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Follow-up Study of the Finances of Chemistry and Physics Departments in UK Universities

IOP Institute of Physics

RSC | Advancing the Chemical Sciences

Acknowledgements

I would like to thank all of the staff in the chemistry and physics departments and the staff in central finance and planning departments in the sample universities for their assistance in providing the data that underpin this study.

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February 2010

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Foreword

A healthy supply of talented chemistry and physics graduates is essential to generate high value-added employment, spur innovation and tackle the challenges that we face as a society. These graduates are employed in industry, research and the wider business community, where their scientific and quantitative skills are highly sought after. They also provide the vital supply of new entrants to the teaching profession, helping to develop the next generation of young scientists and produce a scientifically literate society. Investing in the physical sciences provides our economy with a high value, long-term return. It is essential that this investment is sustained; short-term cuts in funding are likely to have highly detrimental, long-term consequences.

Due to concerns about the state of the finances of chemistry and physics departments, the Royal Society of Chemistry (RSC) and the Institute of Physics (IOP) commissioned Nigel Brown Associates to undertake individual reviews of the finances of chemistry and physics departments based on 2002/2003 and 2003/2004 data, respectively.

These reports demonstrated that chemistry and physics departments in the samples analysed were operating in deficit on both teaching and research income, which unsurprisingly coincided with a number of well publicised and damaging closures of departments, most notably chemistry at the University of Exeter and physics at the University of Reading.

In response to these closures, coupled with the findings of the reports, the Higher Education Funding Council for England (HEFCE) introduced a now recurrent funding measure for strategically important and expensive laboratory-based subjects such as chemistry and physics, with the aim of covering the deficit in the teaching funding provided for them. In addition, from 2006/2007 in England, and a year later in Wales, variable tuition fees of up to £3000 were introduced for all students embarking on undergraduate degree courses.

In light of these changes, among others, Nigel Brown Associates was commissioned to undertake a follow-up study of both chemistry and physics departments across the UK to assess the state of their finances based on 2007/2008 data.

The results show that chemistry and physics departments have made significant "efficiency gains" in recent years, with an increase in class sizes, better use of facilities and fewer technicians per researcher. However, there is likely to be only limited scope for further savings without negatively impacting on teaching quality, the capacity to conduct excellent research and the ability to train technicians.

In addition, chemistry and physics departments continue to attract many students from overseas, with the proportion studying chemistry, in particular, doubling between 2002/2003 and 2007/2008. These students provide a valuable source of income and enhance our global reputation for scientific excellence. However, the supply of domestic graduates must be maintained in order to retain the strength of the UK science base.

The latest findings also reveal that chemistry and physics departments are still receiving insufficient public funding to cover the full cost of their activities – the majority of this deficit is caused by the under-funding of their research activities. Funding deficits for teaching in England have declined since 2007/2008 due to the additional funding for strategically important and expensive laboratory-based subjects, although this deficit was still 10% for English chemistry departments. The overall funding deficits in the other countries of the UK, where there has been no additional funding for teaching, are greater still.

The current economic climate is leading to a downward pressure on spending and this, combined with demographic changes in the future student population, will put further strain on the finances of chemistry and physics departments over the coming decade. The RSC and the IOP are concerned that this pressure may make some chemistry and physics departments vulnerable to closure on an ad hoc, unplanned basis. A strategy for the sustainable provision of chemistry and physics in the UK is vital if we are to reap the benefits that these disciplines can bring to our standard of living and well-being, both now and in the future.

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Executive summary

Background and introduction

This is a follow-up study to individual studies undertaken between 2004 and 2006 of the finances of a sample of chemistry departments in UK universities for the Royal Society of Chemistry[1] and of the finances of a sample of physics departments in English universities for the Institute of Physics[2]. The data collected included cost drivers (student load, staff [full-time equivalents – FTE] and space); teaching and research income by source; budgetary approach and data; and the Transparent Approach to Costing (TRAC) data and data on the allocation of academic staff time.

Findings – cost drivers

Student numbers

The data show a growth for the chemistry departments common to both studies of 26.2% in total undergraduates over five years and a growth for the physics departments common to both studies of 12.9% in total physics undergraduates over four years. The increase in chemistry undergraduates for the universities common to both studies is higher than growth in the sector as a whole because of the transfer of undergraduate numbers from a university that closed its chemistry department to two of the universities in the sample. The level of growth in physics undergraduate numbers for the departments common to both studies is broadly consistent with growth in physics undergraduate numbers for the sector as a whole.

Academic and other staff

In 2007/2008 the proportion of posts funded from departmental budgets (as opposed to those funded by external research grants and contracts) was on average 42.8% of the total academic staff for chemistry departments and 48.8% for physics departments in the sample. Between 2002/2003 and 2007/2008 the average student to permanent academic staff ratio[3] (SSR) increased from 9.2:1 to 11.3:1 for chemistry, whereas for physics the SSR increased from 9.5:1 to 10:1 from 2003/2004 to 2007/2008. The ratio of academic posts to technician posts increased considerably for both the chemistry and the physics departments common to both studies.

Departmental space

The chemistry departments in the sample for 2007/2008 had a mean space per FTE total academic staff of 82.5 m^2. The corresponding figure for the physics departments was 67 m^2. The difference reflects three factors: the lower requirement for teaching laboratory space in physics than in chemistry departments, which often require full extraction facilities; the higher proportion of research in physics than in chemistry that is theoretical; and the higher proportion of research in physics than in chemistry that is undertaken in external national and international research facilities. The mean value of space per FTE academic staff fell between 2002/2003 and 2007/2008 from 102.4 m^2 to 84 m^2 for the seven chemistry departments common to both studies and fell between 2003/2004 and 2007/2008 from 69 m^2 to 64.8 m^2 for the six physics departments common to both studies. This was almost entirely down to the reported increase in total academic staff FTE.

Teaching income

In 2007/2008 for the sample of chemistry departments in English universities, the average teaching income per full-time equivalent home and EU student was £9119 while in the other countries of the UK it was £7676. The corresponding averages for the physics departments in the sample were £8673 for the departments in English universities and £7544 in the other countries of the UK.

These differences between countries reflect the differences in undergraduate tuition fees across the countries of the UK and the additional funding provided by HEFCE from 2007/2008 to English universities for strategically important and expensive laboratory-based subjects, including both chemistry and physics. The principal source of non-publicly funded teaching income for both chemistry and physics departments is overseas student fees for taught programmes. In 2007/2008 the overseas fee income was on average 11.4% of the total teaching income for the chemistry departments in the sample and 6.6% of the total teaching income for the physics departments.

Research income

In 2007/2008 the average total research income for the sample of chemistry departments was £9.4 m and for the sample of physics departments was £7.6 m. In addition, 85.5% of the research income of the chemistry departments and 93% of the research income of the physics departments were from public sources (particularly the UK research councils).

Division of costs between activities: the allocation of academic staff time

For most departments the proportion spent on teaching and research is broadly in line with the income generated by these activities, but for some departments there is evidence of some subsidy from teaching to research or vice versa.

1. *Study of the Costs of Chemistry Departments in UK Universities: Summary Report* Nigel Brown, Nigel Brown Associates (RSC February 2006).

2. *Study of the Finances of Physics Departments in English Universities: A Summary Report* Nigel Brown, Nigel Brown Associates (IOP July 2006).

3. Based on the FTE of all taught students (home and EU, and overseas undergraduate and postgraduate) divided by total FTE of academic staff on permanent contracts, excluding research fellows and postdoctoral fellows.

Financial position: teaching

For the chemistry departments in English universities in the sample the financial position ranged from a surplus of 10% of income to a deficit of nearly 50% of income. For the two chemistry departments in universities in the other countries of the UK the observed deficits were more significant at more than 50% of income. The physics departments in the sample showed a very similar pattern, with those in the English universities ranging from a surplus of 26.7% of teaching income to a deficit of 31%, with an average surplus of 1.7% of total teaching income. For the two physics departments in universities in the other countries of the UK, the deficit was well over 50% of teaching income for each department.

It is noteworthy, however, that the five physics departments in English universities common to both studies for which full TRAC-based data were available showed an overall surplus on teaching activity in 2007/2008 of 8%, compared with a deficit of more than 20% in 2003/2004. Similarly, but to a larger extent, for the three chemistry departments in England for which reliable TRAC data were available, the average deficit fell from 48.2% of income in 2002/2003 to 8.3% in 2007/2008.

Financial position: research

All of the chemistry departments in the sample were in deficit on research in 2007/2008, with deficits ranging from 8.7 to 77.9% of research income. The financial position of research in the physics departments was similar, with deficits ranging from 1.2 to 79.8% .

Analysis and conclusions

These data show that both chemistry and physics departments were by and large operating in deficit overall in 2007/2008. The average deficit on all activities for the chemistry departments in the sample in 2007/2008 was 31.7% of total income, while for the physics departments it was 18.1%.

However, the financial position of teaching in both chemistry and physics departments in England appears to have improved substantially since the earlier studies. These improvements reflect two main factors: the improved income per FTE student in departments in English universities reflecting increased tuition fees for home undergraduates and the additional funding provided by HEFCE for strategically important and expensive laboratory-based subjects provided from 2007/2008; and the improved use of resources from the increase in the numbers of undergraduates.

The prospects for the future financial position of teaching are not as good for a number of reasons:

- the current economic climate and the downward pressure on public expenditure;
- the significant upward pressures on staff costs;
- the decline in the number of 17 and 18 year olds in the UK population between 2010 and 2019.

Nearly all of the chemistry and physics departments in the sample were in deficit in 2007/2008 on research activity due to a number of factors, including:

- The overhead element of grants is still short of full economic costing.
- Research spend in 2007/2008 reflects the effort by institutions to secure the best possible rating in the RAE 2008. The proportion of academic staff time spent on research may well have increased, shifting costs from teaching to research.

Chemistry and physics departments are very dependent on public funding. In 2007/2008 on average 84% of total income in chemistry departments and 89% in physics departments came from public funds. It is inevitable that their financial position will depend heavily on the metrics used to distribute public funding. For instance, it is imperative that the funding councils, in light of current and prospective budgetary restraints, maintain their existing support for initiatives that prioritise STEM subjects, such as chemistry and physics. This especially applies to HEFCE's recurrent targeted allocation of £25 m per annum to strategically important and expensive laboratory-based subjects, which compensates for the shortfall in the unit of resource for teaching; any cuts to this allocation could affect the viability of chemistry and physics departments, with the potential threat of closure for the smaller ones.

In addition, there may be particular difficulties for chemistry and physics departments in the other countries of the UK, which have not benefited to the same extent as departments in English universities from increased funding for teaching in recent years. The devolved administrations need to look at their attitudes to funding higher education in response to the wider fiscal constraints that they will face over the next few years.

Finally, the data used in the follow-up study do not take into account whether the current level of resources for teaching in chemistry and physics departments is sufficient to sustain high-quality provision in the universities concerned. Also, the data used in the current study were not gathered to pursue the question of the sustainability of current provision directly. However, the RSC and IOP, either separately or jointly, may wish to consider commissioning work along the lines of a national study that addresses these issues as they relate to higher-education teaching in chemistry and physics.

1: Introduction

This is the report of a study undertaken by Nigel Brown of Nigel Brown Associates of the finances of chemistry and physics departments in a sample of UK universities commissioned jointly by the Royal Society of Chemistry (RSC) and the Institute of Physics (IOP). It is a follow-up study to individual studies undertaken by the same author between 2004 and 2006 of the finances of chemistry departments in UK universities[4] for the RSC and of the finances of physics departments in English universities for the IOP[5]. In drawing up the sample of departments for this study, participation in the earlier studies was an important criterion to enable comparisons between the current position and that observed in the earlier studies.

It must be borne in mind that this study, like the earlier ones, is very much a "snapshot" of the situation in 2007/2008. The outcome of the 2008 Research Assessment Exercise (RAE) may have had a significant impact on funding council quality-related (QR) income for some chemistry and physics departments after 2007/2008. In the medium term, the review[6] of variable tuition fees for full-time undergraduates could also have a significant impact on departmental income. Universities also face increasing cost pressures, in particular as a result of the new pay and conditions framework for university staff.

In addition, it must be emphasised that the sample of departments included in the study was drawn up on a pragmatic basis rather than a statistical basis.

4. *Study of the Costs of Chemistry Departments in UK Universities: Summary Report* Nigel Brown, Nigel Brown Associates (RSC 2006).

5. *Study of the Finances of Physics Departments in English Universities: A Summary Report* Nigel Brown, Nigel Brown Associates (IOP July 2006).

6. The Independent Review of Higher Education Funding and Student Finance was announced in November 2009. See http://hereview.independent.gov/hereview.

