assets protected by patents; 47% in assets protected by copyright; 3% in assets protected by design registration; 22% in assets protected trademark; and 18% in assets protected by unregistered design rights.

This report proceeds as follows. In section 2 we set out our conceptual framework. In section 3 we discuss our methods for measurement in the context of that framework and present our estimates for UK market sector investment in intangible assets. In section 4 we present our method and results on: the proportions of UK intangible investment protected by IPRs; and therefore our estimates of investment in IPR-protected assets. Section 5 concludes.

# 2. Conceptual Upstream-Downstream Framework

The following section is a summary of the appropriate conceptual framework to consider production of, investment in, and consumption of, intellectual property. It is based on the concept of 'upstream' and 'downstream' sectors, as applied in Corrado, Goodridge and Haskel (2011), where the upstream creates original IP assets and the downstream uses the IP to generate final output. For example, the upstream could produce film originals which are used by downstream cinema projectors or television broadcasters, or in the production and distribution of copies, in the generation of final output. Alternatively the upstream could consist of an R&D (or design) unit that produces commercial knowledge to be used in the downstream operations sector. This upstream-downstream framework can be applied to any form of long-lived knowledge that is used in the generation of final output.

Consider then an economy with an innovation (IP-producing) sector and a final output (IP-using) sector. The innovation sector (upstream) produces long-lasting knowledge assets which contribute to production in the final output (downstream) sector. In this economy we may write the value of gross output in the innovation sector as $P^N N$. This is equal to factor and intermediate costs in the sector multiplied by any mark-up (μ) over those costs, where μ represents the monopoly power earned by the innovator through the ownership of a unique knowledge asset, which may be formally protected by IPRs:

$$P^N N = \mu(P^L L^N + P^K K^N + P^M M^N + P^R R^N) \quad (1)$$

Where: $P^L L^N$, $P^K K^N$ and $P^M M^N$ are payments for labour, capital and intermediates. $P^R R^N$ are payments for intangible capital services, for instance royalty payments to use music in the production of a film original.

Consider next the final output or downstream sector, which uses the innovative good. They could purchase the asset rights (or some component of them) outright, for a cost $P^N N$ (or some proportion of $P^N N$). Alternatively they could rent the good by paying a licence fee, $P^R R$, for T years to the innovation sector. Capital market equilibrium implies that:

$$P^N N = \sum_{t=1}^{T} \frac{P^R R_t}{(1+r)^t} \quad (2)$$

Where R is the stock of knowledge from which they rent; using the perpetual inventory method (PIM) this might be represented by:

$$R_t = N_t + (1-\delta^R) R_{t-1} \quad (3)$$

Equation (2) says that the value of the asset must equal the discounted rental payments from the users of the good.

The final output sector, which uses the long-lived knowledge asset, produces output, $P^Y Y$ .

$$P^Y Y = P^L L^Y + P^K K^Y + P^M M^Y + P^R R^Y \quad (4)$$

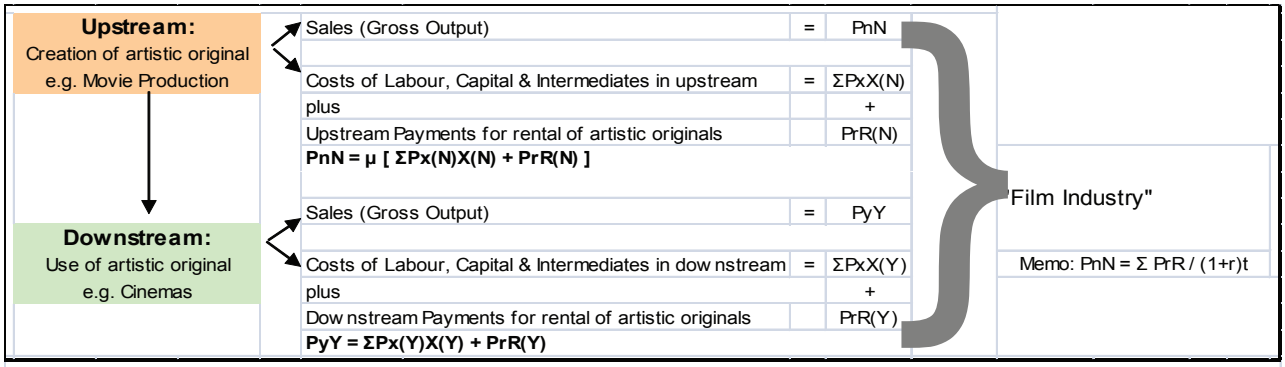
Where $P^L L^Y$ , $P^K K^Y$ and $P^M M^Y$ are the payments to labour, physical capital and materials in the using sector, and $P^R R^Y$ are rental payments for using the IP created in the innovation sector. These payments could be explicit rentals, or implicit in the case where the IP is owned by the using firm. We assume that the final output sector is competitive and so there is no mark-up, μ. A similar income identity for the materials sector completes the model.

An adjusted concept of market sector value-added, that accounts for the capitalisation of intangible capital, consists of all the factor payments to labour and (tangible and intangible) capital, with intermediate payments excluded.

$$P^Q Q = P^L L + P^K K + P^R R \quad (5)$$

The following diagram provides a representation of the model using the example of film originals, but can be applied to any other form of IP.

**Figure 1: Theoretical Framework. Upstream and Downstream in the Movie Industry**




Note to Figure: To make the symmetry clear, a term for μ could also be included in the downstream. We assume that the downstream is competitive, so μ=1, always. Monopoly power does however exist in the upstream, due to the the ownership of rights to a unique asset. So in the upstream, μ>1.

To summarise, in this model, UK investment in IP is the production of long-lived (i.e. with a service life of at least one year) IP assets that are owned by UK residents. Consider then the following distinctions:

– 'UK IP production' is all IP production that takes places in the UK, regardless of ownership and duration of life;

– 'UK IP investment' is restricted to production of IP goods with a service life of more than one year repeatedly used in the production of output (assets), that are owned[2] by a UK resident;

– 'UK IP consumption' is the use of short or long-lived IP, by firms resident in the UK, regardless of the residency of the owner;

– 'Consumption of UK IP' is the use of UK-owned short or long-lived IP, in all downstream firms worldwide (not just those resident in the UK)

– 'UK consumption of UK IP' is use of short or long-lived UK IP in UK downstream firms

So, using our example of a film original, a feature movie produced in the UK but owned by an American firm would be classed as UK production but not UK investment. The projection of that same film in a UK cinema is 'UK IP consumption', but not 'consumption of UK IP'.

The above framework also highlights the weaknesses in analysing UK IP investment using official datasets. Suppose that we wish to measure the value of a TV or radio drama production ($P^N N$). Our framework illustrates why this is hard to do from published industry data as classified by the Standard Industrial Classification (SIC). Consider the SIC class "Television and Radio Activities'. This does not distinguish between the production of programmes and their broadcast. Moreover, production and broadcasting are often both undertaken by the same organisation. So, both upstream and downstream activities are included in this SIC class. Thus, a measure of sales for the whole industry includes: the downstream revenues earned by the broadcaster ($P^Y Y$), whether earned from long-lived IP assets or short-lived IP goods; all UK IP production, including short-lived news or sports programmes, and also UK production of assets owned in the Rest of the World (e.g. a US network funding and owning the rights to a programme produced in the UK); as well as UK IP investment ($P^N N$).

2 In the case of Film the relationships between funding, ownership and performance are clear. A film produced in the UK but with US funding and ownership is a US asset. With other knowledge assets, such as say R&D, these relationships are less clear. R&D performed in the UK with overseas funding may or may not be owned in the UK. Further, even if ownership resides overseas, some of the acquired knowledge remains in the UK. It is not 'forgotten'.

Therefore we cannot use published SIC data to identify UK IP investment. Instead, we identify UK production of IP assets owned in the UK. Continuing with the example of TV originals, we use data from production companies or network production arms. Such data are reported for ITV, BBC, Channel 4 in OFCOM reports. This allows us to make an estimate based on the upstream input costs of asset creation, as in (1). However, we have to undertake a number of adjustments. First, to identify investment, we must subtract the costs of production of short-lived goods such as news and sports. Second, we must deduct the costs of production for exported products (not UK-owned) and add in the value of imports (UK-owned). Third, converting such costs into output values requires an estimate of the mark-up, μ, the value of which is uncertain. Alternatively, if available, measures of investment can be estimated using data on the income earned by that asset class ( $P^R R$ ).[3] This latter approach is taken in the estimation of investment in literary and music originals.

# 3. Measurement

Our measurement approach is designed to be consistent with the UK National Accounts and therefore with official measures of output, income (accruing to labour and capital) and expenditure (including consumption and investment). We start by estimating investment in knowledge assets as identified by Corrado, Hulten et al. (2005) and applied in Goodridge, Haskel and Wallis (2012) for the UK. We then adjust the official data from the National Accounts accurately to count spending on knowledge assets with a shelf-life of more than a year as investment rather than consumption, in a logically coherent framework that avoids double counting.

The categories of knowledge assets in our dataset are as featured in the NESTA Innovation Index, and discussed in greater detail below. Included are new estimates of investment in artistic originals, which have been revised in the national accounts, with the new estimates based on our previous work funded by the UK IPO (Goodridge and Haskel 2011; Goodridge, Haskel et al. 2012). As well as estimates of investment in knowledge by asset, we also present estimates of investment protected by IPRs, including splits between registered rights (patents, trademarks, registered design rights) and unregistered rights (copyright and unregistered design rights).

3 In the steady-state, the value of investment is approximately equal to the value of capital compensation.

Below we provide a brief description of the methodologies and sources used to estimate expenditure and investment on UK production of knowledge goods, by asset type. For a more extensive description please consult past work such as Goodridge, Haskel and Wallis (2012).

Following Corrado, Hulten et al. (2005) we identify three broad groups of knowledge assets: i) Computerised information; ii) Innovative property; iii) Economic competencies. The following table sets out UK investment for each of these groups and the asset types within them. All estimates presented are new to this report.

**Table 1: UK Market Sector Investment; Tangible & Intangible, £bns nominal**

| Year | 1990 | 1995 | 2000 | 2005 | 2010 | 2011 |
|---|---|---|---|---|---|---|
| Buildings | *27.0* | *22.1* | *38.0* | *52.8* | *44.9* | *47.4* |
| Plant & Machinery (incl. IT hardware and CT) | *30.8* | *35.0* | *46.7* | *36.5* | *35.8* | *36.1* |
| Vehicles | *9.0* | *9.4* | *9.1* | *10.9* | *13.6* | *4.4* |
| ***All tangibles*** | **66.9** | **66.5** | **93.8** | **100.1** | **94.4** | **87.9** |
| | | | | | | |
| **Intangible category** | | | | | | |
| **Computerised Information and databases** | **7.3** | **11.0** | **17.2** | **22.3** | **23.4** | **24.3** |
| Own-account Software | 4.8 | 5.8 | 9.9 | 11.9 | 12.9 | 13.2 |
| Purchased Software | 2.5 | 5.2 | 7.3 | 10.4 | 10.4 | 11.0 |
| | | | | | | |
| **Innovative property** | **18.1** | **20.1** | **26.7** | **33.2** | **36.3** | **38.1** |
| Scientific R&D | 7.3 | 8.3 | 10.7 | 12.7 | 14.8 | 15.9 |
| R&D in social sciences and humanities | 0.2 | 0.3 | 0.4 | 0.3 | 0.9 | 0.9 |
| Financial Product Innovation | 0.3 | 0.4 | 0.7 | 0.9 | 1.6 | 1.8 |
| Design (Own-account; Purchased) | 6.7 | 7.0 | 9.5 | 11.6 | 12.8 | 12.9 |
| Artistic Originals (Film; TV & Radio; Music; Books; Misc Art) | 1.9 | 3.0 | 4.9 | 7.0 | 5.7 | 5.8 |
| Mineral Exploration | 1.6 | 1.1 | 0.5 | 0.7 | 0.6 | 0.8 |
| | | | | | | |
| **Economic Competencies** | **22.5** | **32.8** | **48.2** | **62.6** | **67.8** | **64.5** |
| Branding (Advertising; Market Research) | 4.8 | 6.7 | 10.2 | 11.7 | 13.47 | 14.0 |
| Training | 11.8 | 14.4 | 19.9 | 25.2 | 27.4 | 25.0 |
| Organisational (Own-account; Purchased) | 5.9 | 11.7 | 18.1 | 25.7 | 27.0 | 25.5 |
| | | | | | | |
| ***All intangibles*** | ***47.9*** | ***63.9*** | ***92.1*** | ***118.1*** | ***127.6*** | ***126.9*** |

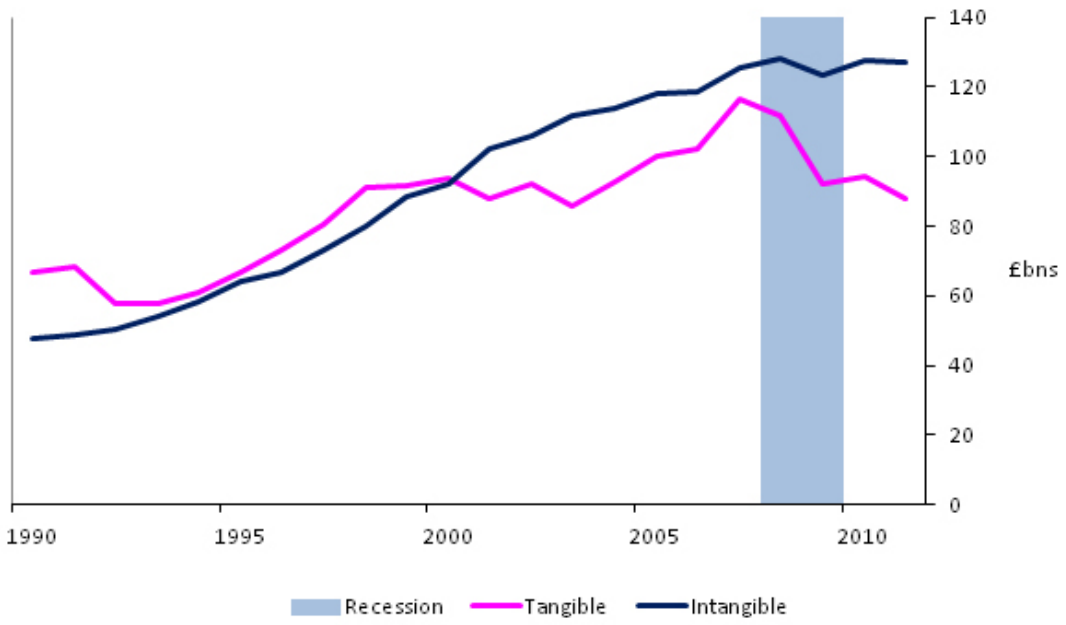
Note to table. Data are investment figures, in £bns, current prices: italicised data are sub-totals for broader asset definitions. MSGVA is presented with no intangibles capitalised; with only NA intangibles capitalized (software, mineral exploration and artistic originals); and with all CHS intangibles capitalised. Market Sector refers to sectors A to K, MN, R to U, thus excluding real estate. Estimates for intangibles are constructed as described below. Note estimates of intangible investment do not equate to expenditure. Sub-totals might not add due to rounding. Source: ONS data for tangibles, this paper for intangibles.

We note that these estimates for tangible investment are somewhat lower than we have presented in the past. This is due to ONS revisions to current price investment in the 1990s and 2000s. ONS (2014) reports that overall estimates of current price GFCF for combined assets has been revised down by about 3% on average over the period 1997 to 2010. Within that, tangible investment has been revised down by some 15% on average over that period, while intangible investment (referring only to intangibles already capitalised in the national accounts, namely purchased and own-account software, artistic originals and mineral exploration) has almost doubled in current prices. Changes to official estimates of intangible investment are due to: a) revisions to estimates of investment in artistic originals, based on our previous work

(Goodridge and Haskel 2011; Goodridge, Haskel et al. 2012); and b) revisions to estimates of investment in own-account software to better account for net operating surplus in own-account software production (i.e. in terms of equation (1), to better account for $P^K K^N$).

The following chart presents estimates of aggregate market sector investment in tangible and intangible asset categories over the period 1990 to 2011. The recession is highlighted using the blue bar.

**Figure 2. UK market sector investment in tangible and intangible assets, Nominal £bns**




Source: ONS for tangible (downloaded 20th January 2014), this report for intangible

There are two main points to note from this chart. First, investment in intangibles has been consistently higher than investment in tangibles since 1999. Second, although investment in intangibles did decline during the recession it has since recovered. Nominal intangible investment grew at 3.5% in 2010, although slightly declined by 0.6% in 2011. In contrast, tangible investment collapsed in 2009 and has failed to recover since. Nominal tangible investment fell by 17.7% in 2009, grew by 2.5% in 2010 and fell again by 6.9% in 2011.

