research report

size matters:
economies of scale in schools and colleges

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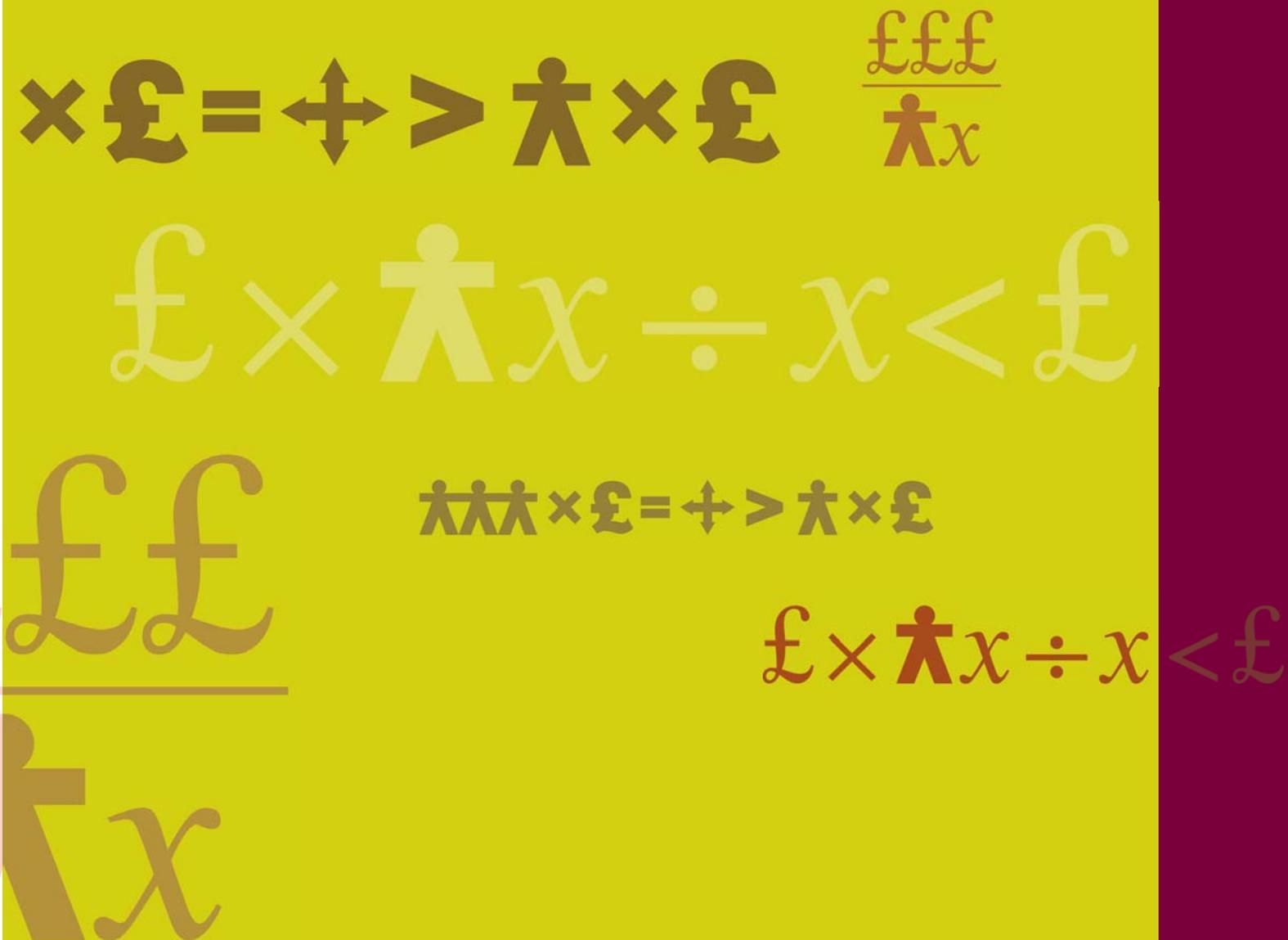
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size matters: economies of scale in schools and colleges

An institution needs substantial numbers of students if it is to exploit to the full the available economies of scale. This report reviews the relationship in England between institutional size and the cost of Level 3 (mainly A-level) provision in three major settings: sixth form colleges (SFCs), general further education colleges (GFECs) and school sixth forms (SSFs).

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Contents

1. Introduction

This report reviews the relationship in England between institutional size and the cost of Level 3 (mainly A-level) provision in three major settings: sixth form colleges (SFCs), general further education colleges (GFECs) and school sixth forms (SSFs).

It is intended in part to inform discussion about the desirability of introducing an 'institutional efficiency factor' into Learning and Skills Council (LSC) funding arrangements, though such a step would require consideration of many factors, of which cost calculations are only one.

Level 3 provision is a major area of public expenditure. In 2004/05, taxpayers spent £4010m (LSC 2005a, p50) through the Learning and Skills Council on school sixth forms and on 16 – 18 year olds in further education, mainly on Level 3 provision, and there is further expenditure on adults (19+) learning at Level 3.

The study models how institutions might behave, given the funding regime and cost structures. It examines quantitative analysis of the accounts of substantially all of England's GFECs and SFCs (there are no corresponding data for school sixth forms), quantitative and qualitative data from 10 case-study institutions, and a range of other sources, including early results from the *Understanding costs* project (Fletcher and Lester 2006) from the Learning and Skills Development Agency. An important background source is the number of A2 awards made by the three examination boards in summer 2005, which offers a measure of the relative popularity of the 80 or so A2 courses available in England.

There is general acceptance that an institution offering a reasonable range of subjects at Level 3 needs a certain number of students for provision to be economically viable. An institution offering, say, 15 subjects at A2 to just 30 students would necessarily have small class sizes, and funding for those students would fall short of the cost of provision.

General acceptance of this point does not extend to consensus about how many students are required for viability or about the cost penalties associated with small size.

Main findings

The main finding of this study is that an institution needs substantial numbers of students if it is to exploit to the full the available economies of scale, and that the cost penalties associated with operation at a smaller size are large. This implies that the total cost of Level 3 provision in England is higher than it would be if it were concentrated in fewer institutions, and could rise still further if the number of institutions were to proliferate. Even modest percentage changes in cost within a budget of more than £4 billion can amount to tens or even hundreds of millions of pounds.

But the study is subject to certain limitations and qualifications. First, it is primarily about A-level provision, because this is where data quality is best. Second, it is about institutions offering a full range of provision, rather than offering just a few subjects and relying on neighbouring institutions to provide other subjects. Third, it takes no account of quality effects that may be associated with smaller class sizes. Fourth, it takes no account of travel-to-learn times, which may well justify operation on a small scale, especially in rural areas. Fifth, it is based on data that are not generally well adapted to the purposes of the study, and that have various defects. Finally, the data permit only simple modelling – we have, for instance, been unable to assess the impact of differing numbers of subjects being

studied per student, even though there are reasonable grounds for supposing that a greater number of subjects per student will raise efficiency.

For all of these reasons, the study is an initial assessment of the facts relating to this major subject, rather than a definitive analysis. Nonetheless:

We find strong evidence for systematic economies of scale.

- College accounts show clear links between financial performance and college size.
- Modelling helps illustrate and quantify the opportunities for economies.
- Case studies confirm the broad assumptions that underpin our model.

The analysis suggests the following.

- Institutions with significantly fewer than 200 A-level students (a year cohort averaging 100) require substantial subsidy, even where they offer only a restricted choice of subjects.
- Institutions with between 200 and 500 students can offer efficient provision but only by restricting choice.
- Institutions with 500 students or more can offer wide subject choice and lower unit costs, though modest economies of scale persist up to 1000 students and perhaps even beyond that point.
- Cost penalties can be very large: unit costs may be twice as high with 100 students as with 500, if comparable subject choice is offered.

These are the implications.

- Efficiency needs to be taken into account when contemplating new provision.
- Large institutions offer significant advantages in terms of cost and learner choice.

1.1 Study objectives

The original purpose of the research was to inform discussion about whether it is desirable to introduce an institutional efficiency factor into LSC funding arrangements, through empirical and modelling work to illustrate the potential scale of efficiency gains under a range of circumstances. The specific objectives were to:

- gather data about institutional practices related to efficiency, for example class size management
- model the potential for efficiency gains under a number of scenarios
- assess whether the differential capacity to achieve efficiency gains is sufficiently clear and on a sufficient scale to justify its explicit inclusion in LSC funding.

The funding formula provided an essential element of the background to the study. The incorporation of colleges saw, for the first time, the use of a common funding formula across the whole English further education (FE) sector. With the establishment of the Learning and Skills Council, the formula was extended to school sixth form and adult and community learning (ACL) provision.

The formula's conceptual basis appears to be to fund the necessarily incurred average costs of provision, subject to the availability of funding. It recognises explicitly that costs vary from subject to subject, from area to area, and from learner to learner. It does not include an institutional factor, though it has been suggested variously that scale, rurality or

split sites might influence costs to an extent sufficient to justify explicit recognition in the formula. The LSC's *Agenda for Change* (2005b) does, however, envisage a 'provider factor' in the formula.

The absence of an institutional factor implies either that all institutions are capable of being equally efficient (or that differences in achievable efficiency are small) or that efficiency is a matter for the institution alone and not the system. This study starts from the view that the first statement is probably false and the second unwise. Evidence on the first point has arisen incidentally during studies of the specialist colleges uplift (Fletcher 2004) and of the funding gap between schools and colleges (Fletcher and Owen 2005). On the second point, omission of an institutional efficiency factor risks systematically under-funding some institutions or over-funding others.

1.2 Methodology

The study's methodology was straightforward, and was conditioned by the resources available for the project, the availability of data and the experience of projects such as LSDA's *Understanding costs* study (Fletcher and Lester 2006).

Past and current experience of work on college and school efficiency – such as *Understanding costs* – indicates that primary information is obtainable only as a result of painstaking and careful work with individual institutions.[1] The resources available for this study were modest (about 40 days' work, in total), and insufficient for primary research on any significant scale.

Accordingly, it was decided to concentrate on analysis of secondary data on college finances collated and published by the Learning and Skills Council and on a limited number of case studies. The purpose of the case studies was to access the views of senior managers in schools and colleges and to ask them, as individuals and as representatives of institutions as a whole, what practices were relevant to our study.

We concentrated on economies of scale, since this appears to be the main institution-specific factor influencing costs; and on A-level provision as an area where reasonably good data are available and as the dominant area in terms of volume of provision.

1.3 Previous research

Trading places, a 1996 Audit Commission report, is – perhaps surprisingly given the high level of expenditure – the most recent quasi-official statement on the subject. The critical paragraph is worth quoting at length:

> *A 1985 DES report* [Better schools] *suggested that 150 was the minimum size for a sixth form to be able to offer a cost-effective and full range of course options (although the report recognised that smaller sixth forms might be viable where there were cooperative arrangements). And the diversification of post-16 course options (for example the introduction of GNVQs) has led some educationalists to argue that 250 is a more realistic minimum size for adequate provision of a full range of options, given current teaching methods. On the other hand, a 1996 Ofsted report* [Effective sixth forms] *indicates that a school sixth form may be educationally and financially viable with fewer than 150 pupils if it focuses on a narrow range of provision. An appropriate size of sixth form will therefore vary,*

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[1] The work so far from *Understanding costs*, though of just this painstaking kind, is inconclusive.

depending on the range of courses offered. But Audit Commission research indicates that, in practice, it is around the Better Schools *threshold that sixth forms become more likely to require subsidy from the rest of the schools budget.* (p17)

The report presents data on 30 schools, showing that the seven school sixth forms in the sample with more than 160 students were all either in financial balance or making a net contribution to the school budget. Of the remaining 23 school sixth forms, all with fewer than 160 students, about two-thirds (15) required 'subsidy from the rest of the school budget'.

