
Assessing the relative health care spending needs of the UK's devolved territories: a Scottish perspective

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Received 20 July 2011; in revised form 4 November 2011

Abstract. This paper applies Scotland's health allocation formula to Primary Care Trusts (PCTs) in England, Health Boards in Wales, and Health and Social Care Trusts in Northern Ireland in order to assess the relative health care expenditure needs of the countries. According to the Scottish formula, England's per capita health care expenditure need is around 10% lower than Scotland's, while Wales' per capita expenditure need is around 2% lower than Scotland's, and Northern Ireland's is around 7% lower than Scotland's. Scotland's relative expenditure need over England is largely a function of higher rates of mortality and long-term illness, rather than its relative sparsity. Northern Ireland's relatively lower need is largely due to it having a relatively young population. We also compare the results of Scotland's allocation formula with the equivalent English formula and find that the two approaches differ in their view of what constitutes an equitable distribution of resources between PCTs.

Keywords: health care expenditure needs, resource allocation capitation formulae

1 Introduction

The UK government determines the level of public expenditure to allocate to the devolved administrations (DAs) for devolved functions through a mechanism known as the Barnett formula. The Barnett formula is allocated as an unconditional block grant to each of the DAs based on changes in comparable spending in England and the population share of each DA (HM Treasury, 2010a). There is increasing dissatisfaction with the Barnett formula. In particular, the formula is seen as unfair because it takes no account of the relative spending requirements of the DAs due to either additional need or higher costs of service delivery (McLean et al, 2008). As a result there have been increasing calls for Barnett to be replaced by some form of needs-based assessment. The Holtham Commission (Independent Commission on Funding and Finance for Wales, 2010) recommended that the Barnett formula should be replaced by a needs-based assessment, as did the House of Lords (Select Committee on the Barnett Formula, 2009), which argued that:

“Public spending per head of population should be allocated across the United Kingdom on the basis of relative need, so that those parts of the UK which have a greater need receive more public funds to help them pay for the additional levels of public services they require as a result” (paragraph 81).

Many commentators have argued that it would be politically infeasible to develop a needs assessment or formula that was acceptable to all stakeholders, given the normative judgments involved in assessing ‘need’ (Morgan, 2001). However, the UK government and devolved administrations are increasingly using formula funding approaches to allocate resources within their respective territories, particularly in relation to local authorities and health trusts (Smith, 2007). These formula funding approaches implicitly attempt to secure horizontal equity, usually defined as being that public sector organisations can provide a similar level (standard) of service given the nature of the clientele they serve

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(Smith, 2003), providing they make equivalent fiscal effort. For example, a resource allocation formula is used by the National Health Service (NHS) in England to allocate resources to Primary Care Trusts (PCTs) across England, while the NHS in Scotland uses its own formula to allocate resources to Health Boards within its territory.

The current pattern of resource allocation to the UK's devolved administrations, driven by the Barnett formula, results in marked differences in per capita spending on health care. Relative to England, average annual per capita spending on health was 15% higher in Scotland (equivalent to £226 per person), 9% higher in Wales (£130 per person), and 6% higher in Northern Ireland (£88 per person) over the five-year period from 2004/05 to 2008/09 (HM Treasury, 2010b).

To date, there has been little work looking at the relative health care expenditure needs of the devolved nations and the extent to which these differences in per capita spend can be explained on the basis of differences in relative health needs. We seek to address this gap by applying the Scottish approach to allocating resources to territorial Health Boards to England, Wales, and Northern Ireland.⁽¹⁾ In this respect the work builds on previous work which has assessed Scotland's relative local authority spending needs from an English perspective (King et al, 2004; 2007a; 2007b).

The primary aims of the paper are thus to examine the extent to which the current health care per capita spending differentials across the UK territories can be justified on the basis of spending need when 'need' in this context is assessed by the formula used by the NHS in Scotland to allocate resources geographically within its jurisdiction.⁽²⁾ Given that health care expenditure accounts for around 40% of each DA's total departmental expenditure limits (DELs) allocations,⁽³⁾ it could be argued that assessing health care spending need will be the most critical element of any future attempt to replace the Barnett formula with some form of needs assessment.

However, the paper also has wider relevance in the context of the trend globally towards increasing decentralisation of public sector activity (Lago-Peñas et al, 2011) and the implications for equity considerations (Costa-Font, 2010). In particular, the paper contributes to the growing body of research on resource allocation to decentralised levels of government, both in developed (Bramley et al, 2011) and in developing countries (Allers and Ishemoui, 2011).

The remainder of the paper is structured as follows. In section 2 we compare the resource allocation formulae that are used to allocate health care resources geographically in Scotland and England. In section 3 we present the results of applying the Scottish health care allocation formula to England, Wales, and Northern Ireland. In section 4 we compare the Scottish and English allocation formulae in further detail by examining how the two formulae would allocate resources to PCTs in England, and we conclude in section 5.

2 Weighted capitation formulae in the NHS

England, Scotland, and Northern Ireland make use of weighted capitation formulae to allocate resources to PCTs. The weighted capitation approach was introduced in England in 1980, in Northern Ireland in the mid-1990s, and in Scotland in 1979. In each country the capitation formula is reviewed on a regular basis by working groups (the Advisory Committee on Resource Allocation in England; the Technical Advisory

⁽¹⁾ Throughout the remainder of this paper we use the expression PCT to refer to Health Boards in Wales and Scotland and Health and Social Care Trusts in Northern Ireland.

⁽²⁾ For comparison, the authors are also undertaking work to apply the English health care allocation formula to Scotland, Wales, and Northern Ireland.

⁽³⁾ DELs set spending limits for departments over a three-year period.

Group on Resource Allocation in Scotland; and the Capitation Formula Review Group in Northern Ireland). In Wales adoption of a capitation formula was considered but has not yet been implemented, and allocations to Health Boards are made on the basis of ministerial letters.

The capitation formulae in England, Scotland, and Northern Ireland have been developed by modelling the variation in health care costs at the small-area level relative to the demographics and characteristics of the local population (after controlling for supply factors). The resulting formulae can appear relatively inaccessible to nonspecialists, and have therefore been criticised by some for a lack of transparency, but others argue that these systematic formulae offer the best prospects of satisfying equity criteria (Smith, 2008).

The basic structure of the weighted capitation formulae used in the three countries is very similar. The base population in each PCT is adjusted to account for three factors: the age and sex structure of the population; the level of additional needs not explained by age–sex structure (for example, because of negative health consequences arising from deprivation); and the costs associated with delivering services in different areas (for example, the effect of rural sparsity in increasing the costs of delivering health care) (see figure 1).



Figure 1. Overview of the Scottish capitation formula (source: NHS Scotland Resource Allocation Committee, 2007).

However, although the broad structure of the formulae in the three countries is similar, the approaches differ markedly in a number of other aspects. For example, the formulae often use different proxy indicators of relative health care need. But there are also some more fundamental differences in structure and emphasis between the two approaches. The Scottish approach to assessing unavoidable excess costs focuses on the additional costs associated with delivery in rural areas and largely ignores the potential effect of higher wages and other costs in more urban areas; the English excess cost formula in contrast focuses largely on a market forces factor that adjusts allocations in favour of areas which face high wage and other costs; the approach used in Northern Ireland considers both issues of rurality and issues associated with the economies of scale of different trusts. There are also differences between the formulae in how they deal with ‘unmet need’ (that is, the observation that some groups perpetually underutilise health care services and that capitation payments based on current patterns of expected utilisation will therefore underestimate the actual need associated with these groups) and the implications for addressing health inequalities (Ball et al, 2011).

The English weighted capitation formula has three elements: hospital and community health services (HCHSs), which is the largest element, accounting for 76% of the allocations made through the formulae; general practitioner (GP) prescribing; and primary medical services (PMSs).⁽⁴⁾

The Scottish weighted capitation formula has two main elements: HCHSs and GP prescribing, with allocations to Health Boards for PMSs being made through alternative mechanisms. The HCHSs component is again the largest, accounting for 85% of the allocations made under the formula, while GP prescribing accounts for the remaining 15%.