On tangible investment, these are the latest ONS data and reflect recent revisions to official estimates of UK investment. They show that, in 2011, the level of nominal tangible investment is below its level in 2000 (£88bn in 2011 compared to £94bn in 2000). Therefore, according to the latest data, it seems that over the longest expansion in post-war economic history, nominal tangible investment declined. The story of the 2000s is one of a slow decline in tangible investment between 2000 and 2004, before a rise in the mid-2000s and then a collapse in the later recession. Detailed data indicate that the rise in the mid-2000s is driven primarily by investment in commercial property and intangibles (i.e. those intangibles already capitalised in the national accounts, namely software, artistic originals and mineral exploration). Nominal investment in plant (including ICT) is recorded at a lower level in 2011 than in 1998 (£36.1bn in

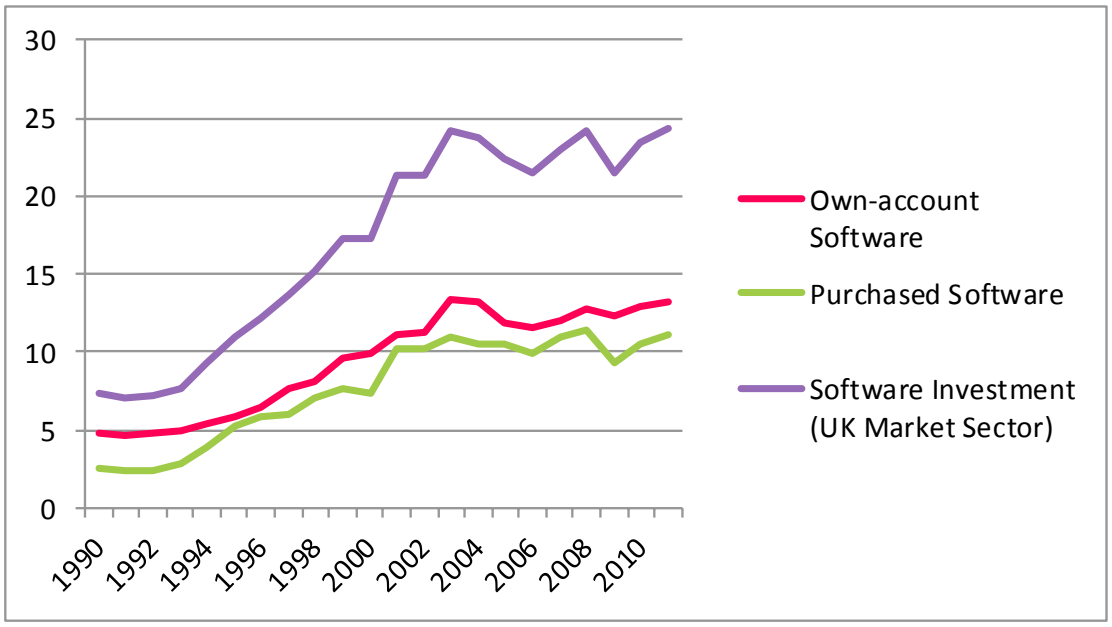
2011 compared to £45bn in 1998). This reflects ONS revisions to nominal investment which primarily consist of a downward revision to investment in plant and an upward revision to investment in intangibles. Note that insofar as plant investment includes computers, whose price is falling, nominal investment might fall even if quantities rise

We now go on to discuss our measurement, and estimates of investment for each asset in more detail.

## 3.1 Computerised Information and databases

As Figure 3 shows, software investment in 2011 was considerable at approximately £24bn, comfortably exceeding Scientific R&D and also a broader definition of R&D that encompasses R&D in social sciences and financial product innovation. Total Software investment comprises both purchased and own-account[4], and also computerised databases. Software is already capitalised in the National Accounts, and so our source for computer software investment is contained in the ONS work described by Chamberlin, Clayton et al. (2007). Purchased software data are based on company investment surveys and own-account based on the wage bill of employees in computer software occupations, adjusted downwards for the fraction of time spent on creating new software (as opposed to, say routine maintenance) and then upwards for associated overhead costs (a method we use for design below). The data, which run from 1997 to 2011, are updated data provided by ONS. The data are backcast further using previous estimates of market sector software investment as reported in Goodridge, Haskel et al. (2012). Estimates are presented below. We assume that 100% of investment in this asset category is protected by copyright.

**Figure 3. Software: UK Investment, Nominal £bns**



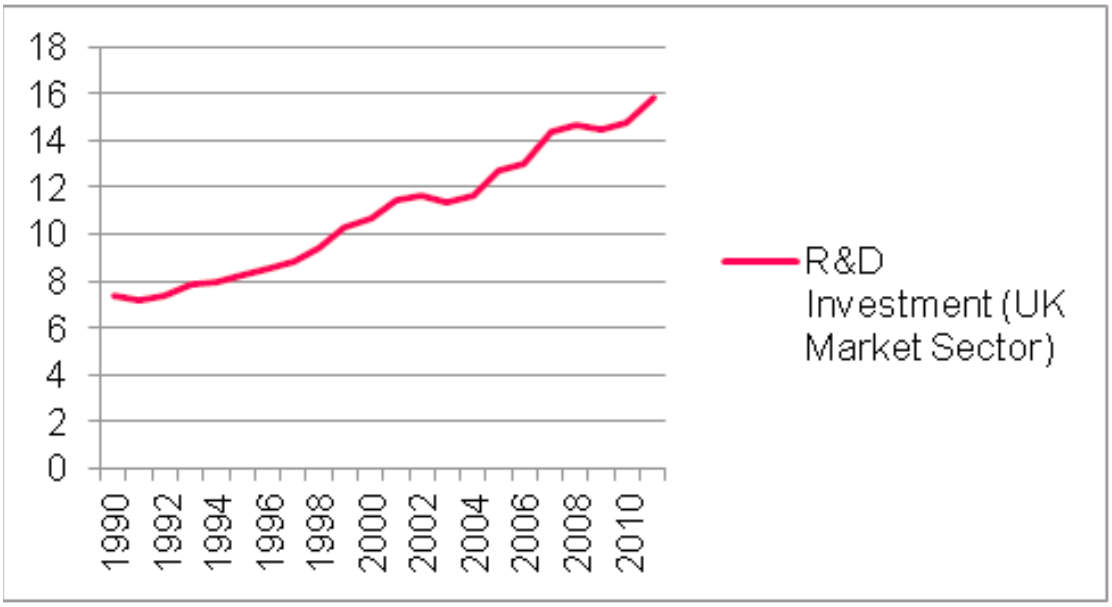

Source: ONS

4 Own-account software is software developed by in-house employees

## 3.2 Scientific R&D[5]

As shown in Figure 4, in 2011 investment in scientific R&D was approximately £16bn. For business Scientific R&D we use expenditure data by industry derived from the Business Enterprise R&D survey (BERD), which provides data back to 1981. To avoid double counting of R&D and software investment, we subtract R&D spending in "computer and related activities" (SIC 72) from R&D spending since this is already included in the software investment data. R&D that takes place in R&D products is assumed to take place in the R&D services industry, and that spend is allocated out using data on shares of R&D purchases in the Supply Use tables.[6] Since BERD also includes physical capital investments we convert those investments into a capital compensation term, using the resulting physical capital stocks for the R&D sector and the user cost relation[7]. Below we estimate that 38% of this investment is protected by patents and 3% by registered design rights.

**Figure 4. Scientific R&D: UK Investment, Nominal £bns**




Source: ONS, BERD

5 Scientific R&D was capitalised in the 2008 revision to the System of National Accounts, and capitalisation in the UK is due to be implemented in 2014.

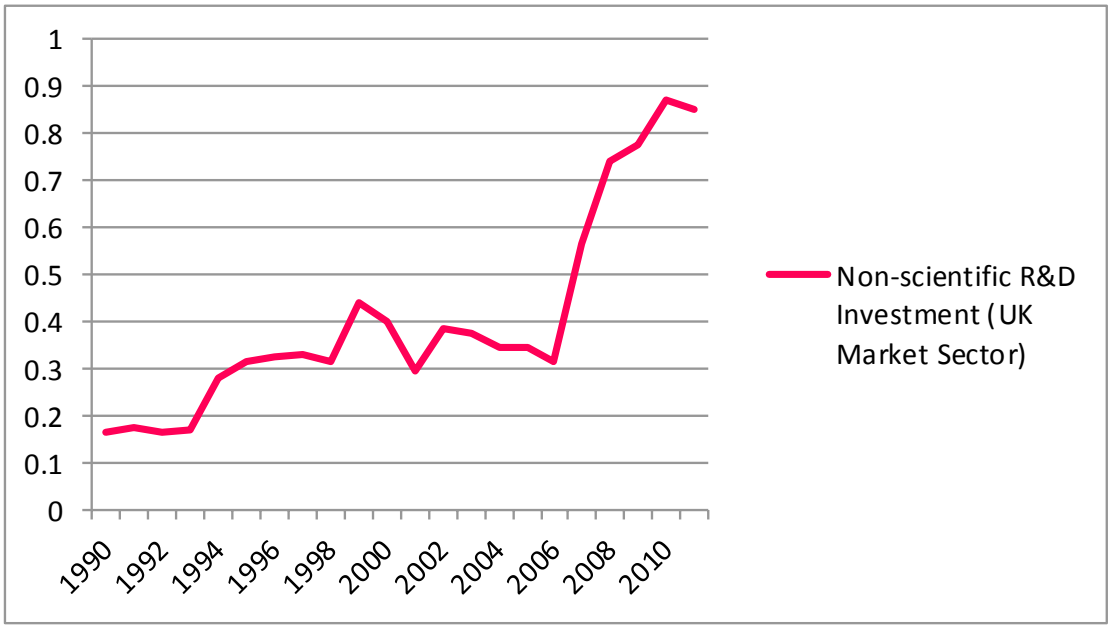
6 The BERD data gives data on own-account spending. Spending is allocated to the industry within which the product upon which firms are spending belongs. That is we assume that R&D on say, pharmaceutical products takes place in the pharmaceutical industry. Spending on "R&D services" is allocated to business services. The R&D services are sold to purchasing firms. We therefore allocate this spending out to the purchasing industries using shares constructed from the supply use tables.

7 $PK = PI(\rho+\delta)$, where PK is the rental price of physical capital; PI is the asset price, $\rho$ is the real rate of return and $\delta$ is the depreciation rate.

## 3.3 R&D in social sciences and humanities

In Figure 5 the estimate for R&D in social sciences and humanities is £0.9bn in 2011. R&D in social sciences and humanities is estimated as twice the turnover of the industry "Research and experimental development on social sciences and humanities" (SIC07 72.2), where the doubling is assumed to capture own-account spending. Turnover data are taken from published data for the Annual Business Survey (ABS) and previously the Annual Business Inquiry (ABI) and are available for 1997 to 2011. Data are backcast using turnover data published in the Service Sector review and Business Monitor. This is a small number and we suspect there is little marginal benefit to improving its measurement. We assume that this investment is not protected by formal IPRs. The series for non-scientific R&D is presented below.

**Figure 5. Non-Scientific R&D: UK Investment, Nominal £bns**

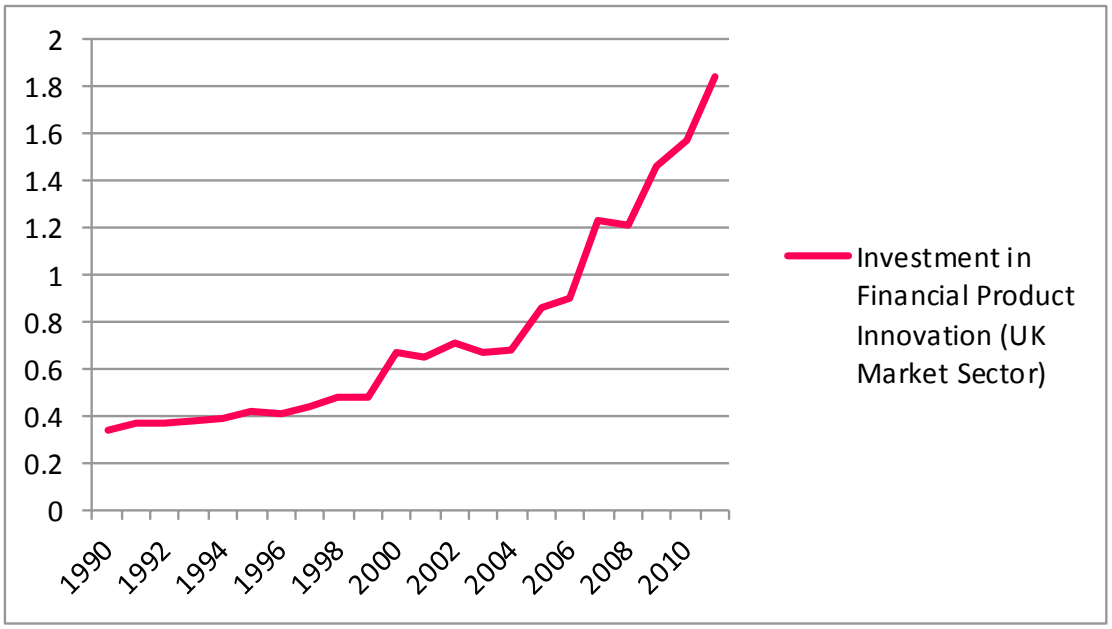



Source: ONS, ABS, ABI

## 3.4 Financial Product Innovation

In Figure 6, investment in Financial Product Innovation is estimated at £1.8bn in 2011. The measurement methodology for New products development costs in the financial industry follows that of own account software. Further details are in Haskel and Pesole (2010) but a brief outline is as follows. First, we interviewed a number of financial firms to try to identify the job titles of workers who were responsible for product development. Second, we compared these titles with the available occupational and wage data from the Annual Survey on Hours and Earnings (ASHE). The occupational classification most aligned with the job titles was 'economists, statisticians and researchers'. Third, we asked our interviewees how much time was spent by these occupations on developing new products that would last more than a year. Some firms based their estimates on time sheets that staff filled out. Fourth, we asked firms about the associated overhead costs with such workers. Armed with these estimates, we went to the occupational data in the ASHE and derived a time series of earnings for those particular occupations in financial intermediation. Own-account investment in product development is therefore the wage bill, times a mark-up for other costs (capital, overheads etc.), times the fraction of time those occupations spend on building long-term projects. This provides data for 1997 to 2011. Data are backcast further using the growth rate of industry turnover. We assume that such investment is not covered by formal IP rights.

**Figure 6. Financial Product Development: UK Investment, Nominal £bns**




Source: Own estimates, based on ASHE

## 3.5 Architectural and Engineering Design

As shown in Figure 7, for 2011 we estimate investment in Design at £12.9bn in 2011. Purchased data are taken from the Supply-Use Input Output (IO) tables. For own-account we use the own-account software method. Full details are set out in Galindo-Rueda, Haskel et al. (2008).

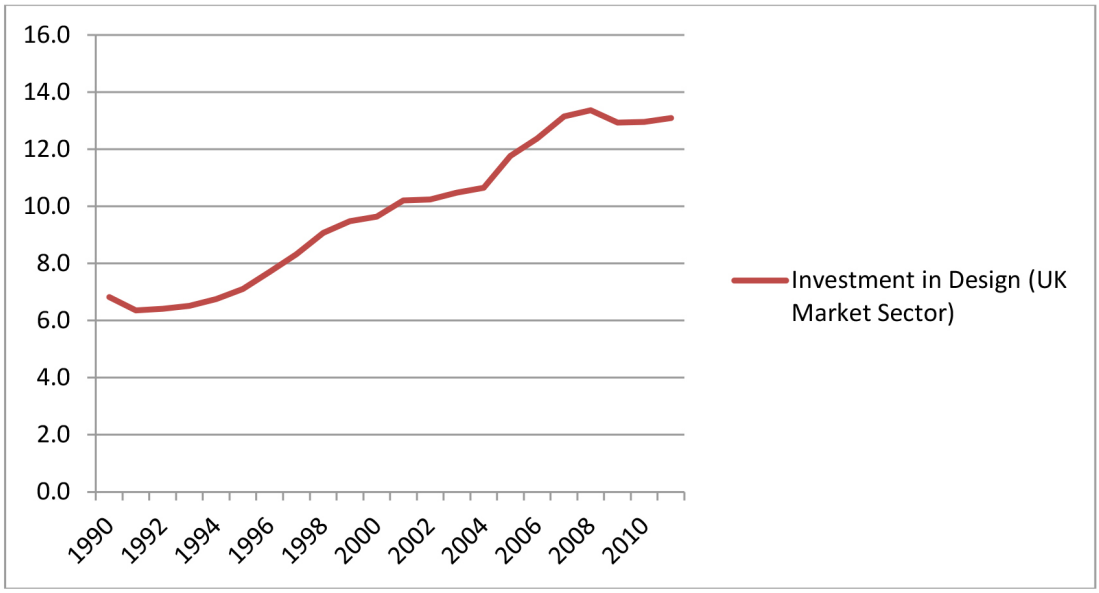
In the case of purchased investments, as in Goodridge, Haskel et al. (2012), we have chosen to exclude purchases of design by the industry itself ('Professional, Scientific and Technical Activities', SIC 69t74), since some of these purchases will certainly include outsourcing and subcontracting arrangements which would be double-counting. On own-account, the choice of occupations and the time allocation are, as in financial services, taken from interviews with a number of design firms. We focus on architectural, engineering and design (AED) activities, including architects, engineers (excluding software) and general designers (graphic, product and clothing designers). Interestingly, almost all of the design firms we interviewed have time sheets for their employees which break out their time into administration, design and client interaction/pitching for new business (almost all firms target, for example, that junior designers spend little time on administration and senior more time on pitching). Thus, for professional designers, we assigned 50% of their time to 'long lived design' and engineers only 10%, with 60% to the rest.

