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ABSTRACT

How Much Does the UK Invest in Intangible Assets?*

We attempt to replicate for the UK the Corrado, Hulten and Sichel (2005, 2006) work on spending on intangible assets in the US. Their work suggests private sector expenditure (investment) on intangibles is about 13% (11%) of US GDP 1998-2000, with intangible investment about equal to tangible capital investment. Our work, using a similar method, suggests the UK private sector spent, in 2004, about £127bn on intangibles, which is about 11% of UK GDP. The implied investment figure is around £116bn (10% of GDP) which is about equal to UK investment in tangible assets. Of the £127bn expenditure, (in round numbers) about 15% is spent on software, about 10% on scientific R&D, almost 20% on non-scientific R&D (design, product development etc.), about 14% on branding, about 20% on training and the rest on organisational capital.

JEL Classification: E1, E22 and O47
Keywords: intangible assets, investment, organisational capital, r&d and training

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1 Introduction

In an important series of recent papers various US authors have attempted to estimate investment in intangible assets for the US. As they argue, statistical agencies (and company accountants) have maintained a good deal of effort into measuring *tangible* asset investment, mostly physical capital, and incorporating them into the National Accounts (and company accounts). Caution is generally argued in the case of *intangible* assets, mainly due to the uncertainty in their measurement. At the same time however, the structure of economies is generally felt to be moving towards "knowledge economy" activities, where intangible assets (information, advice, know-how) are increasingly important.

Corrado, Hulten and Sichel (CHS) (2005, 2006)[1] group intangible assets under three main headings which resonate with many of the activities that advanced economies seem increasingly to do:

1. computerised information (software, computerised databases)
2. innovative property (scientific R&D, non-scientific R&D, design)
3. economic competencies (brand equity, firm-specific human capital and organisational capital).

They use various surveys to try to estimate the expenditure on such assets in various time periods, convert this to investment expenditures, build an intangible asset stock and thereby examine the contribution of intangible assets to US growth.

The aim of this current paper is more modest: it is to use as similar a method as possible to CHS to estimate expenditures and investment in intangibles using UK data for 2004 (future work will look at previous years). We believe this to be of interest in a number of regards. First, we think it of interest to evaluate UK intangible investment and compare it with UK tangible investment for all the reasons that CHS discuss. Second, we think it methodologically informative to use the same method as CHS to compare results across the UK and US. Of course, the economies are not comparable in all regards but we think it would call the method into question if, for example, the UK were to have vastly different intangible asset investment relative to the US. Third, we do use some surveys to attempt to improve and/or confirm some of the assumptions that CHS use.

Our major findings are as follows. First, we estimate investment in intangibles in 2004 in the UK to be around £116bn, which is 104% of existing business investment and around 10% of GDP. This is a considerable number. Third, comparing with the US, we find that expenditure on intangibles in 2004 is about 11% of GDP compared with 13% of US GDP obtained by CHS in 1998-2000.

The plan of this paper is as follows. After a summary in section 2, the next three sections describe data on the three CHS categories. The main issues here are, for quantifiable spending on assets such as

[1] We highlight CHS here since we use their method, but as they acknowledge, their work builds on work by Nakamura (1999, 2001, 2003); Brynjolffson and Yang (1999); Brynjolffson, Hitt, and Yang (2000); McGratten and Prescott (2000)

software, to try to estimate bought-in expenditure, which is usually available if a survey of purchases is in operation, and also own-account spending, which is usually harder to measure without a particular survey. For more difficult-to-measure spending, such as that on managerial competencies, other approaches must be used. In section 6 we describe other data and in section 7 the relation between these expenditures and investment. Section 8 concludes.

2 Overall summary of sources and method

The basic CHS method is set out in Table 1. They group intangible investment under three major headings, as shown in the table, with sub-headings set out as well.[2] Column 2 shows the sources they use to estimate expenditures, which are a mix of National Accounts, of official surveys and estimates from other sources. Column 3 shows our sources as well; where possible we use as similar as possible sources to CHS. As we explain below, most of our sources and surveys match the CHS sources quite closely.

3 Expenditure on computerised information

As Table 1 shows, CHS group this under the headings (a) computer software, consisting in turn of purchased and own-account software, and (b) the value of computerised databases.

3.1 Computer software

The CHS data source is the US National Income and Product Accounts (NIPA), column 2. As column 3 shows, our source is the work already carried out by the UK Office for National Statistics (ONS), described in Chamberlain, Chesson, Clayton and Farooqui (CCCF, 2006)). In CCCF the estimates for purchased software are based on data from three company investment surveys. For own-account spending, estimates are based on the earnings of workers in computer software occupations.

To measure purchases of software, there are three different UK investment surveys that report software purchases all using however, slightly different definitions. Thus CCCF combined all three and in the case of overlaps used the Annual Business Inquiry (ABI, the main UK business survey). Adjustments were also made for non- or low coverage of banking and insurance and the public sector.[3]

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[2] These headings seem to fit well with other estimates of intangibles from competition inquiries, see Appendix 1.

[3] The software questions are as follows. First, on the business spending on capital items survey (BSCI), the question is "*a) Value of Computer Software (include software licences and all capitalised items of computer software consultancy/supply whether bought in or produced on own-account).*" On the Quarterly Inquiry into Capital Expenditure (QICE) the question is *"4. Computer Software. Include all expenditure on computer software to be used for more than one year. This includes the purchase or development of large databases and license payments for the use of software. Software produced foe own use should be valued a production cost included only if its useful life is at least one year. If software and hardware are purchased together and the components cannot be separated, record the purchase under section 4.2 (hardware)."* Finally, the ABI question is *"(iii) Total amount for investment in acquired computer software (including network ware, large databases, specialist packages, word processing or spreadsheet packages), (iv) Total net value of finished work of a capital nature carried out by your own staff*

As regards own-account spending, CCCF chose the occupations of ICT managers, IT strategy and planning professionals, software professionals, IT operations technicians, user-support technicians, database assistants/clerks and computer engineers, installation and maintenance. They calculated their numbers and wages, upwards adjusted the numbers to reflect full costs of employing such staff and then downward adjusted them to reflect the fractions of time spent on development versus maintenance[4]. A final adjustment is made to reflect possible sales to other firms (which would imply double counting).Table 2 sets out the results obtained in the CCCF work. Estimated expenditure by the business sector in 2003 (the latest year available) was £7.5bn on purchased software and £12.4bn own-account spending, a total of £19.8bn (figures here and below may not add exactly due to rounding).

3.2 Computerised databases

CHS also add to computerised information the value of computerised databases, using subscription revenue of the "database and directory publishing industry". The equivalent industries in the UK are SIC72.3 "Data processing" which includes "processing of data, data entry, data scanning, web hosting" and SIC72.4 "Database activities" which includes "on-line database publishing, on-line directory publishing, web search portals". However, two of the three computer purchase surveys (the QICE and ABI) asked firms to include database spending as part of software spending (e.g. on the QICE the question includes "…the purchase or development of large databases"). Similarly, the own-account data includes spending on "database assistants/clerks". Thus to be conservative, we have excluded spending on the database industry since some of the expenditure will already be included in the ONS software numbers and we want to avoid double counting.[5]

3.3 Total and comparison with the US

All this leads to a total of £19.8bn, for software and databases. Table 2, column 2 shows this as a fraction of all intangible investment: it is about 15% of it. Column 3 shows as a fraction of UK GDP, giving a figure of 1.70% of GDP. To compare this with the US, column 5 shows the US expenditure as a fraction of all intangible assets and column 6 as a fraction of US GDP. The CHS figure is, interestingly, for software plus databases, 1.65% of GDP.

