REPORT TO THE NHSSCOTLAND RESOURCE ALLOCATION COMMITTEE

TECHNICAL REPORT E

GEOGRAPHIC DIFFERENCES IN THE COSTS OF DELIVERING HEALTH SERVICES IN SCOTLAND: IMPLICATIONS FOR THE NATIONAL RESOURCE ALLOCATION FORMULA

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At the start of the project our understanding of the issues benefited from discussions with representatives from the following NHS Boards: Ayrshire & Arran; Grampian; Highland and Lothian. These are not intended to be a representative sample of NHS Boards, but provided a perspective on some of the key issues. We also intended to meet with representatives from Orkney; unfortunately it was not possible to reschedule a meeting with them within the timeframe. Two Boards (Ayrshire & Arran and Highland) kindly provided us with data that are not available on a national basis, and we refer to these data at appropriate places in the report.

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1 EXECUTIVE SUMMARY

Chapter 2 - Background

The Arbuthnott Formula is used in Scotland to distribute central resources to NHS Boards. It distributes resources according to measures of population needs for healthcare and makes adjustments to the resulting community and hospital allocations for additional costs associated with remoteness and rurality.

The NHSScotland Resource Allocation Committee (NRAC) was established to improve and refine this formula in the light of new data and evidence. In September 2005 the Scottish Executive Health Department issued a research specification on behalf of NRAC to review the treatment of the excess costs of supply in the Arbuthnott Formula. This report describes the research undertaken for this project.

Population counts, age compositions and levels of morbidity and life circumstances identify the levels of activity that each NHS Board is expected to secure for its resident population. The purpose of an excess cost adjustment is to compensate Boards for the unavoidable factors that influence the unit costs of delivering these levels of activity.

These unavoidable factors will include differences in input prices and differences in the production function determining the levels of input required to deliver the target levels of output. Input prices will be higher where the NHS faces more competition for the inputs required to deliver services such as labour, buildings and land. More dispersed populations will impose higher travel costs on the NHS for community services (where staff deliver some services in patients' homes) and higher costs of provision for hospital services (where local facilities are required that do not benefit from economies of scale).

Chapter 3 – Aims and Objectives

The objectives specified for this research were to review the Arbuthnott Formula remoteness adjustments for hospital and community services and review the evidence for inclusion of other unavoidable excess costs of supply, such as market forces. The scope of the research is confined to hospital and community services. It excludes capital resources, teaching and research, GP prescribing and Family Health Services.

The formula seeks to distinguish between 'need' differences and 'cost' differences. Many aspects of care differ between urban and rural areas and it is unclear in some cases whether these represent additional need or excess costs. Rural populations, for example, are less likely to be treated as (less costly) daycases and more likely to be treated as (more costly) inpatients. This can be labelled as a 'need' for additional units of activity (bed-days) or an excess 'cost' of treating each case.

The existing approach in the formula treats these differences in care as need differences. To ensure no overlap with the revision to the needs element of the formula, we focus on how local unit-costs depart from national unit-costs by examining variations in input prices and the extent to which additional inputs are required in rural areas to treat the levels of activity identified by the needs element of the review.

Chapter 4 – Review of the Arbuthnott Formula

To reflect our remit we have reviewed: the case for an adjustment for variations in input prices; the methods adopted for the existing remoteness adjustments for community and hospital services; and the responses offered by NHS Boards to NRAC.

Variations in input prices

The Arbuthnott Committee examined the case for including adjustments for geographical differences in the prices of labour, land and buildings. It concluded there was no evidence to support an adjustment for labour costs and that the other adjustments were unlikely to have a material impact on allocations because of their minor contribution to overall expenditure.

Private sector pay varies across Scotland to compensate employees for differences in cost-of-living and the relative attractiveness of areas. The NHS competes with the private sector for some of its employees and must offer similar rates of pay to attract staff. Other groups of NHS staff have more specific skills for which there is little or no external market. Review Bodies set national rates of pay for these groups and there is little scope for the NHS to vary the rates of pay offered in some areas. New contractual conditions have limited the scope for regional pay variation in the NHS still further.

Since NHS employees are likely to face similar pressures in terms of cost-of-living and have similar preferences for local amenities, there will be difficulties in attracting NHS employees to these areas. Therefore, while there may not be direct costs to the NHS associated with higher private sector pay, there will be higher indirect costs as exemplified by recruitment and retention problems.

We have reviewed the earlier arguments put forward to the Arbuthnott Committee. The theoretical argument was flawed because it failed to recognise that cost-of-living and amenity differences between areas would impose costs on the NHS. The empirical evidence focused on unemployment rates when it should have considered whether the failure of the NHS to spatially-differentiate pay had implications for recruitment and retention. We therefore revisit the case for a labour price adjustment alongside the consideration of price variations for land and buildings.

Remoteness adjustment for community services

The remoteness adjustment for community services has two components relating to travel-intensive services and clinic-based services. The adjustment for travel-intensive services is based on a simulation of the additional travel associated with the delivery of services by district nurses and health visitors in rural areas. The adjustment for clinic-based services is derived from an analysis of the costs of General Medical Services, which is the subject of a separate review as part of ongoing contract negotiations.

The simulation of travel times is based on 1991 postcode sectors and travel times based on straight-line distances and Local Authority level measures of population dispersion.

Community nurses are assigned to some ‘rural’ postcode sectors regardless of the level of expected demand. The model can be improved with: estimates of drive times derived from the geographical information systems that are now available; a finer definition of population dispersion; and more explicit consideration of how the size of settlements influences the services that will be provided.

Remoteness adjustment for hospital services

The remoteness adjustment for hospital services is based on analysis of Board level information on unit costs and a single indicator of remoteness – road kilometres per 1,000 population. Each of the three wholly island Boards receives the same adjustment.

Although supported by evidence of economies of scale in hospital provision, the existing adjustment is based on statistical analysis of a very small dataset and cannot be disaggregated to below Board level. The robustness of the analysis merits further examination and it would be preferable to base the adjustment on smaller geographical areas to ensure that the geography of Boards with mixed urban-rural areas is reflected accurately.

NHS Board responses

The comments of NHS Boards and other interested parties reflect concerns with the scope of the remoteness adjustment, the treatment of wholly island Boards and Boards with a mixture of urban and rural areas, and the need for an adjustment for input prices. These concerns are addressed by the refinements to the methods we propose.

A case was also made that Boards face infrastructure costs that cannot be adjusted in the short term and that an element of ‘core funding’ should be considered. It would be very difficult to implement such an approach in practice and we discuss its implications later in the report.

Priorities for refinement of the formula

Based on these considerations we focused our attention on a number of issues. Since the remoteness adjustment has not been updated since the original work was undertaken, the existing adjustments do not reflect recent changes in service delivery. The extent to which patterns of care drive higher costs in rural areas are reflected in both the morbidity and life circumstances and the remoteness adjustments in the formula and there is a risk of overlap in the existing formula. We also focused on extending the coverage of the analysis and the adoption of smaller geographical units for the formula.

Chapter 5 – Approaches taken in other countries

Several countries include cost adjustments in their resource allocation formulae. A previous review of international approaches highlighted that, though the principal criteria for judging whether a factor should be included in a formula was whether it explained variations in a statistically significant manner, such an approach to provider costs needed to be careful to distinguish between unavoidable and avoidable determinants. It is the former that that we sought to identify in this project.

We reviewed the approaches taken to cost adjustments in Wales, Northern Ireland, England, Finland, New Zealand, Australia, the United States and Canada. There is no international consensus on the best methods for deriving resource allocation formulae. The approaches adopted reflect data availability, health service organisation and the issues pertinent to the geography of each scheme.

The justifications for excess cost adjustments fall into three groups. First, several schemes adjust explicitly for input prices, but the best formulae adopt indicators that are outside the control of health care providers such as the Market Forces Factor adjustment in England. Second, other schemes focus on the production function, adopting adjustments that reflect economies of scale and higher travel costs for community staff in serving more remote areas. Third, the formulae in New Zealand, New South Wales and Alberta adopt approaches similar to the Arbuthnott Formula hospital adjustment by modelling variations in unit costs directly.

We have structured our empirical investigations around these three groups.

Chapter 6 - Geographic differences in input prices

Since staff costs account for around two-thirds of NHS Board expenditure on hospital and community health services we have devoted the bulk of our effort to labour inputs. We measured geographic variations in private sector pay and then tested whether this has cost implications for the NHS. We also identified data on variations in the prices of buildings and land.

Geographic variations in private sector pay

Spatial variations in private sector pay reflect the industrial, occupational and demographic composition of the workforce in each area. Adjusting for these factors using a large national survey of employees we produce Standardised Spatial Wage Differentials (SSWDs). We test for the appropriate spatial geography and provide estimates for each Local Authority area in Scotland based on the locations where employees work.

We demonstrate that controlling for occupation and industry differences between Local Authorities narrows the variation in private sector pay and reduces the values in those areas that are known to have concentrations of high-pay industries. The remaining differences, the SSWDs, are statistically significant and have changed little over the period 1999-2005. Employers in the central belt, Aberdeen City and the Shetland Islands offer additional pay to compensate employees for higher cost-of-living and other factors that influence whether employees want to work in these locations.

Consequences for the NHS

For staff groups such as maintenance and ancillary staff, admin and clerical staff and managers, the NHS will need to compete directly with the private sector by also paying higher wages in these areas. Where the NHS is restricted by national pay-setting arrangements, it will have difficulty recruiting and recruiting staff.

Using national pay records we confirmed that there was very little spatial variation in NHS pay for doctors, nurses and Allied Health Professionals (AHPs). We then tested whether NHS employers experienced higher vacancy and turnover rates when they tried to recruit in areas where the private sector paid additional compensation. For nurses and AHPs we find these indicators of indirect costs are elevated for employers in high cost areas but we find no such evidence for doctors. We therefore conclude that an adjustment for higher labour input prices is justified for all non-medical staff groups.

Using an index of tender prices for public sector building contracts and NHS land values from the Valuation Office we also demonstrate that there are variations in input prices for buildings and land. The range of 'location factors' for buildings is similar to that observed for the SSWDs but the high building-cost areas are not the same as the high-SSWD areas. An adjustment for building costs will not reward the same Boards as the adjustment for labour costs. The quality of data on hectares that we have used to estimate land values per hectare in different NHS areas is not of the same standard and we conclude that better data are required to inform any adjustment for higher land costs in some areas.

We conclude that estimates of input prices for labour and buildings can be used to derive an adjustment to the resource allocation formula. This would require a matrix measuring the proportions of each Board populations' use of services that are delivered in different locations.

Chapter 7 – Measures of rurality and remoteness

The existing adjustments in the Arbuthnott Formula restrict their attention to the excess costs associated with rurality and remoteness. The indicators of remoteness used in the formula, particularly in the case of hospital services, have been criticised for failing to account for the particular circumstances of some NHS Board populations.

Several indicators have been proposed in the literature. We review the arguments for these indicators and find that classifications based on multiple indicators are generally preferred. A classification that distinguishes between rurality (population dispersion) and remoteness (which captures travel times to major settlements) is preferable for our purposes. Where the mode of service delivery involves significant travel for NHS staff, such as community services, rurality will be the significant cost factor. Where patient access to facilities is the primary concern, such as hospital services, remoteness is likely to be more important.

We identify a recent categorisation created by the Scottish Executive – the Scottish Executive Urban Rural Classification – that distinguishes these two elements for all small geographical areas within Scotland. Rurality and remoteness are reflected in this measure. We propose and obtain a refinement of this classification that separately identifies very remote places on the mainland and islands. This allows us to examine later whether provision of care to island populations imposes additional costs.

In section 7.4 we provide a profile of the pre-2006 NHS Boards using this classification. Most Boards contain a mixture of urban-rural categories and no pre-2006 NHS Board has a monopoly on any of the categories. This measure provides a rich picture of the heterogeneity of the population in each NHS Board area and Scotland as a whole.

Chapter 8 – Remoteness adjustment for community health services

The purpose of this chapter is to refine the model that underpins the Arbuthnott Formula adjustment for remote areas. We begin by considering the utility of the national data on service costs and then analyse empirical data on urban-rural variations in service delivery. These data cannot support the development of an adjustment for the national formula so we concentrate on developing the simulation model for district nurse and health visitor services. Since these services represent less than 25% of community services expenditure we conclude this chapter with suggestions for generalising the model.

Empirical observations on service costs

The range and quality of national data on the costs of community services has increased in recent years. Elements of expenditure on different services are provided by most NHS Boards. The largest element of expenditure is classified as 'Other Services' (34%), followed by District Nursing (16%), Community Psychiatric Teams (14%) and Allied Health Professional services (10%).

For some services, figures are also reported on unit costs. These show very wide variations – for most services unit costs vary five-fold between the highest cost and lowest cost Boards. Most services are cheaper in more remote Boards but there is no consistent correlation with remoteness. A robust adjustment cannot be derived from these highly aggregated data of dubious quality. NHS Ayrshire & Arran provided us with figures from their local systems and these, together with similar data from elsewhere, could be used in the future to derive an adjustment based on service costs.

Empirical observations on service delivery

Practice Team Information (PTI) represents a considerable improvement in the information available for two community health services – district nursing and health visiting. These data contain information on encounters (contacts) between professionals and patients for residents of 9 of the 10 urban-rural categories we consider.

They show that district nurses undertake 91% of encounters in patients' homes compared to 48% for health visitors. These proportions are not consistently patterned by remoteness and rurality. The estimated distance travelled per encounter is similar in Primary Cities, Urban Settlements and Small Towns, but is increased substantially in rural areas. These figures convert into required times per encounter that are approximately 20% higher in more remote rural areas. As a consequence, we would expect community nurses in rural areas to be able to undertake fewer patient encounters per day and, broadly speaking, this is confirmed by the data.

Simulation model for district nursing and health visiting

We simulate the required times per contact for each of 42,604 Output Areas in Scotland based on the size of the settlement in which the Output Area is located (if it is) and the drive time to the nearest settlement (if it is not). This requires values for a key set of parameters, most of which are provided by PTI or are maintained from the model derived for the Arbuthnott Formula. These Output Area estimates can be aggregated to higher-level geographical areas, such as urban-rural categories or NHS Boards, using estimates of the expected demand from each Output Area which we derive using age-sex specific contact rates from PTI.

Assuming these services are based in settlements of 3,000 or more people, we estimate that the unit costs of district nurse and health visitor services are raised in very remote rural areas by over 75% and 40% respectively. The lower figure for health visitors reflects a lower proportion of their contacts in patients’ homes.

As we would expect, providing services in smaller settlements decreases the excess costs in rural areas and restricting provision to larger settlements increases them. Based on national workforce figures we assume that a settlement size of 3,000 or more people is appropriate for these services. Local decision-makers may judge it more efficient to locate nurses in smaller settlements for a wide variety of reasons and it would not be possible to derive a model to account for these. These decisions would result in lower costs in rural areas than our model generates.

A general model for community services

The key parameters of the model can be populated with evidence-based estimates for district nursing and health visiting. However, these services account for less than a quarter of community services expenditure. The key determinant of the excess cost adjustment for rural areas is settlement size. Based on national workforce figures we classify the elements of community services into ‘small settlement’ and ‘large settlement’ services and derive a unit cost adjustment for all community services expenditure.

Values for the key parameters have had to be assumed and the model can be improved with more information on community health services. The model is general, based on very small geographical areas, and capable of refinement as further evidence emerges on patterns of care.

Chapter 9 – Remoteness adjustment for hospital services

Updating the current adjustment

We began by attempting to replicate the existing remoteness adjustment for acute hospital services using data on Board-level expenditure for seven years (1998/9 to 2004/5) and updated Local Authority-level figures on road kilometres per 1,000 population. We propose an alternative approach to deriving the ratio of actual to expected costs for each Board that uses the national activity mix rather than the local activity mix.

There are some serious anomalies in the expenditure series. We interpolated values where these errors were obvious, but the relationships between remoteness and costs remain highly inconsistent year-to-year. Removing the wholly island Boards from the analysis results in a positive correlation between remoteness and the ratio of actual to expected costs, because figures for recent years for NHS Shetland and NHS Western Isles are either missing or much lower than in earlier years.

Depending on the time period, whether the wholly island Boards are included or excluded, and whether or not the statistical analyses are weighted to reflect variations in Board size, we can generate a Board-level adjustment that increases or decreases with remoteness. Such a lack of robustness encourages us to develop more refined methods.

Estimation of unit costs at datazone level

Patient level activity data from hospitals shows how residents of different geographical areas access services from different hospitals and the different specialties within them. Rural populations will tend to use local services for less specialised care and centralised services for more specialised care. The higher unit costs of small-scale facilities will therefore only apply to a proportion of activity for residents of rural areas.

The cost data provided by the NHS in Scotland also contains specific information on expenditure and activity at different hospitals and the different specialties within them. Matching of the patient level activity data with the hospital-specialty cost data provides us with an estimate of the amount spent on providing hospital care for all geographical areas within Scotland. We can create a ratio of these local costs to the costs of providing this care if it had been delivered at national average unit costs and examine whether this ratio varies across urban and rural areas.

We have created these figures for the 6,505 datazones within Scotland for six hospital care programmes: acute; maternity; mental health; continuing care for the frail elderly; people with learning disabilities; and outpatient services. It proved much more difficult in practice to match the information on activity and costs than it should have but, with some exceptions, we provide results based on consistently high levels of matching across urban-rural categories.

Acute hospital services

Patient level activity data were obtained for 2002/3 – 2004/5. Residents from more remote areas are less likely to be admitted as daycases or emergencies and have longer average lengths of stay. They have higher average case-complexity. A greater proportion of their healthcare is provided in smaller general and community hospitals. Excluding residents of Primary Cities, there is little variation in the occupancy rate and numbers of staffed beds in the hospital-specialty facilities used by residents from different urban-rural categories.

The ratio of local costs to national average costs is significantly elevated for residents of islands. Areas in the remaining 7 urban-rural categories have lower than expected costs compared to Primary City areas.

Since these results are unexpected, we provide a detailed explanation of why this occurs. We estimate how three aspects of the patterns of care received by residents of urban-rural areas contribute to their costs. Costs are increased by more than 5% because of greater use of higher cost specialties (such as GP-led care) by rural residents. Controlling for specialty-mix, longer lengths of inpatient stays contribute little to variations in costs. Lower proportions of daycases add a further 3-5% to the costs of providing care to rural residents. Together these three factors account for all of the increased costs in mainland rural areas and more than half of the increased costs for island residents.

In the existing approach to the formula, these causes of increased expenditure are treated as additional *needs* rather than excess *costs*. When we control for these three causes of increased expenditure, residents from remote and rural areas of the mainland do not make greater use of facilities that have higher unit costs.

Maternity services

Activity data relating to all deliveries were obtained for 2000/1 – 2002/3. A higher proportion of deliveries for rural area residents are classified as normal deliveries. There are substantial differences across urban-rural categories in the occupancy rates and sizes of facilities used. The ratio of local to national average costs is lower by 5% in Primary City areas and is higher in most other categories. Costs are increased by approximately 50% for island residents.

Mental health

In these and the other long-stay specialties the latest years for which complete patient activity data are available cover the period 1998/9 to 2000/1. Patients from rural areas tend to be older and those from the most remote areas have longer average lengths of stay. Patients from rural areas are less likely to be discharged under irregular circumstances. Patients from Primary Cities use facilities that are much larger and have higher occupancy rates than patients from other types of areas but there is little difference across the other urban-rural categories.

The ratio of local to national average costs increases consistently with remoteness and rurality. Remote areas impose 10% higher costs than the average and islands increase costs by 50%.

Continuing care of the frail elderly

There is little clear pattern of case-complexity across urban-rural areas in this care programme, though island residents have the longest average length of stay. The ratio of local to national average costs is significantly increased outside areas in large settlements.

People with learning disabilities

Residents of island and very remote rural areas have the highest case-complexity. Rurality tends to be associated with higher occupancy rate facilities and there is no consistent pattern in facility size. Consequently we find no clear pattern in the ratios of local to national average costs.

Outpatient services

Outpatient data are available for three recent financial years, 2002/3 to 2004/5. Patients from rural areas are older on average and are less likely to be recorded as being unable to attend. The ratios of local to national average costs follow a similar pattern to acute hospital services, with significantly higher costs for island areas and Primary City areas.

All hospital care programmes

The results for these six hospital care programmes can be combined using national expenditure weights to provide an adjustment for all hospital care programmes. The derived cost adjustment is approximately 15% for island areas but very similar across the other urban-rural categories. Lower costs of acute and outpatient services in the mainland areas outside the large settlements are broadly offset by higher costs of maternity, mental health and continuing care of the frail elderly.

Chapter 10 – Implications for the resource allocation formula

In this chapter we discuss the overarching issues for the adoption of these adjustments in the formula.

Treatment of fixed infrastructure costs

The current weighted capitation approach does not deal explicitly with fixed infrastructure costs. Whether or not a Board's current infrastructure costs are reflected in their future financial allocation depends on a number of factors and is not simply determined by their weighted share of the Scottish population. Nevertheless, traditional assumptions about the relationship between health service output and costs suggest that there may be short-run increases in unit costs when the level of output is different from what is planned. Problems of trying to adjust the formula accordingly are practical (distinguishing between the long-run and the short-run and between fixed and variable infrastructure costs) and conceptual (failing to consider the additional flexibility at a system level and removing incentives for good service planning). In any case the available data suggest no evidence of a relationship between either output or population change and changes in unit costs.

Combining the input price and remoteness adjustments

We have derived separate adjustments for input prices and for remoteness in community and hospital services. The remoteness adjustment for community services concentrates only on the volume of inputs required and both this and the input price adjustment can be applied to community services expenditure without fear of double counting.

The remoteness adjustment for hospital services refers directly to unit costs and therefore reflects variations in both input price and the volume of inputs required. There is the potential for double counting some of the input price adjustments. This will depend on the extent to which the financial cost data collected by the NHS reflects these input price variations and the extent to which input prices are correlated with remoteness. It is possible that NHS unit costs reflect the prices of land and buildings directly. For staff costs, however, we have seen that the direct costs for the NHS measured in terms of staff pay do not respond to the private sector SSWD and the costs incurred are therefore the indirect costs associated with more recruitment and retention problems. Therefore, the adjustment for staff costs can be applied alongside the remoteness adjustment. Further consideration of the land and building price adjustments is required.

Updating the formula for expected policy changes

A major new strategic direction for the NHS in Scotland has been proposed in *Delivering for Health*. This will impact on the balance of care between different types of hospitals and between the hospital and the community. Explicitly, it is expected to have differential effects in urban and rural areas.

This policy, the outdated nature of some of the data that we have been forced to use, and the relative stability of the underlying factors (remoteness and prices) over time, together suggest that greater priority should be given to updating the weights (such as the ratios of local to national average costs in each urban-rural category) that are applied to the factors in the formula, rather than to updating the factors themselves.

Chapter 11 - Recommendations

On the basis of our research, we make three sets of recommendations relating to the formula, the data that are available and for future research.

For hospital and community health services we recommend (i) revision of the existing remoteness adjustments and (ii) a new and additional adjustment for input prices.

We recommend that substantial improvements be made to NHS pay records and hospital and community health services data on patient activity and costs. It should not be as difficult as it has been to undertake this exercise and a much greater priority should be given to resource mapping in NHSScotland.

If it is thought appropriate to extend our analysis with future research, we suggest further analyses be undertaken on whether other factors (such as age, deprivation and ethnicity) influence unit costs. A future revision of the formula should also consider estimation of the effects of demography, morbidity and life circumstances and excess cost factors in a single, unified analysis that would ensure no problems with overlapping elements of the formula.

2 INTRODUCTION

2.1 Background

Financial allocations to geographical NHS Boards in Scotland are allocated according to a process underpinned by an assessment of need, a weighted capitation formula. This formula was reviewed by a national committee through the period 1997-2000 and resulted in a new formula called the Arbuthnott Formula. The resulting formula was published in 2000 and is based on the shares of the Scottish population resident in each NHS Board area. The formula produced indicative financial shares for each NHS Board based on the weighting of populations to take account of three main factors:

- Additional needs associated with demography
- Additional needs attributed to morbidity and life circumstances
- Excess costs caused by remoteness and rurality

The aim of the excess cost adjustment is to equalise the real resources available to NHS Boards to ensure delivery of the level of healthcare activity required to meet their populations' needs. In this context, NHS Boards are defined by the populations resident within their geographical boundaries. The formula is not concerned with the input actually employed by Boards, or the services provided and managed by them, since these may often be provided to residents from other Board areas. The health care resources needed by *resident* populations form the basis of the formula and each of its adjustments. .

The formula is updated on an annual basis to reflect: changes in population shares; the weightings associated with, and shifts in, the demographic compositions of resident populations; and the changing morbidity and life circumstances of populations in each NHS Board area. The cost adjustments for remoteness and rurality have not been changed since the original analysis was undertaken as this factor changes little over time. The resultant target shares are used to inform decisions about the rates of growth in each NHS Board's funding for health services.

The NHSScotland Resource Allocation Committee (NRAC) was established in 2005 to review the current methods used to allocate resources between NHS Boards in Scotland.[1] The remit of this committee is to:

- improve and refine the Arbuthnott Formula for resource allocation for NHSScotland
- advise on possible formulaic approaches to the parts of health expenditure not currently covered by the Formula (e.g. primary care dental, pharmaceutical and ophthalmic services)
- keep under review the information available to support existing elements of the Formula and consider the inclusion of new data (e.g. ethnicity)
- consider in the light of the pilot exercises adjustments to the Formula for unmet need
- consider any relevant issues that are referred to it.

In September 2005 the Scottish Executive Health Department (SEHD) issued two research specifications on behalf of the NRAC:

[1] www.nrac.scot.nhs.uk

- The first specification concerned research to refine and improve the treatment of morbidity and life circumstances in the Arbuthnott Formula
- The second specification concerned research to refine and improve the treatment of the excess costs of supply in the Arbuthnott Formula

This report describes the research undertaken on the second of these projects.

2.2 Geographical differences in the costs of health service delivery

Population counts, age composition and level of morbidity and life circumstances identify the target share of activity for each NHS Board to commission for its resident population. Different aspects of health care activity (such as inpatient admissions and outpatient attendances) are combined using national average costs.

The purpose of an excess cost adjustment is to alter NHS Board budgets so that they can purchase services at the unit costs they are likely to face in different local circumstances.

Broadly, there are two fundamental reasons why the costs of health service delivery will differ between geographical areas. First, there may be differences in the prices that must be paid for the inputs required to deliver health services. Second, there may be differences in the level of inputs required to deliver a given level of outputs.

Retrospective reimbursement of the costs incurred by healthcare organisations risks rewarding inefficiency and creating perverse incentives to inflate expenditure. The Arbuthnott Formula follows common practice in funding commissioning organisations prospectively and incentivising and managing access, efficiency and quality through other mechanisms. The principle of a formula designed to fund healthcare organisations prospectively to deliver equitable volumes and quality of healthcare services is to reflect only those differences in input prices and volumes that are *unavoidable*.

It would be expected that services delivered at bigger sites would benefit in terms of higher quality and lower costs from specialisation and flexibility. We would expect that the NHS would face higher costs of delivering services in areas where it faces more competition in purchasing inputs such as labour and land, or where it must pay premia to attract employees to high cost-of-living or low-amenity areas.

NHS Boards make local decisions about how to ensure healthcare services are delivered to their resident populations. They will trade-off access, cost and quality. Depending on circumstances, we would expect that some services would be provided locally and other services would be delivered outside the Board area. Where populations are more dispersed or conditions are unfavourable, it is likely that decision-makers will choose service locations and configurations that involve higher costs to improve access for local populations. They may judge access essential to the quality of outcome in some lines of service. They may also seek to improve access because they wish to minimise the travel burden for patients. To the extent that choices of higher-cost options are systematically related to population characteristics, we treat these additional costs as *unavoidable*.

Our approach is to analyse variations in costs to find those factors outside the control of local decision-makers that are systematically correlated with higher costs of service delivery. We extend the analyses used to inform the existing formula to consider causes of variations in input prices and to examine variations in unit-costs below NHS Board level. Throughout, in keeping with the basis of the formula, we focus on differences in costs of the services commissioned for local populations rather than the costs of the providers managed by Boards.

2.3 Structure of this report

Our investigations are structured as follows. The next chapter specifies the aims and objectives of the project, clarifies its scope and the types of services covered, and discusses the problem of distinguishing between need and cost differences that influence the amount of resources required.

In chapter 4 we review the current adjustments. Since part of our remit is to examine the potential for input price variations, we review the previous Committee's decision not to include an explicit adjustment for input price variation in the formula. We then describe the principal features of the adjustments used in community and hospital services to reflect higher costs in more remote areas. We conclude with a list of areas in which we think there is most potential for improvement and refinement.

Adjustments for cost variations are made in the formulae used to distribute resources in many countries. Chapter 5 therefore provides a review of the approaches taken in other countries in the UK and five countries that had been identified by a previous international review to have more sophisticated cost adjustments.

Several schemes make adjustments for variations in input prices. Chapter 6 provides evidence on geographic differences in input prices across Scotland. Because staff costs are a major share of hospital and community health services costs, our consideration of variations in input prices focuses particularly on labour prices but also considers land and buildings.

Our investigations then to remoteness and rurality, which is the focus of the existing supply adjustment in the formula. . There is no clear consensus on how these aspects of geography should be measured and criticism has been made of the indicators selected for the Arbuthnott Formula. In Chapter 7, therefore, we review the literature on measuring remoteness and rurality with a particular focus on the UK. Having identified the best indicator for our purpose we then present a profile of each NHS Board's resident population on this measure.

For community health services, rurality causes excess costs by increasing staff travel and more input is therefore needed to produce the required level of output. Chapter 8 models the extent to which this influences differences in costs across areas within Scotland. For hospital services, remoteness causes excess costs because smaller facilities with excess capacity are maintained to ameliorate access problems. Chapter 9 examines variations in hospital unit costs across Scotland, initially between NHS Boards, and then between small areas.

Chapter 10 considers how these analyses should inform the resource allocation formula. It first considers the case for introducing a 'fixed', infrastructure element into the formula. It then considers how the various adjustments should be combined and how often the adjustments should be updated in light of the expected impact of policy changes.

Chapter 11 contains our recommendations and the references are contained in Chapter 12. Separate appendices to this report provide detailed information on the use of data.

3 AIMS AND OBJECTIVES

This report summarises research undertaken following an Invitation to Tender for research on the 'Review Of The Resource Allocation Adjustment For The Excess Costs Of Supply Of Healthcare Services'. This invitation was sent on behalf of the NHSScotland Resource Allocation Committee (NRAC) by the Scottish Executive Health Department in September 2005. The project commenced in December 2005 and concluded in May 2006.

3.1 Aims

The Invitation to Tender specified that the aims of the work were to review the original adjustment for excess costs in the Arbuthnott Formula and recommend improvements and refinements to the adjustment based on new evidence, methods and data sources that have emerged since the original formula was developed.

3.2 Objectives

The specific objectives for the research outlined in the Invitation to Tender were:

- to review the current remoteness adjustment for hospital services and, if necessary, propose a more appropriate alternative;
- to review the excess cost adjustment for travel-intensive community services and propose improvements taking account of changes in service provision since the original analyses; and
- to review the evidence for inclusion of other unavoidable excess costs of supply in the formula, taking account of changes in service provision and market forces since the original analyses.

3.3 Scope

The focus of this research is the excess costs adjustment for providing hospital and community health services (HCHS). The research is concerned with the excess *revenue* costs of providing HCHS. It does not look at the allocation of capital resources, and it also excludes the allocation of funds to NHS Boards for the Additional Costs of Teaching (ACT) and for research.

Excess infrastructure costs for delivering GP prescribing are reflected in the General Medical Services and Pharmaceutical Services formulae. These, and other Family Health Services programmes (General Dental Services and General Ophthalmic Services), are the subject of separate research projects and/or review processes.

3.4 Description of services covered by this research

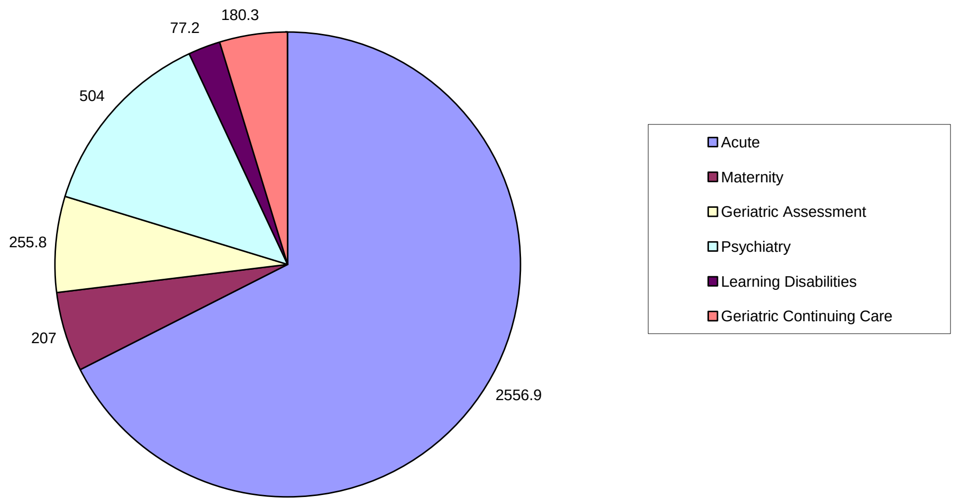
3.4.1 Hospital services

The hospital services covered by this research include the following specialty groups:

- Acute surgical and medical
- Geriatric assessment
- Obstetric services (specialist and GP)
- Mental health
- Learning disabilities
- Geriatric long stay

Total expenditure on these hospital services in 2004-05, the latest year for which figures are available, was £3,781.2m. Figure 3.1 shows the share of expenditure on the different specialty groups. Acute hospital services accounted for some two thirds of this total.

Figure 1: Expenditure on Hospital Services in 2004-05 (£m)



The patient types included in hospital services are inpatient and day case admissions, outpatients (including attendances at Accident & Emergency departments) and day patients.

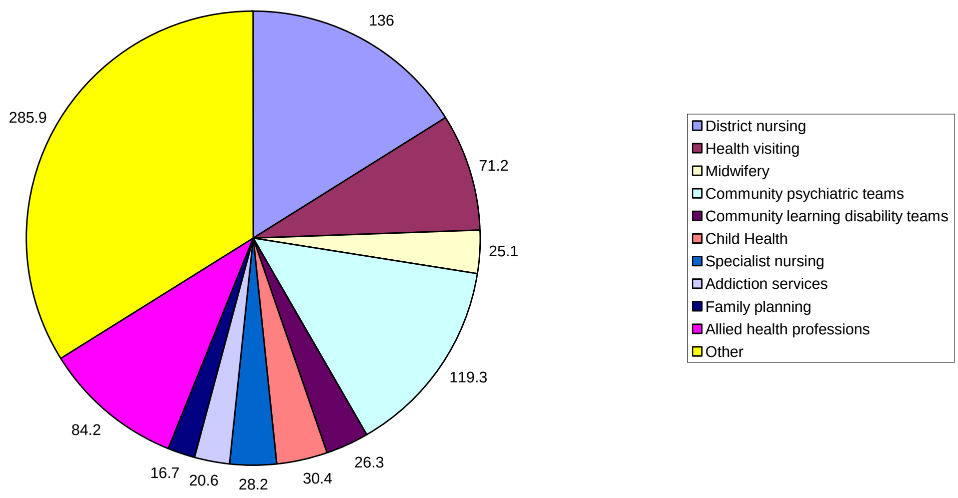
3.4.2 Community health services

Community services include:

- District nursing
- Health visiting
- Midwifery
- Community psychiatric teams
- Learning disability teams
- Allied health professions
- A wide range of other community-based services.

Total expenditure on community health services in 2004-05 was £843.9m. Figure 3.2 shows the share of community health services expenditure accounted for by different services. District nursing remains the largest single service accounting for £136m in 2004-05. However, community psychiatric teams now come a close second, accounting for £119.3m.

Figure 2: Expenditure on Community Health Services



3.5 Distinguishing cost differences from need differences between areas

The Arbuthnott Formula distinguishes need on the basis of population characteristics that are shown to predict the use of healthcare. It applies separate adjustments to population shares for demography, and morbidity and life circumstances to reflect this need. It then includes a further adjustment to take account of the additional costs in remote areas of meeting this need. Because the focus is on the financial consequences of each of these factors, each is expressed in terms of their expected influences on total costs. So, for example, the age weighting is obtained by calculating the costs per capita in each age group using national average costs to weight together different aspects of healthcare activity.

The precise details of this costing process differ by care programme but, in all cases, the costs are designed to reflect differences in specialty-mix and length of stay. For acute hospital services, a further distinction is made between inpatient stays and daycase procedures.

In Chapter 9 we show that many of these aspects of care differ between urban and rural areas. It is not obvious why these differences should be labelled ‘need differences’ and not ‘cost differences’. If the alternative to daycases is an inpatient stay, the latter is more costly than the former, and it is less possible to undertake some procedures as daycases in remoter areas, then there is reason to expect differences in resource requirements between remote and urban areas. We might consider this as either a ‘need’ for additional units of activity (bed-days) or a cause of additional ‘costs’ for treating the same case. Drawing this distinction would be difficult. What is important for resource allocation is that these differences are reflected in one of the formula adjustments.

A further consideration is the correlation between the adjustment factors. *On average*, rural populations tend to be older and experience less material deprivation. A combined analysis that estimated the effects of these factors simultaneously would control for these associations between variables. In a sequential approach to estimating the formula adjustments, such as is applied here, it is important to ensure that those factors that have been analysed at previous stages are controlled for at later stages.

This is the approach that we have adopted in our work. We have taken as given the effects of geographic differences in health service activity quantified using national average costs. In our empirical work, we focus instead on factors that will cause local unit-costs to differ from national unit-costs. We concentrate on input price variations, differences in the level of input required to generate outputs, and departures in local costs from national costs. In each case, we seek to identify the components of these variations that are unavoidable. First we review the methods adopted to arrive at the Arbuthnott Formula.

4 REVIEW OF THE ARBUTHNOTT FORMULA ADJUSTMENTS

In this chapter we describe the evidence-base created for the adjustments that are made in the Arbuthnott Formula. Though the Arbuthnott Formula does not include a separate adjustment for variations in input prices this is explicitly part of our remit. We therefore begin by evaluating the consideration of the case for an input price adjustment (also called a Market Forces Factor) by the previous review.

Next we describe the adjustments created for community services. There are two components: one for services that are travel-intensive for staff and another for clinic-based services. The first concentrates on differences between areas in the production function, represented by the inputs required to generate a given level of output. The second relates overall cost differences to remoteness.

The third element of our review considers the adjustments for hospital services. These too relate overall cost differences between (larger) areas to remoteness and therefore attempt to combine consideration of input price differences and differences in the production function.

The final section of this chapter provides an overall review of the Arbuthnott adjustments. We focus particularly on the differences in approach and the potential for inconsistencies and identify the areas in which there is most scope for refinement.

4.1 Geographic differences in input prices

Prices for some of the inputs essential to deliver services vary geographically. There are three categories of inputs for which prices may differ between Boards: staff costs, these accounted for 66.2 % of current costs in hospital and community health services in 2003/04; energy costs which accounted for just 0.9%; and property including capital charges which were 9.3%.

The Arbuthnott Committee examined the case for including an adjustment in the formula for market forces to reflect geographical differences in the costs of staff, land and capital. The Committee concluded that there was no evidence to support the adoption of a market forces factor for NHS staffing, and that the development of a market forces factor for land and buildings would not be justified because of the relatively small impact that it would have on allocations. However, the Committee felt that further work on the use of a market forces factor for land and buildings should be done in the medium term.