On engineers we note that here there is the potential for double-counting with R&D, since the wages and salaries of engineers that conduct R&D will be reported in the BERD data. Not all engineers will be involved in R&D however. This is another reason for choosing to only allocate 10% of the time of engineers to investment in design.

Further since some design expenditure/activity is short-lived rather than on the building of long-lived assets, we further reduce the estimate by 50% to account for this. This factor is again based on interviews conducted with design companies and the UK Design Council.

These methods provide estimates of investment for 1997 to 2011. Own-account estimates are extended back further using data from the New Earnings Survey (NES) and purchased using data from previous versions of the Supply Use Tables (back to 1992) and prior to that data on the turnover of the design industry as published in the Business Monitor. Our series for UK investment in architectural and engineering design is presented below. Of this estimate that 11% of this investment is protected by registered design rights, and 2% by patents. We assume the remaining 87% is protected by unregistered design rights.

**Figure 7. Architectural and Engineering Design: UK Investment, Nominal £bns**




Source: Own estimates, based on ASHE and ONS Supply Use Tables

## 3.6 Artistic Originals

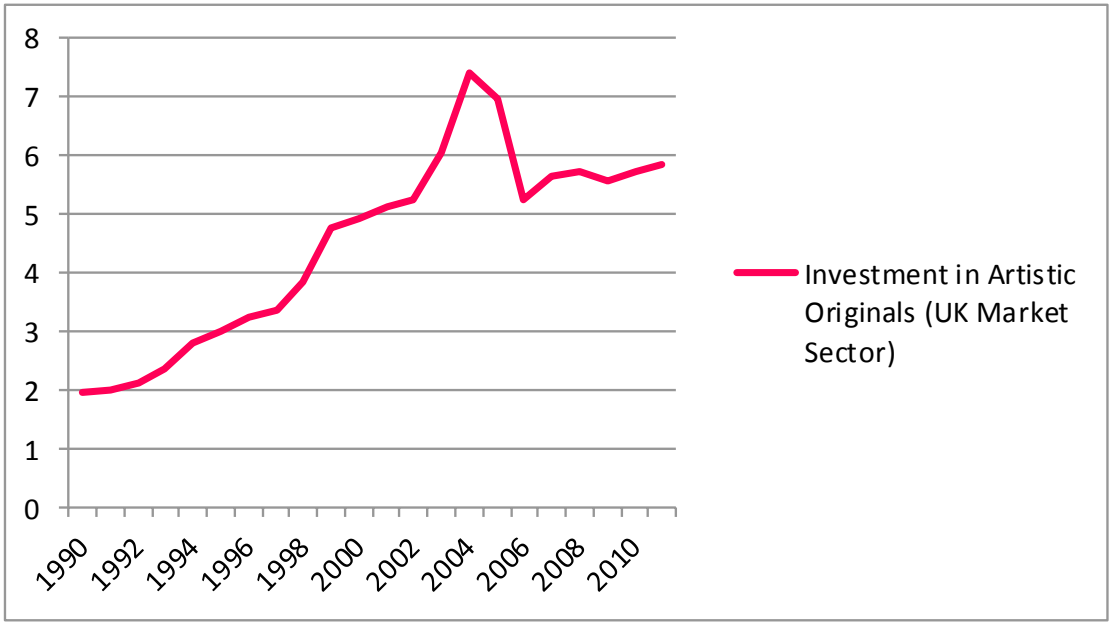
From Figure 8, in 2011 the estimate for investment in 'Artistic Originals' is £5.8bn. Artistic Originals are already capitalised in the national accounts so we use those data. These estimates are revised from past estimates, using new methods and data, based on our previous work funded by the IPO (Goodridge and Haskel 2011; Goodridge, Haskel et al. 2012). We briefly describe the data and methods used below. The estimates incorporate measures of UK investment in: Film; TV & Radio; Music; Books; and Miscellaneous Art.

Estimates for investment in film originals are built bottom-up using data on budgets for UK productions using a microdata set of all UK films produced since 1991. The dataset includes information on co-producing partner countries and indicators on majority and minority funding. We use such information to construct UK ownership shares for each individual film, providing us with an estimate of investment in each UK-owned film original. Estimates for television and radio are based on data for production costs for UK broadcasters, as published in OFCOM Annual Reports, excluding expenditure on short-lived genres or formats such as 'News' or 'Current Affairs'. Estimates for investment in literary originals are calculated using measures of the capital compensation that flows to the owners of rights (namely publishing houses and authors). Under the assumption of steady-state conditions, such compensation can be used as a proxy for investment. Similarly, estimates for investment in recorded originals (music) are also calculated using an income-based approach, with the data on income incorporating the revenues earned by the owners of rights through recording sales, royalties distributed by the music collecting societies, and revenues earned from live performance. For other forms of art that meet the criteria for artistic originals (photography/images, choreographed routines, fine art etc.), estimates are produced using data on the labour costs of relevant occupations as reported in ASHE, and reduced by 50% to account for the possibility of such professions earning a proportion of their income from other sources.

The official data for investment in Artistic Originals run from 1997 to 2011. We extend the estimates back further using a combination of our own estimates (Goodridge and Haskel 2011; Goodridge, Haskel et al. 2012) and the old national accounts estimates from prior to the revision. The series for investment in this asset category is presented below.[8] One of the criteria for identifying artistic originals is that they are covered by copyright. We therefore assume that 100% of investment in this asset category is protected by copyright.

8 We note the unusual spike in the series in the mid-2000s which we intend to investigate further.

**Figure 8. Artistic Originals: UK Investment, Nominal £bns**

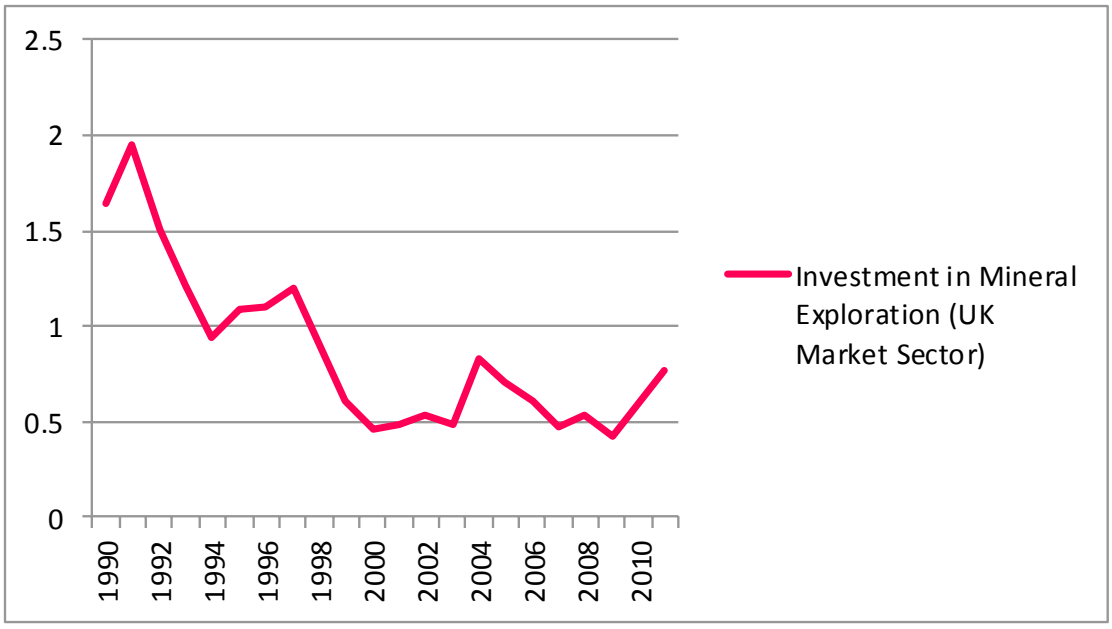



Source: ONS, based on Goodridge and Haskel (2011) and Goodridge, Haskel et al. (2012).

## 3.7 Mineral Exploration

As shown in Figure 9, in 2011 investment in Mineral Exploration was £0.8bn. Like computerised information and artistic originals, mineral exploration is already capitalised in the National Accounts and the data here are simply data for Gross Fixed Capital Formation (GFCF) from the ONS, valued based on "payments made to contractors or costs incurred on own account. The costs of past exploration, not yet written-off, are re-valued (which in this case may well reduce the value). This expenditure covers the costs of drilling and related activities such as surveys. It is included in GFCF whether or not the exploration is successful." (ONS 1998). These data run from 1997 to 2011. They are extended back further using data from past releases of the national accounts.

**Figure 9. Mineral Exploration: UK Investment, Nominal £bns**



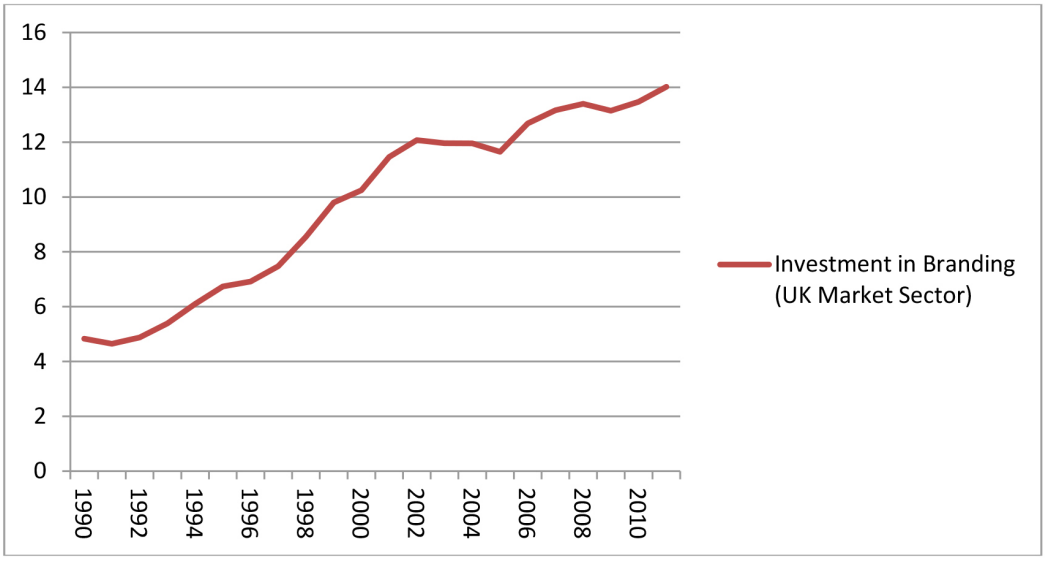

Source: ONS

## 3.8 Branding: Advertising and Market Research

As shown in Figure 10, in 2011 we estimate total investment in Branding to have been around

£14bn. Of this, advertising made up £10.3bn, and market research £3.7bn. Each category is estimated using data on purchases from the Supply Use Tables (product group 73: Advertising and market research services) across all industries. As with design, we exclude purchases made by the industry itself (SIC 69t74, Professional, Scientific and Technical Activities) since some of these purchases include outsourcing and subcontracting arrangements which would be double counting. Advertising and Market research are split using data from the ABS and estimates for market research are further doubled to allow for own-account expenditure. As with design, not all expenditure goes toward the building of reputational assets, since some is short-lived. To account for this we take 60% of the expenditure estimates and assume that proportion represents investment. These data are available from 1997 to 2011. Data are extended back further using previous estimates constructed from past releases of the Supply Use Tables. Our series for investment in Branding is presented on the following page.

**Figure 10. Branding: UK Investment, Nominal £bns**




Source: Own estimates based on ONS Supply Use Tables

## 3.9 Firm-specific human capital (Training)

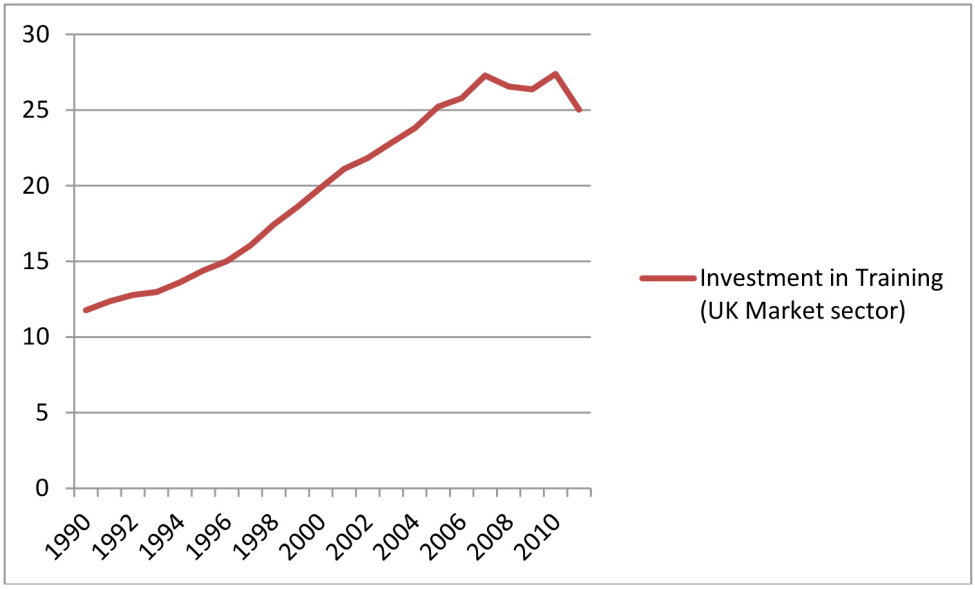
From Figure 11, our estimate of investment in Training is £25bn in 2011. Firm specific human capital - training provided by firms - was estimated using cross sections from the National Employer Skills Survey for 2007 and 2009.

In previous estimates published in January 2014[9] (Goodridge, Haskel et al. 2014a[10]; Goodridge, Haskel et al. 2014b[11]), estimates for investment in training included expenditures on the provision of 'Health & Safety' and 'Induction' training. In these latest estimates (from Goodridge, Haskel et al. (2014c[12])), and consistent with past work (see Goodridge, Haskel et al. (2012)), we use estimates from the National Employer Skills Survey (NESS) on what proportion of training spend is on Health and Safety and Induction training and make an adjustment on that basis.

In the production industries, Health & Safety and Induction training is estimated at between 30 and 40% of total spend. Since it seems reasonable that Health and Safety training may have more impact on firm productivity in the production industries compared to say Business Services, and that Induction training in production may be more likely to include training on job-specific skills, we decided to include this component for production but exclude it in the service sector. As a result, estimated investment in training and hence total intangibles is lower than published in either Goodridge, Haskel et al. (2014a) or Goodridge, Haskel et al. (2014b). Whilst this subtraction lowers the level of training spending, it turns out to have little impact on the estimated contribution of training to growth.

We also have data for 1988 from an unpublished paper by John Barber. We thus backcast the series using the EU KLEMS[13] wage bill time series benchmarking the data to three cross sections, and extend the series forward with ONS compensation of employees. Our series for investment in Training is presented on the following page.

**Figure 11. Training: UK Investment, Nominal £bns**




Source: Own estimates based on NESS

9 Goodridge P, J Haskel, et al (2012). – "UK innovation Index productivity and growth in UK Industries

10 Goodridge P, J Haskel, et al (2014a). – "Estimating UK investment in intangible assets" Preliminary report for NESTA"

11 Goodridge P, J Haskel, et al (2014b). – "Estimating UK investment in intangible assets and Intellectual Property Rights" Report for the UK Intellectual Property Office.