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produced for own use. If this value is more than half of total acquisitions, please give an explanation for this at section 11 (v) Of which, computer software developed by your own staff to be used for more than one year."

[4] From a time-use survey of software professionals.

[5] The UK numbers are quite considerable: in 2004, in SCI72.3 and 72.4, turnover is 6.28bn, value added is £3.74bn and employment 65,000.

4 Expenditure on scientific and creative property

This is the second main area of intangible expenditure used by CHS. They break this expenditure on scientific and creative property into the following, see also Table 1:

1. scientific R&D, typically leading to a patent or license, usually captured in R&D surveys
2. mineral exploration
3. copyright and license costs (spending for the development of artistic originals, usually leading to a copyright or licence)
4. other product development, design and research expenses (not necessarily leading to a patent or copyright), attempting to cover
    i. product development in the financial services industry
    ii. new architectural and engineering designs and
    iii. R&D in the social sciences and humanities.

4.1 Science and engineering R&D

R&D expenditure data in the UK is derived from the Business Enterprise R&D survey (BERD) which is the UK R&D survey conforming to international standards set out in the Frascati Manual. The Frascati manual defines R&D as 'creative work undertaken on a systematic basis in order to increase the stock of knowledge, including the knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications'. This definition is included in the ONS notes on completing the BERD form. It gives additional guidance to those businesses filling out the form, stating, '*that the guiding line to distinguish R&D activity from non-research activity is the presence or absence of an appreciable element of novelty or innovation. If activity departs from routine and breaks new ground it should be included: if it follows an established pattern it should be excluded'*. Companies are asked to ***exclude*** (bold italics on the form) "*a. Routine testing and analysis of all kinds, whether for control of materials, components or products, and whether for control of quantity or quality. (Testing and analysis as part of an R&D programme should be included.) b. Market research, operational research, work study, cost analysis, management science, surveying, "trouble-shooting". c. Royalties payments for the use of the results of research and development unless required as an essential part of the research and development programme within the unit. d. Trial production runs where the primary objective is not further improvement of the product. e. Design costs to meet changes of fashion and artistic design work. f. Legal and administrative work in connection with patent applications, records and litigation; work involved in the sale of patents and licensing arrangements; experimental work performed solely for the purpose of patent litigation.*"

Thus, as is well acknowledged, it is likely that most R&D reported is of a scientific nature and that items such as design; market research etc. will not be counted here. In addition BERD forms are sent out to firms who answered that they did R&D when asked on the Annual Business Inquiry, with the survey boosted by other firms who are detected as performing R&D by other means (see ONS, 2006, p.5). Since

financial services are not covered on the ABI the accuracy of the R&D sampling of this sector depends heavily on these other means. All surveyed companies are asked for estimates of intramural R&D (including both current and capital expenditure), buying of R&D (work conducted outside the company, funded by the business) and average employment on R&D (number of full time equivalents).[6]

When using expenditure on intra and extra mural R&D we were particularly concerned with double counting with software investment. Firms in the computer industry are told the following on the R&D form. *"For software development to be classified as R&D, its aim must include the resolution of scientific or technological uncertainty on a systematic basis. Routine software development is not R&D. The use of software for a new application or purpose does not by itself constitute R&D; the application must be significantly different and resolve uncertainties of general relevance. Software development within an R&D project should be classified to the product sold by your company that makes use of the software in its manufacture or within the product itself. For example work on software to be used within a motor vehicle engine would be allocated to the motor vehicle product group. Software which is developed and sold as software for direct use by customers, should be allocated to product group AE "computer and related services.*"

We therefore decided to subtract R&D spending in the "computer and related activities" industry (£1.11bn according to the R&D survey) from the overall R&D spending figure to avoid double-counting with the software figures. This is an appreciable fraction of the total spending (£1.11bn is the expenditure in the industry out of £13.5bn total expenditure) but we do to be conservative.[7]

At the current stage we have included both current and capital expenditure on R&D as recorded in the BERD survey. This does produce some potential double counting as expenditure on tangible capital (plant and machinery, buildings etc.) for use in R&D will already be included as part of business investment. The ONS is currently working on a Eurostat project to assess the practical and methodological issues involved in capitalising R&D in National Accounts. In the future the estimates produced as part of this work will be used. The double count may not be large as R&D investment (Gross fixed capital formation to use National Accounts terminology) will be made up of current expenditure on R&D plus some estimated return on the tangible capital used. The estimated return is essentially an estimate of the input of the tangible capital used in the R&D process to the R&D capital stock.

Looking at Table 2, this gives £12.4bn R&D spending, which is about 1.1 % of GDP. CHS find a total of 1.98% of GDP. A number of points are worth making regarding this comparison. First, it is well-documented that the UK has lower R&D expenditure than the US so we are not surprised about the smaller UK figure (see e.g. Abramovsky, Griffith and Harrison, 2005).

Second, are the numbers comparable? The US included expenditures are restricted to activities related to "persons trained, either formally or by experience, in the physical sciences, the biological

[6] Larger firms are sent a longer form with more questions.

sciences, and engineering and computer science (but excluding geophysical, geological, artificial intelligence, and expert systems research.". As CHS say, "the NSF's industrial R&D data mainly captures inventive activity by industries that employ these types of workers, hightech, pharmaceutical and other manufacturers, software publishers, telecommunications service providers, and the like." Looking at the UK data (R&D in UK businesses MA14), of the £13.5bn of total expenditure, £3.2bn is in pharmaceuticals, £2bn in aerospace, £1.1bn in computers and related, £1.0bn in machinery and equipment and £0.6bn in posts and telecoms. Thus the surveys should be reasonably compatible. Finally, the US Survey explicitly asks firms not to report on software and so we think that excluding software from the UK survey helps comparability.

4.2 Mineral exploration

For mineral exploration, CHS say they try to capture R&D in the mining industries, using data on mineral exploration from the Census of Mineral Industries and output of the surveying and mapping industries. In the UK, the R&D survey covers the minerals industry. What we wish to capture here is expenditure on e.g. prospecting for new oil wells in the expectation of future returns (as opposed to expenditure on drilling that is part of expenditure to extract current reserves). National accounts data suggest £0.4bn is spent under this heading. As Table 2 shows, this number is small in overall spending and a bit less than that in the US.

4.3 Copyright and license costs

For copyright and license costs CHS wish to use development costs in motion pictures, radio, TV, sound recording and book publishing. In their study, all the latter groups, given the lack of data, are estimated as twice the new product development costs of the motion picture industry, with these development costs estimated using data from the Motion Picture Association of America. The data we use is taken directly from the UK National Accounts. The investment data in UK National Accounts currently relates to TV and radio, publishing and music industries and so may not cover as wider definition as the envisaged by CHS (although these are probably the main industries with the kind of expenditure we are interested in).[8] The estimate of spending from this source is £2.4bn in 2004. Like Mineral Exploration, as Table 2 shows this number is small in overall spending and a bit less than that in the US.

4.4 Other product development, design and research expenses

CHS attempt to cover here (a) product development in the financial services industry (b) new architectural and engineering designs and (c) R&D in the social sciences and humanities.

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7 We were also concerned about extractive industries, which are treated separately in CHS. Extractive industries R&D is reported as £111m (ONS, 2006, Table 4). However, mineral investment is also reported in the national accounts but we at currently unclear whether this is an overlap. Both are included pending clarification of this point.
[8] We are investigating further the precise source of these numbers.