The following reviews the history of the MFF in England and the arguments for and against a MFF for Scotland. It then reviews the arguments and evidence on this issue presented to the Arbuthnott Review.

4.1.1 The Market Forces Factor for staff

Private sector pay differs between areas of Scotland. These spatial variations in private sector pay reflect underlying differences in the cost-of-living and amenities of different areas. These spatial differences in labour costs are also experienced by the NHS either directly, through variations in salary costs, or indirectly, through variations in the costs associated with labour turnover and vacancies.

Private sector employers must compensate employees for differences in the cost-of-living and amenity between different areas. They must set rates of pay that are sufficient to attract and retain the labour they require. There are frictions in wage setting so that rates of pay may not settle immediately at their market clearing level but, taken over a run of years, the private sector can be assumed to be in equilibrium. We should therefore expect the pattern of pay in the private sector to reflect these underlying drivers of spatial pay differences. These same drivers affect NHS employee's desires to work in different parts of the country. This argument has long been accepted in England where spatial pay differences are much greater than they are in Scotland and additional payments to NHS employees in London have been an established feature for many years. A MFF was introduced in 1976 and has undergone several refinements over the years.[2]

Where pay setting is flexible, the NHS will seek to set competitive rates of pay and the rates will reflect local labour market conditions. However the pay of the vast majority of staff in NHS Scotland is set by Review Bodies who set national, UK-wide, rates of pay. Since 2004 this has been underpinned for all non-medical staff by a UK-wide system of job evaluation under Agenda for Change. Under these arrangements pay will not fully reflect differences between local labour markets and there will likely be a difference between what the NHS pays and what the private sector pays in each area. Where this happens the NHS will encounter additional indirect labour costs.

The degree to which the NHS experiences spatial variations in either direct or indirect costs will depend on the impact of private sector labour markets on NHS labour markets. Where an NHS staff group possess general skills for which there is a market outside the NHS, the NHS will be in competition with the private sector for these skills and the pay structure would be expected to reveal the same spatial distribution as that in the private sector. The impact will also depend on the extent to which employees in the NHS have the same preferences for working in different areas of Scotland and experience the same variations in the cost-of-living as employees in the private sector.

The NHS competes directly with the private sector for maintenance and ancillary staff, admin and clerical staff and managers. Evidence has also shown that many trained nurses do not work in the NHS in Scotland[3] and there is therefore evidently an external market for their skills. However a large part of the skills of nurses are specific to the health service and the NHS dominates this market. Nurses appear to have a combination of specific and general skills[4]. The scale of outside competition for nurses' services and the relevance of the external market to the NHS is therefore less clear than in the case of manual, clerical, administrative and managerial staff.

There will be some staff groups, such as doctors, who have very specific skills that are in demand by only the NHS. The NHS may believe it can determine its own rates of pay.

[2] The current method is reported in *Spatial Variations in Labour Costs: 2001 Review of the Staff Market Forces Factor*, Department of Health and Institute for Employment Research March 2002 and *Options for the 2004 MFF: Final Report*, Institute for Employment Research October 2004.

[3] "Geographically differentiated pay in the labour market for nurses", R. Elliott, D Bell, A Scott, A Ma and E Roberts, Journal of Health Economics, forthcoming

[4] Stevens, M. (1994) uses the term 'transferable skills' to describe a combination of skills which are both general and specific in nature. She shows that competition in the outside market for these skills may not be sufficient to drive up pay to a point at which employees are paid their marginal product. See 'A theoretical model of on-the-job training with imperfect competition' *Oxford Economic Papers* 46, 537-62,

However these NHS staff will still have preferences for working in different areas and therefore spatial pay differences will matter to them. If there is a group of employees in the private sector who have similar tastes and preferences to doctors, the spatial distribution of their pay informs the NHS of the appropriate spatial distribution of pay for doctors.

Therefore, whether skills are general or specific, and whether there is private sector competition or not, the spatial distribution of earnings in the private sector matters to the NHS.

4.1.2 Pay setting in the NHS

The degree of sensitivity of NHS pay to local market conditions will be determined by the system of setting pay in the NHS.

Prior to Agenda for Change sixty-five percent of NHS Scotland staff were paid national rates, which were set by the Review Bodies covering Doctors and Dentists and Nurses, Midwives and Allied Health Professionals. These staff groups accounted for 75% of the total NHS Scotland pay bill. The remaining 35% of NHS Scotland staff were recruited in local markets, were on average lower paid, and accounted for 25% of the NHS Scotland pay bill.

Agenda for Change (AfC) has changed this, introducing job evaluation for all non-medical staff and permitting regional differentiation only through the payment of 'high cost area supplements' and 'recruitment and retention premia'. At the moment neither of these is payable in Scotland[5]. AfC was effective from 1 October 2004. The new consultant contract, effective from 1 April 2004, also introduced recruitment and retention premia but Boards have agreed not to use them either.

Prior to AfC the NHS in Scotland formally differentiated regional rewards only through the payment of Distant Island Allowances and Offshore Allowances. However hospitals recruiting nurses and AHPs in tight labour markets may have placed staff higher up pay scales or offered accelerated promotion (Elliott *et al*., 2003). But the scope for these was modest because pay scales are short and promoted posts relatively few. It seems likely that there was very little spatial variation in the pay of each staff grade between different areas of Scotland. The removal of even this limited discretion with the introduction of AfC will have reduced still further the scope for spatial variation. Until 'high cost area supplements' and 'recruitment and retention premia' are introduced there is likely to be a further reduction in the spatial variation of NHS pay in Scotland.

There is very little robust evidence on the existence and scale of spatial variations in the earnings of NHS staff in Scotland. There are some studies for nurses but these do not provide the required detail for Scotland (Rice, 2005; Morris and McGuire, 2002; and Skatun *et al*, 2005). Hospitals may seek to increase the attractiveness of NHS jobs in tight labour markets by improving the non-pecuniary or 'in-kind' rewards they offer to staff. Hospitals have been reported to offer free staff health checks, job rotation schemes, flexible hours contracts, and staff sabbaticals/study leave (Elliott et. al. 2005). But once offered they may be difficult to confine to specific staff groups and may thus be little used to respond to local labour market conditions specific to some groups.

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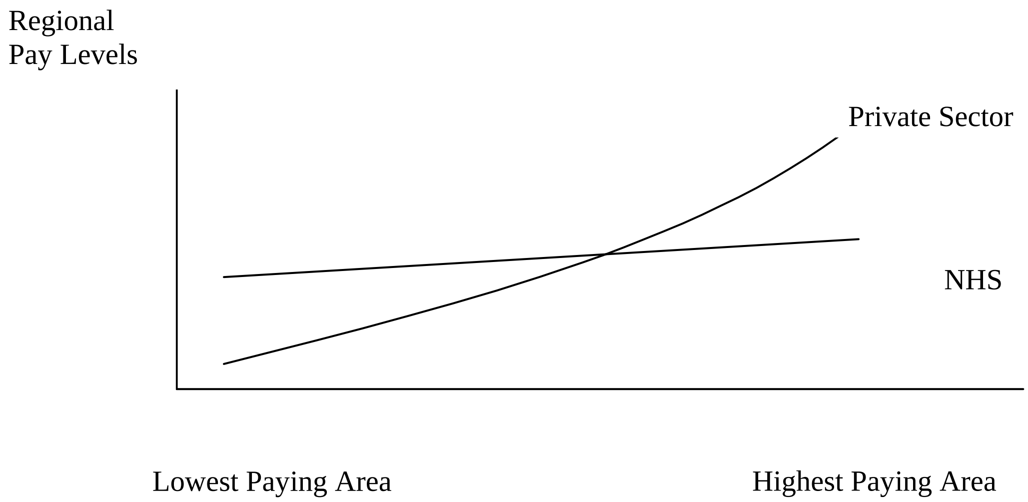
[5] See Policy for the Application of Recruitment and Retention Premia (Agenda for Change), Health Department Letter HDL(2005)47.

4.1.3 The consequences of NHS pay setting

It is likely that the geographical pattern of pay for each of the main staff groups employed by NHS Scotland reveals much less spatial variation than pay in the private sector. The relationship between pay in the private sector and the pay of a NHS staff group is depicted in Figure 4.1 below.

Figure 4.1. Spatial variation in pay in the NHS and the private sector



Under the conditions illustrated above the NHS will overpay in areas to the left of the intersection, and underpay in areas to the right. One consequence is an inefficient use of NHS resources: overcompensating employees in some areas and under compensating them in others. This will have an effect on NHS service delivery and on NHS indirect labour costs. Vacancy rates and employee turnover will be higher in the under compensated areas, with deleterious effects on employee satisfaction, morale and performance. Where there are vacancies, other employees will have higher workloads and longer hours, stress will be higher and productivity lower.

We can therefore assess the importance of the external market by testing for an association between a measure of NHS indirect costs and the spatial pattern of pay in the private sector. If the private sector matters to the NHS, we should expect to see an association between the spatial pattern of private sector pay and NHS vacancy rates. The magnitude of this association will depend on the sensitivity of NHS rates of pay to local market conditions. If a line depicting the spatial pattern of pay for an NHS staff group slopes up, as in Figure 4.1, that is if NHS rates are sensitive to some degree to local market conditions, we should expect to find an association between the gap between the spatial patterns of pay for the NHS staff group and private sector and vacancy rates. If the test reveals no association, then the spatial pattern of pay in the private sector is not relevant to the NHS, and there is no connectedness between the labour market for this NHS staff group and the labour market in the private sector.

If there is an association between vacancy rates and the spatial pattern of pay in the private sector then the magnitude of the association can inform the sensitivity of NHS pay to local labour market conditions. If the magnitude is the same when we take either the difference between the spatial patterns of pay for the NHS staff group and the private sector, or the spatial pattern in the private sector alone, then NHS rates of pay are not sensitive to local market conditions, but indirect costs are. Under these conditions the whole of the adjustment to local labour market conditions is borne by indirect costs. We report results of tests of this hypothesis in Chapter 6 but first examine the previous arguments against an MFF in Scotland.

4.1.4 A review of earlier arguments against an MFF for Scotland

The Expert Group to the previous review of resource allocation in NHSScotland recommended, "for the present no staff MFF effect is included in the national weighted capitation formula"[6]. It did so following two lines of analysis, one theoretical and one empirical. Both pieces of analysis have their limitations. The theoretical argument neglected both cost of living and amenity differences as the underlying drivers of nominal wage differences between areas. The empirical work sought evidence of labour market frictions and an association between them and NHS wage costs, when it should have sought evidence of connectedness between spatial variations in unavoidable indirect labour costs and private sector spatial wage differences. Each of these is explored below.

4.1.4.1 The theoretical argument

The Expert Group argued, "one of the reasons there may be unavoidable cost differences between different parts of the country is due to imperfections in the market for inputs"(op. cit p1). It was proposed that the law of one price would ensure that in a frictionless world (in which all factors of production were mobile) input prices would be equalised across Scotland. The group acknowledged that there were impediments to mobility in labour, housing and other markets. As a result there could be differences in wages rates for a given grade of labour across the country. The argument seemed to run that frictions in labour markets would mean that the balance between supply and demand could differ between areas and as a result wages could differ between areas.

There was no recognition that frictions in other input markets would also be a substantial cause of differences in nominal wages. Differences in wage rates will also result from frictions in housing markets, which result in differences in the cost of living. Nominal wages will differ between different labour markets if there are differences between areas in the cost-of-living.

There is a further reason why nominal wages will differ which went unremarked in the earlier paper. Areas differ in their attractiveness as places to work and employers in some areas, which are judged by employees as unattractive to work in, will have to pay higher wages to attract employees to these areas. Thus wages for any given type of labour will differ due to both differences in the cost-of-living and differences in the relative attractiveness of different areas.

However the extent to which wage rates adjust to reflect these underlying drivers of wage variation will depend on the mechanisms for setting pay. If employers set pay, they will pay

[6] Excess Costs Issues: Market Forces Factors, SG 98(26) 10th June 1998

what is necessary to attract and retain the labour they need and wages will reflect cost-of-living and amenity differences. This is true, as a general statement of behaviour, in the private sector in the UK. Under these circumstances employers in different areas of the country will pay different (nominal) wages.

But will employers in the NHS in different areas of Scotland need to pay different rates? The Expert Group noted that wage rates in the NHS were nationally negotiated and uniform across Scotland and argued that this had the same effect as the free market, allowing the NHS to recruit labour of a given type and quality at the same wage everywhere in Scotland. This contains no recognition that what matters is whether the NHS pays the market rate. It assumes that the labour market in which the NHS operates is unconnected to that in the private sector. There are strong reasons for suggesting this is not the case.

First the NHS is likely to compete with the private sector for many of the staff groups it employs. Cleaners, porters, clerks, administrators, accountants, human resource personnel and managers are all occupations that the NHS and the private sector employ. The NHS must pay the market rate to recruit and retain these occupations. There is evidence that a large proportion of trained nurses work in the private sector in Scotland either as nurses or in other jobs and the NHS therefore faces competition for these skills[7]. Second even where the NHS does not compete directly with the private sector for skills it is likely that NHS staff share the same aversion to a high cost of living and the same aversion to low amenity areas as employees in the private sector. In both cases the pattern of wages in the private sector serves as the benchmark for judging the appropriateness of the spatial patterns of NHS pay. The arguments above connect the NHS to private sector labour markets.

It follows that if the NHS fails to pay appropriate market rates for its staff groups, or if the pattern of pay is so different that it fails to compensate for differences between areas in the cost-of-living and amenities, then this will have consequences for the ability of the NHS to attract and retain the labour it needs. Under these circumstances the NHS will experience ‘unavoidable’ indirect cost differences. For those NHS employers paying less than required, these unavoidable indirect costs will take the form of higher turnover costs, higher recruitment and training costs and loss of experienced staff. Of course those NHS employers paying more than is required will be able to attract better quality staff, hold on to experienced staff and enjoy lower recruitment and training costs. Thus variations in unavoidable indirect costs will have a direct impact on service delivery.

4.1.4.2 The empirical argument

The Expert Group undertook some rudimentary empirical analysis. First they sought to discover whether there was evidence of variations in labour market conditions around Scotland that had resulted from the frictions discussed earlier. The analysis looked at differences in unemployment rates, where the unemployment data were taken from the count of those registered for unemployment benefit. However this is not the right unemployment series to use. The unemployment count under-records women’s unemployment and over-records men’s unemployment. This measure is recognised to be inferior to the much more widely used ILO measure.[8]

[7] See *NHS Labour Markets in Scotland,* R. F. Elliott, K. Mavromaras, A. Scott, D. N. F.Bell, E. Antonazzo, V Gerova and M. Van der Pol.

[8] The ILO measure applies a common definition of unemployment, the International Labour Office definition, irrespective of a person's eligibility to claim unemployment related benefits. The claimant count only records the

At the second stage they sought to explain the relationship between average weekly earnings and unemployment in order to distinguish any relationship between market pressures and earnings. An inverse relationship was distinguished but this was not statistically significant. Note the analysis used gross weekly and not hourly earnings, included no controls for differences between the gender composition and age of the workforce in different areas and included no controls for differences in industry and occupational structure. All the above are known to explain differences between average earnings across areas.

At the final stage of the analysis the relationship between labour market pressures and NHS recruitment and retention difficulties was explored. The correlation coefficients between the unemployment rate and the vacancy rates for nurses and Professions Allied to Medicine were calculated. There was found to be no simple correlation between these series. The Expert Group concluded that "therefore for the most important staff groups there was no significant systematic relationship between recruitment and retention difficulties in Trusts and local labour market conditions" (op cit p6).

There are several weaknesses in this analysis. Setting aside the deficiencies of the chosen unemployment measure, unemployment in itself is a poor measure of labour market pressures. In times of low unemployment, as experienced recently, sustained high levels of unemployment are explained by structural characteristics of the workforce. The unemployed may have the wrong skills or no skills and thus unemployment can often co-exist alongside high rates of vacancies. Where unemployment is structural it serves as a poor measure of labour market tightness and exerts little if any downward pressure on pay.

More fundamentally it is differences between the pattern of private sector spatial wage differences and the NHS pattern of pay that will be the likely cause of recruitment and retention problems. Differences in the spatial pattern of pay in the private sector reflect what is necessary to compensate employees for variations in cost of living and amenity of different areas and it is differences between this pattern and the pattern of NHS pay that may cause recruitment and retention problems. We therefore conclude that the case for the market forces factor should be revisited and this is what we do in Chapter 6.

4.2 Adjustment for community health services

The adjustment for unavoidable excess costs in providing community health services has two components. The first is based on research that was carried out for the Arbuthnott Committee by National Economic Research Associates (NERA, 1999). NERA's research focused on two community services (district nursing and health visiting), which at that time accounted for some 32% of total expenditure on community health services. The second is applied to clinic-based services and was taken from the Arbuthnott Committee's analysis of the additional costs of providing General Medical Services in remote and rural areas.

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number of people that are entitled to claim unemployment benefits at Employment Service local offices. For example, people whose partners are working or who are claiming unemployment related benefits are excluded from the claimant count because they are not eligible to claim such benefits themselves. For more information on the two measures of unemployment see "Labour Market Statistics in Scotland" by Jackie Horne in the September 1998 edition of the Scottish Economic Bulletin and/or "How Exactly is Unemployment Measured?" by The Office for National Statistics.

4.2.1 Model for travel-intensive services

Given the limited information available on the costs and activities in district nursing and health visiting, NERA developed a simulation model that calculated the pattern of travel costs and travel times in different geographical areas based on assumptions about:

- time spent during the day on patient-related work;
- the average length of patient contacts;
- average journey speeds;
- demand for district nursing and health visiting;
- the skill mix of staff;
- the travel patterns of district nurses and health visitors.

4.2.1.1 Structure of the model

The adjustment is postcode sector based. Each postcode sector is split into two components: populations in a 'cluster' and populations outside clusters. Definitions of clusters and population counts were taken from the 1991 Census and have not been updated since then.

The assumptions about the travel patterns of staff were based on the population distribution and the location of staff. NERA calculated two variables for each postcode sector:

- the population in settlements of at least 500 people (localities)
- the straight-line distance to the nearest three settlements of at least 500 people (localities)

Areas within Scotland were then divided into five sub-groups. The first split into two groups depends on whether the population lives in a settlement or outside a settlement of 500+.

For the within-settlement group it was then established whether the settlement would generate a sufficient number of expected visits to warrant at least a full-time nurse. If the settlement was not sufficiently large, an assessment was made as to whether the settlement was sufficiently close to another larger settlement to be served efficiently by a nurse from this larger settlement. If not, the settlement was allocated a nurse that would be under-utilised.

For the outwith-settlement group, a distinction was drawn between rural and non-rural areas. Non-rural areas were assumed to be served by a travelling community nurse. Rural areas were assigned a minimum of 0.5WTE community nurse.

The table below summarises the service delivery assumptions for the five different sub-groups of areas.

Settlement	**Description**	**Service delivery**
Within settlement	Sufficiently large	Dedicated nurse
Within settlement	Not sufficiently large, but close to larger settlement	Served by nurse from nearby settlement
Within settlement	Not sufficiently large, and not close to larger settlement	Dedicated nurse, expected to be under-utilised
Outwith settlement	Non-rural	Travelling nurse
Outwith settlement	Rural	Dedicated nurse, expected to be under-utilised

The first group were assumed to be served by a community health service team located within the locality and within-locality travel times were assumed to be 10 minutes per visit.

To distinguish between the second and third groups, travel times were estimated by the product of:

- the straight-line distance to the nearest three localities
- a measure of dispersion for the Local Authority area.

This measure of dispersion for the Local Authority area was calculated as:

$$\frac{\text{length of B and C roads not in built-up areas in the Local Authority}}{\text{expected number of out of locality visits in the Local Authority}}$$

The next table shows the dispersion measures used for each NHS Board. There doesn't appear to be any clear rural pattern in these measures. Partly this is because NHS Argyll & Clyde, NHS Greater Glasgow and NHS Lanarkshire have been assigned to the national average, even though an average for the Local Authorities that are split across these three NHS Board areas was calculated. While NHS Borders has the highest dispersion measure for both staff groups, NHS Western Isles has the lowest dispersion measure for District Nurses and NHS Fife has the lowest value for Health Visitors.

Dispersion factors used in the NERA model

NHS Board	DNs	HVs
Western Isles	1.3	2.7
Fife	1.4	2.2
Orkney	2.1	3.5
Forth Valley	2.1	3.5
Lothian	2.5	3.5
Ayrshire and Arran	2.6	4.5
Argyll and Clyde	2.6	4.1
Greater Glasgow	2.6	4.1
Lanarkshire	2.6	4.1
Highland	2.7	4.6
Dumfries and Galloway	2.7	4.7
Tayside	2.8	4.2
Shetland	2.9	4.7
Grampian	3.0	3.9
Borders	3.6	5.8

Boards sorted in ascending order of District Nurse dispersion factor

4.2.1.2 Limitations

In the absence of information on other community health services the Arbuthnott Committee concluded that it was reasonable to assume that other travel-intensive services such as midwifery and psychiatric nursing would have excess costs similar to those of district nursing and health visiting.

The NERA model assumes that nurses will be located in some areas where they would be expected to be under-utilised. This is an artefactual issue, and independent of the substantive decision about the appropriate size of settlement, because the definition of geographical areas is for convenience only. This makes the model very sensitive to the size of the units upon which it is built.

The NERA model makes the assumption that a nurse (at least 0.5 WTE) will be located in 'rural' postcode sectors that are outwith settlements but non-rural postcode sectors will be served by a travelling nurse. Little detail is provided about how postcode sectors were classified as rural or non-rural and it is likely that a more systematic classification is now available.

The dispersion factors used in the model are only available at local authority level and no distinction is made between three NHS Boards that share local authorities. Furthermore, the equation used to generate the dispersion factors seems unrealistic and disfavours high workload areas. In the case of a single straight road, it is equivalent to assuming that a nurse will drive the length of the road each day stopping frequently in high workload areas and rarely in low workload areas. While this does capture a real effect that less travel between visits will arise where more locations require visits, it does not reflect that nurses are more likely to have to visit the most remote point when there are more visits.

4.2.2 Adjustment for clinic-based services

Some community health services are delivered in local clinics. The Arbuthnott Committee concluded that the methods used by NERA might be of less relevance to the costs of providing these community health services. It was decided that the costs of providing General Medical Services in remote areas would provide a better proxy for the costs of delivering clinic-based community health services in these areas.

The cost adjustment for GMS provision was estimated using the payments made to practices through the system of fees and allowances in place at that time. These were expressed on a per capita basis and regressed on indicators of the registered population's age, morbidity and life circumstances, and rurality. The estimated coefficients on the three rurality indicators that were found to significantly increase per-capita payments to practices were used to calculate the remoteness adjustment required by each practice and were aggregated to NHS Board level.

The Arbuthnott GMS formula was reviewed as part of the negotiations for the new GMS contract introduced in April 2004. Data on the expenses incurred by practices were obtained from tax records and were used as a more accurate reflection of the costs of service delivery incurred by practices. This formula is currently undergoing a further review and, in the absence of other national data, we do not consider this aspect further in this report.

4.3 Adjustment for hospital services

In this section we summarise the analytical approach adopted for this adjustment, the evidence on economies of scale and the potential limitations of the analysis.

4.3.1 Analytical approach

The adjustment for the costs of delivering hospital services in remote and rural areas was based on an analysis of the relationship between the costs of commissioning hospital services for the residents of each Board and an indicator of remoteness in each Board area.

- First, an estimate was made of the ratio between a Board's actual expenditure on different care programmes for its residents and the expected expenditure. The 'expected' figure was based on calculating what each Board's expenditure would have been had the unit costs of treatment been based on the national average costs across Scotland.

- Second, the indicator of remoteness for each Board was based on the number of road kilometres per 1,000 population.

The ratio of actual to expected costs was regressed on the indicator of remoteness and the estimated relationship was then used to determine the adjustment required through the formula to reflect each Board's level of remoteness.

For the purposes of this analysis, the three island Boards were grouped together and a uniform remoteness adjustment was applied to them. It was thought that, while there might be slight differences between the three island Boards in their remoteness, in practice it would have been difficult to identify significant differences in the extent to which remoteness affects the relative costs of securing hospital services for their residents.

4.3.2 Economies of scale

The tenet underlying this analysis was that Boards with a high proportion of their populations living in relatively remote and rural areas would make proportionately greater use of relatively small hospitals, which would have higher unit costs.

Supporting evidence for this approach was provided by an analysis of the evidence on economies of scale in hospital services. An important reason for higher costs of services in remote and rural areas may be the need to ensure access to services by maintaining relatively small hospitals. If there are economies of scale in hospital services, then these smaller hospitals will experience higher unit costs. There may be several reasons for this. For example, smaller hospitals may not be able to used fixed assets such as theatres and diagnostic equipment as intensively as larger hospitals, and the smaller hospitals may also require a larger margin of spare capacity to deal with day-to-day fluctuations in demand for services.

The analysis that was carried out on this issue for the Arbuthnott committee looked at evidence of economies of scale in acute, mental illness, care of the elderly and maternity hospitals. The analysis considered total costs, as well as specific cost areas including nursing costs, medical costs and allocated (overhead) costs. Regression analysis was used to identify the influences on hospital costs:

- The dependent variable was the ratio of actual to expected costs at each hospital where the latter was measured as the level of costs that would be incurred if unit costs were the same as the average unit costs for the peer group being analysed.

- The explanatory variables included alternatives measures of scale (staffed beds or patient volume), the number of specialties in each hospital, a case complexity measure, and a variable to allow for the additional costs that island hospitals may face because of their remoteness.

The results showed that there was significant evidence of economies of scale in the different programmes of care, and this provided some support for the analysis of the influence of remoteness and rurality on Boards' costs as commissioners of services.

4.3.3 Limitations of the previous analysis

The method of calculating an adjustment for the unavoidable excess costs of commissioning hospital services for populations in remote and rural areas has a number of limitations.

- First, the statistical information used to estimate the relationship between relative costs and the remoteness indicator was based on a very small dataset – only 13 observations for each year (12 mainland Boards and a single observation for the combined island Boards). Inevitably this makes the results quite sensitive to individual observations.

- Second, the single indicator of remoteness at NHS Board level may not take adequate account of the mixture of urban and rural/remote areas that exists within many Boards.

- Third, the estimates are made at Board level and it is not easy to disaggregate the information to show the impact of remoteness on costs at sub-board level. Boards may wish to do this for their own internal planning purposes. Information on the costs of services commissioned was available only at Board level, while the indicator of road kilometres per 1,000 population could at best have been disaggregated to local authority level.

- Fourth, the single adjustment for the three wholly island Boards may fail to reflect differences in the circumstances that they face.

4.4 NHS board and other responses to the existing adjustments

In commenting on the Arbuthnott formula, NHS Boards and others raised a number of issues. Differences in healthcare needs between populations living in different geographical areas are covered in the research commissioned on other aspects of the formula including the influence of morbidity and life circumstances on healthcare needs. This section of the report provides brief comments on the issues raised on the adjustment for excess costs.

4.4.1 The scope of the remoteness adjustment

The Arbuthnott formula includes an adjustment for remoteness that is based on the relative costs of providing hospital and community services in different NHS Board areas and an indicator of remoteness and rurality. In their comments, several Boards pointed out a number of ways in which remoteness and rurality may give rise to additional costs: for example, the high costs of providing small hospitals in these areas or the need to employ staff at a higher grade because of the wider range of responsibilities that they may have to undertake.

The existing adjustment for hospital services was intended to take into account any factors that cause the costs of providing healthcare to be higher in remote and rural areas than in urban areas. To the extent that factors such as economies of scale in hospital services or the need to employ staff at higher grades affect the costs of providing services, this should be reflected in the relative costs of healthcare in Boards with remote and rural areas.

The research described in Chapter 9 of this report also compares the costs of providing hospital services to the population living in different areas with the average cost in Scotland as a whole, though at a much more detailed level than in the earlier work. Again, any factors that give rise to cost differences between different geographical areas should be captured by estimates of the relative costs of services used by these populations.

4.4.2 Core funding

It was suggested by some Boards that it may be more appropriate to provide a level of core funding, which would reflect the need for all Boards to maintain a certain level of services, and a variable element of funding that might be linked to other factors such as morbidity and life circumstances. For a number of reasons it would be difficult in practice to draw a distinction between core funding and variable funding. Nevertheless, we return to this issue specifically in Chapter 10 of this report.

A weighted capitation formula is intended to take into account all of the factors that influence a Board's relative need for healthcare resources including the size of its population, the population's age and sex structure, morbidity and life circumstances together with other factors that give rise to unavoidable excess costs in delivering healthcare. The adjustment for remoteness and rurality in the current Arbuthnott formula is a variable adjustment which is meant to take account of the fact that Boards with population living in remote and rural areas may face additional costs in delivering hospital and community health services to these populations.

4.4.3 The wholly island Boards

A specific concern raised in some comments is that the wholly island Boards may face particular problems in providing healthcare because of their remote circumstances and this needs to be recognised in a formula. The current adjustment for remoteness and rurality uses a single measure – road kilometres per thousand population – to try to capture the effects of remoteness and rurality on the relative costs of delivering hospital services across all NHS Boards.

It was recognised in the Arbuthnott report that this was a relatively simple approach to a complex issue, and the report recommended that further research should be done on this issue. In Chapter 7 of this report we review the literature on measures of remoteness and rurality and the arguments for them and suggest that an area classification that identifies island populations separately be adopted.

4.4.4 Boards with a mixture of urban and rural areas

A different concern raised about the existing adjustment for remoteness and rurality is whether it takes adequate account of the position of Boards that have a mixture of urban as well as remote and rural areas. A related concern is that, because the current adjustment is calculated only at Board level, it cannot be used to inform planning of services at sub-Board level.

Several of the mainland Boards have a significant proportion of their populations living in relatively remote and rural areas. The adjustment for remoteness in the Arbuthnott formula is based on the average figures for road kilometres per 1,000 population for each Board area as a whole. To this extent it should reflect the mix of urban and remote and rural areas within each Board. However, the research set out in this report examines the costs of providing healthcare services at small-area level. It is therefore more sensitive to this distinction and makes it possible to see how Board-level averages are derived from the figures for small areas contained within their boundaries. Moreover, it will enable Boards to examine the influence of this factor at sub-Board level.

4.4.5 Market Forces Factor

A number of Boards have pointed out that they may face increased costs because of the generally high prices for labour and other resources in their local area. Recruitment and retention of staff may also be more difficult in areas where housing costs are high. The Arbuthnott Committee considered the case for a Market Forces Factor (MFF) but decided that the evidence was not strong enough to justify the inclusion of such an adjustment.

The research in this report has examined the evidence about the extent to which Boards may face different costs because of geographical variations in levels of pay and in the costs of land and buildings. The results of this research are described in Chapter 6.

4.5 Scope for refinement of the cost adjustments in the Arbuthnott Formula

Based on our initial evaluation of the cost adjustments in the Arbuthnott Formula and the issues raised by NHS Boards and others, we have identified four broad ways in which we think it is possible to refine the existing cost adjustments in the Arbuthnott Formula: updating; consistency; coverage; and units of analysis. We conclude this chapter with a summary of these issues, which we then seek to address in the later chapters of this report.

4.5.1 Updating

The remoteness adjustment has changed very little since it was introduced. Neither the factors driving the remoteness adjustments nor the weightings applied to them have been updated since the original work was undertaken. There is clearly scope for updating the variables and undertaking analysis on more recent data to obtain weightings that reflect any changes in the way that care is delivered.

4.5.2 Consistency

There are issues of consistency between the (included and excluded) cost adjustments and between the cost adjustments and the other adjustments in the formula.

4.5.2.1 Overlap with other adjustments in the formula

We concluded Chapter 3 with a discussion of the distinction between the need and cost elements of the formula. The existing hospital adjustment is based on analysis of an actual to expected cost ratio that did not take, as its expected costs, the costs adopted for the morbidity and life circumstances adjustment. For both adjustments the ratio of actual to expected costs used in the modelling would have been increased in rural areas by a more expensive specialty-mix, lower proportions of daycases and higher average lengths of stay. We shall see in section 9.4.6 that these are a substantial cause of urban-rural cost differences.

There is the potential for overlap in this approach to the extent that the factors being taken into account at each stage are correlated. It would be preferable to use, as expected costs, the costs that have been used in the morbidity and life circumstances adjustment.

4.5.2.2 Consistency between cost adjustments

We have indicated some weaknesses in the arguments and evidence that were presented to the previous review against the inclusion of an explicit adjustment for input price differences in the Arbuthnott Formula. There is clearly scope for revisiting these arguments. In addition, it is worth noting that, since the hospital adjustment is based on cost differences between Boards, some of the effect of input price variations on costs is captured in the existing adjustment. If, as we have argued, variations in private sector wages cause increased costs (either directly or indirectly) for the NHS, then some of these may be captured in the reported variations in the actual to expected cost ratio modelled for the hospital adjustment.

However, it is certain that all of the indirect costs will not be captured because these can take the form of less experienced staff, higher turnover, more stress, and higher absence and sickness rates when it is difficult for NHS Boards to attract and retain staff. To the extent that private sector wage variation is correlated with remoteness, it will be partially reflected in the existing hospital adjustment. It follows that, while the Committee may have sought to exclude input price variations from the allocation formula, in practice these may have been reflected in part in the derived adjustment.

On the other hand, the adjustment for travel-intensive community health services reflects only the higher amounts of input required to deliver activity in more dispersed areas. Therefore, this adjustment does not capture any input price variation, as the Committee intended.

4.5.3 Coverage

The methods of determining a remoteness adjustment for community health services in the Arbuthnott Review reflect the limited information available about the level and pattern of the unavoidable costs of different community health services. It is based on a model which was applied to only two community health services – district nursing and health visiting – which account for a limited (and declining) share of total expenditure on community health services.

4.5.4 Unit of analysis

Much of the analysis for the Arbuthnott review was undertaken on geographical areas that were amalgamations of 1991 postcode sectors. The 2001 Census and recent developments in geographical analysis in Scotland (such as datazones) offer alternative, finer geographical disaggregations of Scotland.

The existing hospital adjustment is based on analysis of Board-level data and generates an index that cannot be disaggregated below Local Authority level. Concerns have been expressed that such an adjustment cannot accurately reflect the conditions in mixed urban-rural Boards, suggesting smaller units of analysis may be preferable.

The existing adjustment for travel-intensive community health services is based on 1991 postcode sectors. Since the primary focus is on distances between areas, the analysis can be refined using smaller units of analysis.

5 REVIEW OF APPROACHES TAKEN IN OTHER COUNTRIES

5.1 Excess cost adjustments made in other countries

A survey of weighted capitation funding for healthcare in developed countries by Rice and Smith (1999) found that a wide variety of need and cost factors had been used to determine capitations. However, they commented that these seem to be determined by data availability rather than by compelling arguments for a link to the need for healthcare resources.

Their summary of methods for setting capitations emphasised that the main criteria used to determine whether different factors should be incorporated into a funding formula was whether it explained variations in expenditure in a statistically significant manner. As such, specific unmet need for some groups is not captured and "the use of empirical spending patterns to infer needs is problematic, as the methods developed will perpetuate the implied inequity" (p.6). The relevance of this statement for our purposes is clear – using empirical data we will not capture the relative costs of some groups (urban or rural) if they are systematically under-funded under existing arrangements.

It is possible, however, for the statistical analysis of current expenditure patterns to consider the role of all factors that predict health care expenditure and decide afterwards whether these factors are *legitimate* or *illegitimate* criteria on which a funding formula pursuing an equity objective should be based. The importance of estimating the magnitude of unavoidable factors simultaneously with the effects of avoidable factors to avoid confounding has been highlighted in two recent papers (Gravelle et al 2003; Schokkaert and van der Voorde 2004).

Rice and Smith (1999) suggest that this is particularly important in the context of variations in provider costs. They highlight the approach taken in England (where health plans are thought not to be able to influence general input prices and adjustments are made for general wage data and land prices) and contrast this with the approach taken in US Medicare (which compensates plans for variations in per capita expenditure on health care). It is the former (unavoidable causes of cost variation) rather than the latter (largely avoidable cost variations) that we want to identify in this project.

Rice and Smith identified 3 countries where they considered that a relatively sophisticated approach had been taken that sought to identify unavoidable cost variations in allocation formulae: Finland, New South Wales and New Zealand. We have therefore included these three systems in an updated review. Since rurality is a major issue in Canada and the US we also review examples from these systems, alongside the systems used in England, Wales and Northern Ireland.

5.2 Wales[9]

The method that has been adopted in Wales for allocating resources equitably between local health boards is based on population shares adjusted by:

- a health needs index (as measured by a range of health needs indicators multiplied by the average cost of meeting those needs);
- the rural costs index which is applied to community services expenditure (7.5% of the total); and
- the age costs index, which is applied to 65% of expenditure.

The rural cost adjustment is applied to 7.5% of expenditure, reflecting the travel-intensive community services such as district nursing. This is calculated applying the methodology developed by NERA for the Arbuthnott Formula to the Welsh population distribution. This uses settlement patterns and assumptions about travelling time and nurse workload. The research team recommended reviewing the assumptions and the sensitivity of the model and this is included in the planned work programme.

5.3 Northern Ireland[10]

The Capitation Formula Review Group (CFRG) in Northern Ireland examined the evidence on economies of scale and the extent to which this might have funding implications because of the attempts by Health and Social Security Boards to balance access and scale.

The modelling approach adopted by the researchers in respect of Northern Ireland's acute hospitals explored their associated activity and costs in order to:

- Determine whether there was evidence for economies of scale effects in the operations of hospitals;
- Identify and quantify such scale effects if they were present in Northern Ireland so that the relevant scale costs for hospitals of different sizes could be estimated;
- Model a number of alternative hospital configurations or scenarios in terms of access, activities and flows with a view to estimating overall scale costs; and
- Attribute the derived economies of scale costs to each Health and Social Services (HSS) Board taking account of expected or actual patient flows to each hospital in each scenario.

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[9] *Inequalities in Health: The Welsh Dimension*. Final Report by the Standing Committee on Resource Allocation 2005.
http://new.wales.gov.uk/docrepos/40382/dhss/reportsenglish/townsend-report-e.pdf?lang=en

[10] Allocating Resource to Health and Social Services Boards: Proposed Changes to the Weighted Capitation Formula. A Fourth Report from the Capitation Formula Review Group. July 2004 http://www.dhsspsni.gov.uk/capitation-cfrg-fullrpt-no2.pdf

The research undertaken identified a statistically significant effect of economies of scale, and this relationship was then used to model the distribution of costs in different areas under alternative assumptions about the configuration of acute hospital services including the current configuration and the configuration proposed in the policy document, *Developing Better Services*.

The CFRG agreed that as the *Developing Better Services* model represented the strategic plan for hospital services in Northern Ireland it made most sense to recognise this scenario in future allocations. In view of the existing current cost structures in the hospital sector, some group members expressed strong reservations about this. It was, however, acknowledged that as full implementation of *Developing Better Services* would take considerable time, progress and the associated hospital costs should be subject to periodic review and taken into account when moving HSS Boards toward their revised target capitation shares.

The research estimated an economies of scale effect for community services. This effect was based on modelling work, which showed that relatively small teams of community health workers in rural areas would tend to be used less effectively because of greater variability in daily demand. The research also identified economies of scale in day centres, but was unable to estimate similar effects for other facilities because these are often shared with other services, which gives rise to difficulties in apportioning costs. The CFRG also agreed that this scale factor for community services should be taken into account in determining the allocations for HSS Boards.

The Northern Ireland formula also includes a 'rurality budget', which is based on the additional travel costs incurred in delivering community health, services. This is based on modelling travel patterns and journey times for community health staff in rural areas, and is separate from the economies of scale adjustment.

