Fiscal Studies (2000) vol. 21, no. 2, pp. 231–267

Getting the Smaller Picture: Small-Area Analysis of Public Expenditure Incidence and Deprivation in Three English Cities

GLEN BRAMLEY and MARTIN EVANS*

Abstract

This paper examines public expenditure incidence at small-area level in cities. The motivations for such research are briefly reviewed. The article reports on an attempt at measuring public expenditure across the majority of programmes down to the level of Census wards and the actual results obtained for three urban local authorities in England. The relationship between spending, income and deprivation is examined overall and for particular spending programmes, using a number of approaches including regression-based expenditure models. The conclusions suggest that spending is indeed targetted on poorer areas but raise questions about both the strength of this relationship and how best to measure deprivation and the need to spend.

JEL classification: H50, I32, I38, R51.

---

*Bramley is at the School of Planning & Housing, Edinburgh College of Art/Heriot-Watt University. Evans is at the Centre for the Analysis of Social Exclusion, London School of Economics.

This paper is based on research commissioned by the Department of the Environment, Transport and the Regions (DETR) as a pilot study to examine the feasibility of generating small-area estimates of public expenditure across all main locally relevant programmes. A number of government departments were involved in the original commissioning of the research, in the course of the work itself and in commenting on the draft findings. In addition, the local authorities and other local and regional public agencies in the three study areas provided invaluable co-operation with the study in the form of staff time, guidance, contacts and, most importantly, data. The authors would like to acknowledge the contribution of all of these organisations and individuals, as well as of other members of the research team, particularly in the London School of Economics and the London Research Centre, in enabling the overall project to be undertaken and so providing a basis for this paper. The authors of the paper take full responsibility for any errors of fact or interpretation and for any opinions expressed here.

I. INTRODUCTION

This paper is about the pattern of public expenditure incidence at small-area level in cities. It draws on a major recent government-sponsored project that examined the feasibility of measuring public expenditure across the majority of programmes down to the level of Census wards and attempted to generate measures for three urban local authorities in England.[1] The three case-study areas — London Borough of Brent, City of Liverpool and City of Nottingham — are all characterised by substantial concentrations of deprivation and have all been the recent subject of significant government initiatives to promote regeneration under the Single Regeneration Budget (SRB) and earlier programmes. The study was motivated by a concern with urban deprivation and regeneration, which is reflected in this choice of case-study areas and also in the emphasis placed, in analysis and results, on the relationships between spending and deprivation.

The study is probably unique for its combination of small-area focus and comprehensiveness of coverage of public spending (Bramley et al., 1998). It raises a number of interesting questions, ranging from 'why do it at all?', through 'how to do it?' and 'how robust are the methods and data?', to questions about what the results tell us about public spending mechanisms in cities, relationships with deprivation, and the meaning and measurement of deprivation. This paper concentrates on the last two questions. It briefly reviews motivation and provides a summary of the methodology[2] before discussing some major findings. We concentrate mainly on issues relating to the measurement of deprivation and its relationship with different types of spending, taking account of some other factors that may drive spending patterns. Finally, provisional measures of dependency on public spending relative to incomes and of redistributional impacts of government activity by city and small area are considered.

II. WHY DO IT?

It is worth asking the question 'why do it?' in relation to this research, if only because it proved quite difficult and costly to get a reasonably clear and comprehensive picture of spending, even for only three local authorities. Unlike many government research briefs, this one was relatively broad in scope and relatively silent on the reasons for doing it. Partly with the benefit of hindsight, the authors would offer the following suggested reasons for trying to measure the small-area pattern of public spending:

---

[1]Much more detail about the research project and full description of results service by service may be found in the main DETR report (Bramley et al., 1998).

[2]The methodology of the study is discussed in Bramley et al. (1998).

1. Much of public service provision and spending (if not all) is justified in part by arguments about distribution, i.e. public provision is necessary to ensure that the poor receive something or that services are truly universal (Le Grand, Propper and Robinson, 1992; Glennerster and Hills, 1998). Spending evidence from rich and poor small areas can help to monitor whether these assumptions are correct.
2. The welfare state is tending to shift from a universalist to a more targetted mode of provision; this leads to questions about how effective targetting is. Better small-area data on service take-up and costs can form part of the data required for the proper evaluation of policies and programmes, alongside measures of need, outcome and so forth.
3. Special urban regeneration initiatives, such as SRB, have repeatedly (since the 1960s) targetted selected small areas with extra monies and programmes, but it is often pointed out that these are dwarfed by the main spending programmes of central and local government and that the challenge for urban policy may be to 'bend main programmes' (Department of the Environment, 1977; Blackman, 1995); again, whether they need to be bent further may depend on how they are already bent.
4. One of the central questions arising in an urban analysis of deprivation or 'social exclusion' is whether this condition arises wholly or mainly because of *who* the person is (in terms of gender, race, age, education, work experience, health, disability, etc.) or whether it is significantly exacerbated by *where* he or she lives. If location matters for deprivation or exclusion, then public spending may be part of the reason for this problem or may offer some solutions or compensations.
5. There is a fairly high level of ignorance about what the present pattern of spending is, even at the broad level of whole cities or local authorities (LAs) in relation to some major spending programmes (some of those administered by central government), and certainly at neighbourhood level; those working to regenerate areas feel they would be better able to judge what is going on and what the policy options might be if they had a fuller picture of all of the resource flows (Social Exclusion Unit, 1998 and 2000).
6. There is much talk about 'joined-up thinking' in policy circles, and this refers in part to understanding the connections between and contributions of a wide range of policy programmes to the welfare of particular groups or areas (Social Exclusion Unit, 1998). In an era of perpetual public expenditure restraint, ideas about repackaging or remixing existing spending programmes (for example, from benefits to training) are attractive, particularly when the sheer scale of some of the spendings is known.
7. Much resource allocation, certainly to LA level and sometimes to lower levels, is driven by formulae, and these formulae are inevitably subject to debate and review; the standard spending assessments (SSAs) for local government provide a major example. There is increasing interest in the use

of small-area spending measures as a new basis for analysis, often in a multi-level modelling framework, in order to overcome limitations of existing methods (Hepple and Rees, 1998; Bramley and Wyatt, 1998).

8. As the lapse of time since the last Census extends, there is a growing interest in finding ways of updating demographic and socio-economic information about localities and small areas, notably areas of change and stress. There is a significant data and methodology overlap between this study and the use of a range of administrative sources to update key information.

Deprivation and Public Spending

Several of the general arguments just given imply that there ought to be a positive relationship between area deprivation (or poverty) and public spending. Given what we know about the structure, purposes and mechanisms involved in the allocation of public spending, are there grounds for believing that there is, in practice, likely to be such a positive relationship? The answer to this question must surely be 'yes', for a number of reasons:

- significant chunks of public spending, notably in the social security area, are explicitly means-tested;
- means-tested benefits can act as passports to other services or benefits;
- at the top of the income or class structure, people make much more use of private provision (for example, in health and education) and rely less on state provision (a form of voluntary 'social exclusion');
- conflicting pressures of rising demands and costs versus fiscal limitations put pressure on quality standards, leading to some public services becoming more 'residual' in character, so that only the poor (who have no choice) tend to use them;
- concentrated poverty generates negative externalities and damaging social processes at neighbourhood level (for example, crime, drug addiction and drug trafficking), which create additional demands on public services (for example, police, courts, fire service and social work);
- local public authorities may feel obliged to compensate for the lack of private investment or maintenance of the physical fabric, service infrastructure and environment in poor areas.

There are some countervailing arguments or tendencies. For example, the middle classes might be so much more vocal and effective at demanding or making use of services that they capture more of the expenditure (Goodin and Le Grand, 1987). Processes of social exclusion in the most deprived areas may be such as to weaken the links between residents and all aspects of mainstream society, including many public services.

In this paper, we focus centrally on the concept of 'deprivation' rather than on some of the competing concepts of current concern, such as low income,

poverty or 'social exclusion'. We would regard deprivation (like 'poverty') as being a somewhat broader concept than low income, embracing access to income and other kinds of resources that enable households to enjoy an adequate standard of living, access to certain basic and widely accepted goods or services (Gordon and Pantazis, 1997) and the ability to participate in the normal life of the community. Thus deprivation contains low income and its effects but goes somewhat wider, although perhaps not as wide as some concepts of social exclusion. Nevertheless, we would expect low income to be closely associated with deprivation more widely defined.

It should also be recognised that deprivation is only one of a range of hypothesised factors driving local expenditure variation in any more general expenditure model. For example, demographic factors affecting demand and take-up, or physical and geographical factors affecting cost of service production or distribution, would be other factors included in such a general model. This point is discussed further in Section V.

The argument here is couched in terms of areas, rather than individuals or households, although it is hard to separate these. Most analyses of the distributional impact of the welfare state utilise individual- or household-level micro-datasets to demonstrate that, broadly, poorer households gain from state expenditures while contributing less in taxation (Glennerster and Hills, 1998; Sefton, 1997), although some have argued that the extent of redistribution is less than might be expected in some cases (Le Grand, 1982; Goodin and Le Grand, 1987; Bramley and Le Grand, 1992). However, such analyses have provided less evidence on services in kind and little on the specifically territorial dimensions of redistribution. Bramley and Smart (1993) and Bramley (1996) provide a limited exception to this, looking at evidence on local service usage and adequacy.

III. HOW TO DO IT: OVERVIEW OF CONCEPTS AND METHODS

Given the basic task of analysing all locally relevant public expenditure to LA and ward level for case-study areas, a number of practical decisions are necessary as well as consideration of conceptual and methodological issues. The intention was to use direct administrative data wherever possible, which entailed heavy reliance on the co-operation of national and local government departments and agencies. Many of the people and departments approached made major efforts on our behalf, and the project was given priority from the top down in important instances, but it inevitably remained the case that in some areas co-operation was limited while in others local data were simply not available in suitable form.