List of figures and tables

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2: Background

The studies undertaken between 2004 and 2006 compared costs, derived using the methodology of the Transparent Approach to Costing (TRAC)[7], and income from all sources showed that all chemistry and physics departments were at that time operating with significant deficits overall and in most cases deficits on both teaching and research activity.

At that time there were a number of changes taking place to the public funding of higher education and research, including:

- The introduction in England (and Northern Ireland) from 2006/2007 of a variable tuition-fee regime for full-time undergraduate teaching with a substantially higher maximum fee of £3000 per student compared with the means-tested standard fee of around £1200. Under the new fee regime, students were eligible for publicly funded loans repayable after graduation on an income contingent basis through the tax system. A similar system was implemented in Wales from 2007/2008 with the important difference that all Welsh-domiciled students attending higher-education institutions (HEIs) in Wales were eligible for a fee support grant equal to the difference between the fee charged and the standard fee. The undergraduate fee regime in Scotland has continued to diverge from the rest of the UK with fees wholly publicly funded and, from 2008, no required contribution from graduates.
- Increased maintenance support for full-time undergraduate students in England through the introduction from 2006 of a Higher Education Maintenance Grant and a requirement on HEIs that charged the maximum fee to provide student bursaries of at least £300 per year.
- The transfer of funding for postgraduate research students from HEFCE's teaching grant to its research grant (based on research criteria) with the establishment of the Research Supervision Fund.
- The provision of specific R grant by HEFCE towards the overhead costs of research projects funded by UK research charities.
- A move towards research council grants meeting the full economic costs of research projects through an increase in the contribution to overheads.

In addition, in 2007, HEFCE allocated £75 m in time-limited core funding to secure the provision of strategically important and expensive laboratory-based subjects – chemistry, physics, chemical engineering, and mineral, metallurgy and materials engineering (and some other strategically important subjects, such as foreign languages and quantitative social sciences)[8]. The funding was initially for three years and was targeted at those institutions that clearly offered significant and focused taught activity in the expensive subject areas concerned. In January 2009, HEFCE announced that this additional funding of £25 m per annum would continue on a recurrent basis from 2010[9].

In the same period there had been a significant change to the cost structure in higher education with the introduction from 2005 of a new pay and conditions framework for all higher-education staff. Among other things, this brought all staff – academic and support staff – onto a single pay scale, provided for the assessment of all posts and gave greater flexibility to enhance the pay of staff in high demand. This change was expected to increase the overall pay bill by at least 5% in real terms, when fully implemented.

In the light of these changes in the underlying public funding of teaching and research, and the changes to the cost base, the RSC and the IOP jointly commissioned this follow-up study of the finances of chemistry and physics departments in UK universities using 2007/2008 data on income and costs.

7. TRAC was developed for the Joint Pricing and Costing Steering Group of HEIs by JM Consulting to deliver an approach to deriving the full economic costs of publicly funded research as a basis for costing and pricing research projects, especially those funded by the UK research councils.

8. HEFCE circular letter 13/2007, 30 March 2007.

9. See www.hefce.ac.uk/news/hefce/2009/funding.htm.

3: Approach

10. This approach is aimed at providing HEFCE and the other funding councils with a measure of the adequacy of core funding plus tuition fees to meet the mainstream costs by academic cost centre. Subject-FACTS thus excludes non-publicly funded teaching costs and publicly funded teaching costs supported by funding from public agencies other than the funding councils, such as the NHS. It also excludes the cost of activities supported by specific grants – including, of particular relevance here, the special funding for strategically important and expensive laboratory-based subjects. This last exclusion was on the grounds that the primary aim of the funding was to secure these departments against the threat of closure.

In discussion with the RSC and IOP it was agreed that the follow-up study should as far as practicable follow the approach used in the earlier studies to allow comparisons to be drawn between the two sets of data for chemistry and physics. To this end it was also agreed that there should be the maximum possible overlap between the sample institutions in the follow-up study and in the two earlier studies.

Given the divergence across the four countries of the UK in public-funding arrangements for higher education, especially the public funding of teaching, it was agreed that the sample should include institutions from Scotland, Wales and Northern Ireland (although in the event it was not possible to use the Northern Ireland data in the analysis), as well as England, even though the original IOP study of physics departments only covered English HEIs.

The sample of universities was therefore drawn up on the basis of two main criteria:

- Each university should have both a physics and a chemistry department to minimise the load on central university staff who would need to supply some of the data.
- Each university should have participated in either the original study of chemistry departments or the original study of physics departments.

On the basis of these two criteria, 14 universities were identified for inclusion in the sample – 10 English universities and four universities in the other three countries of the UK. All 14 were invited to participate and all agreed. Within the sample, seven of the chemistry and physics departments had been included in the two original studies.

The study used a common questionnaire for all departments, which had been developed and updated from the one used in the original studies to as far as possible secure data on a common basis. The data requested included:

- cost drivers – student numbers, academic and support staff numbers, and space;
- income for teaching, research and other activities, distinguishing publicly funded income from private sources of income;
- budgetary approach and data;
- the allocation of academic staff time between teaching, research, other activities and support;
- TRAC data split between publicly and non-publicly funded teaching, publicly and non-publicly funded research, and other activities; and in turn split between types of expenditure – departmental direct and indirect costs, premises costs, other central charges and full economic cost adjustments.

In practice, there have been further developments of the TRAC methodology since 2005, in particular the development of TRAC for teaching (TRAC [T]), which seeks to identify separately the element of teaching costs supported by funding council core grant and tuition fees by academic cost centre – Subject-FACTS[10] – and other teaching costs. While these data would be of interest, it is not possible to compare them with the data from the earlier studies because comparative data were not available for them.

As was noted in both of the earlier studies, based on the analysis of departmental income data, a very high proportion of teaching and research in chemistry and physics departments is supported by public funding. In practice, this means that the split of total costs for teaching and research within TRAC between publicly funded and non-publicly funded will, to an extent, be notional. For example, overseas (non-EU) undergraduates will be taught alongside home and EU undergraduates so that the direct teaching costs should be identical and many indirect costs are allocated using student numbers as the principal cost driver. Similarly, the day-to-day management of research costs at departmental level will be against a target overall contribution to overheads, irrespective of the source of the research income. Against this background it does not appear helpful to analyse the separate contributions to surpluses or deficits from publicly and non-publicly funded activities. This report therefore analyses income by source, but then compares total income with total TRAC-based costs for teaching, for research and for other activities within chemistry and physics departments, respectively. This issue is considered further in section 5, which compares income and costs.

It has not proved possible to obtain complete data sets for every institution in the sample. Fourteen chemistry departments provided data and 11 of the data sets were sufficiently complete to use for the analysis presented in all of the tables and figures. Thirteen physics departments returned data and 10 of the data sets were sufficiently complete.

Data from the current study are presented in separate tables and figures. Where the data allow, findings from this study are presented alongside earlier data for the studies of chemistry and physics departments common to both studies.

4: Findings – cost drivers

The sections below present data on the principal cost drivers – students, academic staff, technicians and departmental space – for the chemistry and physics departments from the current study and seek to identify significant changes since the earlier studies by comparing relevant findings for the departments common to this study and the earlier ones.

Student numbers

Tables 1a and 1b compare undergraduate student numbers in 2007/2008 with those in the earlier studies for chemistry and physics departments, respectively, for the whole sample and for the departments common to both samples.

These data show a growth in taught student numbers, for the seven chemistry departments common to both studies, of 26.2% in total (home and EU, and other overseas) undergraduates over five years – 5.2% per annum – and a growth for the six physics departments common to both studies of 12.9% in total (home and EU, and other overseas) undergraduates over four years – 3.2% per annum. Both the number and the proportion of overseas chemistry undergraduates has grown significantly over the last five years for the institutions common to both samples, although it remains a low proportion overall. In contrast, the number and proportion of physics undergraduates for the institutions common to both samples from overseas have both fallen over the last four years.

Comparison with growth in total numbers of undergraduates for the same periods for the sector as a whole show that for the chemistry departments common to both samples, undergraduate numbers increased significantly faster than the average for the sector as a whole of 15.5%. On the other hand, for the physics departments common to both samples, undergraduate numbers increased at a very similar rate to that of the sector as a whole. The additional growth in numbers for the chemistry departments common to both studies reflects in part a redistribution to two departments in the sample of student numbers from a department that was closed over this period and not in the sample for the earlier study.

Figures 1a and 1b (p10) show the growth in home and EU undergraduate numbers for the institutions in the current study that were also in the samples for the earlier studies for chemistry and physics departments, respectively. The figures show that, although all but one of the chemistry departments and all of the physics departments since the earlier studies have experienced a growth in undergraduate numbers, the relative growth has not been uniform across the two sets of institutions common to both samples.

Table 1a: Home and EU, and overseas undergraduate student numbers in the sample of chemistry departments in 2002/2003 and 2007/2008

		2002/2003		2007/2008	
		Home and EU	Overseas	Home and EU	Overseas
Whole sample	Range	217–436	1–40	237–558	0–102
	Mean	295	12.4	360	24
Common institutions	Range	223–436	2–40	280–558	0–102
	Mean	307	14	375	30

Source: institutional data.

Table 1b: Home and EU, and overseas undergraduate student numbers in the sample of physics departments in 2003/2004 and 2007/2008

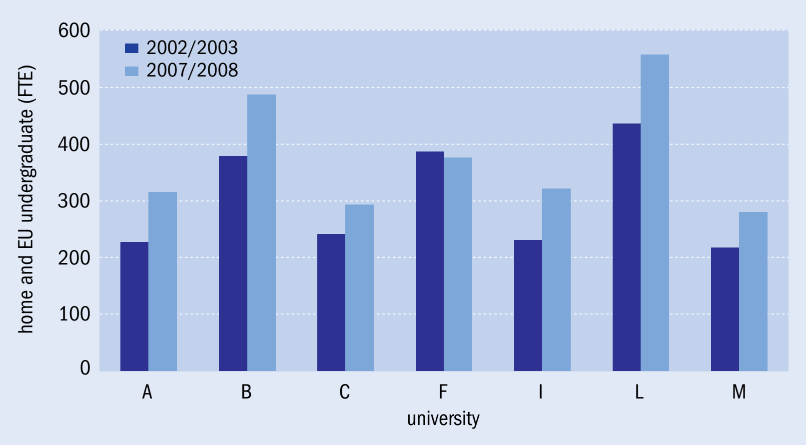
		2003/2004		2007/2008	
		Home and EU	Overseas	Home and EU	Overseas
Whole sample	Range	225–418	2–58	245–541	0–37
	Mean	261	15.4	321.4	13
Common institutions	Range	225–418	2–58	245–541	4–37
	Mean	290	16.5	331	14.9

Source: institutional data.

The overall growth in undergraduates in chemistry and physics largely reflects the growth in first-year enrolments from 2005/2006, as illustrated in table 2 (p11).

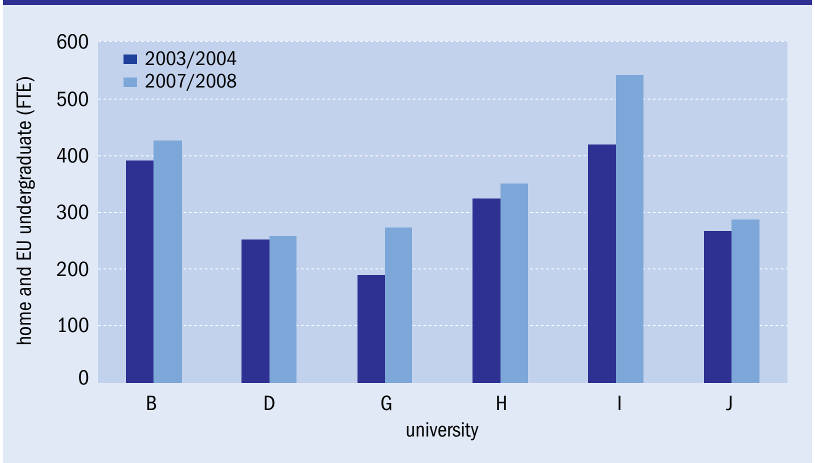
Figures 2a and 2b (p12) show the average number of first-year undergraduate enrolments (home, EU and overseas) for the chemistry and physics departments, respectively, in the sample for the English universities and for the universities in the other countries of the UK. These figures show an increase of 10.1% in first-year enrolments between 2005/2006 and 2008/2009 to chemistry departments in the sample and a 10.6% increase in first-year enrolments to physics departments in the sample over the same period. At the time of the study, UK-wide data from HESA were only available up to 2007/2008. These showed an increase of 5.1% in first-year full-time undergraduate enrolments to chemistry programmes between 2005/2006 and 2007/2008 and an increase of 11.6% in first-year full-time undergraduate enrolments to physics programmes over the same period. As already noted, the significantly higher increase in first-year full-time undergraduate enrolments for the chemistry departments in the sample reflects the transfer of student places to two departments in the sample from a department

Figure 1a: Home and EU undergraduate chemistry students (FTE) for universities common to both samples in 2002/2003 and 2007/2008



Source: institutional data.

