UNIVERSITY
OF YORK

CENTRE FOR HEALTH ECONOMICS
HEALTH ECONOMICS CONSORTIUM

Revising the RAWP Formula : Indexing Deprivation and Modelling Demand

by
ROY CARR-HILL.

DISCUSSION PAPER 41

Revising the RAWP Formula : Indexing Deprivation and Modelling Demand

by

Roy A. Carr-Hill

The Author

Roy Carr-Hill is Senior Research Fellow in Medical Statistics at the ESRC Centre for Health Economics. He has worked in the fields of social indicators and model construction in general for over 15 years and published several articles on this specific area over the last four years.

Acknowledgements

To Sal Cuthbert for typing several versions of this paper, to Alison Eastwood for her assistance on several points, to Pip Stephenson for collecting some of the data, and to Alan Maynard, Charles Normand, and Ken Wright for their comments.

Further Copies

Further copies of this document are available (at price £3.00 to cover costs of publication, postage and packing) from:

The Secretary
Centre for Health Economics
University of York
Heslington
York Y01 5DD

Please make cheques payable to the University of York. Details of other Discussion Papers can be obtained from the same address, or telephone York (0904) 430000 extension 5751/2.

The Centre for Health Economics is a Designated Research Centre of the Economics and Social Research Council and the Department of Health and Social Security.

Abstract

The RAWP formula for the allocation of health care resources between Regional Health Authorities is being revised. It is being suggested that a socio-economic factor should be included as a measure of deprivation as well as the mortality rates. The favoured measure, the Jarman index, is methodologically confused, based on out-of-date data, and uninterpretable. Further, the analysis which has been commissioned appears to rely on hospital use data as a proxy for need. This is essentially a conservative approach and will lead to a formula reflecting existing practices rather than need. Proposed 'adjustments' for avaiability are inadequate in the abscence of a full-scale model. The derivation of a formula should be theoretically based, it should take proper account of supplier-induced demand, and there should be explicit and comprehensible criteria for accepting a formula as an improvement on the current one.

I. Introduction

What are the appropriate criteria for distributing resources to different areas? The correct approach is to find a way of allocating resources according to 'need'. The question of how 'need' for health services (specifically health care services) should be defined has been a rumbling issue ever since the RAWP formula was introduced in 1976/7.

The original RAWP formula started out with the following syllogism:

- Morbidity measures need
- Mortality is a proxy for morbidity
- Therefore mortality is an indicator for need.

Several studies have challenged the second statement that mortality is a good proxy for morbidity (e.g. Knox, 1979). In particular, there have been demonstrations showing a statistical association between various measures of morbidity and socio-economic factors over and above any relationship with mortality. Indeed, it is now commonly agreed that RAWP's choice of mortality as a surrogate for morbidity was inadequate - although it is much less clear what should be put in its place. It has also been argued that it is inappropriate for variations in resources to be directly related to differences in mortality rates (Butts 1986). This latter article provides an important curtain-raiser to the recent review of the RAWP formula.

In announcing the review, the Secretary of State made it clear that "the underlying principle of RAWP, that of securing equal opportunity of access to health care for people in equal need, is not in question ... However, as Regions move closer to their RAWP targets, it becomes

increasingly important that the targets themselves should reflect relative need as fairly as possible. The review will therefore ... look at the scope for improving the measurement of need." (DHSS, 1986, Annex C).

The concern of the Interim Review Report was that there should be

> "An analysis of the proxies for need for health services, including different forms of SMRs, social and other factors carried out on a small area basis".
>
> (DHSS, 1986, para 3.15, p.4)

Coopers and Lybrand were asked to carry out this analysis and co-opted Professor Jarman among others into their team. Their report has not been published but the general lines of their approach undoubtedly follow the brief provided by the NHS Management Board.

The issue therefore, is whether an adequate model can be developed so that the allocation formula more closely reflects the 'need' for health services defined in terms of characteristics of the population. Given the focus on small areas, there are clearly severe practical constraints on the kinds of variables which can be included in a modelling exercise. As a consequence, many statistical analyses of the relationship between socio-economic factors and health status measures at small area level have tended to throw everything into the melting pot and hope the computer comes up with an answer (cf Edwards 1975). But, whilst such an approach is perhaps, not surprising given the paucity of data it is not excusable. The measurement of need by a proxy indicator has to be justified.