Thus it follows that, if a comprehensive picture is to be painted, alternative more indirect methods of expenditure estimation or imputation are needed to fill gaps. There is scope for ingenuity here, but without the luxury of time to analyse

imputation models carefully in cases where good direct data exist as well, it is more difficult to assess their adequacy.

1. Scope and Definitions

By general agreement, not all public spending is locally relevant; this excludes defence, foreign relations and aid, most trade and industry, agriculture, prisons, immigration, research, revenue departments and national financing items. Some of these cases are clearly on the boundary, and determining their relevance depends on the precise purpose and definition of incidence in use.

Locally relevant expenditure still accounts for a substantial majority of the total (nearly 70 per cent). It is dominated by four major departments — Social Security (DSS), Health (DOH), Education and Employment (DFEE) and Environment, Transport and the Regions (DETR) — and includes all of local government expenditure.

Public expenditure is defined in this study following normal UK Treasury public expenditure conventions. Essentially, it comprises actual outlays by general government (central and local), and public grants and lending to other bodies. It excludes tax reliefs, Private Finance Initiative and other loan-financed investment by bodies deemed outside the public sector (for example, housing associations), and trading services income (for example, housing rents paid by tenants). It includes capital spending directly, but coverage in practice was very partial. It is not claimed that this definition is ideal or necessarily preferable to alternatives, nor that it would necessarily naturally apply in the same way in other countries which follow different conventions. While arbitrary and incomplete in some respects, it has advantages of practicality and consistency within the current British public expenditure system.

The study attempts to allocate expenditure on a cost basis to area of residence of users and beneficiaries. It is important to be clear about what this does and does not entail. First, it does not attempt to value the benefits of services on a willingness-to-pay basis, as this would be a formidably difficult undertaking on a comprehensive basis across services. Rather, the intention is the more practically attainable one of allocating the cost of services to their immediate users, by area of residence. It is admitted that the emphasis on ‘immediate users’ narrows the scope relative to a comprehensive concept of beneficiaries, which could include, for example, those who derive an insurance type or ‘option demand’ type of benefit from the knowledge that services are available and other examples of third-party or external benefits (see Bramley and Smart (1993, pp. 62–75)).

Drawing an analogy with regional accounting and the different measures of GDP, one can envisage different approaches to the locational analysis of public expenditure corresponding to the three different measures of GDP, based on production, income or expenditure/consumption. In this study, we are primarily using an expenditure/consumption base for locating public spending. This

implies that we are not trying to analyse the full economic impact of spending on incomes, which would need to take account of where employees live and local multiplier effects. Neither are we, in general, looking at the value of GDP produced in an area. A good illustration of that would be higher education (HE), where we relate the expenditure (on institutions, fees and student maintenance) back to area of home or parental residence of students, not to the area where the HE institution is located. However, this clear distinction is not fully maintained in practice, because there are certain expenditures (particularly some capital spending) that, for practical reasons, are located where they fall 'on the ground'. Arguably, in some cases (housing, local environmental and street maintenance) this is an appropriate approximation to the spatial incidence of beneficiaries, but in other cases it may not be. Clearly, if one is mainly concerned with the physical environment, then an 'on-the-ground' basis for locating spending may be superior. Capital expenditures where this local attribution would clearly be inappropriate (for example, major roads and railways) are treated in the way described above for HE.

A minority of public expenditure is directed to the provision of public goods in the economic sense (i.e. goods that are non-excludable and/or non-rival). Obvious locally relevant examples include police, fire service, parks and highway maintenance. It may be suggested that, since the dominant motive for public provision of these goods may not be to do with redistribution, it is not relevant to include them in an analysis of redistributive impact. This argument is not accepted here, as the aim of the work is to examine the incidence of all expenditure, and public goods, like other public spending, may have distinctive distributional impacts which it is of interest to observe. Local public goods, by definition, have locally variable incidence, and provision may vary, whether as a result of intentional policies, local political pressures or the historical inheritance of facilities and infrastructure or for other reasons.

However, public goods pose serious practical and sometimes conceptual problems for the actual analysis of spending incidence. The conceptual problems are well illustrated by the police service: are the users of this service defined as the victims of crime, the general public or property owners who are protected from suffering crime or the perpetrators of crime (who may well 'consume' or 'cost' the police and criminal justice system a lot of resources, and who could be seen as secondary beneficiaries of prevention and rehabilitation work)? The practical problems relate to obtaining adequate usage workload indicators or proxies and also to the allocation of some expenditures down to territorial units or local facilities.

We attempt to provide a snapshot of spending for a single common base year; this is 1995–96 (out-turn), but some deviations occur for practical reasons, such as the use of current live caseloads being easier than the use of historic caseloads. Capital expenditure is recognised as lumpy and we attempt to allow

for this by pooling expenditure across several years, but this was only a partial solution.

Many minor services were not analysed in detail. They are generally included in the final overall figures through the use of simple proxies.

2. Methods of Estimating and Allocating Expenditure

We sought to tackle the estimation of local spending from both the 'top down', disaggregating budgetary information, and from the 'bottom up', using client and other service delivery databases. The former approach is ultimately limited, certainly in getting below the LA level, although it provides the necessary control totals for expenditure by programme. The main challenge for most services is in getting down to ward level, and here a bottom-up (client-oriented) approach tends to be more helpful.

A range of approaches to allocating expenditure to wards were used, according to the characteristics of the service and the available data. These fall into three broad categories:

1. *Category A:* It is possible to build up robust estimates from actual client location and cost records. Where individual users or recipients are well defined (for example, social security, hospitals, further and higher education students, some social services and probation clients), we use administrative records of addresses or postcodes linked to individual or average unit costs. Where the service is provided through facilities (for example, schools), we first estimate unit costs by facility, then attempt to obtain addresses or postcodes of users by facility. Where facility characteristics are known but not costs, we model costs based on characteristics. The last method may be combined with actual or predicted clients (see below).
2. *Category B:* Where individual user addresses or postcodes are not known, a variety of approaches may be used to estimate usage or cost given actual information about facility provision, socio-demographic characteristics and other factors:
   - Use information on travel distances (for example, from surveys or partial client information) to apportion from facilities to catchments (some leisure services; schools in some cases).
   - For individual user services where direct client information is lacking, surveys (for example, local MORI residents' surveys and the National Travel Survey) may be used with statistical modelling or simple proxies to predict usage rates based on household characteristics, in some cases controlled to client numbers at a higher level. Such a formula may be soundly based — for example, in survey evidence (e.g. local environmental services in Brent and Nottingham) or evidence from other similar areas (e.g. police and fire results from Brent and Liverpool used to

impute values for Nottingham). Regression techniques (including logistic regression in the case of household or individual survey data) are used to calibrate these formulae (Bramley et al., 1998, Ch. 10). Such formulae may take some account of locational effects but will probably understate the influence of particular locational factors.

- For network-based services, locate network links or nodes within wards using Geographic Information Systems (GIS) or maps and apportion expenditure (possibly derived from contract information) on lengths within wards (for example, minor roads maintenance, public transport and street cleaning).
- For public good services covering areas, link facilities and expenditure to areas and apportion to wards using appropriate workload indicators such as number of incidents, street lengths or number of properties (for example, fire service, police and refuse collection).
- For some capital expenditure, locate actual facilities being built or improved by ward using capital programme information (for example, housing and local environmental programmes).

3. *Category C:* In other cases, where there was insufficient information to apply any of the above approaches, simpler proxy formulae using one or a few indicators based on judgement were used to allocate expenditure. This approach was applied to a range of minor services deemed too small to analyse in detail (many in the local environmental and cultural and informational services) and to certain moderate-scale services where more specific information was not obtainable in this study. For example, the three LAs studied had manual records for concessionary fares, so this was apportioned on an elderly population basis, assuming a uniform take-up. The employment service was another example.

The most favourable situation is clearly Category A, and this applies to about 67 per cent of the total of locally relevant public expenditure examined. Category B, involving analysis based on information that is more partial or approximate, is quite a common situation, and applies to about 24 per cent of relevant expenditure. This includes some cases based on regression formulae developed from surveys or from more direct ward estimates made in other authorities. Only 9 per cent of expenditure is allocated on the basis of simple judgemental proxies. It should also be noted that less than 7 per cent of locally relevant expenditure is accounted for by public goods. Appendix A lists the services and programmes of public expenditure that were analysed down to ward level in this project, showing the amount of expenditure involved as a national average per head.

Caution should be exercised in comparing spending on a number of programmes *between cities* or against national levels, because of

- different methods used in different areas;
- different coverage of minor services and overheads; and
- differing quality of local data.

However, in general, expenditure at city level or above is likely to be more accurate, and estimates are generally controlled for consistency with these higher-level estimates.

IV. DEPRIVATION AND PUBLIC SPENDING

1. Measures of Deprivation

There is a large literature on the measurement and assessment of small-area deprivation (Holterman, 1975; Green, 1994 and 1996; Lee, Murie and Gordon, 1995; Department of the Environment, 1995; Dorling, 1996; Murie and Lee, 1997; Burrows and Rhodes, 1998). No attempt is made to review this field comprehensively here. Rather, the intention is to consider the relationship between various distinct deprivation measures drawn from this field and our new evidence of public expenditure incidence within cities. The current official index guiding urban regeneration programmes is the index of local deprivation (ILD; see Department of the Environment, Transport and the Regions (1998)). This is a modified version of the index of local conditions (ILC) developed on the basis of the 1991 Census and other data (Department of the Environment, 1995). Since the ILC was the official index available at the time of the research and, unlike the ILD, uses component values across the full range of deprivation and affluence,[3] we use it as our baseline deprivation measure. The ward-level version is constructed from scores on seven Census indicators expressed as signed chi-squared statistics,[4] yielding a continuous measure for all wards in England.