Regarding (a), CHS measure new product development in financial services as 20% of total intermediate spending by the financial services industry. One problem is that intermediate spending includes the purchase of advertising, software, consulting services and architectural and engineering activities which is counted elsewhere in the spending calculations. Therefore, we subtracted these purchases amount (using the Input Output tables, about £11bn from total intermediate spending of £51bn=£40bn). We then take 20% of this adjusted amount, giving a figure of £8bn (£10bn without the adjustment).

Regarding (b) CHS use 50% of the total turnover of this sector. We too used data from the SIC742 sector whose biggest categories are "Architectural Activities" and "Engineering Design Activities for Industrial Processes and Products". As in financial services, we subtract off purchases of advertising , software and consulting services before applying the 50% figure, giving a final figure of £14bn (£15bn without the adjustment).

Finally, (c) is estimated as twice the turnover of R&D in the SIC732 "Social Sciences and Humanities", with the doubling being assumed to capture own-account spending. This gives a final figure of £0.4bn.

How do these data compare with CHS? Looking at Table 2, spending on design is a bit higher and on social science a bit lower. Spending by financial services is slightly lower than in the US. The overall data for expenditure on innovative property in the US is 4.57% of GDP in 1998-2000. Our numbers, are 3.23% (they would be 3.60% without subtracting off intermediate spending and including the computer industry in the R&D figures). These compare closely with what CHS use which is reassuring. We explore below some more detailed information and checks on these numbers.

5 Expenditure on economic competencies

5.1 Expenditure on brand equity

5.1.1 Advertising

Advertising and brand spending is presumably divided between own-account spending and purchased. We have data on purchases of advertising by all firms (from the ABI) which we can compare with reported turnover of the advertising industry (also from the ABI). However, both are likely to exclude own-account spending. Therefore we also collected data on spending by according to various media (TV, radio, newspapers and magazines etc.). We would expect this third figure to be higher than the former.[9]

First, to measure final spending in various media we used data from the Advertising Association (AA). This measures advertising in newspapers and other media and should capture therefore purchased

[9] Another issue is of course the extent to which advertising expenditure is an investment. Here we just look at measuring expenditures..

and own-account. Their headings are Press (Newspapers and Magazines), TV, Radio, Direct Mail, Internet, Outdoor Transport and Cinema. The data are collected by quite extensive surveys of the industry: national and regional press, consumer, business and professional magazines, radio and TV, cinema and internet. The total spending for 2004 is £18bn.

Second, we used two sources for purchased advertising. We used the ABI turnover of around 3,000 firms in the Advertising Industry (SIC74.4, SIC2003). These data are collected as part of the usual ABI process and survey all large firms and a stratified sample of small firms. In the ABI total turnover consists of commissions and fees charged. This gives a total spend of around £17.8bn for the advertising industry. The other data source is data on advertising spend of all firms. This is also from the ABI, which asks all firms in all surveyed industries to report expenditure on "purchases of advertising and market services". The total is £14.4bn just under the turnover figure above.

A number of points are worth making. The first relate to sector coverage. The AA numbers and the ABI (advertising industry turnover) include public sector advertising. The ABI (total expenditure by all companies on advertising) would only cover the private sector, but excludes financial services. Thus the AA and ABI advertising industry data will overstate private spending on advertising. The second is that the design of the ABI question (total expenditure by all companies on advertising) means that firm will just record purchases of advertising and marketing services and not own-account.[10] Thus we would expect the AA numbers to be greater than the ABI numbers, since they include public sector and own-account. In fact they are not: the AA and ABI advertising industry numbers are similar, whereas the ABI advertising purchases numbers are less. For the moment, we have therefore stuck with the AA numbers.

Third, the question of what part of advertising expenditure is consumed and what is building an asset is a difficult one. An advertisement proclaiming the reliability of a good would seem, at least in part, to be expenditure on an asset. An advertisement proclaiming a price reduction for the next two weeks would seem to be better thought of as an intermediate spending, although if it is building a reputation for low prices that would be an asset. One class of advertising expenditures however are unlikely to be asset building, namely spending on "small" personal ads by individuals or recruiting advertisements for vacancies to be filled in a relatively short time period. The Advertising Association told us that £4bn of expenditure was "classified" advertising (i.e. small advertisements appearing at the end of newspapers typically for small items of sale or vacancies). Thus we subtracted this quantity from the total (we could have included it and adjusted assumed depreciation rates, but we preferred this method here). This gave our final total of £14bn on advertising, around 1.2% of GDP.

How does this compare with the US? The US shows data of about 2.33%of GDP, whereas our numbers are 1.20%, see Table 2. Examination of the US and UK data revealed the following possible

[10] The specific instructions are as follows. Firms are to give "Amounts Payable For Advertising And Marketing Services". These include payments for advertising or marketing campaigns, including payments for television or radio media time, newspaper or billboard space; payments for market research and public relations activities carried out by a third party". But they exclude "market research and public relations activities carried out by your own staff.". This suggests that own-account advertising is excluded.

causes of difference. First, as above, we have subtracted classified advertising from our data, CHS subtract off local advertising in their work as a similar adjustment. Second, we compared the disaggregated spending headings from the AA survey with that of the US source, Universal McCann. As a proportion of total spend the US spending on press is much lower in the UK, TV about the same, but direct mail much higher. In addition the US spend on "miscellaneous" is higher as well (14% of total US spend in the Universal McCann data, 6.4% in the UK). This group is not well defined but includes outdoor transport and cinema.[11]

5.1.2 Market Research

We take, like CHS, turnover of firms in the "market research" industry (SIC74.13), which is about £2.3bn, and double it to include own-account spending. As a percentage of GDP this gives 0.39%, compared with 0.20% in the US.

5.2 Firm-specific human capital: expenditure on employer-provided training

Most UK training surveys, or subsections of surveys on training, are either yes/no surveys of whether the respondent received training, or surveys of skill shortages and hard to fill vacancies. But collecting data on cost of employer-provided training is more complicated since the cost of employer provided training is not only the costs of providing training (whether it be on courses or by other employees) but also the opportunity costs of worker's time whilst undergoing training. Thus here we discuss what surveys are available in the UK, how consistent they are and how they compare with US studies.

The UK surveys on employer-provided training are the National Employer Skills Survey, 2005 (NESS2005), the Learning and Training at Work Survey (2000) and the Community Vocational Training Survey (CVTS, various years). The LTS and NESS obtain training expenditure in two stages: first they survey a large number of firms to see if they are training or not and second, they survey the firms who say they are training in more detail on their training costs. The US data is the Survey of Employer Provided Training carried out in 1995 (SEPT95) by the BLS.

The surveys are described in Table 3. Consider for example the LTW survey (see e.g. LTW, 2000, p.131; the NESS 2005 source book is not currently published). The LTW survey consisted of 4,001 initial telephone interviews with employers, public and private, with 10+employees at the location. All sectors were covered including public and private and the response rate was 66%. To collect data on training costs, a datasheet was sent to providers who stated they had provided training over the last 12 months. 883 usable replies were provided, a response rate of 24%. Results were then grossed up to be representative of employers in England with 10 or more employees.

[11] The US headings are Press, including production costs, TV, Radio, Yellow Pages, Direct Mail, Internet and Miscellaneous.

The LTW Costs of Training Supplement collected data on two types of training, on and off the job. For on-the-job training, the questionnaire asks the number of employees receiving and employees providing such training a typical month in the last 12 months. Each firm is then asked the hours per month each employee spends receiving (providing) on training, the typical annual salary of those employees receiving (providing) training. On the assumption that such periods of time take away from current production and build future competencies, this enables a calculation of the costs of such training incurred by the employer on both the recipient's and provider's time.