Figure 1b: Home and EU undergraduate physics students (FTE) for universities common to both samples in 2003/2004 and 2007/2008



Source: institutional data.

that closed. The observed increase in first-year full-time undergraduate enrolments in the physics departments in the sample is broadly in line with the increase for physics departments across the UK from 2005/2006[11]. These findings provide some assurance that the sample of departments selected for the study is broadly in line with chemistry and physics departments across the UK as a whole.

These data show differences in the change in the average first-year enrolments in both chemistry and physics between departments in English universities and universities in the other countries of the UK in the sample.

English chemistry departments showed an increase of 17.1% in first-year enrolments between 2005/2006 and 2008/2009, whereas chemistry departments in the other countries of the UK suffered a decline of 8.6% on average over the same period. In contrast, physics departments in English universities in the sample showed a more modest increase of 5.9%, while those departments in the other countries of the UK showed a significantly higher increase of 29.2% on average over the same period.

A more detailed analysis of the data shows a decline in average first-year undergraduate enrolments between 2005/2006 and 2006/2007 to chemistry departments in English universities, followed by a substantial increase between 2006/2007 and 2007/2008, reflecting the general pattern of undergraduate enrolments by English universities between 2005/2006 and 2007/2008 as the new tuition-fee regime was introduced from 2006/2007. The pattern of average first-year undergraduate enrolments to physics departments in the sample showed almost no change between 2005/2006 and 2006/2007, and a less marked increase in 2007/2008 than for chemistry departments in the sample.

The chemistry departments in the sample had an average of 109 postgraduate research students (ranging from 70 to 220) in 2007/2008, of which close to 20% were from outside the EU. This was in line with the average for the whole sector of 107 postgraduate research students, with 25% from outside the EU for the 33 departments that made submissions to the RAE 2008 (UoA 18). Data on total postgraduate research students in 2002/2003 were not collected in the earlier study of chemistry departments and it is not possible therefore to draw any comparisons with the numbers in 2007/2008 for those departments common to both samples. The physics departments in the sample had an average of 62.5 postgraduate research students (ranging from 17 to 107) in 2007/2008, of which 14% were from outside the EU. The corresponding figure for the whole sector is an average of 68 postgraduate research students with 21% from outside the EU for the 39 substantial[12] physics departments that made submissions to the RAE 2008 (UoA 19). For the six physics departments in both the 2003/2004 sample and the 2007/2008 sample, the average number of postgraduate research students increased from 45 to 61, a 36% increase. This compares with an increase of 17% in the number of full-time postgraduate research students in physics departments nationally.

As was found in the earlier studies, postgraduate taught programmes in both physics and chemistry departments are unusual, with only a few departments having more than 10 such students in 2007/2008. However, around 40% of these students are from outside the EU, so taught postgraduate courses are potentially a significant source of income.

In terms of overall student numbers, both chemistry and physics departments in the sample have grown over the last four and five years, respectively, and this should contribute to increasing the sustainability of departments in the longer term, if student numbers can be kept at least at current levels (if not increased) in the face of the forthcoming decline in the UK population of young people between 2011 and 2019[13].

11. *Students in Higher Education Institutions 2005/2006 and 2007/2008* Higher Education Statistics Agency 2007 and 2009.

12. Three of the 42 physics departments that made submissions to the 2008 RAE submitted fewer than five staff for assessment.

13. See *The Future Size and Shape of the Higher Education Sector in the UK: Demographic Projections* Universities UK February 2008.

Academic staffing

Academic staff includes all teaching and research staff on permanent contracts funded out of general university income and researchers funded by external grants and contracts. In the report's analysis it is important to distinguish the numbers in these two groups because they are driven by different factors. In 2007/2008, total academic staffing in the chemistry departments in the sample ranged from 30 to 173 and in the physics departments from 23 to 175. In 2007/2008, the proportion of posts funded from departmental budgets (as opposed to those funded by external research grants and contracts) was on average 42.8% of the total for chemistry departments and 48.8% for physics departments in the whole sample.

For the chemistry departments common to both studies the proportion of posts funded from departmental budgets remained broadly unchanged at 47.5% of total academic posts between 2002/2003 and 2007/2008, whereas at national level there was an increase over the same period in the proportion of posts funded other than from departmental budgets from 42.5 to 45.7%[14] of posts. For the physics departments common to both studies, the proportion of posts funded from departmental budgets fell slightly, on average from 52.3% of total posts in 2003/2004 to 50.8% in 2007/2008. This is in line with the pattern at national level, which showed a small decline in the proportion of posts funded other than from departmental budgets from 52.1 to 50% over the same period[15].

At a more detailed level the picture is more complicated for individual institutions, as figures 3a and 3b (p12) demonstrate. These show the FTE academic staff split between those on permanent contracts and those funded through external contracts in chemistry and physics departments that were in both the current and earlier studies.

These two figures show a complex pattern of changes in the numbers of academic staff on permanent contracts and those funded through research grants and contracts between the two years for which data were collected. For those chemistry departments in both samples the average number of FTE permanent academic staff increased from 39.3 to 42.9 (9.2%) between 2002/2003 and 2007/2008, while the average number of FTE academic staff supported by external grants and contracts increased from 46.6 to 51.6 (10.7%). For those physics departments in both samples the average number of permanent academic posts increased from 37.7 to 40.3 (6.9%) while the average number of posts supported by external grants and contracts increased from 35.7 to 41.5 (16.2%) between 2003/2004 and 2007/2008.

While the number of permanent academic posts is likely to be sensitive to total student numbers, in the chemistry and physics departments that were in the earlier respective studies, the observed increase in the average number of permanent academic posts is significantly below the increase in undergraduate numbers. In addition, a more detailed analysis of the permanent posts indicates that a small part of the increase in permanent staff in chemistry and physics departments in the sample has been through an increase in postdoctoral and other research fellows, especially in the chemistry departments common to both studies. These posts may be expected to make only a small contribution to teaching activity. The increase in such posts may reflect the relative success of some of the chemistry departments in the sample in attracting support under the various young researcher programmes operated by the UK research councils. However, it seems likely that in practice, for the sector as a whole, both chemistry and physics departments will have benefited from these schemes.

Table 2: First-year chemistry and physics undergraduate FTEs (including overseas) in 2005/2006 to 2008/2009

		Chemistry (12 departments)			Physics (11 departments)		
		2005/06	2008/09	% change	2005/06	2008/09	% change
English universities	Total	1047	1226	17.1	921	975	5.9
	Mean	116	136		115	122	
Universities in other countries of the UK	Total	395	361	−8.6	233	301	29.2
	Mean	132	120		78	100	
Overall total		**1442**	**1587**	**10.1**	**1154**	**1276**	**10.6**

Source: institutional data.

Between 2002/2003 and 2007/2008 the average student to permanent academic staff ratio[16] (SSR) has increased from 9.2:1 to 11.3:1 for the seven chemistry departments common to both samples. The average SSR for all of the chemistry departments in the sample in 2007/2008 was 10.5:1.

For the six physics departments in both samples the increase in SSR between 2003/2004 and 2007/2008 was from 9.5:1 to 10.0:1. The average SSR for all of the physics departments in the sample in 2007/2008 was 9.2:1.

Figures 4a and 4b (p13) show the change in SSRs for chemistry and physics, respectively, for the institutions common to both studies.

These figures show that SSRs have notably increased in most of the chemistry departments in both samples between 2002/2003 and 2007/2008, whereas in the physics departments there have been increases and decreases in SSRs between 2003/2004 and 2007/2008. The physics departments showing significant decreases in SSRs are those that have increased the number of permanent academic posts substantially since the first study but have also had significant increases in student numbers. It seems likely that these observed changes in SSRs reflect a pattern in the overall growth of the physics departments concerned.

At a national level[17], SSRs for chemistry depart-

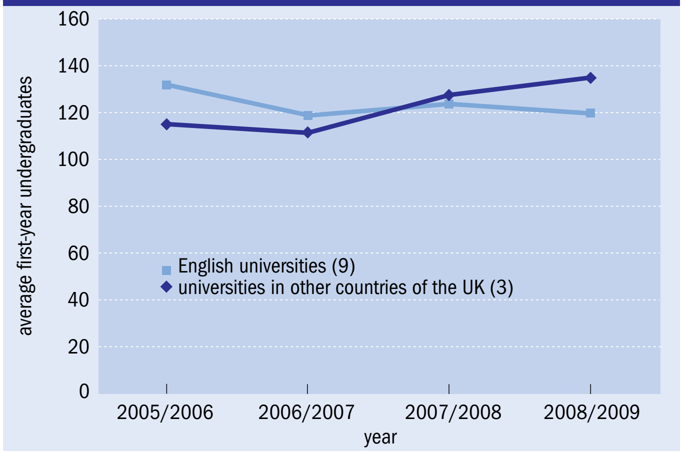
14. *Resources of Higher Education Institutions* (table 12) 2002/2003 and 2007/2008 (HESA 2004 and 2009).

15. *Resources of Higher Education Institutions* (table 12) 2003/2004 and 2007/2008 (HESA 2005 and 2009).

16. Based on the FTE of all taught students (home and overseas and undergraduate and postgraduate) divided by total FTE of academic staff on permanent contracts, excluding research fellows and postdoctoral fellows.

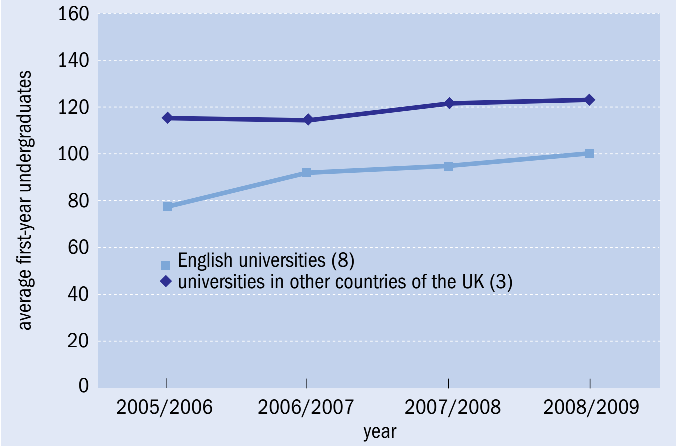
17. Based on taught student data from *Students in Higher Education* (HESA 2004, 2005 and 2009) and data on academic staff numbers from *Resources of Higher Education Institutions* (HESA 2004, 2005 and 2009).

Figure 2a: Average first-year undergraduate numbers in chemistry departments in the sample 2005/2006 to 2008/2009



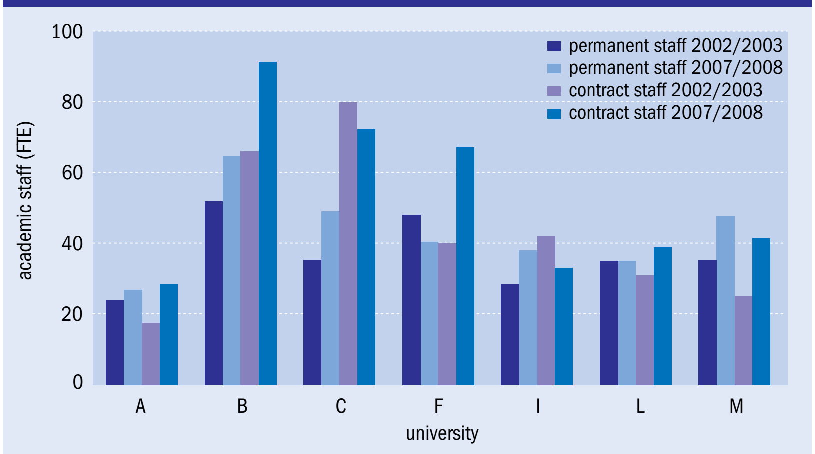
Source: institutional data.