The choice of measure or measures should be theoretically based and empirically valid; that is, indicators should be based on a clear

definition of 'need', and variations in those indicators should reflect variations in need; moreover, the indicators must not be substantially affected by other factors independently of need. For example, a high bed occupancy ratio can reflect over-zealous doctors as much as effective use of resources; a low ratio may be due to a lack of supervising doctors as much as low levels of morbidity. The pitfalls in interpreting such statistics for policy purposes are well-known: but very similar ambiguities occur with socio-economic data.

It might be argued that the demand for a theoretical justification of the indicators chosen is a counsel of perfection. But without any justification, we cannot know precisely what is being measured, how it relates to 'need' and, most importantly, how the allocation formula should be modified.

This paper reviews some of the issues involved in the development of a revised formula (see also Morgan, Mays and Holland 1987). The first section examines the problem of defining and measuring need and/or social deprivation. It focusses in particular on the Jarman Index as a possible candidate given that Professor Jarman was associated with the Coopers-Lybrand team. The second section examines the problems of modelling demand; and, in particular, the difficulties of establishing point estimates for coefficients to be used as parameters in a resource allocation formula.

II Measuring Social Deprivation

A wide variety of indices of social deprivation have been proposed in the literature. Some are 'general purpose', some are specific to particular fields. In health, a wide variety of indicators have been

proposed since Government Bills of Mortality were used by social reformers in the nineteenth century to argue a case for clean water and a sewage system. More recently in the UK, the issue of an appropriate social indicator for use in the health care field has taken on a new lease of life because of the possibility that the review of the formula used for allocating resources to hospital and community services might incorporate some consideration of socio-economic factors.

Empirically, then, the problem is to choose appropriate data to reflect the variations in socio-economic conditions. This has usually been couched in terms of the choice of one of the composite indictors based on the 1981 Census data. Because the 'raw' socio-economic variables which can be derived from Census data are highly correlated, we either have to choose a small subset or use a statistical reduction technique. As the former requires thought the latter has often been the preferred approach (e.g. as used to generate A Classification Of Residential Neighbourhoods), but the DoE index and the Townsend index are purposeful choices of a small subset of variables.

Given the context of devising a formula for annual allocation of resources between RHAs, it is, a priori curious to rely on 1981 Census data. Whilst those might be the only data available on a local "small area" level, there are many other alternatives, up-to-date data sets, on the RHA level. For example, both the General Household Survey and the Labour Force Survey collect data of this kind on an annual or biannual basis and both are large enough to provide reliable estimates at the RHA level.

Even apart from this "commonsense" approach to the problem, there are two cogent and practical arguments against the sole use of such indices in

a formula for annual allocations because they are based on 1981 Census data:

(1) Circumstances may have changed since 1981. None of them can be updated in a precisely similar form as they depend on very specific kinds of data which are only collected at Census. This is acknowledged, yet remains important. It will become an increasing embarrassment over the next five years until corresponding analysis of the 1991 Census data are available. Moreover, if the formula remains the same, there will then be a sudden and mostly unpredictable shift in the pattern of allocations.

(2) Limited Choice of Variables. For a variety of reasons, the Census is restricted in the kind of data it elicits from the population. The obvious restriction, which affected the 1981 Census (Booth, 1986) was the ethnic minority question which asks about country of origin rather than ethnic group membership. As shown elsewhere (Carr-Hill, Eastwood and Stephenson 1988) this produces a distorted picture of the distribution of 'ethnic minorities between regions of the country as compared to any other survey. But there are similar, though less severe, problems with interpreting other variables: for example, the proportion who have changed address within a year includes yuppies as well as vagrants; even the unemployment variable has no contemporary referent because of frequent changes in definition and method of counting. Even more limiting, in the context of constructing an index of deprivation, is the absence of a direct question about income or wealth.

II.1 The GP underprivileged area score (the Jarman index)

The ACORN index and the basic DoE index (but not the derivatives) are obtained from a statistical reduction of the Census variables. They have

no theoretical justification at all, but they can be said to represent some (statistical) best estimates of the combined importance of the particular set of variables included. Their other saving grace is that they do not involve double counting - because of the way they are calculated.

Other indices, such as the DoE social index (Irving and Rice 1984) and the Townsend index (Townsend 1987) are constructed by combining a small, purposefully selected subset of variables with simple weights. Whilst this procedure involves double counting, it's extent can be relatively easily calculated.