5.4 England[11]

The English resource allocation formula takes into account unavoidable geographical variations in the costs of providing services through the use of a Market Forces Factor (MFF). The purpose of the MFF is to equalise the commissioning power of Primary Care Trusts by adjusting for unavoidable variations in provider (NHS Trust or PCT) costs directly related to location. There are separate MFF adjustments for staff, land and buildings. These are described below.

5.4.1 Staff MFF

The staff MFF is based on variation in wages in the private sector. This is necessary in spite of national pay arrangements because geographical variation in the labour market results in some NHS Trusts facing higher indirect staff costs due to recruitment and retention difficulties, grade drift and the use of agency staff.

[11] *Resource Allocation: Weighted Capitation Formula*. Department of Health, May 2005. http://www.dh.gov.uk/assetRoot/04/11/20/67/04112067.pdf

The staff MFF is based on the three latest years of the New Earnings Survey Panel Dataset (NESPD). For 2006/07 to 2007/08 allocations, these were 2001, 2002 and 2003. The data are aggregated into the 303 PCT areas.

Each year's data are used in a regression analysis which isolates the effect of geography on staff costs in each PCT by accounting for the effect of other factors, such as age, sex, industry and occupation. This adjustment is currently being reviewed.

5.4.2 Land MFF

A land index is calculated for each NHS Trust and PCT, using data from the Valuation Office Agency's (VOA) valuation of the NHS estate in 2004. The land index is calculated as the land value per hectare for each NHS Trust and PCT.

5.4.3 Building MFF

The buildings index is based on a rolling average of tender prices for all public and private contracts provided by the Building Cost Information Service to the VOA. It is made available by London borough and county. PCTs are assigned the relevant values. Trusts are assigned values depending on the PCT in which they are located, with account taken of multi-site Trusts in the same way as for the staff index.

5.4.4 MFF matrix

The prices described above refer to the costs experienced by providers. Each PCT's MFF is a weighted average of the MFFs for each of the providers from which it commissions services. Prices are mapped from provider to PCT though a purchaser-provider matrix. The matrix is derived from the application of national costs to activity data on hospital admissions.

5.5 Finland

Allocations are made for health and social services from Parliament to 444 municipalities according to the capitation principle. These are subsidies that account for 24% of municipal health expenditures. The rest of the funds required are raised locally. For health services, these capitation subsidies were calculated during 1993-6 using population, age structure, mortality, population density, land area and the financial capacity of the municipality. New criteria were adopted in 1997, being population, age structure and an age-standardised index of invalidity pensions for persons under the age of 55. New criteria developed in 2000 were not implemented in practice and the current formula remains a simple one, including only age structure and a single morbidity factor with an adjustment for remoteness.

Under the remoteness adjustment the archipelago and other remote area municipalities receive varying additional levels of subsidy.

- Slightly remote municipalities receive an additional 5%;
- The 6 archipelago municipalities (with no road connection to the mainland receive an additional 10%); and
- the municipalities described as 'deeply remote' receive an additional 15%.

The decision about the size of these adjustments for remoteness seems to reflect political judgements rather than objective evidence.

5.6 New Zealand

The New Zealand population based funding formulae (PBFF) has three core elements: personal health, public health and disability support services. Remoteness and rurality are not considered to affect the costs of delivering disability support services and the implications of this factor for public health services are under consideration. For personal health services, however, there has been concern that rural areas have higher costs for rural hospitals, GP services, ambulances and transport assistance and that urban areas have higher salary costs. A survey of regional health authorities estimated the net extra costs of rural areas to be $39.3million in 1995/6 and these are distributed to regions on basis of numbers living more than one hour from a settlement of 30,000+ people.

The Population Based Funding Formula was developed in 2000 and was approved by the Cabinet in November 2002. According to this formula each District Health Board's (DHB) share of funding is determined by:

I. its share of the projected New Zealand population, weighted according to the national average cost of the health and disability support services used by different demographic groups;

II. an additional policy-based weighting for unmet need that recognises the different challenges DHBs face in reducing disparities between population groups; and

III. a rural adjustment and an adjustment for overseas visitors, each of which redistributes a set amount of funding between Boards to recognise unavoidable differences in the cost of providing certain health and disability support services.

The rationale for the rural adjustment is that DHBs face unavoidable costs in providing or funding some community services to rural communities because the population in these communities is widely dispersed. Examples of these additional costs are: the rural practice bonuses paid to rural general practitioners; the unproductive travelling time spent by district nurses in isolated areas; and the diseconomies involved in providing small hospitals in rural areas to maintain access.

Cabinet also agreed that the rural adjustment should be based on the actual extra costs incurred by DHBs in providing these services. In quantifying this adjustment, the Ministry of Health has drawn mainly on a number of factors:

a) The greatest contribution to the adjustment (just over 50 percent) is the rurality premium and diseconomies of scale payments to DHBs. These payments recognise the additional costs related to diseconomies of scale for small hospitals in remote/rural locations, and for providing hospital and some community services in rural or remote areas.

b) A variety of community and primary health care-based rural payments under existing provider contracts have also been included in the adjustment. In particular, payments made to practices in rural areas to assist in GP recruitment and retention have been included.

c) The rural adjuster also includes price premia paid to rural maternity providers where the volume of births is below the threshold level expected of a metropolitan maternity provider.

5.7 Australia (New South Wales)

The key purpose of the Resource Distribution Formula in New South Wales (NSW) is to guide the allocation of funds from the NSW Department of Health to the geographically based 17 Area Health Services.

The allocation covers a number of spending programmes with different formulae:

- Population Health
- Oral Health
- Primary & Community Care
- Outpatient Services
- Emergency Departments
- Acute
- Obstetrics
- Rehabilitation and Extended Care
- PADP
- Teaching and Research

There are adjustments for substitutable private sector activity in Acute and Rehabilitation and Extended Care. The adjustment to allocations to take account of unavoidable excess costs has two elements:

a) three programmes attract a ‘dispersion factor’ amongst the cost factors: Primary and Community Care; Acute; and Rehabilitation and Extended Care;

b) the Acute programme also attracts a ‘small hospital factor’;

5.7.1 Dispersion Cost Factor

The dispersion factor in the Resource Distribution Formula estimates the relative extent to which the State’s population is geographically dispersed and how that spatial distribution of population imposes costs in the delivery of services. The New South Wales health model calculates for each item of cost a set of distance-weighted population units that have been converted to an index of relative dispersion for each Area Health Service. Two separate calculations were used to derive the relative dispersion index for each Area Health Service: one for the distance from the nearest major referral hospital, and another for the distance from the nearest capital city. Analysis of 1997-98 costs showed a relationship between relative dispersion and per capita service costs. As the degree of relative dispersion increased so the per capita costs of different cost items also increased. This relationship can then be used to calculate a cost adjustment in the allocation formula to reflect the relative dispersion index in each Area Health Service.

5.7.2 Small Hospitals Factor

The broad approach used for determining this interim factor was to estimate the extent to which rural Area Health Services operate facilities over and above what would be expected in metropolitan areas. An estimated fixed cost component was then applied to the number of facilities that exceeded the metropolitan figure. An adjustment was made to avoid double counting of those factors that had already been taken into account in the dispersion cost factor. Analysis suggested that a minimum fixed cost adjustment of $500,000 would be justified for those facilities that exceed the number expected in a metropolitan area. The average of 2 hospital facilities per 100,000 population in metropolitan areas was used as the standard against which to assess the excess number of hospitals in rural Area Health Services.

5.8 United States (Veterans Affairs)

Instituted in 1997, the Veterans Equitable Resource Allocation was designed to improve the allocation of the congressionally appropriated medical care budget to the regional service networks that constituted the Department of Veterans Affairs (VA) health system. In January 2001, at the request of Congress, the Veterans Health Administration asked RAND National Defence Research Institute (NDRI), a division of the RAND Corporation, to undertake a study of the Veterans Equitable Resource Allocation system.

The system that has been used to allocate resources within the VA health system recognised that some factors affecting the cost of a patient's care vary by geographic region of the country and cannot be controlled by management. VA considered a number of adjustments to the national price as a way to allocate resources that were outside the network's ability to manage. These included: age of patients, cost of labour, fuel and utilities costs, grounds management, fire departments and beneficiary travel. The criteria for evaluating whether an adjustment should be added to the model were:

1. Were these costs outside of network management's ability to control and manage?
2. If there were uncontrollable variations at the medical facility level, would the allocation of funds to the network allow sufficient flexibility for shifting of resources among network facilities to meet specific needs?
3. If an adjustment were added to the model, would it perpetuate or create inefficiencies at the network level?

Fuel and utilities costs were also considered as a potential adjustment factor, but they were not included because they constitute a very small proportion of the networks' budgets (1-2%) and the variance across the system was less than 1%.

The VERA system recognises that national prices for Basic and Complex Care do not account for some geographic differences in the cost of providing health care that are not under the control of network and local management. VA determined that the most significant factor that is uncontrollable at the network level is the cost of labour. VA labour costs account for about 65% of the total Basic and Complex Care funding. Total labour costs vary across the country due to geographic differences in salaries. Generally, the costs tend to be higher in the northeast, the West Coast and large urban areas, and lower in rural, southern and mid-western areas. To account for the variations in the cost of labour in different parts of the country, network allocations are adjusted according to the cost of wages. This geographic price adjustment has been based on actual labour costs paid by VA facilities as they compare to a national average salary.

For the 2000/1 network allocations the geographic salary adjustment was changed to adopt the labour index methodology recommended by PricewaterhouseCoopers LLP in the Veterans Equitable Resource Allocation Assessment Final Report. This methodology differs from the previous methodology in that it uses a national market basket approach in the formula to create the index, instead of network level staffing patterns. By using national staffing patterns, the index does not intermingle staffing differences with salary variations. Therefore, the index better reflects specific differences in labour costs. This Geographic Price Adjustment was applied to the $14.05 billion labour, contractual labour and non-labour contractual goods dollars expended in 2001/2, which is approximately 66% of the total.

5.9 Canada (Alberta)

Rice and Smith (1999) highlight the Alberta Population Based Funding Model used since 1997/8 as the most ambitious scheme in Canada. It covers approximately 90% of expenditure, allocating resources to 17 Regional Health Authorities (RHAs) with average populations of 160,000. Allocations are based on a capitation matrix that takes account of 124 mutually exclusive groups stratified by age, sex, two classes of low income and aboriginal status. Costs are based on province-wide standard costs per unit of activity. A set of adjustments is made for cross-boundary flows.

The population funding formula applies the same per capita funding rates (provincial average costs) to each regional health authority population. The Cost Adjustment Factor is then applied to compensate for cost factors outside of RHA control that result in above-average service delivery costs in some regions. The Cost Adjustment Factor consists of separate adjustments for the inpatient and non-inpatient services.

For hospital inpatient services, the Cost Adjustment Factor is based on a statistical measurement of RHA cost variations. The methodology uses regression analysis to quantify the impact of various explanatory factors (such as patient remoteness) on regional inpatient costs (MIS determined) per standardized unit of output (RIW). The results were then used to predict regional cost variances from justifiable factors.

When converted to an index (all regions = 1.0), the individual regional cost indices ranged from a low of 0.70 to 1.15. Only the two urban regions have a cost index above the average, largely the result of the higher costs from their large teaching hospitals. The cost variation for each region is applied to the region’s 2004-2005 hospital inpatient utilization (provincial average), as determined by the funding formula and adjusted for import-export, to determine the Cost Adjustment Factor amounts. These amounts were then discounted by 50% given concerns about the preciseness of the cost variation calculations.

For non-inpatient services, the historical Cost of Doing Business and Assured Access methodologies are applied to determine additional cost adjustments. For Cost of Doing Business, a cost supplement of 25% is applied for two regions and of 12.5% for another region on their non-salary non-inpatient budget. Assured Access funding is calculated by applying, to the remote population in each region, special rates equal to 25% (for remote population) and 50% (for very remote population) of the average funding rate.

Funding allocations in 2003/4 included a substantially revised Cost Adjustment Factor and a Northern Allowance. For 2004/2005, the Northern Allowance was consolidated into the Cost Adjustment Factor in the form of an increase to the Cost of Doing Business Factor for one RHA and an increase to the Inpatient Sector Cost Index for two other RHAs.

5.10 Lessons for our work

It is clear from this review of approaches taken in eight international funding schemes that there is no consensus on the best methods for deriving resource allocation formulae. Excluding Finland, all schemes use empirical data to obtain evidence on the need for, and magnitude of, excess cost adjustments. The approaches adopted tend to reflect the organisation of healthcare services, data availability and the issues that are pertinent to the geography of each scheme.

The rationale for excess cost adjustments is expressed in various ways. These can be grouped into concerns for variations in: input prices; the production function (particularly the level of inputs required to deliver a target output level); and overall unit costs.

Several adjustments (including England's MFF, Veterans Affairs and Alberta's Cost of Doing Business Factor) focus on geographic variations in input prices. The Veterans Affairs adjustment is based on the actual salary costs of each facility. Although these are evaluated using national staffing patterns, it appears to be a perverse incentive since it reimburses networks for the prices that they pay and offers little incentive to contain labour costs. In contrast, the English MFF is based on prices observed in the private sector. These are more clearly outside the control of the NHS though robust empirical research has yet to demonstrate the precise mechanisms through which they influence NHS costs.

In other schemes (particularly Northern Ireland, Wales and New South Wales' Small Hospitals Factor), the focus is on the production function for health care. In the case of hospital services, the focus is on economies of scale and the need to maintain more facilities per capita in more rural areas. Having demonstrated higher unit-costs in smaller facilities, a judgement is made on the number of smaller facilities that are required in each region given its level of population dispersion. In the case of community services, the focus is on the additional cost implications of longer travel times for staff to deliver services to more dispersed populations.

The third group of adjustments (including New Zealand, New South Wales' Dispersion Factor and Alberta's Cost Adjustment Factor) focus on overall variations in unit costs. In New Zealand it is based on a regional survey of excess costs. The methods adopted in New South Wales and Alberta appear similar to the approach taken for the Arbuthnott Formula's hospital cost adjustment.

It is clear from this classification how we should structure our examination of the excess cost adjustments in Scotland. We begin in the next chapter by considering geographic variations in input prices. We use information on prices paid by the private sector to ensure that these prices are outwith NHS Board control and consider the evidence for a link to NHS service delivery. Our attention then turns to the excess cost implications of remoteness and rurality. We begin, in Chapter 7, by considering carefully how rurality and remoteness should be measured. In Chapter 8 we then consider how rurality and remoteness affect the production function for community services, which are travel-intensive for staff. Chapter 9 then considers how remoteness and rurality influence unit-costs in the production of hospital services. These variations in unit-costs may be caused by differences in the production function (such as those generated by economies of scale) and/or variations in input prices.

6 GEOGRAPHIC DIFFERENCES IN INPUT PRICES

There may be differences in the prices that must be paid to deliver health services in different geographic areas for a range of inputs. Since staff costs account for almost two-thirds of the expenditure of NHS Boards on hospital and community health services the bulk of our research has focused on staff costs. We have also sought to establish whether there are spatial variations in the costs associated with land and buildings.

The first section of this chapter presents evidence of geographic variations in private sector pay. In the second section we consider the implications of this variation for the NHS. The variation would be expected to affect both direct costs (captured by NHS patterns of pay) and indirect costs (measured by staff turnover and vacancy rates). The third and fourth sections then deal with buildings and land. The final section of this chapter (section 6.6) then considers the implications of these analyses for the resource allocation formula.

6.1 Geographic variations in private sector pay

In this section we present empirical evidence on the spatial patterns of pay in the private sector and the NHS in Scotland. First however we define an appropriate geography for the analysis and then employ this geography to map the evolution of spatial differences in pay in the private sector in Scotland.

In the private sector, average pay differs between areas because of differences between them in the industrial, occupational, age and gender mix of the workforce. In order to map the underlying pattern of spatial wage differentials that reflect differences between areas in the cost-of-living and amenities we need to control for these differences. The resulting spatial wage differentials are termed Standardised Spatial Wage Differentials (SSWDs).

6.1.1 Standardised Spatial Wage Differentials (SSWDs)

To calculate the SSWDs in Scotland we use the New Earnings Survey (NES) and its successor the Annual Survey of Hours and Earnings (ASHE). It is an annual survey of pay that aims to sample 1% of the employed population in Great Britain[12]. This is the only survey that contains a sufficiently large number of observations for Scotland to enable us to distinguish different geographical areas. These geographic areas show where in Great Britain the workplace of the employee is located.

The equation for generating the SSWDs can be written as:

$$\ln w_i = \alpha_i + \boldsymbol{\beta}_1{}'\mathbf{x}_i + \boldsymbol{\beta}_2{}'\mathbf{A}_i , \qquad (1)$$

where w_i is the hourly earnings of individual i, α_i is the constant term, vector $\mathbf{x}_i$ contains all the control variables (age, age^2, gender, industry dummies and occupational dummies), and vector $\mathbf{A}_i$ contains all the dummy variables for areas. The vector $\boldsymbol{\beta}_2{}'$ represents the SSWDs.

[12] See http://www.statistics.gov.uk/StatBase/Product.asp?vlnk=13101

The wage differences are calculated by regressing the natural log of hourly earnings, against age, age-squared/100, gender, industries identifiers, occupation identifiers, and area identifiers. Hourly earnings are calculated by dividing the total weekly earnings by the total number of paid hours. We limit the sample to cover full and part-time private sector employees between the age of 16 to 70, and only employees whose pay was not affected by absence during the reference period (the pay period referred to in the survey). The industry identifiers are coded using the two-digit Standard Industry Classification 2003 (59 categories) and the occupation identifiers are coded using the two-digit Standard Occupation Classification 2000 (81 categories).

The estimates are weighted using the weights provided with the ASHE dataset by the Office of National Statistics (ONS). The weights are designed to ensure the representativeness of the sample.[13] Earlier studies had reported that the response rate differed between geographical areas and had found that the NES tended to under-represent low paid workers.[14]

6.1.2 Defining an appropriate spatial geography

Each observation in the survey has two area identifiers, a local authority district (LAD) and a Travel to Work Area (TTWA) identifier, relating to the location of the employee's workplace. There are 32 LADs in Scotland and 54 TTWAs[15]. As the majority of the population work in the cities, some of the LADs and TTWAs cover relatively large stretches of rural areas and contain very few observations in any one year. We therefore pool the observations across a three-year rolling period so that the wage differentials across areas can be measured with greater accuracy. Pooling also reduces the year-to-year variation resulting from atypically large one-off pay increases or deferred pay increases.

At the first stage of the analysis we sought to determine which geography, LADs or TTWAs, provided the better explanation of spatial variations in pay. TTWAs constitute self-contained labour markets. They are areas of Scotland in which the majority of people who live in the area also work in the area and they might prove a better description of the labour markets in which the NHS in Scotland operates. They are defined by analysing the commuting patterns of the population as reported in the Censuses. The ones currently available were defined in 1998 using information from the 1991 Census on home and work addresses.[16] [17]

The 1991 Census was used to identify commuting patterns and these form the basis for distinguishing the TTWAs. TTWAs constitute geographical areas in which the numbers of

[13] The employment data used to construct the weights are collected in the spring quarter of each year in the Labour Force Survey,

[14] See Low Pay Commission (1998), *The National Minimum Wage First Report of the Low Pay Commission*, and Low Pay Commission (2000), *The National Minimum Wage: The Story So Far, Second Report of the Low Pay Commission*.

[15] The ONS identifies 53 different TTWAs in Scotland. The Scottish TTWAs run from numbers 230 to 285 but the series is not continuous: and numbers 278, 279 and 280 are missing. See http://www.statistics.gov.uk/geography/ttwa.asp. ASHE identifies one additional TTWA, East Ayrshire.

[16] See "1991-based Travel-to-Work-Areas", Office for National Statistics and M. G. Coombes, London, Office for National Statistics, 1998

[17] The 2001 Census data is currently being used to update the TTWA boundaries. We have been unable to establish when the new data will be available.

people who live and work in an area constitute at least 75% of the total number of people who work in the area and 75% of the total workforce who live in the area[18].

TTWAs are defined across all occupation groups; they are not defined by occupational group. Each TTWA therefore constitutes a weighted average of the several different TTWAs that exist for each of the occupations in that area where the effective weights are the numbers employed in each of these occupations in each area. However we know that commuting patterns differ by occupational group[19]. It is therefore quite possible that when taken in aggregate the TTWA geography available to us might provide no better way of disaggregating the geography of Scotland than do LADs. The TTWA definition of geography contains information about both where people live and where they work and we are only interested in where people work. It is therefore not intuitively obvious that TTWAs will prove superior to the other geographical definitions.

We sought to identify the preferred geographical descriptor by distinguishing which one provided the best explanation of the variance of earnings. There are more TTWAs than there are LADs. In the TTWA model therefore, there are more explanatory variables and we would expect this model to provide a better explanation of the data. We therefore calculated three measures of explanatory power that take into account the number of explanatory variables in the model by penalising those models with more variables. These three statistics are the adjusted R-squared, the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC).

The *unadjusted* R-squared is the proportion of the variation in hourly earnings that can be accounted for using the explanatory variables in the model. The higher is the *unadjusted* R-squared, the better is the explanatory power of the model for variations in hourly earnings across Scotland. The *unadjusted* R-squared is however not an appropriate test for distinguishing between the three models. Instead, we use the *adjusted* R-Squared, where the R-squared of models with larger number of explanatory variables are adjusted downwards so that the values are comparable across models with different numbers of explanatory variables.

The AIC is defined as $AIC = -2\ln L + 2k$, where $\ln L$ is the log likelihood of the model and k is the number of regressors in the model. The model with the better fit will have the smaller AIC. The BIC' is defined as $BIC^{'} = k\ln N - \chi^2$, where N is the number of observations in the sample and χ^2 is the likelihood ratio test statistics against the model where no regressor other than the constant is applied, k assumes its previous roles in calculating AIC. The more negative is the figure for BIC' the better fit is the model.

The results are reported in Table 6.1. On two of the three measures the TTWAs provide a better fit to the data. However, the differences are marginal and, even with pooled data, there are still small numbers in some TTWAs; 13% have fewer than 30 observations. Moreover in some of the subsequent analysis we shall distinguish separate occupational groups. At this

[18] For areas where between 3,500 and 20,000 workers live the minimum self-containment required of both measures for defining the TTWA decreases progressively from 75% to 70%. No TTWA has a self-containment of less than 70%.
[19] See Coombes M. G., Green A. E. and Owen D.W. " Substantive Issues in the Definition of 'Localities': Evidence from sub-group local labour market areas in the West Midlands", *Regional Studies,* 22(4) 303-318

disaggregated level, TTWA cell sizes are too small for any meaningful analysis[20]. We therefore employ LADs in the subsequent analysis.

Table 6.1 Measures of fit with LADs or TTWAs as geographical identifiers

	Local Authorities	**Travel to Work Areas**
Number of areas	32	54
AIC*n	16073.152	16049.638
BIC'	-21332.053	-21177.501
Adjusted R-Squared	0.6114	0.6121

6.1.3 The effect of standardisation

Table 6.2 reveals how the introduction of the different controls affects the spatial variation in pay across LADs. Each SSWD is reported as an index value with the average of the computed SSWDs for Scotland set to 100. This enables us to see how the SSWD for each area compare to Scotland's average and the figures can be interpreted as percentages differences from the Scottish average.

The first column presents the SSWDs for each LAD with no controls. The standard deviation across LADs is 10.5 and, since the SSWDs are centred on a national average of 100, this indicates a variation of 10.5%. In the second column, we present the SSWDs controlling for the age-sex composition of the workforce. This widens the distribution of wages slightly, reflected in the increase in the standard deviation to 10.9%.

There is a considerable reduction in the standard deviation when we introduce occupational controls. As expected, there is considerable heterogeneity in the occupational composition of the workforce across LADs and occupational composition has an important effect on wages. Controlling for this occupational composition reduces the 'unexplained' variation in wages across LADs.

In the last column, we present the SSWDs that additionally control for differences in industrial classification. This results in a further reduction in the spatial variation across LADs. As a result of all of the controls, the standard deviation has reduced by more than 50%. It is these fully controlled estimates of spatial wage variation that we use to reflect differences in the pay required to compensate workers for locating in different areas.

There is particular interest in the role that the oil industry plays in increasing wages in the Grampian area. The relevant Standard Industrial Classification (SIC) category is category 11 (Extraction of Crude Petroleum and Natural Gas; Service Activities Incidental to Oil and Gas Extraction Excluding Surveying). SIC 11 has the third highest coefficient, indicating a 38% higher hourly wage than the reference industry 01 Agriculture, Hunting and Related Service Activities and it is highly concentrated in Aberdeen City (88% of observations in this category). This is part of the explanation for the reduction in the SSWD for Aberdeen City from 118.4 (no controls) to 107.9 (all controls).

[20] We focus on SOC Major Group s 2 and 3 in our analysis. In SOC 2 19 of the 54 TTWAs have 0 observations and a further 26 have < 30. In SOC 3 10 of the 54 have 0 observations and 30 have < 30.

Private sector employees in the City of Edinburgh work in occupations and industries that pay higher wages and we consequently observe a substantial reduction in the SSWD for this Local Authority from 117.0 (controls for age-sex only) to 105.2 when we control fully for these effects. Private sector employees in the Shetland Islands work in occupations that pay lower wages and, conditional on occupation, industries that pay higher wages. The net effect is to increase the SSWD from 98.5 (controls for age-sex only) to 105.9 (all controls).

This analysis demonstrates the importance and influence of the standardisation of spatial wage differentials. The residual differences between areas reflected in the SSWDs reflect differences in pay that the private sector offers to recruit and retain workers in different areas.

Table 6.2 Private Sector SSWDs of LADs with different controls, 2003 - 2005

Local Authority District	No controls	Age-sex	Age-sex and occupation	Age-sex, occupation and industry
	SSWD	**SSWD**	**SSWD**	**SSWD**
Aberdeen City	**118.42**	**116.42**	**108.81**	**107.92**
Aberdeenshire	93.42	91.91	97.31	97.57
Angus	*88.34**	**86.51**	*92.86**	*93.45**
Argyll & Bute	**83.20**	**86.46**	*92.60**	*92.53**
Scottish Borders, The	**82.49**	**81.16**	**88.53**	**90.57**
Clackmannanshire	90.28	87.84	94.01	94.52
Dumfries & Galloway	**82.75**	**83.32**	**92.28**	*94.26**
Dundee City	97.24	*97.01**	97.19	97.70
East Ayrshire	**85.39**	**84.31**	**91.53**	**92.43**
East Dunbartonshire	97.96	*99.75**	100.97	101.09
East Lothian	94.96	92.80	94.31	95.18
East Renfrewshire	91.82	90.55	94.34	96.61
Edinburgh, City of	**115.65**	**116.97**	**107.36**	**105.24**
Falkirk	**99.69**	96.45	**101.93**	**102.55**
Fife	91.91	**90.06**	95.47	96.43
Glasgow City	**103.16**	**104.98**	**101.52**	**101.90**
Highland	*90.23**	*90.01**	*94.50**	**94.62**
Inverclyde	89.45	90.32	96.08	94.48
Midlothian	93.94	94.69	94.25	96.93
Moray	**87.54**	**84.80**	**92.34**	**93.30**
North Ayrshire	93.85	92.09	95.14	94.25
North Lanarkshire	95.67	94.81	**100.24**	**100.57**
Orkney Islands	*84.87**	**82.54**	*88.28**	91.06
Perth & Kinross	92.55	93.72	95.34	**93.99**
Renfrewshire	**98.69**	**99.62**	**101.22**	**101.05**
Shetland Islands	*102.99**	98.45	**108.13**	*105.93**
South Ayrshire	*99.18**	*97.79**	*100.28**	*101.71**
South Lanarkshire	95.73	**96.55**	98.04	97.88
Stirling	93.73	94.98	95.79	96.35
West Dunbartonshire	91.49	94.66	*101.20**	**102.49**
West Lothian	**102.62**	**101.23**	**102.19**	**103.32**
Western Isles	**79.90**	**77.67**	**87.68**	*88.51**
Mean	100	100	100	100
SD	10.46	10.89	5.40	4.67
Min	79.90	77.67	87.68	88.51
Max	118.42	116.97	108.81	107.92
Max – Min	38.52	39.30	21.13	19.42

Bold significant at 1% and italics (*) at 5% level

6.1.4 The evolution of private sector SSWDs: 1999 - 2005

The data we have is for the period 1999 to 2005, and we are therefore able to calculate five sets of wage differentials in order to observe whether or not the wage differences across LADs have widened or narrowed.

The figures in Table 6.3 are the summary statistics of the SSWDs by LADs for each of these periods, and the values of all the SSWDs are reported in Table 6.4.

The standard deviation shows that the dispersion of SSWDs across the different Local Authority areas in Scotland has remained fairly constant. The standard deviation was 5.03 percent in 1999–2001, and little changed at 4.67 in 2003–2005. Another measure of dispersion is the difference between the highest and the lowest SSWDs. The dispersion around the mean, as reflected in the difference between the Max-Min, has reduced from 25.28% in 1999–2001 to 19.4% in 2003–2005 reflecting a reduction in dispersion in the lower part of the distribution.

Table 6.3 Summary Statistics of Private Sector SSWDs by Local Authority Districts

	1999-2001	2000-2002	2001-2003	2002-2004	2003-2005
Mean	100	100	100	100	100
Standard Deviation	5.03	5.22	5.04	4.70	4.67
Min	81.98	86.01	86.49	87.48	88.51
Max	107.26	107.72	107.79	107.45	107.92
Max – Min	25.28	21.71	21.30	19.97	19.42
Number of Obs.	23,590	23,735	23,748	23,774	24,195

Table 6.4 identifies the Local Authorities that have SSWDs that are significantly different from the Scottish average. Three of the four city LADs, covering the major conurbations in Scotland, those in Aberdeen, Edinburgh and Glasgow have SSWDs that are significantly above the Scottish average. Many of the LADs in the central belt area also have SSWDs that are significantly above the national average, as does the Shetland Islands. The SSWDs are significantly below the average in many rural local authorities, particularly the Scottish Borders, the Western Isles, Argyll & Bute, East Ayrshire and the Orkney Islands.

Table 6.4 Private Sector SSWDs by Local Authority District in Scotland

Local Authority District	1999-2001	2000-2002	2001-2003	2002-2004	2003-2005
Aberdeen City	105.54**	107.72**	107.79**	107.45**	107.92**
Aberdeenshire	94.23*	94.97	96.32	98.11	97.57
Angus	93.81*	93.68*	93.27*	94.89	93.45*
Argyll & Bute	91.20**	91.71**	93.12*	91.40**	92.53*
Scottish Borders, The	92.87**	93.00**	92.85**	91.65**	90.57**
Clackmannanshire	105.89	102.96	102.59	96.84	94.52
Dumfries & Galloway	93.36**	93.01**	93.51**	94.17*	94.26*
Dundee City	99.09	98.91	98.41	97.62	97.70
East Ayrshire	93.80*	92.20**	91.11**	92.29**	92.43**
East Dunbartonshire	99.51	102.40*	103.40*	102.38	101.09
East Lothian	94.00	95.44	93.98	96.51	95.18
East Renfrewshire	93.21	91.21*	93.75	95.28	96.61
Edinburgh, City of	107.26**	107.58**	106.66**	105.89**	105.24**
Falkirk	104.79**	102.24**	101.76**	100.61*	102.55**
Fife	94.79**	94.56**	94.97**	95.88	96.43
Glasgow City	102.20**	101.87**	101.91**	101.70**	101.90**
Highland	94.53*	95.12	94.87*	95.58	94.62**
Inverclyde	101.29*	100.10	97.45	94.43	94.48
Midlothian	94.71	95.40	94.57	95.93	96.93
Moray	90.98**	91.30**	91.09**	92.57**	93.30**
North Ayrshire	99.98	97.33	96.49	93.22**	94.25
North Lanarkshire	96.27	96.48	98.15	99.37*	100.57**
Orkney Islands	81.98**	86.01**	87.16*	90.10	91.06
Perth & Kinross	92.16**	91.69**	92.32**	93.57**	93.99**
Renfrewshire	98.93	99.38*	100.05*	100.83**	101.05**
Shetland Islands	103.87*	103.37*	103.90*	105.83**	105.93*
South Ayrshire	99.24	98.92	100.06	101.11*	101.71*
South Lanarkshire	99.97**	100.22**	99.14*	98.16	97.88
Stirling	99.81	101.41**	101.88**	99.24	96.35
West Dunbartonshire	102.93**	100.74*	101.92*	101.85*	102.49**
West Lothian	101.82**	102.10**	102.70**	103.99**	103.32**
Western Isles	93.84	91.96	86.49**	87.48**	88.51*

Highlighted figures and ** are shown where the SSWD is significantly different to mean wage in Scotland at 1%, * is shown in cases where the significance level is at 5%. Scotland's average is centred to 100.

6.1.5 An interim conclusion

The above reveals significant spatial wage variation in the private sector in Scotland. It is clear that the general level of pay in the labour markets in which some healthcare providers currently operate is higher than in others. We would expect providers in these high pay areas to experience greater indirect labour costs than providers in other areas.

The Arbuthnott Committee was also presented with evidence of private sector spatial wage variation but decided not to recommend an MFF. We drew attention in Chapter 4 to the limitations of the arguments and empirical analysis that informed their view. One option for this committee is therefore to recommend an MFF based on the above evidence of significant spatial wage variation.

However an MFF for *all* NHS staff groups does not appear to be appropriate. Earlier analysis by these researchers for the Department of Health revealed no systematic association between a measure of indirect costs and private sector spatial wage variation in the case of NHS doctors[21]. The presumption that the spatial pattern of pay in the private sector is appropriate for every NHS Scotland staff group is incorrect. In the next section we have therefore sought to establish the degree of connectedness for the three major professional groups.

6.2 Consequences of variations in input prices for the NHS

In Chapter 4 we argued that any differences between the spatial patterns of private sector and NHS pay will have implication for the recruitment and retention of staff by the NHS. We argued that this was self evident where the NHS competed with the private sector for staff as it does for maintenance and ancillary staff, admin and clerical staff and managers. However it is less clear what the impact of private sector pay is on the recruitment and retention of nurses, doctors and AHPs. Here we focus on these three NHS professional groups for whom the degree of connectedness to the external labour market is an empirical issue. We seek to identify the degree of connectedness between the NHS labour markets for these staff groups and private sector labour markets.

In the previous section we have demonstrated that the private sector offers different wages in different geographical areas. We have argued that such differences will cause variations in the input prices faced by NHS providers in different parts of the country. The consequences may arise partly through direct costs, if NHS providers find methods to regionally differentiate pay, and partly through indirect costs of recruitment and retention problems if NHS wages are not fully adjusted. In this section we attempt to quantify these effects.

To do this, we need to link wage differentials in the private sector with those in the NHS, and further link these to measures of indirect costs. The available data on NHS pay and workforce statistics are produced only for NHS Boards rather than providers at a more disaggregate level (e.g. hospitals). The first stage in the analysis is therefore to map the private sector SSWDs to NHS Boards as employer organisations.

The second stage is the mapping of the spatial pattern of pay in the NHS to distinguish the extent to which pay in the NHS appears to respond to the pattern in the private sector. Though at the local level the NHS had little discretion over what rates to pay we might expect to find higher *average* pay for nurses and AHPs in those areas of Scotland with the highest standardised private sector pay.

At the third stage we identify those parts of the private sector that appear the most relevant to each of the three NHS staff groups. The chosen part of the private sector we call the comparator group. Finally, we seek to identify any association between NHS indirect costs and differences in the spatial patterns of pay in the NHS and private sector.

[21] See *Regional Pay for NHS medical and non-medical staff : Final report for Department of Health*, Elliott B., Scott A., Skåtun D., Ikenwilo D., Bell D. N. F. and Roberts E. 2005.

6.2.1 Private sector SSWDs by NHS Boards as employers

The SSWD for each NHS Board as an employer organisation were identified as follows. First we identified the hospitals that were managed by each Board. Then we identified each hospital's location by its full postcode. We then attached the private sector SSWD to the hospital location based on the LAD in which its postcode was located. To arrive at a Board-level average we need to take account of the different sizes of hospitals managed by the Board. Ideally we would have weighted by the size of each hospital's workforce, but these data were not available to us. We therefore took a weighted average of the hospital-level SSWDs, using the average number of staffed beds as weights[22].

The resulting Board level SSWDs are shown in Table 6.5.

Table 6.5 Private Sector SSWDs by Provider NHS Board

Health Boards	1999-2001	2000-2002	2001-2003	2002-2004	2003-2005
Ayrshire & Arran	97.68	100.22	96.35	96.72	97.16
Borders	93.34	93.20	93.31	92.11	90.98
Argyll & Clyde[1]	98.77	98.32	98.67	97.90	98.26
Fife	95.27	94.76	95.44	96.36	96.86
Greater Glasgow[1]	**102.51**	**101.70**	**102.30**	**102.09**	**102.22**
Highland[1]	95.02	95.33	95.34	96.06	95.04
Lanarkshire	98.11	98.05	99.01	99.42	*100.02**
Grampian	**102.04**	**103.39**	**103.97**	**104.30**	**104.56**
Orkney	82.40	86.20	87.60	90.56	91.46
Lothian	**105.71**	**105.80**	**105.38**	**105.20**	**104.51**
Tayside	96.72	96.19	96.25	96.52	96.27
Forth Valley	**103.17**	**102.13**	**102.36**	100.34	99.87
Western Isles	94.32	92.16	86.92	87.92	88.90
Dumfries & Galloway	93.84	93.21	93.97	94.64	94.68
Shetland	*104.40**	*103.59**	*104.42**	**106.36**	*106.40**

Bold significant at 1% and italics (*) at 5% level

[1] Note that from 1st April 2006 NHS Argyll and Clyde has been abolished with Argyll joining NHS Highland and Clyde joining NHS Greater Glasgow. We present figures based on the pre-2006 configuration, as these are the data we can match to other datasets.

[22] As an example take a Board which manages two hospitals and these hospitals are in different LADs. Assume that the SSWD for the LAD in which hospital A is located equals 110.00 and the SSWD for the LAD in which hospital B is located is 100.00. Further assume that 75% of the Board's expenditure is incurred at hospital A and 25% at hospital B. Then the SSWD faced by the Board is 107.50 (75%*110.00 + 25%*100.00).

6.2.2 SSWDs in the NHS in Scotland

Data were provided by ISD Scotland, Health Information Group. The data contain the anonymised pay records for all NHS employees in Scotland for the three financial years 2002/03 to 2004/05. The data record all payments made to NHS staff during each of these three financial years. AfC was effective from 1 October 2004 so the data at our disposal will capture only a six-month impact. The new consultants contract was introduced earlier, 1st April 2004, and the data for the year to March 2005 should capture the effects of this change.

Each pay record contains information on the various payments that can be made to employees. The majority of pay is for basic hours, but information is also provided for nineteen other types of payment including overtime, enhanced hours, night shifts and weekend working. For all but one of these types of payment, the dataset contains the total amount paid and the number of hours for which these payments were made. The exception is the most important item - information on the number of hours for which basic pay is reimbursed. This is included only for part-time employees. For full-time workers we know only the basic rate and the number of contracted basic hours per week, but not the number of weeks.

This is a substantial drawback of the data because the records do not identify the duration over which the payments are made. We can identify (somewhat unreliably) when a pay record ends but we do not know when it starts. Individuals also have multiple pay records in the dataset for two reasons: any change in contractual conditions, such as a change of grade, generates a new pay record; and some individuals have multiple jobs at the same time. Therefore, although the dataset contains an anonymised person identifier, there is often a combination of sequential and overlapping records for each individual. We cannot therefore infer the start date for a pay record using the end date of the previous pay record. The only solution is to estimate the total number of hours that full-time employees have worked at the basic rate by dividing total basic pay by the basic rate.