The government's current plans for establishing new school sixth forms state that 'whether the proposals represent a cost-effective use of public funds'[2] is one criterion for deciding on proposals to establish sixth forms. LSC guidance (2005c) indicates that:

> *Provision is recommended at not less than the average size of sixth forms inspected by Ofsted (173 students) and preferably over 200 students, which is the number at which Ofsted reports that a sixth form would, generally, be able to offer a range of 20 or more A-levels, with three or four Advanced Vocational Certificates of Education (AVCEs) or equivalent. Competitions for new 16–19 provision will be held where a need is identified for 200 or more new 16–19 places to meet basic need. Proposals for new 16–19 provision for fewer than 200 students will be invited at the discretion of the LSC.* (LSC 2005c)

1.4 Structure of this report

The remaining sections of this report are as follows:

Section 2 presents hypotheses about how institutions organise their Level 3 activity. It draws on the authors' own experiences as well as on the information derived from the case studies and other interactions with institutions during this study.
Section 3 briefly summarises the data sources that we have used. These are presented in detail in Sections 4 to 7.
Section 4 reviews college accounting data from the LSC website – there are, unfortunately, no corresponding data for school sixth forms.
Section 5 reviews national data on A2 examination awards, using these as a measure of the relative popularity of different subjects.
Section 6 presents mainly qualitative data from the 10 case-study institutions, though it includes some *ad hoc* quantitative data as well.
Section 7 presents the main quantitative data sets on Level 3 student numbers collected from each of the case-study institutions and relates the data to observed national patterns of provision.
Section 8 offers concluding comments.

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[2] At the time of writing, the detailed proposals were the subject of consultation. The relevant consultation draft is at:
www.dfes.gov.uk/consultations/downloadableDocs/Annex%20B%20Draft%20Statutory%20Guidance%20for%20decision%20makers%20-%20competitions.doc

2. Context: institutional behaviour

The authors' past observations of schools and colleges, which were confirmed during this study, suggest that the points listed below and then discussed in turn offer a reasonable summary description of the institutional context:

- an incentive to produce surpluses
- a disincentive to produce large surpluses
- varying financial management
- systematic scale economies
- weak links between surplus and scale economies
- scale economies that depend on teaching staff costs
- an incentive to improve the student experience.

An incentive to produce surpluses

Institutions have powerful, inter-linked incentives to pursue financial stability, to produce modest surpluses and to accumulate funds for capital projects.

There is a consensus across our case studies, other work in this project and the authors' wider work with schools and colleges, that surpluses are not an objective in themselves. But all institutions aim to avoid deficits – indeed they have a formal responsibility to do so – and because it is never possible to plan for exact financial balance, there is an implicit requirement to aim for at least a small surplus. Moreover, many individual institutions aim at larger surpluses: to contribute to capital project costs, to 'repay' past deficits, or simply to build a modest financial cushion of accumulated surpluses.

A disincentive to produce large surpluses

Although there are genuine incentives to pursue surpluses, institutions with the potential to achieve large surpluses feel obliged to re-invest those surpluses in improving the student experience. This means that large potential surpluses may not be visible in accounting data.

One way in which larger institutions 'invest' is to offer a wide choice of subjects, often including subjects that are not viable in isolation. Other ways, described to us, of improving the student experience are provision of better facilities, such as laboratory and ICT equipment, of more teaching support staff and of better buildings than might otherwise be possible.

A more general point has been made in relation to sixth form colleges, where the greatest scale economies at Level 3 might be expected because they have the largest groups of Level 3 students on similar programmes. Those (underlying) economies might offer them the opportunity to improve the overall student experience across the board. In 2004/05, 'premium' funding was offered where providers could demonstrate progress against their 3-year development plans and provide evidence of excellence, through either inspection reports or success-rate data for 2001/02 and 2002/03. In 2004/05, 43% of sixth form colleges, but only 6% of general FE colleges, were able to do this. It is at least conceivable that scale effects were one determinant of this differential.

Varying financial management

In the view of our interviewees – and this is confirmed by our own experience – the effectiveness of financial management varies considerably across institutions, and the

specific financial circumstances of individual institutions also differ. As a result, there are enormous differentials in financial performance. This 'noise' means that the economies of scale noted later in this report are observable only on average.

Systematic scale economies

Notwithstanding variability across institutions, there are powerful *a priori* reasons to expect economies of scale associated with the commonsense view that it must be more economical to teach the larger classes that are possible only where provision is on a large scale. It should, however, be carefully noted that the scale effects result from having large numbers of students doing similar things – a large institution may be unable to benefit from economies of scale if its students are spread in small numbers across a diverse set of programmes.

Weak links between surplus and scale economies

Because of the disincentive to generate large surpluses noted above – or to put it another way, because of the incentive to invest potential surpluses in improving the student experience – we would expect to observe only a weak relationship between size and surplus, though as we shall see there was in fact a reasonably strong relationship of this kind among colleges (no comparison being possible for school sixth forms).

Scale economies and teaching costs

We would expect to find scale economies reflected most markedly in teaching staff costs, since the main impact of scale is to allow improved group sizes.

Improving the student experience

We would expect to find evidence of the use of potential surpluses to improve the student experience through better support facilities, equipment, ICT, and also – as explicitly suggested to us – by improving the pay and conditions of staff, and thus potentially supporting better teaching. This may partially offset observable economies in teaching staff costs.

3. Data sources: summary

This study has drawn on the following data sources:

- LSC data on the accounts of colleges
- national data on the volume of A2 provision; specifically, A2 awards made by the examination boards in summer 2005
- qualitative and quantitative data from the case-study institutions.

The use of these data is discussed in full in Sections 4 to 7.

LSC data on college accounts

Section 4 presents data on the accounts of colleges taken from the LSC website. Despite some minor omissions and errors, this source offers a near-complete set of the accounts of all English colleges and an analysis of income and costs.

Against these advantages must be set the disadvantages that the data do not cover schools, and that they include all forms of college activity – not just the Level 3 activity with which this project is primarily concerned.

For simplicity, we have examined only the accounts of general FE colleges and sixth form colleges. We have not examined the accounts of tertiary and various specialist colleges. The SFC accounts relate mainly to Level 3 activity, but the pattern in general FE colleges is much more varied. Nonetheless, the accounting data provide striking evidence of economies of scale and suggest patterns of behaviour consistent with the hypotheses advanced in Section 2.

National data on A2 provision

For the national data on the volume of A2 provision (Section 5), we use as a measure the A2 awards made by the examination boards in summer 2005. The data are complicated by differing syllabuses and subject titles from one board to another. Although awards were made in almost 200 A2 subjects, we concluded that there are in reality about 80 distinct subjects on offer at A2 in England, and that in many subjects volumes are small.

The main purpose in reviewing these data was to compare what the case-study institutions actually provide with what might be implied by the national data. If, for example, Institution Y provides 30 subjects, one might expect that those subjects would be the 30 most popular subjects nationally – to meet demand, maximise student numbers and thereby ensure institutional viability. One might also expect that if subject X attracts 1% of entrants nationally, it will account for about 1% of entrants at Institution Y. This has obvious implications: at an institution with 5000 entrants, 1% is several viable classes, but at an institution with 500 entrants, 1% is unlikely to yield even one class of viable size.

Case-study data

Quantitative data from the case studies (Section 7) indicate that the national data offer reasonable predictions about the behaviour and student numbers of these institutions. Although there are numerous deviations from what might be expected, the bulk of activity is explicable by the national 'model'. The deviations tend to be modest in scale and to have clearly identifiable causes – notably differing attitudes to the provision of General Studies and within the group of Art and Design subjects.

The qualitative findings (Section 6) consist mainly of management explanations of the nature of provision at A-level at the respective institutions and of how the economics of provision are handled. Much of this – it seems to us – is 'art and craft' rather than established and documented practice, and as a result this section provides the basis for a practice manual on the economics of provision and management of class sizes and subjects. Section 6 also includes considerable amounts of quantitative data – all, in fact, except the main quantitative data on student numbers generally presented to us in Excel format and analysed in Section 7.

These quantitative data from the case studies, typically in Section 7, comprise student numbers analysed by subject and by the two levels, AS and A2. These data enable us to compare the actual behaviour of individual institutions with predictions made on the basis of our hypotheses about institutional data. As noted, the institutions conform broadly to the expected pattern of behaviour, and most deviations from that pattern are readily explicable.

4. Data sources: college accounting data

The Learning and Skills Council collects and publishes on its website (www.lsc.gov.uk) details of the income and expenditure of colleges. We have used the data for 2002/03 for the calculations in this section. There are unfortunately no comparable data for schools.

We review, first, the general pattern of types of college and their overall size distribution, before turning to teaching staff costs and administration staff costs. There is evidence of economies of scale for both.

We then consider surpluses (or deficits) earned by colleges. Because there is a rigid relationship in the LSC system, for any college, that income equals cost plus surplus, a consideration of surplus brings into our analysis an implicit consideration of all elements of cost, not just the staff costs that we consider explicitly. Somewhat surprisingly, we find a strong scale effect in the data on college surpluses.

Finally in this section, we summarise our conclusions from the analysis.

4.1 General pattern of the data

The data are in principle comprehensive, but there are inevitably some omissions, mainly the result of colleges failing to submit their accounts on time. There were data on 387 (97%) of the 399 colleges on the database, as summarised in Table 4.1.

While there is Level 3 provision in all types of college, it was decided early in this study to concentrate on general FE and sixth form colleges as the largest groups, accounting for 86% of total income. No analysis of other types of college was undertaken.

Table 4.1 Number and total income of colleges in England, 2002/03
As recorded on www.lsc.gov.uk, mid-2005

	On database		With data		Income at the 387 colleges, £m				
	No	%	No	%	Total	%	Min	Max	Mean
General further education colleges	231	57.9	223	57.6	4096	75.3	4.3	57.1	18.4
Sixth form colleges	103	25.8	102	26.4	601	11.0	2.4	16.6	5.9
Tertiary colleges	26	6.5	26	6.7	481	8.8	4.4	48.7	18.5
Other colleges	39	9.8	36	9.3	265	4.9	2.4	32.3*	7.4
All colleges	399	100.0	387	100.0	5443	100.0	2.4	57.1	14.1

Maximum income among 'other colleges' of a conventional kind was £15.8m. The figure of £32.3m is for the Workers' Educational Association.

The table shows that GFECs (average income £18m) are much larger than SFCs (£6m), but the overlaps are considerable:

- About a fifth (47) of GFECs had incomes of less than £10m, a figure exceeded by five SFCs.

- The great majority (81) of SFCs were larger than the smallest GFEC.

The bulk of college income is derived from the Learning and Skills Council, with fees as a secondary source. There are many other sources of funding, and they may be significant for an individual college, but they are of relatively small importance across the FE sector as a whole.

Unfortunately for our purposes, the data source does not distinguish between income at Level 3 and other provision. The great bulk of SFC provision is at Level 3; as an approximation, we may regard them as Level 3 institutions. This is not the case for all or even most GFECs.

Our analysis in this section concentrates on an assessment of economies of scale, and it must be remembered that the analysis relates to institutions (SFCs and GFECs) as a whole, rather than simply to their Level 3 provision. Moreover, there are no comparable data for school sixth forms.

4.2 Teaching staff costs

The main advantage of scale is the ability to teach a reasonably broad AS and A2 programme in classes of larger average size. As teaching staff costs do not vary significantly with class size, we may expect the accounts to show an inverse relationship between institutional size as measured by income and the percentage of income absorbed by teaching staff.

The data presented graphically in Figures 4.1–4.3 relate only to teaching staff; however, many colleges use as a control variable the substantially higher figure of all staff costs including senior academic staff, teaching support staff and administrative staff.