12 Goodridge P, J Haskel, et al (2014c). – "UK innovation Index 2014. "NESTA Working paper No.14/07

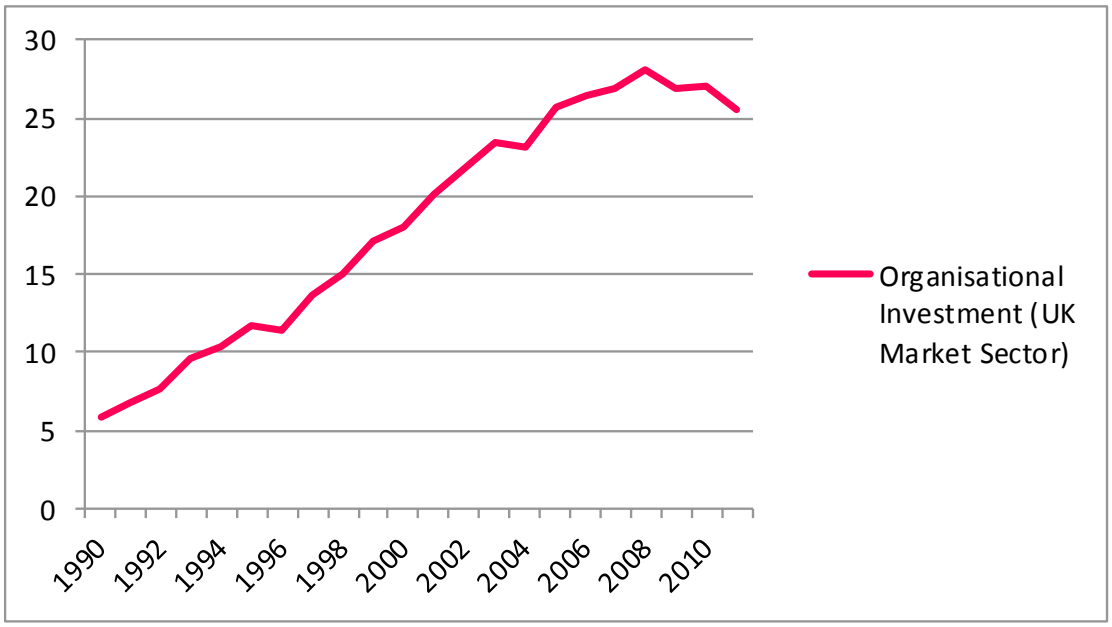
13 http://www.euklems.net/project_site.html

## 3.10 Organisational Structure

As shown in Figure 12, for 2011 we estimate investment in organisational structure at £25.5bn. Our data on investment in organisational structure relies on purchased management consulting, on which we have consulted the Management Consultancy Association (MCA), and own-account time-spend, as before. On purchased, the MCA state that they represent 70% of the industry. We therefore apply an upward adjustment to account for the remainder of the industry. We have MCA data for the years 2002-05 and 2009-10. Estimates for other years are interpolated and extrapolated using data on the turnover of the management consulting industry from the ONS ABS and its predecessors. We also assume that not all purchased organisational knowledge represents investment. Therefore 20% of purchased consultancy is removed from the investment figure, on the basis that not all of the knowledge acquired is long-lived capital. The method for own-account relies on identifying managers by occupation. Then using ASHE, we take 20% of the managerial wagebill and assume that covers the own-account costs of investments in the improvement of organisational processes.

Our own-account estimates run from 1997 to 2011. They are backcast further using data from the NES. Our series for organisational investment is shown below. We assume that none of these investments are protected by formal IPRs.

**Figure 12. Organisational Structure: UK Investment, Nominal £bns**




Source: Own estimates based on data from the MCA and ASHE

All the above estimates are presented at the aggregate market sector level. Appendix 1 presents estimates of intangible investment at the industry-level.

# 4. Estimating the proportions of knowledge investment protected by IPRs

In measuring investment in assets protected by different types of IPRs, we also need to estimate what proportion of investment is protected by IPRs. In this section we discuss our methods to do that.

IPRs can be split into two broad groups: registered and unregistered rights. The first requires formal application from innovators, the second are automatic and invoked by the innovator when necessary. Table 2 summarises the IP rights considered in this report, how they fit into each of these groups and previews our findings of what proportion of investment is protected by IPRs (by asset type).

**Table 2: Registered and Unregistered Rights; % of investment protected by IPRs**

| | Registered | | | Unregistered | | |
|---|---|---|---|---|---|---|
| Asset \ IPR | Patents | Trademarks | Design Registration | Copyright | Unregistered Design rights | % of investment protected by IPRs |
| Artistic Originals | 0% | 0% | 0% | 100% | 0% | 100% |
| Software | 0% | 0% | 0% | 100% | 0% | 100% |
| Branding | 0% | 100% | 0% | 0% | 0% | 100% |
| Scientific R&D | 38% | 0% | 3% | 0% | 0% | 41% |
| Design | 2% | 0% | 11% | 0% | 87% | 100% |

Note to table: estimates for percentage protected by IPRs based on this report. Note that shares of investment protected do not equate to shares of expenditure protected.

First consider 'Artistic Originals'. One of the criteria set out by Eurostat for classification as an artistic original is that it must be covered by copyright. Therefore we consider our estimates of investment in these assets to all fall within the category of 'investment in copyrights'. Regarding software, since all copyrighted works are recognised automatically when asserted by the owner, we classify all investment in software (own-account and purchased) as 'investment in copyrights', alongside investment in artistic originals.

For Branding, we also estimate that 100% of our measure of investment is protected by Trademarks. Our reasoning is as follows. We recognise that not all expenditure on advertising and market research constitutes investment. Based on industry discussions we estimate investment in brands as 60% of expenditure on advertising and market research. In doing so, we effectively remove all short-lived expenditure. Since the remaining investment is by definition long-lived, we allocate all of that to our category 'investment in trademarks'.

The remaining forms of intangible investment that can be protected by formal IPRs are Scientific R&D and Design, each of which can be protected by either patents or design registration. We estimate the proportions of these assets protected by these mechanisms below, using the Community Innovation Survey (CIS) and econometric analysis. On R&D, we estimate that 38% of R&D is protected by patents and 3% by registered design rights. On Design, we estimate that 11% is protected by registered design rights and 2% by patents. Since 'unregistered design rights' are automatic, we allocate the remaining 87% of investment to this IPR category. We summarise our method and results below. We note that results in the wider literature are supportive of these findings.

## 4.1. Allocating IP protection to investment

To estimate the fraction of investment protected by IPRs we may proceed via a) a questionnaire or b) an econometric approach.

a) Questionnaire

There is a small body of work that attempts to ask what type of protection methods are used by firms. First, in US work a minority of firms report using formal IP protection methods, and instead typically report the use of first-mover advantages, secrecy or no formal protection at all. Cohen, Nelson et al. (2000) asked firms whether they introduced a process and/or product innovation and which IP protection mechanism they considered effective. In a sample of 1,065 American research laboratories in manufacturing, 1991-93, patents were considered effective in 34% of product innovations and for 23% of process innovations. Patents were considered most effective in pharmaceuticals (50%) and medical equipment (55%).

Second, in Europe, Arundel (2001) studies the question using the 1993 CIS for innovative manufacturing firms in Norway, Germany, Luxembourg, the Netherlands, Belgium, Denmark, and Ireland. He presents the percentage of the 2,848 R&D performing firms who give the highest rating to lead time, secrecy, complexity, patents and design registration. Patents score 11.2% and 7.3% for product and process innovations.

Third, Haskel and Pesole (2011) use the CIS to estimate how many firms report using design rights. They find that 15% of firms report registering a design and that this is in line with other studies.

Fourth, Farooqui, Goodridge and Haskel (2011) use data from the UK CIS. In a section "Protection of Innovation" firms are asked to report the relative importance (no, low, medium and high) of eight different protection mechanisms:

1. Design Registration
2. Trademarks
3. Patents
4. Copyright

5. Confidentiality Agreements

6. Secrecy

7. Complexity of Design

8. Lead time advantage over competitors

They found that the majority (52%) of firms report using none of these mechanisms, and those that do use a combination of them. They also found that those who do report using such mechanisms tend to be the largest spenders on R&D and other intangibles.

Table 2 from Farooqui, Goodridge and Haskel (2011) is reproduced below. It shows that, in manufacturing for instance, only 31% of firms report using patents but these firms also conducted 94% of industry expenditure on R&D and 81% of industry expenditure on Design. Similarly, in manufacturing, only 31% of firms report using design registration but conducted 49% of design expenditure and 82% of R&D. Similar patterns exist for other industries. In general those authors find that while attitudinal responses show a preference for informal IP mechanisms, the R&D spending relative to sales profile is skewed towards those firms that prefer formal IP mechanisms.

**Table 3: Reported importance of IP methods, by industry**

| Industry | Agric, Fish, Mining | | | Manufacturing | | | Gas Elect Water | | | Construction | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Firms | R&D spend (£'000s) | Design spend (£'000s) | Firms | R&D spend (£'000s) | Design spend (£'000s) | Firms | R&D spend (£'000s) | Design spend (£'000s) | Firms | R&D spend (£'000s) | Design spend (£'000s) |
| | 367 | 84209 | 6492 | 12819 | 4479866 | 760295 | 104 | 11262 | 910 | 3517 | 57174 | 99812 |
| | % | % | % | % | % | % | % | % | % | % | % | % |
| Firms using Patents | 17 | 94 | 81 | 31 | 94 | 81 | 15 | 2 | 91 | 9 | 71 | 90 |
| Firms using Trademarks | 19 | 86 | 66 | 35 | 92 | 80 | 17 | 89 | 94 | 13 | 80 | 89 |
| Firms using Design | 14 | 89 | 34 | 31 | 82 | 49 | 16 | 1 | 40 | 11 | 73 | 34 |
| Firms using Copyrights | 13 | 92 | 32 | 30 | 90 | 50 | 24 | 91 | 49 | 11 | 71 | 33 |

| Industry | Distbn, retails, hotels, restu | | | Financial intermed | | | Business Service | | | Other | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Firms | R&D spend (£'000s) | Design spend (£'000s) | Firms | R&D spend (£'000s) | Design spend (£'000s) | Firms | R&D spend (£'000s) | Design spend (£'000s) | Firms | R&D spend (£'000s) | Design spend (£'000s) |
| | 11245 | 362422 | 130779 | 1533 | 130314 | 37942 | 8815 | 2095602 | 310993 | 132 | 3336 | 239 |
| | % | % | % | % | % | % | % | % | % | % | % | % |
| Firms using Patents | 13 | 72 | 45 | 11 | 52 | 20 | 17 | 89 | 91 | 14 | 5 | 24 |
| Firms using Trademarks | 20 | 70 | 84 | 20 | 62 | 50 | 23 | 85 | 81 | 21 | 19 | 25 |
| Firms using Design | 15 | 66 | 38 | 14 | 53 | 8 | 18 | 79 | 40 | 15 | 7 | 11 |
| Firms using Copyrights | 15 | 65 | 25 | 20 | 66 | 36 | 25 | 85 | 49 | 33 | 26 | 36 |

Note to table. Each cell shows, by industry, the percentage of firms using each protection type and the fraction of all spending on R&D and design in that industry that those using firms account for. Note that firms can report that they use more than one protection type. Source: CIS.

b) Econometric estimation

To examine this for the UK, we use the fifth wave of the CIS (2004-2006). In the econometric approach there are two preliminary issues to be dealt with. First, firms use multiple protection methods. Second, the methods are subject to firm specific response bias. Therefore, in order to isolate response specific variation, we compute the mean importance across all 8 mechanisms ($\overline{m}$), and the associated standard deviation ($\varpi$). All responses are then adjusted by the mean and standard deviation to correct for the response bias. Let $m$ denote the score of a particular mechanism and let $m_s$ denote its standardized value then:

$$m_s = \frac{m - \overline{m}}{\varpi} \tag{6}$$

For example, let's say a firm reports an importance vector of (0, 1, 2, 1, 2, 2, 3, 3) for design registration, trademarks, patents, copyright, confidentiality, secrecy, complexity and lead-time respectively. The firm-specific mean is (0+1+2+1+2+2+3+3)/8=1.75, and the standard deviation is 1.035. The above transformation then returns an importance of (1-1.75)/1.035 = -0.72 for trademark and copyright, equivalently it returns an importance of (3-1.75)/1.035 = 1.2 for complexity and lead-time.

The standardization assumes that each individual response is taken from the same underlying normal distribution. It therefore endows each individual response the same measurement unit and amplifies the importance of those responses that are further away from the firm bias[14]. In doing so the transformation signifies relative importance to the others.

Consider now the allocation of spend. Each firm reports R&D and other intangible spend and the use of possible multiple methods of IP protection. Hence the question is: how do we allocate the spend in each firm to its reported IP?

Consider R&D. How much R&D is: (a) protected by patents; and (b) protected by registered design rights. To answer this we conduct a firm-level regression analysis that correlates the R&D to sales ratio with the different IP types. While the regression analysis does not make any causal assumptions, it can be regarded as a reduced form description of the sensitivity of R&D/sales to reported use of IP. The regression takes the following form:

$$y_{ijt} = \beta' \vec{X}_{ijt} + \gamma' \overrightarrow{\sigma(X)}_{ijt} + \lambda' \vec{Z}_{ijt} + \delta' \vec{D}_{jt} + \varepsilon_{ijt} \tag{7}$$

14 We note that this transformation (a) requires the mean for each firm of the transformed variable is 0 and (b) transforms firm level responses to missing if there is no variation in returns i.e. all importance rankings are firm specific but not response specific.

Where on the left hand side we use R&D as a % of sales. On the right hand side, the vector $\vec{X}_{ijt}$ represents firm level IP use intensity and contains standardized responses for the individual IP mechanisms. The firm level mean and standard deviation of these responses is captured in the vector $\overrightarrow{\sigma(X)}_{ijt}$. The IP use vector can be expanded out as:

$$\vec{X}_{ijt} = \alpha + \beta_0 Design + \beta_1 Trademarks + \beta_2 Patents + \beta_3 Copyright + \beta_4 Confidentiality + \beta_5 Secrecy + \beta_6 Complexity + \beta_7 Lead\ Time \quad (8)$$

Where $\alpha$ captures the R&D/Sales intensity of those firms that do not rely on any IP mechanism, $\beta_2$ captures the elasticity of R&D intensity to patent use holding all other forms of IP use constant, and $\beta_0$ the elasticity of R&D intensity to the use of design registration holding all other forms constant. The $\beta$ coefficients are not structural parameters and therefore do not represent a causal change in demand for R&D intensity i.e. we are not saying that firms first decide on IP use and then how much to spend on R&D. Rather, they are the reduced form correlations and can be regarded as a summary of the various elasticities. As long as the use/importance of each IP mechanism is measured in the same units, we can calculate the ratio $\frac{\beta_i}{\sum_{i=0}^{7}\beta_i}$ which would give the share of spending that would be accounted for by firms using IP type i as protection, as a share of total spending by those firms using any form of protection.

As implied by (7) we also include a number of control variables. As noted we include the firm level mean and standard deviation of IP responses. We also include the % of employees with a degree in science or engineering, the log of employment and industry dummies.

The R&D relationship is analysed using standard OLS. For Design, we note that questions on design expenditure are less well answered on the CIS (Awano, Franklin, Haskel et al (2010a)). There are also many instances where firms respond positively to the question of whether they undertake activity but the expenditure estimate is zero or missing. Therefore we use the binary question on design activity and so employ a probit procedure. Since the questions on R&D expenditure appear to be better answered, we have more confidence in using the expenditure data in the case of R&D.

The results are presented below in Table 4. Column 1 presents a probit regression for design, where the left-hand side variable is a binary yes/no response and the right hand side includes demeaned responses for each IP protection mechanism as described above. Also included in the regression, but not shown, are the control variables described above. Column 2 reports the marginal effects from this regression. Column 3 presents the results of an OLS estimation, where the left-hand side variable is R&D/Sales and the right hand side includes demeaned responses on the importance of IP mechanisms and the control variables. In each regression, in order to identify the idiosyncratic impact of the different mechanisms we assign one mechanism as the reference category and constrain its impact to zero.