We have the following expressions for the basic rate (r^b), total pay (Y^b) and total hours (H^b):

$$r^b = Y^b / H^b = \sum_{t=p}^{q} y_t^b \Big/ \sum_{t=p}^{q} h_t^b \qquad (3)$$

where t indexes time measured in weeks, p is the week that the pay record starts, q is the week that the pay record ends, y_t is the pay received in week t and h_t is hours worked during week t. We do not observe p for any pay records. For part-time workers we observe r^b, Y^b and H^b. For full-time workers we observe only r^b and Y^b.

Pay can also be earned on nineteen other types of payment. For both full-time and part-time workers we observe Y^o and H^o, representing the total amount paid and the total number of hours for these other types of payment, again accumulated over an unknown period $t = p..q$. For part-time workers, we can calculate hourly earnings using the following expression:

$$w = (Y^b + Y^o) / (H^b + H^o) \qquad (4)$$

For full-time workers, we replace the unobserved H^b with (Y^b / r^b) and calculate hourly earnings using the following expression:

$$w = (Y^b + Y^o) / ((Y^b / r^b) + H^o) \qquad (5)$$

We follow ISD's procedures and exclude staff on non-standard payscales and low-hours contracts. We also exclude bank staff, pay records relating to temporary national insurance numbers, and staff employed by the non-geographical Boards. We focused on the following from among the three professional groups:

> *Doctors*: Variations in the hours worked by junior hospital doctors, the impact of differential rates of non-compliance between Health Boards with the Agreement on Junior Doctors Working Hours, and associated penalty payments, will likely have resulted in substantial variations in the pay of these medical grades which may be unrelated to local market pressures. We have therefore identified two groups of doctors not-in-training, a broad and a narrow group. The broad group includes Consultants, House Officers and Senior House Officers, the narrow group only Consultants.
>
> *Nurses*: We selected only qualified nurses. The Review Body for Nursing Staff and Other Health Professionals distinguishes between qualified and unqualified 'Nursing, Midwifery and Health Visiting staff'[23]. The qualified nursing staff are identified as Clinical Grades C to I.[24]
>
> *AHPs:* The 2006 Review Body report for Nursing Staff and Other Health Professionals also identifies qualified AHP workers.[25] From those listed in the Report we were able to identify and include Physiotherapists, Radiographers, Occupational Therapists, Orthoptists, Chiropodists, and Dieticians. We also included Speech Therapists who are described as qualified ST&T staff.

SSWDs were then created for each of these groups. The equation for generating the SSWDs for NHS staff is the same as (2) above except that the control variables in $\mathbf{x}_i$ are only age, age^2, and gender. Again the vector $\mathbf{A}_i$ contains all the dummy variables for areas and the vector $\boldsymbol{\beta}_2'$ therefore represents the SSWDs. The results are reported in Table 6.6.

[23] See Appendix D Review Body for Nursing and Other Health Professions, Twenty-First Report, March 2006, Cm 6752

[24] See Appendix C, Review Body for Nursing Staff, Midwives, Health Visitors and Professions Allied to Medicine, Nineteenth Report, December 2001, Cm 5345

[25] These are listed as the following professions: Physiotherapists, Radiographers, Music, Art and Drama Therapists, Occupational Therapists, Orthoptists, Chiropodists, and Dietitians. Op.cit.2006, Appendix D footnote (c).

Table 6.6 SSWDs for NHS staff groups by Employer NHS Board: 2002/03 to 2004/05

	Consultants, house officers & senior house officers	Consultants only	Qualified nurses (C to I)	Allied Health Professionals
Ayrshire & Arran	98.6	**102.0**	99.8	**98.0**
Borders	99.1	100.2	98.9	104.2*
Argyll & Clyde	98.4	**102.7**	**100.7**	**95.8**
Fife	**100.8**	100.9*	**97.9**	102.1*
Greater Glasgow	**102.1**	100.1	**100.9**	100.7
Highland	98.1	98.9*	100.1*	100.8
Lanarkshire	98.2	**100.8**	**100.6**	99.8
Grampian	98.2	**97.3**	**98.7**	**102.5**
Orkney	**83.4**	**94.1**	99.1	105.0
Lothian	**101.0**	99.3	**100.9**	99.4*
Tayside	**101.3**	100.0	**98.2**	99.4*
Forth Valley	99.5	**101.3**	**101.0**	99.9
Western Isles	**91.1**	99.8	**96.9**	102.9
Dumfries & Galloway	95.7	**98.4**	100.3*	98.7
Shetland	103.7	101.6	100.6	100.0

Bold significant at 1% and (*) at 5% level.

Table 6.6 reports the degree of spatial wage variation in the NHS in Scotland within each of the three staff groups. It reveals that in general there is very little spatial variation in average pay once we have standardised for differences between the age and gender composition of the workforce in different areas. But it still presents a slightly surprising pattern of spatial pay differences for doctors. We might have expected the four Boards in which the major teaching hospitals are located, Greater Glasgow, Grampian, Lothian and Tayside, to exhibit similar SSWDs for consultants, but column (2) shows that this is not the case. There is greater similarity between these four Boards in the SSWDs for Consultants, House Officers and Senior House Officers, column (1), though Grampian is an exception.

The results for qualified nurses and AHPs reveal there is very little spatial variation in hourly earnings for qualified nurses across Scotland. The SSWDs range between 97 and 101. A line drawn in Figure 4.1 to describe the spatial distribution of NHS nurses in Scotland would be almost flat. There is slightly more spatial variation among AHPs where the range for significant values is 99.4 to 104.2. AHPs are a heterogeneous group and differences between Health Boards in the proportions in which the several specialties that comprise this group are employed will likely explain at least part of this.

6.2.3 NHS comparator groups

The connectedness between private sector labour markets and those for NHS staff will depend on the specificity or generality of the skills of NHS staff. Connectedness will likely be to specific occupational groups in the private sector and not to the private sector as a whole. We identify that part of the private sector which is most appropriate to each of these three staff groups and in so doing identify a comparator group for each group. The comparator group comprises the set of private sector employees who have a similar skill level as the NHS group.

In the UK the system used to classify occupations is the Standard Occupational Classification (SOC) system. It classifies occupations into 9 'major groups' according to the concept of 'skill level' and 'skill specialisation'[26]. Skill level is defined with respect to the:

'…*duration of training and/or work experience recognised in the field of employment concerned as being normally required to pursue the occupation competently*'

We choose as the comparator group employees in the private sector in the same 'major group' in the 2000 SOC. We defined them as follows:

> ***Nurses*** and ***Allied Health Professionals*** - private sector employees only in SOC 2000 Major Group 3.
>
> ***Doctors*** - private sector employees only in SOC 2000 Major Group 2.[27]

SSWDs have been calculated for each of the comparator groups above in the manner detailed in equation (2) above using the ASHE data for 2003–05. Table 6.7a below reports the dispersion of the SSWDs for each of these groups, while Table 6.7b reports the complete set by Health Board. There appears to be more dispersion at the level of specific occupational groups than it is in the aggregate. However in some cases this is due to the very low weighted sample numbers in columns (2) and (4) of Table 6.7b. Thus for example the maximum values result from very small sample numbers that are not significant.

Table 6.7a Summary Statistics of the SSWDs for Private Sector Comparators by Provider NHS Board

	2003-2005 Doctors Comparator	2003-2005 Nurses & AHPs Comparators
Mean	100	100
Standard Deviation	7.02	7.86
Min	90.09	83.63
Max	151.99	144.11
Max – Min	61.90	60.47

[26] Standard Occupational Classification 2000, *Volume 1, Structure and Descriptions of Unit Groups*, Office for National Statistics, 2000. SOC 2000 identifies the following nine 'major groups': 1. Managers and Senior Officials: 2. Professional Occupations; 3 Associate Professional and Technical Occupations; 4 Administrative and Secretarial Occupations; 5 Skilled Trades Occupations; 6 Personal Service Occupations; 7 Sales and Customer Service Occupations; 8 Process, Plant and Machine Operatives; 9 Elementary Occupations.

[27] The Doctors and Dentists Review Body in 2002, argued (See p17 para 1.81) "We remain of the view that private and public sector comparators are appropriate for our considerations and we continue to use solicitors, actuaries, chartered engineers, accountants, taxation professionals and architects in both the public and private sectors".

Table 6.7b SSWDs for Private Sector Comparator Groups by Provider NHS Board

Health Boards	2003-2005 Doctors Comparator	Doctors Comparator Sample Size	2003-2005 Nurses & AHPs Comparators	Nurses & AHPs Comparators Sample Size
Ayrshire & Arran	98.42	16.92	106.31	36.26
Borders	101.65	5.00	83.63	39.00
Argyll & Clyde	113.65	28.00	98.38	41.66
Fife	95.12	56.00	89.23	95.00
Greater Glasgow	101.14	231.58	**106.48**	406.89
Highland	92.91	26.00	85.89	75.00
Lanarkshire	96.07	57.26	100.96	90.91
Grampian	102.82	117.39	105.49	169.04
Orkney	122.11	3.00	93.16	10.00
Lothian	100.17	254.61	103.76	304.81
Tayside	90.58	39.71	91.27	49.57
Forth Valley	102.85	19.95	90.05	42.22
Western Isles	-	0	92.21	2.00
Dumfries & Galloway	90.09	6.00	103.44	18.00
Shetland	**151.99**	1.00	*144.11**	7.00

Bold significant at 1% and italics (*) at 5% level

The sample numbers shown in columns (2) and (4) above are the weighted numbers, where the weights are the same as those used earlier to aggregate LADs to Health Boards. Thus NHS Grampian employs staff in the LADs Aberdeen City, Aberdeenshire and Moray, where the sample numbers in the Doctors comparator group are 158, 35 and 9 respectively. If NHS Grampian employed staff only in Aberdeen City the sample numbers would be 158 but because some weight is attached to the other two areas the number falls blow 158 to 117.39. The numbers reflect the relative activity levels in each LAD in which the NHS Board delivers services.

The correlation between the nurses' comparator SSWDs and that of the SSWDs for the GLM is reasonably high (Table 6.8). This is not the case for doctors. The very small number of significant observations means that the SSWDs for specific comparator groups should be treated with caution and we use the GLM SSWD for our further analysis.

Table 6.8 Correlation Matrix between SSWDs of Provider NHS Boards

2003 – 2005	GLM	Doctor Comparator	Nurses/AHP Comparator
GLM	1		
Doctor Comparator	0.3542	1	
Nurses/AHP Comparator	0.6825	0.7201	1

Note: Weighted by number of staffed beds

6.2.4 Measures of indirect costs

We have data on two measures of indirect costs: job vacancies and labour turnover. Job vacancies constitute a statement of an employer's desire to hire labour. Vacancy rates above the average indicate those employers experiencing the most difficulty attracting and retaining staff. Labour turnover rates provide a second, complementary, indicator of recruitment and retention problems where the turnover is voluntary (not due to dismissals) and not due to normal retirement. Those areas with rates of labour turnover above the average will again be those experiencing the most severe retention problems.

6.2.4.1 Vacancy Rates

We used data for the years 2003-05 to calculate two measures of the vacancy rate. The vacancy rate is defined as the number of vacancies as a percentage of establishment and was extracted from the NHS Scotland Workforce Statistics, which records these data at 31st March each year.[28] Evidence of severe recruitment and retention difficulties is provided by a high rate of vacancies that remain unfilled for 3 months or more. This data source provides these data for nurses and AHPs and those outstanding for 6 months or more for consultants. But the source also reveals sometimes quite sizeable numbers of vacancies of unknown duration and for this reason we have also extracted the total vacancy rates. Data on vacancies is available for the main NHS Scotland staff groups for the period 2003–2005 and by Whole Time Equivalent (WTE) and Health Board. The average rates over the three years 2003–05 are reported in Table 6.9 below.

Table 6.9 NHS Vacancy Rates by Board, average across 2002 – 2005

Health Boards	**Consultants** Total Vacancy Rates	**Consultants** Over 6 Months Vacancy Rates	**Registered Nurses and Midwifery** Total Vacancy Rates	**Registered Nurses and Midwifery** Over 3 Months Vacancy Rates	**Qualified AHPs** Total Vacancy Rates	**Qualified AHPs** Over 3 Months Vacancy Rates
Ayrshire & Arran	8.28	3.25	2.4	0.05	3.2	0.35
Borders	9.00	6.15	1.8	0.03	3.6	0.19
Argyll & Clyde	8.68	4.13	4.7	1.89	3.0	0.80
Fife	12.13	7.63	2.9	0.97	6.2	2.18
Greater Glasgow	6.13	1.43	7.1	2.30	8.5	3.16
Highland	10.35	5.53	3.2	0.92	8.5	4.33
Lanarkshire	12.70	9.53	2.2	0.39	4.5	0.97
Grampian	3.73	1.13	4.5	1.06	7.5	2.72
Orkney	23.33	14.18	1.4	0.00	9.9	6.75
Lothian	4.08	1.50	4.7	2.07	4.0	1.70
Tayside	3.75	1.40	1.1	0.00	6.0	2.11
Forth Valley	5.28	1.03	3.2	0.37	2.9	0.51
Western Isles	34.78	28.90	2.6	0.00	11.2	1.71
Dumfries & Galloway	10.55	7.25	1.8	0.23	6.0	1.45
Shetland	12.13	4.75	3.2	1.15	7.0	0.83

The data reveal high and variable vacancy rates for consultants. The rates are very high in two of the island Boards, Western Isles and Orkney, though these rates are a reflection of the very small establishment of consultants in the Boards. Four of the five Boards with the lowest vacancy rates are those serving the major conurbations. The conurbations are where the four Scottish teaching hospitals are located. One hypothesis, which cannot be tested with the data

[28] See http://www.isdscotland.org/isd/files/WFE10.xls

available, is that it is easier to fill vacancies in teaching hospitals because posts in these hospitals offer more opportunities to undertake research, and this in turn enhances promotion prospects. They may also offer more interesting and challenging work. Earlier research by some of the authors of this report found lower vacancies in major cities in England including London even though the cost-of-living is much higher in London[29]. In England the picture is further confused by opportunities to undertake private practice, which are greater in London and some major cities. This is not thought to be a major attraction of working in the four major cities in Scotland. But the results above do suggest that in Scotland as in England consultants are attracted to work in the major cities where the major teaching hospitals are based.

The three-month vacancy rates for qualified nurses and midwives are very low; in only 5 Boards do they exceed 1.0 per cent, but the total vacancy rates are much higher and in 4 Boards exceed 4.5 per cent. Three of these four, Greater Glasgow, Grampian and Lothian are Boards that have private sector SSWDs above the Scottish average.

The rates for AHPs are higher than for nurses. The total vacancy rates are among the highest in Greater Glasgow and Grampian though they are now lower in Lothian. There are high rates in the three Island Boards and in the Highlands.

Boards employ Agency and Bank staff as cover for absences from work and perhaps to increase flexibility. But they may also use Bank and Agency staff to fill vacant posts. If as a result they no longer advertise the vacancy, vacancy rates will be lower in those Boards that adopt this practice. However it is difficult to distinguish this effect in the data. We do not know what number of Bank and Agency staff are covering for absence, and we do not know if some Boards employ more Bank and Agency staff because they require more flexibility. Moreover Agency and Bank staff generally cost more and it is therefore difficult to see why a Board would withdraw a vacancy simply because it was employing Bank or Agency staff.

6.2.4.2 Turnover

Turnover provides another indicator of indirect costs. We have data for all Medical and Dental staff, all nursing and midwifery staff and all AHPs and Clinical Psychologists[30]. The data are not ideal, it covers both junior doctors and consultants and qualified and unqualified nursing and AHP staff. Our focus is on qualified nursing and AHP staff. A study of the Scottish NHS labour market found turnover among doctors to be high relative to the general labour market. Turnover was found to be highest for doctors in training reflecting the short-term nature of many training posts[31]. Training posts are unlikely to be distributed proportionally across Scottish Health Boards and therefore turnover data for doctors will tell us little about differences between Boards in indirect costs, as manifest in differences in recruitment and retention. For this reason we do not report turnover rates for doctors.

The turnover data at our disposal suffers from further weaknesses. It includes normal retirements, early voluntary retirements and dismissals. All turnover gives rise to indirect

[29] See *Regional Pay for NHS medical and non-medical staff : Final report for Department of Health*, Elliott B., Scott A., Skåtun D., Ikenwilo D., Bell D. N. F. and Roberts E.
[30] See http://www.isdscotland.org/isd/files/WFE16_HB.xls
[31] See *NHS Labour Markets in Scotland,* R. F. Elliott, K. Mavromaras, A. Scott, D. N. F.Bell, E. Antonazzo, V Gerova and M. Van der Pol, 2003

costs, where the posts have to be filled, but it is only voluntary turnover, when employees leave to take other jobs, that would be expected to be driven by relative pay.

Table 6.10 below shows variations in the turnover rates across Boards among both nursing and AHP staff.

Table 6.10 Annual Turnover Rates

Health Board	Nurses and Midwifery	AHPs and Clinical Psychology
Ayrshire & Arran	5.62	5.84
Borders	7.12	6.61
Argyll & Clyde	7.23	7.34
Fife	7.09	7.88
Greater Glasgow	6.23	7.18
Highland	7.02	7.34
Lanarkshire	5.84	6.39
Grampian	8.62	7.85
Orkney	6.80	8.17
Lothian	9.07	9.30
Tayside	6.41	7.03
Forth Valley	7.25	5.82
Western Isles	7.79	11.70
Dumfries & Galloway	6.13	8.42
Shetland	11.39	10.60

6.2.5 The relationship between indirect costs and SSWDs

In the final stage of the analysis we attempted to explore the relationship between measures of indirect costs and private sector wage relativities. We plotted the relationship between the annual vacancy and turnover rates for each staff group and the private sector SSWDs (Figure 6.1). Since there are substantial numbers of vacancies that are recorded as being of unknown duration, and this varies across Boards, we use the conceptually less satisfactory, but practically more accurate, indicator of total vacancy rates in this analysis.

The figures are suggestive of higher indirect costs in the case of nurses and AHPs but not medical and dental staff. However, it is important to note that the size of the workforce differs dramatically between NHS Boards. To take account of these differences in size we weight our statistical analyses.

We regressed annual turnover and vacancy rates on the private sector SSWD and year dummies. The analyses were weighted by the size of the workforce and we also ran models that excluded the three Wholly Island Boards, who show the most volatile rates in Figure 6.1. To take account of the repeated observations in each regression, we adjust the standard errors for clustering by NHS Board. In the all sample regressions there are 60 data points and in the analyses that exclude the Wholly Island Boards we have 48 data points.

The coefficients on the private sector SSWDs and their associated p-values are shown in Table 6.11. We find that turnover rates for nurses and AHPs are weakly positively associated with the private sector SSWD. The vacancy rates for medical and dental staff are negatively associated with the private sector SSWD and those for nurses and AHPs are positively associated with the private sector SSWD. This is evidence of impact of private sector spatial wage variation on the recruitment and retention of nurses and AHPs.

Table 6.11 Coefficients on private sector SSWDs from regressions of indirect costs

Sample		Coefficient	p-value
Turnover			
Medical and Dental	All Boards	-0.036	0.701
	Excluding Wholly Island Boards	-0.040	0.700
Nurses	All Boards	0.172	0.056
	Excluding Wholly Island Boards	0.185	0.064
AHPs	All Boards	0.148	0.109
	Excluding Wholly Island Boards	0.173	0.080
Vacancy rates			
Medical and Dental	All Boards	-0.593	0.015
	Excluding Wholly Island Boards	-0.482	0.035
Qualified Nurses	All Boards	0.308	0.008
	Excluding Wholly Island Boards	0.328	0.013
Unqualified Nurses	All Boards	0.239	0.001
	Excluding Wholly Island Boards	0.267	0.001

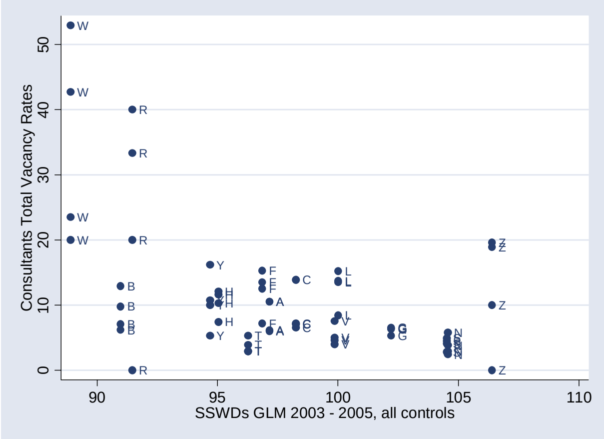
The model we have constructed provides no evidence that the recruitment and retention of doctors is affected by the patterns of private sector spatial pay variation. This is not unexpected, earlier research by some of the authors of this report[32] revealed that a more sophisticated model is needed to explain spatial differences in the vacancy rates of doctors. The attractions of working in teaching hospitals, which offer perhaps both more interesting and more remunerative work, may outweigh the disadvantages of their location in high cost areas. We have not been able to build a robust model incorporating these dimensions for Scotland using available data.

The evidence above suggests that it is appropriate to introduce a staff MFF to compensate for the higher costs of recruiting and retaining staff in some parts of Scotland. A staff MFF would apply to all NHS staff except doctors.

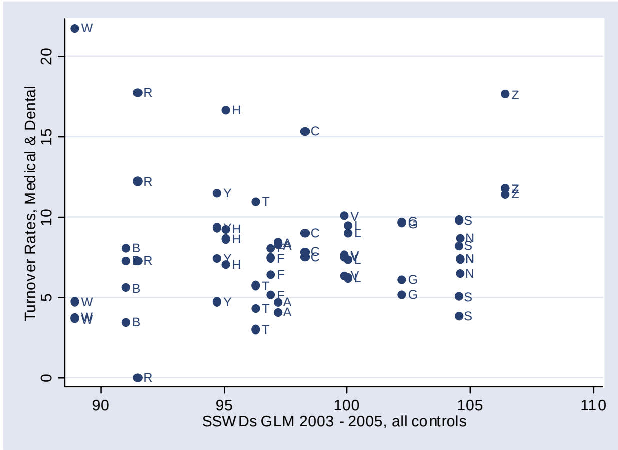
[32] Op. cit footnote 19

Figure 6.1: Indirect cost indicators by NHS Board, 2002-2005

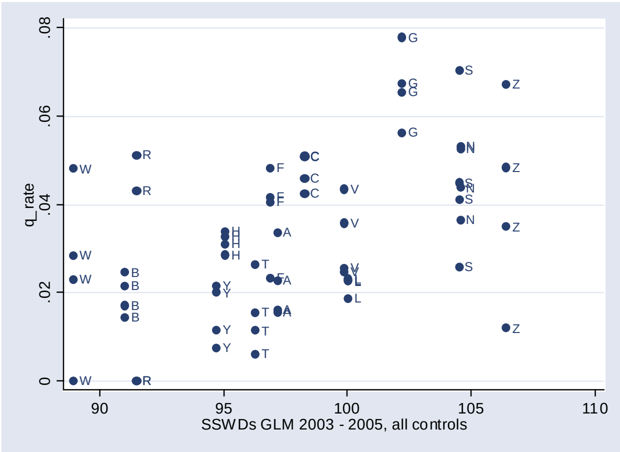
Consultants Total Vacancy Rate



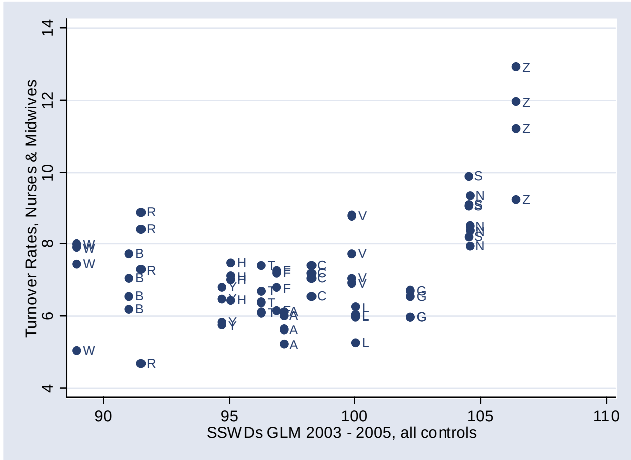
Consultants Turnover Rate



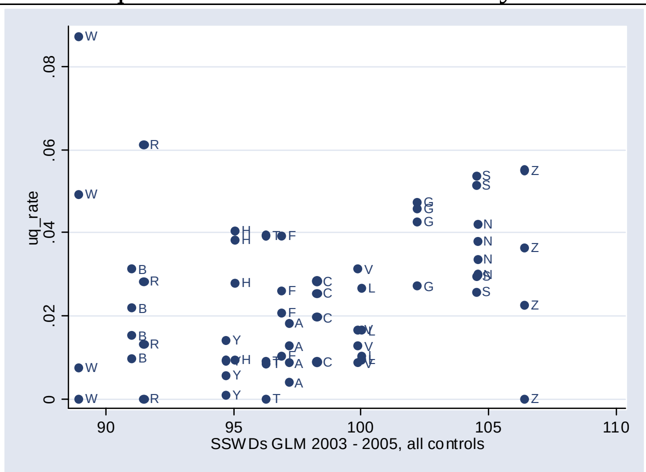
Qualified Nurses Total Vacancy Rate



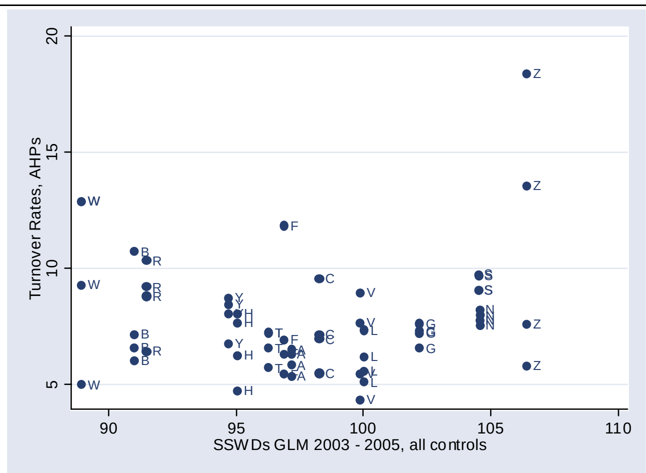
Nurses Turnover Rate



Unqualified Nurses Total Vacancy Rate



AHP Turnover Rate



Codes - A=Ayrshire & Arran; B=Borders; C=Argyll & Clyde; F=Fife; G=Greater Glasgow; H=Highland; L=Lanarkshire; R=Orkney; S=Lothian; T=Tayside; V=Forth Valley; W=Western Isles; Y=Dumfries & Galloway; Z=Shetland

6.3 Variations in prices for buildings

The Scottish Executive compile an index of relative building costs (‘location factors’) based on a 5-year rolling average of tender prices for public sector building contracts. Table 6.12 shows the level of the location factors for each local authority area at April 2005.

The range covered by these location factors is broadly similar to that covered by the private sector SSWDs – i.e. around 90-110. However, there is no significant correlation (r=0.096) between the building location factors and private sector SSWDs across local authority areas. Aberdeen City, for example, has a relatively high private sector SSWD but a comparatively low building cost location factor. The absence of any correlation between the SSWDs and the location factors is perhaps surprising as it might be expected that relatively high labour costs in certain areas would tend to be reflected in relatively high building costs.

These location factors are available at local authority area level. They could be converted to NHS Board areas by weighting the local authority figures – e.g. by the proportion of NHS staffed beds in different areas.

Table 6.12 Location Factors – April 2005

Local Authority	**Location factor** **Scottish Mean (excluding islands = 1.00)**
Aberdeen City	0.94
Aberdeenshire	0.93
Angus	0.97
Argyll & Bute	1.07
Scottish Borders, The	1.05
Clackmannanshire	1.01
Dumfries & Galloway	1.00
Dundee City	0.98
East Ayrshire	1.02
East Dunbartonshire	1.03
East Lothian	1.02
East Renfrewshire	1.03
Edinburgh, City of	1.07
Falkirk	1.01
Fife	1.01
Glasgow City	1.03
Highland (except Highland south)	0.91
Highland-South (previously the mainland area of Lochaber, and Skye & Lochalsh	1.05
Inverclyde	1.03
Midlothian	1.02
Moray	0.93
North Ayrshire	1.02
North Lanarkshire	1.03
Orkney Islands	1.25
Perth & Kinross	0.97
Renfrewshire	1.03
Shetland Islands	1.12
South Ayrshire	1.02
South Lanarkshire	1.03
Stirling	1.01
West Dunbartonshire	1.03
West Lothian	1.02
Western Isles	1.09

6.4 Variations in prices for land

Information on NHS land values in different areas of Scotland is obtained from the estimates carried out by the Valuation Office (VO) in Edinburgh. The latest set of valuations relate to the period March 2005. This valuation information is provided to the Scottish Executive Health Department and forms the basis of the capital charges set for each NHS organisation.

To calculate an index of relative land values in different NHS Boards, the valuation estimates need to be expressed per hectare to show the relative cost of NHS land in each area. Although the VO collect information on the number of hectares on each NHS site when carrying out the valuations this information would need to be extracted manually from their files. As an alternative, we have used some data on the number of hectares at hospital sites published in *Scottish Health Service Costs* (the 'Cost Book'). This information is used in the Cost Book to calculate the cost of ground maintenance per hectare for comparison between hospitals. Where possible we have matched this information on the number of hectares at the main hospital sites with the information on land valuations from the Valuation Office and have then calculated an average value of land per hectare for each NHS Board.

There are a number of problems to note about this approach.

- There are a significant number of NHS sites for which the Cost Book does not provide hectare information. Many of these sites are small clinics, offices, nurses homes, etc, and though large in number they typically account for a relatively low proportion of the NHS estate by value.

- However, there are also a number of hospital sites for which the Cost Book does not include any information on the number of hectares. The proportion of sites (by value) in each Board area for which hectares information is available from the Cost Book ranges from only 25% in Western Isles to 84% in Tayside. For Scotland as a whole the figure averages around 60%.

Table 6.13 summarises the estimates of the average value of NHS land per hectare in each NHS Board area at March 2005.

Table 6.13 Land Values per Hectare by NHS Board Area

Health Board	Total Value £'000	Hectares	Value per Hectare £	Index of Value per Hectare (Scotland =100)	Total Value (all NHS sites)	% of total land value
Argyll & Clyde	36,883	141	261,582	89.8	46,452	79.4
Ayrshire & Arran	13,515	132	102,386	35.2	26,581	50.8
Borders	3,593	27	133,074	45.7	7,246	49.6
Dumfries & Galloway	3,077	34	90,500	31.1	7,920	38.9
Fife	56,603	106	533,991	183.4	68,844	82.2
Forth Valley	33,598	81	414,790	142.5	44,280	45.9
Grampian	15,760	177	89,040	30.6	29,981	52.6
Greater Glasgow	33,620	79	425,570	146.2	109,607	30.7
Highland	13,154	52	252,962	86.9	20,024	65.7
Lanarkshire	29,947	52	575,904	197.8	66,051	45.3
Lothian	88,666	90	985,172	338.4	148,578	59.7
Orkney	290	2	145,000	49.8	771	37.6
Shetland	250	2	125,000	42.9	767	32.6
Tayside	60,864	360	169,067	58.1	72,770	83.6
Western Isles	330	5	66,000	22.7	1,343	24.6
Scotland	**390,150**	**1,340**	**291,157**	**100.0**	**651,215**	**59.9**

Note: the total value figures in the second column relate only to those sites for which information is available in the Costs Book on the number of hectares.

There are wide variations in the value of land per hectare across NHS Boards. In Lothian, the average value per hectare is more than 3 times the national average while at the other end of the range the average value per hectare in Western Isles is around one fifth of the national average. The average value per hectare in Grampian – about one third of the national average seems surprisingly low. We understand that the relatively low figures for land values in Grampian relate to an option available for NHS facilities that serve a wide geographic area to revalue the land on the basis of a replacement alternative site appropriate to that area.

Indices used in a MFF adjustment should be, as far as possible, independent of the decisions taken by NHS Boards. The appropriateness of using the available data on average NHS land value per hectare in a MFF is questionable. Clearly, this value will be influenced to some extent by decisions taken about the location of different sites and about the methods used to value these NHS sites. It might be argued that we should not reimburse a Board for choosing to have its residents treated in buildings at relatively expensive sites. However, it is difficult to envisage an alternative approach and, since the proportion of revenue costs accounted for by land is very small, the material importance of the issue is limited.

If information on land values were to be used in compiling a MFF we would recommend that further work should be done to obtain information on hectares from the Valuation Office. This would provide more comprehensive information on the size of different NHS sites than is available from the Cost Book. The Valuation Office has indicated that this information could be extracted from their files though they would need to be reimbursed for this work.

6.5 Implications for the resource allocation formula

We consider the implications of the findings in this section for the resource allocation formula. First we summarise the case for an adjustment for input prices. Second we clarify how the variations in input prices should be mapped to NHS Boards for the purpose of the resource allocation formula.

6.5.1 Evidence that an adjustment for input prices is needed

Our analysis has focused primarily on staff costs as this is the most important cost item for the NHS. We have presented evidence that there is substantial spatial variation in the pattern of pay in the private sector in Scotland. We suggested that this variation is considerably more than currently exists among the staff groups employed by NHS Scotland. We explored the consequences of the spatial variation in pay in the private sector. We found that the pattern of spatial wage differences in the private sector was associated with some areas of the NHS in Scotland experiencing additional unavoidable indirect labour costs. We found an association between measures of indirect costs and the magnitude of the private sector SSWDs for both nurses and AHPs. We found no such relationship for consultants.

We also examined spatial variation in the prices of land and buildings. Building prices show a similar extent of variation to labour prices but the correlation between them is small. It would appear that there is a case for adjusting for variations in input prices in the resource allocation formula in Scotland. Such an adjustment would be appropriate for land, buildings and all NHS Scotland staff except for consultants. Though we have argued that the staff costs adjustment should be constructed using the SSWDs for the comparator groups appropriate for each NHS staff group the data are not available to allow this to be done with precision. We therefore recommend that an adjustment be made for all staff except doctors using the SSWDs for all the private sector.

6.5.2 Mapping input price variations to NHS Boards

In section 6.2 we described a method for mapping private sector SSWDs to NHS Boards as employer organisations. This was necessary as the figures we required on NHS pay and workforce information are available only for NHS Boards as employers. Therefore, to (i) calculate the spatial gap in standardised wages between the private sector and the NHS and (ii) relate this gap to indicators of indirect costs, private sector SSWD estimates were required at this level. This, however, is not the appropriate mapping of private sector SSWDs to NHS Boards for the resource allocation formula.

The resource allocation formula defines NHS Boards by their resident populations and is concerned with ensuring budgets are set so that Boards can equitably commission services for their populations. An adjustment to the formula to take account of input price variations must therefore take account of cross-boundary flows. To represent these flows, a matrix will be required mapping NHS Board of *residence* to location of *provision.* Each cell within this matrix will represent the costs associated with the patient flows, using the national average costs that are used to derive the age-sex and additional needs elements of the formula.

7 MEASURES OF RURALITY AND REMOTENESS

The previous chapter has considered the effect of input price variation on unavoidable excess costs. The existing Arbuthnott Formula cost adjustment reflects the additional costs associated with remoteness and rurality. These costs accrue primarily because of the effects of remoteness and rurality on the production of health care. Before examining the effect of remoteness and rurality on health service costs we reviewed the literature on the measurement of these concepts.

A wide range of measures has been used to capture differences in levels of rurality and remoteness. We reviewed the literature on rurality and remoteness measures. As we have seen that cost adjustments are made for remoteness in these systems, we begin by describing the measures used in three countries: US, Canada and Australia.

Two approaches have generally been used in the UK when defining rurality and remoteness: use of a single indicator and the use of multiple indicators. Evidence on the definitions of rurality is discussed below under these categories, depending on the number of variables used to measure rurality.

We use these arguments to arrive at our preferred measure of remoteness and rurality. We conclude this section with a description of NHS Board populations by their levels of remoteness and rurality on this measure.

7.1 Definitions of rurality/remoteness in the US, Canada and Australia

Different definitions of rurality/remoteness are used in the United States of America, Canada and Australia.

7.1.1 United States

The US Census of Population uses a descriptively simple definition of rural people: i.e., those who live in places with fewer than 2500 people or in the open country (Copp 1976). For health care delivery, the definitions of rural areas are county-based 'metropolitan' and 'non-metropolitan' areas. This is used by the Office of Management and Budget and divides the USA into 'urban' and ‘rural’ areas (Copp 1976). Counties without a city of 50,000 or more residents are considered to be 'non-metropolitan'. Counties without an urbanised area of 50,000 or more people and without a total population of 100,000 or more, also belong to this group. People living outside of urbanised areas in towns of fewer than 2,500 persons or in open country are categorised as 'Rural' populations. According to this definition a sizable percentage of people in census-defined rural areas live in Office of Management and Budget-defined metropolitan areas, and, conversely, a considerable percentage of metropolitan residents live in census-defined rural areas (Goldsmith et al., 1998).

7.1.2 Canada

The Canadian Medical Association defined rural communities as those with a population of 10,000 or less. Mendelson and Bollman (1998) discussed the definition of rurality given in the

'Rural and small town Canada', where rural populations were defined *'…as a population living outside the commuting zones of larger urban centres - especially outside Census Metropolitan Areas (with population of 100,000 or more) and Census Agglomerations (with core population of 10,000 - 99,999)*'.
The other definition of rurality found in the Canadian literature was a five-fold division of areas used by Statistics Canada, which classified areas into five categories: urban core (Census Metropolitan Area (CMA)/Census Agglomeration (CA)), urban fringe (urban areas within CMA/CA boundaries but not contiguous with the urban core), rural fringe of CMAs/CAs, urban outside CMAs/CAs, and rural Mendelson and Bollman (1998).

7.1.3 Australia

In Australia, population size and an index of remoteness are primarily used to define remote rural and metropolitan areas (RRMA, 1994). According to the RRMA classification, rural areas are categorized into three groups: large rural (25,000-99,000 people), small rural centre (10,000-24,999 people), and other rural areas (< 10,000 people). Remote areas are divided into: remote centre (5,000+ people) and other remote areas (<5,000 people).

In 1998 the accessibility and remoteness index (ARIA) was developed using geographical information system technology to determine the degree of remoteness of a community. It was constructed from census data, using urban centres above 5,000 inhabitants as the threshold population. It used the level of accessibility people have to services using the existing road network. The main aim was to measure actual road distances between settled localities and service centres of 250,000, 458,000, 18,000 and 5,000 population. These were standardized and combined to produce an index. The index scale ranges from 0 to 12. The first group of values (0-1.84) define areas with highly accessible services, whereas the last group (>9.08-12) identify areas very remote (very inaccessible). The objective of the index was to quantify 'remoteness' in order to assist resource allocation in rural areas (Nutley, 2003).

7.2 UK definitions of rurality and remoteness based on a single indicator

7.2.1 Population density

Population density is widely used as a measure of rurality (Daly & Thomas 1992;Jones & Bentham 1997). Being a continuous variable, it is easy to calculate, rank and compare geographical units. In Scotland, the Randall definition of rurality was based on population density (Williams et al. 1998). Local authority districts with a population density of less than one person per square hectare were classified as rural.

Major drawbacks of using population density alone to define rurality include:

- deficiencies in describing the characteristics of communities defined as rural
- aggregating different types of rurality under one group;
- problems of not classifying rural areas if they are close to a large urban area (Deaville 2001);
- the population density thresholds used to define rurality could differ from study to study;
- inconsistency in the area of land covered in the unit of measurement.

The Randall definition does not identify rural areas that are located in predominantly urban districts (Arran and East Lothian) and considers as rural districts areas with significant urban populations (Stirling, Perth, and Inverness) (Williams, Shucksmith, Edmond, & Gemmell 1998). Based on this definition 29% (about 1.5m) of the population of Scotland is defined as rural.