Figure 4.1 Teaching staff costs as % of income by size of college measured in £000 of income (223 GFECs)
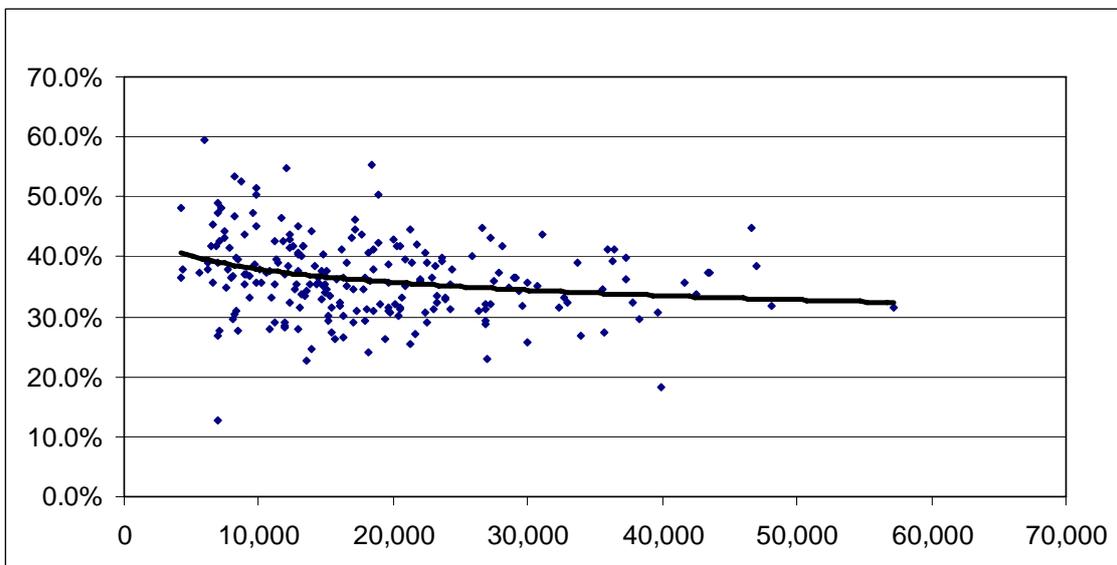
Figure 4.2 Teaching staff costs as % of income by size of college measured in £m of income (102 SFCs)
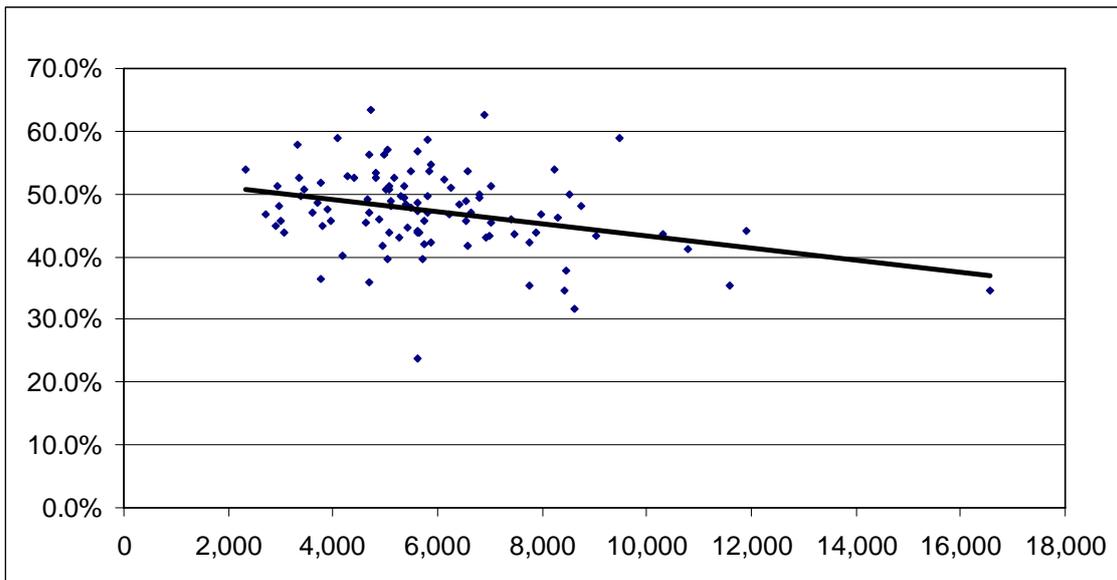
Figure 4.3 Teaching staff costs as % of income by size of college measured in £000 of income (325 GFECs and SFCs)
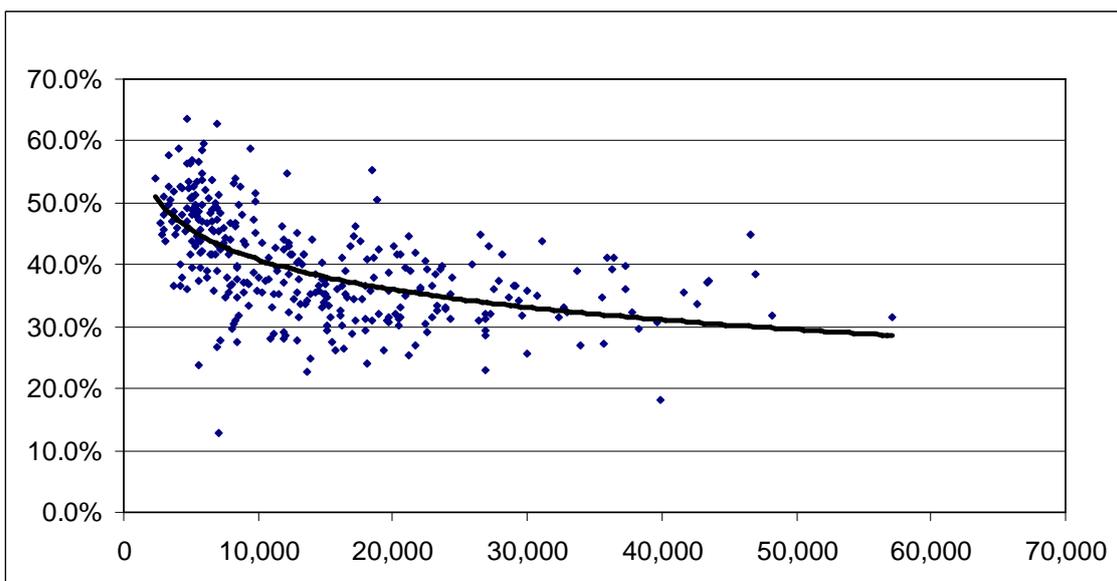
Table 4.2 presents similar information in a different way. The GFEC column shows the ten largest and ten smallest GFECs measured by income, as well as the ten GFECs closest in size to the ten largest SFCs. As one would expect from the graphs above, there is a size gradient, with the smallest group spending 42% of their income on teaching staff and the largest spending only 34%. The SFC column displays a similar gradient, though where size-for-size comparisons are possible, the SFCs spend a higher proportion of income on teaching staff salaries than do the GFECs.

Table 4.2 General FE and sixth form colleges: expenditure on teaching staff salaries as a percentage of total income

General FE colleges			Sixth form colleges		
		(£000)			(£000)
10 largest GFECs	Income	449,540	No SFCs as large as this		
	Teaching staff	153,254			
	Teaching %	34.1%			
10 GFECs closest in size to the 10 largest SFCs	Income	105,579	10 largest SFCs	Income	105,507
	Teaching staff	37,960		Teaching staff	44,659
	Teaching %	36.0%		Teaching %	42.3%
10 smallest GFECs	Income	56,654	10 SFCs closest in size to the 10 smallest GFECs	Income	56,767
	Teaching staff	23,789		Teaching staff	25,364
	Teaching %	42.0%		Teaching %	44.7%
No GFECs as small as this			10 smallest SFCs	Income	30,001
				Teaching staff	14,856
				Teaching %	49.5%

4.3 Administration staff costs

In addition to the clear relationship – associated with class sizes – that we might expect between teaching staff costs and size, there might also be scale economies in administration staff costs.

This is, however, a more ambiguous factor. While handling the necessary administrative procedures might reasonably be expected to cost less per student as the number of students rises, it is sometimes suggested that large institutions become bureaucratic and cumbersome and, correspondingly, that smaller institutions are more in touch with their students and need less bureaucratic apparatus. Whatever the balance of these arguments, the accounting data, as shown below in Figure 4.4, appear to reveal some economies of scale in administration costs, though these are not very pronounced. The general pattern was the same for both GFECs and for SFCs, though we have presented only the 'pooled' graph.

Figure 4.4 Administration staff costs as % of income by size of college measured in £000 of income (325 GFECs & SFCs)
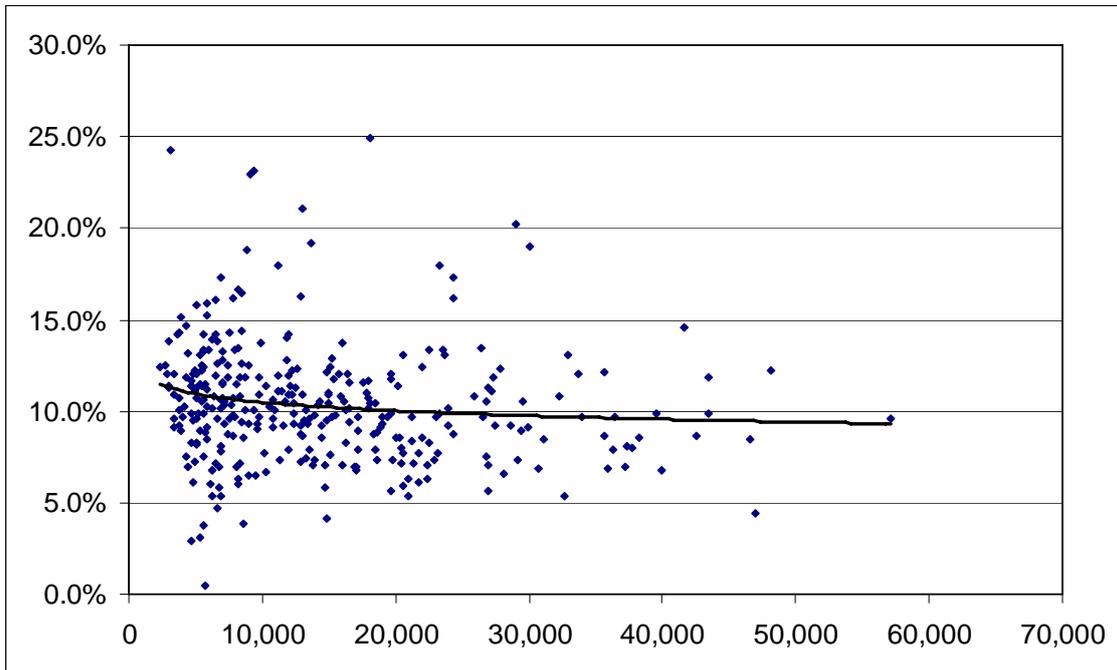
4.4 Financial surpluses

The existence of economies of scale in as large an area of costs as teaching staff salaries would offer larger colleges the opportunity to earn surpluses if they wished.

Surpluses are not the primary objective of colleges, but many colleges need to earn surpluses year on year, and most colleges would prefer to earn a surplus. In these circumstances, and provided there are no offsetting factors, we would expect college surpluses to be linked to size, though perhaps not strongly. In fact, the graphs show reasonably clear relationships.[3]

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[3] Because SFCs are smaller but generate more surplus on average as a percentage of income than do GFECs, 'pooling' the data yields spurious results.