This index has attracted a range of criticisms in the literature which we do not attempt to review in detail. However, several contributors to this debate (Lee, Murie and Gordon, 1995; Burrows and Rhodes, 1998) have suggested that one of the alternative indices available might have some particular claims to consideration, and it is convenient to use this as an alternative for comparison in the present context. This is the so-called 'Breadline index', derived from the analysis of a large household survey focused on poverty and deprivation carried out in 1990 (Gordon and Pantazis, 1997). The Breadline index has a number of

[3]In the ILD, negative values of component indicators are set at zero.

[4]Signed chi-squared statistics provide a measure of the extent to which an area (for example, a ward) has a 'higher-than-expected' number of households or individuals with a given deprivation attribute, where the expected number is based on the national proportion and the size of the statistic takes account of the number of households or individuals in the area and hence the 'robustness' of the estimate. Negative signs are assigned to the statistic where the value is lower than expected. (See Ebdon (1985, pp. 65–70) and Department of the Environment (1995).)

positive features in addition to being a relatively simple index based on the same (1991) Census as the ILC. It is an explicit prediction formula for the probability of households experiencing multiple deprivation in the sense of lacking three or more from a list of goods that a majority of survey respondents agree are essential items for households in Britain today. The score is readily interpretable as the predicted proportion of households in poverty in this sense, and can be calculated at any spatial level. Compared with the ILC, it tends to emphasise areas of low income and poor health in the former industrial areas of England, rather than the housing problems characteristic of Inner London.

We are also interested in income, as distinct from deprivation, partly because this is the basis on which most analyses of the redistributional activity of the state are conducted (Sefton, 1997; Glennerster and Hills, 1998). It is possible to use information generated within the research on the incidence of income poverty as measured by the take-up of the principal official means-tested benefit targetted on low-income households, income support. It is also possible, by drawing on other parallel research into local income patterns (Bramley and Smart, 1996; Bramley and Lancaster, 1998), to construct proxy-based measures of average income for our study areas. This enables us to provide some provisional estimates of the relative dependence of small areas on public expenditure in underpinning the overall incomes of their residents. It also provides additional measures which may be of value in explaining some of the variations in public spending incidence observed. Appendix B describes the derivation of these average income measures from this other research.

2. Deprivation in the Three Study Areas

Table 1 shows the wards in each area by their position in four ILC deprivation bands. Our three areas each have wards with very high deprivation (ILC scores over 12). Brent has just under half of its wards in this most deprived band, Liverpool around 40 per cent and Nottingham 15 per cent. Liverpool also has another 40 per cent of its wards in the next highest band of deprivation, but it has relatively few in the ‘slightly deprived’ band, in contrast with Nottingham.

TABLE 1

Number of Wards by Ward Deprivation Bands and by City, Based on Index of Local Conditions (1991)

ILC band	*Brent*	*Liverpool*	*Nottingham*	*Three cities*
1. Non-deprived (ILC<0)	7	6	3	16
2. Slightly deprived (ILC 0–6)	3	1	13	17
3. Fairly deprived (ILC 6–12)	7	13	7	27
4. Most deprived (ILC>12)	14	13	4	31
All wards	*31*	*33*	*27*	*91*

TABLE 2

Correlation Matrix for Deprivation Measures at Ward Level (90 wards[a] in Brent, Liverpool and Nottingham)

	Index of local conditions	*Equivalent household income*	*IS expenditure per head*	*Breadline Britain poverty index*
Index of local conditions	1.000			
Equivalent household income	–0.397	1.000		
IS expenditure per head	0.828	–0.369	1.000	
Breadline Britain poverty index	0.825	–0.755	0.816	1.000

[a]90 wards excluding Everton in Liverpool as outlier.

Macroeconomic and other conditions have changed since 1991 and hence our 1995–96 spending figures may not fully match the ILC (or Breadline) deprivation pattern based on 1991. We can compare deprivation from 1991 ILC scores with data obtained for this study from the DSS on receipt of income support (IS) in 1995. IS is the means-tested 'safety net' of social assistance, and hence the proportion of the population who claim can be seen as a cross-sectional measure of income deprivation. The IS data provide area profiles similar to those produced by Noble et al. (1994) and Noble and Smith (1996) for Oxford and Oldham and by Dobson et al. (1996) for Leicester.

Table 2 shows the correlation matrix between all four deprivation measures considered here across 90 wards in the three cities. This shows that, in fact, the ILC and IS claiming (expressed as expenditure per head) are the most highly correlated pair, although this correlation is only about 0.83. Correlations linking the ILC and Breadline and IS and Breadline are similar (about 0.82). Breadline also has a reasonable correlation with the fourth measure used, average equivalent household income (–0.76; this is negative because higher income is associated with lower poverty or deprivation). Interestingly, equivalent income has a much lower correlation (between –0.37 and –0.40) with the ILC and IS. We would speculate that this is partly because equivalent income reflects the whole distribution, not just the bottom end, partly because the ILC reflects some non-material dimensions of deprivation and partly because of certain biases in the coverage of IS (for example, non-take-up by certain groups and non-eligibility of the working poor). Household income may be less good as a measure of poverty, but it may still operate as a driver of certain public expenditures and it is certainly relevant to taxation and the overall distributional impacts of government.

Table 3 summarises total public spending per head by ward deprivation (ILC) band in each city. The individual ward distribution is shown in scatter diagram form in Figure 1 later. While a general relationship between total spending and deprivation is apparent, it is clearly not a smooth one. This may reflect the point

TABLE 3

Total Locally Relevant Public Expenditure per Head by Ward Deprivation Bands and by City, 1995–96

	Brent	*Liverpool*	*Nottingham*	*Three cities*
Mean expenditure (£ per head)				
ILC band				
1. Non-deprived (ILC < 0)	3,492	3,679	3,090	3,555
2. Slightly deprived (ILC 0–6)	3,742	3,543	3,595	3,565
3. Fairly deprived (ILC 6–12)	4,182	4,396	4,139	4,304
4. Most deprived (ILC > 12)	5,043	5,393	4,579	5,168
All wards	*4,372*	*4,602*	*3,826*	*4,294*
Index of most to least deprived[a]	144	147	148	145
Range of ward expenditures (£ per head)				
ILC band				
1. Non-deprived (ILC < 0)	934	695	282	1,143
2. Slightly deprived (ILC 0–6)	164	0	936	673
3. Fairly deprived (ILC 6–12)	1,465	1,409	1,266	1,592
4. Most deprived (ILC > 12)	2,341	5,305	724	5,305
All wards	*3,406*	*6,054*	*1,980*	*6,391*

[a]Ratio of expenditure per head in most deprived band of wards (ILC > 12) to non-deprived wards (ILC < 0).

that there is no uniquely correct way of measuring deprivation, which may be multidimensional, as well as the point that expenditure relates to other (non-deprivation) factors too, as confirmed in Section V. Taking mean ward spending by deprivation banding, there is a similar degree of variation between least and most deprived wards in all three cities. Taking ranges within each group, it would appear that there is more spending variation among more deprived wards, and apparently most in Liverpool (although this does reflect one outlier).

3. Spending Results for Individual Services

Lack of space prevents a full description of the spending patterns found for each of the services analysed. Interested readers are referred to the main research report (Bramley et al., 1998).

It is clear that the association of spending with area deprivation varies systematically between different programmes. A simple way of summarising this — the ratio of per capita spending in the most deprived wards to per capita spending in the least deprived — is included in Table A.1 in Appendix A. Many

of these patterns are broadly as would have been predicted on the basis of previously available evidence from household surveys or other sources (Glennerster and Hills, 1998; Sefton, 1997). Some are perhaps more surprising, especially for programmes that have rarely been analysed in this way before.

A number of programmes target spending heavily in favour of deprived wards, with the most deprived wards receiving more than double the per capita spend of the least deprived. These include the major means-tested social security benefits (income support, unemployment benefit and housing benefit), social services for children, some ancillary education (for example, free meals), housing investment and subsidy, police (perhaps surprisingly), regeneration programmes (SRB) and some environmental capital spending.

Programmes that discriminate moderately in favour of deprived wards on average include disability-related benefits, elderly and other social services, primary and (more strongly) special needs education, further education (with some caveats mentioned), fire protection and bus subsidies.

The pattern of spend per capita is relatively flat for the following services: health, secondary education, some contributory social security, most environmental services and some transport. The health spend is rather more pro-poor when divided by age-weighted population.

The following service areas generally deliver more expenditure per capita to affluent or non-deprived wards: higher education; roads; rail subsidies; pensions; and some local environmental services (for example, parks). The case of pensions refers to per capita expenditure; deflating by elderly population totals gives a slightly pro-poor slope. This slightly unexpected result arises because elderly people in the three areas studied tend to live less in the most deprived wards and more in the suburban wards. There are many possible explanations for this, including, for example, the cohort effects of past waves of housebuilding, selective migration processes, residential preferences and the greater longevity of middle-class elderly people (‘fiscal migration’, of the kind suggested by Tiebout (1956), is less relevant here because these are sub-areas within the same LA jurisdiction). It should be noted that our deprivation measures are not age-specific, so it is also possible that deprived elderly people, and not just all elderly people, have a distinctive spatial distribution.