The GP underprivileged area score (Jarman, 1983; Irving 1983) neither used a statistical reduction technique nor summed up the values of a selected subset. Indeed, it is a bit of a methodological mystery. It is based on arbitrary transformations for a selection of the Census variables combined according to weights from a sample of GPs. The selection of factors they were asked to weight were selected by a totally unrepresentative sample of London GPs, so the Index has a built-in London, South-East and Urban bias. Unsurprisingly, there is no factor to represent the problems of, for example, sparse populations.

Of the social factors for which Census data were available, Jarman originally chose ten: Under Fives, Unemployment, Poor Housing, Ethnic Groups, Lone Parent Families, Elderly alone, Overcrowding, Lower Social Classes, Mobility, Fewer Married families. In subsequent applications, the 'poor housing' and 'fewer married families' variables have been dropped, hence the UPA8 (eight-item Under Privileged Area score). Whilst the latter was dropped for apparently technical reasons - it "proved difficult to define accurately from census data" - the explanation for the exclusion of

the former is more interesting. Jarman (1984) reports, it was "because of the responses received by members of the committee [the underpriviledged areas subcommittee of the General Medical Services Committee of the BMA] when the results from their own areas were considered" (p.1590, my italics). Essentially, the results did not fit their preconceptions.

The transformation, which involves taking the inverse of the sine of the square root of each variable, is mystical. The idea is to make the distributions of each of the component variables symmetrical; and indeed it probably does. But the 'real world' is not symmetrical. There might be an argument for transforming the combined score (rather than a component variable) if it were claimed that the thing the index is meant to represent - work-load pressure on GPs - is symmetrical, but that also seems unlikely. It makes the interpretation of the index very difficult.

The scores were obtained from responses to a questionnaire sent to a 1 in 10 sample of all general practitioners in England (N=2584) about the importance of services and social factors. Of these, 1802 questionnaires were used in the final analysis giving a 'response rate' of 70%. These weights were used to construct an index and scores have been devised for all 9821 wards in England and Wales (Irving and Rice, 1984).

This method of combination of variables is not sensible and involves an unknown element of double counting. This is both because of the weights and the overlap between the variables . Assuming, for example, that there is some common element to localities with more lone parents, more unskilled, more unemployed, and more overcrowded, the weighting system means that this 'common element' will be counted thirteen times (3.01 + 3.74 + 3.34 + 2.88 = 12.97) . It is not sufficient for Jarman (1984) to

point to the relatively low the intercorrelations between crucial pairs of variables (like between ethnic minorities and the unemployed) and so argue that, in fact, there will be not much double counting; for, because his procedure used the inverse of the sine of the square root of the variables, the transformed variables are likely to be more highly correlated because they are all forced towards a particular kind of distribution. Indeed, the whole procedure appears to be a bunch of arithmetical tricks applied to Census data for no obvious reason (cf Tukey 1977).

II.2 Is Jarman in any case Appropriate in this context?

There are three further doubts about the relevance the GP underprivileged area score to the problem of allocating resources to the health services in general.

First, its reliability and validity. Irving and Rice (1984) claim that the Borough scores are stable because their relative ranks are only marginally affected by large changes in the relative weights of the different variables. Jarman (1984) claims validity from his follow up comparison of the UPA8 scores and ratings given by GPs in five FPC areas. (Gloucestershire, West Glamorgan, Northamptonshire, Bradford, Merton, Sutton and Wandsworth). He asked the LMC in the five FPC areas to shade the "worst" and the "intermediate" areas and compared their maps with those generated by the UPA8 scores. He concluded that at most, only 26 pairs of wards out of 413 pairs differed (6.3%)

If, however, the UPA8 map were to be used as a decision tool for allocating resources within each of the FPCs (which is the parallel exercise in the present context), then the issue is how many areas should be selected for 'different' treatment. In most FPC areas this is a case of

seeing which of the 'worst areas' according to the LMC are not identified by UPA8; but in West Glamorgan where the bulk of areas are rated 'worst', the issue is the identification of 'intermediate areas' (see Table 1, columns 2 and 3).