Figure 2b: Average first-year undergraduate numbers in physics departments in the sample 2005/2006 to 2008/2009



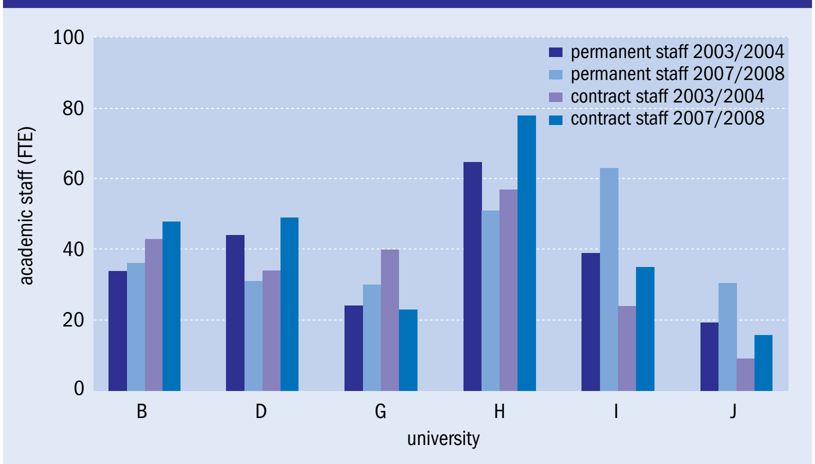
Source: institutional data.

Figure 3a: Permanent and contract academic staff (FTE) in chemistry departments in both samples in 2002/2003 and 2007/2008



Source: institutional data.

Figure 3b: Permanent and contract academic staff (FTE) in physics departments in both samples in 2003/2004 and 2007/2008



Source: institutional data.

ments increased from 9.0:1 in 2002/2003 to 9.5:1 in 2007/2008, while those for physics departments increased from 7.2:1 in 2003/2004 to 7.4:1 in 2007/2008. The change is in the same direction but the absolute levels are lower, especially for physics. The differences between the national figures and the data from the study almost certainly reflect differences of coverage in the data and in particular the inclusion in the national data (but not in the study) of academic-related staff (such as senior professionals and managers, who usually do not teach).

The number of staff funded by external grants and contract income is clearly related to the level of that income and this is considered further in section 5 on income and costs. On the other hand, given the requirements of European employment law, it is possible that in some departments there has been a shift to employing more staff on permanent contracts.

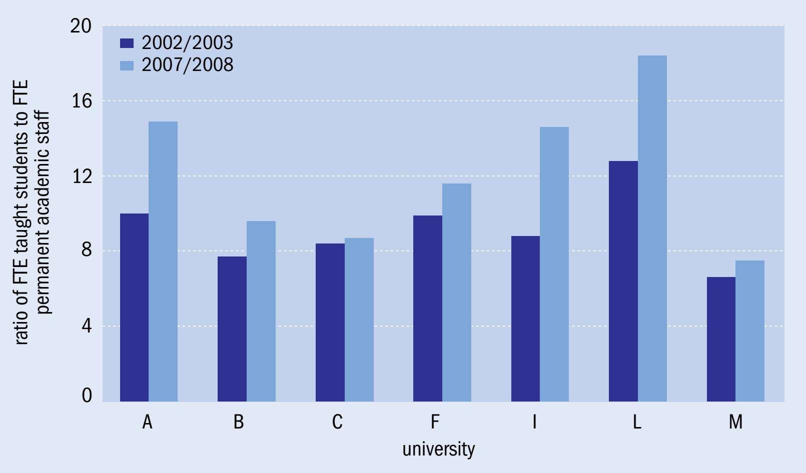
Technicians

Technicians are an essential part of the support for teaching and research in laboratory-based subjects. Discussions with heads of department suggest that recruitment to technician posts has become more difficult in recent years and some universities have developed apprenticeship schemes to try to increase the pool of qualified people.

In 2007/2008, the average number of technicians per chemistry department in the sample was 21.8 with a ratio of one permanent technician post for every 1.8 permanent academic posts. The corresponding figures for the physics departments in the sample were an average of 16.1 technician posts with a ratio of one permanent technician post for every 2.4 permanent academic posts.

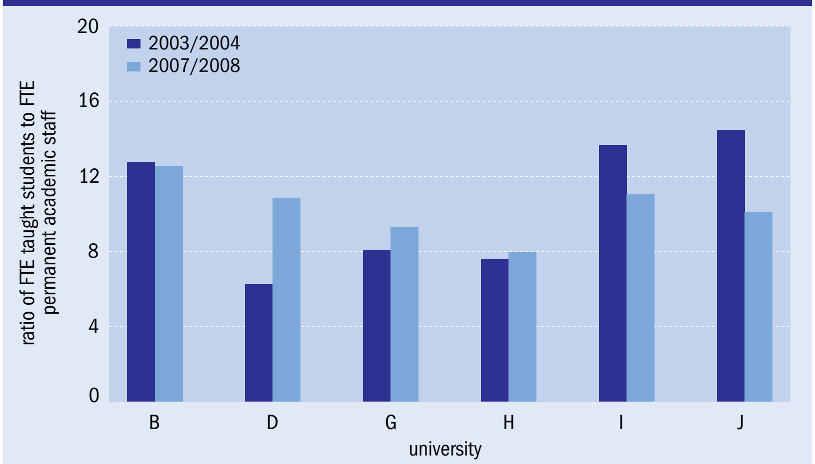
These ratios have increased considerably since the earlier studies. For the chemistry departments common to both studies, the ratio of permanent academic posts to permanent technician posts increased from 1.3:1 in 2002/2003 to 1.6:1 in 2007/2008, although the numbers of technicians had changed little. For the physics departments common to both studies, the ratio of permanent academic posts to permanent technician posts increased from 2.2:1 in 2003/2004 to 2.9:1 in 2007/2008; there was an increase in the number of permanent academic posts and a decline of 13% in permanent technician posts. This decline may reflect an increased tendency to employ more highly qualified and skilled technology officers (who may be employed on academic contracts instead of technician contracts) rather than traditional technicians to support cutting-edge research. It may also reflect attempts by some universities to rationalise technician support across laboratory-based subjects.

Figure 4a: Taught student to permanent academic teaching staff ratios for chemistry departments in both samples in 2002/2003 and 2007/2008



Source: institutional data, calculations by Nigel Brown Associates.

Figure 4b: Taught student to permanent academic teaching staff ratios for physics departments in both samples in 2003/2004 and 2007/2008



Source: institutional data, calculations by Nigel Brown Associates.

Space

Dedicated space primarily includes teaching laboratories, research laboratories and staff offices. Laboratory-based subjects like chemistry and physics have a greater need for dedicated space than most other subjects and the costs of space are therefore a more significant element within total costs. For the chemistry and physics departments in the sample for 2007/2008, around 60% of the total space was in each case research laboratories and staff offices and 19% was teaching laboratories. Although the driver for total space is a complex combination of taught students, permanent academic staff FTE, and contract research staff FTE and research students, the simplest driver for comparative purposes is the total FTE of all academic staff, both permanent academic staff and those funded by external research grants and contracts.

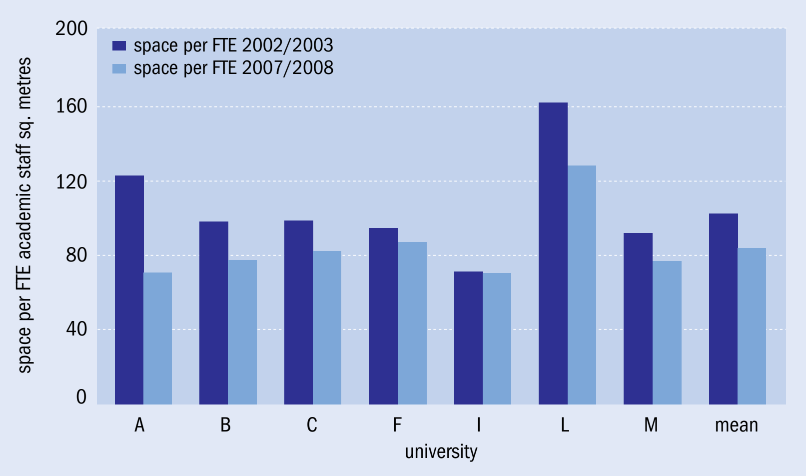
The chemistry departments in the sample for 2007/2008 had a mean space per FTE total academic staff of 82.5 m^2. The corresponding figure for the physics departments was 67 m^2. This difference of nearly 25% reflects three factors: the lower requirement for teaching laboratory space in physics than in chemistry; the higher proportion of research in physics than in chemistry that is theoretical and not requiring laboratory space; and the higher proportion of research in physics than in chemistry that is undertaken in external national and international research facilities, which, other things being equal, one might expect to reduce the demand for university-provided laboratory space.

These conclusions are supported by a more detailed analysis of the data between teaching laboratory space and research laboratory and staff office space. For the sample as a whole in 2007/2008, the average teaching laboratory space per FTE permanent academic staff member (excluding postdoctoral and other research fellows) was 40.2 m^2 for the chemistry departments and 27.6 m^2 for the physics departments. The average research laboratory and staff office space per FTE total academic staff (all permanent academic staff plus those funded from research grants and contracts) for the whole sample in 2007/2008 was 50.7 m^2 for the chemistry departments and 30.9 m^2 for the physics departments.

Figures 5a and 5b (p14) show, for the chemistry and physics departments common to both samples, respectively, the changes in space per FTE member of academic staff between 2002/2003 and 2007/2008 for the chemistry departments, and between 2003/2004 and 2007/2008 for the physics departments. A detailed breakdown of the space between teaching laboratories, research laboratories and staff offices was not collected in the earlier studies.

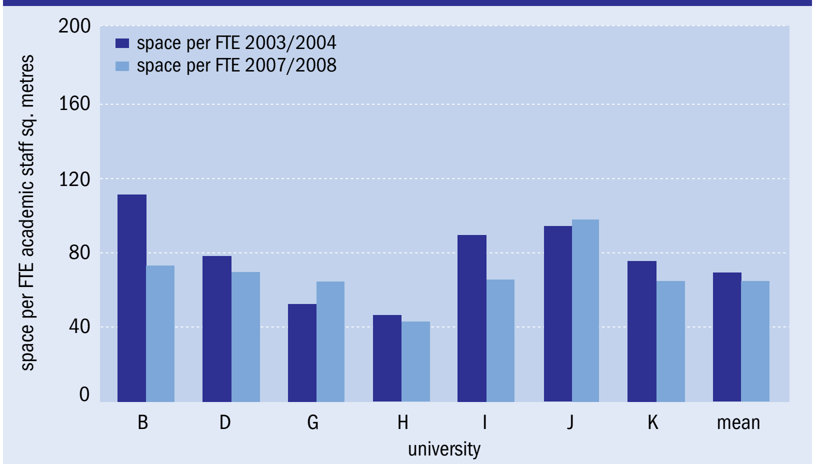
The mean value of space per FTE academic staff fell between 2002/2003 and 2007/2008 from 102.4 m^2 to 84 m^2 for the seven chemistry departments common to both samples, and fell between 2003/2004 and 2007/2008 from 69 m^2 to 64.8 m^2 for the six physics

Figure 5a: Space per FTE academic staff for chemistry departments common to both samples in 2002/2003 and 2007/2008



Source: institutional data, calculations by Nigel Brown Associates.

Figure 5b: Space per FTE academic staff for physics departments common to both samples in 2003/2004 and 2007/2008



Source: institutional data, calculations by Nigel Brown Associates.

18. *Survey of Academic Appointments 2004–2008*, www.iop.org/activity/policy/Publications/file_38783.pdf.

departments common to both samples. In both cases this average increased space efficiency was largely down to the reported increase in total academic staff FTE. However, there is evidence from the IOP 2004–2008 academic survey[18] that there has been significant growth in academic staff numbers undertaking research in astronomy and particle physics, which are mainly undertaken in national and international facilities and do not therefore require much departmental space. At a national level this will have enabled physics departments to operate at a higher level of space efficiency as observed for the sample of physics departments common to both studies.

The total space occupied by the seven chemistry departments in both studies and for the six physics departments in both studies was virtually unchanged. Some departments had reduced their total space between the two years but others had increased it. Nevertheless, figures 5a and 5b show a reduction in the range of departmental space measured against academic staff FTE since the previous studies.

5: Findings – income and costs

Teaching income

The principal sources of income for teaching are public funding from the UK funding councils, such as HEFCE, and tuition-fee income in support of home and EU students, and non-public funding from tuition fees paid by overseas (non-EU) students. These include both undergraduate students and taught postgraduate students. Income from postgraduate research students is included within research income, which is considered later.

In practice, non-publicly funded teaching income for chemistry and physics departments is only a small proportion of total teaching income and, as discussed in section 3, this report considers total teaching income (publicly funded and non-publicly funded) for the purposes of comparison with teaching costs. However, the two components are first presented separately in this section of the report.

Tables 3a and 3b (p16) present the publicly funded teaching income for chemistry and physics departments, respectively, in the sample split between undergraduate income and postgraduate income. Because of the introduction of the variable tuition-fee regime for full-time undergraduates in England from 2006/2007 and in Wales from 2007/2008, and the introduction of additional funding for strategically important and expensive laboratory-based subjects (including both chemistry and physics) from 2007/2008, the tables show the English departments separately from the departments in the other countries of the UK.