4. Overall Spending by City or Borough

Locally relevant public spending, when added up across programmes, is very significant in all wards. The average for the 91 wards in our three areas is just under £4,300 per head of population, which equates to about £10,750 per household. Spending is highest in absolute terms in Liverpool (£4,602 per head) and lowest in Nottingham (£3,826). The Brent figure (£4,372) would be markedly less in real terms if deflated for ‘London costs’ (a 15 per cent deflation would reduce it to £3,802, below the Nottingham level. For our three cities

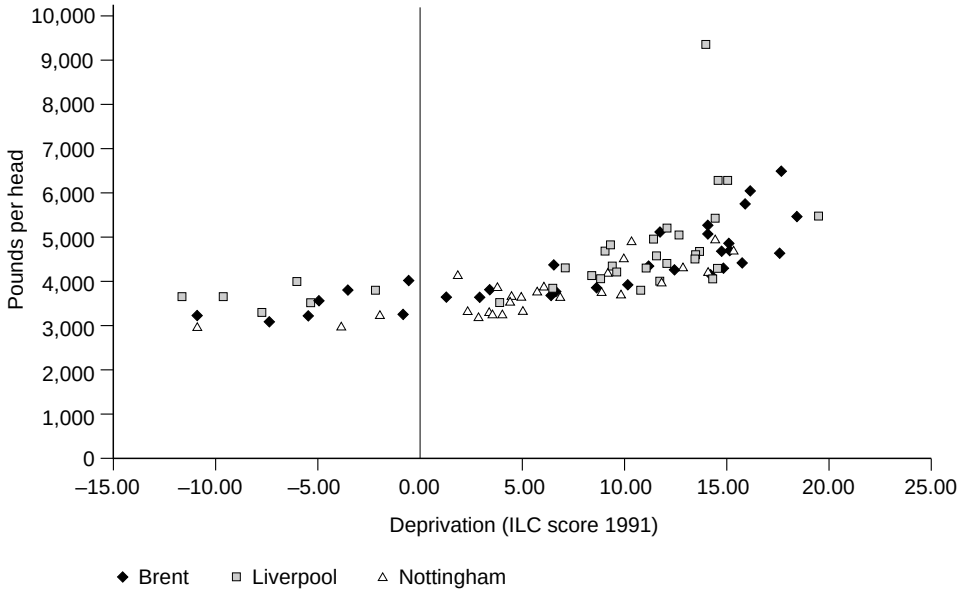
together, average spending is about 25 per cent above national average per capita spending for the range of public programmes covered by our analysis. However, since Liverpool is about 20 per cent above the other two, we can say that Liverpool spends about 35 per cent above the average, while Nottingham spends about 12 per cent above and Brent only about 11 per cent above in real terms. Thus, of the three cities and boroughs, it is Liverpool that really stands out as a relatively high spender. Of course, these spending differences might be regarded as rather modest, given that these are some of the most deprived LA areas in England.

5. Ward-Level Variation

Public spending per head varies quite a lot at ward level, even allowing for deprivation. Table 3 shows not just mean total spending by deprivation band but also the range of variation. Across the three cities, ward spending ranges from under £3,000 to over £9,000. However, it is clear that there is one outlier in the dataset: Everton (in inner Liverpool, £9,382), whose spending is £2,850 higher than the next nearest ward (in Brent). Many factors contribute to the Everton phenomenon, including small population and central city location, and it is not obviously a product of error, but it remains something of a puzzle. In general,

FIGURE 1

Ward Expenditure per Head by Deprivation (ILC) in Three Cities



although particular spending heads may show lumpy distributions across wards, when adding up across all the spending programmes these tend to average out. Even so, there is clearly a good deal of variation, of the order of £1,000–2,000 per head, between individual wards at the same deprivation levels (subject to the caveats discussed above). Figure 1 confirms this by showing a scatter diagram of the relationship between the ILC and total spend per head.

The graph suggests that there is a positive relationship between spending and deprivation, albeit not a smooth or noiseless one. This may reflect the point made above about different aspects of deprivation, but more importantly the fact that many other factors may influence spending (as discussed further below). In addition, Figure 1 suggests a non-linear relationship, with spending rising more steeply in the most deprived wards. Table 3 also shows this, with spending per head rising from £3,555 in the non-deprived band to £3,565 and £4,304 in the next two bands, and then jumping to £5,168 in the most deprived band. The overall headline result is that the most deprived group of wards spend 45 per cent above the least deprived.

V. MODELLING SPENDING AT WARD LEVEL

The conclusions summarised above, and more fully in Bramley et al. (1998, Ch. 11), are descriptively effective in summarising the pattern of expenditure out-turn by ward deprivation. But they are limited in dealing with the simultaneous influence of other variables on expenditure, while leaving open a number of questions concerning the precise definition and functional form of the deprivation factor. A logical next step is to explore these relationships further by employing multiple regression analysis to identify which other characteristics of wards or their populations may be systematically associated with spending in total or of particular types, and to take account of these effects when estimating the deprivation effect itself.

Modelling local expenditure as a function of attributes of those areas belongs in a long tradition associated particularly with grant distribution formulae but also with research into local political behaviour, service costs and efficiency and other questions (Bramley, 1990, Ch. 6; Audit Commission, 1993). Such local expenditure models may or may not be based in a formal theoretical framework, and the frameworks used vary, but in general they must be regarded as reduced forms of more complex sets of functions, including demand functions, rationing functions and production or cost functions (Bramley, 1990 and 1996). When fitted across LAs as observations, they may be interpreted as models of local political behaviour, subject to financial constraints (Duncan and Smith, 1995). At small-area level, this interpretation is less relevant, and indeed small-area expenditure models have been proposed as a solution to problems in the existing grant system (Hepple and Rees, 1998; Bramley and Wyatt, 1998; Carr-Hill and Smith, 1997; Hall, Preston and Smith, 1996). While the particular types of

explanatory variables and their definitions are likely to vary for models applied to different services and types of expenditure, in general one can say that a reduced form expenditure model has to take account of factors relating to demand, rationing criteria and service production costs. For example, demand-side factors may include age, household structure and income levels; rationing criteria may highlight particular demographic groups (elderly living alone, disabled, lone parents) or socio-economic groups as being eligible for or priority recipients of rationed services; costs may be influenced by geographical features of settlement pattern or regional wage rates. The reasons why deprivation may be associated with expenditure were reviewed in Section II, and these can be placed in the wider context considered here.

Having constructed a comprehensive dataset of expenditure and other indicators for all wards (91 in all) across the three cities, we now wish to test more closely the influence of deprivation in a broader expenditure model framework, taking account of these wider influences. A general model framework is applied, using broad indicators to represent the classes of factor identified above, in multiple regression models seeking to explain variations in expenditure per head on broad aggregates of locally relevant public services. We examine certain specific questions relating to the relationship between expenditure and deprivation:

- Which measure of deprivation best 'explains' expenditure variation, and which components within the indices seem most important?
- Is the relationship non-linear or subject to thresholds?
- Is there a city-level effect, and does this affect the responsiveness as well as the level of expenditure?
- What other factors, apart from deprivation, including demographic and geographic features, are important influences on spending levels?
- How far is the apparent relationship between deprivation and spending reinforced or weakened when account is taken of these other factors?
- How do these relationships vary across broad classes of expenditure?

Table 4 lists the main variables used in this analysis and gives summary statistics. Various expenditure measures are used as dependent variables, all expressed per head of population, including total expenditure, total less means-tested benefits (MTBs) and five broad economic categories — MTBs, universal benefits, individual in-kind services, public goods and capital. Total expenditure excluding MTBs is the major focus in the analysis, because this allows fair comparison across the deprivation measures without spurious correlation effects. It should be remembered that some of these dependent variables include a proportion of 'modelled' expenditures, as explained in Section III.[5]

[5]Where values for local expenditure used as dependent variables in these regressions have been partly generated by modelling exercises, the estimates reported here will only pick up correlations between the explanatory

TABLE 4

Summary Statistics for Expenditures, Deprivation Measures and Other Demographic and Geographic Variables (90 wards[a] in three cities, 1995–96)

Variable	*Mean*	*Standard deviation*
Expenditure per head		
Total locally relevant	4,237	776
Excluding means-tested benefits	3,233	425
of which:		
Means-tested benefits	1,004	424
Universal benefits	1,014	213
Individual in-kind services	1,604	190
Public goods	276	104
Capital	230	154
By spending agency		
Local government	1,484	420
Central government	4,237	776
Deprivation measures		
ILC[b]	7.32	7.59
Equivalent income[c]	255	62.3
IS expenditure	553	228
Breadline poverty (%)	28.9	8.5
City dummies		
Brent	0.34	0.48
Liverpool	0.36	0.48
Geographic variables		
Density (people per hectare)	52.9	27.3
Road length (metres per head)	2.63	1.07
Distance from CBD (km)	6.87	3.72
Demographic variables[d]		
Children (%)	20.8	3.0
Elderly (%)	14.2	3.7
Lone adult (%)	16.1	7.3
Socio-economic variables[d]		
Non-white (%)	20.1	19.9
High social class (%)	28.5	13.9
Moved house (% p.a.)	10.5	3.9

[a]90 wards excluding Everton in Liverpool as outlier.
[b]ILC squared term is set to zero for negative ILC values.
[c]See Appendix B for derivation of equivalent income estimate.
[d]Derived from 1991 Census, updated to 1995 for population change.

variables and that part of expenditure varying systematically with the predictive variables used for proxying expenditure.