In total, Scotland's allocation formula accounts for around 85% of all funding allocated to Health Boards and around 67% of all NHS Scotland expenditure.⁽⁵⁾ In England the significance of the weighted capitation formula is higher, accounting for around 78% of total NHS revenue expenditure.

3 Applying Scotland's weighted capitation formula to England, Wales, and Northern Ireland

3.1 Overview of approach

This paper applies the weighted capitation formula used by NHS Scotland to allocate resources to Health Boards in 2009/10 to PCTs in England, Wales, and Northern Ireland. We compare each PCT's value on a particular index with the Scottish average for that index. Thus we develop a capitation index for each PCT which compares relative need in that PCT with a Scottish benchmark, where the Scottish benchmark represents the average per capita allocation for health in Scotland and has an index value of 1.

The seven Welsh Health Boards and five Health and Social Care Trusts in Northern Ireland are coterminous with local authority boundaries, making collation of relevant data relatively straightforward. In England we apply the formula to the 151 PCTs in operation in April 2010. Of these 151 PCTs, 129 are coterminous with local authority boundaries. The remaining twenty two are based in part on ward boundaries, or, in a few cases, on parts of wards. We have calculated the age–sex and excess cost elements of the formula based on the true (ie, ward-based) definitions of each of these PCTs, but we have had to collect some of the indicators for the additional need element based on a best-fit definition of these twenty-two PCTs based on local authority boundaries. The PCTs affected are shown in appendix B (table B1). Note that we have amalgamated the three Birmingham PCTs into one Birmingham-wide PCT for the purposes of our analysis; similarly, we have amalgamated the two Cheshire PCTs into one Cheshire-wide PCT.

⁽⁴⁾ PMSs relate to GP surgeries and out-of-hours services, but does not include costs associated with GP Prescribing (ie, the drugs bill).

⁽⁵⁾ The Scottish weighted capitation formula is used to allocate resources to Health Boards for HCHSs and GP prescribing. These two elements account for around 82% of the allocations made to Scottish Health Boards. The remaining funding is allocated to Health Boards for spending on capital, PMSs, and primary care services. Although other mechanisms are used for the distribution of these funding elements, the pattern of allocations for these elements follows the pattern of allocations made through the Scottish allocation formula very closely (see data in table A1 in appendix A). The correlation coefficient between the 82% of allocations made to the fourteen Health Boards through the formula and the remaining 18% of allocations is 0.997. Thus while our analysis technically covers 82% of the funding allocation made to Health Boards, the results can be taken as a reasonable approximation of the relative funding need of Health Boards across all elements of health care service.

3.2 Age – sex index

The Scottish age – sex index takes account of the differing need for health care across different age groups for males and females separately. It is calculated for each of five care programmes within HCHS and GP prescribing. The five care programmes in the HCHS index are: acute, care of the elderly (COTE), mental health and learning disabilities (MHLDs), maternity, and community.

For each care programme the population structure in each area (PCT) is applied to the national (ie, Scottish) average age – sex costs over twenty age categories. In the acute care programme, for example, PCTs are allocated £989, £175, and £1749 for each male aged 0 – 1, 15 – 19, and 75 – 79, respectively. The costs are summed over all individuals in the PCT population and divided by the total population to give a cost per head for each PCT. The cost per head is then divided by the national cost per head (in our analysis the Scottish average cost per head) to arrive at an index figure for each PCT. Further methodological information on how we applied the Scottish formula to England, Wales, and Northern Ireland is provided in appendix C.

The overall results of applying the Scottish age – sex formula to England, Wales, and Northern Ireland are shown in table 1.⁽⁶⁾ The value of each index is benchmarked to the Scottish average, where Scotland equals one. England's score on the age – sex indices is very similar to Scotland's, while Wales' score is 3.8% above Scotland's (implying a per capita allocation of 3.8% more than Scotland on the basis of the age and sex distribution of its population) and Northern Ireland's is 6.1% below. The explanation for these differences is due to differences in population structure (figure 2). Although the precise trend varies by care programme, the general pattern is that cost weights are high for individuals under the age of five, decrease during adolescence, and then begin increasing again for individuals aged 20 and over, with the extent of this increase varying markedly for different care programmes. Figure 2 shows that Wales has the highest proportion of its population in all age categories from 60 – 64 and above. Northern Ireland, by contrast, has a particularly low proportion of its population in the more elderly age categories, explaining its relatively low overall score. Northern Ireland has a high score for the maternity care programme, but as this reflects only 3.6% of the overall index, this does little to compensate for its below average scores on the other care programmes.

Table 2 shows the highest and lowest ranked PCTs on the age – sex index in each country (where high rank corresponds to high expenditure need and vice versa).

Table 1. Scottish age – sex indices applied to England and the devolved territories.

	Acute	COTE	MHLDs	Maternity	Community	GP prescribing	Total age – sex index
Weights (%) ^a	48.9	4.4	13.1	3.6	14.7	15.3	
England	0.996	1.033	1.000	1.129	1.000	0.991	1.003
Wales	1.044	1.111	1.021	1.014	1.005	1.050	1.038
Northern Ireland	0.925	0.860	0.929	1.172	0.988	0.913	0.939
Scotland	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Notes: COTE = care of the elderly; MHL D = mental health and learning difficulty.

^aThe weights reflect the role of the particular programme in determining average overall Health Board costs in Scotland—that is, the acute care programme on average accounts for 49% of all hospital and community health services and prescribing costs.

⁽⁶⁾Normally, the five care programmes Acute, COTE, MHLDs, maternity, and community are aggregated to form the HCHS index. Given constraints on space, we have amalgamated the HCHS and GP prescribing index into one overall index.

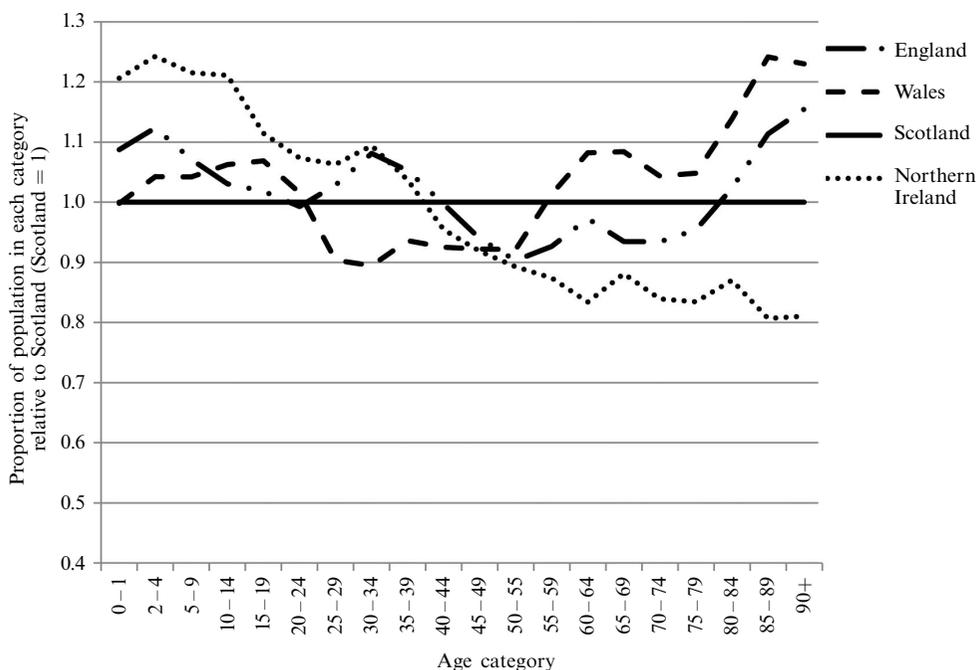


Figure 2. Age profile of populations (males and females) relative to Scotland (Scotland = 1).