Figure 4.5 Surplus as % of income by size of college in £000 income (223 GFECs)
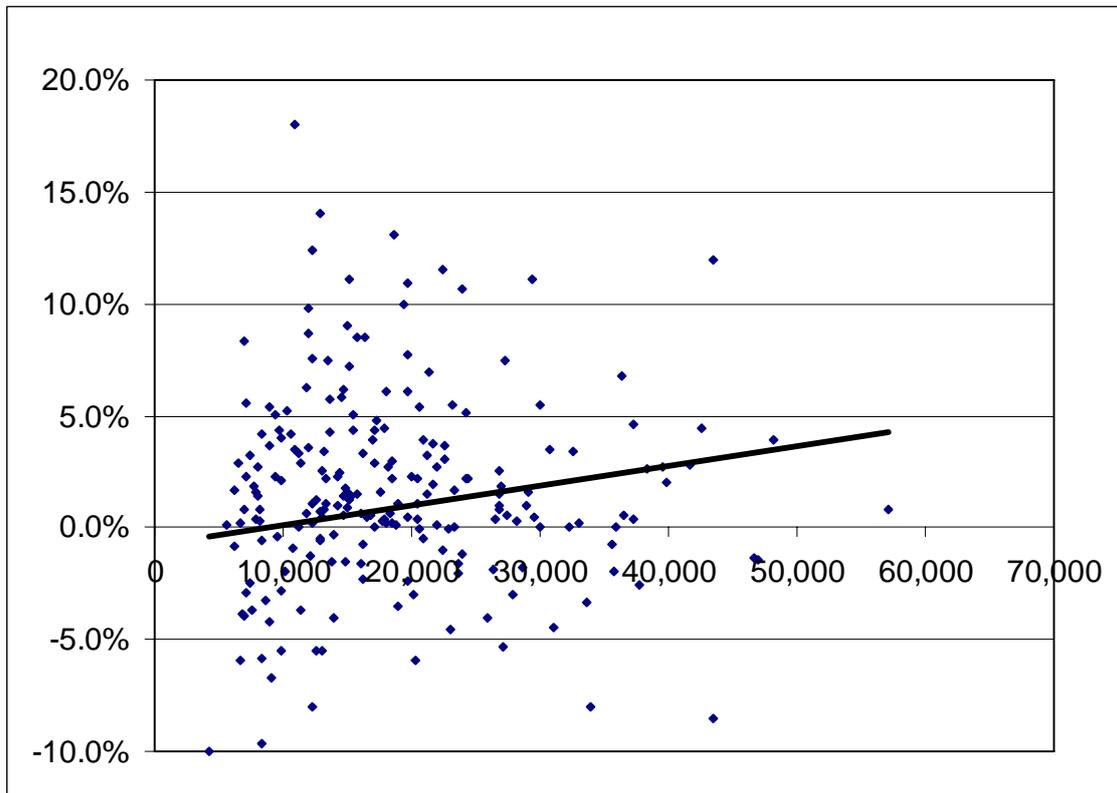
Figure 4.6 Surplus as % of income by size of college in £000 income (102 SFCs)
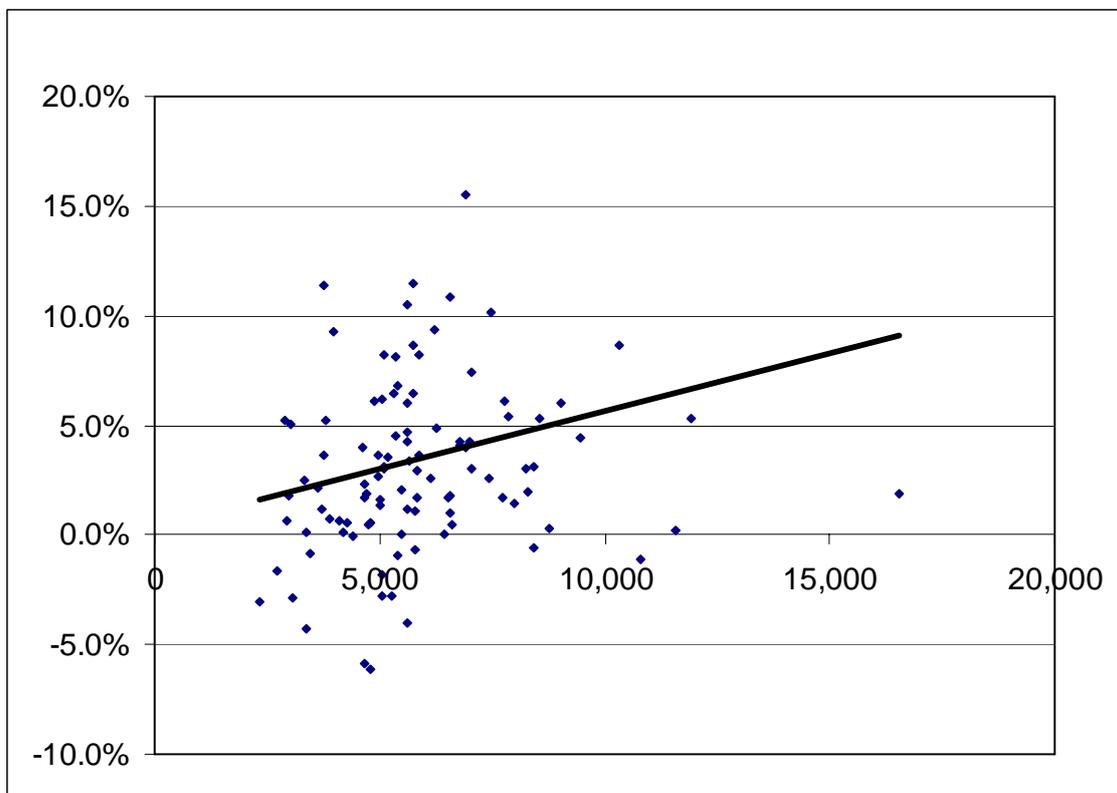
The graphical relationships are borne out by Table 4.3, which shows results for the largest and smallest college of each type.

Table 4.3 General FE colleges and sixth form colleges: surplus as a percentage of total income, £000

General FE colleges			Sixth form colleges		
10 largest GFECs	Income	449,540	10 largest SFCs	Income	105,507
	Surplus	7381		Surplus	7134
	Surplus %	1.6%		Surplus %	6.8
	No in surplus	7		No in surplus	9
	No in deficit	3		No in deficit	1
10 smallest GFECs	Income	56,654	10 smallest SFCs	Income	30,001
	Surplus	-3653		Surplus	120
	Surplus %	-6.4		Surplus %	0.4
	No in surplus	4		No in surplus	6
	No in deficit	6		No in deficit	4

4.5 Conclusions from the college accounting data

We anticipated that the most marked evidence of economies of scale would be in teaching staff costs, where the advantage of large class sizes enjoyed by larger institutions is most apparent.

In summarising the evidence below, it must be remembered that the data are for all college activities, not just Level 3, and that Level 3 study is a minority activity for many general FE colleges. Further, complex research would be needed to establish whether the conclusions summarised here relate in full to Level 3 provision within GFECs.

The accounting data show widely differing percentages of income being absorbed by teaching staff salaries, both in general FE colleges and in sixth form colleges. On average, however, the smallest SFCs spent about 50% of income on teaching staff salaries, while the largest spent about 42%, a differential of eight percentage points. The figures were lower in GFECs – 42% of income spent at the smallest GFECs and 34% at the largest – but again the differential was about eight percentage points.

The differential between the smallest SFCs and the largest GFECs was as much as 16 percentage points, though a range of factors, not least a general difference in pay scales, make comparisons across the two college sectors difficult.

Various explanations have been posited for the differentials within each college sector, for instance the greater reliance of smaller colleges on teaching staff, rather than on other forms of learner support. There is doubtless some value in these explanations, and we have already emphasised that this study is limited in scope and its findings are provisional in character. Nonetheless, the two differentials each of eight percentage points noted above seem to us, in conjunction with the evidence from financial surpluses, to offer powerful *prima facie* evidence of substantial economies of scale.

The case for expecting economies of scale in administrative staff costs is weaker than that for teaching staff. As well as the potential for economies in dealing with large numbers of students, there is potential for (bureaucratic) diseconomies. As with teaching staff costs, administrative staff costs vary greatly between institutions, but the norm seems to be for

them to absorb about 12% of income at the smallest institutions, falling to about 9% at the largest – a possible economy of about three percentage points of income.

At any college, costs and surplus taken together must equal 100% of income. The elements of cost not so far considered[4] present difficulties of analysis, because there is a strong probability that they will absorb part of the economies of scale so far identified as larger colleges use their underlying efficiencies to improve the student experience.

Because of this effect we did not necessarily expect to find any strong relationship between size and surplus. In fact, however, there was a marked relationship. The largest sixth form colleges enjoyed an average surplus of about 7% of income, while the smallest were just about in financial balance – a differential of seven percentage points of income. The financial position of general FE colleges was worse, but the differential between the largest and smallest was about the same as for SFCs. The largest GFECs had a surplus of perhaps 2% to 3% of income,[5] while the smallest GFECs were in deficit[6] – a differential of perhaps five or six percentage points.

The most straightforward interpretation of these calculations is that:

- **the largest colleges benefit from substantial economies of scale in teaching staff costs and, secondly, in administrative staff costs**

- **compared with the smallest colleges, these economies represent savings of about 10% of income**

- **the bulk of the savings is translated straight into financial surpluses.**

We would emphasise that the accounting data show 'revealed' economies of scale, that is economies of scale that are observable after colleges have used part of the potential economies of scale to improve the student experience. We may reasonably expect potential economies of scale to be greater, as colleges with opportunities to earn surpluses will, quite justifiably, spend part of those surpluses.

Furthermore, although it is now over a decade since incorporation, the college system is still in transition. A harsh interpretation of the data would be that economies of scale go straight through to the 'bottom line' rather than being used to benefit learners. But in our view the primary motivation for earning surpluses is to build a financial contingency reserve and to save for capital projects, both of which will eventually benefit learners.

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[4] While the high proportion of costs accounted for by teaching staff justifies the focus on them, it is remarkable that so little attention has been paid to the 60% of spending under other heads.
[5] The regression results shown in the chart suggest a surplus of about 4% as the 'best fit' for a college with an income of £50m. The average result for the 'top 10' GFECs was just 1.6%, but this result was distorted by a very large deficit at one top 10 college.
[6] The regression results suggest a small deficit (of perhaps 1%), but the 10 smallest GFECs actually had deficits averaging over 6% of income.

5. Data sources: national patterns of A2 provision

This section concentrates on A2 alone, on the grounds that covering AS as well would complicate the description while not changing patterns significantly.

It is not easy to say precisely how many A-levels are on offer in England. We have taken as a starting point the 185 A-levels for which students received results from the Assessment and Qualifications Alliance (AQA), the Oxford, Cambridge and RSA Exam Board (OCR) and Edexcel in summer 2005.

In many subjects, each board offers an identically titled A-level (Music and French are examples). Although each syllabus differs and there is a genuine choice to make between syllabuses, few people would argue that student choice in, say, French, requires a particular institution to offer more than one syllabus. We have counted subjects of this type as one rather than two or three.

There are more complex cases, Mathematics being the most complex. In summer 2005, across the three boards, there were: nine Mathematics A-levels, ten in Further Mathematics, eight in Pure Mathematics, and one in Use of Mathematics. A full choice would require an A-level to be offered in each of these four categories, but certainly not all 28 potentially available. In these cases, we have reached decisions that seem to us sensible: in the case of Mathematics, identifying four subjects rather than one or 28. Easier cases include the 'A' and 'B' alternative syllabuses available in various subjects. In these cases, we have assumed simply that it is sufficient to offer one of the two.

On the assumptions above, there were 83 distinct A-levels offered in 2005, with numbers of students awarded results ranging from four in Mechanics to 70,290 in General Studies. (See Annex 1 for a full list.)

There is a marked breakpoint in the student numbers between the 24 most popular A-levels (Annex 1), each of which had more than 10,000 awards, and the remainder each of which had fewer than 7000.[7] Many interviewees said that 'about 20'[8] A-levels were necessary to offer students a reasonable degree of choice. Doubtless, they had in mind a list such as the 'top 24' list, though a few qualifying comments are needed.

- Some subjects, though newly popular, are not perhaps regarded as indispensable to the curriculum: Critical Thinking is an example.

- The most popular subject – General Studies – is not offered by some institutions.