**Table 4: Regression estimates of proportions of R&D and Design protected by IPRs**

| | | (1) | (2) | (3) |
|---|---|---|---|---|
| EQUATION | VARIABLES | Design (1/0) | Marg. Effects of Col (1) | R&D/Sales |
| | | | | |
| design_yn | Design | 0.0549* | 0.0190* | 0.0368 |
| | | (0.0283) | (0.00981) | (0.145) |
| | Trademarks | 0.0119 | 0.00412 | |
| | | (0.0263) | (0.00910) | |
| | Patents | 0.00958 | 0.00332 | 0.415*** |
| | | (0.0294) | (0.0102) | (0.146) |
| | Confidentiality | 0.0250 | 0.00867 | 0.00889 |
| | | (0.0297) | (0.0103) | (0.118) |
| | Copyright | 0.0619** | 0.0214** | 0.160 |
| | | (0.0274) | (0.00947) | (0.137) |
| | Complexity | 0.247*** | 0.0854*** | 0.343*** |
| | | (0.0292) | (0.0101) | (0.122) |
| | LeadTime | 0.0948*** | 0.0328*** | 0.00972 |
| | | (0.0252) | (0.00871) | (0.111) |
| SINGLE | Secrecy | | | 0.129 |
| | | | | (0.118) |
| | | | | |
| | Observations | 6,823 | 6,823 | 3,965 |
| | R-square | | | 0.165 |
| | Standard errors in parentheses | | | |
| | *** p<0.01, ** p<0.05, * p<0.1 | | | |
| | | | | |
| | Sum of marginal effects: $\Sigma\beta i$ | | 0.17471 | 1.10241 |
| | % protected by Patents | | 1.9% | 37.6% |
| | % protected by Design rights | | 10.9% | 3.3% |

Note to table: Column 1 is a probit regression using a binary yes/no variable on whether firms conduct design as the regressor. Column 2 reports the marginal effects for the regression in column 1. Column 3 reports an OLS regression using the firm R&D/sales ratio as the regressor. Columns 1 and 3 include controls such as industry dummies, the mean and standard deviation of responses on IP mechanisms, employment and the proportion of employees with a degree in science or engineering.

Column 2 reports the marginal effects for the regression in Column 1. According to these estimates, the most important IP protection mechanisms for firms conducting design are: 1) Complexity; 2) Lead Time; 3) Copyright; 4) Design registration; in that order. We wish to determine what proportion of design is protected by: a) registered design rights; and b) patents. Taking the marginal effect for each of these mechanisms as the sum of all the marginal effects we estimate that: 11% of design is protected by registered design rights; and 2% of design is protected by patents. By assumption, the remainder of design (87%) is protected by unregistered design rights.

Column 3 presents our results for R&D, this time using R&D intensity as the dependent variable. The results suggest that the most important protection mechanisms for R&D are: 1) Patents; 2) Complexity; 3) Copyright; 4) Secrecy; and 5) Design Registration. Since the coefficient on each mechanism provides an estimate of the marginal effect, taking the coefficient on patents and design registration as a sum of all the coefficients, we estimate that: 38% of R&D is protected by patents; and 3% of R&D is protected by registered design rights.

One might reasonably imagine that these effects vary by industry and hence we would wish to run separate regressions for each industry. We are however limited in our ability to conduct a similar regression exercise for each and every industry. On the one hand, most R&D activity is limited to specific sectors. On the other hand, the CIS survey simply does not survey enough firms in very detailed industries of interest, such as pharmaceuticals, and we are limited in our ability to exploit firm level variations and draw statistically meaningful conclusions. In addition, disclosure concerns dictate a certain degree of aggregation. With these trade-offs in mind, we only conduct our analysis at the aggregate market sector level.

Of the remaining assets not discussed in this section, such as Training and Organisational Structure, we assume that none of these investments are protected by formal IPRs. Of course certain licensing rights apply to activities such as Mineral Exploration, but not IPRs which are our interest in this report.

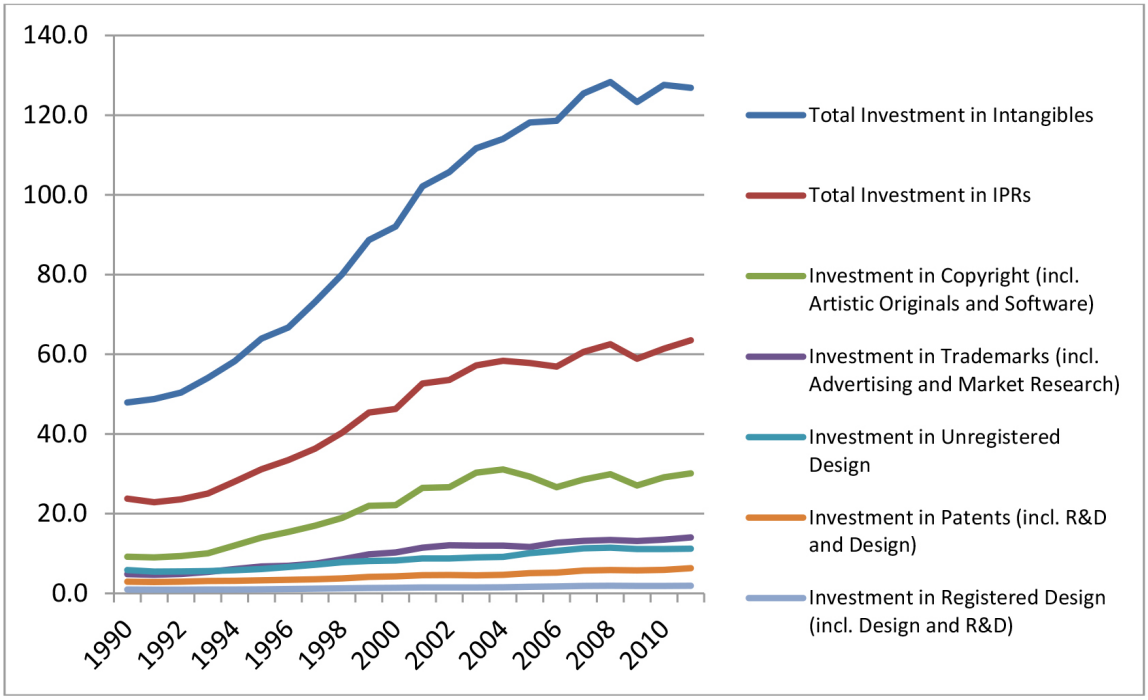
We now apply our estimates of what proportion of investment is protected by IPRs, to our dataset. Results are presented below in Table 5. We estimate that almost half (48% in 2011) of UK investment in intangibles is in assets protected by formal IPRs, amounting to £65.6bn in 2011. Of that, almost half (46% in 2011) is in assets protected by copyright, namely software and artistic originals. Of the remainder, trademarks and unregistered design rights each account for 21%, patents for 10%, and registered design rights for 3%. A chart showing estimated investment in each of the five types of IPR is presented below in Figure 13.

**Table 5: UK Market Sector Investment in Intellectual Property Rights (Nominal, £bns)**

| | 1990 | 1995 | 2000 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|
| Investment in Patents (incl. R&D and Design) | 2.9 | 3.3 | 4.3 | 5.1 | 5.2 | 5.8 | 5.9 | 5.8 | 5.9 | 6.3 |
| Investment in Copyright (incl. Artistic Originals and Software) | 9.2 | 14.0 | 22.1 | 29.3 | 26.7 | 28.6 | 29.9 | 27.0 | 29.1 | 30.1 |
| Investment in Registered Design (incl. Design and R&D) | 1.0 | 1.0 | 1.4 | 1.7 | 1.7 | 1.9 | 1.9 | 1.8 | 1.8 | 1.9 |
| Investment in Unregistered Design | 5.9 | 6.1 | 8.3 | 10.1 | 10.6 | 11.3 | 11.5 | 11.1 | 11.1 | 11.2 |
| Investment in Trademarks (incl. Advertising and Market Research) | 4.8 | 6.7 | 10.2 | 11.7 | 12.7 | 13.2 | 13.4 | 13.1 | 13.5 | 14.0 |
| | | | | | | | | | | |
| ***Total Investment in IPRs*** | ***23.8*** | ***31.1*** | ***46.3*** | ***57.8*** | ***56.9*** | ***60.6*** | ***62.5*** | ***58.9*** | ***61.4*** | ***63.5*** |
| | | | | | | | | | | |
| ***Total Investment in Intangibles*** | ***47.9*** | ***63.9*** | ***92.1*** | ***118.1*** | ***118.6*** | ***125.5*** | ***128.3*** | ***123.3*** | ***127.6*** | ***126.8*** |

Note to table: Investment in patents estimated as 38% of investment in scientific R&D plus 2% of investment in design. Investment in copyright estimated as 100% of investment in artistic originals and software. Investment in registered design estimated as 11% of investment in design plus 3% of investment in scientific R&D. Investment in unregistered design estimated at 87% of investment in design, that is, the remainder of design investment not allocated to patents or registered design. Investment in trademarks estimated as 100% of investment in advertising and market research.

**Figure 13. Total Investment in assets by IP coverage, Nominal £bns**




Source: Own estimates, see note to Table 5.

In this report we have presented nominal measures of investment in intangible assets, and on intangible assets protected by formal IPRs. Real, or volume, measures would require deflating these estimates with an appropriate price index. In this context it is worth saying something about real investment in R&D and therefore patented R&D. Here our estimate for investment in patented R&D is £6.4bn in 2011, having risen from £2.9bn in 1990. The average rate of growth in nominal patented R&D, over the period 1990 to 2011, is 3.7%. Applying an output price index such as a GDP deflator, as is typical for R&D, rising at a rate of approximately 3 to 4% p.a., would imply that there has been almost no rise in real R&D investment. However, recent studies suggest that the implicit price of R&D may have been falling rapidly due to technological innovation in the R&D upstream sector (Corrado, Goodridge and Haskel (2011)). Those authors estimate the price of R&D in the UK to have fallen at an average rate of approximately -7.5% p.a. over the period 1985 to 2005. Applying this price index would therefore imply that real patented R&D investment has grown at a rate of approximately 11% p.a. over the period considered here.

# 5. Conclusions

Applying the intangibles framework, as used in the NESTA Innovation Index, we find that total UK market sector investment in intangible assets reached £126.8bn in 2011, compared to £88bn of investment in tangible assets. We also note that since the recession of 2008-9, intangible investment has recovered and grew in 2010-11. In contrast investment in tangible assets has fallen. Of the £126.8bn invested in intangibles in 2011, we estimate that approximately half (£63.5bn) was investment protected by formal IPRs (patents, copyright, registered design rights, unregistered design rights or trademarks). Of investment protected by IPRs, the largest component is investment in copyright, which stood at £30.1bn in 2011. Investment in unregistered design rights and trademarks were £11.2bn and £14bn respectively in 2011, investment in patents, £6.3bn, and investment in registered design rights, £1.9bn.

In forming these estimates we first identify investment in each intangible asset, as set out in Corrado, Hulten et al. (2005). We then form estimates of how much investment in each asset type is formally protected by IPRs. In doing so, we allow for the fact that both scientific R&D and Architectural and Engineering Design can be protected by either patents or registered design rights. We estimate that 38% of investment in scientific R&D is protected by patents and 3% by registered design rights. We also estimate that 11% of investment in Design is protected by registered design rights and 2% by patents. The remainder of investment in Design is assumed to be protected by unregistered design rights. We further assume that 100% of investment in Artistic Originals and Software is protected by copyright, and that 100% of investment in Advertising and Market Research is protected by Trademarks.

We emphasise that this work estimates investment in knowledge assets and the proportions of that investment protected by formal IPRs. We take no stand on whether investment in knowledge assets is higher or lower than it would have been were those assets not protected by IPRs. That area requires further work. Whilst some evidence suggests that the ability to use IPRs increases investment in innovation through the incentive of monopolist revenues, others suggest that the same mechanism reduces innovation by removing the incentive to continually innovate.

Nevertheless, the scale of investment in IPR-protected assets is not fully appreciated. Investment in IPRs is higher than that in commercial buildings and also higher than plant & machinery (including ICT) and vehicles combined. The role of assets protected by IPRs, as drivers of growth, deserve greater consideration in both measurement and policy.

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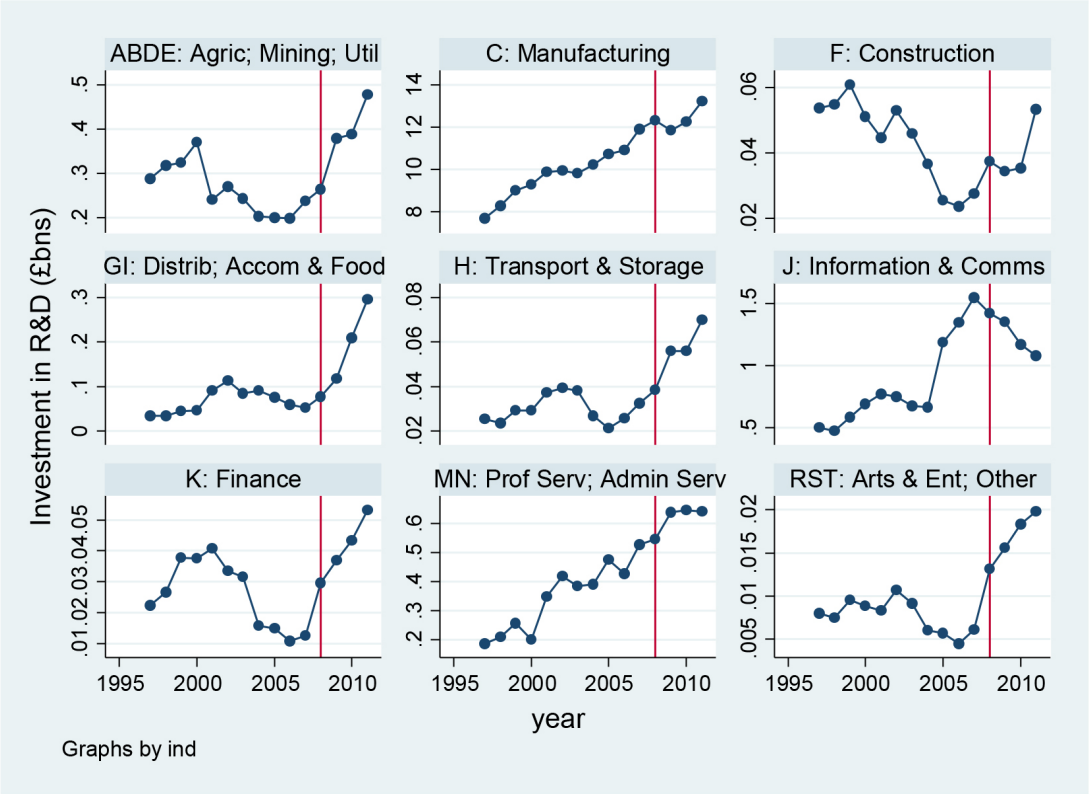
# Appendix 1: Industry-level Intangible Investment

This appendix presents data for nominal intangible investment at the industry level, based on a nine industry breakdown. The following charts present industry data for each intangible asset. Where relevant, estimates of own-account and purchased estimates have been summed for that category. Estimates for advertising and market research have also been summed to form the asset category 'Branding'. In each chart the line at 2008 marks the start of the recent recession.