Table 2. Highest and lowest ranked Primary Care Trusts (PCTs) in each country (age–sex index)

Rank PCT	Acute	COTE	MHLDs	Maternity	Community	GP prescribing	Total age–sex index
Weights (%)	48.9	4.4	13.1	3.6	14.7	15.3	100.0
<i>Highest ranked</i>							
1 Dorset	1.246	1.637	1.184	0.853	1.075	1.245	1.216
6 Powys Teaching	1.167	1.353	1.111	0.894	1.034	1.175	1.139
10 Western Isles	1.146	1.351	1.106	0.815	1.025	1.152	1.121
114 Belfast	0.954	0.999	0.964	1.194	1.009	0.932	0.970
<i>Lowest ranked</i>							
123 Lothian	0.951	0.965	0.986	0.988	1.001	0.936	0.962
125 Cardiff and Vale	0.940	1.012	0.968	1.126	1.003	0.920	0.960
158 Western Northern Ireland	0.877	0.716	0.884	1.188	0.962	0.868	0.893
174 Tower Hamlets	0.714	0.445	0.839	1.555	0.945	0.683	0.778

Notes: COTE = care of the elderly; MHLD = mental health and learning difficulty.

The table also shows the overall rank of each of these PCTs within our total sample of 174 PCTs.⁽⁷⁾ The highest ranked PCTs are those with a relatively high proportion of population within older age groups, whilst the lowest ranked are those whose population is concentrated within early middle age. These differences in population distribution are shown graphically in figure 3, which compares the population distribution of the highest and lowest ranked PCTs (Dorset and Tower Hamlets, respectively) with the population distribution of Scotland.

⁽⁷⁾ Some 148 PCTs in England; fourteen Health Boards in Scotland; seven Health Boards in Wales; and five Health and Social Care Trusts in Northern Ireland.

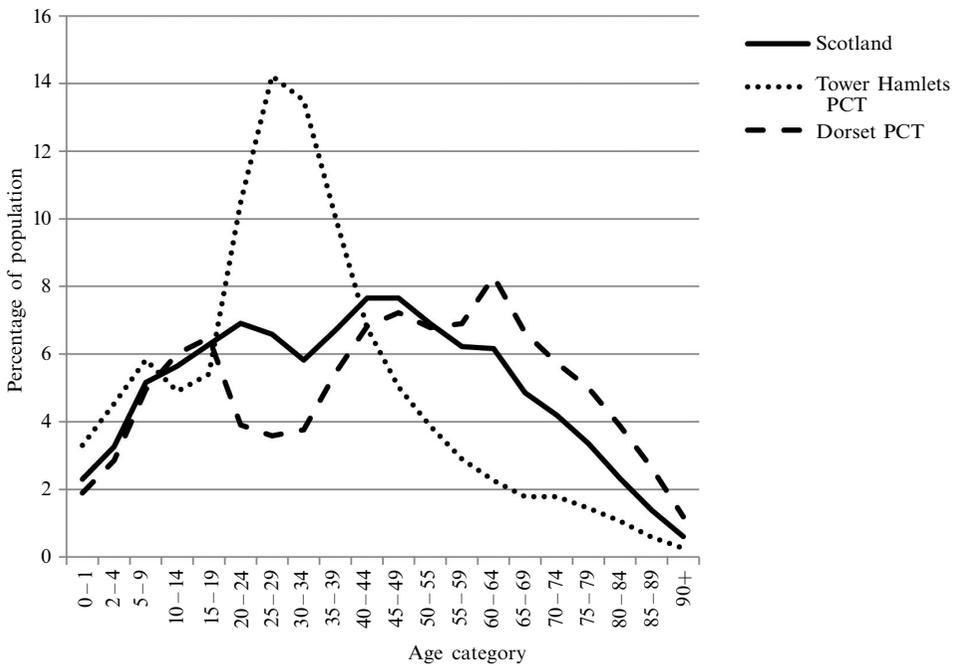


Figure 3. Age profile of Tower Hamlets and Dorset Primary Care Trusts (PCTs) relative to Scotland.

3.3 Additional needs (MLC) index

The additional needs index takes into account factors that predict the need for health care over and above age and sex—in other words, the additional needs that arise as a result of differing morbidity and life circumstances (MLCs). For each care programme the Scottish capitation formula calculates indices based on various indicators, shown in table 3. These indicators were selected from regression analysis to identify the indicators which best explain the variation in spending on each care programme at the small-area level.

The indicators are normalised and combined into an index value for each care programme. The index values are then applied to regression coefficients for each diagnostic group. Needs indices for each diagnostic group are then combined to produce a needs index for each care programme. The resulting indices are centred on a Scottish mean of one, with a needs index above one implying greater than average spending need per head as a result of MLCs.

To apply the Scottish formula to our 174 PCTs, we collated the indicators shown in table 3 at local authority level and aggregated the indicators to PCT level. Notes within the table explain any deviation in our approach from that adopted by the Scottish formula. The mean values of each of these additional needs indicators for Scotland, England, Wales, and Northern Ireland are shown in table C1 in appendix C.

The additional needs indices for England, Wales, and Northern Ireland are shown in table 4. England's overall index score is 0.901, implying that its additional needs as a result of MLCs are around 10% per capita lower relative to Scotland. Wales' implied needs on the additional needs index are around 5% less than Scotland's, while Northern Ireland's needs are fractionally less per capita than Scotland's.

The fact that Scotland's 'additional needs' are assessed as being higher than those of the other countries of the UK reflects the selection of needs indicators used in the Scottish formula, and in particular the significant weight attached to mortality rates.

Table 3. Indicators used in the additional needs index.

Care programme	Indicator	Period	Source
Acute ^a	All-cause standardised mortality rate, age 75 and under	2001–05	General Register Office of Scotland (GROS); Health Statistics and Analysis Unit, Welsh Assembly Government; National Centre for Health Outcomes Database; Northern Ireland Statistics and Research Agency (NISRA) Census in each country
	Limiting long-term illness rate, age–sex standardised	2001	
COTE	As for acute programme		
MHL D	Proportion of 16+ population claiming Severe Disablement Allowance	2004	Department for Work and Pensions data (accessed through NOMIS); Department for Social Development in Northern Ireland Census in each country
	Proportion of households that are one person	2001	
	Proportion of households that are social rented	2001	Census in each country
Maternity	Mean house price	1994–2005 ^b	Communities and Local Government; Registers of Scotland Office for National Statistics; GROS; NISRA Scottish Government
	Birth rate per female population aged 15–44	2005 ^c	
	Urban rural	2004 ^d	
Community	Cost-weighted average of COTE, maternity, MHL D, and acute outpatients indices		
GP prescribing ^e	As for the acute programme		

Notes: COTE = care of the elderly; MHL D = mental health and learning difficulty; NOMIS = Office for National Statistics website for labour market statistics; PCT = Primary Care Trust.

^a Within the acute care programme additional needs indices are developed for the following diagnostic groups: circulatory; cancer; respiratory; digestive; injuries and poisoning; acute outpatients; and other.

^b Given data availability, our analysis calculates this indicator (for all PCTs) for 2003–09. The fact that the period of analysis is somewhat different from that proposed is unlikely to influence the relative differences between PCTs, which is what we are interested in assessing.

^c Given data availability, our analysis calculates this indicator for 2009 rather than 2004.

^d The urban–rural supplementary variable is a categorical variable applied to each datazone. There are practical difficulties in applying it to our analysis which is undertaken at a larger spatial scale given that these large spatial areas cannot be categorised into one rather than another urban–rural category. Instead, we have allowed for urban–rural effects in the maternity care programme by applying the excess cost index for each PCT/ Health Board (described further in subsection 3.3), with a weight of one third.

^e Within the GP prescribing index additional needs indices are developed for the following diagnostic groups: cardiovascular; central nervous system; gastrointestinal; infections; musculoskeletal; and other prescribing.

Table 4. Scottish additional need indices applied to England, Wales and Northern Ireland.

	Acute	COTE	MHLD	Maternity	Community	GP pres- cribing	Total age–sex index
Weights (%) ^a	48.9	4.4	13.1	3.6	14.7	15.3	100.0
England	0.906	0.909	0.843	0.942	0.929	0.899	0.901
Wales	0.959	0.961	0.891	0.988	0.964	0.954	0.951
Northern Ireland	1.002	1.001	0.947	1.019	0.990	1.009	0.995
Scotland	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Notes: COTE = care of the elderly; MHLD = mental health and learning difficulty.