In 2007/2008, for the sample of chemistry departments in English universities for which data were available, the average teaching income from funding council grants and fees per FTE home and EU taught student was £9119, while the corresponding average per FTE for the chemistry departments in the sample universities in the other countries of the UK was £7676. The corresponding averages for physics departments were £8673 for the departments in English universities and £7544 for the departments in universities in the other countries of the UK. On average the chemistry departments were larger (in terms of student numbers) than the physics departments; overall gross teaching income is higher for chemistry than for physics departments before the deduction of central charges.

For the chemistry departments in English universities common to both studies, the mean public funding for teaching per FTE home and EU student has increased from £6102 in 2002/2003 to £8913 in 2007/2008, an increase of 46.1% over five years. Excluding the department that was funded at a level beyond the HEFCE resource (it benefited from such additional funding in both 2002/2003 and 2007/2008), the mean public funding for teaching per FTE taught student increased from £5963 to £8469, an increase of 42% over five years. The corresponding increase for the six English physics departments in both studies was from £5683 per FTE home and EU student in 2003/2004 to £8631 in 2007/2008, an increase of 51.9% over four years. These increases arise from two main factors:

- The introduction of variable tuition fees in England for full-time undergraduates entering from 2006/2007. All of the English universities in the sample charged the maximum fee of £3070 in this period for first- and second-year students.
- The introduction in England only from 2007/2008 of the additional funding for strategically important and expensive laboratory-based subjects of approximately £1000 per eligible student. All of the English universities in the sample received additional funding for chemistry and physics undergraduates under this scheme.

The principal source of non-publicly funded teaching

Table 3a: Publicly funded teaching income for the sample of chemistry departments for which full data were available (12 departments) in 2007/2008

		Home and EU undergraduate income (£000s)[1]	Home and EU postgraduate taught income (£000s)	Total publicly funded teaching income (£000s)	Home and EU students (FTE)	Publicly funded teaching income (£) per FTE student
English universities	A	2793	10	2803	315.5	8884
	B	4631	6	4637	486	9541
	C	3565	337	3902	319	12 332[2]
	D	2434	71	2505	289.4	8656
	F	3104	44	3148	378.5	8317
	G	1934	0	1934	237	8160
	H	2224	15	2239	260.5	8595
	I	2656	140	2796	335	8346
	J	4060	140	4200	467.5	8984
Universities in other countries of the UK	K	3401	0	3401	461.7	7366
	L	4714	219	4933	588	8389
	M	1912	24	1936	288.2	6718

[1]Includes additional funding for strategically important and expensive laboratory-based subjects. [2]This high figure reflects a decision by the university to fund at a higher level than implied by the HEFCE funding formula.

Source: institutional data and HEFCE circular letter 13/2007 to check additional funding for strategically important and expensive laboratory-based subjects.

Table 3b: Publicly funded teaching income for the sample of physics departments for which full data were available (11 departments) in 2007/2008

		Home and EU undergraduate income (£000s)[1]	Home and EU postgraduate taught income (£000s)	Total publicly funded teaching income (£000s)	Home and EU students (FTE)	Publicly funded teaching income (£) per FTE student
English universities	A	2022	0	2022	233.9	8645
	B	4010	0	4010	425.5	9424
	D	2131	2	2133	257.2	8293
	F	2455	25	2470	273.4	9034
	G	2205	0	2205	272	8107
	H	2911	97	3008	361.6	8319
	I	4642	16	4658	549	8485
	J	2553	0	2553	286	8927
Universities in other countries of the UK	K	3104	116	3220	447.1	7207
	L	1856	47	1903	253	7522
	M	1433	18	1451	224.4	6466

[1]Includes additional funding for strategically important and expensive laboratory-based subjects.

Source: institutional data and HEFCE circular letter 13/2007 to check additional funding for strategically important and expensive laboratory-based subjects.

Table 4a: Overseas tuition-fee income for undergraduate and postgraduate taught students for the chemistry departments in the sample for which data were available (12 departments) in 2007/2008

University	Overseas tuition-fee income (£000s)	Overseas undergraduate and taught postgraduate students (FTE)	Overseas fee income per FTE student (£)
A	334	27.5	12 145
B	395	29.4	13 435
C	1975	108	18 287
D	94.6	9.9	9556
F	348	28.5	12 211
G	72	6	12 000
H	608	42	14 476
I	386	31	12 452
J	276	23.7	11 646
K	189	15.1	12 517
L	195	19	10 263
M	63.6	3.3	19 273

Source: institutional data, calculations by Nigel Brown Associates.

income recorded by institutions in the sample is fees paid by overseas (non-EU) students. Universities are free to set their own tuition fees for overseas students, and postgraduate taught courses in particular are often charged at substantial fee premiums compared with the fees charged to home and EU students.

Tables 4a and 4b (p17) present the overseas fee income in 2007/2008 for the sample of chemistry and physics departments, respectively.

The median fee income per FTE overseas undergraduate and postgraduate taught student was around £12 500 for chemistry departments and £11 800 for physics departments in the sample in 2007/2008, but with some significant outliers. The reported low figures for one physics department may reflect a specific arrangement with an overseas university. The low figures for both chemistry and physics for one university include some overseas foundation-year students who were charged a lower fee.

The comparable figure for the institutions common to both samples was a median fee income per FTE overseas student in chemistry departments in 2002/2003 of just over £9000 and in physics departments in 2003/2004 of around £10 000.

Tables 5a (p18) and 5b (p19) present the split of total teaching income between publicly funded teaching income and income from overseas fees in 2007/2008 for chemistry and physics departments, respectively, in the sample for which full data were available.

In 2007/2008, income from overseas undergraduate and postgraduate taught students was 11.4% of total teaching income for the chemistry departments in the sample for which full data were available and 6.6% for the physics departments.

Tables 6a (p19) and 6b (p20) compare total teaching income per FTE undergraduate and taught postgraduate student with data from the earlier studies for the chemistry and physics departments, respectively, common to both studies.

In considering these findings, the following points need to be borne in mind:

- The chemistry data cover a period of five years and include two institutions outside England, whereas the physics data cover a period of four years and relate only to English universities.
- One chemistry department was allocated funding per FTE home and EU student above the HEFCE assumed resource in both 2002/2003 and 2007/2008.

With the exception of that one chemistry department, the impact of overseas fee income on funding per FTE student is modest for the chemistry and physics departments in the sample in 2007/2008. This supports the case for analysing publicly funded and non-publicly funded teaching income and costs together because there is little additional information to be gained from considering them separately.

Research income[19]

There are six categories of income that support research activities in HEIs:

- Funding council main QR grant, allocated on the basis of performance in the most recent RAE with a factor to reflect differential costs of disciplines.
- Other funding council subsidiary QR grants – predominantly in England – including the Research Degree Supervision Fund, Charity Support Funding and Business Research Support.
- Research grant and contract income from public sources, predominantly from UK research councils but also from UK government departments, health authorities and EU funds.
- Home and EU postgraduate research student fees.
- Research grant and contract income from non-public funds, including non-governmental EU sources, UK research charities, business and industry, and overseas sources.
- Overseas postgraduate research student fees.

Tables 7a (p20) and 7b (p21) present the research income by category for the chemistry and physics departments in the sample, respectively.

These tables illustrate the complex pattern of funding to support research in university departments. The actual distribution of income by category is, however, very similar for chemistry and physics departments. As noted in the two earlier studies, these data confirm the heavy dependence of chemistry and physics departments on publicly funded research income. Tables 8a and 8b (p23) show the division of total research income between public and non-public sources for chemistry and physics departments, respectively. They indicate that the average total research income for chemistry departments in the sample in 2007/2008 was £9.4 m and for physics departments in the sample was £7.6 m.

These data confirm that, as with teaching income, research income in both chemistry and physics departments is predominantly from public sources, particularly the UK research councils. TRAC makes it possible to compare research costs with income for each source of income, but for the purposes of this exercise the comparisons presented later are of total research income and total research costs.

Because of the changes in the funding of research students since the earlier studies, the best available comparison between the current study and the earlier ones is the level of research grant and contract income generated per FTE permanent member of academic staff. Figures 6a and 6b (p22) compare the level of research grant and contract income generated per FTE permanent member of academic staff for 2002/2003 and 2007/2008 for the chemistry departments in both samples, and between 2003/2004 and 2007/2008 for the physics departments in both samples, respectively.

These data show that all but one of the chemistry departments substantially increased their research grant and contract income per FTE permanent academic staff member between 2002/2003 and 2007/2008. However, two of the six physics departments in both samples experienced a reduction in research grant and contract income generated per permanent member of academic staff, but these comparisons are especially difficult for physics departments because of the significant proportion of allocations from research councils that are in the form of time spent on national and international facilities rather than grants to support in-house research activity. Data on the financial equivalence of such allocations are not readily available and the generally lower level of research grant and contract income per FTE member of permanent academic staff in physics departments almost certainly reflects the exclusion of this element of research allocations, which may also vary from year to year. In addition, a proportion of research activity in physics departments is theoretical and attracts lower levels of research grants. These two factors are less important on the whole in chemistry departments.

Table 4b: Overseas tuition-fee income for undergraduate and postgraduate taught students for the physics departments in the sample for which data were available (10 departments) in 2007/2008

University	Overseas tuition-fee income (£000s)	Overseas undergraduate and taught postgraduate students (FTE)	Overseas fee income per FTE student
A	76	7.2	10 555
B	193	15.8	12 215
D	323.5	33.4	9686
F	384	31.5	12 190
G	47	4	11 750
H	515	43.2	11 921
I	237	22	10 773
J	68	5.8	11 724
K	221	18.7	11 818
M	31	5.5	5636[1]

[1]This low figure may reflect a specific arrangement with an overseas university.

Source: institutional data, calculations by Nigel Brown Associates.

Total income

The distribution of total income from teaching, research and other activities for the chemistry and physics departments in the sample for which full data are available is presented in figures 7a and 7b (p22), respectively.

Total income for the chemistry departments ranged from £7.4 m to £20.4 m. For all but two of them, research income was more than 60% of total income and for five of them it was around 75%.

19. For the purposes of this study, research income is the income accrued in the financial year 2007/2008, which is particularly important in terms of long-term research contracts. It excludes grants of time on external (national or international) research facilities.

Table 5a: Split of total teaching income between publicly funded income and overseas student fees for chemistry departments in the sample for which full data were available (12 departments) in 2007/2008

University	Publicly funded teaching income (£000s)	Overseas student-fee income (£000s)	Total teaching income (£000s)	Overseas student-fee income as a percentage of total teaching income
A	2803	334	3137	10.6
B	4637	395	5032	7.8
C	3902	1975	5877	33.6
D	2505	95	2600	3.7
F	3148	348	3496	10.0
G	1934	72	2006	3.6
H	2239	608	2847	21.3
I	2796	386	3182	12.1
J	4200	276	4476	6.2
K	3401	189	3590	5.3
L	4933	195	5128	3.8
M	1936	64	2000	3.2
Total	**38 434**	**4937**	**43 371**	**11.4**

Source: institutional data, calculations by Nigel Brown Associates.

Total income for the seven chemistry departments common to both studies increased on average by nearly two-thirds between 2002/2003 and 2007/2008. However, for two of the departments, income more than doubled in this period.

Total income for the physics departments in the sample ranged from £5.6 m to £23.7 m and, as with the chemistry departments, for all but two of the physics departments, research income was more than 60% of total income and in three departments it was more than 75%.

Total income for those physics departments that were common to both studies increased on average by close to 50% between 2003/2004 and 2007/2008, but the increase ranged from under 20% to close to 100%.

Capital funding

Among the departments surveyed, only three chemistry and three physics departments had received capital investments in buildings of more than £3 m in the period between the original studies and the current study. Nearly all of them had received some capital investment in buildings and equipment under the former Science Research Investment Fund (SRIF) initiative. In addition, most universities have provided modest annual capital allocations for equipment – presumably for teaching laboratories because research equipment is often funded through research grants. One chemistry department had, however, received very substantial capital equipment grants in both 2005/2006 and 2007/2008.

Financial position: costs and income

To draw out the financial position of the chemistry and physics departments across the sample of universities, TRAC-based costs were sought from universities in the sample for the five activities – publicly funded teaching, non-publicly funded teaching, publicly funded research, non-publicly funded research, and other activities. This is in line with the earlier studies. However, as noted previously, the proportion of non-publicly funded activity in both teaching and research is, with one or two exceptions, very low in the sample departments. The comparisons drawn in this study are therefore between total teaching income and total teaching costs, and between total research income and total research costs (publicly funded plus non-publicly funded).