**Figure A1.1: Industry-level investment in R&D**




Note to figure: Y-axes for each chart have different scales

**Figure A1.2: Industry-level investment in Mineral Exploration**

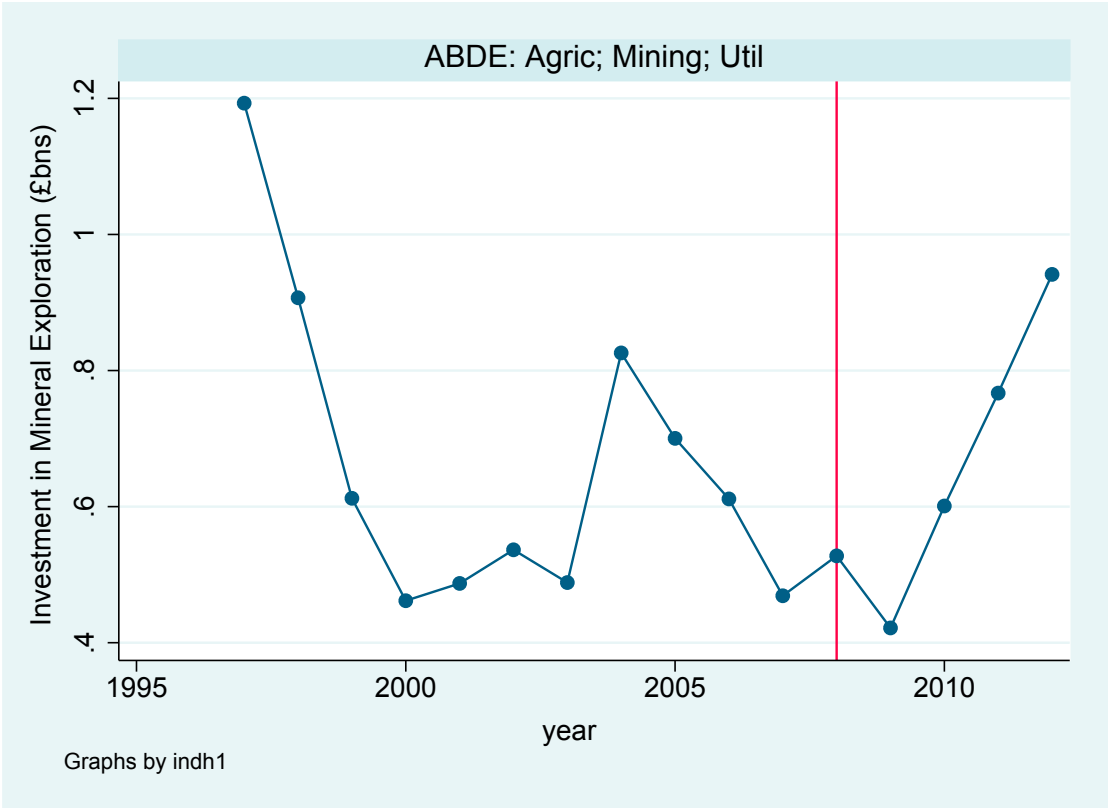



**Figure A1.3: Industry-level investment in Financial Product Innovation**

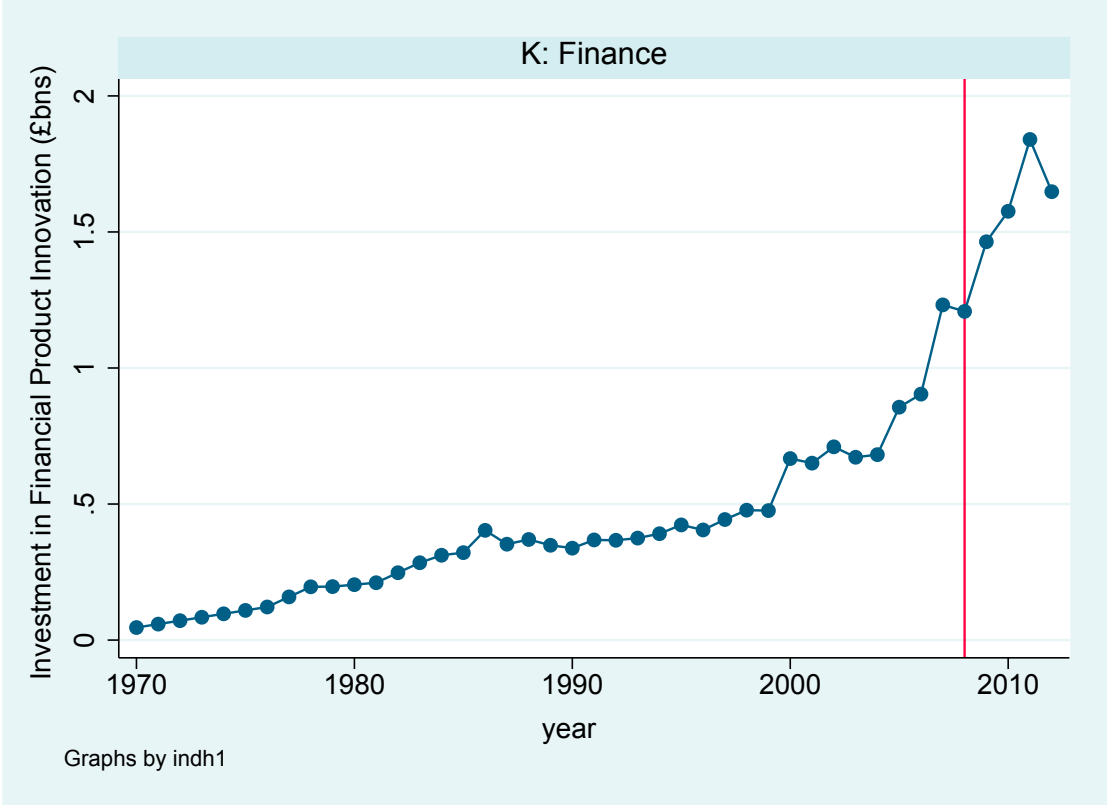


**Figure A1.4: Industry-level investment in Design**

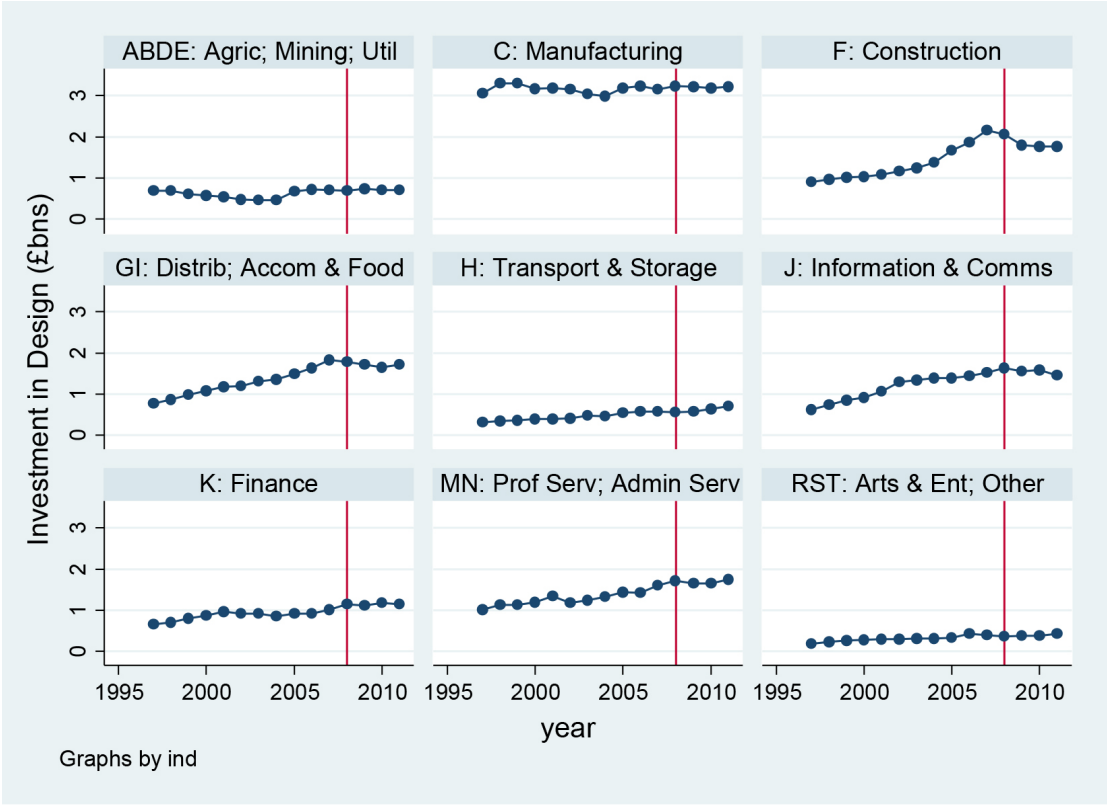



**Figure A1.5: Industry-level investment in Non-scientific R&D**

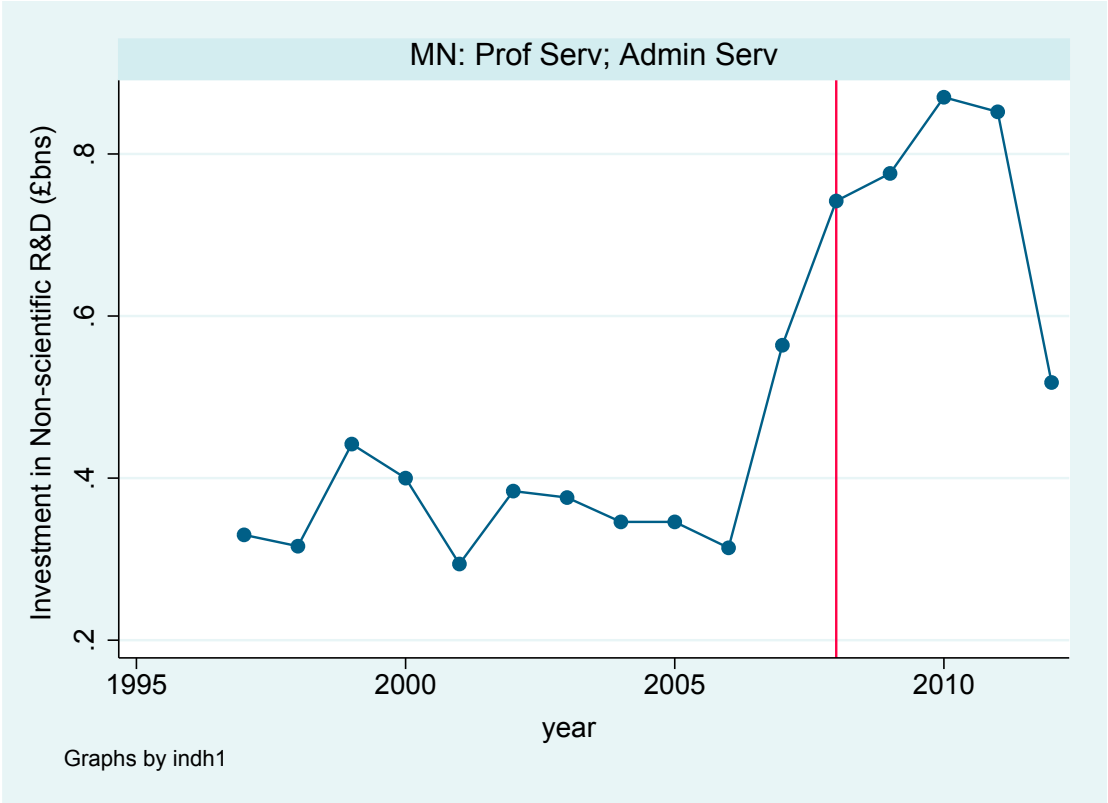


**Figure A1.6: Industry-level investment in Training**

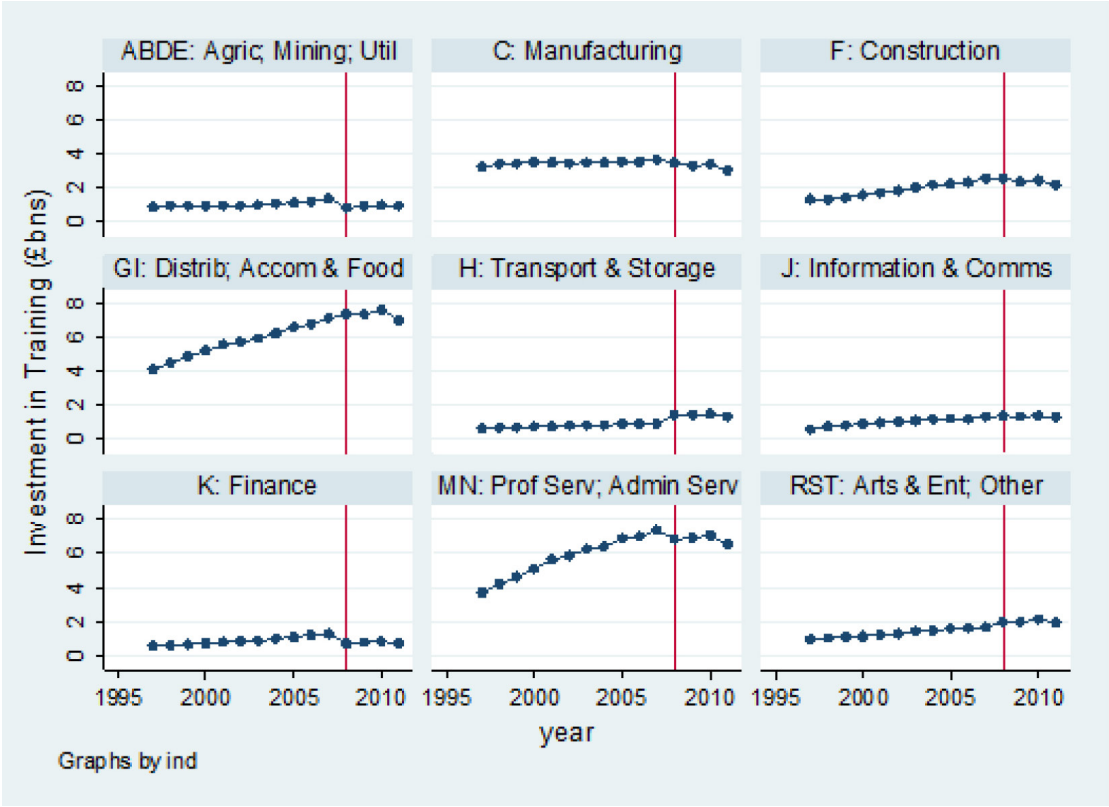
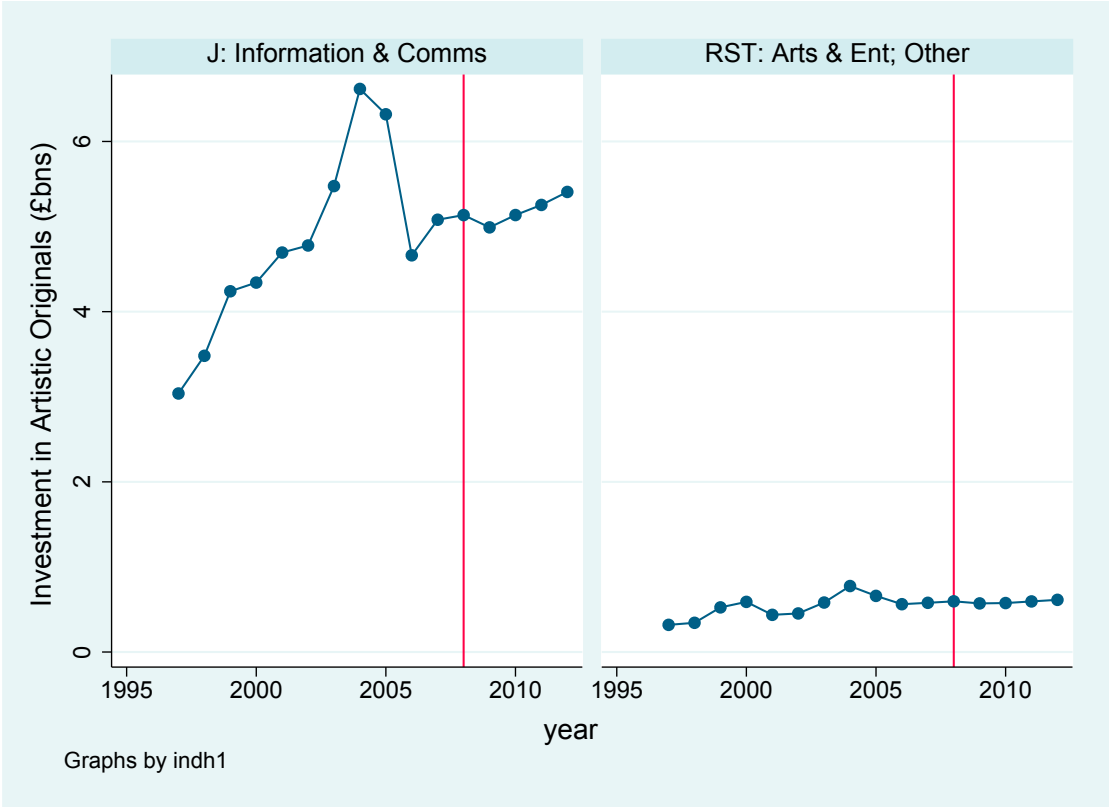