Scotland's mortality rates are significantly higher than the other countries making up the UK, and Scotland has a higher death rate than England for every major cause of death (McLaren et al, 2010). Even after controlling for the effects of deprivation, Scotland's mortality rate seems to exhibit a significant unexplained element, which has been referred to as the 'Scottish effect' (Hanlon et al, 2005) and more recently the 'Glasgow effect' following research indicating that deaths in Glasgow were 15% higher than those observed in Liverpool or Manchester, despite the three cities having almost identical deprivation profiles (Walsh et al, 2010). The English health care allocation formula's assessment of additional needs relies on a wider range of socioeconomic indicators than the Scottish formula does, and it is thus feasible that application of the English formula to Scotland would not allocate Scotland such a wide expenditure differential.

The highest and lowest ranked PCTs on the Scottish additional needs index in each country are shown in table 5. The highest ranked PCTs (ie, those with greatest additional expenditure needs over the need implied by their age and sex structure) are large cities with relatively high levels of deprivation (Manchester and Knowsley, not shown in the table, are ranked 2nd and 3rd, respectively). The highest ranked Welsh PCT is

Table 5. Highest and lowest ranked PCTs in each country (additional needs index).

Rank	PCT	Acute	COTE	MHLDs	Maternity	Community	GP pres- cribing	Total age–sex index
Weights (%)		48.9	4.4	13.1	3.6	14.7	15.3	100.0
<i>Highest ranked</i>								
1	Liverpool	1.124	1.118	1.200	1.020	1.083	1.151	1.128
4	Greater Glasgow and Clyde	1.118	1.112	1.140	1.007	1.067	1.145	1.113
5	Belfast HSCT	1.078	1.073	1.118	1.007	1.046	1.107	1.080
14	Cwm Taf	1.098	1.092	0.880	1.003	1.013	1.125	1.057
<i>Lowest ranked</i>								
77	South Eastern (Northern Ireland)	0.932	0.936	0.854	1.017	0.949	0.914	0.925
111	Orkney	0.881	0.885	0.859	1.079	0.928	0.866	0.890
130	Powys Teaching	0.855	0.861	0.854	0.975	0.914	0.843	0.866
174	Buckinghamshire	0.794	0.801	0.709	0.870	0.852	0.786	0.793

Notes: COTE = care of the elderly; MHLD = mental health and learning difficulty; MLC = morbidity and life circumstance; PCT = Primary Care Trust; HSCT = health and social care trust.

Cwm Taf (covering Rhondda, Cynon, Taff, and Merthyr Tydfil). The ten lowest ranked PCTs on the additional needs index are all in the south of England. Buckinghamshire has the lowest additional needs—20% below the Scottish average.

3.4 Unavoidable excess cost

The Scottish unavoidable excess costs index takes account of the fact that the cost of providing health care in remote and rural areas is likely to be higher than elsewhere because hospitals and clinics serve smaller populations and dispersed populations mean greater travelling distances for staff. The Scottish capitation formula calculates excess cost separately for hospital and community services. Excess costs for community services are calculated for two types of service: travel based and clinic based. The weights for the final index are: hospital (82%); travel (12%); and clinic (6%). There is no excess cost calculation for the GP prescribing programme as drug reimbursement costs are uniform across the country.

The Scottish excess cost index is based around a ten-category definition of rurality (table 6). Research underpinning the formula has estimated cost indices for each of these urban–rural categories.⁽⁸⁾ For hospital services the islands and very remote rural areas have the highest costs, with little difference among the other categories. For community services the emphasis remains very much in favour of the ‘very remote’ areas, although more accessible rural areas also benefit.

Table 6. Unavoidable excess cost adjustments by urban–rural category used in the Scottish formula (source: Technical Advisory Group on Resource Allocation, 2010).

Category of residence	Hospital	Community (travel)	Community (clinic)
Primary cities	1.005	0.985	0.920
Urban settlements	0.982	0.985	0.952
<i>Small towns</i>			
Accessible	1.002	0.946	1.021
Remote	0.988	1.009	1.132
Very remote			
mainland	1.030	1.222	1.341
island	1.120	1.227	1.121
<i>Rural areas</i>			
Accessible	0.999	0.982	1.083
Remote	0.998	1.064	1.340
Very remote			
mainland	1.024	1.481	1.915
island	1.162	1.502	1.522
Scotland	1.000	1.000	1.000

⁽⁸⁾The excess cost indices were developed by researchers during the development of the formula as follows. For hospital and community services the indices were developed by modelling the ratio of local to national average costs for the urban–rural category within which the datazone lies. For community travel-based services research simulated the additional travel time associated with delivering services by health care professionals to patients’ homes, based on assumptions about contact duration, travel times, the proportion of visits in patients homes, and the time required to visit islands. For community clinic based services a rurality weighting was developed for each datazone as a proxy for the excess costs of clinic-based community services. The rurality weighting is based on combined weightings of three variables: density and sparsity of the GP practice population and the proportion of people in the GP practice population that attract road mileage payments.

In order to apply the Scottish excess cost adjustment to PCTs in England, Wales, and Northern Ireland, the challenge was to reconcile the English, Welsh, and Northern Irish urban–rural categories with the ten categories of urban–rural classification used in the Scottish formula. Our approach to doing this is described in appendix B. This reconciliation provided us with an estimate of the proportion of each PCT’s population resident within each of the Scottish urban–rural categories. These proportions were then applied to the cost indices in table 6 to calculate the additional excess cost indices for each PCT. The results are shown in table 7. The results indicate that England’s overall allocation on the excess cost index would be around 0.7% less per capita than Scotland’s as a result of Scotland’s greater degree of rurality and sparsity. Scotland’s spending needs to account for increased sparsity are 0.4% per capita higher than Wales’ and 0.1% higher than Northern Ireland’s.

Table 7. Scottish unavoidable excess cost indices applied to England, Wales, and Northern Ireland.

	Hospital	Community (travel)	Community (clinic)	Final excess cost index
Weight (%)	82	12	6	100
England	0.998	0.982	0.954	0.993
Wales	0.997	0.988	1.000	0.996
Northern Ireland	0.998	0.994	1.023	0.999

Whilst it may to some extent seem surprising that Scotland’s relative sparsity should equate to an additional payment of just 0.7% per capita over England, and somewhat less over Wales and Northern Ireland, this result is intuitive for the fact that the Scottish excess cost adjustment essentially has the effect of increasing capitations in very remote islands without materially changing the capitations allocated to other areas. Figure 4 shows the actual excess cost index for each of the

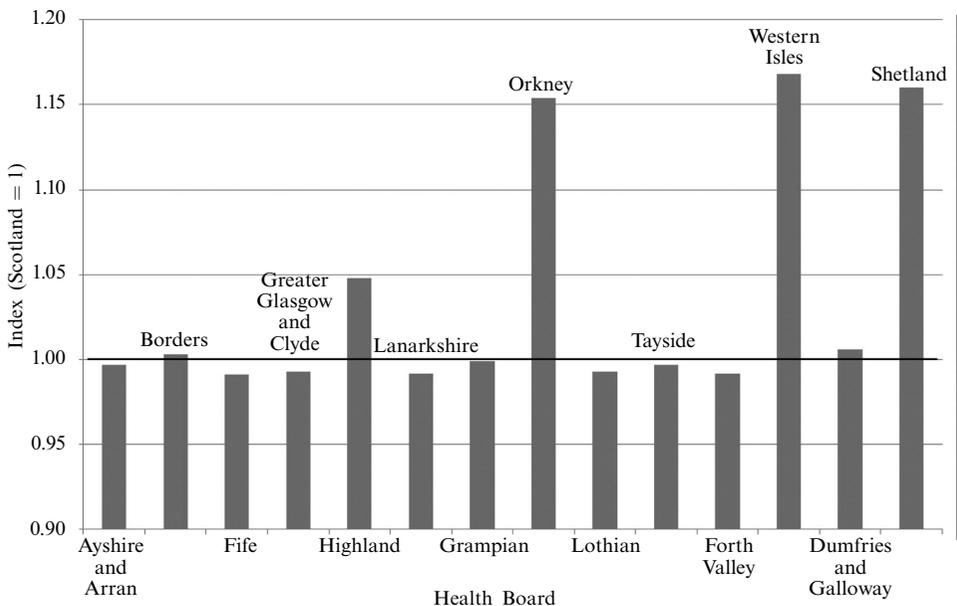


Figure 4. Unavoidable excess cost index for Scottish Health Boards (source: NHS Scotland Resource Allocation Committee, 2007).