- The subjects towards the bottom of the list of 24 may not be regarded as essential, especially where an alternative is offered: Economics (20th) may not be considered essential if Business Studies is offered; English Language and Literature (21st) may not be offered if both English Language and English Literature are.

- Some institutions feel obliged to offer at least two Modern Foreign Languages, even though only French (22nd) is in the top 24.

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[7] Two subjects in the 'Art & Design' groups of subjects had between 7000 and 10,000 awards.
[8] One interviewee said that 14 was sufficient, though this was an 'outlier'.

6. Case-study institutions

Our fieldwork with schools and colleges aimed to speak to well-informed senior individuals within institutions to assess their views about the management, and cost effectiveness, of Level 3 provision. Such individuals almost invariably have experience of working in more than one institution, and we asked not only 'how are things done here?' but also about their experiences of the sector as a whole.

6.1 Case-study selection

We planned to undertake work with 8–12 institutions (the final figure was 10), spread across three types of institution. With so small a number, there was no question of aiming at quantitative, statistically reliable survey results. Nonetheless, we aimed at reasonable representativeness across institutional sizes (as well as the three types) and across geographical areas within England.

Large sixth form colleges were of specific interest to us, as offering particularly clear opportunities for economies of scale because they have large numbers of students on the same or similar programmes. We were also interested in GFECs with Level 3 programmes comparable in size to those in the largest SFCs, though these are not numerous, and we wished to consider both small and large school sixth forms.

These factors led us to consider Hampshire,[9] Greater Manchester, Birmingham and Solihull, and East London local LSC areas, which contain institutions of the types we were seeking, and also offer a range of area types: London, two urban areas outside London, and a rural area, albeit densely settled.

We approached institutions of the relevant types by letter and e-mail in each of the three areas. We were seeking a considerable commitment from them – time for a one-day visit including interviews with the principal, director of finance (or equivalent) and relevant heads of department or faculty. Many did not have time to make this commitment, but we secured the cooperation of six institutions within the geographical areas mentioned above.

The six included, however, only one GFEC and no school with a small sixth form. On an entirely pragmatic basis, therefore, we selected four institutions from outside those areas.

The issues to be covered were reasonably regarded by the institutions as sensitive, especially as most of them faced competition from neighbouring institutions. To encourage openness we gave an assurance of confidentiality. As a result, we give below only the briefest descriptions of the case studies to avoid identification.

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[9] Hampshire is our 'rural' case study area. For that reason, we excluded the urban areas (Portsmouth, Southampton) within the local LSC area. Nor did we consider the Isle of Wight.

6.2 The case-study institutions

The case-study institutions in this report agreed to speak to us on condition of anonymity. They are characterised briefly in Table 6.1 below.

Table 6.1 Descriptions of the case-study institutions

Institution	Description
GFEC-A	A large college with a separate sixth form centre in a major urban area
GFEC-B	A large college with a separate sixth form centre in a major urban area
SFC-C	A medium-sized college in a major urban area
SFC-D	A large college in a rural area
SFC-E	A medium-sized college in a rural area
SFC-F	A large college in a major urban area
SSF-G	A school with a medium-sized sixth form in a rural area
SSF-H	A school with a small sixth form in a large urban area
SSF-I	A school with a large sixth form in London
SSF-J	A school with a large sixth form in a major urban area

Table 6.2 summarises student numbers and the number of subjects being studied at the case-study institutions at the time of our visits to them in the first half of the 2005/06 academic year.

'Enrolments' are the total numbers of individual subjects being studied. So, for example, at SFC-F there were over 1000 students (head-count) on AS programmes who, together, were pursuing 4505 AS courses in 42 individual subjects. In other words, the average AS subject at SFC-F had 107.3 students.

Table 6.2 Enrolment and subject numbers at case-study institutions
ranked by number of AS students

	AS			A2		
	Enrolments	Subjects	Enrolments/ subject	Enrolments	Subjects	Enrolments/ subject
SFC-F	4505	42	107.3	2286	40	57.2
SFC-E	3136	36	87.1	2339	36	65.0
GFEC-A	2929	41	71.4	1420	36	39.4
GFEC B	2895	37	78.2	1841	31	59.4
SFC-C	2351	30	78.4	1460	29	50.3
SFC-D*	4327	34	63.6			
SSF-I	992	27	36.7	669	26	25.7
SSF-J	852	30	28.4	614	28	21.9
SSF-G	561	25	22.4	254	24	10.6
SSF-H	195	18	10.8	110	17	6.5
SFC-D provided only total numbers across AS and A2, taken together						

Table 6.2 shows the high average numbers studying each subject at the case-study SFCs and GFECs, but the implications for viability are less clear than they may seem. For example, SFC-E, the institution with most students per A2 qualification, had 2339 enrolments in 36 A2 subjects. Suppose it offered the 36 most popular A2s nationally and

attracted students in the same proportions as nationally. The 36th most popular subject nationally (Performance Studies) accounted for 0.41% of A2 awards in summer 2005, implying that about 10 students at SFC-E would wish to pursue Performance Studies. In fact, SFC-E had one group (in Electronics) with just eight students. In short, uniform viability in every subject is not to be expected even at the very largest colleges.

6.3 The basic costing model

The case-study institutions all used similar costing models, though they differed in how the model was described, the extent to which it was articulated formally, and how its results were communicated to middle managers and frontline staff. In many cases, staff were simply told that a given class size was their target; sometimes the approach was more sophisticated, and heads of department or faculty were provided with something approximating to an income and expenditure account for each subject in their department. The model has the variables listed below. For each variable, we have given a plausible value for 2002/03, but we would emphasise that *our conclusions do not depend on the precise accuracy of the illustrative figures given.*

Variables

S	a salary cost for teaching staff, about £28,000 a year in 2002/03
H	a number of hours that each full-time member of staff is expected to teach, about 800 a year in colleges
O	a mark-up overhead[10] representing all institutional costs other than teaching staff salaries, of about 150% (ie, teaching staff salaries account for about 40% of all costs
F	funding per hour of tuition received by a student, about £6 for an AS or A2 class[11]
C	the average class size

For the college to break even, funding (F*C) for a class must equal the cost of delivery ([S/H]*[1+O]). Rearranging yields:

$$C = [S*[1+O]]/[H*F]$$

Average class size, C, is equal to about 15 (actually 14.58) on the values for each variable quoted above as rough averages. In other words, an institution with an average class size of 15 will break even if its cost factors correspond to those above.

The same equation can be couched in slightly different terms to calculate the cost per student hour (CSH), as follows:

$$CSH = S*(1+O)/(H*C)$$

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[10] Though not all overheads are proportionate to staff costs, some – such as learner materials, awarding body fees and catering space costs – are student-related. In general, overheads are an area requiring more investigation; the formula presented here is an approximation.
[11] The funding formula is much more complex than a simple payment per student hour. This approximate figure is based on LSC funding guidance for 2002/03, which provides an example ('Example 3') of a full-time learner aged 16–18 generating £6082 of funding over the 2 years of an AS/A2 programme. We have assumed that such a student would receive approximately 1000 hours of tuition over the 2 years.

If we insert the illustrative numbers given above into this equation and assume a class size of 15, we get a cost per student hour of about £6 (actually £5.83), an amount equal to the assumed level of funding per student hour. This, of course, is another way of expressing the break-even relationship discussed above.

This variant of the model illustrates that, regardless of the values used for S, O and H, the cost per student hour is inversely proportional to class size. Putting it simply, if class size doubles, cost per student hour will halve.

A significant qualification of the formula must, however, be mentioned at this point: suppose the average class size at an institution doubles from 10 to 20, it is reasonable to suppose that teaching staff costs will be unchanged in total, but that cost per student hour will halve. However, the formula assumes that all other costs – encapsulated in the overhead percentage – will also remain unchanged in total and will halve per student hour. This is less likely. Total 'other' cost will probably rise somewhat and, although cost per student hour will fall substantially, it will fall by less than 50%.

We have not attempted to modify our calculations to reflect this factor, and, as already noted, the formula is in widespread use, but we would note that the effect is that the formula overstates the available economies of scale.

6.4 Class size management

Institutions typically define most or all of the following limits on class sizes. In listing the limits, an indicative figure is given in brackets, though there is considerable variation between institutions and subjects, and the limits are themselves used flexibly within each institution.

- **Maximum** class size (27[12]), determined by:
    - physical limitations – noting that rooms are designed with health and safety and pedagogical circumstances in mind, though with a huge random legacy
    - health and safety – but with no consistency over how many it is acceptable to have in, say, a Chemistry[13] class
    - pedagogy.

- **Target** class size (22), ie the ideal number that the institution would like to have in a class.

- **Target average** class size (18), recognising that class sizes will fall short of the target class size more often than they exceed it.

- **Break-even** class size (15).

- **Minimum** class size (11): institutions value continuity and breadth of offer. They often set a minimum class size below the break-even level, where in the short run at least they are prepared to continue.

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[12] The possibility of lectures was raised more than once during our fieldwork. The largest institutions can have several hundred students doing a single AS or A2 course. Some of their contact time could be delivered through lectures to 100 students or more, increasing the potential for scale efficiencies.
[13] One case study cited a health and safety maximum of 12 for Chemistry, while another taught classes of over 20; however, there may be genuine differences in the appropriate maximum associated with the particular types of laboratory accommodation available to each institution.

- **Exceptional minima** for class size (6): for Modern Foreign Languages in particular, secondly for Music, and for other subjects occasionally, there is an institutional commitment to run courses unless hopelessly uneconomic. Very small class sizes are also rejected on pedagogical grounds. Further cases of this kind involve unequivocal commitments by most institutions to provide the follow-on A2 to any AS that they run,[14] and in one case-study institution to provide both AS and A2 in all subjects offered at GCSE by any 11–16 feeder school. These commitments resulted in classes occasionally as small as a single student.

6.5 Management tactics

The difference between a favourable financial position and financial losses may be the difference between an institutional average class size of 15.5 and 14.5. In that context, tactical decisions by middle managers may be of great importance. Some tactics:

- declaring courses to be 'full' at, say, 25 students, to avoid having to split a slightly larger number into two less economic classes (if a waiting list gets to, say, nine, two classes of 17 may indeed be formed from the 34 available students); it has, however, been pointed out to us that declaring courses to be full may be unacceptable in areas – typically rural areas – where one institution has a monopoly of provision

- occasional use of classes larger than the institution's normal maximum size, especially where some drop-out is expected

- reduced class contact for small classes, eg 3.5 hours a week rather than 5 for a group of six students

- being willing to maintain an uneconomically small class for students who particularly wish to do that subject, to avoid losing those students

- marginal costing in exceptional circumstances, for instance where a subject teacher is under hours and cannot teach other subjects, where there is a shortage of staff hours, and where a class of reasonable albeit uneconomic size (say six) can be formed

- merging classes, a near universal practice where, say, a planned three classes totalling 60 students is reduced before the start of the year to two classes because only 40 students have been recruited, and an occasional practice even after the start of teaching if drop-out is exceptionally high

- using AS as a stand-alone qualification, avoiding the possible commitment to run a follow-on A2 with small numbers

- keeping staff up to hours; the issue of fractional under-utilisation was described as being of special importance (where, for instance, a staff member contracted to teach 800 hours a year has only 780 hours timetabled, it may be difficult to use the odd 20 hours, but this 2.5% saving may be the difference between surplus and deficit)

- tight overhead control, recalling that costs other than teaching staff salaries may account for over half of all costs; our case studies tended to control overheads by controlling the percentage of income accounted for by all staff costs (including National Insurance and pension contributions) and implicitly therefore controlling the percentage spent on everything else – a less sophisticated approach than that used to control staff hours and class sizes.

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[14] However, one case study institution expressly informed students that there was no such commitment.

6.6 Marginal costing

Where rooms are unused and staff hours are available, it is possible to provide courses at low, even near zero, marginal cost.