**Figure A1.7: Industry-level investment in Artistic Originals**



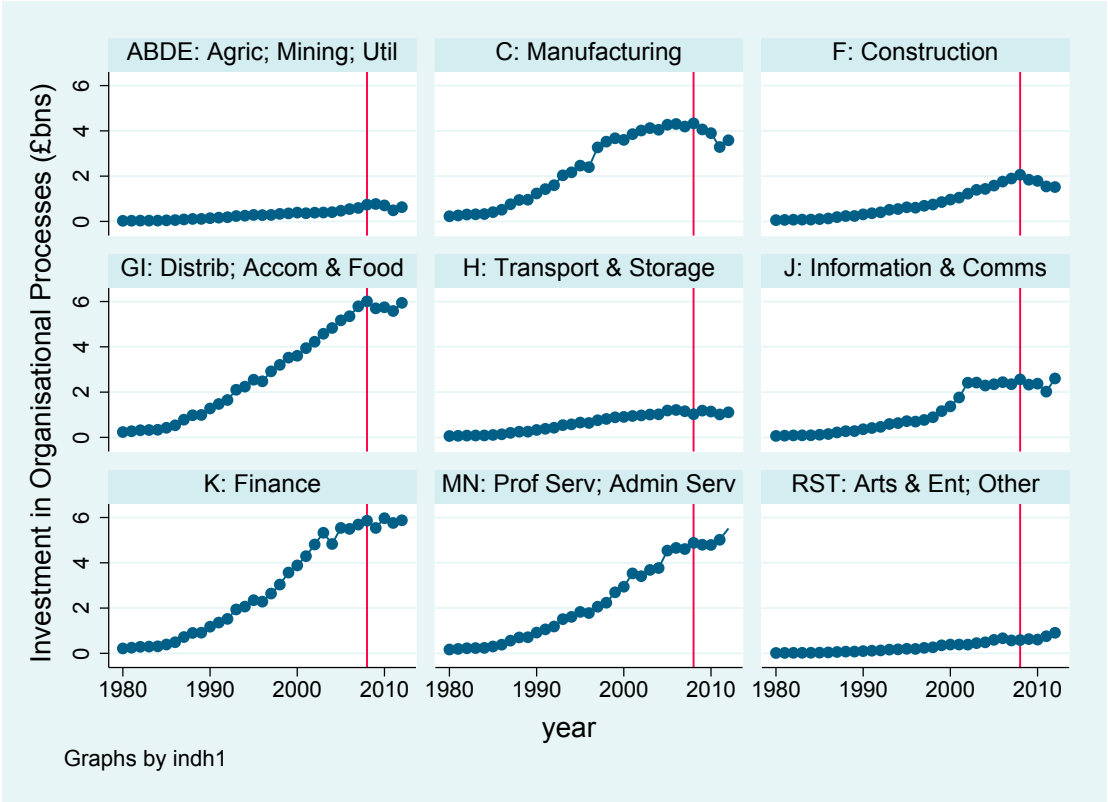



**Figure A1.9: Industry-level investment in Software**

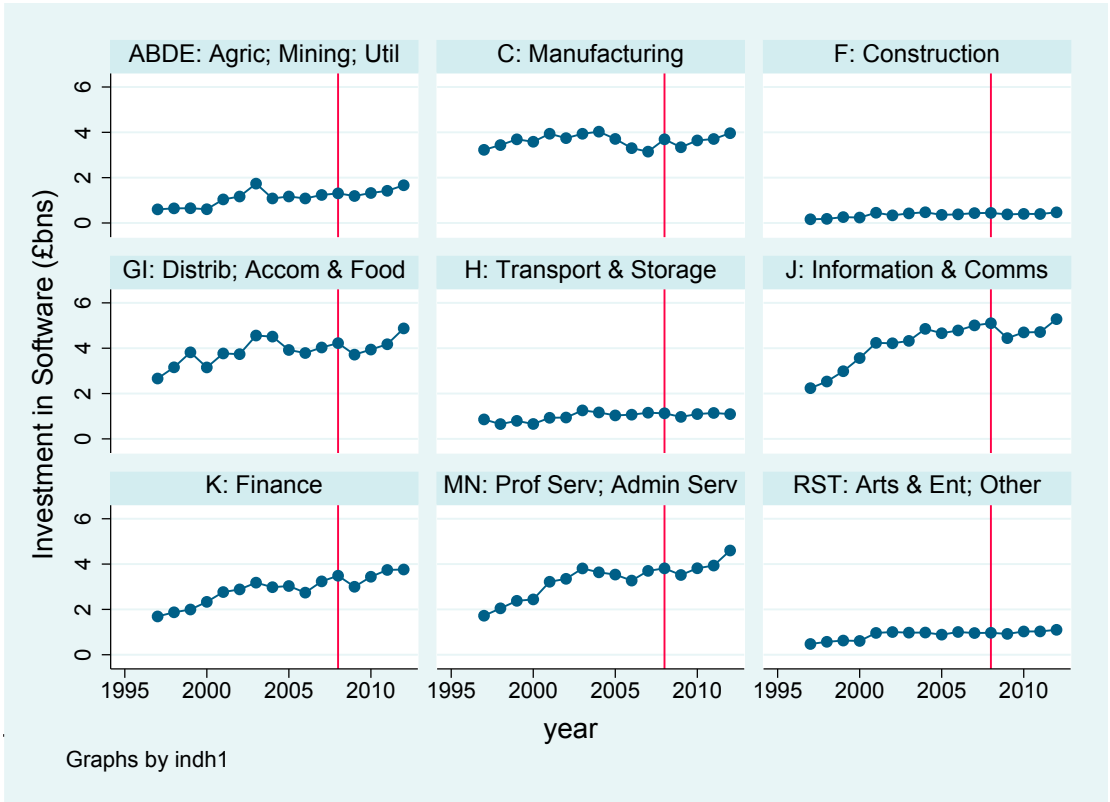
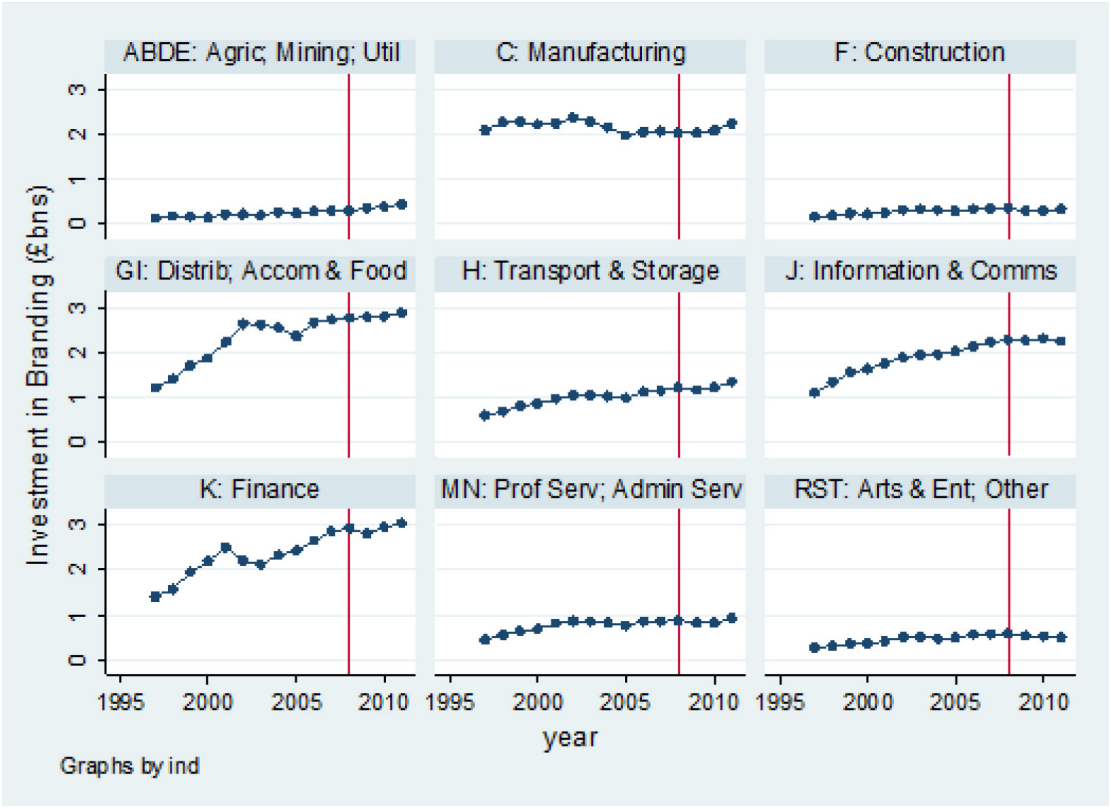


**Figure A1.10: Industry-level investment in Branding**




Data in the above charts, for 1997 to 2011, are summarised below in Table A1.1.

## Table A1.1: Intangible investment by asset, industry and year, Nominal £bns

| | | Investment (£bns) in: | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Industry (SIC07) | year | Scientific R&D | Mineral Exploration | Financial Product Innovation | Design | Non-scientific R&D | Training | Artistic Originals | Organisational Structure | Software | Branding | *Intangibles (Total)* |
| ABDE: Agric; Mining; Util | 1997 | 0.29 | 1.19 | 0.00 | 0.69 | 0.00 | 0.89 | 0.00 | 0.29 | 0.60 | 0.15 | 4.09 |
| | 1998 | 0.32 | 0.91 | 0.00 | 0.69 | 0.00 | 0.95 | 0.00 | 0.33 | 0.65 | 0.18 | 4.02 |
| | 1999 | 0.32 | 0.61 | 0.00 | 0.61 | 0.00 | 0.94 | 0.00 | 0.35 | 0.65 | 0.17 | 3.67 |
| | 2000 | 0.37 | 0.46 | 0.00 | 0.58 | 0.00 | 0.95 | 0.00 | 0.39 | 0.61 | 0.16 | 3.52 |
| | 2001 | 0.24 | 0.49 | 0.00 | 0.55 | 0.00 | 0.96 | 0.00 | 0.36 | 1.04 | 0.23 | 3.87 |
| | 2002 | 0.27 | 0.54 | 0.00 | 0.48 | 0.00 | 0.95 | 0.00 | 0.39 | 1.17 | 0.23 | 4.02 |
| | 2003 | 0.24 | 0.49 | 0.00 | 0.46 | 0.00 | 1.02 | 0.00 | 0.40 | 1.74 | 0.20 | 4.54 |
| | 2004 | 0.20 | 0.83 | 0.00 | 0.46 | 0.00 | 1.09 | 0.00 | 0.41 | 1.08 | 0.28 | 4.35 |
| | 2005 | 0.20 | 0.70 | 0.00 | 0.68 | 0.00 | 1.17 | 0.00 | 0.47 | 1.17 | 0.26 | 4.66 |
| | 2006 | 0.20 | 0.61 | 0.00 | 0.72 | 0.00 | 1.23 | 0.00 | 0.55 | 1.08 | 0.29 | 4.69 |
| | 2007 | 0.24 | 0.47 | 0.00 | 0.71 | 0.00 | 1.39 | 0.00 | 0.60 | 1.24 | 0.31 | 4.95 |
| | 2008 | 0.26 | 0.53 | 0.00 | 0.70 | 0.00 | 0.86 | 0.00 | 0.74 | 1.31 | 0.30 | 4.71 |
| | 2009 | 0.38 | 0.42 | 0.00 | 0.74 | 0.00 | 0.94 | 0.00 | 0.77 | 1.19 | 0.37 | 4.82 |
| | 2010 | 0.39 | 0.60 | 0.00 | 0.71 | 0.00 | 1.02 | 0.00 | 0.71 | 1.32 | 0.40 | 5.15 |
| | 2011 | 0.48 | 0.77 | 0.00 | 0.71 | 0.00 | 0.97 | 0.00 | 0.49 | 1.42 | 0.46 | 5.29 |
| C: Manufacturing | 1997 | 7.69 | 0.00 | 0.00 | 3.05 | 0.00 | 3.26 | 0.00 | 3.26 | 3.23 | 2.09 | 22.58 |
| | 1998 | 8.28 | 0.00 | 0.00 | 3.30 | 0.00 | 3.41 | 0.00 | 3.53 | 3.44 | 2.28 | 24.25 |
| | 1999 | 9.00 | 0.00 | 0.00 | 3.30 | 0.00 | 3.45 | 0.00 | 3.66 | 3.69 | 2.30 | 25.40 |
| | 2000 | 9.30 | 0.00 | 0.00 | 3.17 | 0.00 | 3.51 | 0.00 | 3.59 | 3.58 | 2.22 | 25.38 |
| | 2001 | 9.86 | 0.00 | 0.00 | 3.18 | 0.00 | 3.51 | 0.00 | 3.85 | 3.94 | 2.24 | 26.59 |
| | 2002 | 9.94 | 0.00 | 0.00 | 3.16 | 0.00 | 3.46 | 0.00 | 4.03 | 3.74 | 2.36 | 26.70 |
| | 2003 | 9.83 | 0.00 | 0.00 | 3.03 | 0.00 | 3.48 | 0.00 | 4.15 | 3.94 | 2.29 | 26.71 |
| | 2004 | 10.23 | 0.00 | 0.00 | 2.99 | 0.00 | 3.48 | 0.00 | 4.08 | 4.03 | 2.16 | 26.97 |
| | 2005 | 10.73 | 0.00 | 0.00 | 3.19 | 0.00 | 3.58 | 0.00 | 4.32 | 3.71 | 1.98 | 27.51 |
| | 2006 | 10.90 | 0.00 | 0.00 | 3.24 | 0.00 | 3.55 | 0.00 | 4.35 | 3.30 | 2.07 | 27.41 |
| | 2007 | 11.90 | 0.00 | 0.00 | 3.16 | 0.00 | 3.68 | 0.00 | 4.20 | 3.15 | 2.08 | 28.18 |
| | 2008 | 12.30 | 0.00 | 0.00 | 3.23 | 0.00 | 3.50 | 0.00 | 4.34 | 3.69 | 2.04 | 29.10 |
| | 2009 | 11.85 | 0.00 | 0.00 | 3.22 | 0.00 | 3.29 | 0.00 | 4.07 | 3.34 | 2.04 | 27.81 |
| | 2010 | 12.24 | 0.00 | 0.00 | 3.19 | 0.00 | 3.41 | 0.00 | 3.90 | 3.64 | 2.10 | 28.48 |
| | 2011 | 13.20 | 0.00 | 0.00 | 3.21 | 0.00 | 3.07 | 0.00 | 3.29 | 3.71 | 2.25 | 28.73 |

| | | Investment (£bns) in: | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Industry (SIC07) | year | Scientific R&D | Mineral Exploration | Financial Product Innovation | Design | Non-scientific R&D | Training | Artistic Originals | Organisational Structure | Software | Branding | *Intangibles (Total)* |
| F: Construction | 1997 | 0.05 | 0.00 | 0.00 | 0.90 | 0.00 | 1.35 | 0.00 | 0.69 | 0.16 | 0.17 | 3.33 |
| | 1998 | 0.05 | 0.00 | 0.00 | 0.97 | 0.00 | 1.35 | 0.00 | 0.75 | 0.18 | 0.21 | 3.51 |
| | 1999 | 0.06 | 0.00 | 0.00 | 1.03 | 0.00 | 1.44 | 0.00 | 0.85 | 0.26 | 0.25 | 3.89 |
| | 2000 | 0.05 | 0.00 | 0.00 | 1.03 | 0.00 | 1.58 | 0.00 | 0.96 | 0.24 | 0.23 | 4.09 |
| | 2001 | 0.04 | 0.00 | 0.00 | 1.08 | 0.00 | 1.70 | 0.00 | 1.05 | 0.45 | 0.27 | 4.60 |
| | 2002 | 0.05 | 0.00 | 0.00 | 1.16 | 0.00 | 1.88 | 0.00 | 1.23 | 0.34 | 0.33 | 5.00 |
| | 2003 | 0.05 | 0.00 | 0.00 | 1.24 | 0.00 | 2.03 | 0.00 | 1.41 | 0.42 | 0.34 | 5.49 |
| | 2004 | 0.04 | 0.00 | 0.00 | 1.37 | 0.00 | 2.20 | 0.00 | 1.45 | 0.47 | 0.32 | 5.85 |
| | 2005 | 0.03 | 0.00 | 0.00 | 1.66 | 0.00 | 2.26 | 0.00 | 1.61 | 0.36 | 0.31 | 6.22 |
| | 2006 | 0.02 | 0.00 | 0.00 | 1.87 | 0.00 | 2.35 | 0.00 | 1.78 | 0.38 | 0.34 | 6.75 |
| | 2007 | 0.03 | 0.00 | 0.00 | 2.16 | 0.00 | 2.57 | 0.00 | 1.90 | 0.44 | 0.36 | 7.45 |
| | 2008 | 0.04 | 0.00 | 0.00 | 2.06 | 0.00 | 2.58 | 0.00 | 2.06 | 0.45 | 0.37 | 7.56 |
| | 2009 | 0.03 | 0.00 | 0.00 | 1.81 | 0.00 | 2.40 | 0.00 | 1.84 | 0.38 | 0.31 | 6.77 |
| | 2010 | 0.04 | 0.00 | 0.00 | 1.77 | 0.00 | 2.45 | 0.00 | 1.79 | 0.40 | 0.31 | 6.76 |
| | 2011 | 0.05 | 0.00 | 0.00 | 1.77 | 0.00 | 2.20 | 0.00 | 1.55 | 0.40 | 0.34 | 6.31 |
| GI: Distrib; Accom & Food | 1997 | 0.03 | 0.00 | 0.00 | 0.78 | 0.00 | 4.08 | 0.00 | 2.91 | 2.66 | 1.20 | 11.67 |
| | 1998 | 0.03 | 0.00 | 0.00 | 0.86 | 0.00 | 4.45 | 0.00 | 3.21 | 3.16 | 1.40 | 13.12 |
| | 1999 | 0.04 | 0.00 | 0.00 | 0.98 | 0.00 | 4.84 | 0.00 | 3.51 | 3.82 | 1.72 | 14.92 |
| | 2000 | 0.05 | 0.00 | 0.00 | 1.08 | 0.00 | 5.17 | 0.00 | 3.59 | 3.15 | 1.87 | 14.91 |
| | 2001 | 0.09 | 0.00 | 0.00 | 1.18 | 0.00 | 5.52 | 0.00 | 3.93 | 3.77 | 2.24 | 16.73 |
| | 2002 | 0.11 | 0.00 | 0.00 | 1.20 | 0.00 | 5.68 | 0.00 | 4.26 | 3.74 | 2.63 | 17.62 |
| | 2003 | 0.09 | 0.00 | 0.00 | 1.32 | 0.00 | 5.90 | 0.00 | 4.63 | 4.56 | 2.62 | 19.12 |
| | 2004 | 0.09 | 0.00 | 0.00 | 1.35 | 0.00 | 6.22 | 0.00 | 4.89 | 4.51 | 2.55 | 19.62 |
| | 2005 | 0.08 | 0.00 | 0.00 | 1.48 | 0.00 | 6.56 | 0.00 | 5.29 | 3.92 | 2.37 | 19.70 |
| | 2006 | 0.06 | 0.00 | 0.00 | 1.63 | 0.00 | 6.71 | 0.00 | 5.47 | 3.79 | 2.66 | 20.32 |
| | 2007 | 0.05 | 0.00 | 0.00 | 1.83 | 0.00 | 7.08 | 0.00 | 5.83 | 4.03 | 2.74 | 21.55 |
| | 2008 | 0.08 | 0.00 | 0.00 | 1.78 | 0.00 | 7.29 | 0.00 | 6.03 | 4.22 | 2.76 | 22.15 |
| | 2009 | 0.12 | 0.00 | 0.00 | 1.71 | 0.00 | 7.31 | 0.00 | 5.71 | 3.72 | 2.79 | 21.35 |
| | 2010 | 0.21 | 0.00 | 0.00 | 1.65 | 0.00 | 7.59 | 0.00 | 5.76 | 3.94 | 2.81 | 21.95 |
| | 2011 | 0.30 | 0.00 | 0.00 | 1.71 | 0.00 | 6.98 | 0.00 | 5.60 | 4.18 | 2.88 | 21.65 |