Scottish Health Boards, as calculated by the Scottish formula. This shows that while the island Health Boards of Orkney, Western Isles, and Shetland benefit considerably, nonisland Health Boards are not materially negatively affected because the populations of the island Health Boards are small enough that capitations can be increased significantly in these areas without a noticeable reduction in capitations elsewhere.

It is worth noting that the way in which the Scottish formula calculates the unavoidable excess cost index is very different from the way that the index is calculated by the English formula. The English formula is based largely on the prices of labour and other factor costs and therefore tends to allocate resources towards large cities (and London, in particular) rather than rural areas. Thus, from an English perspective the Scottish excess cost index is likely to be seen to underestimate expenditure need for unavoidable excess costs because very little account is made of factor prices, whereas from a Scottish perspective the English formula is likely to be seen to underestimate expenditure need associated with delivering in remote areas.

The highest ranked PCTs on the excess cost index are the Scottish island PCTs of Shetland, Western Isles, and Orkney, each with per capita excess expenditure needs of over 15% above the Scottish average. Fourth highest is Highland (1.05), and fifth ranked is Powys (1.01). Other than the three island PCTs, the spread of scores of individual PCTs is small.

An interesting effect of the Scottish excess cost index is that while it adjusts capitations in favour of very remote areas, it does not particularly adjust in favour of less remote or accessible rural areas, and it adjusts in favour of primary cities more than it does for urban areas.⁽⁹⁾ Consequently, the PCTs that have the lowest excess cost index are places such as Derby, Luton, Plymouth, Torbay, and Forth Valley which have large proportions of their populations categorised as 'urban', whilst those PCTs that are uniquely based within 'primary cities' tend to rank relatively highly. PCTs which might be thought of as containing relatively rural areas—such as Herefordshire, Cumbria, Cornwall, and Northumberland—tend to achieve fairly average scores by virtue of the fact that: (a) they are not particularly rural relative to Scotland; and (b) they also have reasonable proportions of their populations in urban areas and accessible small towns which can bring their scores down.

It could be argued that our approach to applying the excess cost index to England, Wales, and Northern Ireland is likely to underestimate the unavoidable excess costs incurred in these countries, as we have assumed that no areas in these countries are classified as 'very remote' according to the Scottish definition. We undertook some sensitivity analysis by assuming that 1% of the population of Cornwall, Cumbria, Northumberland, and Herefordshire PCTs and 2% of the population of Betsi Cadwaladr, Powys, and Hywel Dda could be classified as very remote (and in the case of Betsi Cadwaladr we assumed that half of this very remote population was based on the Isle of Anglesey). At the national level this had no effect on England's overall excess cost index, but it did increase Wales' score from 0.996 to 0.997. The revised analysis made relatively little difference to the scores of individual PCTs on the excess cost index, but because there is so little variation between PCT scores these changes could make significant differences to a PCT's rank. For example, Cumbria's score on the excess cost index increased from 0.994 to 0.998, but this had the effect of raising Cumbria from 101st to 15th among the 174 PCTs.

⁽⁹⁾ See appendix B for definitions of primary cities and urban areas.

3.5 Final indices

The final weighted capitation indices for the four countries are shown in table 8. These results combine the HCHS and GP prescribing indices into one overall capitation index. The results indicate that England's per capita spending need for health care is almost 10% less per head than Scotland's, as assessed using the Scottish weighted capitation formulae. The additional spend in Scotland is largely required to offset the inferior MLCs in Scotland, while Scotland requires an additional 0.7% per capita to meet the costs of delivering services in relatively sparser areas.

Table 8. Final weighted capitation indices for England, Wales, and Northern Ireland [hospital and community health services (HCHS) and general practitioner (GP) prescribing combined] based on the Scottish formula.

	Final age–sex index	Final MLC index	Final excess cost index	HCHS/GP prescribing index
England	1.003	0.901	0.993	0.899
Wales	1.038	0.951	0.996	0.984
Northern Ireland	0.939	0.995	0.999	0.934
Scotland	1.000	1.000	1.000	1.000

Note: MLC = morbidity and life circumstance.

Wales' per capita health care expenditure needs are around 1.6% per capita lower than Scotland's. The higher expenditure needs associated with Wales' relatively older population almost exactly offset Wales' relatively lower 'additional' expenditure need relative to Scotland associated with MLCs. Northern Ireland's per capita expenditure need for health care is around 6.6% less than Scotland's. This is largely accounted for by Northern Ireland's population distribution being relatively more skewed towards younger people, with Northern Ireland's needs for MLCs and 'unavoidable excess cost' being approximately the same as Scotland's.

Table 9 shows the highest and lowest ranked PCTs in each country according to the Scottish formula. Overall, with the HCHS and GP prescribing indexes combined, the Western Isles attract the largest per capita allocation. The highest ranked English PCTs are Blackpool (ranked 2nd overall), Torbay (5th overall), and Knowsley (6th overall).

Table 9. Highest and lowest ranked PCTs.

PCT	Rank	Age–sex	MLC	Excess cost	Overall index ^a
<i>Highest ranked</i>					
Western Isles	1	1.120	0.960	1.197	1.256
Blackpool	2	1.062	1.050	0.999	1.115
Cwm Taf	13	1.006	1.057	0.992	1.056
Belfast HSCT	15	0.971	1.080	0.999	1.048
<i>Lowest ranked</i>					
Grampian	94	0.995	0.909	1.002	0.906
South Eastern HSCT	100	0.968	0.925	1.001	0.896
Cardiff and Vale University	122	0.960	0.903	0.992	0.861
Kingston	174	0.915	0.813	0.999	0.744

Notes: PCT = Primary Care Trust; HSCT = Health and Social Care Trust.

^aThe overall index is derived by combining the age–sex, morbidity and life circumstance (MLC), and excess cost index scores for hospital and community health services and weighting this by 0.847 and then combining the age–sex and MLC (but not excess cost) index scores for general practitioner prescribing and weighting this by 0.153.

Blackpool ranks highly because of a combination of a relatively elderly population and relatively high additional needs as a result of general ill health; Torbay, on the other hand, scores highly simply as a result of its (relatively) elderly population. The highest ranked Welsh PCT is Cwm Taf, with per capita expenditure needs of 5.6% above the Scottish average; the highest ranked Northern Irish PCT is Belfast, with per capita expenditure needs of 4.8% above the Scottish average.

The five lowest ranked PCTs are all located in the southeast of England. Kingston's per capita spending need is 25.6% below Scotland's, as a result of both having a relatively young population and having a low 'additional need' for health care due to ill health.

4 Comparing the Scottish and English formulae results

As noted previously, England and Scotland make use of weighted capitation formulae to allocate resources to PCTs. An interesting question to consider is the extent to which the two formulae would allocate resources to PCTs in a similar pattern. Figure 5 plots, on the x -axis, the proportion by which each PCT's expenditure need for HCHS and GP prescribing is above or below the average English expenditure need, as assessed by the Scottish formula. On the y -axis it plots the proportion by which each PCT's expenditure need is above or below the English average expenditure need, as assessed by the English formula.⁽¹⁰⁾ PCTs which fall on the 45° line are those for which the expenditure need is assessed as being the same relative to the English average by both the English and Scottish formulae. PCTs which fall above this line are assessed as having higher needs (relative to the rest of England) by the English formula compared with the Scottish formula. PCTs which fall below the dotted line are assessed as having higher needs (relative to the rest of England) by the Scottish formula than the English formula.

We have also included Welsh Health Boards on the chart. Although Wales does not use an allocation formula, we have inferred actual per capita expenditure weights for Wales by looking at the actual allocations made to Health Boards for HCHS and GP prescribing services and comparing these with the Welsh average. Thus for Welsh Health Boards the chart compares the expenditure need relative to the Welsh average (as assessed by the Scottish formula) on the x -axis with the actual allocations relative to the Welsh average (y -axis).