Table 1 : Identifying Wards with Jarman

	Numbers of Wards	According to LMC		Number of Target Areas	Identified by UPA8	
		Worst	Intermediate		Correctly	Mistakenly
	(1)	(2)	(3)	(4)	(5)	(6)
Bradford	30	9	9	9	8	1
Merton Sutton & Wandsworth	67	14	20	14	13	2
Gloustershire	136	4	0	4	3	1
West Glamorgan	55	49	6	6	4	1
	288	76	35	33	28	5

On this basis, Table 1 (columns 4, 5 and 6) shows how 'targetting' would have worked if based on Jarman UPA8 rather than LMC prejudices. Comparisons of the last three columns suggest a much higher level of misallocation than is implied by Jarman's figure of 6.3%.

Leavy and Wood (1985) compared the value for the index with 'objective' indicators of general practitioner workloads in three selected family practitioner committee areas (Manchester, Salford and Trafford). They compared the GP underprivileged area score with empirical ward based evidence about areas of greatest difficulty - whether that was defined in terms of areas with the greatest need for general practitioner services,

areas where general practitioners are under greatest pressure, and areas where hospital and community health services are "deficient". They found that doctors in the "worst" wards (as identified by high GP underprivileged area scores) had the highest doctor-patient ratios; further analysis showed that the index could not be used to directly identify wards which posed the greatest health challenge.

Secondly, assuming that, with appropriate adjustments - and using a wider range of data than is available in the Census - the method can identify factors which tend to increase the workload in primary care, there is no reason to believe that the factors influencing the relative need for community health services and for hospital care will be the same. Indeed, they ought to be different as each of the three segments of the National Health Service - community care, hospital care and primary care - is intended to respond to different needs.

Thirdly, the classifications and ranking are idiosyncratic. Twelve of the fifty most underprivileged health districts in England, according to GP underprivileged area score are in London.* Obviously, there are other - equally plausible - indices of deprivation which would lead to very different rankings; from the point of view of assessing health-related deprivation, it is interesting to note that none of the 25 health districts in England and Wales with the highest SMRs are in London (Table 2).

Of course, this bizarre result is due as much to the idiosyncratic selection of variables included within the Census itself as to the particular method of combination, but it makes it difficult to understand

---

* A similar remark applies to the DoE social index.

how such an index can sensibly be used in a current resource allocation formula.

Table 2 : The Twenty Five Health Districts in England with the Highest SMRs (1983).

Health District	Health Region	SMR
North Manchester	North Western	128
Salford	North Western	123
Blackburn, Hyndburn & Ribble Valley	North Western	120
Dewsbury	Yorkshire	120
Halton	Mersey	120
Oldham	North Western	119
Wigan	North Western	119
Wakefield	Yorkshire	119
St. Helens & Knowsley	Mersey	118
Burnley, Pendle & Rossendale	North Western	118
West Cumbria	Northern	118
Gateshead	Northern	117
Tameside & Glossop	North Western	117
Hartlepool	Northern	116
South West Durham	Northern	116
Bolton	North Western	116
Central Manchester	North Western	116
North Tees	Northern	115
West Birmingham	West Midlands	115
South Manchester	North Western	115
South Tees	Northern	114
Liverpool	Mersey	114
West Lancashire	North Western	114
South Tyneside	Northern	113
Walsall	West Midlands	113

Source: OPCS 1983 Vital Statistics Servies VS, No. 10.

Finally, it should be remembered that the Jarman Index was devised in order to reflect variations in need (for GP services) at a local level. It is, a priori inappropriate for use at the Regional level. It is unclear how a Regional score should be calculated whether directly using Regional values for the variables or indirectly by compositing District scores. The former approach would seem to be against the spirit of Jarman (an index to be used for identifying small areas); the latter poses difficult problems

of interpretation. For, assuming it is some weighted average of the District scores, the relationship between the final RHA score and 'deprivation' is completely unfathomable because of the transformation. Just as the weight of a five litre demijohn is not the same as the weight of five, one litre bottles, the sum of transformed variables is not the same as the transformed value of the sum of the variables.

II.3 So What?

Despite these criticisms of Jarman one might argue that the choice is limited to one of the indexes currently available, and that the choice has little impact on the final allocations. After all, they are based on similar kinds of variable (see Table 3) and, although the various combinations include different variables, their overall effect in any statistical analysis is usually very similar (cf. Johnson and Ganley, 1986). The issue is obviously empirical but that approach seems a little cavalier if one remembers that a typical RHAs budget is around £1bn so that then even a 0.1% shift in weighted population is worth £1m.