## Table A1.1: Intangible investment by asset, industry and year, Nominal £bns

| | | Investment (£bns) in: | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Industry (SIC07) | year | Scientific R&D | Mineral Exploration | Financial Product Innovation | Design | Non-scientific R&D | Training | Artistic Originals | Organisational Structure | Software | Branding | *Intangibles (Total)* |
| H: Transport & Storage | 1997 | 0.03 | 0.00 | 0.00 | 0.32 | 0.00 | 0.60 | 0.00 | 0.76 | 0.86 | 0.60 | 3.16 |
| | 1998 | 0.02 | 0.00 | 0.00 | 0.34 | 0.00 | 0.65 | 0.00 | 0.82 | 0.65 | 0.68 | 3.16 |
| | 1999 | 0.03 | 0.00 | 0.00 | 0.37 | 0.00 | 0.67 | 0.00 | 0.88 | 0.80 | 0.82 | 3.56 |
| | 2000 | 0.03 | 0.00 | 0.00 | 0.39 | 0.00 | 0.71 | 0.00 | 0.90 | 0.66 | 0.86 | 3.55 |
| | 2001 | 0.04 | 0.00 | 0.00 | 0.40 | 0.00 | 0.74 | 0.00 | 0.94 | 0.93 | 0.96 | 4.02 |
| | 2002 | 0.04 | 0.00 | 0.00 | 0.41 | 0.00 | 0.79 | 0.00 | 0.98 | 0.94 | 1.05 | 4.21 |
| | 2003 | 0.04 | 0.00 | 0.00 | 0.48 | 0.00 | 0.80 | 0.00 | 1.02 | 1.26 | 1.04 | 4.65 |
| | 2004 | 0.03 | 0.00 | 0.00 | 0.47 | 0.00 | 0.82 | 0.00 | 1.03 | 1.17 | 1.03 | 4.54 |
| | 2005 | 0.02 | 0.00 | 0.00 | 0.54 | 0.00 | 0.88 | 0.00 | 1.21 | 1.04 | 0.99 | 4.67 |
| | 2006 | 0.03 | 0.00 | 0.00 | 0.58 | 0.00 | 0.89 | 0.00 | 1.23 | 1.07 | 1.12 | 4.91 |
| | 2007 | 0.03 | 0.00 | 0.00 | 0.57 | 0.00 | 0.93 | 0.00 | 1.16 | 1.16 | 1.15 | 5.00 |
| | 2008 | 0.04 | 0.00 | 0.00 | 0.56 | 0.00 | 1.42 | 0.00 | 1.03 | 1.13 | 1.22 | 5.39 |
| | 2009 | 0.06 | 0.00 | 0.00 | 0.57 | 0.00 | 1.42 | 0.00 | 1.19 | 0.97 | 1.16 | 5.37 |
| | 2010 | 0.06 | 0.00 | 0.00 | 0.64 | 0.00 | 1.47 | 0.00 | 1.14 | 1.10 | 1.22 | 5.62 |
| | 2011 | 0.07 | 0.00 | 0.00 | 0.71 | 0.00 | 1.30 | 0.00 | 1.02 | 1.14 | 1.34 | 5.57 |
| J: Information & Comms | 1997 | 0.50 | 0.00 | 0.00 | 0.62 | 0.00 | 0.59 | 3.04 | 0.77 | 2.24 | 1.10 | 8.85 |
| | 1998 | 0.47 | 0.00 | 0.00 | 0.74 | 0.00 | 0.71 | 3.48 | 0.89 | 2.53 | 1.32 | 10.15 |
| | 1999 | 0.58 | 0.00 | 0.00 | 0.85 | 0.00 | 0.81 | 4.24 | 1.16 | 2.99 | 1.56 | 12.19 |
| | 2000 | 0.69 | 0.00 | 0.00 | 0.91 | 0.00 | 0.89 | 4.34 | 1.36 | 3.57 | 1.64 | 13.40 |
| | 2001 | 0.77 | 0.00 | 0.00 | 1.07 | 0.00 | 0.98 | 4.69 | 1.76 | 4.24 | 1.77 | 15.28 |
| | 2002 | 0.75 | 0.00 | 0.00 | 1.29 | 0.00 | 1.02 | 4.78 | 2.43 | 4.22 | 1.88 | 16.36 |
| | 2003 | 0.68 | 0.00 | 0.00 | 1.35 | 0.00 | 1.09 | 5.48 | 2.44 | 4.32 | 1.96 | 17.31 |
| | 2004 | 0.66 | 0.00 | 0.00 | 1.39 | 0.00 | 1.14 | 6.62 | 2.31 | 4.85 | 1.96 | 18.94 |
| | 2005 | 1.19 | 0.00 | 0.00 | 1.39 | 0.00 | 1.18 | 6.32 | 2.39 | 4.66 | 2.03 | 19.16 |
| | 2006 | 1.35 | 0.00 | 0.00 | 1.43 | 0.00 | 1.17 | 4.66 | 2.48 | 4.78 | 2.13 | 18.01 |
| | 2007 | 1.55 | 0.00 | 0.00 | 1.52 | 0.00 | 1.32 | 5.08 | 2.36 | 5.01 | 2.23 | 19.07 |
| | 2008 | 1.42 | 0.00 | 0.00 | 1.64 | 0.00 | 1.36 | 5.14 | 2.57 | 5.10 | 2.28 | 19.50 |
| | 2009 | 1.35 | 0.00 | 0.00 | 1.56 | 0.00 | 1.31 | 4.99 | 2.33 | 4.45 | 2.26 | 18.25 |
| | 2010 | 1.17 | 0.00 | 0.00 | 1.58 | 0.00 | 1.37 | 5.14 | 2.38 | 4.70 | 2.31 | 18.64 |
| | 2011 | 1.08 | 0.00 | 0.00 | 1.45 | 0.00 | 1.27 | 5.25 | 2.03 | 4.71 | 2.25 | 18.05 |

| | | Investment (£bns) in: | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Industry (SIC07) | year | Scientific R&D | Mineral Exploration | Financial Product Innovation | Design | Non-scientific R&D | Training | Artistic Originals | Organisational Structure | Software | Branding | *Intangibles (Total)* |
| K: Finance | 1997 | 0.02 | 0.00 | 0.44 | 0.66 | 0.00 | 0.62 | 0.00 | 2.67 | 1.69 | 1.42 | 7.52 |
| | 1998 | 0.03 | 0.00 | 0.48 | 0.70 | 0.00 | 0.65 | 0.00 | 3.02 | 1.87 | 1.59 | 8.34 |
| | 1999 | 0.04 | 0.00 | 0.48 | 0.80 | 0.00 | 0.69 | 0.00 | 3.63 | 2.00 | 1.96 | 9.60 |
| | 2000 | 0.04 | 0.00 | 0.67 | 0.87 | 0.00 | 0.78 | 0.00 | 3.95 | 2.33 | 2.20 | 10.84 |
| | 2001 | 0.04 | 0.00 | 0.65 | 0.96 | 0.00 | 0.81 | 0.00 | 4.34 | 2.77 | 2.52 | 12.09 |
| | 2002 | 0.03 | 0.00 | 0.71 | 0.92 | 0.00 | 0.83 | 0.00 | 4.68 | 2.88 | 2.21 | 12.27 |
| | 2003 | 0.03 | 0.00 | 0.67 | 0.91 | 0.00 | 0.89 | 0.00 | 5.09 | 3.18 | 2.13 | 12.91 |
| | 2004 | 0.02 | 0.00 | 0.68 | 0.85 | 0.00 | 0.98 | 0.00 | 4.58 | 2.98 | 2.33 | 12.42 |
| | 2005 | 0.02 | 0.00 | 0.86 | 0.91 | 0.00 | 1.11 | 0.00 | 5.08 | 3.03 | 2.44 | 13.44 |
| | 2006 | 0.01 | 0.00 | 0.90 | 0.91 | 0.00 | 1.23 | 0.00 | 5.01 | 2.74 | 2.65 | 13.46 |
| | 2007 | 0.01 | 0.00 | 1.23 | 1.02 | 0.00 | 1.30 | 0.00 | 5.55 | 3.24 | 2.86 | 15.21 |
| | 2008 | 0.03 | 0.00 | 1.21 | 1.14 | 0.00 | 0.73 | 0.00 | 5.80 | 3.49 | 2.94 | 15.34 |
| | 2009 | 0.04 | 0.00 | 1.46 | 1.12 | 0.00 | 0.81 | 0.00 | 5.51 | 3.00 | 2.82 | 14.76 |
| | 2010 | 0.04 | 0.00 | 1.58 | 1.18 | 0.00 | 0.85 | 0.00 | 5.93 | 3.44 | 2.96 | 15.99 |
| | 2011 | 0.05 | 0.00 | 1.84 | 1.14 | 0.00 | 0.71 | 0.00 | 5.69 | 3.74 | 3.05 | 16.23 |
| MN: Prof Serv; Admin Serv | 1997 | 0.19 | 0.00 | 0.00 | 1.02 | 0.33 | 3.72 | 0.00 | 2.05 | 1.72 | 0.45 | 9.48 |
| | 1998 | 0.21 | 0.00 | 0.00 | 1.13 | 0.32 | 4.22 | 0.00 | 2.25 | 2.05 | 0.56 | 10.73 |
| | 1999 | 0.26 | 0.00 | 0.00 | 1.14 | 0.44 | 4.65 | 0.00 | 2.67 | 2.38 | 0.65 | 12.19 |
| | 2000 | 0.20 | 0.00 | 0.00 | 1.19 | 0.40 | 5.12 | 0.00 | 2.92 | 2.44 | 0.69 | 12.96 |
| | 2001 | 0.35 | 0.00 | 0.00 | 1.35 | 0.29 | 5.66 | 0.00 | 3.52 | 3.22 | 0.82 | 15.20 |
| | 2002 | 0.42 | 0.00 | 0.00 | 1.18 | 0.38 | 5.89 | 0.00 | 3.46 | 3.35 | 0.88 | 15.56 |
| | 2003 | 0.38 | 0.00 | 0.00 | 1.24 | 0.38 | 6.23 | 0.00 | 3.78 | 3.81 | 0.86 | 16.68 |
| | 2004 | 0.39 | 0.00 | 0.00 | 1.32 | 0.35 | 6.39 | 0.00 | 3.87 | 3.64 | 0.83 | 16.79 |
| | 2005 | 0.48 | 0.00 | 0.00 | 1.43 | 0.35 | 6.88 | 0.00 | 4.73 | 3.54 | 0.78 | 18.18 |
| | 2006 | 0.43 | 0.00 | 0.00 | 1.41 | 0.31 | 7.00 | 0.00 | 4.86 | 3.27 | 0.86 | 18.15 |
| | 2007 | 0.53 | 0.00 | 0.00 | 1.61 | 0.56 | 7.34 | 0.00 | 4.66 | 3.70 | 0.87 | 19.27 |
| | 2008 | 0.55 | 0.00 | 0.00 | 1.72 | 0.74 | 6.83 | 0.00 | 4.90 | 3.81 | 0.89 | 19.45 |
| | 2009 | 0.64 | 0.00 | 0.00 | 1.66 | 0.78 | 6.92 | 0.00 | 4.81 | 3.52 | 0.84 | 19.16 |
| | 2010 | 0.65 | 0.00 | 0.00 | 1.65 | 0.87 | 7.09 | 0.00 | 4.80 | 3.82 | 0.83 | 19.71 |
| | 2011 | 0.64 | 0.00 | 0.00 | 1.74 | 0.85 | 6.56 | 0.00 | 5.05 | 3.94 | 0.93 | 19.70 |

## Table A1.1: Intangible investment by asset, industry and year, Nominal £bns

| | | Investment (£bns) in: | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Industry (SIC07) | year | Scientific R&D | Mineral Exploration | Financial Product Innovation | Design | Non-scientific R&D | Training | Artistic Originals | Organisational Structure | Software | Branding | *Intangibles (Total)* |
| RST: Arts & Ent; Other | 1997 | 0.01 | 0.00 | 0.00 | 0.19 | 0.00 | 0.95 | 0.32 | 0.24 | 0.48 | 0.29 | 2.47 |
| | 1998 | 0.01 | 0.00 | 0.00 | 0.23 | 0.00 | 1.04 | 0.34 | 0.27 | 0.57 | 0.32 | 2.77 |
| | 1999 | 0.01 | 0.00 | 0.00 | 0.27 | 0.00 | 1.10 | 0.52 | 0.36 | 0.63 | 0.37 | 3.25 |
| | 2000 | 0.01 | 0.00 | 0.00 | 0.28 | 0.00 | 1.17 | 0.59 | 0.39 | 0.61 | 0.37 | 3.41 |
| | 2001 | 0.01 | 0.00 | 0.00 | 0.29 | 0.00 | 1.23 | 0.44 | 0.39 | 0.96 | 0.42 | 3.74 |
| | 2002 | 0.01 | 0.00 | 0.00 | 0.29 | 0.00 | 1.31 | 0.45 | 0.39 | 1.00 | 0.51 | 3.98 |
| | 2003 | 0.01 | 0.00 | 0.00 | 0.31 | 0.00 | 1.41 | 0.58 | 0.45 | 0.98 | 0.52 | 4.28 |
| | 2004 | 0.01 | 0.00 | 0.00 | 0.31 | 0.00 | 1.48 | 0.78 | 0.49 | 0.98 | 0.49 | 4.53 |
| | 2005 | 0.01 | 0.00 | 0.00 | 0.33 | 0.00 | 1.60 | 0.66 | 0.60 | 0.89 | 0.50 | 4.6 |
| | 2006 | 0.00 | 0.00 | 0.00 | 0.43 | 0.00 | 1.65 | 0.56 | 0.67 | 1.01 | 0.57 | 4.90 |
| | 2007 | 0.01 | 0.00 | 0.00 | 0.40 | 0.00 | 1.68 | 0.58 | 0.57 | 0.96 | 0.57 | 4.78 |
| | 2008 | 0.01 | 0.00 | 0.00 | 0.36 | 0.00 | 1.98 | 0.60 | 0.59 | 0.97 | 0.60 | 5.11 |
| | 2009 | 0.02 | 0.00 | 0.00 | 0.38 | 0.00 | 1.97 | 0.57 | 0.63 | 0.92 | 0.55 | 5.03 |
| | 2010 | 0.02 | 0.00 | 0.00 | 0.38 | 0.00 | 2.14 | 0.58 | 0.61 | 1.03 | 0.53 | 5.28 |
| | 2011 | 0.02 | 0.00 | 0.00 | 0.44 | 0.00 | 1.96 | 0.59 | 0.76 | 1.03 | 0.52 | 5.32 |

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