Explanatory variables include the four alternative deprivation measures discussed above and quadratic terms to test for non-linearity (the latter are not shown in Table 4 to save space). The individual components of the ILC (seven variables) and Breadline (six variables) are also used in certain tests but not shown in the table, again to save space. Dummy variables for Brent and Liverpool are included to reflect LA-level variations in policy and provision, London cost differences and any differences in expenditure estimation methodology and coverage. Three geographic variables are included, mainly to capture cost influences but also to test for systematic locational effects. These are: simple population density, which highlights areas of intensive residential development including flats; road length per head, which highlights more leafy suburban wards but also areas with more commercial land use and intensive transport infrastructure; and distance from Central Business District (CBD), the classic measure of location within the urban economy. Obvious demographic variables include the share of elderly and children, given the targetting of many services on these groups. The share of lone-adult households captures an important dimension of household structure and highlights areas of transience characteristic of inner cities. There are substantial minority ethnic populations in parts of these cities, so we include a variable to measure this, as well as a general social class indicator and an indicator of housing mobility (which reflects private renting plus buoyancy of the housing market).

It is clear that there is a good deal of multi-collinearity in this dataset, as in any cross-sectional urban dataset. This point should be borne in mind when interpreting results; some individual variables may have their effects masked in terms of statistical significance when other correlated variables are included. Taken together with the earlier characterisation of these models as 'reduced forms', this underlines a general note of caution about the interpretation of individual coefficients and t-statistics. We approach the question of testing for the overall effect of classes of explanatory variable by including or excluding them as blocks and performing F-tests on the implied restrictions.

1. Nature of Deprivation–Expenditure Relationship

Table 5 shows the results of applying our 'standard' regression model to the explanation of variations in total expenditure excluding MTBs across 90 wards in three cities. The models differ by using different deprivation measures. The table provides some evidence (albeit inconclusive) on the issues of whether deprivation affects expenditure, of which measure is the most effective predictor and of whether the relationship is non-linear. The t-statistics suggest that at least one of the deprivation terms is significant in each case. These indicators suggest that IS expenditure is the best predictor, even for the non-MTB expenditure. However, this is misleading, because the adjusted R-squared and F-statistics

TABLE 5

Regression Models for Aggregate Expenditure Comparing Deprivation Measures Controlling for Demographic and City Effects (expenditure per head excluding means-tested benefits for 90 wards[a] in three cities, 1995–96)

	Deprivation measure							
	ILC		Equivalent income		IS expenditure		Breadline poverty (%)	
Explanatory variables	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*
Constant	1,289	2.2			701	1.2	665	0.8
Deprivation measures								
ILC	8.38	0.8						
ILC^2/mean[b]	9.98	1.8						
Equivalent income[c]			–7.48	–1.5				
(Equivalent income)^2/mean			–0.45	–0.2				
IS expenditure					1.66	2.5		
(IS expenditure)^2/mean					–0.42	–1.7		
Breadline poverty (%)							61.5	2.3
(Breadline poverty)^2/mean							–13.3	–1.1
City dummies								
Brent	62	0.4	811	4.2	128	0.8	241	1.5
Liverpool	240	2.9	299	4.0	274	3.4	296	3.8
Geographic variables								
Density (persons/ha)	–1.61	–1.0	–1.27	–0.9	–1.23	–0.8	–1.82	–1.2
Road length (m/head)	96.0	2.4	86.0	2.3	87.0	1.6	73.9	1.7
Distance from CBD (km)	21.9	1.6	18.5	1.4	12.5	0.9	7.5	0.6
Demographic variables[d]								
Children (%)	21.2	1.4	–14.9	–0.8	24.2	1.7	6.1	0.4
Elderly (%)	52.7	4.5	12.7	0.4	55.5	5.0	38.9	3.2
Lone adult (%)	36.9	3.5	36.8	4.5	42.8	5.0	27.5	2.6
Socio-economic variables[d]								
Non-white (%)	10.5	3.2	4.66	1.4	10.5	3.2	12.0	3.8
High social class (%)	–5.2	–1.2	9.7	2.0	–3.7	–1.1	3.0	0.7
Moved house (% p.a.)	–50.0	–3.6	–44.9	–3.3	–56.0	–4.1	–55.6	–4.3
R-squared (adjusted)	0.710		0.755		0.717		0.738	
F-ratio	17.8		22.1		18.4		20.3	
Standard error	228.9		210.5		226.1		217.4	
Number of cases	90		90		90		90	

[a]90 wards excluding Everton in Liverpool as outlier.
[b]ILC squared term is set to zero for negative ILC values.
[c]See Appendix B for derivation of equivalent income estimate.
[d]Derived from 1991 Census, updated to 1995 for population change.

indicate that the 'best model' is that using equivalent income, followed by that using Breadline. The equivalent income model represents conditions across the whole population, not just the poor, and is derived from a wider range of information (see Appendix B), but it interacts in a different way with the demographic control variables. The evidence from Table 5 on non-linearity is mixed, suggesting that the expected 'increasing' effect with deprivation only clearly occurs using the ILC. The effect seems to be decreasing under IS and Breadline measures.

As a further test for more pronounced or complex non-linearity, thresholded versions of the four indices (highlighting variation at the most deprived end of the range) were included in the standard model. In no case did this improve the overall model significantly and in no case did this variable have either a positive or a significant coefficient.

We can clarify some of the ambiguities about the best form of model by performing formal tests on model restrictions, evaluated using F-ratios. Table 6 presents relevant results for a series of variations on the same four basic models. The first row looks at the restriction of excluding the nine demographic, socio-economic and geographic variables. This restriction is clearly rejected in all cases; these variables as a group are a key part of the model. The second row looks at excluding deprivation. This restriction is also rejected in all cases; however, it should be noted that, in the case of the ILC, this is based on the 5 per cent confidence criterion rather than the 1 per cent. The ratios again suggest that equivalent income is the best predictor, followed by Breadline, in the context of this model. It should be noted that, in single-variable models, by contrast, equivalent income is the poorest predictor with IS the best, Breadline again coming second. Restricting deprivation to linear form (Table 6, row 3) is not rejected, except marginally in the ILC model. In models using only deprivation variables, the quadratic is preferred for the ILC and Breadline (marginal at the 1 per cent level).

Table 6 also examines two further possible model refinements, relating to the way deprivation affects expenditure. One is to postulate that the response function of expenditure to deprivation varies by city, by including terms in the product of city dummies and deprivation. This refinement is rejected in the ILC model but marginal (5 per cent level) in the Breadline case. The other possible refinement is to enter the individual components of the deprivation composites separately, on the grounds that they might have markedly different specific expenditure effects. The final row of Table 6 suggests that this may be justified in the case of the ILC but not in the case of Breadline. There is more support for this disaggregation in the context of simple models without the demographic controls. The particular component of the ILC that appears to play a strong role in explaining expenditure is the 'children in flats/unsuitable accommodation' indicator, which is fairly strongly associated with Brent and may therefore be

TABLE 6

Testing Restrictions on Regression Models for Aggregate Expenditure Using Different Deprivation Measures (expenditure per head excluding means-tested benefits for 90 wards[a] in three cities, 1995–96)

	Deprivation measure							
	ILC		Equivalent income		IS expenditure		Breadline poverty (%)	
	F-value	*Signif.*	*F-value*	*Signif.*	*F-value*	*Signif.*	*F-value*	*Signif.*
Restrictions (versus 'standard model' — Table 5)								
Exclude demographic, socio-economic and geographic variables	9.6	<1%	9.6	<1%	7.6	<1%	7.4	<1%
Exclude deprivation	4.6	<5%	13.3	<1%	5.8	<1%	9.8	<1%
Linear deprivation only	3.1	NS (marg.)	0.05	NS	2.75	NS	1.2	NS
Exclude city dummies	0.72	NS	2.55	NS (marg.)	0.99	NS	1.33	NS
'Standard model' versus refinements								
Deprivation slope varying with city	0.7	NS					3.2	<5% (marg.)
Individual components instead of composite deprivation	2.56	<5%					1.18	NS

[a]90 wards excluding Everton in Liverpool as outlier.
Note: Columns headed 'Signif.' indicate significance at level shown or insignificance (NS); 'marg.' = marginal.

proxying some other Brent (or London) effect. Overall, these tests tend to support the simpler approach of utilising a single, composite, linear deprivation indicator in general models for small-area expenditure.

Returning to the choice between deprivation measures, it is possible to use a 'non-nested' test — the J-test of Davidson and MacKinnon (Gujerati, 1995, pp. 490–4) — to establish which competing deprivation index is preferred, although this is not necessarily conclusive in small samples. This test involves using predicted values from each of the models in Table 5 as additional regressors in the other models and looking at the t-test for significance of the coefficient on this additional term. For each pairwise comparison involving the equivalent income model, this model appears superior to the models based on the other deprivation indices (t-values of 3.88, 3.81 and 2.88 respectively). For none of the other pairwise comparisons is there a clear advantage either way. This confirms

the indication from the simple F-test and R-squared statistics in Table 5 that equivalent income is a more effective predictor of local expenditure, in conjunction with demographic and other factors, than the other three deprivation indicators.

Although equivalent income appears to make for a better model in some contexts, it is a more complex construct than the other three indicators. Breadline appears to perform quite well across the range of models, and could be argued to be the best of the simpler indices on this evidence. However, the evidence of Tables 5 and 6, together with the J-test, does not really suggest that the different measures are very different in their predictive power, and to that extent the choice is not critical.

2. Strength of Deprivation Relationship

What we have shown so far is that deprivation has a significant impact on public expenditure at small-area level within a selection of British cities. What we have not shown quite so clearly is how strong or substantial that effect is on the quantity of spending. Table 7 attempts to do this by using our standard models (from Table 5) to estimate the maximum difference in expenditure that is predicted to be associated with differences in deprivation in these cities. In other words, we predict expenditure for the most and least deprived wards, holding other things constant, measure the difference (per head) and express this as a percentage of (a) the mean and (b) the range of expenditure within the set of wards. The model used here contains quadratic terms in deprivation, and the calculations allow for this.