This approach, using total income generated by the department and TRAC-based costs to determine the overall financial position, was used in both the earlier studies and the current one because the alternative – the use of budgetary income and expenditure figures – is beset by practical difficulties as a basis for comparison between different universities. Budgetary income and expenditure figures are subject to the precise resource allocation model and approach to budgeting used by each university and may not cover the full range of costs that need to be taken into account. In particular, some elements of income that are attributable to departmental activities may be treated in the first instance as university-wide resources.

The use of total department-generated income and TRAC-based costs as a measure of the financial position of a department may not produce a readily recognisable bottom line for the head of department but does allow comparisons to be drawn across different universities. To overcome this difficulty, the observed financial position on this basis is compared below with the budgetary position of the departments.

The TRAC methodology, originally developed to provide data on the full economic costs of research, has now been extended to cover teaching (TRAC [T]). Under TRAC (T), institutions provide information to the funding councils that distinguishes between teaching costs directly comparable to funding council grants plus tuition fees by academic cost centre[20] (Subject-FACTS) and other teaching costs. More widely, TRAC requires institutions to break down research costs between source of funds and activity. To provide this level of analysis would have required the collection of substantially more data from institutions and it is not clear that this additional burden would have been justified in terms of the extra understanding of the overall position that would have been provided.

TRAC-based costs are derived using common princi-

20. This approach, which has been developed over the last few years within the TRAC (T) framework, is particularly important in relation to the possible use of institutional cost data for determining academic subject cost weightings in the teaching funding method and where departments have significant numbers of students from different academic cost centres, which by and large is not the case for chemistry and physics departments.

ples accepted by the funding councils and the research councils that were drawn up with the direct involvement of the higher-education sector. TRAC aims to provide the full economic cost of activities with all institutional costs allocated out to income-earning budget centres, including estates costs (where these are not charged to departments under a capital charging regime), the costs of central student services, administrative costs and the full economic cost adjustments.

The key element within TRAC is the allocation of the time of academic staff (as the principal income generators) between the main activities, based on data collected from individual academic staff on their use of contracted time. Figures 8a and 8b (p22) show the allocation of academic staff time between teaching, research and other activities with support time allocated out on a pro rata basis to the main activities for chemistry and physics departments, respectively, for which the relevant data are available.

As might be expected, this broadly parallels the distribution of departmental income by activity shown in figures 7a and 7b (p22). In a few cases the academic staff time spent in teaching was a significantly higher proportion of the total time than teaching income, representing a subsidy of teaching from research. In the case of one department, this almost certainly reflected the lower level of total income per student in a university outside England. For several other departments, there appears to have been a subsidy from teaching to research. This may reflect efforts by these departments to improve their position in the 2008 RAE since all were rated four in the 2001 RAE.

As with the chemistry departments, the distribution of academic staff time by activity in 2007/2008 in the physics departments was broadly consistent with the proportion of total income attributable to those activities. In several departments, however, a significantly higher proportion of staff time was allocated to teaching than teaching income represented as a proportion of total income. This might indicate some subsidy of teaching from research and it is noteworthy that three of the departments showing this pattern were in the universities in countries of the UK other than England. For a few of the physics departments, a significantly lower proportion of staff time was allocated to teaching than teaching income as a proportion of total income. As with the chemistry departments, this pattern almost certainly reflects efforts to secure an improved departmental performance in the 2008 RAE compared with 2001.

While it is possible to compare the allocation of academic staff time by principal activity for the chemistry and physics departments that were in the two earlier studies, it would possibly be misleading because the data collection by institutions of the allocation of academic staff time is known to have improved substantially over the last few years.

Table 5b: Split of total teaching income between publicly funded income and overseas student fees for physics departments in the sample for which full data were available (11 departments) in 2007/2008

University	Publicly funded teaching income (£000s)	Overseas student-fee income (£000s)	Total teaching income (£000s)	Overseas student-fee income as a percentage of total teaching income
A	2022	76	2098	3.7
B	4010	193	4203	4.6
D	2133	324	2457	13.2
F	2470	384	2854	13.5
G	2205	47	2252	2.1
H	3008	515	3523	14.6
I	4658	237	4895	4.8
J	2553	68	2621	2.6
K	3220	221	3441	6.4
L	1903	nil	1903	0.0
M	1451	31	1482	2.1
Total	**29 633**	**2096**	**31 729**	**6.6**

Source: institutional data, calculations by Nigel Brown Associates.

Table 6a: Total teaching income per FTE undergraduate and taught postgraduate student in chemistry departments (7 departments) in 2002/2003 and 2007/2008

University	2002/2003			2007/2008			Percentage change 2002/03 to 2007/08
	Teaching income (£000s)	FTE taught students	Income per FTE student (£)	Teaching income (£000s)	FTE taught students	Income per FTE student (£)	
A	1173	239.2	4904	3137	343	9146	86.5
B	2228	400	5570	5032	515.4	9763	75.3
C	2251	296.1	7602	5877	427	13763	81.0
F	2292	394.2	5814	3496	407	8590	47.7
I	1627.8	252.1	6457	3182	366	8694	34.6
L	3144	450.7	6976	5128	607	8448	21.1
M	1406	232.2	6055	2000	292	6849	13.1

Source: institutional data, calculations by Nigel Brown Associates.

Teaching income and costs

Tables 9a and 9b (p23) show total teaching income and total TRAC teaching costs (publicly funded and non-publicly funded) for the sample of chemistry and physics departments, respectively, for which full data are available. As noted previously, it is important to emphasise that the use of these figures is to ensure a degree of

Table 6b: Teaching income per FTE undergraduate and taught postgraduate student in physics departments (6 departments) in 2003/2004 and 2007/2008

University	2003/2004			2007/2008			Percentage change 2003/04 to 2007/08
	Teaching income (£000s)	FTE taught students	Income per FTE student (£)	Teaching income (£000s)	FTE taught students	Income per FTE student (£)	
B	2343	396.3	5912	4203	441.3	9524	61.4
D	1482	270	5489	2457	290.8	8449	54.0
G	1131	193	5860	2252	276	8159	39.2
H	3033	439	6909	3523	404.8	8703	26.0
I	2630	435.1	6045	4895	571	8572	41.8
J	1365	268.4	5086	2621	291.8	8982	76.6

Source: institutional data, calculations by Nigel Brown Associates.

Table 7a: Research income by category for the chemistry departments for which full data were available (11 departments) in 2007/2008

University	Research income from public sources (£000s)					Research income from non-public sources (£000s)	
	Main QR	Other funding council	UK research councils	Other publicly funded research grants and contracts	Home and EU PGR student fees	Non-publicly funded research grants and contracts	Overseas PGR student fees
A	273	487	2719	4	226	411	76
B	2363	1873[1]	5586	1666	2426[2]	582	709
C	2622	1580	5183	772	389	1870	399
D	1483	912	2714	370	590[2]	255	104
F	1678	968	5064	741	1242[2]	1174	370
G	1657	979	3779	1217	374	363	229
H	2077	923	3815	348	276	701	211
J	1493	1048	4486	941	300	1783	130
K	3072	nil	3935	1036	1171	1588	271
L	1570[3]	nil	1782	120	519	1042	110
M	1638	nil	4335	488	521	2830	294

[1]Includes HEFCE specific research grants. [2]Includes Research Training Support Grants. [3]Includes a significant amount of funding provided by the Scottish Funding Council under the research funding pooling arrangements arising from the establishment of the EastChem/WestChem collaboration (this may also apply to department K).

Source: institutional data.

comparability between departments in different universities. The observed balance of income and expenditure does not easily relate to the budgetary position of the departments and therefore might not readily be recognised by heads of department. To address this issue, a comparison is drawn below between the financial position using both earned income and TRAC-based costs and the budgetary position.

Table 9a shows that although the majority of chemistry departments in English universities in the sample were in deficit on teaching activity in 2007/2008, the financial position ranged from a surplus of 10% of income to a deficit of nearly 50%. The average deficit for the chemistry departments in English universities in the sample for which full data were available in 2007/2008 was 10% of income. However, both of the departments for which full data were available in universities in the other countries of the UK had deficits on teaching of more than 50%. This reflected the lower level of income per FTE home and EU student than in England in the absence of the additional funding for strategically important and expensive laboratory-based subjects.

For the three chemistry departments in English universities for which reliable TRAC data were available in 2002/2003 and 2007/2008, the average deficit on teaching had fallen from 48.2% of income to 8.3%. This reflects the increased funding for teaching in English universities through tuition fees and for strategically important and expensive laboratory-based subjects. Nevertheless, on average they are still in deficit.

The data for the physics departments show a very similar pattern, with most physics departments in English universities showing modest surpluses or modest deficits on teaching with an average surplus of 1.7% of teaching income. Physics departments in both universities in the other countries of the UK for which full data were available showed significant deficits on teaching activity.

For the five physics departments in English universities that were common to both studies and for which reliable TRAC data were available for 2003/2004 and 2007/2008, the financial position on teaching activity improved from a deficit of just over 20% of income to a surplus of 8% of income.

The observed improvement in the finances of teaching largely reflects the impact of the new variable tuition-fee regime for full-time undergraduates and the extra funding for chemistry and physics undergraduate students in England from HEFCE under the strategically important and expensive laboratory-based subjects initiative.

Research income and costs

Tables 10a and 10b (p24) present the total research income and TRAC-based costs for each of the chemistry and physics departments, respectively, for which full income and cost data were available.

These data show a wide range of deficits in 2007/2008 on research activity across the sample of chemistry departments. The average across all of the departments for which reliable TRAC data were available was 35.8% of income. However, for the three chemistry departments in English universities for which reliable TRAC data were available for 2002/2003 and 2007/2008, the average deficit across the three departments narrowed from 33.8 to 17.7%.

These data show an average deficit on research activity for the physics departments in the sample of 20.2% in 2007/2008. As with the chemistry departments, there are a small number of physics departments with much higher percentage deficits than the others. For the five physics departments in English universities for which reliable TRAC data were available for 2003/2004 and 2007/2008, the percentage deficit fell from 31.7 to 18.8% of research income.

Total income and total costs

Tables 11a and 11b (p24) present the total income and TRAC-based costs for 2007/2008 covering all activities (teaching, research and other activities) for the chemistry and physics departments, respectively, for which full income and cost data were available.

These data show a wide range of deficits for chemistry departments on the basis of full economic costs in 2007/2008 driven to a significant extent by deficits on research activity. The average deficit across all of the departments was 31.7%. For the three departments in English universities for which reliable TRAC data were available for 2002/2003 and 2007/2008, the average deficit declined from just under 30 to 18%. Nevertheless, on a full economic cost basis, overall deficits in chemistry departments were still substantial in 2007/2008.

Apart from the one department that essentially broke even in 2007/2008, the overall deficits across all activities for the physics departments in 2007/2008 for which full income and cost data are available are clustered between 6 and 35%. The average deficit for all of the physics departments was 18.1%. For the five departments in English universities that were common to both studies, and for which reliable cost and income data were available, the average deficit narrowed from 33.1% in 2003/2004 to 9.4% in 2007/2008.

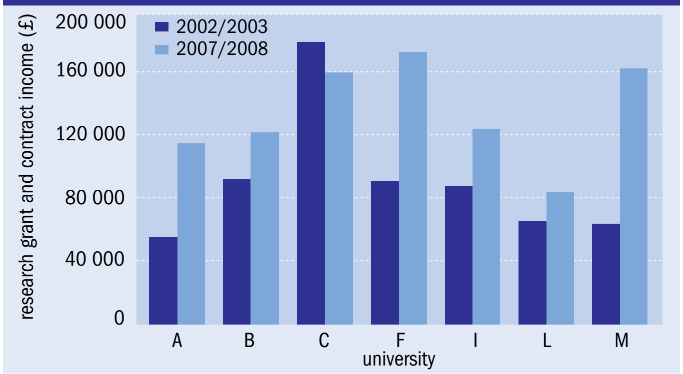
Table 7b: Research income by category for the physics departments for which full data were available (11 departments) in 2007/2008

University	Research income from public sources (£000s)					Research income from non-public sources (£000s)	
	Main QR	Other funding council	UK research councils	Other publicly funded research grants and contracts	Home and EU PGR student fees	Non-publicly funded research grants and contracts	Overseas PGR student fees
A	298	287	1733	314	101	457	99
B	1792	397[1]	3832	336	672[2]	361	123
D	1446	725	2783	726	1592[2]	230	86
F	1174	611	3456	968	717[2]	559	272
G	1540	451	2674	238	188	41	106
H	2120	408	7177	215	327	633	122
I	1259	437	6094	906	240	236	125
J	262	222	1265	227	118	178	60
K	4029[3]	nil	9116	3928	585	1015	122
L	965[3]	216	3746	188	317	703	83
M	1123	nil	3588	263	151	140	90

[1]Includes HEFCE specific research grants. [2]Includes Research Training Support Grants. [3]May include a significant amount of funding provided by the Scottish Funding Council under the research funding pooling arrangements arising from the establishment of the Scottish Universities Physics Alliance (SUPA) collaboration.

