Routledge
Taylor & Francis Group

Spatial Definitions of the City: Four Perspectives

John B. Parr

Summary. The extent of the city is important in a number of respects, not least in relation to the question of city size, an issue of considerable significance in urban and regional analysis. Four definitions of the city are considered here. The first involves the city as a physical entity, or the area devoted to primarily urban uses. This Built City (BC) is perhaps the most familiar perception of the city, largely because it is relatively easy to visualise. The BC forms the core or basis of each of the other three definitions of the city. These are as follows: the Consumption City (an area within which most of the consumption of goods and services occurs in the BC); the Employment City (an area in which the bulk of the employed workforce works in the BC); and the Workforce City (an area upon which the BC draws for a given majority of its labour requirements). These four definitions of the city are brought together and shown to be interrelated.

1. Introduction

In attempting to understand the city, various approaches have been pursued. Among the more important viewpoints that have been adopted are the economic (Ratcliff, 1949; Sombart, 1902), the sociological (Weber, 1921/1958; Wirth, 1938), the cultural (Mumford, 1938; Zukin, 1995) and the historical (Pirenne, 1936; Weber, 1899). While providing considerable insight into the nature and functioning of the city, these approaches are generally not concerned with the space that it occupies—i.e. its territorial extent. This would appear to be a rather mundane concern, certainly when set along-side the many powerful ideas contained in the above-mentioned works. Yet spatial definitions are important for a variety of reasons, the most obvious being the determination of a city's boundaries to establish the jurisdictional competence of its municipal government. Within the field of urban analysis, the definition of a city assumes a critical

importance in relation to the question of city size, a statistic of fundamental significance. Size is of obvious relevance in the ranking and hierarchical ordering of cities, as well as their size distribution and how this changes over time. Size is also of crucial importance when it is being related to such variables as per capita income, the unemployment rate, inequality in levels of well-being and the extent of diversification and specialisation. It is usually the case that city size is measured in terms of some aggregate such as total population, employment or income, and any measure of this type is only possible with adequate information on the areal extent of the city—i.e. with a specification of its boundary.

On the surface at least, this appears to be straightforward enough. Such is not the case, however, and a couple of simple examples serve to illustrate the point. First, the 2002 population of the City of Nottingham was 274 000, whereas the population of its

John B. Parr is in the Department of Urban Studies, University of Glasgow, 25 Bute Gardens, Glasgow, G12 8QQ, UK. Fax: 0141 330 4983. E-mail: J.B.Parr@socsci.gla.ac.uk.

'continuous urban area' has been estimated at 681 000 (City of Nottingham, 2005a). Secondly, the City of Manchester had a 2001 population of 393 000, while that of the City of Liverpool was 440 000, but the populations of the respective metropolitan counties (Greater Manchester and Merseyside) were 2 482 000 and 1 362 000, representing a reversal in the ranking (ONS, 2003 and 2004). In the Nottingham case, the difference in size depends on whether or not the city is being defined as a legal entity (the *de jure* city) or as a physical one (the *de facto* city). In the Manchester/Liverpool case, however, the differences in size turn on what type of administrative division is used. Surprisingly, the failure to make these distinctions when comparing cities is common, not simply in everyday discussion or newspaper coverage (often resulting in much confusion), but also in studies concerned with cross-sectional comparisons of cities in terms of population or population-related variables, particularly on an international basis. It hardly needs emphasising that city size must be measured meaningfully and consistently over the entire range of cities under consideration, as would need to be the case, for example, where the population of a city was being treated as an explanatory variable in a multivariate analysis of urban productivity. Similar considerations apply, with no less force, when the concern is with city growth rates, this being of particular relevance in tests of the 'law of proportionate effect' (Gibrat, 1931; Eeckhout, 2004).