A number of points stand out:

- The Scottish formula consistently underestimates the relative expenditure needs of the London PCTs (shown with diamonds) relative to the English formula. According to the Scottish formula, all London PCTs have below the English average expenditure needs, whereas the English formula gives most London PCTs above-average needs. This difference is largely due to the fact that the Scottish formula largely ignores the higher factor costs experienced in London.
- Across other English PCTs (shown with squares) the Scottish formula seems to underestimate the expenditure needs of deprived urban areas, particularly those in the north of England, compared with the English formula. This is likely to reflect the fact that the two formulae use slightly different combinations of needs indicators and, in particular, the English formula incorporates a wider range of indicators of employment deprivation, which may favour urban areas. It may also be because the English formula makes a much more significant adjustment to address 'health inequalities' and this has the effect of adjusting allocations in favour of relatively more deprived areas.

⁽¹⁰⁾ English PCTs' relative expenditure need for HCHS and GP prescribing was derived from the 2009–10 Revenue Allocations Exposition Book, available from the Department of Health (2009). We weighted PCTs scores for HCHS and GP prescribing by the same proportion as they are weighted in the Scottish formula (0.847 and 0.153, respectively).

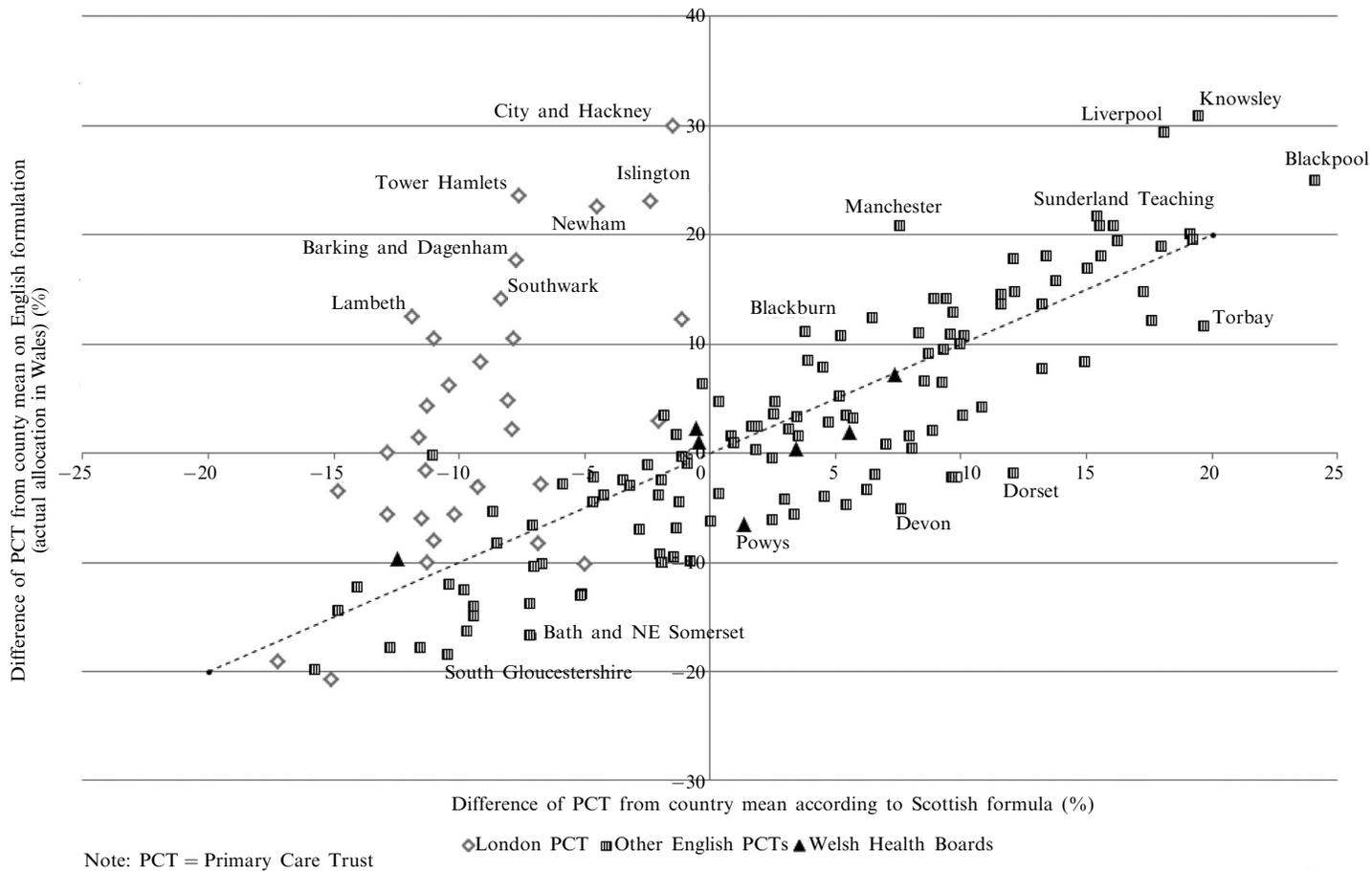


Figure 5. Comparing scores using the Scottish and English formulae.

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- Conversely, the Scottish formula seems to exaggerate the expenditure need of more affluent PCTs in the south of England relative to the English formula. These PCTs have relatively high proportions of elderly populations, which the Scottish formula seems to associate with higher expenditure need than its English equivalent formula.
 - The Scottish formula seems to provide a reasonably good approximation to the actual distribution of resources for HCHS and GP prescribing to Welsh Health Boards (shown with triangles). The main outlier is Powys Health Board, which the Scottish formula assesses as having per capita expenditure needs of 2% above the Welsh average but which was allocated 6% per capita below Welsh average spending for 2010/11. This is again commensurate with the observation that the Scottish formula is relatively more generous to areas with a more elderly population.

5 Conclusions

Since 1979 NHS Scotland has used a weighted capitation formula to allocate resources to the fourteen territorial Health Boards in Scotland. The application of the current version of this formula to PCTs in England, Health Boards in Wales, and Health and Social Care Trusts in Northern Ireland indicates that Scotland's relative need for health care funding is around 10% per capita higher than England's, 2% per capita higher than that of Wales, and 7% per capita higher than Northern Ireland's. This compares with actual per capita spending on health that is around 15%, 9%, and 6% higher in Scotland, Wales, and Northern Ireland, respectively, relative to England.

Scotland's additional need relative to England is accounted for largely by Scotland's relatively poor health, and not because of its relative sparsity (which accounts for around one tenth of Scotland's 10% relative need over England). In contrast, Scotland's relative health care expenditure need over Northern Ireland is largely because Northern Ireland has a much higher proportion of its population among younger age groups which have a lower demand for health care services. Wales has a higher proportion of its population among the over-65s, who demand high health care, than Scotland, but this effect is countered by Wales' lower need for MLCs factors compared with Scotland.

The comparison of the relative need of PCTs assessed by the Scottish capitation formula with the relative need of PCTs assessed by the English capitation formula indicates that there is a reasonable correlation between the two formulae in terms of how they assess relative need. But there are also notable differences between the two approaches in their view of what constitutes an equitable distribution of resources. To some extent these differences reflect the fact that the Scottish formula makes no allowance for any form of London weighting or any other adjustments for market forces factors, and from this point of view it could be argued that the Scottish formula is likely to underestimate England's expenditure need to an extent. It also appears to reflect a slightly different combination of additional need indicators in the two formulae, and in particular the English formula's inclusion of a wider range of employment deprivation indicators as proxies for health need.

Our assessment of relative health care expenditure need of the DAs is based on the Scottish health care allocation formula. The Scottish formula was developed by observing the relationship between health care utilisation and population characteristics in Scotland, and it is possible that the relationship between utilisation and these characteristics might not be the same in other countries. In other words, the fact that the Scottish capitation formula identifies a correlation between a particular indicator and health care utilisation does not mean that the relationship would necessarily hold within or between areas in the other territories. Thus the results should be interpreted as reflecting the health care expenditure needs of the DAs if the relationship between

the needs indicators and health care utilisation is the same in England, Wales, and Northern Ireland as it is in Scotland.