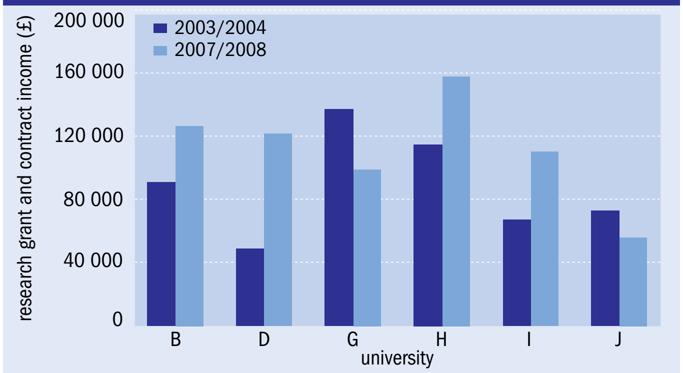
Source: institutional data.

Figure 6a: Comparison of research grant and contract income per FTE member of permanent academic staff for the chemistry departments common to both samples between 2002/2003 and 2007/2008



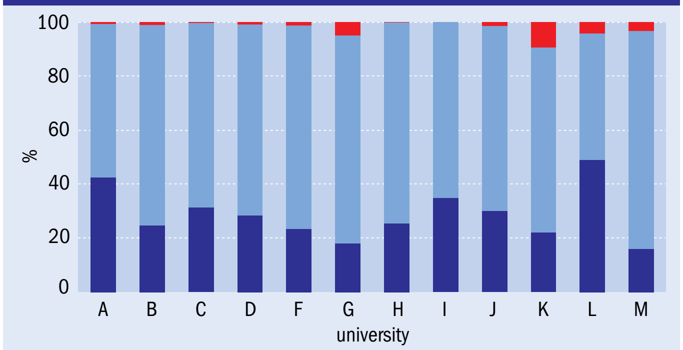
Source: institutional data, calculations by Nigel Brown Associates.

Figure 6b: Comparison of research grant and contract income per FTE member of permanent academic staff for the physics departments common to both samples between 2003/2004 and 2007/2008



Source: institutional data, calculations by Nigel Brown Associates.

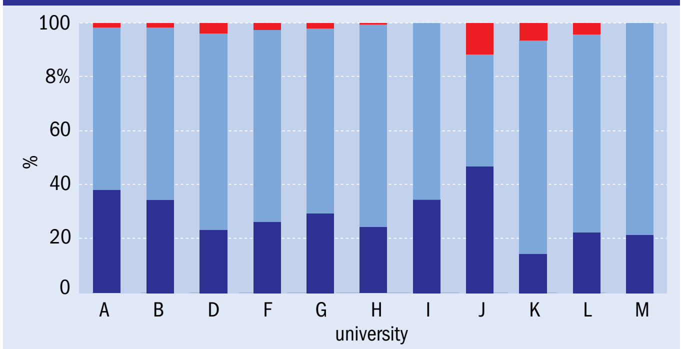
Figure 7a: Distribution of total income by activity for the chemistry departments in the sample for which full data were available in 2007/2008



	A	B	C	D	F	G	H	I	J	K	L	M
other	52	196	50	80	172	540	8	0	205	1507	433	414
research	4196	15 205	12 765	6428	11 297	8598	8349	5932	10 181	11 073	5143	10 106
teaching	3137	5032	5877	2599	3496	2006	2847	3182	4476	3590	5128	1999

Source: institutional data (12 departments).

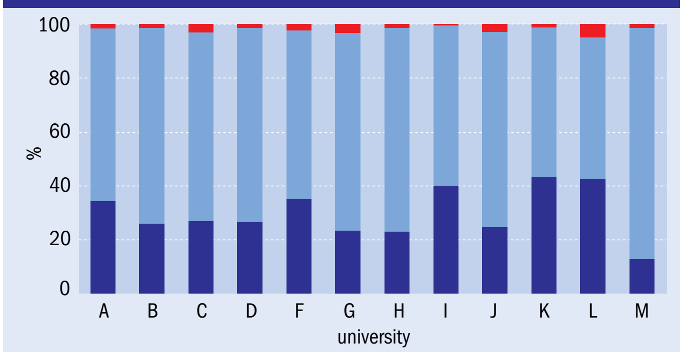
Figure 7b: Distribution of total income by activity for the physics departments in the sample for which full data were available in 2007/2008



	A	B	D	F	G	H	I	J	K	L	M
other	84	154	382	250	128	39	0	636	1465	333	0
research	3289	7513	7588	7757	5238	11 002	8985	2322	18 795	6218	5335
teaching	2098	4203	2456	2864	2252	3603	4985	2621	3441	1903	1482

Source: institutional data (11 departments).

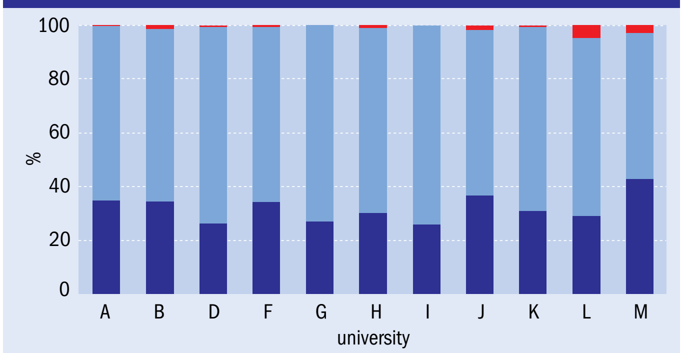
Figure 8a: Distribution of academic staff time by activity for chemistry departments for which full data were available in 2007/2008



	A	B	C	D	F	G	H	I	J	K	L	M
other	1.5	1.4	3	1.4	2.3	3.2	1.4	0.4	2.9	1.2	5	1.4
research	64.9	72.6	70	71.8	62.6	73.4	75.6	59.2	72.5	55.3	52.5	85.7
teaching	34.6	26	27	26.6	35.1	23.4	23	39.8	24.6	43.5	42.5	12.9

Source: institutional data (12 departments).

Figure 8b: Distribution of academic staff time by activity for physics departments for which full data were available in 2007/2008



	A	B	D	F	G	H	I	J	K	L	M
other	0.2	1.4	0.5	0.6	0	1	0	1.6	0.5	4.7	2.8
research	65	64.2	73.3	65.1	73	68.8	74	61.7	68.5	66.2	54.3
teaching	34.8	34.4	26.2	34.3	27	30.2	26	36.7	31	29.1	42.9

Source: institutional data (11 departments).

Table 8a: Split of total research income of chemistry departments for which full data were available (11 departments) between public and non-public sources in 2007/2008

	Publicly funded income (£000s)	Non-publicly funded income (£000s)	Total research income (£000s)	Non-publicly funded income as a percentage of total
A	3709	487	4196	11.6
B	13 914	1291	15 205	8.5
C	10 546	2219	12 765	17.4
D	6069	359	6428	5.6
F	9753	1544	11 297	13.7
G	8006	592	8598	6.9
H	7437	912	8349	10.9
J	8268	1913	10 181	18.8
K	9214	1859	11 073	16.8
L	3991	1152	5143	22.4
M	6982	3124	10 106	30.9
Mean	**7990**	**1405**	**9395**	**15.0**

Source: institutional data, calculations by Nigel Brown Associates.

Table 8b: Split of total research income of physics departments for which full data were available (11 departments) between public and non-public sources in 2007/2008

	Publicly funded income (£000s)	Non-publicly funded income (£000s)	Total research income (£000s)	Non-publicly funded income as a percentage of total
A	2733	556	3289	16.9
B	7029	484	7513	6.4
D	7272	316	7588	4.2
F	6926	831	7757	10.7
G	5091	147	5238	2.8
H	10 247	755	11 002	6.9
I	8936	361	9297	3.9
J	2094	238	2332	10.2
K	17 658	1137	18 795	6.1
L	5432	786	6218	12.6
M	5125	230	5355	4.3
Mean	**7140**	**531**	**7671**	**6.9**

Source: institutional data, calculations by Nigel Brown Associates.

Table 9a: Total teaching income and costs for the sample of chemistry departments for which full data were available (11 departments) in 2007/2008

	Teaching income (£000s)	Teaching costs (£000s)	Surplus/deficit (£000s)	Percentage of income
A	3137	3326	−189	−6.0
B	5032	5600	−568	−11.3
C	5877	5818	+59	+1.0
D	2599	2341	+258	+10.0
F	3496	3710	−214	−6.1
G	2006	2981	−975	−48.6
H	2847	3991	−1144	−40.2
I	3182	3849	−667	−21.0
J	4476	4308	+168	+3.8
K	3590	6365	−2775	−77.3
M	1999	3120	−1121	−56.1

Source: institutional data, calculations by Nigel Brown Associates.

Table 9b: Total teaching income and costs for the sample of physics departments for which full data were available (10 departments) in 2007/2008

	Teaching income (£000s)	Teaching costs (£000s)	Surplus/deficit (£000s)	Percentage of income
A	2098	2456	−358	−17.1
B	4203	4195	+8	+0.2
D	2457	2070	+387	+15.8
F	2864	3094	−230	−8.0
G	2252	2950	−698	−31.0
H	3523	4042	−519	−14.7
I	4895	3477	+1418	+29.0
J	2621	2741	−120	−4.6
K	3441	8234	−4793	−139.3
M	1482	2299	−817	−55.1

Source: institutional data, calculations by Nigel Brown Associates.

Table 10a: Total research income and costs for the sample of chemistry departments for which full income and cost data were available (10 departments) in 2007/2008

	Research income (£000s)	Research costs (£000s)	Surplus/deficit (£000s)	Percentage of income
A	4196	6082	−1886	−44.9
B	15 205	16 533	−1328	−8.7
C	12 765	19 457	−6692	−52.4
D	6428	7346	−918	−14.3
F	11 297	13 543	−2246	−19.9
G	8598	12 029	−3431	−39.9
H	8349	13 308	−4959	−59.4
I	5932	10 554	−4622	−77.9
J	10 181	15 215	−5034	−49.4
K	11 073	13 653	−2580	−23.3
Mean	**9402**	**12 772**	**−3370**	**−35.8**

Source: institutional data, calculations by Nigel Brown Associates.

Table 10b: Total research income and costs for the sample of physics departments for which full income and cost data were available (10 departments) in 2007/2008

	Research income (£000s)	Research costs (£000s)	Surplus/deficit (£000s)	Percentage of income
A	3289	4517	−1228	−37.3
B	7513	8261	−730	−9.7
D	7588	8889	−1301	−17.1
F	7757	9987	−2230	−28.7
G	5238	5956	−718	−13.7
H	11 002	13 161	−2159	−19.6
I	9297	10 283	−986	−10.6
J	2322	4174	−1852	−79.8
K	18 795	22 827	−4032	−21.5
M	5335	5400	−65	−1.2
Mean	**7814**	**9346**	**−1532**	**−19.6**

Source: institutional data, calculations by Nigel Brown Associates.

Table 11a: Total income and TRAC-based costs for all activities for the sample of chemistry departments for which full income and cost data were available (10 departments) in 2007/2008

	Total income (£000s)	Total costs (£000s)	Surplus/deficit (£000s)	Percentage of income
A	7385	9525	−2140	−29.0
B	20 433	23 751	−3318	−16.2
C	18 692	25 677	−6985	−37.4
D	9107	9711	−604	−6.6
F	14 965	17 308	−2343	−15.7
G	11 144	15 431	−4287	−38.5
H	11 204	17 976	−6772	−60.4
I	9114	14 462	−5348	−58.7
J	14 862	19 727	−4865	−32.7
K	15 970	21 440	−5470	−34.3
Mean	**13 288**	**17 501**	**−4213**	**−31.7**

Source: institutional data, calculations by Nigel Brown Associates.

Table 11b: Total income and TRAC-based costs for all activities for the sample of physics departments for which full income and cost data were available (10 departments) in 2007/2008

	Total income (£000s)	Total costs (£000s)	Surplus/deficit (£000s)	Percentage of income
A	5385	7067	−1682	−31.2
B	11 870	12 946	−1076	−9.1
D	10 426	11 063	−637	−6.1
F	10 871	13 220	−2349	−21.6
G	7618	9078	−1460	−19.2
H	14 644	17 317	−2673	−18.3
I	14 326	13 760	+566	+4.0
J	5579	6968	−1389	−24.9
K	23 701	32 061	−8360	−35.3
M	6817	8010	−1193	−17.5
Mean	**11 124**	**13 149**	**−2025**	**−18.2**

Source: institutional data, calculations by Nigel Brown Associates.