For off-the-job training, firms were asked for data on the number of employees attending external courses, the direct cost of doing so and the opportunity cost of employee's time (calculated as the time spent doing on these courses times the hourly wage of employees spending such time). In addition, firms were asked to provide information on the costs of in-house training centres and costs of travel to such centres.

As Table 3 shows relative to other surveys, the NESS2005 is similar in conception to the LTW, but is applied to a larger sample and also asks for data for all firm sizes. The CVTS is a survey carried out by Eurostat and we have here data for the 1993 survey. The major difference is that this survey asks firms to exclude expenditure on initial start up training and practising skills on the job.

The row at the bottom of Table 3 show the raw totals. The NESS05 raw total is £33bn, the LTW is £23bn, the CVTS £10.6bn (spending in 1993) and the SEPT $53.6bn. The rows beneath show various adjustments we have made. In the first row we convert the LTW data to all firm data using the ratio of training spending in small firms to larger firms, from the NESS survey that included all firm types. The second row subtracts off the public sector. The final row converts England data to UK data for the NESS05 and the LTW (by multiplying by the ratio of UK to English workforce receiving any training[12]). The final row of shows the adjusted data. Note that the CVTS survey shows a much smaller number, which is consistent with the narrower definition of training that is used.

Returning to Table 1 we show the NES2005 to get the expenditure numbers for 2004. The total is £28bn which is more than software and, if it can be thought of as employer "R&D" in individuals, more than formal R&D but about 2/3rds total expenditure on "innovative property". Note too that the direct firm expenses are about equal to the opportunity cost of employees' time, emphasising how important it is to measure both.[13]

How do these numbers compare with the US? As Table 2 shows US have lower expenditure on training overall and a much lower share spend on direct-firm expenses relative to wage and salary costs. Since this is a case where the UK survey seems to show higher results than the US, we shall study this in a little detail. Precise details are in appendix 1.

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[12] These data come from the Labour Force Survey which has asked various training questions at various times, but nothing on expenditure.

[13] This split is in fact only available for public and private expenditure combined, so the split in this table is the same ratio applied to the private sector spending only.

First, OECD (2003) set out some cross-country evidence on employer provided or sponsored training using two main cross country data sets, the IALS and the CVTS. The IALS data asks workers to self-report training or education in the 12 months prior to the survey and the OCED use that deemed as training provided by employers or partially paid for. (The CVTS ask employers to report employer sponsored training. It excludes formal education and training related to induction, but it does not cover the US). According the IALS, the fraction of employed persons participating in employer-training is 0.45 in the UK and 0.35 in the US in 1994 and the annual hours per employed person are 30 and 22 respectively. Thus on this data set, the incidence of employer-provided training is greater in the UK[14]

Second, the SEPT survey is of firms above 50 employees. According to the LTW and NESS, the firms of above 50 employees account for 44% of all training, which would make the US data too low.[15]

Third, the SEPT95 excludes payments on equipment, supplies, space and travel for training. These data are specifically asked for in the NESS2005 and are £3.45bn (both public and private) i.e. a 12% of expenditure excluding them (3.45/(33.33-3.45)). If they were to be included in the US figures in the same proportion, this would raise the US figures.

Finally, these data on training refer to expenditures by firms in building assets once the worker has been hired (all questions on the LTW for example refer to expenditures on employees). However, one might argue that firms also make investments in advance of workers being hired e.g. by paying a recruitment consultancy to help find a better quality worker, having pre-employment aptitude tests etc. Of course, this pre-hiring expenditure might depreciate quickly if the worker does not stay long or is not hired at all for example. Nonetheless, it seems worth asking if some sort of estimate of their effects can be made and if these might be counted as building an intangible asset. Since CHS do not do this then we do not include these data in our work here, but give a possible estimate and discussion in Appendix 2.

5.3 Expenditure on organisational structure

Organisational capital refers to the body of knowledge in a firm enabling it to combine conventional factors of production in the production process. Team-working or quality circles are examples of organisational arrangements designed to try to boost organisational capital. Incentive pay and deferred compensation schemes are examples of incentive mechanisms designed to boost organisational capital. Micro evidence suggests that firms adopting such measures also have increased productivity and market value although the direction of causation is disputed. The measurement question is how to capture this level of capital, or the expenditure associated with investments into it. In some ways this mirrors the measurement problem of establishing a volume of R&D knowledge capital from observed expenditures on R&D. An important problem here however is that expenditures on investment in organisational capital are

[14] Acemoglu and Pischke (1999) note more employer provided training in the EU is consistent with their theories of training in imperfect labour markets, whereby firms are more likely to provide general training if they can appropriate the returns from doing so, which in turn is easier with a more compressed wage spread.

unobserved. Thus CHS suggest two ways to capture external and own-account spending. External spending is captured by expenditure on management consultant activities. Own account spending is assumed to be a fraction of executive time (10% to 33%, with a central estimate of 20%). A number of comments are worth making.

First, regarding expenditure on management consultants, at least some of it might not be investment in the sense that it might be on short-term problems (e.g. closing down a business, discharging an employee). We are currently consulting with the UK Management Consulting Association about using their managerial time-use data to try to measure this.

Second, regarding own-account spending, the numbers are clearly highly dependent, as CHS, acknowledge, on the assumed fraction of time spent on organisational matters. We shall use their assumptions in our work here. Third, some consulting might be on IT related activities. This might then overlap with software investment if purchases of software are bundled with purchases of consulting services. Alternatively, it might be simply be a reflection of the empirical finding that IT requires organisational change.

Regarding UK data sources, we follow CHS and try to build data for purchased capabilities and own-account spending. The purchased capabilities are derived from an annual survey from the UK Management Consulting Association (MCA) of 64 firms in the UK consulting industry, employing 59,000 people. They estimate their members are 70%of the industry and put their members fee income, in 2004, at £6.5bn, giving an estimated industry turnover of £10.1bn. MCA data provides output for the firms they surveyed and a public/private sector split for the source of spending We calculated the ratio of private/total and then we applied this ratio to the MCA estimates for the whole industry to obtain private sector spending on consultancy activties.

How much of such expenditure is investment? This is a difficult question, but as a first step we looked at the MCA fee income by various categories. IT-related consultancy (systems development, IT consulting on activities such as IT strategy, technical architecture and supplier selection) accounted for 21% of total fee income from UK clients (£7.6bn, these and the following figures in this paragraph are for 2005). Outsourcing-related consulting accounted for 37% of the total (consulting around the outsourcing deal, typically supplier selection, contract negotiation and change management). Fees for delivering a managed service accounted for 41% of the total, consisting of programme/project management (11%), human resources (10%), strategy (5%), business process re-engineering (5%) operations (5%), financial (3%) and change management (1%). It might be that some of these expenditures double count with investment or are devoted to activities too short-lived to be asset-building, but for the moment we left them as they are.

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[15] The NESS2005 and LTW gives a size breakdown that straddles size 50 i.e. class 25-99. Thus the ratio of above-25 is 58%. Assuming half of training expenditure is allocated within the 25-99 category gives the ratio of size 50 and above of 44% as quoted. See Appendix 1.