The results of applying the Scottish formula to the other countries of the UK lend support to those who argue that the Barnett formula tends to disadvantage Wales relative to England (Kay et al, 2005). However, our findings in themselves cannot show whether the current mechanism for allocating resources to the devolved administrations, the Barnett formula, is fair or not given that the Barnett allocations are not earmarked for particular areas of expenditure (theoretically, it is possible for Wales to increase its expenditure on health care, although this would necessarily come at the expense of a reduction in expenditure on other services).

Although dissatisfaction with the Barnett formula has led some to call for its replacement with a needs assessment, it remains to be seen whether there is sufficient political will for this to happen at the current time. Some commentators argue that the Barnett system, characterised as a per capita funding formula with significant scope for political influencing of 'special circumstances' at the margin, will remain more favourable to the DAs than a more transparent and rigid needs-based formula (Christie and Swales, 2010; Kay et al, 2005).

Should Barnett be replaced by a needs based assessment, however, robust assessment of health care expenditure need will be paramount given the significance of health care spending in the DAs' budgets. This paper has shown that existing formulae used within the UK's respective territories to allocate health care revenue expenditure are likely to provide a useful starting point in undertaking any such assessment. The similarity of the formulae used, in terms of their objectives and broad structure, suggests that agreeing the broad parameters for a health care needs assessment may not be as impossible as some suggest. Furthermore, application of the Scottish formula to the UK territories suggests that for health a needs-based assessment of spending needs would not necessarily entail a drastic redistribution of resources relative to the status quo.

Acknowledgements. We acknowledge the support of an ESRC grant in the preparation of this paper. We would like to thank Sandra Quickert and Ahmed Mahmoud at Information Services Division Scotland for advice on interpreting the Scottish capitation formula and Iain Pearce at the Scottish government for supplying the data in table A1. Any remaining errors are our own.

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Appendix A.**Table A1.** Resource allocation to Scottish Health Boards 2009–10 (£000) (source: Health Finance Directorate, Scottish Government, personal communication).

	NRAC	Capital	PMS	GDS	GOS	GPS	Total
NHS Ayrshire and Arran	557 200	21 800	45 455	23 208	7 087	13 372	668 122
NHS Borders	162 200	6 100	14 742	6 190	1 450	3 770	194 452
NHS Dumfries and Galloway	232 900	9 200	20 698	6 392	2 645	5 687	277 522
NHS Fife	490 300	18 400	42 037	16 729	6 062	11 509	585 037
NHS Forth Valley	383 900	14 800	35 379	15 796	4 883	9 744	464 502
NHS Grampian	660 700	29 800	68 310	20 758	8 905	16 111	804 584
NHS Greater Glasgow and Clyde	1 825 000	98 900	153 953	82 858	24 179	45 930	2 230 820
NHS Highland	469 600	18 900	54 446	20 063	4 538	11 423	578 970
NHS Lanarkshire	777 400	30 000	65 391	33 108	10 631	19 036	935 566
NHS Lothian	987 100	52 300	98 630	45 831	13 300	21 961	1 219 122
NHS Orkney	30 500	900	4 551	1 963	203	651	38 768
NHS Shetland	35 900	1 000	3 414	2 766	334	843	44 257
NHS Tayside	578 600	25 000	52 833	21 584	7 244	12 693	697 954
NHS Western Isles	56 600	1 900	5 804	2 458	376	1 069	68 207
Total	7 247 900	329 000	665 643	299 704	91 837	173 799	8 807 883

Notes: NRAC is the sums allocated through Scotland's resource allocation formula, overseen by the National Resource Allocation Committee (NRAC); capital is the amount allocated for capital investment; PMS is allocated for primary medical services; GDS, GOS, and GPS are general dental services, general ophthalmic services, and general pharmaceutical services, respectively.

Appendix B. English PCTs not coterminous with ward boundaries

Table B1 shows, for each of the twenty-two English PCTs that are not coterminous with local authority boundaries, the combination of local authorities (in bold) and wards (in italics) that make up each PCT. The table also shows how the ward was treated in the calculation of the additional needs index. In most cases the impacts of these redefinitions of PCT boundaries are likely to be relatively small, as these PCTs are typically based on a local authority definition with the addition (or subtraction) of only one or two wards. The key exceptions are Tameside and Glossop PCT (which contains eleven wards in High Peak local authority) and Derbyshire County PCT (which excludes the eleven High Peak wards), whereas we have defined all High Peak wards as being within Derbyshire County. Moreover, we have amalgamated the three Birmingham PCTs (South Birmingham, Heart of Birmingham, and Birmingham East and North) into one Birmingham-wide PCT for the purposes of our analysis; similarly, we have amalgamated the two Cheshire PCTs (Western Cheshire, and Central and Eastern Cheshire, which are in part based on ward boundaries) into one Cheshire-wide PCT.

Table B1. Geographical definition of selected English Primary Care Trusts (PCTs).

PCT	Geographical definition	Treatment
Tameside and Glossop PCT	All Tameside ; <i>11 wards in High Peak</i>	All High Peak local authorities were classified as being in Derbyshire PCT
Derbyshire (Derbys) County PCT	Amber Valley; Bolsover; Chesterfield; Derbys Dales; Erewash; High Peak (<i>17 wards only</i>); North East Derbys; South Derbys	
Western Cheshire PCT	Cheshire West and Chester (<i>minus 8 wards</i>); <i>one ward in Cheshire East (Cholmondeley)</i>	Two Cheshire PCTs were amalgamated into one
Central and Eastern Cheshire PCT	Cheshire East (<i>except Cholmondeley ward</i>); <i>8 wards in Cheshire West and Chester</i>	
North Lincolnshire (Lincs) PCT	North Lincs (<i>minus Ferry ward and minus Ridge ward</i>)	The results for North Lincs were calculated without deducting the two wards
North East Lincs Care Trust plus Lincs Teaching PCT	North East Lincs (<i>plus Ferry ward</i>)	The results for North East Lincs were calculated without adding Ferry ward The results for Lincs were calculated without adding Ridge ward
South Birmingham PCT	Boston; East Lindsey; Lincoln; North Kesteven; South Holland; South Kesteven; West Lindsey (<i>plus Ridge ward from North Lincs</i>)	
Heart of Birmingham Teaching PCT	Birmingham (<i>14 wards</i>)	The three Birmingham PCTs were amalgamated into one
Birmingham East and North PCT	Birmingham (<i>16 wards</i>)	
North Staffordshire (Staffs) PCT	Newcastle Under Lyme; Staffs Moorlands (<i>minus three wards: Bognall and Stanley; Brown Edge and Endon; Caverswall</i>)	Results for North Staffs PCT were calculated without deducting the three wards
Stoke on Trent PCT	Stoke on Trent; Staffs Moorlands (<i>3 wards only: Bagnall and Stanley;</i>	<i>Brown Edge and Endon; Caversall</i>)

Table B1 (continued).

PCT	Geographical definition	Treatment
West Essex PCT	Epping Forest; Harlow; Uttlesford; <i>plus Bumpstead ward in Braintree local authority</i>	West Essex PCT was calculated without adding Bumpstead ward
Mid Essex PCT	Braintree (<i>minus Bumpstead ward</i>); Chelmsford; Maldon	Results for Mid Essex PCT were calculated without subtracting Bumpstead ward
Surrey PCT	Elmbridge; Epsom and Ewell; Guildford; Mole Valley; Reigate and Banstead; Runnymede (<i>except Engleford Green East and Engleford Green South</i>); Spelthorne; Surrey Heath; Tandridge; Waverley; Woking	Results for Surrey PCT were calculated without deducting the two Runnymede wards
Berkshire East PCT	Bracknell Forest; Slough; Windsor and Maidenhead; <i>plus two wards from Runnymede (Engleford Green East; Engleford Green West)</i>	Results for Berkshire PCT were calculated without adding the wards from Runnymede
East Sussex Downs and Weald PCT	Eastborne; Lewes; Wealden (<i>all wards except Ninfield and Hooe with Wartling</i>)	Results for East Sussex PCT were calculated without deducting Ninfield ward
Hastings and Rother PCT	Hastings; Rother; <i>plus Ninfield and Hooe with Wartling from Wealdon</i>	Results for Hastings PCT were calculated without adding Ninfield ward
Milton Keynes PCT	Milton Keynes; <i>plus Great Brickville and Newton Longville wards from Aylesbury Vale</i>	Results for Milton Keynes PCT were calculated without adding the two Aylesbury Vale Wards
Buckinghamshire PCT	Aylesbury Vale (<i>all wards except Great Brickhill and Newton Longville</i>); Chiltern; South Buckinghamshire; Wycombe; <i>plus four wards from South Oxfordshire (Aston Rowant, Chinnor, Thame North, Thame South)</i>	Buckinghamshire PCT was calculated without deducting the two Aylesbury Vale wards and without adding the South Oxfordshire wards
Oxfordshire PCT	Cherwell; Oxford; South Oxfordshire (<i>minus four wards</i>); Vale of White Horse (<i>except Shrivenham ward</i>); West Oxfordshire	Oxfordshire PCT was calculated without deducting the four wards in South Oxfordshire and the ward in Vale of White Horse
Swindon PCT	Swindon; <i>plus Shrivenham ward from Vale of White Horse</i>	Results for Swindon PCT were calculated adding the ward from Vale of White Horse