The issue then is how much effect does one or other variable have on the overall score, as compared to the range of RHA scores. The data (and scores) are not publicly available at RHA level but plausible estimates can be made of the "impact" of changes. Whilst Jarman (1984) shows how the range of scores for electoral wards is from -63 to +73 (in arbitrary units), clearly any larger area (such as DHA or RHA) will combine wards with different scores so that the range will be narrowed. Suppose that the range is halved at each step up, so that the range between DHAs is c. -30 to +36 and that between RHAs is c. -15 to +18. Then, on the basis of calculations for two of the Standard Regions the South East and Yorkshire and Humberside Regions) it can be seen from Table 4 that the impact of

Table 3 : Weights combining variables into indicators of deprivation

	Department of the Environment Basic index	Department of the Environment Social index	Under Privileged Areas*
OVER 65	0	0	2.5
PENSIONERS ALONE	1	2	2.6
UNDER 5	0	0	1.9
ONE PARENT	1	2	1.2
UNSKILLED	0	0	1.5
UNEMPLOYED	2	2	1.3
LACKS AMENITY	1	1	1.4
OVERCROWDED	1	1	1.2
CHANGED ADDRESS	0	0	1.1
ETHNIC MINORITY	1	1	1.0

* For easier comparison with other columns UPA weights here are reduced by a factor of 2.5, and the actual weights are given with technical details in the appendix.

Table 4 : Does it Matter : Effects of Excluding Variables from UPA8 Score

	South East Standard Region	Yorkshire and Humberside Standard Region
	Deviation from original score	
Excluding one at a time		
Ethnic Group	-3.5	+0.9
Change of Address	-2.5	+0.1
Excluding both		
Ethnic/Change	-6.0	+1.0

excluding specific variables, thereby generating another "index", is not marginal (a fifth of the range).

III Revising the Formula

At the same time, the review of RAWP was undertaken in order to improve on the existing formulae. The choice of criteria to assess whether or not a proposed formula is an improvement is clearly crucial.

Given the brief from the NHS Management Board, the analysis has almost certainly been restricted to hospital use data. In the light of the prior exercise carried out by Coopers and Lybrand for SETRHA, the 'test' has probably been related to the extent to which variations in hospital use between small areas can be accounted for by a combination of socio-economic variables. Both features pose considerable problems of analysis and interpretation.

III.1 A conservative formula?

The focus on hospital use is curious as a measure of need. First, the most comprehensive measure of hospital use is probably the amount of resources consumed - or, in monetary terms, the expenditure on hospital services. On this line of argument, the best indicator for distributing resources to the hospitals is simply the amount they already get! Second, the claims that hospital use is a good proxy for morbidity is very contentious. Morgan, Mays and Holland (1987) succinctly summarise a substantial body of recent evidence to show how both variations in provision and variations in professional and patient behaviour affect hospital use. More poignantly, the original (1974) Resources Allocation Working Party specifically ruled out using hospital based measures because hospital use is, at least in part, determined by supply.

This means that there are two simultaneous processes which jointly determine the amount of health care publicly provided. The public 'demand' a level of provision depending, we suppose, on their socio-economic characteristics and physical constraints on access; the professionals supply a given level of service again according to the socio-economic profile and physical constraints. Since the only empirical data available is the amount of provision without an explicit analysis of this joint determination, it is unclear whether it is demand or supply which is being modelled.

Superficially, it looks as if this problem could be avoided by introducing a measure of 'access' and/or 'availability' into the analysis. Spatial interaction models, used by health service planners (see, e.g. Mayhew 1986) to predict patterns of patient flows after the installation of a new facility, might be used in an attempt to 'control' for the effects of supply. But this procedure is fraught with difficulties (see also Morgan, Mays and Holland, 1987).

The usual approach is to concentrate on the variations between small areas. The idea is that the level of hospital use, or whatever, will be a characteristic of the area because the pattern of provision will be uniform across a small area and because the area will be relatively homogeneous on the characteristics of its population.