We cross checked these data with value added from the ABI for the SIC7414 industry "Business and management consultancy activities", with further description of each industry "provision of advice, guidance or operational assistance to businesses and the public sector". The subdivisions are "public relations activities, financial management, general management consulting activities and miscellaneous business and management consultancy activities". We were concerned that public relations might overlap with advertising, so we excluded it from the industry value added.[16] This gave a figure of £12bn (£19.4bn for turnover), close to the MCA total.[17]

The own-account spending in CHS is derived from the value of an assumed fraction of senior executive time. To calculate this we used the ASHE (Annual Survey of Hours and Earnings), the most complete survey of earnings in the UK, to estimate the wage bill of salaries of senior managers in the private sector.[18] We then multiplied this product by 0.20 on the assumption, following CHS, that 20% of time is spent on organisation building activities. Note that we have excluded, from the list of managers, "ICT managers" since they were accounted for in software. All this gave a total wage bill of £76.5bn, 20% of which was £15.3bn.

How does all this compare with the US? We then obtain total spending on organisational structure as 1.92% of GDP (or 2.12% if we included ICT managers) which compares with 3.13% for CHS. Thus expenditure is less in the UK which is consistent with poorer investment suggested by micro-comparisons of management. Note the ratio of purchased to own-account is, in the US 38%, and 45% for the UK which is reassuring.

6 Using other data sets to cross-check results

6.1 The Community Innovation Survey

In the data above we have tried to cross check results using, for example, industry surveys and official industry data. However, the UK is one of the European countries that runs an innovation survey, the *Community Innovation Survey* (CIS). This asks firms for data on innovation outputs and innovation expenditures, including spending on R&D, design and marketing. The essential problem with this survey is that whilst overall response rates, at 43% (CIS Wave 3, Mercer, 2004) and 58% (CIS Wave 4, DTI, p.60) are quite high, non-response to the expenditure questions is the worst of all questions at 41% (for

[16] We were told that large management consultants often subcontract to smaller ones in the same industry. Using value added should help get over this at the cost of subtracting out other spending however.

[17] A separate industry, SIC74.15 "Management Activities of Holding Companies" has a turnover (value added) of £3.4bn (£1.0bn) and employment of 56,000. This industry consists of, for example, head offices of large companies. We did not include this industry for the moment.

[18] An alternative method is to use employment numbers from the LFS. The numbers in the case of managers are very similar in fact (numbers for low pay occupations typically do not match due to dramatic differences in sampling). Note we are considering employed managers only here, we omit self-employed. Whilst the self-employed are presumably all managers and presumably spend some fraction of their time building future assets it is not clear they are building organisational capital in the way that employed managers are.

CIS3, Mercer, 2004, Chart 1, data for CIS4 not currently available). Thus these data are generally viewed as not being reliable enough to replace other surveys, see the Appendix for more discussion.

6.2 The Design Council Survey

The Design Council (2006) carried out their own a survey consisting of 2,433 telephone interviews of design companies.[19] Interestingly for our work here, they surveyed both design companies (from whom design services would be purchased) but also in-house design teams (to get an idea of own-account design efforts). Their sample included designers in communications (graphics, brand, print, information, corporate identity), product and industrial design, interior and exhibition design, fashion and textiles design, digital and multimedia design (website, animation, file and TV indents, digital design and interaction design) and other (advertising, aerospace design, building, engineering design, etc.). For our purpose an important finding is that 50% of total design industry turnover was bought in services and 50% own-account.

Consider the CHS assumption that 50% of industry turnover is investment expenditure. If 50% of expenditure on design is bought in, this suggests that total design expenditure should be twice purchased services. Thus using 50% of measured turnover implies we are assuming that 25% of all design expenditure is investment.

6.3 Spending on ICT and organisational change

Brynjolfsson, Hitt and Yang (2002) and Brynjolfsson and Hitt (2003) have examined the relation between computer investment and investment in organisational change. As they suggest "Whereas early applications of computers were primarily directed at factor substitution (particularly of low-skilled clerical workers) modern uses of computers have both enabled and necessitated substantial organizational redesign and changes in the skill mix of employees….To realize the potential benefits of computerization, investments in additional "assets" such as new organizational processes and structures, worker knowledge and redesigned monitoring, reporting and incentive systems may be needed". (Brynjolfsson, Hitt and Yang, 2002, p.138).

This provides a possible cross-check with our numbers. In Brynjolfsson, Hitt and Yang (2002), table 1 and 2, they show that a dollar of company computer asset value is associated with around $10 of company market value. This leads them suggest that "…complementary investments in "organizational capital" may be up to 10 times as large as the direct investments in computers". How does this relate to data provided here? ONS data on total private sector computer hardware investment is around £7bn in 2004 (ONS, 2006). The estimates here of investment in organisational capital are £27bn, about 4 times

[19] We are investigating the precise way their sample was drawn. Note the Department of Culture Media and Sport (DCMS) produces the DCMS Creative Industries Economic Estimates Statistical Bulletin. This relies on data from the ONS and a study by the Design Council. The ONS data are industry data value added where the DCMS has specified industries that it treats as design industries. Their list is quite broad and includes for example design, software writing, fashion and some textile manufacturing industries.

the investment hardware, well within the 10 to 1 ratio. Note however that the survey of organisational practices used in Brynjolfsson, Hitt and Yang (2002) and Brynjolfsson and Hitt (2003) from which they try to proxy organisational capital (which is also correlated with market values) includes training (and also team management, decentralised control).[20] Adding the training figures (£28bn) to our figure of organisational investment gives a total of £55bn, which is about 8 times hardware investment, still below the 10 times figure. This suggests our spending on organisational change is in line with this yardstick.

7 Expenditure and investment

As CHS point out, by no means all this expenditure is necessarily investment. National accounts conventions usually treat as an investment an expenditure producing a benefit for more than one year, but these conventions can vary. We follow the CHS assumptions by assuming that 60% of measured expenditures on advertising are investments, 80% of own-account organisational structure expenditure and 100% of other types (such as software, R&D and training). This means that our expenditure of £126.7bn translates into investment of £116.3bn, which is 10% of GDP. Conventionally measured investment in 2004 is £111.8bn, of which £14.7bn is software, mineral exploration, copyright and licence costs and hence included in our intangible investment data. Therefore total investment on intangibles not already included in measured business investment is £101.6bn, about almost as much as traditionally measured investment. A similar result is obtained in the US.

8 Conclusion

We have attempted to replicate the CHS work for the UK. Our work suggests that, in comparison with their intangible investment of 11.7% of US GDP in 1998-2000, the UK invests, in 2004, 10% of UK GDP in intangibles, which is approximately as much as investment on tangible assets. This is very much an exploratory figure but suggestive, we think, that the method has merit and that developing numbers for other years should be possible. It also outlines how important intangible investment could be for understanding growth in the UK economy and possibly the well documented productivity gap with the US. We aim to take this up in future work.

[20] The questionnaire is at <http://opim-sun.wharton.upenn.edu/~lhitt/survey.pdf>. The training questions are "Does your firm cross-train workers?" and "What percentage of production workers received any work-related training off-the-job during the last 12 months? ("Off-the-job" training includes classroom training, or courses or seminars apart from regular work activities.)" and "How important is educational background when conducting pre-employment screens for new production workers?