2. Background Considerations

We may begin by briefly considering the city as corresponding to the legal city. Under certain conditions, this definition is perfectly adequate—particularly where the legal boundary of the city is closely coincident with its physical extent. This represents the case of the so-called true-bounded city (International Urban Research, 1959). There are, however, problems with using the legal definition of the city and these may be especially serious for larger urban areas. Above a certain population level, which varies considerably among nations but which is usually in excess of around 150 000 inhabitants, the legal city exists as part of a broader urban or metropolitan area. In such a setting, the boundary of the legal city is very porous in functional terms, with the result that this definition can only have a limited validity in urban analysis. Furthermore, the population of the legal city relative to that of the overall urban area usually displays considerable variation, rendering comparisons among legal cities virtually meaningless. Moreover, using the legal city may cast the city in an unfavourable light, which can have an adverse influence on investment decisions affecting its economy. This is especially the case with older industrial cities. Research by the City of Nottingham (2005b) has revealed that if 'Greater Nottingham' is used rather than the legal entity, the city's performance is considerably improved, in terms of such indicators as unemployment, the uptake of incapacity benefit, health problems, educational attainment and drug abuse. It is perplexing, therefore, that the legal definition of the city continues to be used in comparative urban analysis.

Problems also exist at the other end of the size spectrum. An important strand of urban research in the past half-century has been concerned with relating the city to its broader spatial labour market (Goodman, 1970; Smart, 1974). In the UK, this has involved studies of commuting and, more recently, attempts to reconstitute travel-to-work areas (TTWAs) originally introduced in 1953 (*Employment & Productivity Gazette*, 1968). These now represent approximations of self-contained labour markets. More specifically, within a given TTWA at least 70 per cent of the resident workforce is employed there, while at least 70 per cent of those employed there are also residents. Such TTWAs, which have been subject to certain criticisms (Turok, 1997; Webster, 1997), have been used to track unemployment and to identify areas for economic development assistance.

In the US, the approach has been rather different (somewhat less policy-oriented, though still policy-relevant), probably reflecting the greater extent of the nation and the

higher levels of daily mobility. To deal with the complex phenomenon of commuting, Berry *et al.* (1968) introduced the concept of the 'functional economic area'. For a particular labour market (a set of counties sending commuters to a given central county), the functional economic area consisted of

> all those counties within a labour market, for which the proportion of resident workers commuting to a given central county exceeds the proportion commuting to alternative central counties (Berry *et al.*, 1968, pp. 24–25).

With some modification, the concept of the functional economic area was applied in western Europe (Hall and Hay, 1980), where it has become known as the 'functional urban region' (FUR). In a six-nation study of FURs directed by Brunel (2002, p. 18), a 'municipality' was included within the FUR, if at least 10 per cent of its employed workforce commuted to the 'core city' (generally a metropolitan area). The problem here was that the resulting entity was extremely large: over 150 km in diameter in the cases of Paris and London. As the term indicates, the FUR is a region and not a city, and there is little to be gained by suggesting otherwise. The real conceptual value of the FUR, of course, lies in its ability to highlight the linkage between the built-up area of the city and a surrounding territory.

It is evident that the city is increasingly regarded not so much as a concentration in its own right, but rather as a focus of some wider space. A particular example of this is an urban-centred territory, termed in western Europe the 'city-region' (Parr, 2005). This refers to a territory within which the city and the area surrounding it are engaged in a complex and interrelated set of economic and social interactions. The concept of the city-region is employed at different spatial scales, sometimes to avoid an underbounding of the city, but more commonly to emphasise the significance and extent of these interactions. In fact, the FUR, referred to above, can be said to represent a particular scale of city-region. Although the interaction

here is frequently concerned with commuting, the FUR may be based on migration, the housing market, patterns of retail trade, etc. (Coombes, 2004). The argument that the city should be viewed as part of a larger entity (the city-region) is an especially strong one that has considerable validity. Nevertheless, there are various justifications for confining attention to the city, while not denying the existence of some more extensive structure, of which it is the focus. The balance of the paper is based on this premise.