7.2.2 Industry based definition

According to this classification, rurality is defined based on the proportion of economically active population employed in agriculture. This district level classification classifies a place as rural if at least 10% of the economically active population are employed in agriculture (Shucksmith 1990). The population employed in agriculture is declining and this influences the way geographical areas are defined.

7.2.3 Settlement size

Rural areas have also been defined on the basis of settlements below a certain threshold. In Scotland, areas with no urban settlements of over 100,000 persons and where less than 50% of the population live in settlements of between 10,000 and 99,999 people have been classified as rural districts (Shucksmith 1990). This definition has a crucial defect in that it excludes significant rural areas within the Central Belt (e.g., East Lothian), and includes many large urban settlements such as Perth, Sterling, Inverness, Dumfries and Ayr (Shucksmith 1990). Another Scottish definition based on settlement size defined rural areas as postcode sectors with <3000 inhabitants (Shucksmith et al. 1997; Scottish Executive 2004a)

In England and Wales, enumeration districts have been used for the definition of rurality, with districts containing < 5,000 people defined as rural (ref). On the other hand the Rural Development Commission, defines rural England as any area with settlements of less than 10,000 inhabitants (The Countryside 2004).

7.2.4 Distance or access to services

Another major indicator used to define rurality has been distance or access to services. Since access to services is more likely to be a problem in rural areas than urban areas, be it for health care, transport, post offices, education or other services, accessibility is usually discussed in relation to the rural areas. Moseley et al (1977) defined accessibility in the rural context as the ability of rural residents to get to, or be reached by, activities, services or facilities that are relevant to them. Geographical distance has been shown to impede access to services (Parkin 1979; Gravelle, Dusheiko, & Sutton 2002; Sutton et al. 2002). A recent report included access to a set of core services including GP surgery as a separate domain of deprivation (Scottish Executive 2004b).

In Scotland drive times to amenities (petrol stations) was used as a simple definition of rurality in a study, which intended to explore the social, economic and environmental impact of petrol stations in Scotland. Areas with up to 30 minutes drive were defined as *peri–urban* areas, 30-60 minutes *(rural),* 1-2 hours drive *(remote rural* areas), and more than two hours drive *(very remote* areas) (Scottish Office 1997c).

Recent developments have been the use of Geographical Information Systems to calculate distance and travel times to nearest healthcare facilities (Hotvedt et al. 1996;Jones & Bentham

1997;Rawles et al. 1998;Round & Marshall 1994). The use of drive times is better than straight-line distances because it incorporates the nature as well as the length of the roads travelled (Scottish Executive 2004b). The recent report on multiple deprivation in Scotland included drive times to core services. It is described however as a measure of deprivation rather than rurality. The disadvantage of using accessibility as a measure of rurality/remoteness is that it makes the definition service-specific. A rural population may have good access to a general practice surgery but poor access to other health care services (such as hospitals, community pharmacy), or other services (such as education). Defining rurality on one single measure for a specific purpose might not be relevant in another context.

7.2.5 Rural practice payments

Rural practice payments are intended to compensate practices for the increased time spent in visiting patients living at a distance. They are based on the number of rural patients on a practitioner's list who live over three miles away from the practice. Rural payments have been used to define the rurality of a practice.

Rousseau and McColl used the proportion of the population living over three miles from the main surgery of their general practice as a threshold to form three practice categories: those with >50% of the population living over three miles (defined as *sparsely* populated), those with 20% to 50% (*intermediate* populated) and those with <20% (*densely* populated) (Rousseau & McColl 1997). The drawback of this definition is that rural practice payments are a measure of service configuration and access costs rather than rurality and remoteness. Rural practice payments may be made to some suburban practices, making the value of its use in defining rurality of practices questionable. The rurality of an area is also affected by closure of a practice or opening a new one.

7.3 UK definitions of rurality and remoteness based on multiple indicators

The other approach to defining rurality has been to use two or more indicators, which are thought to be necessary attributes of the setting. Proponents of this approach stress the heterogeneous nature of rural areas and emphasise the importance of including indicators that reflect salient features of rurality. Scholars of this approach criticise definitions based on single variables as being unable to explain the multifaceted nature of rural areas.

7.3.1 Population density and accessibility

The level of isolation and accessibility has been used to define areas in Scotland as rural. Towns in rural areas are identified first, as the base for a variety of services to neighbourhood areas. Areas with a population of between 5,000 and 10,000 were designated as market towns. The next stage was to assess the degree of accessibility of neighbouring populations to different public services, such as GP surgeries, post offices, primary schools, banks and petrol stations. To determine the degree of accessibility a maximum of 10 minutes drive time was used as the baseline. Market towns have 5,000-10,000 populations and are within 10 minutes drive time of such amenities. Settlements with less than 5,000 population but within 10 minutes drive time of public services were classified as accessible rural areas, and those with more than 10 minutes drive time were considered to be inaccessible rural areas (Scottish Homes 1998).

7.3.2 Accessibility, population dispersion and settlement size

McCleery identified three indicators of rural and remote areas in his study of social and economic change in the Highlands and Islands. These were: population dispersion (area of land per person), settlement size (proportion of population living in settlements of less than 1,000 people) and accessibility (minimum distance a person would need to travel in order to reach a certain population centre of gravity) (McCleery et al. 1987). The direct distance measure, however, ignores the nature of roads.

7.3.3 Population density, employment and demographic structure

In the mid 1990s, the Scottish Office identified five types of rural areas with a distinct nature. Areas were classified as *remote rural, less remote rural, mixed urban/rural, remote settlement dominated, and prosperous high growth areas,* according to the proportion of the population engaged in agriculture, population density, and the demographic structure of the population (Scottish Office 1996).

7.3.4 Index of Rurality

Multiple indicators believed to capture a number of the characteristics of rural areas were brought together to create a composite rurality index (Cloke 1977;Cloke & Edwards 1986;Harrington & O'Donoghue 1998). Transport, social class and asset holding variables from the Census data were used to generate a Rurality Index for England and Wales. Using factor analysis the following variables were included in the index: population density, occupancy rate, commuting out pattern, percentage of population with females aged 15-44 years, percent of population over 65, household amenities (percent households with exclusive use of fixed bath and inside WC, and occupational structure (percent employed in socio-economic groups). The main aim of the work was to classify areas so that comparisons could be made within rural areas rather than between rural and urban areas.

The main drawback of this approach lies in its exclusion of urban areas, limiting its use to rural areas and so preventing rural-urban comparisons. Thus, it is a measure of the degree of rurality (of the places already considered to be non-urban) rather than a general classification of areas into rural/urban categories.

7.3.5 Settlement size and remoteness

The most recent definition of rurality used in Scotland was developed by the Geographical Information Systems (GIS) department of the Scottish Executive (Hope 2002). It distinguishes between settlement size and remoteness and uses drive times to capture the extent of remoteness.

The General Registers Office for Scotland (GROS) definition of settlements based on the Census 2001 output areas was used to set boundaries of settlements. A postcode with greater than 2.1 residential addresses per hectare or greater than 0.1 non-residential addresses per hectare were classified as urban. This is based on residential addresses and non-residential addresses are excluded. Non-residential addresses include accommodation in hospitals, nurses' homes, prisons, military bases and larger student halls.

Neighbouring urban postcodes are then combined together to contain more than 210 residential addresses to create a settlement. This is equivalent to a population of 500. GIS information and drive time to nearest settlement of 10,000 population or more were next used to differentiate accessibility of areas. Settlement size of 10,000 or more inhabitants and drive time of 30 minutes were used as thresholds to distinguish between accessible and more remote/peripheral rural areas. This lead to a 2-fold definition of remoteness, i.e., areas within 30 minutes or less drive time from a settlement of 10,000 are defined as accessible and those with more than a 30 minutes drive time from a settlement of 10,000 as remote and very remote.

This yields four settlement sizes ranging from primary cities to rural areas. Settlements with a population over 125,000 were defined as primary cities. Based on these criteria, the four primary cities in Scotland are Aberdeen, Dundee, Glasgow and Edinburgh. Other settlements with a population between 10,000 – 124,999 were called ‘other urban’. Settlements with 3-10,000 population and within 30 minute drive time of a settlement of 10,000 or more and those with greater than a 30 minutes drive time are distinguished as ‘Accessible small towns’ and ‘Remote small towns’ respectively. Settlements between 3,000 and 10,000 population and over 60 minutes drive time of a town/settlement centre with a population of 10,000 or more are categorized as ‘Very remote small towns’. Lastly, settlements of less than 3000 people and within a 30 minute, between 30 and 60 minute, and over 60-minute drive time are said to be ‘Accessible rural’, ‘Remote rural’, and ‘Very remote rural’ respectively. Table 7.1 shows how the classification defines different areas.

Table 7.1 Eight-fold Scottish Executive Urban-Rural Classification

Drive time to nearest urban settlement	**Settlement size (population)**			
	>125,000	**10,000-124,999**	**3,000-9,999**	**< 3,000**
<30 minutes	Primary cities	Urban settlements	Accessible small towns	Accessible rural areas
30-60 minutes	-	-	Remote small towns	Remote rural areas
60+ minutes	-	-	Very remote small towns	Very remote rural areas

7.4 Lessons for our work

Rurality is hard to define because it is not a single phenomenon (Cox, 1995; Farmer, 2001). Attempts to define rurality in the literature range from simple subjective definitions (Ritchie, Jacoby, & Bone 1981) that aim to capture perceptions of the population and health care professionals, to various indices formulated using different variables are that believed to capture major ‘rural’ characteristics (Bentham, 1984; Carstairs and Morris, 1991; Philmore and Reading, 1992; Haynes, 1991). The review indicated that population density and sparsity, distance from a major metropolitan area, and settlement size are some of the indicators that have been used to define rurality (McCabe 2002).

Economic criteria like land-based activities and dependence on agriculture, social and demographic criteria like size of population and geographical criteria (such as, remoteness from urban and midland settlements) and other criteria have been used to identify a place as rural. Based on the criteria selected various divisions of rural areas emerged with some degree of overlap.

The use of a large number of different definitions of rurality and remoteness highlights the problem of trying to produce a single, universally accepted definition. Various authors and the recent review conducted by the ONS on behalf of the Office of the Deputy Prime Minister of the UK, have identified that defining 'rural' areas is a notoriously difficult task (ONS 2005) (Haynes and Bentham 1982; Rural White Paper, 1996).

Rurality and remoteness has tended to be defined depending on the objective of the study and the availability of data. The Scottish Executive Urban-Rural Classification captures two aspects of geography that we expect to influence the costs of service delivery. In rural areas, where populations are dispersed, geography imposes higher travel costs that must be borne by healthcare professionals or service users. In remote locations it may be necessary to provide healthcare services locally in the knowledge that there is an insufficient volume of activity to ensure the full use of capacity at all times. We therefore adopt this classification in our analysis.

7.5 Urban-rural profile of pre-2006 NHS Boards

We used data provided by the Scottish Executive Geographic Information Service (SEGIS) to generate urban-rural profiles of pre-2006 NHS Boards using this measure. The dataset provided by SEGIS contains information on each 2001 Output Area. For each Output Area we have resident populations as at the 2001 Census, the Scottish Executive Urban-Rural Classification, the datazone in which the Output Area is located and drive times to the nearest urban settlement (defined as 10,000+ persons).

We aggregated the file to datazone level, taking the modal SEURC classification of the constituent Output Areas as the SEURC classification for the entire datazone. We defined island datazones as those that contain Output Areas requiring a ferry journey to reach the nearest urban settlement. We then matched this classification file to the datazone population estimates for 2003 and a lookup file assigning each datazone to a pre-2006 NHS Board area. The population estimates classified by SEURC and island location are provided for each pre-2006 NHS Board area in Table 7.2.

These data serve two purposes. First, we are interested in the urban-rural profile of each NHS Board. Second, we are interested in the contribution of each NHS Board's population to the Scotland population within each urban-rural category. The former captures the rurality of each Board. The latter identifies which NHS Boards account for Scotland's urban and rural populations.

Table 7.3 expresses the population figures from Table 7.2 as row percentages, which is the percentage of each NHS Board's population that falls within each urban-rural category. NHS Greater Glasgow is the most urban Board, with 93% of its population lying within a Primary City. NHS Lothian also has more than half of its population within a Primary City. Four other Boards (NHS Tayside, NHS Lanarkshire, NHS Grampian and NHS Argyll & Clyde) have significant populations in Primary Cities.

Three Boards have very substantial populations in Urban Settlements (NHS Forth Valley, NHS Fife and NHS Ayrshire & Arran). All but three of the remaining Boards have substantial populations in Accessible Small Towns or Accessible Rural Areas. These three exceptions are

NHS Orkney, NHS Shetland and NHS Western Isles, whose populations are all located on islands.

Only three other Boards (NHS Argyll & Clyde, NHS Ayrshire & Arran and NHS Highland) have populations located on islands but these populations represent very small percentages of the total Board population. NHS Argyll and Clyde was unique in having populations in each of the ten urban-rural categories. NHS Borders, NHS Dumfries & Galloway, NHS Grampian and NHS Highland are unusual for having more than 10% of their population in Remote or Very Remote locations.

In Table 7.4 we provide a different analysis of the population figures in Table 7.2. Here we present column percentages, representing the contribution of each NHS Board to the Scottish population in each urban-rural category. No NHS Board has a monopoly on a particular urban-rural category. Only in two cases, does a single NHS Board account for more than a half of the Scottish population in any category. NHS Highland accounts for 68% of the Scottish population in Mainland Very Remote Rural Areas and 65% of the Scottish population in Mainland Very Remote Small Towns. In two other cases, a single NHS Board accounts for more than one-third of a particular urban-rural category. NHS Greater Glasgow accounts for 41% of the population living in Primary Cities and NHS Argyll & Clyde accounts for 35% of the population living in Mainland Very Remote Small Towns.

Table 7.2 Resident populations ('000s) by pre-2006 NHS Board and Urban-Rural Category, as at 2003

NHS Board	Primary Cities	Urban Settlements	Accessible Small Towns	Remote Small Towns	Mainland Very Remote Small Towns	Island Very Remote Small Towns	Accessible Rural Areas	Remote Rural Areas	Mainland Very Remote Rural Areas	Island Very Remote Rural Areas	All
Argyll & Clyde	150	152	26	10	13	5	27	3	20	12	420
Ayrshire & Arran	-	215	71	10	-	-	60	5	-	7	367
Borders	-	28	21	5	-	-	46	8	-	-	108
Dumfries & Galloway	-	42	27	8	-	-	41	29	-	-	147
Fife	-	218	63	-	-	-	71	-	-	-	352
Forth Valley	-	199	30	-	-	-	47	4	-	-	280
Grampian	194	61	78	23	-	-	123	42	3	-	524
Greater Glasgow	801	30	22	-	-	-	11	-	-	-	864
Highland	-	45	21	13	24	-	29	23	53	1	209
Lanarkshire	219	219	52	-	-	-	62	-	-	-	553
Lothian	454	170	77	14	-	-	56	10	-	-	780
Orkney	-	-	-	-	-	6	-	-	-	13	19
Shetland	-	-	-	-	-	7	-	-	-	15	22
Tayside	153	101	40	-	-	-	78	14	1	-	386
Western Isles	-	-	-	-	-	8	-	-	-	18	26
Scotland	1,972	1,479	529	82	38	26	651	138	78	66	5,057

"-" indicates zero; "0" indicates less than 500 persons.

Table 7.3 Percentages of pre-2006 NHS Board resident populations in each Urban-Rural Category, as at 2003

NHS Board	Primary Cities	Urban Settlements	Accessible Small Towns	Remote Small Towns	Mainland Very Remote Small Towns	Island Very Remote Small Towns	Accessible Rural Areas	Remote Rural Areas	Mainland Very Remote Rural Areas	Island Very Remote Rural Areas	All
Argyll & Clyde	36%	36%	6%	2%	3%	1%	7%	1%	5%	3%	100%
Ayrshire & Arran	-	59%	19%	3%	-	-	16%	1%	-	2%	100%
Borders	-	26%	20%	5%	-	-	43%	7%	-	-	100%
Dumfries & Galloway	-	29%	18%	5%	-	-	28%	20%	-	-	100%
Fife	-	62%	18%	-	-	-	20%	-	-	-	100%
Forth Valley	-	71%	11%	-	-	-	17%	2%	-	-	100%
Grampian	37%	12%	15%	4%	-	-	23%	8%	1%	-	100%
Greater Glasgow	93%	3%	3%	-	-	-	1%	-	-	-	100%
Highland	-	21%	10%	6%	12%	-	14%	11%	25%	1%	100%
Lanarkshire	40%	40%	9%	-	-	-	11%	-	-	-	100%
Lothian	58%	22%	10%	2%	-	-	7%	1%	-	-	100%
Orkney	-	-	-	-	-	31%	-	-	-	69%	100%
Shetland	-	-	-	-	-	33%	-	-	-	67%	100%
Tayside	40%	26%	10%	-	-	-	20%	4%	0%	-	100%
Western Isles	-	-	-	-	-	29%	-	-	-	71%	100%
Scotland	39%	29%	10%	2%	1%	1%	13%	3%	2%	1%	100%

“-” indicates zero; “0%” indicates less than 0.5%.

Table 7.4 Percentages of Urban-Rural Category resident populations in each pre-2006 NHS Board, as at 2003

NHS Board	Primary Cities	Urban Settlements	Accessible Small Towns	Remote Small Towns	Mainland Very Remote Small Towns	Island Very Remote Small Towns	Accessible Rural Areas	Remote Rural Areas	Mainland Very Remote Rural Areas	Island Very Remote Rural Areas
Argyll & Clyde	8%	10%	5%	12%	35%	20%	4%	2%	26%	18%
Ayrshire & Arran	-	15%	13%	12%	-	-	9%	3%	-	10%
Borders	-	2%	4%	6%	-	-	7%	6%	-	-
Dumfries & Galloway	-	3%	5%	10%	-	-	6%	21%	-	-
Fife	-	15%	12%	-	-	-	11%	-	-	-
Forth Valley	-	13%	6%	-	-	-	7%	3%	-	-
Grampian	10%	4%	15%	28%	-	-	19%	31%	4%	-
Greater Glasgow	41%	2%	4%	-	-	-	2%	-	-	-
Highland	-	3%	4%	16%	65%	-	4%	17%	68%	2%
Lanarkshire	11%	15%	10%	-	-	-	10%	-	-	-
Lothian	23%	11%	15%	17%	-	-	9%	7%	-	-
Orkney	-	-	-	-	-	23%	-	-	-	20%
Shetland	-	-	-	-	-	28%	-	-	-	22%
Tayside	8%	7%	8%	-	-	-	12%	10%	2%	-
Western Isles	-	-	-	-	-	29%	-	-	-	28%
Scotland	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

“-” indicates zero; “0%” indicates less than 0.5%.

8 REMOTENESS ADJUSTMENT FOR COMMUNITY SERVICES

In this chapter we consider how the costs of service delivery vary across the geographic classification of areas highlighted in the previous chapter. We begin by describing and analysing the available data on service costs. Although extended in recent years, national cost data are not sufficiently refined to permit robust estimation of an adjustment for community health services. There have, however, been more useful developments in patient activity datasets for the two aspects of community health services, district nursing and health visiting, that were covered by the NERA report. The second section of this chapter therefore provides analyses of these data with respect to remoteness and rurality.

These activity data remain limited for our purposes because they contain no information on service costs, cover only two professional groups within community services and are available only for a sample of areas. In the third section of this chapter we derive a simulation model for district nursing and health visiting. This is a development of the NERA model. As well as updating the model with more recent data on populations, contact rates, settlements and geography, we have also examined the basic structure of the existing model. We use this section to identify the key parameters for the simulation model and in the fourth section of this chapter we derive a general model for community health services. The implications for the resource allocation formula are discussed in the final section.

8.1 Empirical observations on service costs

8.1.1 National data

The range and quality of information provided in the Cost Book on community health services has been increasing in recent years. Information is available on the total expenditure by each NHS Board on the provision of a range of different community health services. The elements of expenditure on which cost data are available are listed in Table 8.1. Not all Boards provided data in 2004/5 and the final column of Table 8.1 gives the number of the 15 geographical NHS Boards that provided information for each expenditure element.

The largest expenditure element in the community is classified as ‘Other Services’ (33.9%), followed by District Nursing (16.1%), Community Psychiatric Teams (14.1%), and services provided by Allied Health Professionals (10.0%). Although a further breakdown of ‘Other Services’ is provided, almost three-quarters of this expenditure remains unclassified. Within Allied Health Professional services, the largest components are represented by Chiropody and Physiotherapy.

Table 8.1 Elements of community services expenditure

Expenditure element	£000	%	Number of Boards providing data
Top-level summary			
Direct Nursing	136,023	16.1%	15
Health Visiting	71,156	8.4%	15
Midwifery	25,061	3.0%	14
Community Psychiatric Team	119,250	14.1%	15
Community Learning Disabilities Team	26,342	3.1%	13
Child Health	30,447	3.6%	13
Specialist Nursing	28,240	3.3%	12
Addiction Services	20,580	2.4%	10
Family Planning	16,692	2.0%	12
AHPs	84,181	10.0%	15
Other Services	285,912	33.9%	15
Total	843,885	100.0%	15
Breakdown of AHP costs			
Clinical Psychology	13,566	13.9%	12
Physiotherapy	23,262	23.8%	15
Occupational Therapy	12,788	13.1%	15
Chiropody	24,130	24.7%	14
Dietetics	6,297	6.4%	13
Speech Therapy	17,704	18.1%	15
Total AHPs	97,747	100.0%	-
Breakdown of Other Services costs			
Community Dentistry	34,492	12.7%	15
Home Dialysis	4,976	1.8%	8
Breast Screening	10,455	3.8%	5
Incontinence Services	16,418	6.0%	12
Health Promotion	4,489	1.6%	6
Other	201,518	74.0%	14
Total Other Services	272,347	100.0%	-

Notes: Derived from Scottish Health Services Costs 2004/5

For some of these services information is also available on the volume of contacts (or visits) between community staff and patients and the average cost per contact (or visit). These data are summarised in Table 8.2. There are very large differences between elements of community health services in national average costs per visit from £23 per chiropody visit to £249 per home dialysis visit. There are also very substantial differences between Boards in the reported cost per visit estimates. Column 3 of Table 8.2 shows the ratios of the maximum figures to the minimum figures. The element with the least variation is Community Psychiatric Teams, where there is a 3.4-fold difference between the Board with the maximum value and the Board with the minimum value. In some elements of CHS the range is very wide indeed.

The final column of Table 8.2 shows the correlation between costs per visit and the Arbuthnott Formula remoteness adjustment for community services. There are positive correlations between costs per visit and remoteness for 6 of the 14 elements of community services. Eight of the 14 elements reveal negative correlations between the costs per visit and remoteness. Breast Screening, Clinical Psychology and Chiropody have the strongest correlations with remoteness. Occupational Therapy and Physiotherapy have the strongest negative correlations with remoteness.

Table 8.2 National figures on costs per visit for community services

Element	Cost per visit (£)	Number of Boards providing data	Ratio of maximum to minimum value	Correlation with Arbuthnott adjustment
Direct Nursing	30	14	5.6	0.46
Health Visiting	35	14	6.5	0.15
Midwifery	59	14	6.0	-0.26
Community Psychiatric Team	162	13	3.4	-0.11
Community Learning Disabilities Team	220	13	10.8	-0.24
Clinical Psychology	148	11	5.5	0.89
Physiotherapy	26	14	19.2	-0.41
Occupational Therapy	79	13	53.4	-0.51
Chiropody	23	12	34.0	0.60
Dietetics	76	11	4.0	-0.28
Speech Therapy	47	14	5.6	-0.06
Community Dentistry	77	12	8.4	0.64
Home Dialysis	249	6	22.3	-0.10
Breast Screening	72	4	4.2	0.96

Notes: Derived from Scottish Health Services Costs 2004/5

Community health services are an extremely heterogeneous collection of health services. The data available for assessing the relationship between unit costs and remoteness are limited to NHS Board level, show very wide variation across Boards and are not consistently related to the measure of remoteness used for community services in the Arbuthnott Formula.

We do not believe that a robust adjustment for the additional costs of service delivery in remote areas can be obtained from these data. NHS Ayrshire & Arran provided us with data from their local systems that should prove more useful. Within the timescales available we have not been able to analyse these data but, especially if other Boards can provide similar information, these would provide more reliable estimates of the costs of community health service delivery.

8.2 Empirical observations of service delivery

Although the information on service costs is very limited, developments in patient activity datasets now provide richer information on patterns of service delivery in the community. In this section we use an extract of individual patient data from Practice Team Information (PTI) to examine urban-rural differences in service delivery and provide empirical support for some of the assumptions that underpin our simulation model.

The first sub-section contains a description of the dataset and this is followed by a consideration of the extent to which these data provide representation of different types of areas. In the third sub-section we analyse urban-rural differences in the proportion of encounters that take place in the patient's home. We then provide estimates of the distances associated with encounters in urban and rural areas and the probable consequences for urban-rural differences in the length of time associated with each contact. Higher travel times associated with each contact in rural areas would be expected to reduce the number of encounters that each healthcare professional can undertake. This is considered in the final sub-section.

8.2.1 Description of data

We obtained an extract of data from Practice Team Information (PTI) collected by ISD on encounters between patients and the practice team (GP, practice nurse, district nurse and health visitor) from 47 general practices during the period 2003/4. The dataset contains the following variables for each patient encounter:

- Practice code
- Anonymised patient identifier
- Contact date
- Encounter serial number
- Anonymised healthcare professional identifier
- Encounter type
- Patient postcode of residence

The required variables are not available for all records and the extract was cleaned prior to the analysis. Details of this process are given in Appendix 1.

8.2.2 Representation of different types of areas

The PTI dataset is drawn from a small number of practices but represents a substantial number of individual patients. For our purposes we do not necessarily require a dataset that is representative of the Scottish population. We only require sufficient information on patterns of care delivery in each of our ten categories of remoteness and rurality that are representative of these categories.

Table 8.3 shows the breakdown of the PTI encounters by the Scottish Executive Urban-Rural Classification (SEURC) of the patient postcode of residence. There is a clear over-representation of Urban Settlements and under-representation of Primary Cities. However, all eight SEURC categories and island locations in Very Remote Rural Areas are represented in the dataset. There are, however, no records from island locations in Very Remote Small Towns.

Table 8.3 Breakdown of PTI dataset by category of residence

	Population	District Nurse encounters		Health Visitor encounters	
SEURC	%	N	%	N	%
Primary Cities	39.0	31,298	16.6	19,464	19.9
Urban Settlements	29.2	98,330	52.3	48,211	49.2
Accessible Small Towns	10.5	25,244	13.4	15,590	15.9
Remote Small Towns	1.6	1,429	0.8	498	0.5
Very Remote Small Towns – Mainland	0.7	6,257	3.3	1,613	1.7
Very Remote Small Towns – Island	0.5	0	0.0	0	0.0
Accessible Rural Areas	12.9	21,546	11.5	11,359	11.6
Remote Rural Areas	2.7	577	0.3	847	0.9
Very Remote Rural Areas - Mainland	1.5	1,693	0.9	250	0.3
Very Remote Rural Areas - Island	1.3	1,780	1.0	141	0.1
Total	100.0	188,154	100.0	97,973	100.0

8.2.3 Location of encounters

District nurses and health visitors deliver services in a range of ways including some in the surgery (individual consultations, appointment-based and drop-in clinics, and group contacts) and some in the patient's home (daytime and night time). The unit-cost consequences of rurality and remoteness will depend on the proportions of contacts that involve travel for healthcare staff as opposed to travel for patients. Where a healthcare professional is required to travel to see the patient, the amount of time spent travelling will obviously increase in more remote and rural areas. Where healthcare professionals deliver services at the surgery, the higher travel costs in remote and rural areas are borne by the patient.

Table 8.4 shows the proportion of encounters that take place in patient homes. Overall 91% of district nurse and 48% of health visitor encounters are house visits. For district nurses the highest proportion of house visits is in Very Remote Rural Areas (Mainland), but the second highest proportion is in Primary Cities and there is little evidence of a clear pattern in the results. For health visitors there is perhaps stronger evidence of a consistent trend across urban-rural categories, with lower proportions in Primary Cities, Urban Settlements and Accessible areas and higher proportions in Remote and Very Remote areas, though Very Remote Rural Areas (Mainland) are an exception to this trend.

Table 8.4 Proportion of encounters that are house visits

Category	District Nurse	Health Visitor
	%	%
Primary Cities	97.5	53.1
Urban Settlements	87.3	44.5
Accessible Small Towns	93.3	44.1
Remote Small Towns	94.3	73.3
Very Remote Small Towns	97.1	60.0
Accessible Rural Areas	94.7	52.3
Remote Rural Areas	84.6	76.9
Very Remote Rural Areas - Mainland	98.3	49.6
Very Remote Rural Areas - Island	93.9	91.5
Total	91.2	47.8

Where there is discretion about the location of the encounter, healthcare professionals will trade-off the opportunity costs of travel for themselves (in terms of reduced contact time available for other patients) and the costs (both financial and time-related) to patients of travelling to the surgery. It is not clear that this should be patterned by remoteness and rurality and will of course be determined by capacity considerations. Decisions about the location of the encounter are most likely determined by practice styles and individual circumstances.

8.2.4 Travel between encounters

We have used the PTI data extract to estimate the amount of travel associated with encounters in different urban-rural categories. The encounter number on the data extract provides us with an indication of the order in which each healthcare professional saw each of their patients on each day. Since this information is generally entered when the nurse returns to the practice, they are not necessarily entered consecutively and the sequence may be measured with error. At a group level, however, differences between urban-rural categories are likely to be a reasonable indicator of the differences in travel involved in serving different populations.

We have assumed that professionals start the day at the main surgery of the practice, travel to the first contact, then on to the next contact (if relevant), and so on, before returning to the surgery at the end of the day. The first visit attracts the distance from the surgery and half the distance to the next contact. The final encounter attracts half the distance from the previous encounter and the distance to the surgery. The intervening encounters attract half the distance from the previous encounter and half the distance to the next encounter.

Encounters in the surgery are given the postcode of the surgery and consecutive surgery encounters will therefore attract zero distance. The average distance travelled per encounter will therefore reflect the differences in the proportions of surgery encounters previously shown in Table 8.4.

We calculate the straight-line distance between consecutive encounters using the Easting and Northing grid references of the full postcode associated with the encounter. We are forced to use straight-line distances as travel times are not available linking every postcode to every other postcode. There are approximately 200,000 full postcodes and a matrix of travel times between all postcodes would therefore require 40 billion calculations. Nevertheless, straight-line distances will under-estimate travel distances and would be expected to do so more in rural areas and remote areas, particularly involving travel over sea. These calculations are therefore likely to underestimate the differences in travel costs between urban and rural areas.

Table 8.5 provides the results. On average, district nurse encounters (including surgery encounters) involve 2.2km of travel. This differs markedly between urban-rural categories, with clear evidence of higher distances per encounter in Rural Areas that increase with increasing remoteness and is highest on islands. The average distance per encounter on islands is more than four times the average.

There is little variation though between the categories covering Primary Cities, Urban Settlements and Small Towns. Indeed, the lowest average distance travelled is observed in Very Remote Small Towns. In part, the lower average distance in Urban Settlements reflects the lowest rate of home visiting in this category. But the figures must also reflect the sizes of catchment areas across categories. It is intuitive that Primary City practices can have larger catchment areas than Small Town practices, though this does not seem unavoidable and should not be reimbursed in a resource allocation formula.

The pattern for Health Visitors follows that for District Nurses, though distance per encounter is lowest in Urban Settlements rather than Very Remote Small Towns. Distances are higher in Rural Areas and increase with remoteness in Rural Areas.

Table 8.5 Mean straight-line distances per encounter

Category	District Nurse		Health Visitor	
	N	km	N	km
Primary Cities	30,619	2.26	18,830	1.09
Urban Settlements	95,268	1.55	47,071	0.69
Accessible Small Towns	24,236	1.90	15,019	0.76
Remote Small Towns	1,426	1.73	498	1.14
Very Remote Small Towns	6,215	1.21	1,611	0.71
Accessible Rural Areas	20,889	4.61	10,882	1.95
Remote Rural Areas	567	6.63	836	4.22
Very Remote Rural Areas - Mainland	1,630	7.25	250	5.33
Very Remote Rural Areas - Island	1,634	9.00	141	8.88
Total	182,484	2.19	95,138	0.98

8.2.5 Urban-rural differences in times required per contact

We can convert these figures on estimated distances per contact to estimated times per contact using the NERA assumptions of 29 minutes per encounter, a fixed time element of 5 minutes per encounter and average travel speeds of 20 miles an hour. These figures are provided in Table 8.6. Because travelling time is only a proportion of the total time spent by community nurses, differences in time per contact are not as wide as differences in distances per contact. Therefore, while island location encounters involve over four times the amount of distance than the average, the times per contact are just 34% higher than the average.

Table 8.6 Estimated times per contact by category of residence

Category	District Nurse		Health Visitor	
	Minutes	Ratio	Minutes	ratio
Primary Cities	38.2	1.00	36.1	1.01
Urban Settlements	36.9	0.97	35.3	0.99
Accessible Small Towns	37.6	0.99	35.4	0.99
Remote Small Towns	37.3	0.98	36.1	1.01
Very Remote Small Towns	36.3	0.95	35.3	0.99
Accessible Rural Areas	42.6	1.12	37.7	1.05
Remote Rural Areas	46.4	1.22	41.9	1.17
Very Remote Rural Areas - Mainland	47.6	1.25	44.0	1.23
Very Remote Rural Areas - Island	50.9	1.34	50.7	1.41
Total	38.1	1.00	35.8	1.00

8.2.6 Daily encounters per healthcare professional

As a consequence of these higher travel times per contact we would expect that the average number of patient encounters undertaken per day by each healthcare professional would be lower in more rural areas. The PTI data extract provides some information on whether this is observed in practice. We stratify the sample by healthcare professional and date and calculate the number of encounters undertaken. We can then calculate the average number of encounters undertaken per day by each healthcare professional and attribute these averages to the category of residence of the individual patient.

Information is not available on whether each healthcare professional works full-time or part-time. We calculate figures as if all healthcare professionals work full-time and will therefore tend to underestimate the average number of encounters for a full-time professional. This may bias our results if professionals serving particular urban-rural categories are more or less likely to work part-time. In addition there are a small number of strata with implausible values. We therefore exclude values above the 99^{th} percentile that would have disproportionate influence on the mean values for particular categories.

Table 8.7 shows the average number of encounters per day by District Nurses analysed by the category of the patient's residence. On average, District Nurses undertake 6 home visits and one surgery visit per day. Patients in Urban Settlements are seen by District Nurses that see most patients per day (an average of 7.4 per day). The number of patient encounters per day is lowest in Remote Small Towns. This is unexpected and may reflect that this category has the second lowest number of observations (Table 8.3).

Nevertheless, there is clear evidence that patients in Remote and Very Remote areas are seen by District Nurses that have fewer patient encounters per day. Excluding patients on island locations, the average number of patients per day in Remote and Very Remote areas of 4 visits is 51-65% of the average rate of 7 visits.

Table 8.7 Mean number of visits per day for each District Nurse

	Home	Surgery	Total	Total
SEURC	Per day	Per day	Per day	Ratio
Primary Cities	6.5	0.4	6.9	0.99
Urban Settlements	5.9	1.5	7.4	1.06
Accessible Small Towns	6.2	0.6	6.8	0.97
Remote Small Towns	3.2	0.4	3.6	0.51
Very Remote Small Towns	4.3	0.2	4.5	0.65
Accessible Rural Areas	6.1	0.6	6.7	0.96
Remote Rural Areas	3.7	0.8	4.5	0.64
Very Remote Rural Areas - Mainland	4.0	0.1	4.1	0.59
Very Remote Rural Areas – Island	4.9	0.4	5.3	0.76
Total	6.0	1.0	7.0	1.00

Table 8.8 provides a similar analysis for Health Visitors. On average patients are seen by Health Visitors that are undertaking 3.7 home visits and 6.6 surgery visits per day. The pattern for Health Visitors is more variable. Patients in Remote areas are seen by Health Visitors undertaking 7 visits per day compared to an average of 10 visits per day. However, patients in Very Remote areas are seen by Health Visitors with contacts per day that are very similar to the average, mainly because they have numbers of home visits that are substantially above the average (5.4 home visits compared to an average of 3.7 per day). Patients on islands are seen by Health Visitors with daily caseloads that are less than half of the average, though note this primarily reflects a very low rate of surgery contacts, is based on a small number of observations (141 encounters) and reflects working practices at a single general practice.

Table 8.8 Mean number of visits per day for each Health Visitor

SEURC	Home Per day	Surgery Per day	Total Per day	Total Ratio
Primary Cities	3.6	5.5	9.1	0.88
Urban Settlements	3.7	7.4	11.0	1.07
Accessible Small Towns	3.5	6.6	10.1	0.98
Remote Small Towns	5.2	2.2	7.4	0.71
Very Remote Small Towns	5.4	5.3	10.6	1.03
Accessible Rural Areas	4.0	6.0	9.9	0.96
Remote Rural Areas	5.4	1.8	7.2	0.70
Very Remote Rural Areas - Mainland	5.2	5.3	10.5	1.01
Very Remote Rural Areas - Island	4.0	0.4	4.4	0.42
Total	3.7	6.6	10.3	1.00

8.2.7 Summary of the empirical evidence on service delivery

We have used a large extract of community activity data to compare patterns of service delivery between urban and rural areas. Though 9 of the 10 categories of interest are represented in the dataset, the percentages from each category do not match the size of these categories in the Scottish population. We first considered the proportions of encounters that take place in the patient's homes. There is a substantial difference in the home visit proportions between district nurses and health visitors but no consistent evidence of a trend across urban-rural categories.

There is, however, a clear trend in the distances associated with each encounter across urban-rural categories. There is little difference between Primary Cities, Urban Settlements and Small Towns but distances increase substantially in Rural Areas, particularly if these are also remote. As a consequence we have estimated that the time requirement per contact is approximately 20% higher in remoter rural areas.

8.3 Simulation model for district nursing and health visiting

The data from PTI provide us with empirical observations to confirm the underlying assumptions of the adjustment but cannot provide the building blocks of the adjustment for particular NHS Boards. The sample is not representative and island locations for Very Remote Small Towns are not represented. Moreover, it is a small sample of professionals' behaviours and it might be misleading to derive an adjustment for all community nurses working in a particular urban-rural category from such a sample. Finally, we are seeking a model that can be applied to all community healthcare professionals. We therefore need to use national data on population dispersions to derive the community adjustment.

8.3.1 Description of source data

We obtained data from the Scottish Executive Geographic Information Service (SEGIS) on all output areas in Scotland. These are the smallest geographical areas for which data from the

2001 Census were produced. There were 42,604 output areas at the 2001 Census and each output area represents an average of 119 persons. These areas are contained within datazones.

For each output area SEGIS provided information on the population size of the settlement in which the output area was located (if it was) and the drive time to the nearest settlement if the output area was not located in a settlement.

Table 8.9 shows the number of settlements and population counts within settlements as at the 2001 Census. Approximately 70% of the population live in urban settlements of at least 10,000 people. Substantial differences in the numbers of settlements occur between 500+ and 3,000+ and between 3,000+ and 10,000+.

Table 8.9 Populations and numbers of different settlement sizes

Settlement size	*Resident population*	*Settlement count*
500 +	4,637,810	493
1,000 +	4,536,970	359
1,500 +	4,450,880	288
2,000 +	4,352,910	231
3,000 +	4,209,810	172
5,000 +	4,010,860	121
10,000 +	3,539,660	55

We therefore requested figures for the two standard sizes of settlement used to calculate the Scottish Executive Urban-Rural Classification – Urban Settlements (10,000+ persons) and Small Towns (3,000+ people) – and for the smallest definition of a settlement (500+ people), the definition used by NERA for the existing community adjustment.