Table 1: Overall classification and methods, US and UK

	CHS method and data sources	Currrent paper method and data sources
(1)	(2)	(3)
Computerized information		
Computer software	Based on NIPA data on three components: own use, purchased, and custom software.	ONS estimates , same method
Computerized databases	Own use captured in NIPA software measures. Purchased component estimated from Services Annula Survey (SAS)	Included in our software estimates, see text
Innovative property		
Scientific R&D	Mainly R& D in m anufacturing, software publishing, and telecom industries. Census on behalf of the National Science Foundation (NSF)	Current expenditure on R&D from BERD. R&D in computer industry subtracted
Mineral exploration	NIPA	National Accounts
Copyright and license costs	Mainly R& D in mining industries. A) Mineral exploration, Census of Mineral Industries and NIPAs. B) Other geophysical and geological exploration R &D in mining industries, estimated from Census data	National Accounts
Other product development, design and research		
New product development costs in the financial industry	No broad statistical information. Estimated as 20 percent of intermediate purchases by the Financial Services industry	20% of all intermediate purchase by Financial Services industry, ONS data. Intermediate purchases reduced by purchases of adv, software, consulting and design.
New architectural and engineering designs	No broad statistical information. Estimated as half of all US industry purchased services, estimated in turn as half of revenues of the architectural and design industry	Estimated as half of the total turnover of the architecture and design industry SIC 742, ABI data. Turnover reduced by purchases of adv, software, consulting.
R&D in social science and humanities	No broad statistical information. Estimated as twice industry revenues of social science and humanities R&D industry	No broad statistical information. Estimated as twice industry revenues of social science and humanities R&D industry
Economic competencies		
Brand equity		
Advertising expenditure	Grand total by type of advertiser as reported by Universal-McCann	Total spending on advertising as reported by Advertising Association, less expenditure on classified ads
Market research	Outlays on market research, estimated as twice revenues of the market and consumer research industry as reported in SAS.	Twice revenues of the market and consumer research industry as reported in ABI.
Firm-specific human capital	Broad surveys of employer-provided training were conducted by the Bureau of Labor Statistics (BLS) in 1994 and 1995. Includes: A) Direct firm expenses (in-ho use trainers, outside trainers, tuition reimbursem ent, and outside training funds) B) Wage and salary costs of employee time in fo rmal and informal training.	NESS05, a similar survey of employer provided training, adjusted to consider private sector expenditure and all UK
Organizational structure		
Purchased	No broad statistical information. Estimated using SAS data on the revenues of the management consulting industry.	Data on revenues of managment consulting industry from Management Consulting Assocation. To obtain the private sector expenditure we applied the private sector/total expenditure of the MCA to the grossed up total of the industry (still provided by the MCA)
Own account	No broad statistical information. Estimated as 20% of value of executive time using BLS data on employment and wages in executive occupations.	No broad statistical information. Estimated as 20% of value of executive time using ASHE data on wages in executive occupations, excluding software occupations.

Source: CHS (2004)

Table 2: Business Intangible expenditure 2004

		UK			US		
Type of intangible investment	**Source**	**Total spending £bn**	**Total spending as a percentage of total intangibles spending**	**Total spending as a percentage of GDP**	**CHS Total spending (1998-2000) $**	**CHS Total spending as a percentage of total intangibles spending**	**CHS Total spending as a percentage of GDP**
		(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Computerized information							
Software: purchased	ONS estimates	7.5	5.9%	0.64%			
Software: own account	ONS estimates	12.4	9.7%	1.06%			
Total		**19.8**	**15.7%**	**1.70%**	**154**	**12.6%**	**1.65%**
Innovative property							
Scientific R&D	BERD	12.4	9.8%	1.06%	184	15.0%	1.98%
Mineral exploration	National Accounts	0.4	0.3%	0.04%	18	1.5%	0.19%
Copyright and license costs	National Accounts	2.4	1.9%	0.21%	75	6.1%	0.81%
Other product development, design and research:							
New product development costs in the financial industry	UK input output analysis	8.0	6.3%	0.69%	74	6.1%	0.79%
New architectural and engineering designs	ABI	14.0	11.0%	1.20%	68	5.6%	0.73%
R&D in social science and humanities	ABI	0.4	0.3%	0.03%	7	0.6%	0.08%
Total		**37.6**	**29.7%**	**3.23%**	**426**	**34.8%**	**4.57%**
Economic competencies							
Brand equity							
Advertising expenditure	Advertising Association	14.0	11.0%	1.20%	217	17.7%	2.33%
Market research	ABI published data	4.5	3.6%	0.39%	19	1.6%	0.20%
Total		18.5	14.6%	1.59%	236	19.3%	2.53%
Firm-specific human capital							
Direct firms expenses		14.8	11.7%	1.27%	22	1.8%	0.24%
Wage and salary costs of employee time		13.6	10.8%	1.17%	94	7.7%	1.01%
Total	NESS2005	28.5	22.5%	2.45%	116	9.5%	1.25%
Organizational structure							
Purchased	MCA	7.0	5.5%	0.60%	81	6.6%	0.87%
Own account	ASHE	15.3	12.1%	1.31%	210	17.2%	2.26%
Total		22.3	17.6%	1.92%	291	23.8%	3.13%
Total		**69.3**	**54.7%**	**5.95%**	**643**	**52.6%**	**6.91%**
Grand Total		**126.7**		**10.88%**	**1223**		**13.13%**

Notes to table. Purchased software data is for 2003. BERD is Business Enterprise R&D, ABI is Annual Business Inquiry, MCA is Management Consultants Association, ASHE is Annual Survey Hours and Earnings, NESS2005 is National Employers Skills Survey, Training data for 2005.
Source: Authors' calculations, CHS

Table 3: Comparison of different cost of training surveys

	Ness05	**UK, LTW,Cost of training supplement 2000**	**CVTS, 1993**	**US, SEPT1995**
Survey agency	DfES	DfES	Eurostat	BLS
Size coverage	All sizes	883, employment 10+, public and private, England	10+ employees in the UK	1,433 estabs, repreent of private estabs 50+ employees
Usable data (response rate)	3,736 (53%)	883 (24%)		949 (66%)
Data refer to	2005	1999	1993	1994
Data type	Employer recall over last 12 months			Log of training over two week period, employers, also employee survey, log over 10 days
Comments	All training expenditure	All training costs	Excludes: induction training and training allowing the employee to become familiar with the company of working environment; cost of practising skills taught by on-the-job means	Excludes training costs payments for equipment, supplies, space and travel.
Raw total	33.3	23.5	10.6	$53.6bn
Adjustments				
All firms (for LTW)		31.7		
Subtract public sector	24.2	23.0		
England to UK	28.5	26.8		
Adjusted total	28.5	26.8		$53.6bn

Notes to table. Sources: Learning and Skills Council (LSC) (2006) "National Employer Skills Survey 2005: Key findings", Department for Education and Skills (2000) "Learning and training at work 2000", Eurostat "Continuing Vocational Training Survey 1993", Frazis, H., Gittleman, M., Horrigan M., Joyce M. (1998) "Result from the 1995 Survey of Employer-Provided Training" June 1998, *Monthly Labour Review*

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Appendix 1: Treatment of intangible assets in competition inquiries

We can further triangulate our work by looking at the competition literature. Competition authorities are frequently required to assess profitability in the market concerned. One important measure is return on capital employed. It is often argued however that the conventional measure of this, return on tangible capital employed, may be flawed if intangible assets are ignored.[21] Thus there is growing work on valuing intangible assets in this case.

The UK Competition Commission (CC) has set out, in a number of recent cases, the conditions under which it will value intangible assets for a business, see the CCs report on Small Business Banking (2000), Home Credit (2006) and comments on the Small Business Banking by Carsberg (2002), see also Oxera (2003). The intangible assets valued by the CC in the Banking inquiry were, broadly, (a) corporate reputation/brand (b) trained workforce (c) the customer base (d) IT systems and development costs (see for a summary e.g. the Home Credit, 2006, Appendix 3.8).[22] Their approach was to estimate the depreciated replacement cost of each asset with the life of the asset depending on different assumptions. Whilst these cases were banking specific it is of interest to review how their calculations relate to the calculations here.