The concern here is with four definitions of the city, one of which is also being used as a foundation for each of the other three. In all cases, the focus is on the particularity (rather than the superiority) of each definition. Note that in keeping with current practice in urban research, no distinction is made between the terms 'town' and 'city', and that no significance attaches to the designation 'city' when this refers to some honorary, historical or religious status. Recent discussions of the definition of the city include those by Champion (2004), the European Commission (2004), Frey and Zimmer (2001), O'Sullivan *et al.* (2004), Pumain *et al.* (1991) and the United Nations (UN-Habitat, 1996).

3. The Built City

The initial definition of the city is concerned with its built-up area—i.e. a continuous or near-continuous tract of territory devoted predominantly to such uses as housing, manufacturing and commercial activity, transport and public spaces. There is a strong case for imposing a minimum size threshold on this 'built city' (the BC) and here we take the arbitrary, though common, level of 50 000 population as the lower limit (below this limit, the categories of 'smaller urban areas' and 'rural areas' could be used). And in the exact delimitation of the BC there is also the need to apply some minimum-density criterion, along with certain rules regarding the treatment of ribbon (strip) development and urban areas in very close proximity.

This physical view of the city is of obvious relevance in the case of larger metropolitan

areas. Here, the BC emerged either as a result of successive rings of peripheral expansion (Berlin, Chicago, London, Paris, etc.) or because of the coalescence of neighbouring urban areas, to form a single metropolitan area (Birmingham, Boston, Glasgow, Manchester, the urban agglomeration of Lille–Roubaix–Tourcoing, etc.). The latter examples are more in the spirit of what Geddes (1915) termed a 'conurbation'. We should not allow ourselves to be detained by the fact that the BC (whatever its form) may sometimes contain non-urban tracts. Physical impediments to urban growth, the existence of parks, nature reserves, areas devoted to sports, as well as the imposition (by planning authorities) of green wedges and other restrictions on land use, all account for such discontinuities in the urban surface. In contrast to the case of the legal city where this forms part of a much larger urban area, the BC provides a considerably better indication of the relative importance of the city as a focus of economic activity and a concentration of the demand for labour. Furthermore, the economy of the BC is typically characterised by complex patterns of internal trade, not only between households and firms but also among firms. The latter form of trade partially reflects the presence of agglomeration economies, particularly those of the urbanisation type—i.e. external economies of scope.

National statistical agencies have, of course, recognised the importance of this broader view of the city. In 1951, the census authorities in the UK introduced a unit termed the 'conurbation', to identify major areas of more or less continuous urbanisation (General Registry Office, 1956; General Registry Office, Edinburgh, 1954, pp. xxxiii–xxxiv). The conurbation was based on local government units, with account taken of density considerations. A locality was

> considered for inclusion in a conurbation, to whose focal centre it was strongly attached as a centre for work, shopping, higher education, sports or entertainment (General Registry Office, 1956, p. xiv).

The conurbation was an accurate representation of the BC and it was unfortunate that only seven were identified (Robinson, 1953; Dickinson, 1964). This statistical division was not used after the 1961 Census, but the metropolitan counties of England, created in the 1960s and 1970s, were similar to the former conurbations (London was somewhat underbounded, while the others tended to be overbounded). The 'urban area', currently used by the Office for National Statistics, probably represents as good an approximation to the BC as is possible. This is a 'bricks-and-mortar' definition, which includes urban areas below the 50 000 population threshold employed here. In the case of larger urban areas, these are sub-divided into constituent parts. The definition of urban areas in England and Wales differs only slightly from that used in Scotland (ONS, 2004).

The situation in the US is somewhat different. In 1949, the Bureau of the Census introduced the concept of the 'urbanised area' (Berry et al., 1968; Wrigley, 1950). This unit, having a population exceeding 50 000, was designed in part to emphasise urban–rural differences. Based on minor civil divisions, such a unit is a reasonable description of the BC. It cannot be stated strongly enough, however, that the 'urbanised area' is quite separate from the 'metropolitan statistical area' (MSA), first introduced in 1990 and emerging from various previous designations, starting with the 'metropolitan district', used in the 1910 Census. The MSA employs counties as building blocks and, since these often contain a large rural component, the MSA tends to overstate the extent of the BC, especially in certain Western states. This may be a serious problem when cities (i.e. MSAs) are being compared in terms of density or density-related attributes. More generally, when such MSAs continuously cover more than two-thirds of the surface area of California, for example, or when contiguous MSAs form a 1000 km belt from Portland, Maine, to Richmond, Virginia, the use of such a unit to measure the extent of a city has to be questioned, its advantages in terms of intertemporal comparability notwithstanding.