The drive times provided are based on road travel using the road network in existence in 2003. There are some output areas for which travel to the nearest settlement involves travel over water. SEGIS do not provide travel times for these output areas. Table 8.10 shows the numbers and percentages of persons living in settlements of different sizes and, for those outwith settlements, the areas involving travel over water. Sixty-eight percent of the population live in settlements larger than 10,000 persons. Ninety percent of the population live in settlements larger than 500 persons. For those persons living outwith settlements, travel to the nearest settlement of more than 500 persons involves sea travel for 14,000 persons representing 0.3% of the population. Ninety thousand persons need to travel over water to reach the nearest settlement of more than 10,000 persons.

Table 8.10 Populations by settlement size and drive times

Population size defined as a 'settlement'	500+		3,000+		10,000+	
Group	'000s	%	'000s	%	'000s	%
Within settlement	4,539	89.7%	4,117	81.3%	3,456	68.3%
Outwith settlement, with drive time	509	10.1%	918	18.1%	1,516	30.0%
Outwith settlement, ferry route	14	0.3%	27	0.5%	90	1.8%
Total	5,062	100.0%	5,062	100.0%	5,062	100.0%

8.3.2 Model structure and assumptions

Our simulation model focuses on the average time required for patient contacts in different areas. We assume that healthcare professionals are based in settlements and travel to patients' homes for the proportion of their contacts that take place outside of their base. We therefore require values for the following parameters:

- contact duration
- travel times
- proportion of visits in patients' homes
- the time required for visits to island locations

We also need to define the size of settlements in which it can be assumed that healthcare professionals will be based and to justify why additional considerations that may determine service costs should be treated as at local discretion. This section specifies and discusses the assumptions underpinning our simulation model for district nurses and health visitors.

8.3.2.1 Contact duration

We follow the NERA assumptions of 29 minutes contact time.

8.3.2.2 Travel times

We have noted some reservations about the calculation of travel times for out-of-locality visits in the NERA model. The use of straight-line distances weighted by Local Authority measures of dispersion seems limited and to generate some unexpected results. We instead use drive times estimated using the same methodology as is used for the SEURC by SEGIS.

For populations living within settlements we follow the NERA assumptions of 10 minutes fixed time per home visit.

We assume that the fixed time cost associated with each surgery contact is 5 minutes.

For output areas outwith settlements we estimate that times per contact are equal to 29 minutes contact time plus 5 minutes setup time plus the time taken to travel from the nearest settlement. We follow NERA's model in assuming only a one-way trip because healthcare professionals will tend to travel between patients' homes rather than returning to the base between each visit.

These assumptions will produce unexpected results if the travel time to the nearest settlement is less than 5 minutes. To reflect the time required to reach the boundary of the settlement, we impose the restriction that the time per contact outwith settlements can never be less than the time per contact within settlements. Therefore, we assume that travel times outwith settlements are never less than 5 minutes.

8.3.2.3 Proportion of visits in patients' homes

In their simulation model NERA assumed that the proportion of encounters that will be house visits varies by staff group but not by levels of remoteness and rurality. We make the same assumption in our model because we have not found a consistent effect of remoteness and rurality on the proportion of visits undertaken in the patient's home.

In all output areas we assume that 91% of District Nurse contacts are home visits and 48% of Health Visitor contacts are home visits.

8.3.2.4 Time required for visits to island locations

We also need to make an assumption about the time required for contacts in output areas for which travel from the nearest settlement involves crossing water. We have assumed that the total time per contact in such areas is 120 minutes.

A dedicated trip to an island location might be expected to take at least half a day. However, the PTI results suggest that community nurses manage a daily caseload of 4-5 home visits when the caseload involves an island location. It is clear, therefore, that not all home visits on island locations are dedicated trips. In some cases it may be possible to visit more than one patient on a particular island location on the same day and in others nurses may be based on the island location.

The figure of 120 minutes seems an acceptable compromise and is always above the 95th percentile of the values for mainland locations outwith settlements.

8.3.2.5 Resulting times per contact

Within a settlement the average time per District Nurse contact is estimated as 38.55 minutes (=9%*(29+5) + 91%*(29+10)). Because health visitors undertake fewer visits in patient homes, the average contact duration within settlements for health visitors is lower at 36.4 minutes (=52%*(29+5) + 48%*(29+10)).

The total time required for a contact outwith a settlement additionally includes travel time. An output area that is 20 minutes travel time from the nearest settlement will have an average time per District Nurse contact equal to 52 minutes (=9%*(29+5) + 91%*(29+5+20)). For Health Visitors average time per contact equals 43.6 minutes (=52%*(29+5) + 48%*(29+5+20)).

8.3.2.6 Settlement size

Community health service professionals will not be located in all settlements of 500+ people. There are some community health services for which this assumption may be appropriate but others are relatively rare, and there are insufficient staff nationally to locate at least one member of staff in each settlement of at least 500+ people.

National workforce data indicates that at September 2005 there were 2,048 WTE district nurses and 1,479 WTE health visitors working for geographical NHS Boards. There are, therefore, approximately 2,470 persons per WTE district nurse and 3,420 per WTE health visitor.

From Table 1 we can deduce that the average number of persons in settlements greater than 3000+ people but less than 10,000+ people is 5,730 (=(4,209,810-3,539,660)/(172-55)). Similarly, the average number of persons in settlements between 500+ and 3,000+ people is 1,330 (=(4,637,810-4,209,810)/(493-172)). Allocating a community nurse to each settlement of 500+ people would therefore involve much smaller population to staff ratios in the smaller settlements and is unlikely to be efficient.

For the purposes of our simulation model, we therefore assume that district nurses and health visitors are based in settlements of 3,000+ people. Due to uncertainty over this parameter, we demonstrate its influence on the results.

8.3.2.7 Local decisions on workforce distribution

The NERA model made the assumption that a nurse (at least 0.5 WTE) will be located in rural postcode sectors regardless of the expected demand. We have estimated a time requirement if nurses were located in settlements of a certain size and travelled out to patients.

Local decision-makers may conclude that it is more efficient in some cases to locate a (part-time) nurse in a remote location outwith a settlement. Such a nurse may need to be of a higher grade because they are working alone. There may be more substitution between professionals or extended scopes of role. The unreliability of travel may make travel times effectively infinite and there may be over-provision locally to plan for emergencies.

We do not treat these factors as additional costs of remoteness in our model. Indeed, in some cases, such considerations represent potential cost savings in our model that will be made at local discretion.

8.3.3 Aggregation to higher-level geographical areas

Our simulation model is applied to all Output Areas and times per contact have been generated for each of these areas. For a formula that allocates resources to NHS Boards we are required to aggregate the Output Area figures. In this section, we describe how this is done using age-sex weighted population estimates.

Once we have obtained estimated times per contact for each output area we need to consider the extent to which each output area will contribute to the overall workload for higher level geographical aggregations of these output areas. A simple measure of the expected contribution of each output area is given by its population size. However, the work of District Nurses and Health Visitors is heavily concentrated amongst particular demographic groups.

Table 8.11 provides PTI figures on average contact rates by sex and age group for these two staff groups. It is clear from these figures that output areas with large populations of younger adults would be expected to contribute little to DN and HV workload. The expected contribution of each output area should therefore be weighted by its demographic profile.

Table 8.11 Annual deprivation-standardised contact rates by sex and age group; 2004/05

Sex	Age group	Estimated contact rate District Nurse	Estimated contact rate Health Visitor
Male	0 - 4 years	0.031	3.635
	5 - 14 years	0.020	0.052
	15 - 24 years	0.048	0.012
	25 - 34 years	0.068	0.025
	35 - 44 years	0.138	0.017
	45 - 54 years	0.202	0.016
	55 - 64 years	0.518	0.024
	65 - 74 years	1.223	0.053
	75 years and over	3.497	0.165
Female	0 - 4 years	0.040	3.683
	5 - 14 years	0.026	0.060
	15 - 24 years	0.064	0.297
	25 - 34 years	0.108	0.580
	35 - 44 years	0.167	0.193
	45 - 54 years	0.271	0.040
	55 - 64 years	0.589	0.050
	65 - 74 years	1.337	0.070
	75 years and over	5.364	0.192

Source: Practice Team Information (PTI), ISD Scotland

Demographic breakdowns of output area populations have not been updated since the 2001 Census and we therefore must use the demographic profile of the datazone in which the output area is located to reflect the demographic weighting.

We calculated an expected number of contacts for each datazone by multiplying the PTI age-sex contact rates by the datazone age-sex populations. We then used the output area population counts provided by SEGIS based on the 2001 Census to divide the expected figure for the datazone amongst its constituent output areas. These expected numbers of contacts for each output area could then be used as weights when calculating average values for higher-level geographical aggregations of output areas.

8.3.4 Urban-rural differences in simulated times per contact

We aggregate to urban-rural categories to confirm the face validity of the model. Table 8.12 shows our results from aggregation of output areas into urban-rural categories. We provide estimates of the average number of minutes per contact in each category and the ratio of these values to the national average.

The settlement size definition of 3,000+ persons means that all output areas in Primary Cities, Urban Settlements and Small Towns are classified as within settlements and attract the same time cost estimates. The time cost estimates are higher in Rural Areas, where the population lives outwith settlements, and increase with increasing remoteness.

Table 8.12 Simulated average times per contact

Staff group	District Nurse		Health Visitor	
SEURC of residence	mins.	ratio	mins.	ratio
Primary Cities	38.6	0.954	36.4	0.980
Urban Settlements	38.6	0.954	36.4	0.980
Accessible Small Towns	38.6	0.954	36.4	0.980
Remote Small Towns	38.6	0.954	36.4	0.980
Very Remote Small Towns - Mainland	38.6	0.954	36.4	0.980
Very Remote Small Towns - Island	38.6	0.954	36.4	0.980
Accessible Rural Areas	41.7	1.031	37.8	1.018
Remote Rural Areas	47.2	1.169	40.8	1.097
Very Remote Rural Areas - Mainland	71.5	1.769	53.7	1.445
Very Remote Rural Areas - Island	77.4	1.917	55.1	1.482
Average	40.4	1.000	37.2	1.000

8.3.5 The effects of varying settlement sizes

We have developed models based on the following settlement sizes:

- 500+ (as now)
- 3,000+ (as Scottish Executive definition of "Small Towns")
- 10,000+ (as Scottish Executive definition of "Urban Settlements")

Table 8.12 shows the effect of varying the settlement size definition on the simulated average times per District Nursing contact and Table 8.13 contains the same figures for Health Visitors.

Moving from a settlement size definition of 3,000+ to 500+ persons has no effect on the first six categories because all output areas in these categories remain within settlements. However, the average times per contact decrease quite markedly for the Rural Areas. The Accessible Rural Areas now have ratios below one and mainland Very Remote Rural Areas have simulated average times per contact that are 23% above the average for District Nurses.

The simulations change for Small Towns most markedly when a settlement size definition of 10,000+ persons is used. For District Nurses, the results indicate that, on average, output areas in Remote and Very Remote Small Towns are further in travelling time from settlements of 10,000+ persons than Remote and Very Remote Small Areas. For Health Visitors this is true of Remote Small Towns but not Very Remote Small Towns. Since the only difference is the weighting of output areas by expected contacts it must reflect different dispersions of the young and old.

Table 8.12 Simulated average times per District Nurse contact depending on settlement size

District Nurse	500+		3,000+		10,000+	
SEURC	mins.	Ratio	Mins.	ratio	mins.	ratio
Primary Cities	38.6	0.985	38.6	0.954	38.6	0.865
Urban Settlements	38.6	0.985	38.6	0.954	38.6	0.865
Accessible Small Towns	38.6	0.985	38.6	0.954	44.3	0.994
Remote Small Towns	38.6	0.985	38.6	0.954	62.5	1.402
Very Remote Small Towns - Mainland	38.6	0.985	38.6	0.954	112.0	2.511
Very Remote Small Towns - Island	38.6	0.985	38.6	0.954	112.3	2.518
Accessible Rural Areas	38.9	0.993	41.7	1.031	45.0	1.009
Remote Rural Areas	40.1	1.025	47.2	1.169	60.9	1.367
Very Remote Rural Areas - Mainland	48.0	1.227	71.5	1.769	111.0	2.489
Very Remote Rural Areas - Island	61.5	1.572	77.4	1.917	112.3	2.518
Average	39.1	1.000	40.4	1.000	44.6	1.000

Table 8.13 Simulated average times per Health Visitor contact depending on settlement size

Health Visitor	500+		3,000+		10,000+	
SEURC	mins.	ratio	mins.	ratio	mins.	Ratio
Primary Cities	36.4	0.994	36.4	0.980	36.4	0.933
Urban Settlements	36.4	0.994	36.4	0.980	36.4	0.933
Accessible Small Towns	36.4	0.994	36.4	0.980	39.1	1.002
Remote Small Towns	36.4	0.994	36.4	0.980	48.9	1.253
Very Remote Small Towns - Mainland	36.4	0.994	36.4	0.980	72.5	1.859
Very Remote Small Towns - Island	36.4	0.994	36.4	0.980	75.3	1.930
Accessible Rural Areas	36.6	0.998	37.8	1.018	39.4	1.010
Remote Rural Areas	37.2	1.016	40.8	1.097	47.8	1.224
Very Remote Rural Areas - Mainland	41.0	1.120	53.7	1.445	75.7	1.941
Very Remote Rural Areas - Island	47.8	1.304	55.1	1.482	75.3	1.930
Average	36.6	1.000	37.2	1.000	39.0	1.000

8.4 A general model for community services

The analyses in the previous section demonstrate that travel times per contact will depend on the following factors:

- the geographical distribution of expected demand
- the average proportion of contacts that are house visits
- the settlement size in which community services are based

The first of these requires age-sex specific contact rates that can be applied to the Output Area populations. These are currently only available for district nurses and health visitors.

The second requires information on the national rate of home visiting for each service. These are also currently only available for district nurses and health visitors.

The third is the most substantive issue since the size of settlement from which community staff will travel depends on the size of the national workforce and the trade-off between efficiency of resource use and travel times per contact. Larger national workforces mean that staff can be located in smaller settlements. Smaller national workforces imply longer travel times for each home visit.

We have run the simulation model for two additional scenarios that we label ‘small settlement services’ (located in all settlements of 3,000+ people) and ‘large settlement services’ (located in all settlements of 10,000+ people). We assume that 50% of contacts for small settlement services take place in patients’ homes and 25% of contacts for large settlement services take place in patients’ homes. The age-sex specific contact rates used to weight each output area’s population are taken from Practice Team Information and refer to contacts by general practitioners, practice nurses, district nurses and health visitors.

The relative weights attached to each of these models in the overall calculation for community services are based on total workforce numbers. We have assigned those services with national workforce numbers that are greater than or similar to health visitors to small settlement services. These include community psychiatric teams, physiotherapy and occupational therapy and constitute 18.4% of total community services expenditure. The remaining services are allocated to the large settlement services category and represent 57.0% of total community services expenditure.

These assumptions are summarised in Table 8.14.

Table 8.14 Parameter values for general types of community services

Service type	Small settlement	Large settlement
Contacts in patients’ homes	50%	25%
Settlement size	3,000+	10,000+
Age-sex contact rates	Practice Team Information	Practice Team Information
Proportion of CHS expenditure	18.4%	57.0%

Based on these assumptions we can derive an illustrative set of cost indices for each of our urban-rural categories. These are provided in Table 8.15. The cost indices for Primary City, Urban Settlement and Small Town categories are equal for the district nurse, health visitor and small settlement service models. This is the design of the model as we assume that these services are located in these areas and servicing these populations involves travel within the settlement only. It is only for the large settlement services that service provision to populations in Small Towns involves travel outwith the settlements in which services are located.

The influence of remoteness and rurality on the cost index is largest for district nurse services. This reflects the high proportion of contacts that occur in patients’ homes. The same factor causes the cost indices for health visitors and small settlement services to be similar, though the weighting of output area populations by different age-sex specific contact rates also influences the averages for each category. Since the large settlement services model attracts the highest expenditure weight, the cost index for this model has the largest influence on the overall cost index.

Based on these models, the costs of service delivery in Very Remote Rural Areas are raised by more than 50% and for Very Remote Small Towns are raised by more than 25%. The estimates seem plausible but there is little evidence available to support the key assumptions.

8.5 Implications for the resource allocation formula

The derivation of a cost adjustment for community health services is blighted by a lack of appropriate data. National data on unit-costs are available only at a highly aggregate level and for a limited set of services. The available data are highly variable across NHS Boards and show no consistent relationship with remoteness.

For these reasons, we have derived a model based on a simulation of the travel times associated with providing community services to dispersed populations. Recent developments in patient activity data for two community services – district nursing and health visiting – mean that we have been able to verify some of the assumptions underpinning this simulation model and obtain estimates of some of the key parameters.

The simulation model that we have developed represents a refinement of the existing model originally derived by NERA. The basic building blocks for our model are output area population and locations. These are considerably smaller than the postcode sectors used by NERA and provide a more accurate picture of the dispersed nature of populations. More importantly, we were provided with travel times between each output area and settlements of different sizes and the use of these travel times represents a considerable improvement on NERA’s use of straight-line distances.

There are five key parameters for the model:

- contact duration
- travel times
- proportion of visits in patients’ homes
- the time required for visits to island locations
- the minimum size of settlement in which services will be located.

For district nurses and health visitors we have obtained estimates of some of these parameters. These services, however, together represent just under 25% of community services expenditure. We therefore are required to make further assumptions about the nature of services provided using the remaining three-quarters of resources. We have derived two general models for ‘small settlement services’ and ‘large settlement services’ and have assigned the expenditure representing the largest workforce numbers to the former group.

The cost indices that we have derived for urban-rural categories of the Scottish population appear plausible. Since the underlying data are available for all geographical areas, it is possible to derive estimates for each NHS Board directly once the key model parameters are agreed. Further information is required to obtain these values.

Table 8.15 Simulated cost indices by category of residence for different community health service models

Service type	District nurse	Health Visitor	Small settlement	Large settlement	Overall
Parameter values					
Settlement	3,000	3,000	3,000	10,000	-
Proportion at home	91%	48%	50%	25%	-
Expected contacts	District nurse	Health Visitor	Practice Team	Practice Team	-
Expenditure weight	16.1%	8.4%	18.4%	57.0%	100.0%
Category of residence	Index	Index	Index	Index	Index
Primary Cities	0.954	0.980	0.975	0.959	0.963
Urban Settlements	0.954	0.980	0.975	0.959	0.963
Accessible Small Towns	0.954	0.980	0.975	0.999	0.986
Remote Small Towns	0.954	0.980	0.975	1.137	1.065
Very Remote Small Towns - Mainland	0.954	0.980	0.975	1.492	1.267
Very Remote Small Towns - Island	0.954	0.980	0.975	1.509	1.277
Accessible Rural Areas	1.031	1.018	1.018	1.004	1.012
Remote Rural Areas	1.169	1.097	1.101	1.123	1.124
Very Remote Rural Areas - Mainland	1.769	1.445	1.456	1.507	1.534
Very Remote Rural Areas - Island	1.917	1.482	1.533	1.509	1.577
Average	1.000	1.000	1.000	1.000	1.000

9 REMOTENESS ADJUSTMENT FOR HOSPITAL SERVICES

The adjustment for hospital services is based on analysis of variations in unit costs. It therefore captures urban-rural differences in input prices and differences in the production function.

We begin this chapter with an introduction to the data available on the costs of hospital services. This demonstrates that cost data by specialty and hospital are available as a source of information on how local costs depart from national average costs.

The existing adjustment for hospital services is based on analysis of Board-level data that has not been updated since the original work was undertaken. The next section of this chapter therefore provides an update of the original analysis for acute hospital services with more recent data.

We have indicated that there is scope for refining the hospital services adjustment using data at a less aggregate level. In the third section of this chapter we describe the methods that we have adopted to obtain estimates of the costs of service delivery for each datazone in Scotland. In the following sections we provide the results that we have obtained for each of six hospital care programmes: acute; maternity; mental health; geriatric continuing care; people with learning disabilities and outpatient services.

The final section draws out the implications for the resource allocation formula and provides a summary of the overall results.

9.1 Data available on the costs of hospital services

Scottish Health Services Costs (the *Costs Book*) is published annually by the Information Services Division of NHS National Services Scotland. This provides information on the total costs of different hospital and community health services, the volume of patient activity, and the average costs per patient. The most recent publication relates to the financial year 2004-5.

9.1.1 Hospital services

The costs information in the hospital sector covers the following patient types:

- Inpatients
- Day cases
- Outpatients
- Day Patients

Tables 9.1 and 9.2 show, respectively, a summary of hospital running costs, patient activity and average costs per case in the NHS Scotland in 2004-05 for two groups of hospitals:

- All hospitals other than long stay hospitals. (These are essentially acute hospitals, including maternity services)
- The long stay hospitals. ‘Long stay’ includes those hospitals that are providing continuing care for patients – as distinct from hospitals (essentially acute and

maternity) which provide episodes of treatment. These will include continuing care for the frail elderly, psychiatric hospitals and hospitals for people with learning disabilities.

Table 9.1 Acute Hospitals in 2004-05

Patient Type	Expenditure £m	Patient Activity	Cost per Case £
Inpatient cases	2,046.3	929,589	2,201
Day cases	242.5	439,035	552
Outpatient attendances (Consultant)	426.8	4,042,435	106
Outpatient attendances (Nurse-led)	14.4	272,911	53
Outpatient attendances (Allied Health Professions)	167.2	4,015,774	42
A&E attendances	107.5	1,428,078	75
Day patients	68.4	347,981	197
Total	3,073.1		

Table 9.2 Long Stay Hospitals in 2004-05

Patient Type	Expenditure £m	Patient Activity	Cost per Case £
Inpatient weeks	706.1	485,657	1,454
Day cases	1.9	3,656	514
Outpatient attendances (Consultant)	25.8	224,523	115
Outpatient attendances (Allied Health Professions)	19.1	466,870	41
A&E attendances	6.8	83,489	81
Day patients	44.8	430,580	104
Total	804.5		

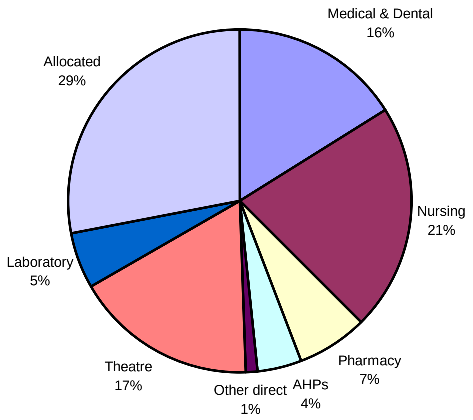
The data in Table 9.1 cover all hospitals other than long stay hospitals. This includes the major teaching hospitals, general hospitals, specialist children’s hospitals, community hospitals, maternity hospitals and clinics. The hospitals range in size from teaching hospitals with over 800 staffed beds, to small community hospitals with fewer than 20 staffed beds. Two thirds of the costs of acute hospitals are accounted for by inpatient services, and in 2004-5 almost 930,000 patients received inpatient treatment at an average cost of £2,201 per case.

Many of the hospitals in the ‘long stay’ group are quite small with fewer than 50 beds, though some of the mental illness hospitals have between 200 and 500 beds. Almost 90% of expenditure on hospital services is accounted for by inpatient care. In the long stay sector the number of inpatient weeks provides a better measure of the volume of patient activity, and in 2004-5 there were almost 500,000 inpatient weeks of care in NHS hospitals at an average cost of £1,454 per week.

These cost figures are based on the annual running costs of NHS hospitals. The costs include both ‘direct patient care’ costs – e.g. the costs for medical staff, nursing staff and allied health professionals, as well as the costs of drugs and theatre services – as well as ‘allocated costs’ – i.e. the costs of administration, property maintenance, cleaning, catering, laundry services, heating and lighting, and capital charges.

Figure 9.1 provides an example of the profile of costs for inpatients treated in General Surgery. Allocated costs account for almost 30% of the total cost of treating an inpatient case, with nursing accounting for 21% and medical and dental accounting for 16%. This is fairly typical of the pattern of costs in acute specialties, though the precise breakdown will vary from one acute specialty to another. In the long stay specialties, allocated costs usually account for a higher percentage – around 40% - of the costs of inpatient care.

Figure 1. Profile of Inpatient Costs in General Surgery



9.1.2 Specialty costs

The figures for acute and long stay hospitals in Tables 9.1 and 9.2 are summaries of expenditure, activity and unit costs for Scotland as a whole and cover all of the different specialties provided in NHS hospitals. In practice, the average costs of treatment vary widely between specialties. Table 9.3 shows the variation in average cost per inpatient case for some of the acute specialties in NHS hospitals.

Table 9.3 Cost per Inpatient Case in Selected Acute Specialties in 2004-05

Specialty	£
General Surgery	2,022
Orthopaedics	3,223
ENT	1,508
Ophthalmology	1,895
Neurosurgery	3,429
Cardiac Surgery	9,758
General Medicine	1,395
Obstetric (specialist)	1,321
Intensive Care Unit	7,661

The wide variation in cost per inpatient case between acute specialties reflects several factors including the intensity and complexity of treatment and the length of time that people spend in hospitals. In Cardiac Surgery, for example, the average cost of medical and dental input per inpatient case is £1,164, while in General Medicine the medical and dental input is £209 per inpatient case. Average lengths of stay also vary widely between specialties. The average stay in Orthopaedics is 6.5 days compared with 2.1 days in ENT.

9.1.3 Hospital costs

The figures for costs per inpatient case in selected specialties are averages for all hospitals in Scotland which provide that specialty. In practice, the cost per inpatient case in the same specialty will differ between hospitals. There may be a number of reasons for this.

- First, the mix of cases treated within one hospital may be more complex than the mix treated in another hospital. In general we might expect that teaching hospitals will tend to see a more complex mix of cases in most specialties than the non-teaching hospitals.

- Second, there are significant differences between hospitals in the volume of cases treated and in the range of specialties provided. There may be economies associated with the provision of a larger volume of activity that will reduce the unit cost per case. For example, larger hospitals can make greater use of complex and expensive diagnostic equipment and may also be able to use operating theatres more intensively. It may also be possible to achieve higher average occupancy rates in staffed beds in large hospitals because fluctuations in demand for non-elective admissions will be less pronounced as a proportion of all activity.

- Third, there may also be differences in the way that hospitals record and allocate costs both between different specialties and between different patient types and this will give rise to differences in average costs per case in the same specialty between hospitals.

- Fourth, errors in recording information on costs and/or activities will also produce differences between average costs per patient across hospitals.

Other factors that may affect cost levels in different hospitals include the additional costs associated with teaching activities and extra costs related to research activities. However, these costs are separately identified in the Cost Book and we have excluded them when calculating overall average unit costs. In principle, therefore, these two factors should not distort the comparison of unit costs, though in practice much will depend on the particular methods used in different hospitals to apportion income from teaching and research activities between different specialties and different patient types.

9.2 Updating the existing adjustment with more recent data

The Arbuthnott Formula remoteness adjustment for hospital services is based on how a ratio of actual to expected costs of commissioned hospital services correlates with a single measure of remoteness – the number of road kilometres per 1,000 population. The analysis was undertaken using three years' worth of data, relating to the period 1996/7 to 1998/9, at NHS Board level. The three wholly island Boards were combined. The measure of remoteness was available for Council Areas and was averaged at NHS Board level.

9.2.1 Data

In the original work, the actual costs of commissioning hospital care for each Board's resident population was obtained from Performance Template data - a quarterly statistical return provided by each Board to the Scottish Executive Health Department. It showed the level of expenditure by each Board on services commissioned for the resident population. This particular statistical return is no longer provided by Boards, though information on Boards' expenditure on different services and the volume of patient activity continues to be published in Scottish Health Service Costs.

This analysis uses data collected on the report R210 for acute hospital services. Data were obtained for seven years (1998/9 through 2004/5). These R210 reports provide the information described in Table 9.4. There are a few problems with the data that are detailed in Appendix 2. As far as possible we have attempted to impute values where they appear erroneous.

Table 9.4 Contents of R210 reports

Activity	Total expenditure	Total cases	Cost per case
Inpatients	✓	✓	✓
Day Cases	✓	✓	✓
Outpatients	✓	✓	✓
Accident and Emergency	✓	✓	✓
Day Patients	✓		
Total	✓		✓*

* Cases defined as resident populations.

Updated information on road kilometres were obtained from Scottish Transport Statistics for 2002, 2003 and 2004. Kilometres for all public roads were included, including trunk roads and local authority roads. Resident population data for Council Areas were obtained from the GRO Mid-Year Estimates (MYEs).

There are three NHS Boards that contain Council Areas that cross NHS boundaries – NHS Argyll & Clyde, NHS Greater Glasgow and NHS Lanarkshire. The figures for NHS Argyll & Clyde are based on the totals for Argyll & Bute, Inverclyde and Renfrewshire, plus a proportion of the road lengths and populations of East Renfrewshire and West

Dunbartonshire. These proportions are based on the additional populations required to give the NHS Board MYEs. The figures for NHS Lanarkshire are based on a proportion of the total road length and populations in North Lanarkshire and South Lanarkshire, again based on the NHS Board MYEs. The figures for NHS Greater Glasgow are based on the totals for East Dunbartonshire and Glasgow City, plus the residual elements of its shared Council Areas - East Renfrewshire, West Dunbartonshire, North Lanarkshire and South Lanarkshire.

9.2.2 Method

In the original work, the ratio of actual to expected costs for each Board was calculated as follows:

$$r_i^L = 100 * \frac{\sum_j c_{ij}.x_{ij}}{\sum_j \bar{c}_j.x_{ij}}$$

where *i* indexes Boards, *j* indexes types of activity, *c* is the cost per case, *x* is the number of cases and $\bar{c}_j$ is the national average cost per case for activity *j*. The numerator is the total expenditure reported by Board *i*. The denominator is the level of expenditure that Board *i* would have incurred if it had delivered the same levels of the different types of activity at national average costs per case. The expression therefore reflects differences in costs per case between Boards and differences in the *proportions* of activity but not their levels.

An alternative index that does not reflect differences in activity mix is given by:

$$r_i^N = 100 * \frac{\sum_j c_{ij}.X_j}{\sum_j \bar{c}_j.X_j}$$

The measure is still a measure of relative costs, comparing local unit costs to national unit costs, but the overall cost index is derived using a standard bundle of activities, representing the total national number of cases of each type *j* (denoted by X_j). The interpretation of the numerator is the total cost of national activity if national activity was delivered at each Board's local costs. The denominator is national activity costed at national unit costs and represents total national expenditure.

The difference between them is the difference between direct and indirect standardisation and direct standardisation is generally preferred. The advantage in this context is that it removes local decisions on activity mix from the calculation of the relative cost index. It avoids a situation where Boards may systematically be less expensive on the things that they do more of, which would lead to less variation in r^L compared to r^N.

Although the data contain information on five types of activity the calculation is based on only three types of activity. Day Patients are excluded because there is no information on the number of cases. Inpatients and Day Cases are combined as in the original work. It is expected that urban Boards will make greater use of Day Cases and therefore experience lower costs per case. This is thought to be a rationale for urban-rural differences in costs and the expenditure and activity data for Inpatients and Day Cases are combined prior to standardisation so that these cost differences are reflected in the ratio of actual to expected costs.

First, we present for each year and each type of activity the costs per case reported by each NHS Board and the percentage change between the first two years (average of 1998/9 and 1999/2000) and the last two years (average of 2003/4 and 2004/5). We then calculate and report the correlation of each of these variables with road kilometres per 1,000 population, for all Boards (r(all)) and excluding the three Wholly Island Boards (r(excl. WIB)) to assess the influence of these Boards on the results. In each of the tables the Boards are ranked in ascending order of rurality as measured by road kilometres per 1,000 population.

9.2.3 Results

Table 9.5 shows the figures for inpatient costs per case. In the first four years, inpatient costs per case are positively correlated with road kilometres per 1,000 population. In 1998/9 this result is dominated by NHS Western Isles – removing the three Wholly Island Boards results in a negative correlation coefficients. In the last three years, the correlation becomes negative. This is caused by a dramatic fall in costs per case in NHS Shetland in 2003/4 and the re-inclusion of NHS Western Isles with substantially lower costs per case in 2004/5. Excluding the wholly island Boards entirely, leads to positive correlation coefficients in all years (except 1998/9). The largest increases in costs per case over the period are in NHS Lothian (second most urban Board) and NHS Grampian (slightly more rural than the average).

Table 9.5 Inpatient costs (£) per case by year and NHS Board ranked by rurality

Board	Road kms per 1,000	1998	1999	2000	2001	2002	2003	2004	Change (2003&4:1998&9)
GG	3.7	1,467	1,483	1,619	1,624	1,600	1,810	1,986	29%
Loth	5.4	1,352	1,332	1,478	2,035	2,099	2,134	2,228	63%
Lan	6.2	1,462	1,497	1,642	1,672	1,625	2,090	2,337	50%
Fife	6.9	1,286	1,411	1,471	1,547	1,601	1,834	1,979	41%
FV	8.3	1,318	1,463	1,505	1,570	1,891	2,013	2,140	49%
A&A	9.5	1,348	1,350	1,581	1,593	1,717	1,807	2,044	43%
A&C	9.8	1,323	1,269	1,452	1,581	1,572	1,731	2,206	52%
Tay	13.0	1,564	1,443	1,575	1,813	1,796	1,813	2,139	31%
Gram	15.3	1,188	1,218	1,386	1,537	1,763	1,813	2,025	60%
Bor	29.0	1,299	1,606	1,697	1,707	1,869	2,275	2,021	48%
D&G	30.3	1,435	1,473	1,567	1,604	1,787	1,845	2,505	50%
High	36.6	1,361	1,420	1,631	1,814	1,945	1,835	2,205	45%
WI	45.4	1,889	1,891	2,318	2,752	-	-	759	-60%
Shet	47.6	1,408	1,586	1,682	1,108	1,172	412	754	-61%
Ork	50.9	1,325	1,576	1,748	1,640	2,010	1,992	2,315	48%
r (all)		0.30	0.64	0.62	0.14	-0.04	-0.42	-0.49	-0.57
r (excl. WIB)		-0.08	0.28	0.39	0.10	0.37	0.07	0.31	0.09

Day Case costs per case are shown in Table 9.6. Costs per case are positively correlated with road kilometres per 1,000 population in all years. These correlations remain positive when the three wholly island Board are omitted, with the exception of the first year. There has been a general trend towards higher costs per case over time and these increases tend to be larger in more rural mainland Boards. Exceptions are NHS Lothian, which has a high rate of increase and is an urban Board, and NHS Grampian, which has a low rate of increase and is an above average rural mainland Board. Low rates of increase in costs per case are seen in all three wholly island Boards.

Table 9.7 shows costs per case for Outpatients. Costs per case are negatively correlated with road kilometres per 1,000 population in all years. The correlation close to zero in the final year is caused by the re-inclusion of NHS Western Isles in the final year with substantially higher costs per case than in the previous period. Removing the three wholly island Boards from the analysis also gives negative correlations with rurality in all years. There are large fluctuations year-on-year in costs per case for particular Boards.

Table 9.6 Daycase costs (£) per case by year and NHS Board ranked by rurality

Board	Road kms per 1,000	1998	1999	2000	2001	2002	2003	2004	Change (2003&4:1998&9)
GG	3.7	279	290	286	321	248	280	473	32%
Loth	5.4	312	394	515	704	661	653	738	97%
Lan	6.2	235	215	233	377	370	330	378	57%
Fife	6.9	272	290	325	348	451	458	568	83%
FV	8.3	314	307	403	331	513	496	605	77%
A&A	9.5	251	250	284	333	372	398	459	71%
A&C	9.8	311	299	375	441	624	786	444	102%
Tay	13.0	339	306	366	456	573	607	747	110%
Gram	15.3	364	374	370	457	513	543	467	37%
Bor	29.0	249	261	401	521	746	839	835	229%
D&G	30.3	306	404	441	458	496	742	1,001	145%
High	36.6	278	296	269	422	357	570	637	111%
WI	45.4	467	488	526	505	-	-	760	59%
Shet	47.6	660	687	828	963	752	807	928	29%
Ork	50.9	434	665	575	647	581	674	618	18%
r (all)		0.68	0.77	0.66	0.60	0.41	0.60	0.58	-0.06
r (excl. WIB)		-0.04	0.18	0.06	0.18	0.17	0.56	0.60	0.66

Table 9.7 Outpatient costs (£) per case by year and NHS Board ranked by rurality

Board	Road kms per 1,000	1998	1999	2000	2001	2002	2003	2004	Change (2003&4:1998&9)
GG	3.7	274	274	287	291	356	426	433	57%
Loth	5.4	198	209	346	316	293	424	544	138%
Lan	6.2	157	136	147	306	301	189	209	36%
Fife	6.9	179	197	219	236	310	255	255	36%
FV	8.3	206	266	300	322	331	292	399	46%
A&A	9.5	182	133	231	282	312	339	380	128%
A&C	9.8	172	191	232	235	234	277	296	58%
Tay	13.0	139	119	191	222	211	266	336	133%
Gram	15.3	210	204	228	239	274	240	293	29%
Bor	29.0	174	188	211	246	273	128	165	-19%
D&G	30.3	138	158	161	249	205	233	415	119%
High	36.6	195	208	184	245	244	330	334	65%
WI	45.4	145	158	164	172	-	-	759	402%
Shet	47.6	243	262	177	296	128	297	258	10%
Ork	50.9	120	135	152	170	131	156	134	14%
r (all)		-0.29	-0.12	-0.64	-0.57	-0.85	-0.42	-0.03	0.17
r (excl. WIB)		-0.33	-0.15	-0.51	-0.48	-0.62	-0.39	-0.24	-0.13

The costs per Accident and Emergency attendance are shown in Table 9.8. There are substantial positive correlations with rurality in all years. There have been steady increases in costs per case over the period in all Boards except NHS Lothian. There is evidence that the rates of increase have been larger in the more rural Boards, with the exception of NHS Greater Glasgow for whom costs per case have doubled over the period. The costs per case in the three wholly island Boards are very influential on the headline results. Removing these Boards leads to negative correlations with rurality in four of the seven years. Only in 2000/1 and the two latest years do costs per case show a positive correlation with rurality in the mainland Boards.

Table 9.8 A&E costs (£) per case by year and NHS Board ranked by rurality

Board	Road kms per 1,000	1998	1999	2000	2001	2002	2003	2004	Change (2003&4:1998&9)
GG	3.7	43	42	44	46	48	63	106	99%
Loth	5.4	55	55	37	49	42	41	50	-18%
Lan	6.2	59	61	69	72	77	83	93	47%
Fife	6.9	53	47	46	50	53	53	62	15%
FV	8.3	56	57	53	57	99	96	73	49%
A&A	9.5	52	49	52	54	59	63	73	35%
A&C	9.8	50	53	51	53	65	70	63	30%
Tay	13.0	47	39	41	48	65	66	82	73%
Gram	15.3	44	43	46	62	58	58	58	33%
Bor	29.0	56	60	50	41	43	90	90	56%
D&G	30.3	47	45	46	44	51	53	68	31%
High	36.6	48	48	61	66	76	92	96	96%
WI	45.4	49	60	60	67	-	-	-	-
Shet	47.6	57	73	87	101	185	160	197	175%
Ork	50.9	66	80	114	129	144	142	129	85%
r (all)		0.32	0.62	0.70	0.67	0.69	0.77	0.69	0.63
r (excl. WIB)		-0.18	-0.07	0.19	-0.04	-0.04	0.34	0.22	0.33

The results using the ratio of actual to expected costs are shown in Table 9.9. The pattern of results over the years follows broadly the results for inpatient costs per case. The ratio is most strongly positively correlated with rurality in the first three years. This relative index of costs per case increases most in NHS Lothian (the second most urban Board) followed by NHS Dumfries & Galloway (the second most rural mainland Board). Excluding the three wholly island Boards leads to positive correlations with rurality in all years. As with inpatient costs per case, it is the dramatic decline in costs per case in NHS Shetland towards the end of the period, and the re-introduction of NHS Western Isles with substantially lower costs per case, that drive the results in the later years.