The argument that the electoral wards are small enough to be relatively homogeneous in the characteristic of its population is not unusual; indeed, many other studies in this field (see, for example, Hume and Womersley, 1985; Leavey and Wood, 1985; Scott-Samuel, 1984; Townsend, Simpson and Tibbs, 1984) have argued for analyses at the electoral ward level because Health Districts (or Local Authorities) are too large and

heterogeneous. But the choice of electoral ward is "faute de mieux" (Townsend, Simpson and Tibbs, 1984; Townsend, Phillimore and Beattie, 1986) and it is difficult to justify the choice of the electoral ward as relevant to any practical or policy considerations. Electoral wards are only relevant to policy at local election time and their practical relevance depends upon the extent to which they correspond to a "community".

Those authors are correct to argue that there is considerable variation between electoral wards within a Health District (see the left hand column of Table 5) and hence dangers of committing the ecological fallacy "of making causal inferences on the basis of associations at the group level". But the same problem can obviously also apply to their choice of electoral wards. This is illustrated by comparing the range of characteristics in the census enumeration districts of an electoral ward with the range of characteristics between electoral wards in a Health District (see the right hand column of Table 5).

The implication of that argument is that aetiological analysis is best conducted at the level of the individual or 'perhaps' the enumeration district. But however desirable it might be, individual-based data, whether of health status or of living standards, are simply not available on a routine basis; and no data are collected for enumeration districts except at Census time. A "pure" version of this argument therefore condemns us to using special studies (for data based on individuals) or to out-of-date data (for census enumeration districts).

On a more practical level, the electoral ward is simply not appropriate for the analysis of the distribution of health care resources. People move across electoral ward boundaries to use health care services

Table 5 : Variability Between and Within Wards : Unemployment and Lack of Amenities : 1981 Census.

	Unemployment			Lacking Amenities			
Wards in Barnsley		EDs in Ward AA		Wards in Barnsley		EDs in Ward AA	
AA	5.5	1	8.7	AA	1.6	1	9.0
AB	6.9	2	5.7	AB	0.2	2	8.6
AC	5.5	3	4.9	AC	1.7	3	3.6
AD	5.6	4	2.3	AD	5.3	4	1.4
AE	5.5	5	2.1	AE	1.4	5	0.0
AF	4.0	6	10.3	AF	5.0	6	0.0
AG	3.1	7	6.3	AG	0.9	7	0.0
AH	5.5	8	9.0	AH	4.9	8	0.2
AJ	6.1	9	6.5	AJ	3.3	9	2.2
AK	3.2	10	4.9	AK	0.9	10	0.0
AL	3.8	11	7.6	AL	2.8	11	1.1
AM	4.0	12	4.7	AM	2.5	12	0.5
AN	6.1	13	4.4	AN	1.0	13	4.7
AP	4.4	14	3.3	AP	1.2	14	0.3
AQ	5.5	15	1.8	AQ	2.4	15	0.0
AR	2.6	16	8.8	AR	3.2	16	2.4
AS	4.5	17	11.5	AS	2.0	17	0.0
AT	3.8	18	5.1	AT	1.4	18	0.8
AV	3.8	19	1.7	AV	1.4	19	2.1
AW	4.6			AW	2.6		
AX	4.2			AX	1.7		
AY	4.6			AY	4.6		

for reasons of convenience and quality which may be unrelated either to distance or to aggregate characteristics of the electoral ward as derived from the Census.

The argument that supply factors are standardised because the analysis focusses on small areas is phoney even if electoral wards could be treated as homogeneous because of variations in GP referral practices (e.g. Wilkin and Smith, 1986) and of variations in patient tolerance levels (e.g. Blaxter 1984). Even ignoring such intra-District variations, the fact that the pattern of supply of hospital services is constant across electoral wards within a District would only avoid the problems of distortion due to supplier-induced demand, if the empirical analysis could be restricted to one District at a time. But, of course, any useful empirical analysis will

be across many Districts - and therefore across many (groups of) hospitals - so that there is considerable variation on the pattern of supply among the observations unrelated to either distance or socio-economic characteristics.

In sum, therefore, the attempts to 'control' for supply have two problems: the most disaggregated level at which data is available may still not avoid the 'ecological fallacy'; and because there is no obvious way of allowing for variations in professional and patient behaviour, the proposed adjustment, based only on distance and volume, are mechanistic. The basic problem is that 'supply' and 'demand' are jointly determined and disentangling this simultaneity requires a more sophisticated approach than those currently proposed.