The basic model for expenditure excluding MTBs involves sizeable deprivation effects in all cases. The attributable difference in spending between most and least deprived wards ranges from 19 per cent of the mean and 32 per cent of the range in the IS model to 59 per cent and 99 per cent in the equivalent

TABLE 7

Estimated Magnitude of Deprivation Effect on Spending: Difference in Predicted Spend between Most and Least Deprived Wards relative to Expenditure Mean and Range (total expenditure across 90 wards[a] in three cities, 1995–96)

Deprivation measure	*Excluding means-tested benefits*		*Including means-tested benefits*	
	% of mean	% of range	% of mean	% of range
ILC	24	40	47	56
Equivalent income[b]	59	99	211	253
IS expenditure	19	32	60	72
Breadline poverty (%)	38	63	65	78

[a]90 wards excluding Everton in Liverpool as outlier.
[b]See Appendix B for derivation of equivalent income estimate.

income model. Including MTBs in total expenditure increases all of these figures, typically to the range 50–80 per cent but with exceptionally (and implausibly?) high values of over 200 per cent with equivalent income. While these last figures should be taken with a pinch of salt, being affected by interactions with demographic factors within the model, it seems clear that deprivation has not just a significant impact on spending but a large impact as well. This is most obviously the case when MTBs are included but remains true even when they are excluded. Locally relevant public expenditure is clearly redistributive in a significant way. The evidence here also confirms that the headline descriptive finding, that 45 per cent more is spent in the most deprived wards than in the least, is robust and consistent with these slightly more sophisticated modelling results.

3. Other Influences on Expenditure

Returning to Table 5, we can see that a range of other factors influence ward spending as well. This finding is in line with expectations, and is formally confirmed by the first line of Table 6. It is also worth referring forward to Table 8, which shows the standard expenditure model applied to five distinct sectors of public spending and to local and central government separately.

Before considering specific variables, we consider the role of the city dummy variables. Table 5 suggests that Liverpool spends significantly more, controlling for deprivation and other factors, across all four models. Higher spending in Brent is only suggested by one of the models. However, the fourth row of Table 6 suggests that including these dummies does not represent a significant improvement over the model that excludes them. Therefore we cannot be very confident about the apparently higher spending in Liverpool. Table 8 suggests that Liverpool is only a significantly higher spender on universal transfers (including, notably, incapacity benefit) and public goods, which are on balance more central government responsibilities. Table 8 also suggests that in Brent it is public goods which show the clearest tendency to higher spending (police would account for some of this). It is rather surprising to find little evidence of a positive Brent effect across the board, given that most estimates suggest that the higher cost of providing services in London is of the order of 15–20 per cent.

Considering geographical factors, we find that density tends to have a negative sign but is not generally significant. Table 8 suggests this negative effect is clearer for public goods and capital spending. The negative relationships are slightly surprising, given the role of density in many SSA formulae (Audit Commission, 1993). Road length is consistently positive in the overall spending model. While it is as expected that this effect occurs in the public goods sector, it is surprising to find it also strongly present in both transfer payment categories. It was suggested that this variable proxied leafy suburbs *and* commercial areas; both these types of areas may have a high share of benefit-dependent elderly.

Distance from CBD tends to have a positive effect overall, and this affects most categories of spending except public goods. Taking these two points together, one could suggest that, in models that take account of deprivation and demographic influences, expenditure may actually tend to be higher in the suburbs than in the inner areas. One possible general explanation for this is that middle-class people may tend to make more use of services and take up available benefits more readily (Goodin and Le Grand, 1987). However, it should be noted that in both Liverpool and Nottingham there are substantial relatively poor public housing estates on the periphery of the city. In this case, they attract spending partly because they are publicly owned, as well as because they are deprived.

The demographic variables generally have the kind of effects expected. Some of the signs may look perverse in the model using equivalent income, but that is because of interactions with demographic components contained in the income model. The effects of the share of children are positive but not particularly strong, a slightly surprising finding given the role of education. There is a negative association in the case of universal transfers. Some of the child effect may be masked by the deprivation variables, since there is an association between deprivation and a higher share of children. The positive effect of elderly population is as expected and relates to both universal transfers and services in kind. An area that had, say, 25 per cent elderly might be expected to spend about £500 per head more in total (about 12 per cent on average) than an area that had 15 per cent elderly.

Interestingly, the share of lone adults (non-elderly) is associated with higher spending overall and in most categories other than universal transfers. It may be that the areas that have high shares of this group (typically transient inner-city areas) also have a disproportionate number within them who are vulnerable and highly dependent on benefits and public support. There may be some interaction between this variable and that for moving house, which tends to have the opposite sign.

Non-white ethnicity is significant and positive in most of the equations, except those for transfer payments. An area that is 55 per cent non-white (not uncommon in Brent) might spend about £500 (12 per cent) more than one that was only 5 per cent non-white. This extra spending would be concentrated on services in kind and capital investment, particularly spending within the local government sphere.

Table 8 also allows us to draw certain conclusions about the relative influence of deprivation (measured by quadratic ILC) on different sectors of public expenditure. The largest effects are, not surprisingly, found in the MTB category. Universal transfers relate to the ILC in a linear way but without the increasing tendency in the most deprived wards. Capital spending is the other area that shows this tendency to concentrate in the most deprived wards, reflecting recent priorities in the housing programme particularly.

TABLE 8

Regression Models for Broad Expenditure Categories
Using ILC Deprivation and Selected Demographic and Geographic Attributes
(expenditure per head for 90 wards[a] in three cities, 1995–96)

	Means-tested transfers		Universal transfers		Individual in-kind services		Public goods		Capital		Local government		Central government	
Explanatory variables	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*
Constant	–282	–0.7	1,005	4.8	524	1.7	–28	–0.2	257	0.8	210	0.4	797	1.7
ILC deprivation	13.7	1.9	8.11	2.2	–1.93	–0.4	–2.85	–1.2	0.91	0.2	3.47	0.4	18.9	2.2
$ILC^2/mean$[b]	15.6	4.0	0.39	0.2	2.87	1.0	0.69	0.5	5.51	1.8	15.8	3.5	9.75	2.1
Brent dummy	144	1.2	–31.3	–0.5	1.9	0.0	174	4.4	–207	–2.2	–95	–0.7	301	2.1
Liverpool dummy	–123	–2.1	119	4.1	21	0.5	119	6.5	–66	–1.5	–27	-0.6	143	2.1
Density (people/ha)	1.37	1.3	0.94	1.7	–0.13	–0.2	–0.71	–2.1	–1.62	–2.0	–1.02	–0.8	0.78	0.6
Road length (m/head)	151	5.4	46.1	3.3	1.06	0.0	40.7	4.6	–4.0	–0.2	78	2.5	169	5.2
Distance from CBD (km)	23.2	2.4	8.11	1.7	6.23	0.9	–5.5	–1.8	10.9	1.5	20.7	1.9	24.4	2.2
Children (%)	14.7	1.4	–13.9	–2.6	22	2.9	1.95	0.6	–2.87	–0.4	15.1	1.2	20.8	1.7
Elderly (%)	1.63	0.2	22.7	5.5	21.5	3.6	2.06	0.8	–3.6	–0.6	16.2	1.7	38.1	4.0
Lone adult (%)	16.4	2.2	–8.9	–2.3	19.5	3.6	8.44	3.6	5.41	0.9	31.6	3.7	21.7	2.5
Non-white (%)	–2.16	–0.9	–1.12	–1.0	6.4	3.8	1.91	2.6	3.2	1.8	7.77	2.9	0.56	0.2
High social class (%)	–5.53	–1.8	–1.47	–1.0	–2.1	–1.0	–1.95	–2.1	–0.83	–0.4	–6.3	–1.9	–4.14	–1.3
Moved house (% p.a.)	–6.28	–0.6	–13.1	–2.6	–13.6	–1.9	–0.67	–0.2	–1.13	–0.1	–24	–2.1	–32.6	–2.9
R-squared (adjusted)	0.859		0.857		0.615		0.761		0.358		0.808		0.791	
F-ratio	42.8		42.1		11.9		22.8		4.8		29.9		26.9	
Number of cases	90		90		90		90		90		90		90	

[a]90 wards excluding Everton in Liverpool as outlier.
[b]ILC squared term is set to zero for negative ILC values.

We can also compare local and central government spending using the evidence in Table 8. It appears that the positive effect of deprivation on spending applies in both cases. However, what differs is that local government appears to concentrate spending more on the most deprived wards, whereas central government displays a more even positive relationship. This is not, of course, a complete account of the redistributive role of these two levels of government, because it does not consider the taxation side of the equation.

VI. CONCLUDING COMMENTS

The starting-off point for this paper is the availability of a unique new set of estimates of public expenditure incidence at local and small-area level for three urban areas in England. We did not do more than summarise the methodological basis and limitations of these spending estimates, but would argue that they represent a robust picture that yields new insights into the urban spatial dimension of public finance.

The main substantive question posed by this paper is 'what is the relationship between public spending and area deprivation?'. This in turn raises a further methodological issue, of the best way of measuring deprivation. We compared the official deprivation measure (the index of local conditions — ILC) with three alternatives, based on income support (IS) expenditure, the Breadline Britain index and a measure of average equivalent income. On the criterion of predictive power with respect to public spending, we conclude that there is not a great deal to choose between the different indices. The most complex measure (modelled equivalent income) worked best in a full model but less well on its own, and has other disadvantages. The evidence provided some support for regarding the effects of deprivation measured using the official ILC as being non-linear and increasing, but this was not so for the other indices.