Table 9.10 shows the same figures using the national activity mix. The results are quite similar to those using the local activity mix. However, using the national activity mix rather than the local activity mix produces a more positive correlation with rurality in the final two years when the Wholly Island Boards are excluded.

Table 9.9 Ratio of actual to expected costs using local activity mix by year and NHS Board

Board	Road kms per 1,000	1998	1999	2000	2001	2002	2003	2004	Change (2003&4:1998&9)
GG	3.7	112	110	105	97	94	99	101	-10%
Loth	5.4	90	99	107	122	116	117	116	23%
Lan	6.2	100	96	94	101	95	98	99	1%
Fife	6.9	87	93	87	84	90	87	85	-4%
FV	8.3	100	108	103	90	105	97	109	-1%
A&A	9.5	96	89	96	92	98	97	97	5%
A&C	9.8	99	96	98	94	93	98	87	-5%
Tay	13.0	107	94	98	104	101	100	109	4%
Gram	15.3	99	98	97	99	110	104	97	2%
Bor	29.0	94	104	103	100	111	95	85	-10%
D&G	30.3	99	102	96	93	94	100	125	12%
High	36.6	106	109	108	111	111	107	110	1%
WI	45.4	143	145	154	158	-	-	82	-43%
Shet	47.6	127	138	128	97	86	45	58	-61%
Ork	50.9	107	124	117	106	110	109	101	-10%
r (all)		0.63	0.80	0.71	0.42	0.10	-0.34	-0.33	-0.62
r (excl. WIB)		0.13	0.39	0.25	0.18	0.33	0.10	0.24	-0.01

Table 9.10 Ratio of actual to expected costs using national activity mix by year and NHS Board

Board	Road kms per 1,000	1998	1999	2000	2001	2002	2003	2004	Change (2003&4:1998&9)
GG	3.7	108	104	100	94	93	101	103	-4%
Loth	5.4	87	93	102	120	115	118	118	31%
Lan	6.2	96	90	89	99	94	98	99	6%
Fife	6.9	84	87	83	82	89	88	87	2%
FV	8.3	95	101	97	88	103	98	111	6%
A&A	9.5	92	84	92	90	96	98	99	12%
A&C	9.8	96	90	93	91	92	99	88	1%
Tay	13.0	105	91	94	102	102	102	111	9%
Gram	15.3	95	92	92	97	108	105	99	9%
Bor	29.0	90	97	96	96	109	118	96	14%
D&G	30.3	95	96	91	91	92	100	127	19%
High	36.6	101	102	102	108	109	108	111	8%
WI	45.4	133	130	139	146	-	-	80	-39%
Shet	47.6	118	125	116	91	82	54	64	-52%
Ork	50.9	104	118	114	106	117	113	107	-1%
r (all)		0.61	0.81	0.72	0.40	0.15	-0.20	-0.28	-0.57
r (excl. WIB)		0.10	0.37	0.22	0.14	0.29	0.37	0.35	0.23

In Table 9.11 we present results for total expenditure per resident. Expenditure per capita has increased in all NHS Boards, ranging from 45% (NHS Fife) to 91% (NHS Orkney). There is a positive correlation between expenditure per capita and road kilometres per 1,000 population in all years, except the first year. The rate of increase in expenditure per capita is generally higher in the more rural Boards (r=0.48). Removing the three wholly island Boards reduces the magnitude of the positive correlation between expenditure and rurality but the coefficients do not change sign.

There is no evidence in these figures that expenditure has fallen in NHS Shetland between 2002/3 and 2004/5. These trends in expenditure are reflected in NHS Shetland's expenditure figures for the different types of activity. The reason that we observe the decline in unit costs in Shetland is that a 204% increase in inpatient cases in 2003/4 compared to 2002/3 is accompanied by only a 7% increase in expenditure. These types of data issues are typical of the series of figures at Board level.

Table 9.11 Expenditure (£) per resident by year and NHS Board ranked by rurality

Board	Road kms per 1,000	1998	1999	2000	2001	2002	2003	2004	Change (2003&4:1998&9)
GG	3.7	325	347	373	391	422	455	529	46%
Loth	5.4	293	283	339	391	384	431	480	58%
Lan	6.2	312	305	328	393	411	450	505	55%
Fife	6.9	301	309	323	345	370	419	468	45%
FV	8.3	274	272	290	318	364	378	424	47%
A&A	9.5	279	282	337	360	400	437	496	66%
A&C	9.8	290	302	349	370	388	461	555	71%
Tay	13.0	339	328	375	437	429	471	574	57%
Gram	15.3	271	264	293	315	360	383	437	53%
Bor	29.0	278	330	346	366	404	505	415	52%
D&G	30.3	279	326	354	379	397	454	534	63%
High	36.6	290	319	352	414	442	458	592	72%
WI	45.4	299	451	545	648			582	55%
Shet	47.6	310	366	404	371	343	425	618	54%
Ork	50.9	270	319	386	402	480	543	585	91%
r (all)		-0.23	0.60	0.62	0.45	0.29	0.49	0.58	0.48
r (excl. WIB)		-0.36	0.31	0.20	0.20	0.38	0.40	0.21	0.45

9.2.4 Derivation of a Board-level adjustment

It is possible to derive a cost adjustment based on these Board-level figures. This requires regression of the actual to expected cost ratios on the remoteness indicator. The estimated coefficient (the 'slope of the line') then provides an indication of the strength of the relationship between remoteness and excess costs. The linear equation can then be used to derive an adjustment for each Board as in the existing Arbuthnott formula:

*Cost adjustment = Constant term + Coefficient * Remoteness Indicator*

We have undertaken this analysis for the actual to expected cost ratios presented in Tables 9.9 and 9.10. In the first case we pool the data for the first three years (1998/9 to 2000/1) and in the second case we pool the data for the last three years (2002/3 to 2004/5). We provide results based on analysis that includes all fifteen Boards (where data are available) and which excludes the three Wholly Island Boards. Since we would expect greater volatility in the ratios for smaller Boards, we also undertake unweighted and weighted analyses, using the expected cost figures as weights.

Since the results are similar using either the local activity mix or the national activity mix we present results only for the preferred measure based on the national activity mix. We present only the estimated constant terms, the estimated coefficient on the road kilometres per 1,000 population and the p-value associated with this coefficient. The results are presented in Table 9.12.

In the earlier period (1998/9 to 2000/1) we find a statistically significant effect of remoteness on cost when we include the Wholly Island Boards and do not weight the analysis. The estimated equation is *88.0 + 0.565 * road kilometres per 1,000 population*. The ratio of actual to expected costs therefore increases by 0.565 for each one-unit increase in road kilometres per 1,000 population. The remaining results for 1998/9 to 2000/1 demonstrate however that this result is sensitive to both the inclusion and exclusion of the Wholly Island Boards and whether or not the analysis is weighted. It is only when the Wholly Island Boards are included and the analysis is unweighted that we find a significant influence of remoteness.

Table 9.12 Regression of actual to expected cost ratio on road kilometres per 1,000 population

Weighting	Wholly Island Boards	Constant term	Coefficient	p-value
1998/9-2000/1				
Unweighted	Included	88.0	0.565	0.003
Unweighted	Excluded	92.8	0.120	0.412
Weighted	Included	93.7	0.165	0.408
Weighted	Excluded	95.1	-0.005	0.983
2002/3-2004/5				
Unweighted	Included*	102.6	-0.131	0.669
Unweighted	Excluded	98.1	0.295	0.080
Weighted	Included*	101.1	0.025	0.917
Weighted	Excluded	99.4	0.218	0.285

* where data are available

Moreover, the significance of remoteness is not robust to estimation on more recent data. It is only when the Wholly Island Boards are excluded and the analysis is unweighted that we find an effect of remoteness that is significant at 10%. Even here the ‘slope of the line’ is almost half of the value estimated on the data for the earlier years.

9.2.5 Implications

The figures seem to show a pattern of higher costs in more remote and rural Boards, particularly where the data are probably of higher quality, inpatients and daycases. However, we have noted earlier that the ratio of actual to expected costs reflects the lower daycase proportion in rural areas and that this is already captured in the analysis of morbidity and life circumstances.

This analysis has demonstrated the sensitivity of the results to including or excluding the Wholly Island Boards. Unlike the original work, the analysis has not grouped island Boards together. This is partly because a complete series for all three wholly island Boards is unavailable but it has also allowed us to see the problems with the series for NHS Shetland.

Therefore, our attempts to replicate the existing Arbuthnott Formula remoteness adjustment for acute hospital services has demonstrated the sensitivity of the results to the cost data provided by individual NHS Boards. In addition, the correlation between unit costs and remoteness is not stable on a year-to-year basis. For these reasons we have not repeated the analysis for the other care programmes (inpatient mental health; maternity; and care of the elderly) but instead consider a less geographically aggregated approach that provides cost estimates for datazones.

9.3 Methods for estimating cost differences between datazones

There are clearly odd annual changes in the Board-level cost data. With such a small dataset these values can be highly influential on the results. More robust analysis can be undertaken on a less aggregated dataset that makes full use of the detailed cost figures for hospitals and specialties available in *Scottish Health Service Costs*. These cost figures are also likely to contain inaccuracies but, in a large dataset, they can be treated as statistical variation in the standard manner.

We seek estimates of the extent to which residents in different categories of remoteness and rurality impose excess costs on the Boards responsible for financing their care. Residents of a particular area will use services from a range of specialties within different hospitals. Rural residents will tend to use central services for more specialised care and local services for less specialised care.

We begin with an extract of hospital records that provides information on specialty, hospital and length of stay for each episode. We aggregated the data by specialty, hospital and datazone calculating the number of episodes and the total length of stay. This file was then merged with *Scottish Health Service Costs* by speciality and hospital. This allows us to calculate the costs of the activity recorded for each datazone at both national average costs and local costs. The activity recorded at national costs is the numerator used for the analysis of age-sex and additional need being undertaken in the complementary projects.

We used the same methodology to generate the local cost estimates. For long-stay specialties we use costs per week stratified by speciality. For acute and maternity inpatient stays we use the fixed and variable cost splits that are applied to each specialty. For acute we have an additional stratification by inpatient or daycase.

We apply the national fixed and variable cost splits to the local costs. If, for example, 30% of costs in specialty A have been assigned to fixed costs we do the same for each hospital. Therefore, we calculated 30% of the total net costs recorded for the specialty at each hospital and divided this by the number of discharges. This provides the estimated fixed costs per discharge for this specialty at this hospital. The remaining costs are variable costs. We divided these by the total number of bed-days recorded for this specialty at this hospital to estimate variable costs per day for this specialty at this hospital. Each record is then assigned two cost estimates: a national cost given by the national average fixed cost plus the length of stay multiplied by the national average variable costs per day; and a local cost given by the local fixed cost plus the length of stay multiplied by the local variable cost per day.

Expressed algebraically, the national cost (c_{ijk}^{N}) applied to episode *i* in specialty *j* of hospital *k* is given by:

$$c_{ijk}^{N} = \bar{f}_j + \bar{v}_j d_{ijk}$$

in which $\bar{f}_j$ is the national average fixed cost for specialty *j*, $\bar{v}_j$ is the national average variable cost per day for specialty *j*, and d_{ijk} is the length of stay for the episode.

The local cost (c_{ijk}^{L}) applied to episode *i* in specialty *j* of hospital *k* is given by:

$$c_{ijk}^{L} = f_{jk} + v_{jk} d_{ijk}$$

in which f_{jk} is the fixed cost for specialty *j* at hospital *k* and v_{jk} is the variable cost per day for specialty *j* at hospital *k*.

Simpler expressions are used for daycases and long-stay specialties. For acute daycases the variable costs per day (*v*) are set to zero. For long-stay specialties in mental health and care of the elderly, the fixed costs (*f*) are set to zero and length of stay is measured in weeks rather than days.

The cost ratio for each datazone (z) is then obtained by allocating each episode to the datazone of residence of the patient, calculating the sum of local and national costs for each datazone, and taking a ratio of the two:

$$r_z = \frac{\sum_{i \in z} c_{ijk}^{L}}{\sum_{i \in z} c_{ijk}^{N}} = \frac{C_z^{L}}{C_z^{N}}$$

It is important to note that the denominator in this ratio is the numerator used in the additional need analysis. It is a function of the number of episodes, the specialty-mix of those episodes, the length of stay of those episodes and (where appropriate) the inpatient-daycase mix. Urban-rural differences in these aspects of care are therefore captured in the ratios used in the additional need modelling. The ratio that we have calculated is a summary measure of those differences in costs that emerge for episodes in different areas having standardised for differences in speciality-mix, the inpatient-daycase mix and length of stay.

It is also important to recognise that analysis of a local to national cost ratio specifies the way in which the cost adjustment should be applied. We model the ratio with a set of independent variables:

$$r_z = \alpha + x_z ' \beta + \varepsilon_z$$

in which α is a constant term, x_z is a matrix of characteristics of the datazone that determine r_z, β is a vector of coefficients that measure the effects of these variables on r_z, and ε_z is a error term that captures deviations of r_z from that which is expected. We estimate the values of α and β using weighted least squares regression and can then predict the value of the ratio for each datazone using these estimates:

$$\hat{r}_z = \hat{\alpha} + x_z'\hat{\beta}$$

in which ^ signifies an estimated value. This should then be combined through multiplication with the measure of the activity expected for the area ($\hat{C}_z^N$) that has been produced by previous stages of the analysis using national costs:

$$\hat{C}_z^L = \hat{r}_z \,.\, \hat{C}_z^N$$

The methods we have adopted therefore are consistent with the Arbuthnott Formula approach of multiplying the population counts for each NHS Board by the ratio adjustments for age-sex, additional need and excess costs.

9.4 Acute hospital services

We begin with an extract from SMR01 for three financial years – 2002/3 through 2004/5. This extract provides episode level information on the geographical location of patient residence, patient characteristics, the complexity and type of episode, and the provider of care. This was linked to cost information from the Blue Book, details of which are contained in Appendix 3.

9.4.1 Urban-rural differences in patterns of care

Table 9.14 summarises differences in patterns of care between urban and rural areas. The proportion of elective episodes undertaken as daycases is highest in Urban Settlements, tends to decline with increasing rurality and is lowest on island locations. The proportion of episodes that are admitted as emergencies tends to be highest in more urban areas, with the exception of Remote and Very Remote Small Towns. Average lengths of stay are highest in the more remote areas.

Table 9.14 Patterns of acute hospital care by category of residence

Category	Daycase proportion of elective episodes[1]	Emergency proportion of episodes[2]	Mean length of stay (days) per inpatient admission[3]
Primary Cities	0.489	0.395	6.13
Urban settlements	0.530	0.389	5.78
Accessible Small Towns	0.502	0.387	6.11
Remote Small Towns	0.423	0.415	6.82
Very Remote Small Towns – Mainland	0.417	0.437	6.17
Very Remote Small Towns – Island	0.417	0.415	6.89
Accessible Rural Areas	0.510	0.379	5.91
Remote Rural Areas	0.429	0.381	6.52
Very Remote Rural Areas – Mainland	0.406	0.387	6.57
Very Remote Rural Areas – Island	0.382	0.374	7.13

[1] Weighted by elective episodes. [2] Weighted by number of episodes. [3] Weighted by number of admissions.

9.4.2 Urban-rural differences in case complexity

There may also be systematic differences in case complexity between urban and rural populations. Table 9.15 shows differences in three measures of case mix. The average age of patients tends to be higher in more remote areas, particularly remote rural areas. A similar pattern arises for the average costs expected per episode on the basis of the national tariff. Whereas average costs per episode would be expected to be £2,077 in Primary Cities, this rises to £2,277 in Remote Rural Areas. Expected average costs, however, tend to be lower on island locations compared to mainland locations in the same urban-rural category. We have also included the HRG-based measure of case complexity. The HRG case-mix measure was not matched to approximately 18% of episodes and the percentage of matches is lower in Primary Cities.

Table 9.15 Average case complexity by category of residence

Category	Mean age (years)[1]	Mean tariff costs[1]	Mean HRG complexity index[2]	Episodes with missing complexity[1]
Primary Cities	54.5	2,077	1.222	16.7%
Urban settlements	53.5	2,090	1.221	18.1%
Accessible Small Towns	54.2	2,140	1.242	17.9%
Remote Small Towns	57.4	2,184	1.293	18.7%
Very Remote Small Towns – Mainland	54.2	2,020	1.238	18.2%
Very Remote Small Towns – Island	54.7	2,008	1.176	17.6%
Accessible Rural Areas	53.8	2,151	1.234	17.5%
Remote Rural Areas	56.7	2,277	1.315	18.7%
Very Remote Rural Areas – Mainland	57.9	2,186	1.279	17.3%
Very Remote Rural Areas – Island	57.2	2,122	1.218	17.9%

[1] Weighted by number of episodes. [2] Weighted by number of episodes with HRG complexity information.

9.4.3 Urban-rural differences in types of hospital used

Table 9.16 shows the differences between urban-rural areas in the proportions of their acute activity that flows through different types of hospitals. As expected, people living in Primary Cities receive much of their care at Teaching hospitals, and much more than for people in other categories. Populations in urban settlements and accessible areas have similar profiles of hospitals used. Remoter populations make more use of smaller general hospitals and community hospitals.

Table 9.16 Hospital type by category of residence

Category	Teaching	Large General	General	Community	Other
Primary Cities	53%	39%	0%	0%	8%
Urban settlements	17%	73%	5%	1%	4%
Accessible Small Towns	27%	61%	3%	3%	6%
Remote Small Towns	28%	44%	3%	19%	6%
Very Remote Small Towns – Mainland	8%	21%	65%	3%	2%
Very Remote Small Towns – Island	15%	12%	65%	6%	3%
Accessible Rural Areas	29%	58%	5%	3%	5%
Remote Rural Areas	28%	51%	6%	10%	5%
Very Remote Rural Areas – Mainland	11%	40%	30%	14%	6%
Very Remote Rural Areas – Island	20%	16%	58%	4%	2%

9.4.4 Urban-rural differences in characteristics of hospital provision

Average occupancy rate and numbers of staffed beds at the services used by residents of different areas are shown in Table 9.17. The average occupancy rate is slightly higher in Primary Cities but in general there are minor differences between categories. Occupancy rates are lowest in mainland very remote areas. The average numbers of staffed beds in the facilities used by residents of Primary Cities are larger than all other groups. The size of facilities tends to decline with increasing rurality and remoteness.

Table 9.17 Occupancy rate and average staffed beds by category of residence

Category	Occupancy rate (%)	Average number of staffed beds
Primary Cities	77.55	46.9
Urban settlements	76.51	40.7
Accessible Small Towns	76.88	40.6
Remote Small Towns	76.23	37.5
Very Remote Small Towns – Mainland	74.48	37.5
Very Remote Small Towns – Island	76.12	35.4
Accessible Rural Areas	76.41	39.3
Remote Rural Areas	76.20	36.3
Very Remote Rural Areas – Mainland	73.89	35.2
Very Remote Rural Areas – Island	76.41	38.0

9.4.5 Urban-rural differences in costs

Table 9.18 shows how the ratio of local to national costs varies across categories. Only the two island location groups have higher cost ratios than Primary Cities. We tested the statistical significance of these differences using weighted least squares regression. All categories have significantly different ratios to the reference category, Primary Cities. The proportion of records that have been successfully costed is above 97% in all categories.

Table 9.18 Cost ratios by category of residence

Category	Cost ratio	Percentage of records costed
Primary Cities	101.38	98.0%
Urban settlements	98.96***	98.6%
Accessible Small Towns	98.68***	98.1%
Remote Small Towns	98.64***	98.4%
Very Remote Small Towns – Mainland	99.31*	98.9%
Very Remote Small Towns – Island	104.31*	98.7%
Accessible Rural Areas	98.23***	98.1%
Remote Rural Areas	97.85***	97.7%
Very Remote Rural Areas – Mainland	98.26***	98.9%
Very Remote Rural Areas – Island	109.72***	98.2%

Primary cities is the reference group * $p<0.05$; ** $p<0.01$; *** $p<0.001$

9.4.6 Explaining the lack of variation in costs

Our analysis of the excess costs of acute care shows little difference between costs in urban areas and remote or rural areas. This result is surprising and at odds with the results found by the previous review at Board level.

NHS Highland provided us with the tariff that they use locally to evaluate cost variations across providers and areas. We applied our method to these estimates of unit costs for acute hospital episodes and outpatient services. The results were very similar to those reported here using national cost figures and suggest no significant increase in unit costs in more rural and remote mainland areas.

To further understand these findings, this section provides a decomposition of the differences in costs across urban-rural categories and clarifies why we have found these results.

Activity in acute hospitals is costed to reflect differences in specialty-mix, the inpatient to daycase ratio, and lengths of stay for inpatient episodes. This method is applied to the activity data to generate the actual costs for each geographical area in the additional needs work. In our work, we have taken these estimates as the denominator in the calculation of our ratio of local to national average costs. For our numerator we apply the same methodology but use local estimates of costs for the hospitals at which the activity is located.

In the original work, the ratio of actual to expected costs generated at Board level for the estimation of the remoteness adjustment did not distinguish costs by speciality-mix, inpatient to daycase ratio or length of stay. It was the ratio of actual costs to the costs that would have been expected if all cases had been treated at national average costs per case.

The next section provides a formal definition of the cost variables that we can generate under different assumptions. We have applied these equations to the data used in our acute cost adjustment and the results are contained in the proceeding section.

9.4.6.1 Formal definitions of cost variables

In this section we reiterate the expressions for the variables we use in the costing exercise. We have the following variables:

c_F	'Fixed' costs per inpatient episode
c_V	'Variable' costs per inpatient day
c_D	Costs per daycase
p_I	Proportion of cases that are treated as inpatients
p_D	Proportion of cases that are treated as daycases (=1-p_I)
v_I	Average length of stay for inpatient episodes

Each of these variables is specific to the local area but can be obtained as a national average. We denote the local values by *l* and the national values by *n*.

Each of these variables is also specific to the specialty in which it occurs. We use specialty-specific values throughout and therefore omit the specialty identifier to avoid notational clutter.

The basic expression for cost per case is:

$$C = p_I(c_F + c_V.v_I) + p_D c_D$$

The cost of an inpatient episode is given by the fixed costs plus the variable costs multiplied by the average length of stay. The cost of a daycase is simply the daycase cost. The average cost per case is a weighted average of these two values, given by the proportions that are inpatients or daycases.

The most area-specific cost variable uses local values of all of the parameters.

$$C^l = p_I^l(c_F^l + c_V^l.v_I^l) + p_D^l c_D^l$$

The national version of this uses national unit-costs and patterns of care:

$$C^n = p_I^n(c_F^n + c_V^n.v_I^n) + p_D^n c_D^n$$

We can also define a variable that uses local patterns of care and national unit-costs. This is the expected costs of activity for the area at national unit-costs:

$$C^e = p_I^l(c_F^n + c_V^n.v_I^l) + p_D^l c_D^n$$

The ratio of C^l to C^e is the pure cost effect evaluated at local patterns of care:

$$\frac{C^l}{C^e} = \frac{p_I^l(c_F^l + c_V^l.v_I^l) + p_D^l c_D^l}{p_I^l(c_F^n + c_V^n.v_I^l) + p_D^l c_D^n}$$

The ratio of C^e to C^n is the cost effect of variations in local from national patterns of care evaluated at national unit-costs:

$$\frac{C^e}{C^n} = \frac{p_I^l(c_F^n + c_V^n.v_I^l) + p_D^l c_D^n}{p_I^n(c_F^n + c_V^n.v_I^n) + p_D^n c_D^n}$$

This ratio reflects two aspects of patterns of care – the inpatient:daycase ratio and length of stay. A further disaggregation evaluates the differences at national unit-costs but fixes one of the elements of patterns of care. We can, for example, evaluate expected costs when length of stay is allowed to vary but the inpatient:daycase ratio is fixed at the national average.

$$C^{\bar{p}} = p_I^n(c_F^n + c_V^n.v_I^l) + p_D^n c_D^n$$

Then the ratio of C^e to $C^{\bar{p}}$ reveals the effect of the variation in the inpatient:daycase ratio, and the ratio of $C^{\bar{p}}$ to C^n reveals the effect of varying the length of stay only.

Finally, the full cost effect is given by the product of three ratios:

$$\frac{C^l}{C^n} = \frac{C^l}{C^e}.\frac{C^e}{C^{\bar{p}}}.\frac{C^{\bar{p}}}{C^n}$$

Although national values of all of the parameters are used to calculate C^n, it will still vary across areas. Each of the parameters varies across specialties and areas may make different relative use of different specialties. Deviations in C^n therefore reflect the cost effects of differences in specialty-mix across areas evaluated at national unit-costs.

9.4.6.2 Results

We have calculated each of the cost variables described in the previous section for each of the urban-rural categories for the acute hospital care programme. The results are provided in Table 9.19.

The most local cost ratio (C^l) has a value of 1.271 in the most remote and rural category. This indicates that costs per case are 27.1% higher than the national average in this category. The most national version of the cost ratio (C^n) equals 1.109 in this area. This indicates that the national unit-costs in this category are 10.9% higher than the national average. Therefore differences in specialty-mix account for a 10.9% higher average cost per case in the most remote and rural category. Further inspection of the specialty-specific data shows that this effect is primarily generated by a single specialty – GP excluding Obstetrics. Fifteen percent of acute hospital episodes are within this specialty in island very remote rural areas compared to only 1.8% across Scotland as a whole. Since this specialty has national unit-costs that are almost double the average cost per case (£3,000 versus £1,600), greater reliance on this specialty in remote areas exerts a considerable impact on costs.

The ratio that controls only for specialty mix is provided in the row (C^l/C^n). This shows that costs per case are 14.6% higher in the most remote and rural category. Part of this is caused by longer length of stay and part by a lower daycase proportion. The ratio (C^p/C^n) shows the contribution of longer lengths of stay. The ratio (C^e/C^p) shows the contribution of the lower daycase proportion. The latter is much more important.

The residual ratio (C^l/C^e) is the element that we have calculated as unavoidable excess costs of supply. The element (C^e) is reflected in the numerator of the additional needs work. This analysis shows that the activity data modelled in the additional needs work attracts a 15.8% higher cost per case in the most remote and rural category because of its specialty-mix, daycase proportion and length of stay.

Across the rural categories we see that most of the higher resource use of rural areas in this care programme is reflected in the needs element of the formula.

Table 9.19 Different definitions of acute hospital cost ratios by category of residence

Cost ratio	Primary Cities	Urban Settlements	Accessible Small Towns	Remote Small Towns	Very Remote Small Towns - Mainland	Very Remote Small Towns - Island	Accessible Rural Areas	Remote Rural Areas	Very Remote Rural Areas - Mainland	Very Remote Rural Areas - Island
Local care patterns, local costs (C^l)	1.024	0.950	0.992	1.073	1.047	1.172	0.971	1.068	1.064	1.271
Local care patterns, national costs (C^e)	1.010	0.960	1.005	1.087	1.054	1.124	0.989	1.091	1.083	1.158
National daycase proportion, national costs (C^p)	1.004	0.974	1.007	1.061	1.001	1.076	0.997	1.058	1.042	1.113
National care patterns, national costs (C^n)	0.991	0.985	1.000	1.123	1.049	1.066	1.005	1.071	1.087	1.109
C^l/C^e	1.014	0.990	0.987	0.986	0.993	1.043	0.982	0.979	0.983	1.097
C^e/C^p	1.007	0.986	0.998	1.025	1.053	1.044	0.992	1.032	1.039	1.040
C^p/C^n	1.013	0.989	1.007	0.945	0.954	1.010	0.992	0.988	0.959	1.004
C^l/C^n	1.034	0.964	0.992	0.955	0.998	1.100	0.966	0.997	0.979	1.146

9.5 Hospital maternity services

We analysed hospital records for all deliveries for the most recent three years for which complete data are available (2000/1 to 2002/3). Details of the datasets and linkage to cost data are provided in Appendix 4.

9.5.1 Urban-rural differences in case-complexity

Table 9.20 summarises the proportion of deliveries that result in live births and the proportion that are described as 'normal deliveries'. The proportion of live births is high in all categories and none of the differences are statistically significant. The proportion of normal deliveries is significantly higher in remoter areas.

Table 9.20 Live births and normal deliveries by category of residence

Category	Proportion of live births	Proportion of normal deliveries
Primary Cities	0.993	0.606
Urban settlements	0.993	0.613
Accessible Small Towns	0.994	0.618*
Remote Small Towns	0.991	0.657***
Very Remote Small Towns – Mainland	0.993	0.642*
Very Remote Small Towns – Island	0.989	0.668**
Accessible Rural Areas	0.994	0.613
Remote Rural Areas	0.992	0.633**
Very Remote Rural Areas – Mainland	0.993	0.648**
Very Remote Rural Areas – Island	0.995	0.664***

Significantly different from Primary Cities *** $p<0.001$ ** $p<0.01$ * $p<0.05$

9.5.2 Urban-rural differences in characteristics of hospital provision

Table 9.21 shows the average characteristics of the facilities used by residents of different categories of remoteness and rurality. The occupancy rate is highest in Primary Cities and falls to below 50% in very remote locations. There is an almost two-fold difference in the number of staffed beds at the facilities used by residents of Primary Cities and island Very Remote Rural Areas.

Table 9.21 Occupancy rate and average staffed beds by category of residence

SEURC	Occupancy rate (%)	Average number of staffed beds
Primary Cities	66.80	67.60
Urban settlements	56.01	54.51
Accessible Small Towns	59.68	57.49
Remote Small Towns	56.64	53.53
Very Remote Small Towns – Mainland	44.00	30.43
Very Remote Small Towns – Island	40.22	26.78
Accessible Rural Areas	57.39	54.78
Remote Rural Areas	55.66	47.35
Very Remote Rural Areas – Mainland	49.73	39.22
Very Remote Rural Areas – Island	44.70	34.24

9.5.3 Urban-rural differences in costs

The differences in costs between urban and rural areas are summarised in Table 9.22. The percentage of records successfully linked to the cost data is above 97% in all categories. The costs are higher in Rural Areas and Remote categories. The ratio of local to national costs is also higher for residents of urban settlements. Table 9.21 showed that these populations attend hospitals with considerably lower occupancy rates and average numbers of beds.

Table 9.22 Differences in costs by category of residence

Category	Percentage of records costed	Ratio of local to national costs
Primary Cities	99.7%	94.75
Urban settlements	99.7%	101.17***
Accessible Small Towns	99.5%	98.90***
Remote Small Towns	99.0%	92.05
Very Remote Small Towns - Mainland	99.5%	132.70***
Very Remote Small Towns - Island	99.7%	153.97***
Accessible Rural Areas	99.3%	103.08***
Remote Rural Areas	98.3%	101.67***
Very Remote Rural Areas - Mainland	97.6%	109.58***
Very Remote Rural Areas - Island	99.5%	145.13***

Significantly different from Primary Cities *** p<0.001

9.6 Hospital mental health services

We modelled data for the three most recent financial years for which complete data are available (1998/9 to 2000/1). The file contains 115,664 records. Costs are provided for four specialties: Adolescent Psychiatry, Child Psychiatry, General Psychiatry, and Geriatric Psychiatry. Appendix 5 provides details of the matching of files.

9.6.1 Urban-rural differences in case-complexity

Mean values for four indicators of case-complexity are provided in Table 9.23. On average, patients from Primary Cities and Urban Settlements are approximately 5 years younger than patients from other categories. Patients from Primary Cities have longer average lengths of stay than patients in Urban Settlements and Small Towns with the exception of island residents. Island residents have the highest average lengths of stay.

There are three broad classes of discharge from long-stay specialties: regular discharge; irregular discharge; and dead on discharge. The proportion of patients that have an irregular discharge is highest in Primary Cities and tends to decline with increasing remoteness and rurality. There are substantial differences across categories in the percentage of patients that are dead on discharge but no consistent pattern across urban-rural categories.

Table 9.23 Patient characteristics by category of residence

Category	Mean age (years)	Mean length of stay (days)	Irregular discharge (%)	Discharged dead (%)
Primary Cities	50.6	72.0	4.6	6.9
Urban settlements	50.4	65.0	3.6	6.5
Accessible Small Towns	55.2	66.2	3.3	7.8
Remote Small Towns	54.4	62.5	3.0	8.9
Very Remote Small Towns - Mainland	48.4	54.0	2.3	5.9
Very Remote Small Towns - Island	55.5	91.7	0.8	5.6
Accessible Rural Areas	56.4	86.0	2.7	10.4
Remote Rural Areas	57.6	59.8	2.2	8.4
Very Remote Rural Areas - Mainland	58.6	77.0	1.1	11.3
Very Remote Rural Areas - Island	55.4	94.8	1.7	6.6

9.6.2 Urban-rural differences in characteristics of hospital provision

Table 9.24 shows average values of facility characteristics for each of the urban-rural categories. The occupancy rate is highest in the facilities used by Primary City residents but shows little trend across the other categories. Similarly, Primary City residents use facilities that are substantially larger than other categories but there is little trend across these other categories.

Table 9.24 Occupancy rate and average staffed beds by category of residence

Category	Occupancy rate (%)	Average number of staffed beds
Primary Cities	87.1	178
Urban settlements	83.1	81
Accessible Small Towns	80.7	98
Remote Small Towns	77.5	102
Very Remote Small Towns - Mainland	81.0	92
Very Remote Small Towns - Island	83.4	112
Accessible Rural Areas	81.6	102
Remote Rural Areas	80.6	91
Very Remote Rural Areas - Mainland	84.0	80
Very Remote Rural Areas - Island	83.0	93

9.6.3 Urban-rural differences in costs

The differences in the ratios of local to national average costs are summarised in Table 9.25. More than 90% of records have been costed in all categories. The costs are lowest in Primary Cities and increase with increasing remoteness and rurality. All categories are significantly different from Primary Cities.

Table 9.25 Cost ratios by category of residence

Category	Percentage costed	Ratio of local to national costs
Primary Cities	95.5%	95.40
Urban settlements	95.7%	99.73***
Accessible Small Towns	93.7%	104.74***
Remote Small Towns	98.8%	110.24***
Very Remote Small Towns - Mainland	99.5%	113.45***
Very Remote Small Towns - Island	100.0%	150.23***
Accessible Rural Areas	95.3%	101.91***
Remote Rural Areas	95.3%	113.95***
Very Remote Rural Areas - Mainland	98.1%	109.56***
Very Remote Rural Areas - Island	99.5%	144.36***

*** significantly different from primary cities ($p<0.001$)

9.7 Hospital geriatric continuing care

We modelled data for the most recent three financial years for which complete data are available (1998/9 to 2000/1). Details of the matching of the activity data to the cost data are provided in Appendix 6.

9.7.1 Urban-rural differences in case-complexity

The characteristics of patient records from different urban-rural categories are summarised in Table 9.26. There is little difference in the average age of patients across categories. Patients from islands have considerably higher average lengths of stay than the other categories. Patients from Very Remote Small Towns are the most likely to be dead on discharge, followed by patients from Primary Cities.

Table 9.26 Patient characteristics by category of residence

Category	Mean age (years)	Mean length of stay (days)	Discharged dead (%)
Primary Cities	81.8	143.9	41.4
Urban settlements	80.7	118.9	35.8
Accessible Small Towns	80.2	110.2	31.4
Remote Small Towns	79.0	79.9	28.6
Very Remote Small Towns - Mainland	76.6	152.9	53.4
Very Remote Small Towns - Island	80.3	184.8	49.5
Accessible Rural Areas	80.9	103.0	30.8
Remote Rural Areas	80.9	79.9	25.2
Very Remote Rural Areas - Mainland	76.4	80.4	30.2
Very Remote Rural Areas - Island	81.5	194.9	31.0

9.7.2 Urban-rural differences in characteristics of hospital provision

Table 9.27 summarises the characteristics of the facilities used by residents of different urban-rural categories. Patients from Primary Cities and Urban Settlements use facilities with the highest occupancy rates and highest average numbers of beds.

Table 9.27 Occupancy rate and average staffed beds by category of residence

Category	Occupancy rate (%)	Average number of staffed beds
Primary Cities	87.5	75.4
Urban settlements	89.1	53.2
Accessible Small Towns	82.2	45.3
Remote Small Towns	65.2	30.2
Very Remote Small Towns - Mainland	82.8	24.6
Very Remote Small Towns - Island	87.1	25.4
Accessible Rural Areas	79.8	40.6
Remote Rural Areas	72.0	20.2
Very Remote Rural Areas - Mainland	73.5	19.3
Very Remote Rural Areas - Island	80.8	24.1

9.7.3 Urban-rural differences in costs

Table 9.28 provides figures on the differences in costs between urban-rural categories. In most categories the proportion of activity records that have been costed is above 90%. The exception is Primary Cities. Appendix 6 reveals that this is because many providers managed by NHS Greater Glasgow did not return cost data in the Blue Book. Since Chapter 6 showed that NHS Greater Glasgow had typical input prices for Primary Cities, we do not expect this to bias the results.

The ratio of local to national costs is lowest in Urban Settlements and is also below the national average in Primary Cities. Costs tend to increase with increasing remoteness and rurality.

Table 9.28 Cost differences by category of residence

Category	Ratio of local to national costs	Percentage costed
Primary Cities	96.0	72.1%
Urban settlements	92.5*	93.3%
Accessible Small Towns	109.0***	94.9%
Remote Small Towns	139.6***	100.0%
Very Remote Small Towns - Mainland	127.4***	100.0%
Very Remote Small Towns - Island	117.6**	100.0%
Accessible Rural Areas	102.5**	98.5%
Remote Rural Areas	136.7***	99.9%
Very Remote Rural Areas - Mainland	141.6***	100.0%
Very Remote Rural Areas - Island	125.4***	100.0%

9.8 Hospital services for people with learning disabilities

We modelled data for three financial years: 1998/9, 1999/2000 and 2000/1. Details of the matching of the activity data to the cost data are provided in Appendix 7.

9.8.1 Urban-rural differences in case-complexity

Table 9.29 summarises the characteristics of patients and their care episodes in different urban-rural categories. Island residents and patients from Very Remote Rural Areas tend to be older than patients from other categories. The trend in average length of stay tends to follow the trend in average age. The categories with older patients on average also have higher proportions of patients that are dead on discharge.

Table 9.29 Patient characteristics by category of residence

Category	Mean age (years)	Mean length of stay (days)	Discharged dead (%)
Primary Cities	35.3	158	3.5%
Urban settlements	31.0	105	2.1%
Accessible Small Towns	27.6	74	1.0%
Remote Small Towns	40.3	200	3.3%
Very Remote Small Towns - Mainland	33.9	146	1.8%
Very Remote Small Towns - Island	45.9	271	7.7%
Accessible Rural Areas	30.4	121	2.2%
Remote Rural Areas	28.3	110	3.1%
Very Remote Rural Areas - Mainland	42.9	131	5.7%
Very Remote Rural Areas - Island	42.2	209	7.9%

9.8.2 Urban-rural differences in characteristics of hospital provision

Table 9.30 shows the average characteristics of the facilities used by residents of different categories of remoteness and rurality. Patients from the most remote areas tend to use facilities with higher rates of occupancy. The size of facilities used by patients from remote and rural areas tends to be smaller but patients from two of the most remote categories receive treatment at large providers.