Appendix C. Data issues in applying the Scottish capitation formula to England, Wales, and Northern Ireland

Age – sex index

To apply the Scottish formula to PCTs in England, Wales, and Northern Ireland, data on population structure were accessed from the Office for National Statistics (ONS).⁽¹¹⁾ The ONS data were available only for nineteen quinary age groups, and we had to make an assumption that the proportion of the over-85 population in each PCT could

⁽¹¹⁾ Usually, the indices would be calculated for a given future year, based on population projections. As we are interested in what the relative allocations between PCTs would have been in 2009/10, we have simply used 2009 mid-year population estimates as an accurate reflection of population structure.

be categorised as being 85–90 and the proportion of the over-85 population that was aged over 90. This adjustment was made on an assumption that the proportion for each PCT was the same as the proportion for males and females in England, Wales, and Northern Ireland, respectively. Similarly, whereas the Scottish formula is applied to age groups 0–1 and 2–4, the population data for England, Wales, and Northern Ireland were available for age groups 0 and 1–4. We therefore made an assumption that 25% of the 1–4 age group in each PCT was 1 year old.

For the maternity care programme the age–sex index is based on the number of births by age of mother, and these data were aggregated to PCT level from local-authority-level data held by the ONS, the Northern Ireland Statistics and Research Agency, and the General Register of Scotland. For GP prescribing the index is calculated on the basis of the population structure of the registered GP population in each area, which was available from the Department of Health for both England and Wales and from Information Services Division Scotland for Scotland.⁽¹²⁾

Additional need index

Table C1 shows the mean values of the needs indicators for each of the four territories. Note that the weight attached to each indicator within the regression equations varies according to the care programme in question.

Table C1. Comparing additional needs indicators for Scotland, England, Wales, and Northern Ireland.

Indicator	Scotland	England	Wales	Northern Ireland
All-cause standardised mortality rate	100	76.6	83.2	81.5
Limiting long-term illness rate	100	88.7	100.5	112.9
Severe Disablement Allowance rate (%)	0.82	0.62	0.86	0.99
Single-person households (%)	32.9	30.1	29.1	27.3
Social rented households (%)	27.2	17.9	16.8	21.2
Mean house price (£)	141 603	211 136	151 528	162 392
Birth rate (%)	5.66	6.38	6.09	6.64

Excess cost index

The rural and urban classification for England and Wales (Bibby and Shepherd, 2005) is developed from hectare grid squares, and uses two measurement criteria. These are:

- Settlement form—each hectare grid square is associated with a particular settlement type: urban areas (with a population of greater than 10 000); small towns and urban fringe areas; and rural areas (including dispersed dwellings, hamlets, and villages).
- Sparsity—each hectare grid square is given a sparsity score based on the number of households in surrounding hectare squares up to a distance of 30 km.

Thus each ward in England and Wales can be categorised into one of six categories: urban (sparse and less sparse), town and fringe (sparse and less sparse), and rural (sparse and less sparse).

In England the urban category has been further categorised into four: major urban (population > 750 000); large urban (population 250 000–750 000); other urban (population 10 000–250 000 not classified as a market town); and large market towns (population 10 000–250 000 that meets market town service availability criteria).

⁽¹²⁾ For Northern Ireland data on the age structure of GP Registered populations were unavailable, so mid-year population estimates were used instead.

The Northern Irish urban–rural classification identifies eight categories of rurality (NISRA, 2005). These are based on population size but do not account for sparsity directly. The eight categories are: Belfast Metropolitan Urban area; Derry Urban area; large town; medium town; small town; intermediate settlement; village; and small village, hamlet, and open countryside.

Our approach to applying the Scottish excess cost formula to England, Wales, and Northern Ireland was as follows. The urban–rural classification of each ward in England and Wales was combined with estimates of ward population and aggregated to the level of each PCT to derive the proportion of each PCT’s population in each of the eight urban–rural categories available for England and six categories available for Wales. For Northern Ireland NISRA was able to provide estimates of the proportion of the population in each local authority that live within each of the eight urban–rural categories, and we aggregated these figures to PCT level. The ten Scottish urban–rural categories were reconciled to the eight urban rural categories available for England, the six urban rural categories available for Wales, and the eight categories available for Northern Ireland (table C2).

This provided us with an estimate of the proportion of each PCT’s population resident within each of the Scottish urban–rural categories. These proportions were then applied to the cost indices in table 6 to calculate the additional excess cost indices for each PCT.

Table C2. Reconciling urban–rural categories.

Scottish category (% of Scottish population)	Definition of Scottish categories	Corresponding English category (% of English population)	Definition of English categories	Corresponding Welsh category (% of Welsh population)	Definition of Welsh categories	Corresponding Northern Ireland category	Definition of Northern Ireland categories
Primary cities (38%)	Over 125 000 population	Major urban (33%) Large urban (14%)	>750 000 population 250 000–750 000 population	50% of 'urban— less sparse' (31.5%)	Identified by population density within 1 ha squares and other morphological traits	Belfast urban area (34%)	
Urban settlements (29%)	10 000–125 000 population	Other urban (27%) Large market town (8%)	Population of 10 000–250 000 not classified as a market town Population 10 000–30 000 and meets service availability criteria	50% of 'urban— less sparse' (31.5%) urban—sparse (2%)		Derry urban area (5%) Large town (13%) Medium town (6%)	18 000–75 000 population 10 000–18 000 population
Accessible small town (10%)	3000–10 000 population and within 30 min drive of a 10 000 settlement	Town and fringe—less sparse (9%)	Identified by population density within 1 ha squares and other morphological traits	Town and fringe—less sparse (14%)	As England	Small town (6%)	4500–10 000 population
Remote small towns (2%)	3000–10 000 population and with a 30–60 min drive to a 10 000 settlement	Town and fringe—sparse (<0%)		Town and fringe—sparse (4%)	As England	Intermediate settlement (4%)	2250–4500 population

Very remote small towns, mainland (1%)	3000–10 000 population and with a drive time >60 min to a 10 000 population settlement	None		None		None	
Very remote small towns, island (1%)	3000–10 000 population and with a drive time >60 min to a 10 000 population settlement	None		None		None	
Accessible rural areas (14%)	<3000 population and within 30 min drive of a 10 000 population settlement	Rural—less sparse (8%)	Identified by population density within 1 ha squares and other morphological traits	Rural—less sparse (8%)	As England	Village (4%) + 50% of small village, hamlet, and open countryside (13.5%)	1000–2250 population
Remote rural areas (3%)	<3000 population and with a 30–60 min drive of a 10 000 population settlement	Rural—sparse (1%)		Rural—sparse (9%)	As England	50% of small village, hamlet, and open countryside (13.5%)	Settlements of <1000 and open countryside
Very remote rural areas, mainland (2%)	<3000 population and with a >60 min drive to a 10 000 population settlement	None		None		None	
Very remote rural areas, island (1%)	<3000 population and with a >60 min drive to a 10 000 population settlement	None		None		None	

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