The overall hypothesis that deprivation affects spending positively at the small-area level is certainly confirmed by the statistical modelling as well as by the simple descriptive patterns. The relationship is statistically significant and quite sizeable. Other geographical and demographic effects also play a substantial role in explaining spending variations, and most of these effects are as expected, although some of the geographical factors do not quite conform to expectations. None the less, deprivation still clearly raises expenditure when allowance is made for these other factors.

To the extent that small areas are more socially homogeneous than large ones, one would expect greater variation in deprivation-related spending between wards than between local authorities (LAs). We have not explored this point explicitly in this article, but the evidence of small-area variations may increasingly be called upon in debates about the adequacy of grant systems' treatment of variations between LAs in wealth, poverty or deprivation.

The evidence is less conclusive on whether there are significant city effects on these broad spending levels, after allowing for deprivation and other factors. Most of the differences between the cities overall are explained by their socio-economic differences. We would expect a degree of uniformity anyway, given (a) the general capping of LA budgets since 1991 and (b) the fact that the majority of spending is on national programmes. Similarly, the evidence that spending responds more to deprivation in some cities than others is not conclusive, although there are some signs of this in particular sectors. However, not too much of a general nature can be concluded from this, since we only looked at three cities.

We would see evidence of this kind as being relevant to various policy debates linking public finance and local governance. First, the continuing practical debate about grant distribution formulae could be genuinely informed by new evidence about the small-area pattern of spending and its relationship with deprivation and other variables, particularly since the extent of skewing of spending 'need' with deprivation is often central to the controversies. Second, local government structural reorganisations may involve changes in boundaries, but, with redistribution being so variable at small-area level, boundaries can have very sensitive fiscal effects. Some of the fiscal problems of cities in Britain in the mid-1990s may be attributable, in part, to under-bounding and the move to unitary status. Third, while local government units in Britain tend to be large, there is considerable demand for decentralisation and devolution of responsibility to smaller neighbourhoods, particularly neighbourhoods with serious problems or attracting major action to promote regeneration (Social Exclusion Unit, 1998). This raises issues about local budgets, including how the money is allocated at this level and whether the parallel flows of money from different budgets going into the same area really appear, from a local perspective, to be the best way of using those resources. Finally, methods of service delivery have undergone some near-revolutionary changes in Britain over the last decade, including the development of various forms of 'quasi-market' mechanism (Bartlett and Le Grand, 1993). This research raises questions about the outcomes of these mechanisms, individually and cumulatively, at neighbourhood level.

This study has opened up a new field for the analysis of public finance at the micro-spatial scale. As such, this can complement and inform much-better-established frameworks for the analysis of the distributional impacts of public finance based mainly on micro household-level datasets for national samples. One obvious area for further research and development is in the integration of these perspectives, to tease out the role of locality and neighbourhood in influencing who gets what out of the system. A second area would be the extension of this kind of micro-spatial analysis of expenditure to a wider range of localities, or even, for certain blocks of expenditure where national databases exist, to the whole national system of neighbourhoods. A third area is to examine

the relationships between spending, needs and outcomes, a focus of follow-up research based on this pilot study. Only when this third area has been examined can we begin to approach the question of whether the degree of responsiveness of spending to deprivation, which we have demonstrated in this article, is actually enough to achieve the wider goals of our society.

APPENDIX A
Summary of Spending Categories and Estimation Methods

See overleaf

APPENDIX B
Derivation of Proxy-Based Estimates of Average Income

The estimates of average and equivalent household income by ward used in this paper are derived from a separate programme of research concerned with local income distributions and housing affordability. The thrust of this work has been to construct a model of local household income distribution to enable local distributions to be derived from national distributions, disaggregated by household type and economic activity, and calibrated initially on national sample surveys. These are then applied to local data on household composition and attributes relevant to relative incomes, derived mainly from Census and other locally reliable data.

The version of this model utilised here models incomes for English local authority districts, as reported for 1991 in Bramley and Smart (1996) and updated to 1995–96. Some of the updating and refinement of this model was carried out first in Scotland, as reported in Bramley and Lancaster (1998). This version of the model also disaggregated by tenure and made estimates for postcode sectors (similar to wards), but did not generate all of the measures used here and was calibrated specifically on Scottish data. Therefore it was preferred to use the English districts model, suitably updated to 1995–96. The model provides a range of measures, including mean gross and disposable income and a measure of equivalent income, at district level. The model is calibrated to generate income levels consistent with national and regional figures derived from the relevant national surveys, namely the Family Expenditure Survey (FES) and Survey of English Housing.

The model divides the household population into 24 sub-groups based on nine household types by two or three economic activity categories (0, 1 or 2+ workers). For each sub-group, gross household income is assumed log-normal and national average parameters (median and standard deviation of the log of income) are estimated from the FES. Household composition at local level is

TABLE A.1

Locally Relevant Expenditure per Head in Three Cities and Nationally, Ratio of Spending in Most to Least Deprived Wards and Methods of Expenditure Estimation, by Expenditure Categories or Programmes

Service	*Three cities' mean*	*National mean*	*Deprivation ratio of expenditure*[a]	*Method category*[b]	*Comment on method*
Retirement pension	473	477	0.66	A	Full claimant and amount scan by postcode
Widows' benefit	15	18	0.78	A	As above
Industrial injury benefit	11	12	1.37	C	Actual regional totals, imputed to wards using demographics
Incapacity benefit	161	115	1.47	A	Full claimant and amount scan by postcode
Unemployment benefit	33	18	2.08	B	National On-Line Manpower Information System (NOMIS) claimants by ward, IS information, local totals
Attendance allowance	37	38	0.76	A	Full claimant and amount scan by postcode
Disability living allowance	103	66	1.53	A	As above
Severe disability allowance	20	15	1.48	A	As above
Invalid care allowance	25	11	1.41	A	As above
Child benefit	118	109	1.03	A	As above
Income support: elderly	91	66	1.73	A	As above
Income support: disabled or long-term sick	69	28	3.69	A	As above
Income support: unemployed	179	75	2.83	A	As above
Income support: other and lone parent	230	129	3.00	A	As above
Housing benefit	347	153	3.15	A	As above

Service	*Three cities' mean*	*National mean*	*Deprivation ratio of expenditure*[a]	*Method category*[b]	*Comment on method*
Council tax benefit	61	35	2.73	AB	Claimants by ward/postcode, varying detail on amounts
Family credit	37	29	1.82	A	Full claimant and amount scan by postcode
War pensions	18	22	0.67	C	Actual regional totals, imputed to wards using demographics
Independent Living Fund	6	2	1.21	C	As above
Social Fund	14	4	2.79	C	As above
Health service	649	676	1.11	AB	Hospital episodes × postcode × speciality cost; mixture of more approximate measures for other sectors
Social services: children	66	74	2.73	A	Clients × main categories × ward × unit cost
Social services: elderly	94	42	1.70	B	Partial client/cost data at different spatial scales
Social services: physically disabled	16	12	1.47	C	Demographic proxy formula
Social services: mental health	14	8	2.05	AC	Direct client data in Brent; regression based on this for others
Social services: other	34	24	1.99	C	Demographic proxy formula
Higher education	98	120	0.69	A	Direct student data by home residence
Primary schools	162	137	1.17	AB	Pupils × age/school/postcode and school budgets, or pseudo-catchments
Secondary and GM schools	175	135	0.98	AB	As above
Special education	36	29	1.41	A	Direct pupil or special education records
Other local education	24	19	2.02	AB	Varying depending on type of spend and LEA
Further education	64	55	1.36	A	Funded students × cost/type × postcode
Training and Enterprise Councils	40	16	1.23	AC	Funded trainees × cost/type × postcode (two areas)
Employment service	38	26	1.87	C	Demographic proxy formula

Service	*Three cities' mean*	*National mean*	*Deprivation ratio of expenditure*[a]	*Method category*[b]	*Comment on method*
Housing corporation capital investment	86	24	5.56	A	Direct programme information × postcode/address, multi-year
LA housing capital	61	31	4.58	AB	As above
LA net housing subsidy	81	16	4.34	C	LA total from Housing Revenue Account (HRA), pro rata stock
Trunk roads	28	42	0.59	B	Regional totals, pro rata travel rates based on National Travel Survey (NTS) and car ownership × broad urban type
Local roads	45	64	0.90	B	Local totals, pro rata travel rates
Rail subsidies	58	51	0.87	B	Regional totals, pro rata travel rates based on NTS and car ownership × broad urban type
Underground subsidy	27	11	0.86	B	Regional totals, related to proximity to stations
Bus subsidy	7	7	1.99	B	Distance of subsidised route in ward
Concessionary fares	18	9	0.85	C	Demographic proxy formula
Police	107	143	2.20	B	Budget allocation to stations/divisions, ward allocation on incidents
Fire service	22	26	2.00	B	As above
Probation	12	10	1.42	AC	Direct client postcodes (one case) or simple demographic proxy
Sport, swimming and leisure centres	13	10	1.13	B	Facility locations × costs and survey-based catchments, and/or survey predicted usage
Parks and open spaces	18	12	0.93	B	As above
Libraries	15	10	1.16	B	As above
Refuse collection	9	6	0.99	BC	Modelled on street index and contract data for one area, with regression to apply to others
Street cleaning	12	12	1.03	BC	As above

Service	*Three cities' mean*	*National mean*	*Deprivation ratio of expenditure*[a]	*Method category*[b]	*Comment on method*
Local environmental capital	13	20	1.07	AC	Full scheme data × ward in one area, simple proxies in others
Single Regeneration Budget	20	6	11.47	AC	Scheme location (× ward) data in most cases, some use of proxies
Other local environmental	97	74	1.12	C	Demographic proxy formula
Local government overheads	–12	50	0.65	C	As above
Grand total, locally relevant public spending	4,294	3,429	1.45		
Ratio of three cities to national mean	1.25				

[a]Ratio of expenditure per head in most deprived band of wards (ILC > 12) to non-deprived wards (ILC < 0).
[b]See Section III(2) for categorisation.

derived from the 1991 Census. Economic activity propensities are estimated by regression models calibrated on 1991 data, using various unemployment and activity rates as predictors. Relative income levels are predicted using composite indices including factors for average and low earnings (based on the New Earnings Survey), occupational and industrial composition, part-time workers, and indicators of deprivation (unemployment, long-term unemployment and lone parents) and wealth (tenure, house prices and occupational class). These are calibrated judgementally in the light of a range of evidence, including regional fit to the FES, micro-analyses of large-scale surveys to identify key predictors and models to predict factors strongly related to income (particularly car ownership) at district level (see Bramley and Smart (1996) and Bramley and Lancaster (1998)).