An ambitious and, in many ways, successful attempt to define the major metropolitan

areas of the world on a consistent basis was undertaken in the late 1950s by a team from the University of California, Berkeley (International Urban Research, 1959). The study employed criteria broadly similar to those used by the US Bureau of the Census to define the Standard Metropolitan Area, one of the precursors of the MSA. Local government units were added to the 'principal city' (in excess of 50 000), to form the metropolitan area, if at least 65 per cent of the employment was in non-agricultural activities. Unfortunately, this often resulted in the metropolitan area extending beyond the BC (the conurbation). In the case of London, for example, the defined metropolitan area was sufficiently far-reaching as to contain a 1956 population of 10.5 million, the 1961 population of the BC being around 8 million.

While the BC is able to reflect the economic importance of a city, it suffers from a serious weakness. Over the past half-century (somewhat longer for certain nations) the boundary of the BC has become increasingly porous, a development mentioned in the previous section in relation to the legal city when it merely formed part of a larger BC. It is frequently the case that the boundary of the BC fails to reflect adequately the operation of the labour market, the housing market, systems of service provision (private and public), etc. In the case of the labour market, for example, a significant share of those employed within the BC resides outside it, the proportion for London in 2001 being 20 per cent (CEBR, 2005, p. 20). In addition, part of the employed resident workforce of the BC works beyond its boundaries and for London in 2001 this amounted to around 7 per cent (Oxford Economic Forecasting, 2004). In other words, for the BC there is a lack of correspondence between the location of the workforce and the location of employment.

Problems of this nature prompt the search for additional definitions of the city, three of which are considered here. In each case, the BC represents the base. To this base a locality in the outer area (i.e. the area surrounding the BC) is added: if it satisfies a certain specified criterion; if it is directly or indirectly contiguous with the BC; and, if its exclusion would result in a discontinuity or gap in the surface of the type of city being defined. The outer-area localities may consist of 5-km grid squares, for example. Alternatively, these localities could represent local government jurisdictions. A further possibility is for the localities to be urban-centred territories. Whatever the type of areal unit employed, the question of appropriate frequency is pivotal. With too many units, each will tend to lack functional integrity: with too few units, each becomes an awkward building block. Clearly, the appropriate frequency of areal units is likely to require preliminary experimental testing.

4. The Consumption City

Households in the BC consume goods and services, most of which are supplied by the BC. Households in localities beyond it also consume such goods and services supplied from the BC. This consumption involves expenditures on food, clothing, durable and non-durable goods, and personal services of various kinds, including certain types of social services. From the viewpoint of the economy of the BC, such consumption by non-BC households is exogenous and is no different in its income-generating effect from the supply of machinery to an overseas market, for example. However, from the viewpoint of the economy of a wider city (to be specified shortly) these expenditures are endogenous. Let us consider why consumption expenditures by non-BC households should take place in the BC. One reason is that individual localities simply lack the purchasing power to permit the provision of specialised goods and services, such as a bespoke suit, a rare book, a theatre performance or a concert. The supply of such high-order goods and services is generally confined to larger cities (in their capacity as central places), a tendency that is reinforced by the opportunities there for comparison-shopping. Another reason for goods and services available within the BC being consumed by

non-BC households is related to commuting to the BC from the outer-area localities (something that will be considered in the following section). Commuters typically use the opportunity created by daily travel to the BC for lunchtime shopping and/or after-work attendance at entertainment and sporting events.