First, training. It was argued that most of the costs of employing staff, (i.e. wages) were expenses. Furthermore, much of the gains in expertise of employees was via learning by doing. Such costs did therefore create a future benefit, but, it was argued, but were also necessary to supply the product at all. Hence the view was taken to treat them as expenses. Appropriate expenditures for capitalisation were items such as staff recruitment costs, initial and subsequent training costs and initial payments to new staff (to compensate them for reduced initial earnings whilst training). Staff costs such as maternity leave, career breaks, and recruitment for junior staff or relocation of junior staff were not included. To estimate such training costs the CC took a similar approach to that taken here, namely to ask for expenditures on trainees and expenditures incurred by company employees on time spent in training (from e.g. the value of time spent by senior managers on training new recruits). This was depreciated over the mean life of an employee. In the Banks case, this was five years (CC, 2006, Appendix 3-6, para 14).

Second, advertising. The CC took the view not to allow all advertising costs on the basis that at least some were defensive, some wasted and some maintained relationships rather than enhancing reputation or existing relationships. The issue of waste is analogous to the appropriate costing of R&D on the basis of ex ante expenditures or ex post outcomes. In Banks, the CC therefore disallowed 80% of advertising costs (CC, 2006, Appendix 3-6, para 17), although some reservations about this were expressed by commentators who were in favour of ex ante evaluation, Carsberg (2002).

Third, knowledge of the customer base. This is a key asset in banking businesses. One way it can be priced is via the cost of data searches provided by Credit Reference Agencies (typically about £1.50 per customer). If recent credit history, say within the last year, is the most appropriate guide to future behaviour then this value can be assumed to depreciate within a year. In the banking case the average life of a customer was seven years (CC, 2006, Appendix 3-6, para 15).

Fourth, on IT investment, the questions identified by the CC was the distinction between expenditure maintenance and capital investment. The CC proposed a depreciation life of IT asset expenditure of four to five years.

In sum, the CCs taxonomy and calculations mirror those used here. Finally, they comment that a potential drawback of using market values to value intangibles is that they can be volatile and that in competition cases since firms are often multi-activity judging profitability in the particular market of interest is not possible from the market value of the company as a whole.

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[21] Suppose for example, for example, a company has built up intangible assets via expenditures in the past. On the basis of return on tangible capital it may appear highly profitable, but if intangible assets are included the return will be calculated on the basis of total capital.

[22] One of the current authors, Jonathan Haskel is a member of the Competition Commission hearing this case. The views expressed in this paper are his alone.

Appendix 2: Further comparative details of training surveys**.**

As mentioned in the text, we believe that the UK training survey is of interest since it has extra data relative to the US. The Table below shows some details, by showing the breakdown of expenditure that is asked in some detail in the LTW2000 and NESS2005. The bulk of expenditure consist of spending on trainee wages whilst undergoing training, confirming that training surveys which only ask for employer spending on e.g. outsourced training courses understate the costs of training. Other significant costs are under the heading training management (more precisely these are time vale of fraction of time spent on training matters for "people involved in providing, administering or making policy decisions about training"). Note in particular in the top panel the spending categories we believe not covered in the SEPT: (c) the on-site training centre, (d) off-site training centre (f) non-training centre equipment and materials and (g) travel and subsistence. The lower panel shows data for training costs by size giving the size adjustment proposed in the text.

	Training cost components						
	NESS05		**LTW2000**				
	Overall cost (£bn)	%	Overall cost (£bn)	%			
Off the job training: course-related:							
a) Trainee labour costs	4.173	13%	3.544	15%			
b) Fees to external providers	1.654	5%	1.919	8%			
c) On-site training centre	2.287	7%	1.243	5%			
d) Off-site training centre (in the same company)	0.381	1%	0.535	2%			
e) Training management	5.1	15%	3.735	16%			
f) Non-training centre equipment and materials	0.446	1%	0.376	2%			
g) Travel and subsistence	0.337	1%	0.39	2%			
h) Levies minus grants	-0.067	*	0.008	0%			
Off-the-job training: other (seminars, workshops etc.)							
i) Trainee labour costs	1.788	5%	2.051	9%			
j) Fees to external providers	0.708	2%	0.702	3%			
On-the-job training							
k) Trainee labour costs	9.998	30%	4.736	20%			
l) Trainers' labour costs	6.526	20%	4.288	18%			
Total	33.331		23.527				
(source NESS 2005)							
Sum of c) d) f) g)	3.451						
Training expenditure without c) d) f) g)	29.88						
Ratio (3.45/33.33-3.45)	12%						
	Total training cost by size (NESS 2005)						
	unweighted base	*weighed base*	**Total (£m)**	**On the job**	**Off the job**	**% of total training expenditure**	**% of all trainees (NESS05)**
Overall	*7,059*	*896,639*	33,331	£16,807m	£16,524m	%	%
Less than 5	*1,665*	*366,461*	4,552	£2,590m	£1,962m	14	6
5 to 24	*3,309*	*392,031*	9,518	£5,034m	£4,483m	29	23
25 to 99	*1,457*	*109,600*	8,862	£4,088m	£4,774m	27	27
100 to 199	*356*	*16,365*	3,152	£1,482m	£1,670m	9	12
200 to 499	*221*	*10,032*	4,217	£1,961m	£2,256m	13	17
500+	*51*	*2,151*	3,030	£1,650m	£1,380m	9	15
(source NESS 2005)							

Appendix 3: Should we count pre-employment expenditures as investment?

The data on training above refer to expenditures by firms in building assets once the worker has been hired. However, one might argue that firms also make investments in advance of workers being hired. Firms might for example pay a recruitment consultancy to help find a better quality worker. Or, the 2004 WERS reports that 20% and 50% of firms conduct personality and aptitude tests of their job applicants and time spent interviewing might be significant. One has to be careful here, since to the extent that monies are paid to find, say temporary staff, this pre-hiring expenditure might depreciate quickly (and may not even last a year). Nonetheless, it seems worth asking if some sort of estimate of their effects can be made. As usual, one is interested here in both own-account and purchased services.

Regarding purchased services, the ABI reports turnover for the industry, SIC74.50 "Labour recruitment and provision of personnel" which includes the following headings: personnel search and selection, screening and testing of applicants, investigation of references, head-hunters and labour contracting activities (supply to others, chiefly on a temporary basis, of personnel hired by agency and whose emoluments are paid by the agency). These expenditures in the UK are around £23.6bn (£17.6bn in value added) and employment is some 750,000 so are very considerable. What fraction of these expenditures are asset building however?

The main problem here is that as an institutional fact, many agency employees working in company X are in fact paid by the *agency*. The ABI employment question asks agency firms to include employees in company X as being employed by the agency if the agency pays them. Thus at least some fraction of the 750,000 apparent employees in the industry are likely agency staff employed physically in another industry. Hence at least some fraction of the turnover in SIC74.50 reflects not to rewards for placement services but simply an accounting-driven expenditure on salaries.

Fortunately, to clarify this, the DTI conducted its own survey of the industry in 1997 (Hotopp, 2000) and compared this to the ONS data and surveys by the industry body (the Recruitment and Employment Confederation, REC). Actual employment by the sector was estimated at 78,000 (ONS recorded employment was 523,000 at that time), confirming that many of the workers counted were in fact employees based physically elsewhere. Let us then assume that the share of turnover that actually relates to the placement services provided is (78,000/523,000) times £23.6bn, which is £3.52bn.