Most components of the LA-level model are updated from the original 1991 base using a range of sources, including the Labour Force Survey (economic activity and occupational and industrial composition), household projections

TABLE B.1

Income Prediction Formulae
Based on Regression of Modelled ln(Income) at District Level

	Gross income	*Net income*	*Equivalent income*
Constant	5.637	5.499	5.917
Density of population (people per hectare)	–0.000169	–0.000313	0.0000304
Sparsity of population (hectares per person)	0.0134	0.00574	0.00987
Lone-parent households with dependent children	–0.0159	0.0126	–0.0117
Lone elderly households	–0.03	–0.0154	–0.203
Average household size	0.0145	–0.00601	–0.219
High social class of head of household	0.00461	0.00358	0.00391
No car	–0.0039	–0.00394	–0.00233
Part-time workers as a proportion of all workers	–0.0088	–0.00682	–0.00732
Unemployment rate	–0.0101	–0.00793	–0.00886
Married women economically active	0.00276	0.00214	0.0021
Average earnings index (county or borough level, by workplace)	0.704	0.589	0.627
Share of work-force in agriculture	–0.00704	–0.0047	–0.00415
Share of work-force in banking, financial and business services	0.00604	0.0047	0.00503
Social renting housing tenure	0.0117	–0.000959	–0.0014

(household composition), the National On-Line Manpower Information System (NOMIS) database (claimant unemployment), the New Earnings Survey (earnings) and local authority returns (housing tenure).

The household-type sub-group structure enables means-tested benefit scale rates to be calculated and used as an equivalence scale for calculating equivalent income. Similarly, notional tax allowances can be applied, along with typical tax rates, to generate tax and National Insurance deductions and hence net disposable income.

This relatively complex income simulation model yields estimates of mean gross, net and equivalent income for each of 366 LA districts in England in 1996. (It can also yield many other distribution-based measures, particularly useful for calculating poverty incidence or looking at housing affordability problems, but these go beyond the scope of this article.) We then simplify and linearise it in order to predict incomes at ward level in our case-study cities. In each case, a proxy prediction formula is derived by regressing the relevant income estimates on a set of variables that capture the main demographic, economic and social characteristics that drive the model. This prediction formula is then applied to data on these characteristics for the wards in our three case-study cities. The variables and weights used in these prediction formulae are listed in Table B.1. Statistical significance measures are not included because we do not wish to portray these regressions as being of actual income data; we are merely seeking a simplified representation of a synthetic estimate.

REFERENCES

Audit Commission (1993), *Passing the Bucks: The Impact on Economy, Efficiency and Effectiveness of the Standard Spending Assessment System*, London: HMSO.

Bartlett, W. and Le Grand, J. (1993), *Quasi-Markets and Social Policy*, London: MacMillan.

Blackman, T. (1995), *Urban Policy in Practice*, London: Routledge.

Bramley, G. (1990), *Equalization Grants and Local Expenditure Needs: The Price of Equality*, Aldershot: Avebury.

— (1996), 'Who uses local public services? Need, demand and rationing in action', in G. Pola, G. France and R. Levaggi (eds), *Developments in Local Government Finance: Theory and Policy*, Cheltenham: Edward Elgar.

—, Evans, M. and Atkins, J. with Lancaster, S., Lomax, D., McIntosh, S., Russell, J., Chell, M. and Flatley, J. (1998), *Where Does Public Spending Go?*, Report of a Pilot Study to Analyse the Flows of Public Expenditure into Local Areas for the DETR, London: Department of the Environment, Transport and the Regions.

— and Lancaster, S. (1998), 'Modelling local and small-area income distributions in Scotland', *Environment & Planning C: Government & Policy*, vol. 16, pp. 681–706.

— and Le Grand, J. (1992), *Who Uses Local Services? Striving for Equity*, Belgrave Papers no. 4, Luton: Local Government Management Board.

— and Smart, G. (1993), 'Who benefits from local services? Comparative evidence from different local authorities', London School of Economics, Welfare State Programme, Discussion Paper no. WSP/91.

— and — (1996), 'Modelling local income distributions in Britain', *Regional Studies*, vol. 30, pp. 239–55.

— and Wyatt, G. (1998), *The Use of Non-Expenditure Information in Standard Spending Assessments*, Report of Research to the Department of Environment, Transport and the Regions (Local Government Research Unit).

Burrows, R. and Rhodes, D. (1998), *Unpopular Places? Area Disadvantage and the Geography of Misery in England*, Partridge Green, West Sussex: Policy Press / Biblios Publishers' Distribution Service.

Carr-Hill, R. and Smith, P. (1997), *A Model of the Determinants of Expenditure on Children's Personal Social Services*, Report of a Study Commissioned by the Department of Health from the University of York.

Department of the Environment (1977), *Policy for the Inner Cities*, London: HMSO.

— (1995), *1991 Deprivation Index: A Review of Approaches and a Matrix of Results*, DOE Research Report, London: HMSO.

Department of the Environment, Transport and the Regions (1998), *1998 Index of Local Deprivation*, London: DETR.

Dobson, B., Trinder, P., Ashworth, K., Stafford, B., Walker, R. and Walker, D. (1996), *Income Deprivation in the City*, York: Joseph Rowntree Foundation.

Dorling, D. (1996), *Identifying Disadvantaged Areas: Health, Wealth and Happiness*, Position Paper for Joseph Rowntree Foundation Area Regeneration Programme.

Duncan, A. and Smith, P. (1995), 'Modelling local government budgetary choices under expenditure limitation', *Fiscal Studies*, vol. 16, no. 4, pp. 95–110.

Ebdon, D. (1985), *Statistics in Geography*, Oxford: Blackwell.

Glennerster, H. and Hills, J. (eds) (1998), *The State of Welfare: The Economics of Social Spending*, 2nd edition, Oxford: Oxford University Press.

Goodin, R. and Le Grand, J. (1987), *Not Only the Poor: The Middle Classes and the Welfare State*, London: Allen & Unwin.

Gordon, D. and Pantazis, C. (1997), *Breadline Britain in the 1990s*, Aldershot: Ashgate.

Green, A. E. (1994), *The Geography of Poverty and Wealth*, Coventry: Institute for Employment Research, University of Warwick.

— (1996), 'Aspects of the changing geography of poverty and wealth', in J. Hills (ed.), *New Inequalities: The Changing Distribution of Income and Wealth in the United Kingdom*, Cambridge: Cambridge University Press.

Gujerati, D. N. (1995), *Basic Econometrics*, New York: McGraw-Hill.

Hall, J., Preston, I. and Smith, S. (1996), *Alternatives to Current Regression Methods in the Calculation of Standard Spending Assessments*, Report to the Department of the Environment by the Institute for Fiscal Studies, London: IFS.

Hepple, L. and Rees, H. (1998), *Standard Spending Assessments and Multilevel Modelling*, Report to the Department of the Environment, Transport and the Regions by Geoconomic Research.

Holterman, S. (1975), 'Areas of urban deprivation in Great Britain: an analysis of census data', *Social Trends*, vol. 6, London: HMSO.

Lee, P., Murie, A. and Gordon, D. (1995), *Area Measures of Deprivation: A Study of Current Methods and Best Practices in the Identification of Poor Areas in Great Britain*, Birmingham: Centre for Urban and Regional Studies, University of Birmingham.

Le Grand, J. (1982), *The Strategy of Equality: Redistribution and the Social Services*, London: Allen & Unwin.

—, Propper, C. and Robinson, R. (1992), *The Economics of Social Problems*, London: MacMillan.

Murie, A. and Lee, P. (1997), *Poverty, Deprivation and Housing Tenure*, Bristol: Policy Press.

Noble, M., Smith, G., Avenall, D., Smith, T. and Sharland, E. (1994), *Changing Patterns of Income and Wealth in Oxford and Oldham*, Oxford: Department of Applied Social Studies and Social Research, University of Oxford.

— and Smith, G. (1996), 'Two nations? Changing patterns of income and wealth in two contrasting areas', in J. Hills (ed.), *New Inequalities: The Changing Distribution of Income and Wealth in the United Kingdom*, Cambridge: Cambridge University Press.

Sefton, T. (1997), *The Changing Distribution of the Social Wage*, London: STICERD, London School of Economics.

Social Exclusion Unit (1998), *Bringing Britain Together: A National Strategy for Neighbourhood Renewal*, Cm. 4045, London: The Stationery Office.

— (2000), *National Strategy for Neighbourhood Renewal: A Framework for Consultation*, London: The Stationery Office.

Tiebout, C. M. (1956), 'A pure theory of local expenditures', *Journal of Political Economy*, vol. 64, pp. 416–24.