The case studies offer some evidence of this behaviour, though most institutions do not think in terms of marginal costing as it is hard enough to gather and make sense of average cost data. Some also raised the standard objection to marginal costing, namely that all costs are variable in the long run and should be adjusted as rapidly as possible; and that marginal costing is simply an excuse for failing to make necessary changes.

In one case study, marginal costing was employed under strictly limited circumstances. Firmly contracted staff hours that could not be used in any other way (for example, on General Studies) had to be available in the relevant subject, and there had to be a plan for resolving the difficulty in future years.

More generally, marginal costing was seen as making more sense for A2 (a one-year commitment) than for AS (a two-year commitment), and for cases where growth is expected, whether in market demand or, for example, when an institution offers a new subject for the first time.

6.7 Quality of costing data

Cost data tend to be poor by commercial standards. It appears to be unusual to cost individual courses in financial terms. Budgets for faculties, departments and courses tend to mean the very small budgets for consumables expenditure. The usual practice is for middle managers to control consumables expenditure, class size and staff utilisation, and for institutional management to control overheads. As one principal expressed it, 'everything will then stack up'.

6.8 Market-related behaviour

The institutions that we consulted saw themselves as offering a service to their students and the wider community. They did not see themselves as operating like companies in a private-sector market. Post-16 education does, however, have similarities to markets: 'prices' are paid, through the funding formula, costs are incurred, and surpluses or deficits result in broadly the same way as in commercial enterprises.

Table 6.3 contrasts Chemistry with Psychology as described to us by one interviewee. Psychology is, financially, a very attractive proposition, while Chemistry is marginal at best. It is tempting to attribute at least part of the upsurge in the popularity of Psychology and the decline in the popularity of Chemistry to this market signal, though no institution gave any indication that it responded to market signals of this kind.

Table 6.3 Case-study comparison of provision

	Chemistry	Psychology
Location	Laboratory	Classroom
Maximum class size	18–20 (though many more than 20 in one case-study institution)	25 or more

Formula funding	Programme weighting premium	Programme weighting premium
Costs per class	High	Low
Staff salary per class	High – staff tend to be older and at 'top of scale'	Low – many relatively young staff
Surplus or deficit	Difficult to break even – needs careful management to maximise class size within laboratory constraints	Opportunities for substantial surpluses

6.9 The link between institutional size and viability

Table 6.4 illustrates the impact of size on enrolment patterns using three of our case studies as examples. (As a result, it is influenced by the particular policies of the case-study institutions featured.) The table takes 12 students as the lower limit of viability; it is more often said to be 15.

Table 6.4 The link between institutional size and class viability: a large SFC, a large SSF and a small SSF compared

		SFC-F	SSF-I	SSF-H
Enrolments	AS	4505	992	195
	A2	2286	669	110
Number of subjects taught	AS	42	27	18
	A2	40	26	17
Enrolments per subject	AS	107	37	11
	A2	57	26	6
Percentage of subjects with 12 or fewer enrolments	AS	12%	18%	67%
	A2	12%	31%	100%
Percentage of all student enrolments in subjects with 12 or fewer enrolments	AS	0.6%	4.2%	42.6%
	A2	1.5%	8.7%	100.0%

The large sixth form college (SFC-F) has some non-viable classes: five A2 and five AS subjects are non-viable. Indeed, because of this college's commitment to offer AS and A2 in all subjects offered by any of its feeder comprehensive schools, some of these groups are very small (two or three learners). But because of the college's large overall size, fewer than 1% of its enrolments are in non-viable groups.

The large school sixth form (SSF-I) is only about one-quarter the size of the sixth form college. It offers a more restricted range of A-levels, but students can still choose from a fairly wide range. The impact on viability of its comparatively small size is limited. Although the percentage of non-viable subjects is higher – 31% of all A2 subjects – the percentage of enrolments in non-viable subjects remains manageably low at 6%.

The substantially smaller numbers at the small school sixth form (SSF-H) do have a dramatic impact on viability. Despite offering minimal choice, there are few viable subjects at AS and none at A2. Overall, 63% of enrolments are in non-viable subjects.

6.10 Use of surpluses

The case-study visits suggested that on the whole the larger institutions had better resources in terms of equipment, libraries, learning centres, and so on. There were some exceptions, however, where smaller institutions had invested in 'flagship' resources, such as theatres or science labs, in areas that they saw as strengths.

Some interesting comments were made about the type of resources bought. One school suggested that new equipment and so forth tended to be pitched at A-level requirements. Two colleges stated that they tended to invest at the 'upper end' – studio equipment, IT, science equipment – to give students experience of what they would use at university or in industry. A third college commented that resources tended to be 'industry-standard' for subjects such as Engineering, but pitched 'in the middle' elsewhere (for example, library stock, IT), meaning that higher education (HE) and professional students got a poorer deal.

6.11 A note on AVCEs

Provision of AVCEs in the case-study institutions was limited: some offered them, others did not. Subjects typically included Business Studies, Health and Social Care, ICT and Performing Arts. Interviewees, especially at the most senior levels, often needed to be prompted to distinguish AVCEs from GCE A-levels, rather than talking exclusively about the latter. Two rationales were encountered for offering AVCEs:

- broadening the curriculum to include more vocational subjects
- providing more practically-oriented courses with greater appeal to some students.

There were no particular plans to expand AVCE offerings, and no views were expressed on whether AVCE costs were higher or lower than GCE costs.

7 Quantitative data from case studies in relation to national data

This section compares the quantitative data from case-study institutions with national statistics on subject choice at A2.

First, the number of students per subject and the number of subjects are compared with institutional size, with the finding that larger institutions offer somewhat more subjects but have far more students per subject than smaller institutions.

Two approaches to modelling scale efficiencies are described:

- 'Type 1' economies of scale, where large institutions offer a given set of subjects more cost effectively than smaller institutions

- 'Type 2' economies, where large institutions offer a wider range of subjects but, even so, are more cost effective than smaller institutions.

We use national data to present models of hypothetical institutions to quantify the potential for Type 1 and Type 2 effects.

Finally, the actual behaviour of four of our case-study institutions is compared with the model, leading to the conclusion that the model is a reasonable representation of behaviour, though actual behaviour is influenced by institutional policy choices that are not incorporated in the model.

7.1 Subject choice and students per subject compared with size

Figure 7.1 shows how subject choice, and the average number of students per subject at the case-study institutions, vary with institutional size. The graph relates to AS and A2 programmes considered separately at the 10 case-study institutions.[15]

The measure of size is the total number of qualifications being pursued by students at the institution. For instance, 4000 on the chart represents 4000 AS or A2 qualifications, or 1000 students each pursuing four AS levels on average.

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[15] One institution provided only totals for AS and A2, which we have averaged. There are thus 19 points on the chart.

Figure 7.1 Average enrolments per subject and numbers of subjects against size[16]
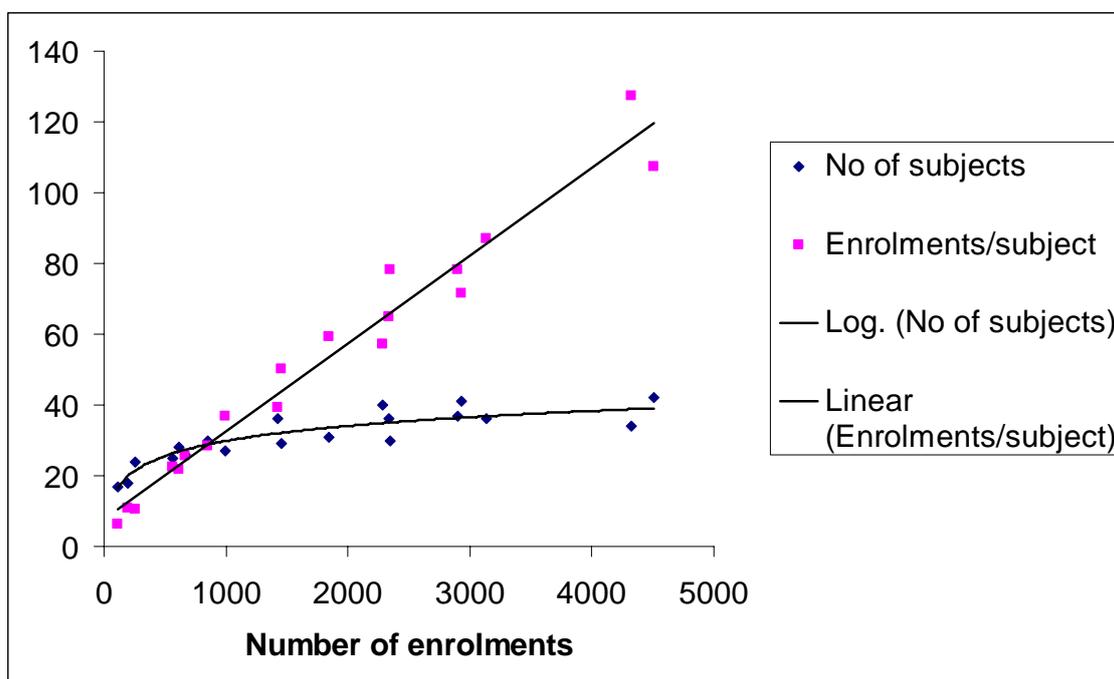
The smallest institutions offered fewer than 20 subject choices (the lowest number was 17). Subject choice widened as size increased, but the rate of increase slowed rapidly beyond about 1000 'qualifications pursued', corresponding to about 250 students at either AS or A2 or to an institutional student body of about 500 (AS and A2).

If the number of subjects offered did not vary at all between institutions but was fixed at 20, for example, the average number of students taking each subject would vary directly with size. This is quite close to the reality as depicted in the graph. The graph reveals, for example, that an institution with 1000 enrolments would have an average of 32.5 students doing each subject, while one with 2000 would have an average of 57.3 students. Size has doubled, but students per subject have not quite doubled because the number of subjects offered has increased a little.

What does this mean?

- Small institutions economise by offering a 'minimum' range of about 20 subjects. Somewhat larger institutions offer a 'full' range of 30–40 subjects; and choice does not expand much in the largest institutions.

- As institutional size increases, the number of students per subject increases more or less *pro rata*. The increase is moderated slightly, but only slightly, by wider subject choice.

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[16] The relationship between the number of subjects offered is curvilinear with a logarithmic function (shown) offering the best regression fit among the standard functional forms of relationship.

7.2 Institutional scale efficiency

While a specialist institution could conceivably offer just a handful of subjects with reasonable efficiency, leaving other providers to complement that offer, our concern here is with institutions that are aiming to offer a full service to their Level 3 learners.

There are at least two possible approaches to the efficiency comparisons that are the basis of this report.

One approach is to define an 'offer' to students and to examine the relative efficiency of institutions of differing size in making that offer. The offer might, for instance, be 'reasonable choice between 24 A-level subjects'. This approach maximises economies of scale: for instance, a large college can deliver such a programme at much lower cost than a small school sixth form. We describe these as 'Type 1' economies of scale.

But institutions do not actually behave in this way. A small institution, with perhaps 100 AS and A2 students in total, is unlikely to offer as many as 24 subjects. Conversely, an institution with 2000 students might be regarded as neglecting its responsibilities if it offered as few as 24 subjects.

A second approach to efficiency is to take account of reasonable patterns of provision and to compare efficiency across those patterns. We could, for instance, compare a small institution offering 18 subjects with a large one offering 40. This approach would lessen the economies of scale, as the larger institutions are effectively using some of their potential scale efficiencies to broaden subject choice. We describe these as 'Type 2' economies of scale.

This second approach could be seen as unfair to larger institutions because implicitly it places no value on the wider choice offered. On this reasoning, the only fair basis for efficiency comparisons is a like-for-like offer. But there are two important counter-arguments. First, smaller institutions claim to offer advantages that their larger counterparts do not (and *vice versa*), suggesting that choice is one factor in the balance of non-financial advantages and disadvantages of the respective institutions. The second argument is that in the urban areas where most people live, there is frequently an equilibrium between smaller and larger institutions, suggesting that a large institution with wide choice will not automatically corner the market.