Table 9.30 Occupancy rate and average staffed beds by category of residence

Category	**Occupancy rate (%)**	**Average number of staffed beds**
Primary Cities	79.4	157
Urban settlements	78.0	147
Accessible Small Towns	75.8	108
Remote Small Towns	85.2	125
Very Remote Small Towns - Mainland	80.9	125
Very Remote Small Towns – Island	89.2	214
Accessible Rural Areas	76.8	101
Remote Rural Areas	75.2	56
Very Remote Rural Areas - Mainland	83.2	150
Very Remote Rural Areas – Island	83.9	122

9.8.3 Urban-rural differences in costs

The rather inconsistent trends observed in case-mix and facility characteristics are replicated in the ratios of local to national average costs (Table 9.31). Only 3 categories have cost ratios that are significantly different from Primary Cities and these are not the mot remote and rural categories.

Table 9.31 Cost differences by category of residence

Category	Ratio of local to national costs	Percentage costed
Primary Cities	95.6	95.3%
Urban settlements	103.9***	98.2%
Accessible Small Towns	102.5**	96.1%
Remote Small Towns	99.1	98.4%
Very Remote Small Towns - Mainland	104.7	100.0%
Very Remote Small Towns - Island	95.2	100.0%
Accessible Rural Areas	104.0***	97.2%
Remote Rural Areas	99.9	98.6%
Very Remote Rural Areas - Mainland	97.4	100.0%
Very Remote Rural Areas - Island	95.5	100.0%

Significantly different from primary cities *** $p<0.001$ ** $p<0.01$

9.9 Outpatient services

We modelled data for all outpatient specialties on the SMR00 for three financial years: 2002/3, 2003/4 and 2004/5. Details of the matching of the activity data to the cost data are provided in Appendix 8.

9.9.1 Urban-rural differences in case-complexity

Indicators of the complexity of patients requiring outpatient attendances from different urban-rural categories are summarised in Table 9.32. Patients from more remote and more rural categories tend to be older on average. Patients from more urban areas are more likely to be recorded as unable to attend their appointment. Patients from other categories are more likely to be recorded as having been unable to wait for treatment but, overall, the likelihood of a successful planned attendance is higher in more rural and remote areas.

Table 9.32 Differences in case-complexity by category of residence

Category	Mean age (years)	Patient not able to attend	Patient could not wait for treatment
Primary Cities	44.3	14.1%	5.6%
Urban settlements	44.4	11.0%	8.5%
Accessible Small Towns	44.8	9.9%	5.5%
Remote Small Towns	47.5	9.0%	8.2%
Very Remote Small Towns - Mainland	44.7	8.7%	4.4%
Very Remote Small Towns - Island	45.8	8.6%	6.4%
Accessible Rural Areas	45.1	8.3%	6.5%
Remote Rural Areas	47.7	7.0%	4.9%
Very Remote Rural Areas - Mainland	48.5	6.5%	6.3%
Very Remote Rural Areas - Island	47.7	6.6%	9.0%

9.9.2 Urban-rural differences in costs

Table 9.33 provides the ratios of local to national average costs for each of the patient categories. The percentage of records to which costs can be applied is generally lower in this care programme but there is no clear pattern across categories that might bias the results. Based on the costed activity, we find that costs are significantly higher for residents of islands. For the other categories, costs are generally significantly lower than the Primary Cities category, the costs for which are 3.2% above the national average.

Table 9.33 Cost differences by category of residence

Category	Ratio of local to national costs	Percentage costed
Primary Cities	103.2	88.6%
Urban settlements	98.9***	90.5%
Accessible Small Towns	95.4***	89.0%
Remote Small Towns	91.5***	79.6%
Very Remote Small Towns - Mainland	101.4	87.8%
Very Remote Small Towns - Island	113.6***	96.7%
Accessible Rural Areas	96.0***	88.7%
Remote Rural Areas	90.6***	83.5%
Very Remote Rural Areas - Mainland	93.9***	93.6%
Very Remote Rural Areas - Island	116.5***	92.9%

*** significantly different from Primary Cities ($p<0.001$)

9.10 Implications for the resource allocation formula

The adjustment for hospital services is based on analysis of variations in the unit costs of facilities used by residents from different areas. At the start of this chapter we demonstrated that cost data by specialty and hospital are available as a source of information on how local costs depart from national average costs.

The existing adjustment for hospital services is based on analysis of Board-level data that has not been updated since the original work was undertaken. We provided analyses of these data for a seven-year period and updated the original analysis for acute hospital services. We highlighted the sensitivity of the results to the cost data returned by individual Boards and concluded that an adjustment based on these data would not be robust.

It is possible to refine the hospital services adjustment using data at a less aggregate level. We proposed an alternative method that allows us to obtain estimates of the costs of service delivery for each datazone in Scotland. We examined how indicators of case-complexity, and the characteristics of facilities used, varied depending on the urban-rural category of patients' areas of residence. We then provided ratios of local to national average costs for each of six hospital care programmes: acute; maternity; mental health; geriatric continuing care; people with learning disabilities and outpatient services. We have not included Accident & Emergency or Daypatient services because no national patient activity datasets are available.

Table 9.34 reproduces the ratios of local to national costs that our analysis has produced. Costs for maternity, mental health and geriatric continuing care are clearly higher than the national average for residents in more rural and remote categories. For island residents, there is also clear evidence of higher costs for acute and outpatient services.

The bottom row of Table 9.34 shows the percentage of national hospital expenditure for each of the care programmes. In the final column of the table we provide a summary measure of the cost ratios using these expenditure weights to combine the six care programmes. Overall, the costs of providing hospital services to island residents are found to be approximately 15% higher than the national average. There is little difference in costs between the other categories.

Table 9.34 Ratios of local to national costs by hospital care programme

Category of residence	Acute	Maternity	Mental health	Geriatric continuing care	People with learning disabilities	Outpatients	Total
Primary Cities	101.38	94.75	95.40	96.0	95.6	103.2	100.30
Urban settlements	98.96	101.17	99.73	92.5	103.9	98.9	99.00
Accessible Small Towns	98.68	98.90	104.74	109.0	102.5	95.4	99.31
Remote Small Towns	98.64	92.05	110.24	139.6	99.1	91.5	100.02
Very Remote Small Towns – Mainland	99.31	132.70	113.45	127.4	104.7	101.4	104.46
Very Remote Small Towns – Island	104.31	153.97	150.23	117.6	95.2	113.6	114.83
Accessible Rural Areas	98.23	103.08	101.91	102.5	104.0	96.0	98.80
Remote Rural Areas	97.85	101.67	113.95	136.7	99.9	90.6	100.27
Very Remote Rural Areas – Mainland	98.26	109.58	109.56	141.6	97.4	93.9	101.15
Very Remote Rural Areas – Island	109.72	145.13	144.36	125.4	95.5	116.5	117.59
Share of total expenditure	57.3%	5.3%	12.6%	4.0%	1.8%	19.0%	100.0%

10 IMPLICATIONS FOR THE RESOURCE ALLOCATION FORMULA

In the preceding chapters we have described our approach to reviewing the excess cost adjustments in the national resource allocation formula and summarised the results we have obtained from a wide range of empirical analysis. At the end of each of the three empirical chapters (Chapters 6, 8 and 9), we have summarised the implications of the analyses for the resource allocation formula. In this chapter we consider the overarching issues.

We begin by considering whether there are alternative approaches to a weighted capitation formula for dealing with the infrastructure costs associated with the supply of healthcare services. The next section then considers whether and how the adjustments for input prices and remoteness can be combined without double counting these effects.

In the final two sections of this chapter we turn our considerations to the future. First, we consider how expected policy changes may impact on the need for excess cost adjustments and second, in the light of this, we make recommendations on the frequency with which these adjustments should be updated.

10.1 Treatment of infrastructure costs in the resource allocation formula

The responses from NHS Boards described in section 4.4 suggest concerns with the implicit assumption in the current weighted capitation formula approach that Boards can vary their costs directly in line with changes in their (needs-weighted) population. It has been argued that, in practice, this may not be possible because of fixed 'infrastructure' costs. This suggests that some consideration needs to be given to the treatment of these fixed costs in an allocation formula.

10.1.1 Arbuthnott Formula

Under the current formula, the target share of resources, *S*, allocated to the ith Board is determined by the population share weighted by a number of adjustments.

$$S_i = P_i * A_i * M_i * C_i$$

where

P = population share;
A = adjustment for age/sex structure of the population;
M = adjustment for morbidity and life circumstances;
C = adjustment for remoteness.

The first point to note is that the formula links the *share* of resources to the *share* of population; it does not directly link the level of funding to the size of the population. Depending on what is happening to the overall size of the population and the total level of NHS expenditure, the link between changes in a Board's population size and the change in the level of funds allocated to it could be quite weak. For example, if a Board's population is falling at the same rate as the total Scottish population, there will be no change in its share of resources – provided that the other determinants in allocation formula remain unchanged. Even if its population is falling relative to the Scottish population, it may still receive an increase in resources if the overall NHS budget is rising rapidly.

In practice, however, since the Scottish population is broadly stable it might be expected that a Board that experiences a decline in the size of its resident population will also see a decline in its target *share of resources* as determined by the allocation formula. How this translates into a change in the *level of resources* available to it will then be influenced by a number of factors.

The rate of growth in the overall NHS budget to be allocated through the formula relative to the rate of decline in a Board's population share
Where a Board's population is falling, its level of funding will still increase if the rate of growth in the overall NHS budget is at least equal to the rate of decline in population share.[33] Annual changes in NHS Boards' population shares in recent years have generally been less than 1% (up or down). The largest reduction seems to have occurred in Western Isles where the population share fell by 3.6% between 1999 and 2004. Given the slow rate at which population shares have fallen in practice, fairly modest increases in overall NHS funding offset the effect of a declining population share on a Board's funding level.

The method of determining the movement towards parity
Parity is the target share of resources for each Board determined through the weighted capitation formula. It has long been accepted in practice that it is difficult to implement progress towards parity by actually reducing a Board's level of funding. Under the previous SHARE formula, there were few occasions when a Board's funding was reduced – though after allowing for health service inflation there may have been reductions in volume terms.

Since the Arbuthnott formula was introduced in 2001, all Boards have received significant increases in funding. Slightly higher increases have been given to Boards whose actual shares are below their target shares. This differential growth has provided the mechanism through which progress towards parity has been achieved.

In circumstances where the overall NHS budget is growing rapidly, it is possible to provide all Boards with a significant minimum uplift in their allocations while also maintaining some progress towards parity targets. However, in periods when the overall growth in NHS funding is limited, it becomes much more difficult to combine progress towards parity with a guarantee that all Boards will receive some minimum increase in funding.

The effect of the remoteness adjustment
The current formula includes an adjustment for remoteness that may offset, to some extent, the effect of a decline in population. For example, where the remoteness adjustment is based

[33] The minimum rate of growth in the total budget (R_m) that is necessary to ensure that a Board's level of funding is maintained is given by:

$$R_m = \left[\left(\frac{P_t}{P_{t+1}} \right) - 1 \right] * 100$$

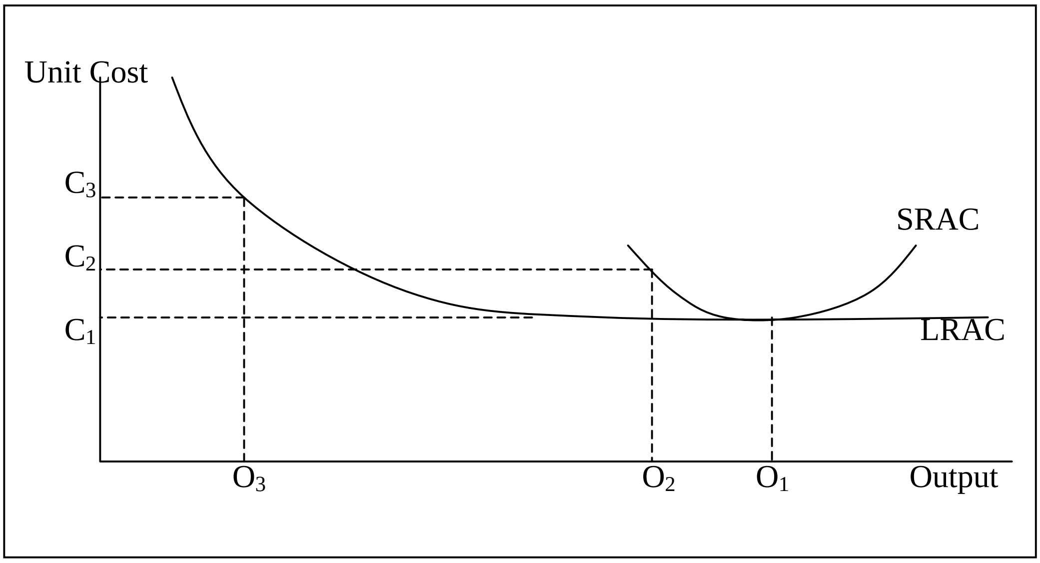
where P_t and P_{t+1} are a Board's population shares in year t and $t+1$. This would only maintain a Board's level of funding in cash terms. Obviously to maintain funding in volume terms, the NHS budget needs to grow by the rate of inflation in NHS costs *plus* the rate R_m.

on a population measure such as population density or road kilometres per 1,000 population, a Board with a declining population may gain additional funding as its remoteness index increases. Clearly the extent to which it gains some additional funding to offset the direct effect of population decline will depend on the specific form of the remoteness adjustment. Also, a remoteness adjustment based on a population measure will not offset the effect of a decline in the weighted population share that comes about as a result of changes in the age/sex adjustment or in the adjustment for morbidity and life circumstances.

10.1.2 Relationship between health service output and costs

The traditional assumptions about the relationship between health service output and costs in the short and longer term are illustrated in Figure 10.1. It is generally assumed that the long-run average cost curve (LRAC) provides economies of scale at relatively low levels of output but, beyond a certain level, there are constant returns to scale. The effects of short-run variations in output with capacity fixed are shown by the short-run average cost curve (SRAC).

Figure 10.1 Short Run and Long Run Average Costs



These assumptions suggest that there are two different ways of interpreting the argument that a Board has fixed infrastructure costs that cannot be varied directly in line with changes in population size and health output.

- First, where there are constant returns to scale a health service organisation may not be able to adjust all of its costs in the short term. When output falls from O_1 to O_2 the short run effect is to raise unit costs from C_1 to C_2. This rise is a temporary problem because capacity can be adjusted in the longer term and the unit cost will fall back from C_2 to C_1.

- Second, even in the long run, it may not be possible for a Board to reduce costs proportionately if there are economies of scale. A fall in output from O_2 to O_3 would lead to a proportionately smaller decline in total costs.

In principle, then, it could be argued that some allowance should be made in an allocation formula for the short-term transitional cost that Boards may face in adjusting its infrastructure to match a fall in output as a result of declining population. However, it is not at all clear that the cost curves look as those described and there are a number of practical difficulties to consider.

- First, the argument that infrastructure costs are fixed and cannot be adjusted in the short term could be applied to Boards experiencing an increase in population as well as a decrease. The short-run average cost curve in Figure 10.1 shows that both increases and decreases in population may cause a short-term rise in unit costs.

- The distinction between the ‘short-term’, when certain costs are fixed and cannot be adjusted to reflect changes in need as a result of population movements, and the ‘long-term’, when all costs including infrastructure costs are variable and can be adjusted, might be difficult to apply in practice. Much might depend on local circumstances – e.g. the scope for reorganising and rationalising services between different sites.

- A distinction is sometimes made between those costs which are judged to be ‘variable’ (e.g. supplies) and those that are regarded as ‘fixed’ (e.g. the costs of maintaining property and capital charges). However such distinctions are usually rather arbitrary and are not based on any empirical evidence about the extent to which different elements of cost are variable and the timescale over which different costs become variable.

- The argument that there are certain infrastructure costs that are unresponsive to changes in population movements – at least in the short term – is perhaps easier to apply when looking at a particular facility such as a hospital or a health centre. The cost curves shown in Figure 10.1 might be seen as typical of such specific service units. The argument becomes less clear when applied to a wider healthcare system. In the system as a whole there is likely to be much greater scope for reorganising and redistributing service across different sites, with surplus capacity being sold off to reduce infrastructure costs.

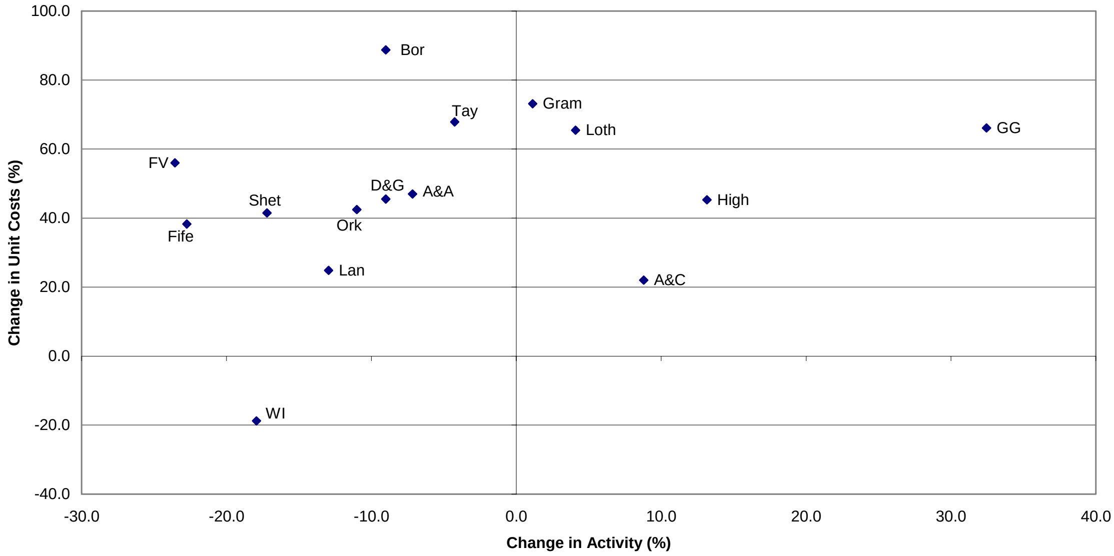
- While acknowledging that the scope for infrastructure adjustments may become greater when viewed in the context of a wider healthcare system, it might still be argued that such adjustments take time to plan and implement and are not costless to carry through. However, this line of argument tends to assume that all changes in population are unforeseen. In practice, when planning future levels of service and capacity, Boards take into account expected population movements. Clearly, actual population movements will differ to some extent from projected movements, but attempting to apply this distinction in an allocation formula would be impossible.

- A further concern about the view that infrastructure costs cannot be adjusted in response to population falls is the risk that it simply becomes an argument that is used to insulate Boards from the need to adapt to changing circumstances and which weakens their incentive to do so.

10.1.3 Evidence

Population and output changes over the last few years vary between Boards and we might consider looking for any evidence that Boards which are experiencing a relative decline in patient activity also face a relatively high increase in costs. This might provide evidence that Boards find it difficult to adjust capacity downwards when output falls. Figure 10.2 shows the changes in the average cost of treating acute inpatients and day cases and the change in this activity over the period 1999-00 to 2004-05.

Figure 2: Percentage Change in Acute Inpatient and Day Case Activity and Unit Costs by Health Board 1999-00 to 2004-05

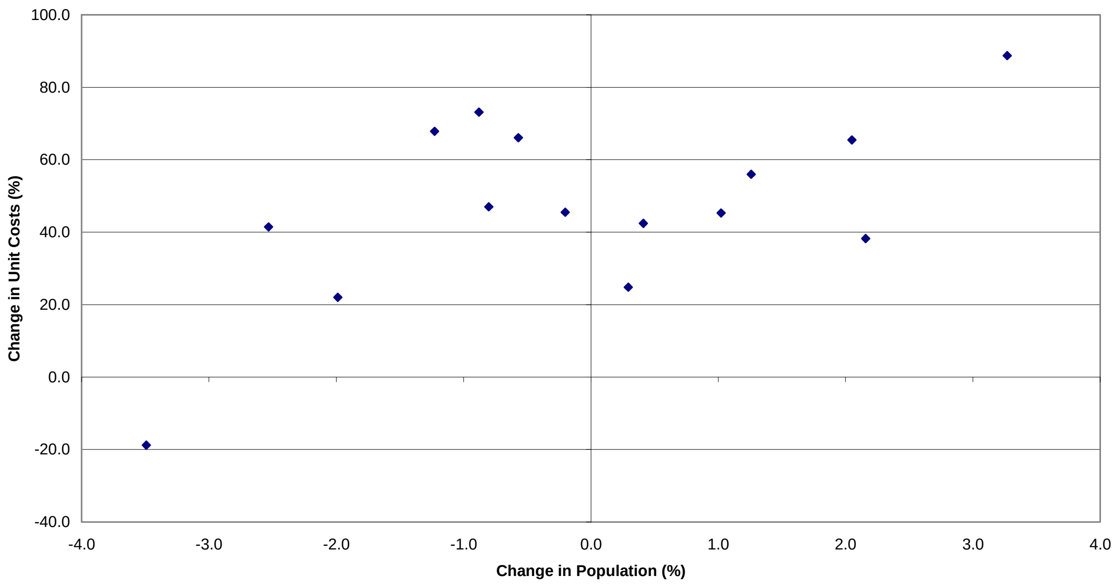


There is no evidence here to suggest that Boards that have experienced relatively large falls in acute activity (for whatever reason) have also experienced relatively large increases in unit costs because of the difficulties of adjusting their infrastructure costs. However, the data in Figure 10.2 need to be treated with caution. As we have already highlighted in Chapter 9, some of the changes in activity look odd – with the figures ranging from reductions of around 20-30% in Forth Valley and Fife to an increase of over 30% in Glasgow. Western Isles, despite experiencing a fall in activity of almost 20% managed to reduce its unit costs in *cash terms* by around 20%.

The changes in activity across Boards in Figure 10.2 are not correlated with the changes in population. Perhaps this is not entirely surprising given that the changes in population over this 5-year period are quite small, and that this particular effect may be outweighed by other changes related to medical advances, patterns of care, pressures to reduce waiting times, etc.

Figure 10.3 shows the change in total population over the period 1999-00 to 2004-05 in each Board and the associated change in the average unit costs of treating acute inpatients and day cases. As in Figure 10.2, there seems to be something wrong with the data for unit costs changes in the Western Isles. For the remaining Boards, perhaps there is some weak evidence here that the larger the change in population (up or down) the larger the increase in unit costs. However, the differences in the rates of change in unit costs between Boards are implausibly large when set against relatively small changes in population.

Figure 3: Percentage Changes in Acute Unit Costs and Changes in Population by Health Board 1999-00 to 2004-05



10.2 Combining adjustments for MFF and HCHS

The empirical chapters of this report have focused on different aspects that generate a requirement for an adjustment for excess costs of the supply of health care services. In Chapter 6 we provided evidence that there are geographic variations in input prices and that these influence the costs of service delivery. In Chapter 8 we demonstrated how the geographical dispersion of the population influences the production of community health services and derived a general model of the additional inputs required to deliver the required levels of activity in different areas. Finally, in Chapter 9 we showed how the unit costs of hospital service provision vary depending on the geographic nature of areas. This section considers how these adjustments can be combined for (a) community services and (b) hospital services.

10.2.1 Community services

Chapters 6 and 8 deal with distinct aspects of excess costs. The former considers the prices that must be paid for inputs and the latter considers the volume of inputs required. These two adjustments can both be applied to the community services budget without fear of double counting. Some areas may benefit from both adjustments, some areas may not benefit from either adjustment and other areas may benefit from one adjustment and not the other. This is appropriate since urban areas, for example, may face higher input prices but require less volume of inputs to deliver the required level of output.

10.2.2 Hospital services

In the case of hospital services there is some scope for double counting. Chapter 9 examined variations in unit costs and variations in input prices will partially account for these. To some extent, therefore, the results of Chapter 9 may reflect the findings of Chapter 6.

The extent to which this is the case reflects the extent to which the cost implications of higher input prices are reflected in the cost data that we have examined. We have seen in section 6.2.2 that there is little evidence of a response in NHS wages to higher private sector wages because of the nature of pay setting in the NHS. However this causes indirect costs, as evidenced by higher turnover and vacancy rates for some staff groups. These indirect costs may have financial implications if, for example, greater use is made of temporary staff or overtime paid at higher hourly rates. But other aspects of these indirect costs may not manifest in the financial data. We would expect to find, for example, lower quality of services in areas that struggle to recruit and retain staff and the current NHS cost data will not reflect this.

There are two extreme options that we do not recommend. First, it is possible to apply the input price adjustment only. This would assume that there are no unavoidable rurality-related differences in the production function for hospital services. Second, it is possible to apply the rurality-based unit cost adjustment only. This would assume that the variation in input prices is perfectly correlated with rurality and remoteness and the figures in section 6.1.4 demonstrated that this was not the case.

Further options are based on attempts to disentangle the input price adjustment from the rurality-related unit cost adjustment. There are two possible approaches to this:

(a) include the private sector SSWD as a determinant of variations in hospital costs
(b) remove the costs associated with input price variations from the cost data used to derive the rurality-based unit cost adjustment

The first approach, (a), would ensure that the unit cost adjustment reflected the consequences of rurality and variations in input prices for the financial data on costs collected by the NHS. It would, however, capture input price variation only to the extent that the costs are revealed in these data and we have argued that there are additional indirect costs.

The second approach, (b), would ensure that the rurality-based unit-cost adjustment did not reflect differences in input prices and would therefore capture only differences in the production function. To make this feasible would require common data on two of the three following variables: input prices; input volumes and total cost. For example, if we knew the pay bill costs and staff input for each specialty-hospital combination we could strip the costs of variations in input prices. We have seen earlier that the cost data available do not provide the required information.

Since these approaches are either undesirable or infeasible with current data we recommend a highly pragmatic approach. Table 10.1 below shows the combined rurality-based unit cost adjustment for hospital services alongside the average values of the private sector SSWDs for the hospital locations used by the residents of these areas. There is little consistency between the series except in that the Primary Cities have higher unit costs than Urban Settlements and higher labour input prices. This suggests that the rurality-based unit cost adjustment primarily reflects differences in the production function. But the higher unit costs in the Primary Cities category may reflect higher input prices for labour in three of the four cities in this category. It is only for this category that there may be double counting if the rurality and labour cost adjustments are both applied.

Table 10.1 Combined hospital cost adjustments and average private sector SSWDs by urban-rural category

Category	Combined hospital cost adjustment	Average private sector SSWD
Primary Cities	100.30	101.8
Urban settlements	99.00	99.0
Accessible Small Towns	99.31	98.7
Remote Small Towns	100.02	98.6
Very Remote Small Towns – Mainland	104.46	96.3
Very Remote Small Towns – Island	114.83	96.6
Accessible Rural Areas	98.80	99.3
Remote Rural Areas	100.27	98.5
Very Remote Rural Areas – Mainland	101.15	97.0
Very Remote Rural Areas – Island	117.59	97.1

There may be double counting if the other input price adjustments for land and buildings are applied alongside the rurality-based adjustment. Prior to their application we recommend that consideration is given to the extent that they may be reflected in the NHS cost figures.

10.2.3 Summary

The MFF and travel-time adjustments for community services capture different causes of excess costs and can both be applied without fear of double counting.

For hospital services there is potential for double counting. For staff costs this appears to only affect the Primary Cities. We therefore recommend application of the staff cost and rurality adjustments with Primary Cities set equal to Urban Settlements for the rurality-based unit cost adjustment.

10.3 The impact of expected policy changes

A limitation of any analysis that uses empirical data from the NHS is that it reflects historical patterns of care and associated costs. Therefore, it is important to consider the relevance of the findings against the likely consequences of planned policy changes. In this section we consider the possible consequences of the major strategic documents for the NHS in Scotland.

The key aims of the *Kerr Report* and *Delivering for Health* include:

- Improving care for people with chronic conditions at home or in the community, reducing the likelihood of admission to hospital;
- Targeting deprivation and inequalities;
- Supporting people's abilities to manage their own health needs;
- Concentrating specialised or complex care on fewer sites;
- Increased emphasis on ICT including telemedicine.

The development of services for people living in remote and rural areas will be affected by some of these general changes – which are relevant to all areas of Scotland.

10.3.1 Remote and rural areas

In addition, there will be some specific changes that will affect remote and rural areas. In particular:

- Changing roles for staff – e.g. the development of staff (both GPs and nursing staff) with more specialised skills as well as strengthening of their general role.

- The development of the role of the Community Hospital (71 in Scotland). The range of services that might be provided in future in these hospitals might include:

    - Pre-admission and routine testing
    - Outpatient and specialist clinics
    - Day surgery
    - Convalescence and rehabilitation

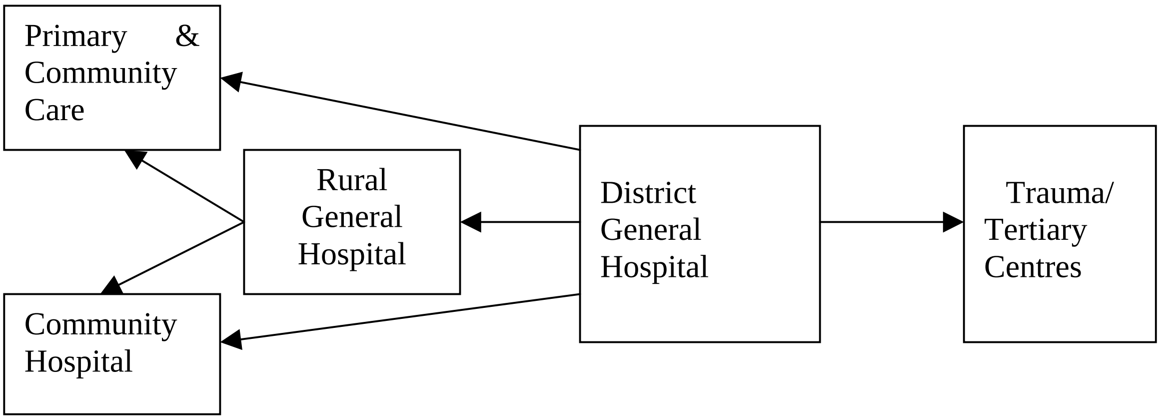
- The development of the role of the Rural General Hospital - currently around 7 RGHs in Scotland. A key difference between RGHs and Community Hospitals is that the former would provide a consultant-led service. Services provided in RGHs would include:

    - Emergency medical care
    - Planned work

The ability of Community Hospitals and Rural General Hospitals to undertake the relevant range of work would be strengthened through the use of tele-medicine, appropriate training of staff, the development of Managed Clinical Networks, etc.

10.3.2 Implications

The proposals in the *Kerr Report* and in *Delivering for Health* imply a number of possible shifts in patterns of activity as shown in the following diagram.



- A shift in specialised or complex activity away from the traditional DGH towards tertiary centres.
- A shift in emergency activity away from some DGHs towards more specialised trauma centres. Some DGHs would concentrate on planned work, but some would continue to provide a mixture of planned and emergency work.
- A shift in the care of people with chronic conditions (especially in the elderly) from DGHs towards primary and community care.
- Some shift of activity away from DGHs towards the Rural General Hospital, which could take on an increased range of services.
- Possibly some shift in activity from DGHs towards the Community Hospitals as well.
- Finally, there might also be some shift in activity from the Rural General Hospitals towards community hospitals and towards primary and community care. For example, where the RGHs are currently providing care for older people with chronic conditions, this activity would shift towards the community as it should more generally across Scotland.

The net effect of all of these changes on levels and patterns of activity might be:

- A reduction in the volume of services provided in the traditional DGHs, in particular there would be less emergency work provided in the DGHs and fewer admissions related to management of older people with chronic conditions.
- The pattern of work carried out in RGHs might change significantly – much less emphasis on the management of the elderly with chronic conditions and more emphasis on planned work related to diagnosis, relatively less complex acute treatment (day surgery and some inpatient work).
- Increased work in Community Hospitals related to minor surgery, diagnosis, rehabilitation.

10.4 Updating the formula

Although the other elements are updated annually, the existing remoteness adjustments in the Arbuthnott Formula have not been updated since the original work was undertaken.

There are two main components of any adjustment in a resource allocation formula – the 'factors' and the 'weights'. The factors are the local characteristics of populations and settings that are used to distinguish between areas. The weights are the estimates of how important each of the factors are in driving cost differences between areas. These estimates are derived from empirical analyses such as we have presented in this report.

10.4.1 Factors

The factors that underpin the adjustments presented in this report are:

Market Forces Factor

- Standardised Spatial Wage Differentials in the private sector labour market
- Relative tender prices for public sector building projects
- Values per hectare of NHS land

Remoteness adjustment – community services

- Proportions of population within settlements of particular sizes
- Travel times between settlements and areas outwith settlements

Remoteness adjustment – hospital services

- Proportions of population living in remote areas and on islands

The SSWDs that we used in our modelling used data from the Annual Survey of Hours and Earnings pooled over three years, 2003-2005. Table 6.4 provided a series for five years and showed considerable stability over this period. We recommend that these are rolled forward on an annual basis.

The geographical variables are based on settlements as measured by the 2001 Census and datazone populations and travel times as at 2003. The next update of settlements is expected at the 2011 Census but the population estimates and travel times can be updated on an annual basis.

Overall, however, we suspect that these factors change little on an annual basis.

10.4.2 Weights

The weights that we have estimated in this report are based on the latest available data. In some cases, particularly hospital activity, some of these data are already quite old. For long-stay specialties, for example, we have been forced to use data covering the period 1998/9 to 2000/1. If our recommendations are accepted, they will inform financial allocations for the 2008/9 financial year. We are concerned that in some cases these weights will be based on data that are ten years old.

Changes in the patterns of care and modes of service delivery may generate significant changes in the weights that should be attached to some factors. Planned changes to shift the balance of care towards local provision for some services and centralised provision for more specialised services could change the proportions of activity provided in high-cost locations for remote areas.

More routine linking of local activity and cost information in the NHS and an initiative to update available information on service delivery would permit estimation of more current weights for the factors that we have highlighted.

10.4.3 Summary

The factors underpinning the excess cost adjustments that we have derived are unlikely to change substantially on an annual basis. Some of the data available to us to calculate the weights attached to these factors are already quite out-of-date. In our opinion, therefore, priority for updating the excess cost adjustments should be placed on the *weights* (such as the ratios of local to national average costs for each urban-rural category) rather than the *factors* (such as the proportions of each Board’s population in each urban-rural category). There is considerable scope for updating the weights prior to implementation of these adjustments if more recent data can be obtained, particularly for long-stay hospital specialties.

With constraints on analytical resources available to maintain the formula, we recommend that the factors be updated on a three-yearly basis and the weights on an annual basis.

11 RECOMMENDATIONS

In this section we summarise our recommendations for the formula, improving the data available and future research.

11.1 Recommendations for the formula

Given the different focus of the adjustments for community and hospital adjustments we present our recommendations separately. In both cases we recommend a common adjustment for variations in input prices. General recommendations are provided at the end.

11.1.1 Community health services

Recommendation F1
An adjustment for input prices should be introduced into the community services element of the formula. It will be based on the Local Authority figures for private sector SSWDs provided in Table 6.4. Each NHS Board's adjustment will be based on a matrix describing shares of their target levels of activity (derived from the population, age-sex and morbidity and life circumstances exercises) that are delivered from locations in each Local Authority area. The adjustment will only be applied to the non-medical staff element of community services expenditure.

Recommendation F2
The community services formula should also contain an adjustment for the effect of geography on the volume of inputs required to deliver the target level of output. This adjustment will focus on the cost consequences of the additional travel entailed in serving more dispersed populations. The general structure of the model requires estimates of the proportion of activity within and outwith settlements, travel times to areas outwith settlements, and the national proportion of activity taking place in patients' homes.

11.1.2 Hospital services

Recommendation F3
An explicit adjustment for input prices should be introduced into the hospital services element of the formula. It will be based on the Local Authority figures for private sector SSWDs provided in Table 6.4. Each NHS Board's adjustment will be based on a matrix describing shares of their target levels of activity (derived from the population, age-sex and morbidity and life circumstances exercises) that are delivered from hospital locations in each Local Authority area. The adjustment will only be applied to the non-medical staff element of hospital services expenditure.

Recommendation F4
The hospital services formula should also contain an adjustment for higher unit costs in remote areas. Adjustments will only be made for populations living on islands (whose costs will be increased by 15% in Small Towns and 18% in Rural Areas) and in Very Remote Small Towns (whose costs will be increased by 4%).

11.1.3 General

Recommendation F5
There may be a need for input price adjustments for land and buildings but consideration needs to given of whether they are already reflected in NHS cost figures and whether their inclusion would represent double counting.

Recommendation F6
A considerable effort should be made to update the remoteness-related hospital services weights using the methods described in this report prior to their introduction. Use of more recent activity data for long-stay specialties, corrections to some of the cost figures reported in the Blue Book and better matching of local activity and cost data would improve the evidence-base for the hospital costs adjustment.

Recommendation F7
Higher priority should be given to updating the weights applied to the excess cost adjustments in the formula. These are likely to evolve more rapidly than the underlying factors. The analysis used to create the weights should be updated each year and the factors should be updated every three years.

11.2 Recommendations for improving data

Our recommendations for improving data are organised by dataset.

11.2.1 NHS pay records

Recommendation D1
NHS pay records should specify the site at which each employee works. Data provided by NHS Ayrshire & Arran demonstrated that this was collected in local systems and should be retained on the national dataset.

Recommendation D2
NHS pay data should record accurately when each pay records starts and ends.

Recommendation D3
The number of hours that each pay record refers to should be recorded alongside the amount of money paid.

11.2.2 Community health services

Recommendation D4
Given the priority accorded to the delivery of health care in the community, information should be collected on patient activity for all community health services. This should record similar variables as are currently collected for hospital service activity, including diagnosis, date and duration of contact, procedure and patient characteristics including place of residence.

Recommendation D5
Cost data should be collected for all sites responsible for delivering community health services. This should contain similar fields as are currently collected for hospital sites, including elements of expenditure on staffing, equipment, supplies and allocated costs.

11.2.3 Hospital services

Recommendation D6
Greater priority should be given to maintaining accurate and up-to-date figures on patient activity in hospitals including long-stay hospitals.

Recommendation D7
Attention needs to be given to the quality of cost data reported for each specialty in each hospital. Data should be collected according to common definitions across Scotland. Where definitions are changed over time it should be possible to back-map data to ensure a consistent series.

11.2.4 General

Recommendation D8
It is not possible to track resource use in the NHS in Scotland without clear consistency between activity and cost data and without accurate mapping between these data sources at local level. If resource use cannot be tracked accurately in the NHS, it is difficult to derive a formula for equitably distributing available resources throughout Scotland and impossible to judge performance against these equity principles. A higher priority needs to be placed on collecting data that permits tracking of resource use throughout the NHS in Scotland.

Recommendation D9
Clinically-useful patient data should not be collected separately from financial information. Integrated information is required on the price and volume of inputs and the volume and quality of outputs. Such information is necessary for accurate resource allocation but would serve a multitude of other clinical, managerial and policy purposes. The data should be arranged so that it is possible to use the same core data set to derive information on an individual patient's pathway through the NHS, on an individual healthcare professional's activity and workload, on an area population's needs and services received from the NHS, and on the performance of a particular clinical team, site or organisation.

11.3 Recommendations for future research

Recommendation R1

In this analysis we have used only urban-rural categories to describe differences in costs between datazones. Now that cost ratios have been generated for each datazone, further analysis should be undertaken to assess whether population characteristics such as age, deprivation and ethnicity may affect costs as well as needs.

Recommendation R2

We have demonstrated a risk of overlap in the adjustments because of the sequential approach to their estimation. Future approaches to estimating the formula should estimate the adjustments for age, morbidity and life circumstances and excess costs in a single analysis.

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