III.2 Estimated Coefficients*

The lack of a proper model makes it difficult to place any confidence in the coefficients from simplistic regression analyses of the kind which have so far appeared in the literature (e.g. Butts 1986). Clearly, however, for purposes of resource allocation, some coefficients have to be used, even if only implicitly, to translate variations in measured 'need' to variations in resources.

One particular issue is the current linear relationship between SMRs and allocations to RHAs. Butts (1986) implied, in his article published prior to the current work on the national RAWP formula, that the existing direct relationship in the RAWP formula was inappropriate. Estimating a model with standardised admission rates and both SMRs, the Jarman 8 score

* Any coherence the argument in this section might have is owed to discussions with Alison Eastwood and Charles Normand.

and a proximity measure, he says "the form of the model clearly indicates the need for a constant term. In other words, the demand expected from a particular area is an average value with modifications about the average to reflect the different features of that local area". (Butts, 1986, p827).

He goes on to say that "this is in contrast to the RAWP assumptions that SMRs have a direct effect - that is no constant term", and that "the inclusion of a constant term attenuates the effect of SMRs". It is unclear, exactly what the parallel is meant to be between an analysis of 'need' (what SMRs purported to proxy) and of demand; but it is likely that a similar approach has been adopted by the Coopers-Lybrand team for the current review.

The argument is difficult to follow. There will indeed be an average demand across electoral wards within a Region, or across RHAs within England, but it does not therefore follow that there should be a constant term in any model predicting demand: if conditions are wonderful, demand could be zero. One might suppose a "fixed" or "minimum" level of demand among otherwise perfectly healthy populations because of the vicisstudes of entry to, survival in, and exit from this mortal coil. Then demand (or need?) would increase as conditions got worse but the rate by which it would increase depends on the relationship between need and demand (=use in this case); and, in particular, upon the resources required to provide appropriate (and effective) treatment per unit of need.

In the absence of substantial evidence on this point, making it very difficult to talk about an efficient resource allocation policy (pace Culyer 1988), one can only speculate as to exactly how 'need' should be taken into account (whether need is measured by SMRs or anything else). Changes in the measure of need might overstate the case for more resources

(e.g., if SMRs are used, because in areas with high SMRs, people are dying from conditions not amenable to medical intervention); or, changes in the measure of need may understate the case (e.g., if SMRs are used, because people become desensitised to high levels of mortality). Moreover, the correct coefficient for policy purposes depends on a view about the balance of these and other factors and one's confidence in the proxies for need actually used in any empirical work.

In the case of the proposed 'abatement' for SMRs, no judgement appear to have been made about these factors. The argument in the pevious section raises considerable doubt about the adoption of hospital use as a proxy for need and, indeed about the adequacy in this context of the kind of regression model employed by Butts (1986). In the abscence of a proper analysis, there is no good case for changing the current, easily comprehensible, 1:1 relationship between variations in SMRs and variations in resources.

IV Conclusions

The RAWP targets have nearly been reached. The DHSS are proposing to modify the formula to approximate need more closely; in particular they are concerned that their SMRs may not be a very good proxy for need and that a socio-economic factor should be introduced.

There are good, a priori reasons for introducing a measure of need based on socio-economic factors, although Mays and Bevan (1987) argue strongly that there is no convincing empirical case for displacing SMRs. In any case, whatever measure of need is used it should be clearly defined empirically plausible, and transparent in its effects. The GP

underprivileged area score fulfills none of these criteria. Why not use simple, current, measures of poverty? (see Carr-Hill 1987).

The introduction of another measure - as well as SMRs - raises the issue of the form of the formula. Just prior to this review exercise, Butts (1986) had argued, on the basis of an analysis of hospital use data, that a regression adjustment was more appropriate than a proportionate one. In principle, it would be preferable to base allocations upon statistically reliable estimates of the relationships between health care resources and variations in need. But, neither the data nor current theory are adequate to support such a model. In their absence apart from providing the opportunity to display statistical virtuosity, there is little to commend the use of indicators based on inappropriate data and estimates which are likely to reflect existing rather than appropriate practice.

Without full access to the data, it is difficult to assess the force of these criticisms. The crude calculations in section II suggest that the choice of index to measure "social deprivation" matters; clearly given the range of SMRs between RHAs, a less than proportionate adjustment also has a substantial impact upon allocations. Should resource shifts of whatever magnitude be based on analyses of such a fragile and ambiguous nature?