There is a consensus that a scale effect exists. The effect is, however, related to the concept of full-service provision. Full-service provision means offering a reasonable choice of subjects to A-level students.

We know from national statistics that there are some exceptionally small school sixth forms, some with fewer than 10 students. They cannot, presumably, offer full-service provision. Equally, there may be institutions that offer only a limited range of provision (perhaps just one or two subjects) on the assumption that other nearby institutions will offer choices, allowing a student full choice overall. This study is not concerned with such cases.

There is no clear definition of how many subjects must be offered to constitute full-service provision. Some of our interviewees said as few as 15, but there was a degree of consensus around 20 subjects.

7.3 Type 1 and Type 2 scale economies

Our Type 1 model looks at hypothetical institutions with the following characteristics.

- They offer a reasonable range of choice, which we have taken to be the 'top 24' subjects.

- They actually recruit students in the same proportions as are enrolled nationally in the top 24 subjects relative to one another.

- They cap class sizes at 24 or, for laboratory, performance or active subjects, at 20.

- They vary in size from 100 to 2500 Level 3 learners, representing an annual cohort of 50–1250.

- Each student takes 3.5 subjects on average, meaning that the number of subject enrolments in a cohort ranges from 175 to 1250 (3.5x50=175; 3.5x1250=4375).

This allows us to identify how many students there will be in each subject at each institutional size.

For instance, Geography attracts 4.3% of all 'top 24 entries' so the smallest institution considered (175 enrolments per cohort) will have 7.52 geography entries, which we round to eight, all of whom will be in one class. But an institution with 1400 enrolments per cohort will have 60 Geography enrolments in three classes of 20 (based on a maximum of 24 per class).

We then make the following assumptions about institutional costs, based on the cost conditions of 2002/03, and noting that our findings are not sensitive to the particular costing assumptions made:

- teaching staff salaries average £28,000 per annum

- staff teach an average of 800 hours annually

- students receive 170 hours of class contact per subject

- all costs other than teaching staff salaries amount to 150% of the teaching staff salary bill.

The results of the modelling exercise are summarised in Tables 7.1 and Figures 7.2 and 7.3. The average class size rises sharply with cohort size until the learner cohort numbers 250, but progress slows rapidly thereafter.[17]

Table 7.1 shows that the cost per enrolment varies inversely to class size, from over £2000 per enrolment at the smallest size and to under £700 at the largest size range. We have noted that our costs are by no means precise, but they are intended to be reasonable for the academic year 2002/03. We have noted also that in that year the LSC funding formula would have provided £6082 for a 2-year programme of learning comprising 4 AS levels and 3 A2s, or seven enrolments over 2 years – matching our assumed average of 3.5. This represents £869 per enrolment. Our model indicates that institutions with more than 1000 learners can reasonably be expected to deliver learning for less than this sum, but that

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[17] As institutional size grows so do the enrolments in that subject, but as successive class size maximum boundaries are passed, class size *falls*. The overall average class size at an institution rises therefore with institutional size but rather 'jerkily'. This explains why – by chance – there is no apparent rise in class size between 1500 and 2000 learners.

institutions with significantly fewer than 300 learners are unlikely to be able to deliver within this sum. Between these limits, cost levels are very roughly equal to funding.

Table 7.1 Type 1 Economies of Scale: class sizes and costs by institutional size

Number of Level 3 learners	100	200	300	500	800	1000	1500	2000	2500
Learner cohort	50	100	150	250	400	500	750	1000	1250
Enrolments per cohort (3.5 per learner)	175	350	525	875	1400	1750	2625	3500	4375
Number of subjects offered	24	24	24	24	24	24	24	24	24
Number of classes	24	28	34	48	75	88	127	169	204
Overall average class size	7.3	12.5	15.4	18.2	18.7	19.9	20.7	20.7	21.4
Overall average cost per enrolment (£)	2040	1190	963	816	797	748	720	718	694

Figure 7.2 Average class size by number of enrolments: Type 1 economies of scale
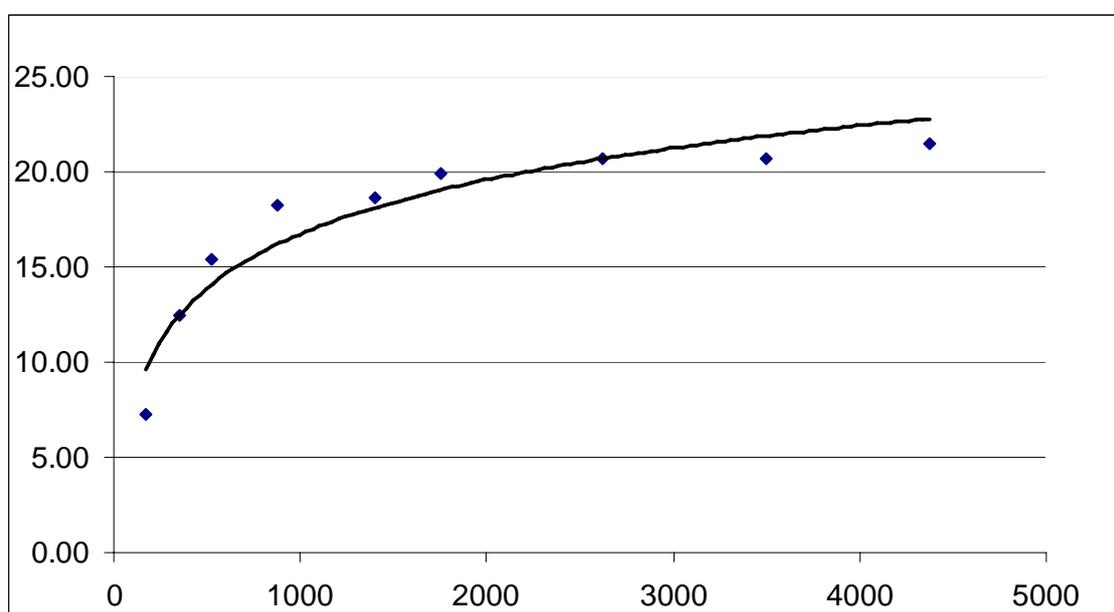
Figure 7.3 Average cost (£) per enrolment by number of enrolments: Type 1 economies of scale
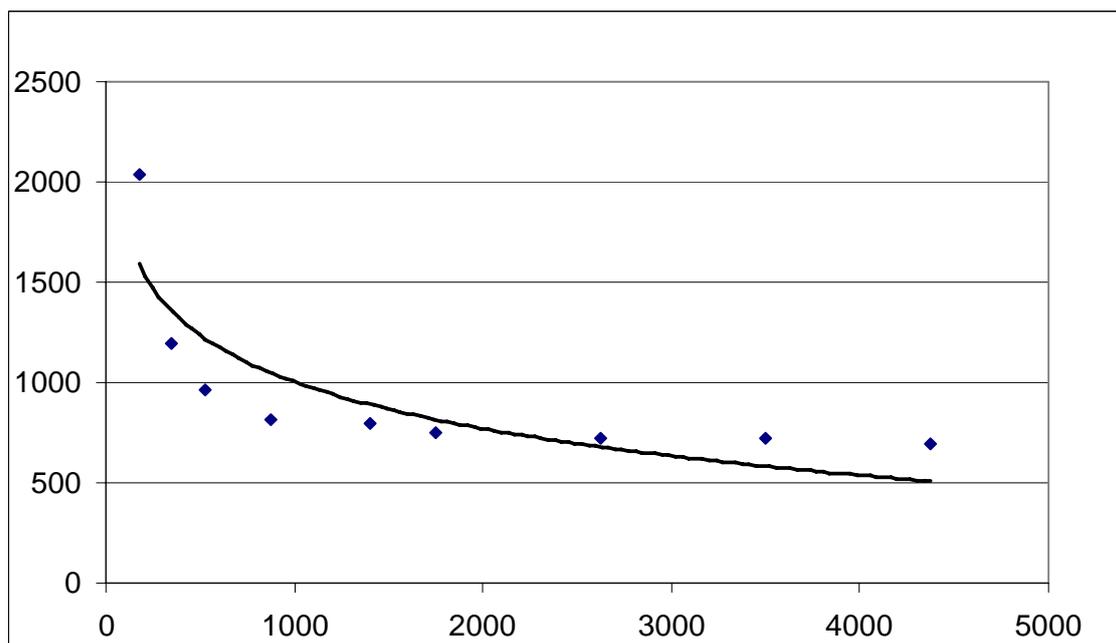
The variations in cost seen in Table 7.1 are mitigated by institutional behaviour. The smallest institutions offer fewer subjects than 24 to offset, in part, their scale diseconomies. The largest institutions deploy part of their scale economies in the provision of a wide range of subjects. 'Type 2' economies of scale allow for this factor.

In the Type 2 table (Table 7.2, below), we have assumed that institutions in the three smallest size bands offer as few subjects as possible, consistently with offering a reasonable range of choice. We have taken this to mean 18 subjects. Institutions in the three largest size bands are assumed to offer a much wider range of choice. We have taken this to be 40 subjects, about the maximum observed in our case studies.

The effects of the changed assumptions are substantial, and Type 2 economies of scale are apparent only in contrast to the diseconomies at the smallest size ranges.

Table 7.2 Type 2 economies of scale: class sizes and costs by institutional size

Number of Level 3 learners	100	200	300	500	800	1000	1500	2000	2500
Learner cohort	50	100	150	250	400	500	750	1000	1250
Enrolments per cohort (3.5 per learner)	175	350	525	875	1400	1750	2625	3500	4375
Number of subjects offered	18	18	18	24	24	24	40	40	40
Number of classes	18	22	28	48	75	88	148	195	233
Overall average class size	9.7	15.9	18.7	18.2	18.7	19.9	17.7	17.9	18.8
Overall average cost per enrolment (£)	1530	935	793	816	797	748	846	836	799

Figure 7.4 Average class size by number of enrolments: Type 2 economies of scale
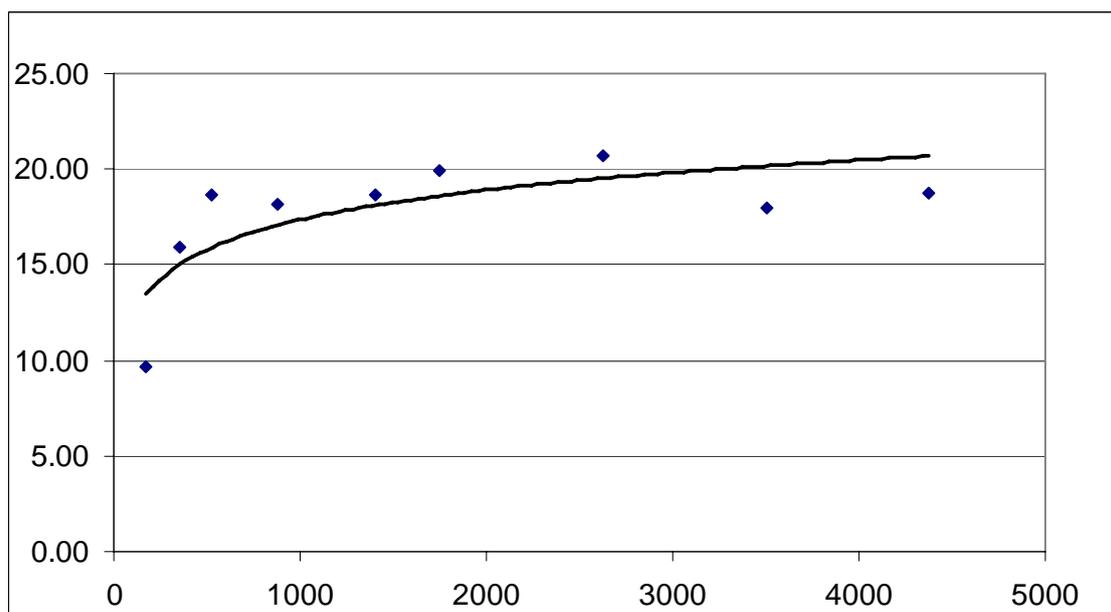
7.5 Modelled and actual provision at four case-study institutions

The rather complex table below (Table 7.3) compares modelled and actual behaviour using four of our case studies as examples. Our simple model predicts that the institutions will offer all subjects where they can attain a class size of 15, allowing for their size, but will in any case offer at least 18 subjects to allow a reasonable degree of choice. So the first case-study example in the table (GFEC-A) has 1420 A2 enrolments, and a class of 15 would represent 1.06% of those enrolments. We assume therefore that GFEC-A will offer all subjects that, nationally, attract more than 1.06% of total enrolments, a total of 25 subjects (see Annex A). In contrast, SSF-H cannot achieve a class size of 15 in any subject, but is still assumed to offer 18 subjects.