6: Analysis and conclusions

These data show that both chemistry and physics departments were, by and large, operating in deficit overall in 2007/2008 on the basis of TRAC-based costs. The average deficit for the physics departments as a whole was lower than that for the chemistry departments. This position is reflected in departmental budgets where nearly all chemistry departments were in deficit in 2007/2008 on the basis of the university resource allocation models, but around half of the physics departments were operating in surplus or close to breaking even on the same basis.

On the basis of TRAC-based costs, the majority of chemistry and physics departments for which full data were available in England were close to breaking even or even in surplus on total teaching activity. The lower level of funding for teaching per student in the departments in universities in the other countries of the UK generated higher deficits on teaching activity in these departments.

On the other hand, nearly all chemistry and physics departments were in deficit on research activity. The average deficit for chemistry departments was significantly higher than that for physics departments in 2007/2008 and this was the principal reason for the lower overall deficits for the physics departments.

It is clear that, while most universities recognise that the deficits in chemistry and physics departments reflect the high inherent costs of the disciplines, they maintain pressure on them to minimise the deficits. Nevertheless, in some cases implicitly and in at least one case explicitly through increasing funding beyond the HEFCE level of resource, the universities concerned accept that the deficit is not amenable to reduction through simply applying good management.

Teaching

Although reliable TRAC data were only available for 2002/2003 for a limited number of the chemistry departments and in 2003/2004 for slightly more of the physics departments, the finances of teaching have improved substantially for chemistry and physics departments in English universities since the earlier studies. This is to be expected given the substantial increase in full-time undergraduate fees for students entering from 2006/2007 and the extra funding for strategically important and expensive laboratory-based subjects from 2007/2008. Both chemistry and physics departments benefited from the extra funding and will continue to do so as it is now a recurrent fund. On the other hand, the increased tuition fees applied from 2006/2007 in Northern Ireland and from 2007/2008 in Wales; they do not apply in Scotland. Furthermore, the extra funding for strategically important and expensive laboratory-based subjects is only available to English universities.

This contrast is reflected in the data for 2007/2008, with much higher deficits on teaching activity in those departments in countries of the UK other than England.

The finances of teaching of at least some of the chemistry and physics departments have been helped by increased full-time undergraduate enrolments, particularly in the chemistry departments in English universities and in the physics departments more widely. For chemistry departments this has led to some increase in student to permanent academic staff ratios since 2003 and for both chemistry and physics departments to a reduction in space per FTE total academic staff (permanent staff plus contract staff). The data show a mixed pattern of change in staffing levels since the two earlier studies and this is likely to reflect the balance of changing demands from teaching and research activities.

The differential impact on income and costs of teaching can be seen from the data[21] from the institutions common to both samples for the two years set out in tables 12a (p26) and 12b (p27) for chemistry and physics, respectively.

There are several tentative conclusions that can be drawn from these limited data:

- The improvement in the financial position of teaching has arisen both from increased income per student and from downward pressure on unit costs from increased enrolments making use of spare capacity. In the case of two chemistry departments, they benefited from a substantial increase in student numbers following the closure of another department.
- The much lower increase in unit costs per FTE student for physics departments suggests that there may have been greater spare capacity in physics departments in 2003/2004 and perhaps also that chemistry departments faced some increases in costs, such as health and safety, which were not directly within departmental control. However, the cost data for the earlier years must be treated with caution because in 2002/2003 and 2003/2004 universities were at the development stage with TRAC.
- The financial position in departments outside England is markedly different because of the different tuition-fee regimes, especially in Scotland where tuition fees remain lower than elsewhere in the UK, and in Wales where the introduction of the increased fees was delayed until 2007/2008. In addition, the per capita extra funding for strategically important and expensive laboratory-based subjects does not apply outside England.

The prospects for the future financial position of

21. The comparisons of the cost data should be treated with a degree of caution because institutions are known to have improved their application of the TRAC methodology, which has itself also been subject to change through the development of TRAC (T).

Table 12a: Income and costs per FTE student for teaching in chemistry departments common to both samples for which full data were available in 2002/2003 and 2007/2008

University	2002/2003			2007/2008		
	Income per FTE student (£)	Costs per FTE student (£)	Surplus/deficit per FTE student (£)	Income per FTE student (£)	Costs per FTE student (£)	Surplus/deficit per FTE student (£)
A	4904	9502	−4598	9146	9696	−550
B	5570	8498	−2928	9763	10 862	−1099
F	5814	6790	−976	8589	9115	−526
M	6054	6778	−724	6849	10 684	−3835

Source: institutional data, calculations by Nigel Brown Associates.

teaching are not as good for a number of reasons:

- Teaching income per student will continue to rise until 2009/2010 as the full impact of the higher variable-fee regime works through in England and Wales, but thereafter the position on income is very uncertain. The Westminster government has already imposed a significant reduction in planned HEFCE funding for 2010/2011 and the two subsequent years. There is likely to be significant pressure for further reductions in public expenditure in subsequent years, which will affect higher-education income. Even if the forthcoming review of variable fees recommends a raising of the fee cap, it is difficult to see how, in the current public expenditure climate, this can be achieved without significant additional contributions from individuals, given that the current loans system requires public funding upfront.
- At the same time there are significant upward pressures on costs. Since the introduction of a new pay framework for university staff from 2006, with increased opportunity to pay key staff market supplements coupled with two recent above-inflation pay settlements, staffing costs have risen substantially above the level of increase in public funding and this will increase baseline costs. The pressure for market supplements may be driven by the need to retain high-performing research staff, but this inevitably feeds into the costs of teaching. In addition, from 2010 there are prospective increases in employer national insurance rates and increased pension contributions to the Universities Superannuation Scheme.
- Finally, unless chemistry and physics can increase their share of total new entrants, the number of undergraduates may decline again in the face of the decrease in the number of 17 and 18 year olds in the UK population between 2010 and 2019. It will be more difficult for departments to contain unit costs as they have done over the last four or five years.

The data here take no account of whether the current level of resources for teaching in chemistry and physics departments is sufficient to sustain high-quality provision in the universities concerned. A recent report[22] by JM Consulting for the Financial Sustainability Strategy Group[23] shows, that across a range of disciplines and institutions, the continuing cost pressures on teaching are such that current resourcing levels appear to be a threat to the quality and sustainability of higher education. The data used in the follow-up study do not take into account whether the current level of resources for teaching in chemistry and physics departments is sufficient to sustain high-quality provision in the universities concerned. Also, the data used in the current study were not gathered to pursue the question of the sustainability of current provision directly. However, the RSC and IOP, either separately or jointly, may wish to consider commissioning work along the lines of a national study that addresses these issues as they relate to higher-education teaching in chemistry and physics.

Research

The continuing research deficits reflect several factors:

- Although the research councils (which represent a high proportion of the research grant and contract income of chemistry and physics departments) and some government departments are seeking to move to determining grants on the basis of full economic costing, the initial stage has been to increase the overhead element short of full economic costing.
- The increase in overhead rates is being phased in by the research councils, with existing contracts continuing to be funded at the then current overhead rate.
- Research spend in 2007/2008 reflects the effort by institutions to secure the best possible rating in the RAE 2008. The proportion of academic staff time spent on research may well have increased, shifting costs from teaching to research.
- There are a number of funding streams that support the training and living costs of postgraduate research students. It is not clear how far this income takes into account the full economic cost of this activity.

Deficits on research activity occur across a wide range of disciplines and the nature of these deficits and their causes continues to be the subject of debate within the sector. The Department for Business, Innovation and Skills has recently established a review of the full economic costing system in relation to research.

22. *The Sustainability of Learning and Teaching in English Higher Education* Financial Sustainability Strategy Group December 2008. See www.hefce.ac.uk/finance/fundinghe/trac/fssg/.

23. The Financial Sustainability Strategy Group (FSSG) is a high-level forum that considers the strategic, policy, cultural and technical issues around the use and development of TRAC. It aims to meet institutions' needs for management information for decision-making and to satisfy accountability requirements, and inform public policy and funding decisions at a high level.

Table 12b: Income and costs per FTE student for teaching in physics departments common to both samples for which full data were available in 2003/2004 and 2007/2008

University	2003/2004			2007/2008		
	Income per FTE student (£)	Costs per FTE student (£)	Surplus/deficit per FTE student (£)	Income per FTE student (£)	Costs per FTE student (£)	Surplus/deficit per FTE student (£)
B	5912	8405	−2493	9501	9506	−5
D	5488	7044	−1556	9001	7585	+1416
G	5860	10 352	−4492	8159	10 688	−2529
I	6103	5240	+863	8309	6089	+2220
J	5085	8066	−2981	8982	9393	−411

Source: institutional data, calculations by Nigel Brown Associates.

This will be chaired by Sir William Wakeham, former vice-chancellor of the University of Southampton. It is understood that the aim of the review is to provide reassurance about how funding based on full economic costs is used and how it contributes to sustainability.

Although HEFCE has adjusted its QR funding for 2009/2010, following the availability of the results of the 2008 RAE, to ensure that the proportion of total mainstream QR allocated to each main panel subject group in science, engineering, medicine and mathematics is not less than in 2008/2009, some chemistry and physics departments may receive less QR funding than they had expected. This could clearly impact on their financial position.

As with teaching, research activity faces the twin pressures of a much tighter public expenditure regime over the next few years and increased cost pressures, especially in respect of staff costs and equipment. While the government may wish to offer some protection to investment in scientific research, it seems likely that there will be increased competition for the resources that are available. The cost pressures are likely to increase competition for limited funds further. Even if it is possible to reflect cost pressures in grant submissions, they may limit the number of good proposals that can be funded. All of this may serve to reduce the efficiency of the use of the research infrastructure in chemistry and physics departments.

The competition for support for physics research has been intensified by the financial difficulties encountered by the Science and Technology Facilities Council.

Conclusions

The financial position, as measured by the balance between departmental income and TRAC-based costs of chemistry and physics departments, has improved since the earlier studies undertaken for the RSC in 2004 using data for 2002/2003 and for IOP in 2005 using data for 2003/2004. The main improvement has come from increased income and some holding of the costs per student for teaching through increased undergraduate enrolments. There continue to be significant deficits on research activity with considerably higher deficits in chemistry departments than physics departments in the sample. This difference might reflect the higher proportion of physics research that is undertaken at national and international facilities, which are not included in the calculations.

The pressures to reduce public expenditure in the face of the current economic crisis and the cost pressures, particularly in relation to staff costs, suggest that the financial position of chemistry and physics departments may deteriorate over the next few years. Within the general financial climate it may prove more difficult to protect them, especially if demand from home and EU undergraduates should fall, particularly in response to the demographic decline in the number of 17 and 18 year olds in the UK.

Chemistry and physics departments are highly dependent on public funding. In 2007/2008 on average 84% of total income in chemistry departments and 89% in physics departments came from public funds. It is inevitable that their financial position will depend heavily on the metrics used to distribute public funding. For instance, it is imperative that the funding councils, in light of current and prospective budgetary restraints, maintain their existing support for initiatives that prioritise STEM subjects, such as chemistry and physics. This especially applies to HEFCE's recurrent targeted allocation of £25 m per annum to strategically important and expensive subjects, which compensates for the shortfall in the unit of resource for teaching; any cuts to this allocation could affect the viability of chemistry and physics departments, with the potential threat of closure for the smaller ones.

In addition, there may be particular difficulties for chemistry and physics departments in the other countries of the UK, which have not benefited to the same extent as departments in English universities from increased funding for teaching in recent years. The devolved administrations need to look at their attitudes to funding higher education in response to the wider fiscal constraints that they will face over the next few years.

None of this takes account of the additional cost requirements to sustain high-quality provision in chemistry and physics. The RSC and IOP may wish to commission further work on the risks to long-term sustainability.

The Institute of Physics (IOP) is a scientific charity devoted to increasing the practice, understanding and application of physics. It has a worldwide membership of more than 36 000 and is a leading communicator of physics-related science to all audiences, from specialists through to government and the general public. Its publishing company, IOP Publishing, is a world leader in scientific publishing and the electronic dissemination of physics.

The Royal Society of Chemistry (RSC) is the UK professional body for chemical scientists and an international learned society for advancing the chemical sciences. Supported by a network of more than 47 000 members worldwide and an internationally acclaimed publishing business, its activities span education and training, conferences and science policy, and the promotion of the chemical sciences to the public.

Follow-up Study of the Finances of Chemistry and Physics Departments in UK Universities

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