The next question is how much of this asset expenditure is investment. The issue here is that many placement activities are for temporary staff e.g. during maternity leave.[23] The DTI and REC survey estimated that 73% and 93% respectively of turnover was derived from temporary placements (the REC survey is somewhat higher since it sampled temporary agencies particularly heavily). Let us then assume that 20% of turnover arises from permanent placements giving 0.20*£3.52b=£0.70bn. This then is the revealed value of the purchased service of finding permanent employees.

This then gives two further questions. First, at least some of that fraction might of course be current and not capital expenditure e.g. paperwork etc. Second, we do not know how much own-account spending there is. Since the 2004 WERS reports that 20% and 50% of firms conduct personality and aptitude tests of their job applicants this is unlikely to be zero but it is hard to assign. If we were to double the purchased service data that would give an expenditure of £1.41bn.

Finally, as a further check, Hotopp reports that the DTI survey gave a 1997/8 turnover of £12bn, of which 23% was on permanent staff, with 600,000 placed into permanent jobs. If we take 20% of the 23% of the £12bn we have £1,080 of investment expenditure per permanent staff member hired.

[23] This could be accounted for by including all spending but using different depreciation rates for different staff types. Here we consider it simpler to pre-adjust the spending.

Appendix 4: Further information on the Community Innovation Survey

As is clear from above there are a number of assumptions, particularly about design, that have to be made due to lack of data. One interesting check therefore is to use the UK version of the EU *Community Innovation Survey* (CIS), a survey that asks firms for data on innovation outputs and innovation expenditures, including spending on R&D, design and marketing.

The CIS is a voluntary postal survey carried out by ONS on behalf of the DTI. Eurostat proposes an initial questionnaire and the DTI adds questions. ONS randomly selects a stratified sample of firms with more than 10 employees, drawn from the Inter-Departmental Business Register (IDBR) by SIC92 2-digit class and 8 employment size bands. The IDBR excludes agriculture, fishing and forestry, public administration and defence, education, health and social work. The survey covers both the production (manufacturing, mining, electricity, gas and water, construction) and the service sectors. There have been 4 surveys. CIS3 and CIS2 did not cover retailing and wholesaling, CIS1 was unusable due to very low response rates.

The main question for our purposes is about innovation expenditure the questions of which are set out in the Table below. The table shows the questions and two response data. In the questionnaire, firms are asked whether or not they spend on each category and, if so, how much they spend. As mentioned above, it is important to note response rates. To the overall survey, they are 43% (CIS3, Mercer, 2004) and 58% (CIS4, DTI, p.60). Non-response analysis suggests that larger firms were less likely to respond (Criscuolo et al). to the extent that larger firms are more likely to spend on intangibles, this suggests a too low figure. Weighting is done by size and industry band, but there is no correction for non-response by size.

Turning to the question itself, the expenditure on innovation activity is the most poorly replied to of all the surveys (CIS3 41%, Mercer, 2004, Chart 1, data for CIS4 not currently available). Thus it may be misleading to use the numbers on expenditure, but rather the numbers who answer whether they spend or not on the item. The table below shows both. A much larger fraction of firms reply that they spend on training for example than the expenditiure shares. This could of course be due to smaller firms replying they spent, but it could be due to non-response.

	Shares of overall expenditure	Shares answering they perform such exptre
	CIS4	CIS4
Creative work undertaken within your enterprise on an occasional or regular basis to increase the stock of knowledge and its use to devise new and improved goods, services and processes	33%	36%
Same activities as above, but purchased by your enterprise and performed by other companies (including other enterprises within your group) or by public or private research organisations		
Acquisition of advanced machinery, equipment and computer hardware or software to produce new or significantly improved goods, services, production processes, or delivery methods	37%	42%
Purchase or licensing of patents and non-patented inventions, know-how, and other types of knowledge from other enterprises or organisations	4%	12%
Internal or external training for your personnel specifically for the development and/or introduction of innovations	6%	37%
Expenditure on design functions for the development or implementation of new or improved goods, services and processes. Expenditure on design in the R&D phase of product development should be excluded.	5%	15%
Activities for the market preparation and introduction of new or significantly improved goods and services, including market research and launch advertising.	16%	22%
	£33bn	

Can these data help us either in examining the robustness of the expenditure data above, or in inferring what part of expenditure is investment? A number of points are worth making.

Let us consider a number of direct checks. First, Third, Cricsulo and Haskel provide a direct check of the CIS3 numbers by matching the CIS and the R&D survey. They find the R&D expenditure numbers to be poorly reported, but the R&D employment numbers to correspond quite closely. This suggests these expenditure numbers might be a poor guide, but employment numbers might be worth considering as a guide to innovation in the financial services sector.

Second, the largest CIS item is "the acquisition of machinery and equipment (including computer hardware)". This gives £12bn according to the CIS (37% of £33bn. In other work we have shown this is closely related to ICT investment. Expenditure on software is £7bn purchased, £12bn own-account and on hardware expenditure in the period was about £7.0bn (ONS, 2006). Thus the understatement is 16% if the respondants are replying about hardware and bought in software (total £14bn, understatement expressed at (14-12)/12, so the "true" figure can be obtained as the CIS figures times (1+understatement in %/100). Or the understatement is 116% if the response is to hardware and bought in software and own-account.

Third, turning to R&D, the sum of intra- and extra-mural R&D on the R&D survey, including spending on capital and equipment, gives a total expenditure of around £13.5bn. This CIS figures is 33% of £33bn= £11bn, and understatement of about 20%. Surprisingly these numbers are very close. Criscuolo and Haskel (2005) report that the major problem with CIS is that there are a very large number of firms who report R&D employment but no expenditure and even those firms reporting expenditure on both BERD and CIS surveys report very different expenditures on CIS. So this would seem to be a co-incidence.

Fourth, turning to training, the CIS figure is about £2bn. This is clearly a very substantial underestimate relative to our estimate of £28bn (although it is worth mentioning that the CIS data are for firms of over 10 employees and the comparable NESS2005 figure for private sector firms of over 10 is £24.7bn). It is likely due to the question: the CIS question refers to expenditure "on internal or external training for your personnel specifically for the development and/or introduction of innovations". Thus it is likely much narrower than the training question we use. Note too that the fraction of firms reporting any training is much greater than the fraction of expenditures. It could be that this reflects many small firms are training, but it could also reflect non-response to the expenditure question.

Fifth, on marketing, the CIS number suggests marketing of new products to be about £5bn (16% of £33bn). If the understatement of R&D and software/hardware is about 20%, this suggests a figure of about £6bn. Our figure for advertising and market research is £14bn and £4.5bn respectively, an overall figure of £18.5bn which is much more than the CIS figure. Recall however, that the CIS figure asks for expenditure on "market preparation and introduction" and so might be thought of as closer to a possible figure for investment in advertising rather then expenditure (to the extent that some of expenditure is simply on maintaining brand equity). CHS assume that 60% of total advertising expenditure is investment, giving £10.8bn (60% of £18.5bn). This is rather greater than the £6bn figure implied by the CIS. On the other hand, the CIS does ask about expenditure related to "new or significantly improved products" and it is quite possible that firms invest in existing products as well, meaning the CIS is an understatement of spending.

Sixth, as for design, the CIS number suggests an expenditure of £1.65bn (5% of £33bn), a figure substantially lower than our figure of £14bn (the output of the architectural and engineering design industry) and £8bn, expenditure on product development in the financial services industry. This may again reflect under-reporting.