Table 7.3 on the next page shows the subjects that each case-study institution might be expected to offer and those that each actually offers. The case studies actually offered most of the predicted subjects, with about 80% of actual enrolments in the predicted subjects. All four offered more subjects than were predicted by the model, but this is understandable since the model assumes that nothing will be offered if non-viable. The 'deviations' – predicted subjects not actually offered, and non-predicted subjects that are actually offered – are discussed below the table.

Table 7.3

	GFEC A	SFC C	SSF J	SSF H
A2 enrolments	1420	1460	614	110
15 students as % of enrolments	1.06%	1.03%	2.44%	13.64%
Predicted number of subjects offered	25	25	18	18
Number of the predicted subjects actually offered	20	19	14	13
Enrolments in predicted subjects	1180	1206	458	90
Enrolments in predicted subjects as % of all enrolments	83.10%	82.60%	74.59%	81.82%
Number of subjects offered but not predicted	15	10	14	6
Enrolments in unpredicted subjects	240	254	156	20
Enrolments in unpredicted subjects as % of all enrolments	16.90%	17.40%	25.41%	18.18%
Enrolments per subject in predicted subjects	59	63	33	7
Enrolments per subject in unpredicted subjects	16	25	11	3
Total number of subjects offered	35	29	28	19
Predicted subjects	General Studies Psychology Mathematics Biology A English Literature History Chemistry Business studies Physics Geography Sociology Media Studies Sport & Physical Education Religious Studies English Language Information & Communications Technology Critical Thinking Art & Design (Fine Art) Drama & theatre studies Economics English Language & Literature French Design & Technology (Product Design) Government & Politics Art & Design		General Studies Psychology Mathematics Biology A English Literature History Chemistry Business studies Physics Geography Sociology Media Studies Sport & Physical Education Religious Studies English Language Information & Communications Technology Critical Thinking Art & Design (Fine Art)	
Predicted subjects not offered	Religious Studies Critical Thinking Art & Design (Fine Art) Design & Technology (Product Design) Art & Design	General Studies Media Studies Critical Thinking Art & Design (Fine Art) Design & Technology (Product Design) Art & Design	General Studies English Literature Critical Thinking Art & Design (Fine Art)	Geography Information & Communications Technology Religious Studies Sport & Physical Education General Studies Critical Thinking

	GFEC A	SFC C	SSF J	SSF H
Subjects actually offered but not predicted	Law Accounting Philosophy Art Computing Human Biology Archaeology Art & Design (Graphic Design) Art & Design (Textiles) Dance Art & Design (Three Dimensional Design) Electronics Music Spanish German	Law Statistics Computing Accounting Human Biology Further Mathematics Geology Environmental Science Music Spanish	English Language & Literature Art Art & Design (Graphic Design) Communication Studies Art & Design (Textiles) Economics Performance Studies Drama & theatre studies Design & Technology (Food Technology) French Government & Politics Further Mathematics Music Dance	Philosophy Art & Design (Textiles) Design & Technology (Product Design) German Music Performance Studies

Predicted subjects not offered

Although significant numbers of predicted subjects were not offered, the reasons for this are straightforward.

- Ambivalence about General Studies – the one institution from these four cases that chose to offer General Studies had, predictably, large enrolments, but the other three institutions chose not to offer General Studies.

- Ambivalence about Religious Studies, which some institutions view as essential but others consider peripheral to the curriculum – this comment relates to our work generally and not necessarily to the four case-study institutions here.

- Critical Thinking – an enormously popular new subject that none of these four case studies has yet adopted.

- The pattern of provision in the complex field of art and design – the 'requirement' appears to be that institutions offer some of these subjects rather than all or the most popular.

Subjects offered but not predicted

The subjects actually offered, other than those predicted, were determined in part by the complexity of the Art and Design field, as noted above. The main reason, though, appears to be a wish to exploit particular strengths or to respond to market or other imperatives. All four institutions offered an 'unpredicted' language, but it would be unwise to generalise further – for instance, to comment on the fact that two of the four offered Law – because the placing of these subjects in the national rankings indicates that any patterns noted would necessarily be specific to these four case studies.

8. Conclusions

This section draws together our findings on economies of scale in Level 3 provision. In view of the weakness of the data sources and the need for further work, summarised in Section 1, these results should be regarded as tentative early estimates from a small-scale piece of research.

A crucial piece of evidence is the uniform view of our interviewees that economies of scale exist and are important. Even the small school sixth form that we visited accepted that it faced major diseconomies of scale, and said that the rationale for its existence was to do with academic choice and competitive positioning.

The accounting data, which are available only for colleges, show economies of scale in administration staff and particularly teaching staff costs, such that the largest colleges are able to spend about 10 percentage points of income less on these costs than the smallest colleges. Most of this large saving is, for the moment, reflected directly in the greater financial surpluses of large colleges.

Accounting data show results after part of the underlying economies of scale have been spent on improving the student experience. We found numerous examples where potential surpluses had been spent on staff, equipment, buildings and other enhancements. The accounting data therefore understate the underlying economies of scale.

We modelled the costs of Level 3 provision using a simple costing model widely used by institutions, nationally available data on the relative popularity of A2 subjects, and consensus views on attainable and desirable class sizes.

Type 1 economies of scale in our model arise when we compare the costs of provision of a standard 24-subject portfolio of A-level subjects at institutions of differing size.

Type 1 economies of scale continue to apply until an institution has 1000 Level 3 learners (a year cohort of 500). There are even some modest further gains from expansion beyond this size. The cost penalty from operating at half this size is 9%. In other words, costs per learner are 9% higher with 500 learners than with 1000. However, we believe that the model formula overstates somewhat the available economies of scale, so we are reluctant to conclude that operation with 500 rather than 1000 learners entails substantially higher costs.

With 200 learners, however, costs are 59% higher than at 1000; and with 100 learners costs are 173% higher. These large diseconomies cannot be explained by the uncertainties in the data or model. At these levels of enrolment, the absolute cost per learner is substantially higher than the available funding per learner, meaning that institutions almost certainly need to cross-subsidise their Level 3 provision from other activities. The corollary of operating on a very small scale is, however, that the total cross-subsidy needed may be small in relation to the resources available to a large institution.[18]

Type 2 economies of scale in our model take into account the restriction of student choice at small institutions and the wider choice at large institutions. We make the same

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[18] It should be carefully noted that the model is concerned with underlying economies of scale, which are in part spent on various beneficial measures, so only part of the economies will show in the accounting data as described above.

assumptions as for Type, 1 except that we assume that the smallest institutions offer only 18 subjects, mid-scale institutions 24 and the largest institutions 40. The rationale for these particular choices is explained in Section 7.

The Type 2 assumptions about subject choice lessen the scale economies observed in Type 1, and the results are sensitive to the precise assumptions about numbers of subjects at particular scales of operation. Type 2 economies of scale appear to be exhausted with 300 learners; in other words, the economies of scale from having more than 300 learners are largely absorbed by the provision of greater student choice. With 200 learners, costs per learner are 18% greater than with 300 learners; and with 100 learners, costs per learner are 94% greater than with 300 learners.

The *Trading places* (Audit Commission 1996) findings cited in Section 1 are, perhaps, consistent with the Type 2 model. *Trading places* found that the school sixth forms with more than 160 learners did not require subsidy, while most of the smaller sixth forms did. 'Type 2' suggests that in 2002/03 institutions with 200 learners would have generated only slightly more costs than funding.[19] On balance, we consider that *Trading places* understates the size of 'sixth form' now required for viability; nor did it quantify the costs of provision below the size that it (implicitly) identified as the minimum required for viability. We note also that it mentions an alternative view that 250 learners were needed, rather than 160.

Our final conclusion from the evidence is that institutions with fewer than 500 Level 3 learners face substantial diseconomies of scale. The diseconomies can largely – though not wholly – be accommodated by restricting student choice in institutions with 200–500 learners. With fewer learners still, the diseconomies cannot be accommodated: with 100 learners, for example, the cost per learner is roughly twice as high as it is with 500 learners.

This conclusion is broadly consistent with the LSC's (2005c) *Guidance for 16–19 competitions*, which recommends provision for 200 learners or more with a view to offering 20 A-levels and 3 or 4 AVCEs – a range of choice that is 'restricted' when compared with that typically offered by larger institutions.

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[19] 'Type 2' suggests costs at this size of £935 per enrolment against funding of £869 in LSC's 'Example 3' cited earlier in this report. But allowing for differing subject programme weights and guaranteed funding for school sixth forms, the position may have been about break-even.

9. References

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Annex 1: A2 awards, summer 2005

Number of awards made by the three main examination boards in England at GCE
Advanced (A2) level, Summer 2005, ranked by number of awards

	Awards	Rank
General Studies	70290	1
Psychology	54413	2
Mathematics	52732	3
Biology	50556	4
English Literature	45856	5
History	41974	6
Chemistry	33854	7
Business Studies	33084	8
Physics	29342	9
Geography	29101	10
Sociology	28995	11
Media Studies	24132	12
Sport & Physical Education	23055	13
Religious Studies	16365	14
English Language	16335	15
Information & Communications Technology	16088	16
Critical Thinking	15834	17
Art & Design (Fine Art)	15801	18
Drama & Theatre Studies	15086	19
Economics	14723	20
English Language & Literature	13738	21
French	13435	22
Design & Technology (Product Design)	11987	23
Government & Politics	10326	24
Art & Design	8949	25
Art & Design (Photography)	7144	26
Law	6954	27
Music	6748	28
Computing	6453	29
Spanish	5915	30
German	5755	31
Further Mathematics	5673	32
Human Biology	4540	33
Accounting	4396	34
Classical Civilisation	4178	35
Performance Studies	3216	36
Art & Design (Graphic Design)	2917	37
Art & Design (Textiles)	2900	38
Economics & Business Studies	2651	39
Philosophy	2509	40
Music Technology	2498	41

	Awards	Rank
Communication Studies	2177	42
Chinese	2062	43
Applied Mathematics	1545	44
Dance	1529	45
Latin	1408	46
Environmental Science	1285	47
Electronics	1256	48
Geology	1112	49
Art	1111	50
History of Art	901	51
Italian	812	52
Design & Technology (Systems & Control Technology)	801	53
Design & Technology (Food Technology)	793	54
Ancient History	746	55
Urdu	739	56
Statistics	669	57
Art & Design (Three-Dimensional Design)	666	58
Home Economics	665	59
Design & Technology (Product Design)	656	60
Russian	636	61
Archaeology	595	62
Arabic	429	63
Turkish	411	64
Science	385	65
Art (Critical & Contextual)	311	66
Pure Mathematics	275	67
Classical Greek	260	68
Japanese	251	69
Portuguese	219	70
Persian	204	71
Punjabi	203	72
Greek (Modern)	159	73
Polish	141	74
Dutch	133	75
Bengali	83	76
Biblical Hebrew	57	77
Gujarati	52	78
Modern Hebrew	51	79
Use of Mathematics	39	80
Design & Technology (Systems & Control Technology)	35	81
Social Policy	9	82
Mechanics MEI	4	83
Total	786373	