References

Blaxter, M. (1984). "Equity and consultation rates in general practice" Brit. Med. J., 288, 1963-7.

Booth, H. (1988) "Identifying Ethnic Origins". Chapter 9 in Britain's Black Population, 2nd Edition, Farnborough, Gower.

Butts, M. (1986) "Questioning Basic Assumptions" The Health Service Journal, 19 June, 826-27.

Carr-Hill, R.A. (1983). Indicators of Health and of Inequalities in Health, Royal Society of Medicine, London, November 21st/22nd, 1983.

Carr-Hill, R.A. (1987). Health Status, Resource Allocation and Socio-Economic Conditions, Interim Report of Health Needs Research Study, for Wolverhampton Borough Council and District Health Authority; York, Centre for Health Economics, University of York.

Carr-Hill, R.A., Eastwood, A. and Stephenson, P., (1988) "Using Census-Based Information on Ethnic Minorities to Compare Regions". mimeo, Centre for Health Economics, University of York.

Culyer, A.J. (1988) "Inequality of Health Services is, in General, Desirable". In Green, D.G. Acceptable Inequalities, IEA, Health Unit Paper, No. 3, pp.33-47.

Department of Health and Social Security (1976). Sharing resources for health in England Report of the Resource Allocation Working Party, London, DHSS.

Department of Health and Social Security (1986) Review of the Resource Allocation Working Party Formula, Report by the NHS Management Board, December.

Edwards, J. (1975), "Social Indicators, Urban Deprivation and Positive Discrimination", J. Social Policy, 4, 3, 275-287.

Hume, S.M. and Womersley, J. (1985) "Analysis of death rates in the population aged 60 years and over of Greater Glasgow by postcode sector of residence". J. Epidemiology and Community Health, 39(4), pp. 357-365.

Irving, D. (1983). Identification of Underprivileged areas: Measuring the Need for NHS Services in the Community, Technical Paper, LSE, London.

Irving, D. and Rice, P. (1984) Information for health services planning from the 1981 Census 84/11, London, Kinds Fund.

Jarman, B., (1983) "Identification of underprivileged areas", Brit, Med, J., 286, 1705-1709.

Jarman, B., (1984) "Underpribileged areas: validation and distribution of scores", Brit. Med. J., 289, 1587-1592.

Johnson, K.W. and Ganley, M.G. (1986). Social Deprivation Indices for Revenue Allocation Formulae, prepared for West Midlands RHA.

Knox, P. (1979). "Medical deprivation, area deprivation and public policy", Social Science and Medicine, 15D, 3223-328.

Leavey, R. and Wood, J. "Does the underprivileged area index work", Brit. Med. J., 291, pp. 709-711.

Mayhew, L. (1986). Urban Hospital Location, London, George Allen and Unwin.

Mays, N. and Bevan, G., (1987) Resource Allocation in the Health Service: A review of the methods of the resource allocation working party, Occasional Papers in Social Administration 87, London, Bedford Square Press/NCVO.

Morgan, M., Mays, N. and Holland, W.H. (1987) "Can Hopspital Use be a measure of need for health care? J. Epidemiology and Community Health, December, 41, 4, 269-274.

Scott-Samuel, A. (1984). "Need for primary health care: an objective indicator", Brit. Med. J., 288, 457-458.

Townsend, P., (1987). "The Geography of Poverty and Ill-Health" in Williams, A. Economics and Health, Croom Helm.

Townsend, P., Phillimore, P. and Beatie, A. (1986). Inequalities in Health in the Northern Region An Interim Report, Newcastle and Bristol: Northern Regional Health Authority.

Townsend, P., Simpson, D. and Tibbs, N. (1984). Inequalities of Health in the City of Bristol, Department of Social Administration, University of Bristol.

Tukey, J.W. (1977). Exploratory Data Analysis, McGraw Hill, Princeton, New Jersey.

Wilkin, D., Metcalfe, D.H.M., Hallam, C., Cooke, M., Hodgkin, P.K. (1984). "Area Variation in the process of care in urban general practice" Brit. Med. J., 289, 29 July 1984, pp. 229-232.

Wilkin, D. and Smith, A. (1986). Variation in GP referrals to consultants, DHSS Centre for Primary Care Research, Department of General Practice, University of Manchester.