The pattern of consumption expenditure by non-BC households underlies the second definition of the city: the 'consumption city' (the CC). This draws attention to the fact that households primarily dependent on the BC for purposes of consumption are not confined to the BC itself. A first approximation to defining the CC would involve adding to the BC each locality with more than 50 per cent of its consumption expenditures occurring in the BC. However, some of the consumption by BC households will be external to the BC. For example, out of the total consumption by BC households, a certain proportion x is spent on mail-order purchases and Internet shopping, as well as recreation and holiday activity in other regions of the nation or overseas. By the same token, households in locality i could be expected to make similar external expenditures beyond the neighbouring BC. For this reason, there needs to be some downward adjustment of total consumption expenditure of locality i. The CC, apart from subsuming the BC, will also include each locality i for which the following inequality holds

$$\frac{C_{BC}^i}{C_T^i(1-x)} > 0.5 \qquad (1)$$

where, C_{BC}^i is the consumption by locality i households in BC; C_T^i is the total consumption by locality i households; and x is the proportion of consumption expenditure made externally by locality i households, other than in the relevant BC (if x is known to differ significantly from that of the BC and/or to vary widely among localities, it is possible to use the term x^i).

It follows that the existence of large shopping centres in the outer suburbs of the BC will raise the value of expression (1), while the presence of branches of major retail chains in locality i of the outer area will lower this value.

Attention is drawn to three qualifications of this definition of the CC. First, housing expenditures (whether outright purchases, mortgage repayments or rents) are excluded from the consumption package. This is because the choice of location has already been made, whereas for non-housing consumption expenditure a certain degree of locational discretion is possible, with respect to level and composition. The second qualification concerns those services for which there is only a partial charge or no charge at all, such as higher education, certain types of medical and related services, visits to parks and museums. Since the city is being defined in terms of consumption, services of this type cannot justifiably be excluded, but for the above definition to be used, such consumption items have to be expressed in monetary terms. A third qualification concerns the fact that, by the definition of a CC given in inequality (1), one (or more) of the included localities may represent a smaller BC, thus having a population in excess of 50 000. Rather than attempt to construct a CC based on this BC, it is expedient to treat such a BC as part of the CC. Thus while this BC remains within the group of BCs, it does not form the basis for an independent CC.

5. The Employment City

It has already been noted that for many cities, especially larger ones, a significant proportion of the employed workforce is resident beyond the boundary of the BC. This forms the background for a third definition of the city. The underlying argument here is that since the majority of the employed resident workforce of the BC works there, then all localities which have such an employment dependence on the BC, should be combined to form some wider city. This is termed the 'employment city' (the EC), a preliminary definition of which would include the BC, as well as each locality in which at least 50 per cent of the employed resident workforce commuted to the BC. However, this definition makes

no allowance for that element of locally orientated employment which is supported by locality i commuters to the BC—i.e. part of the locality i employment in retailing, entertainment, personal services, local transport, etc. A more realistic condition for the inclusion of a locality within the EC would therefore be for the commuting employment, *plus* the local employment which this generates, to be greater than 50 per cent of the employed workforce resident within the locality.

In defining the EC, the following notation is introduced

E_{BC}^i is the employed resident workforce of locality i commuting to the BC;

E_L^i is the employed resident workforce of locality i engaged in the locally oriented sector of the locality i economy; and

E_T^i is the total employed workforce resident in locality i;

with

$$k^i = \frac{E_L^i}{E_T^i} \qquad (2)$$

The direct and indirect employment in locality i that is associated with commuting to the BC may thus be expressed as

$$E_{BC}^i + E_{BC}^i k^i + E_{BC}^i (k^i)^2 + \ldots .$$
$$= E_{BC}^i \left[\frac{1}{(1-k^i)} \right] \qquad (3)$$

Locality i is therefore included in the EC, if

$$\frac{E_{BC}^i [1/(1-k^i)]}{E_T^i} > 0.5 \qquad (4)$$

The term $1/(1-k^i)$ represents the employment multiplier for locality i.

In a related manner, the inclusion of a locality within the EC can be approached in terms of income. Now, however, the criterion for the inclusion of locality i is for the income (direct and indirect) derived from commuting, to be greater than 50 per cent of the total income of locality i—i.e. for the following

condition to be satisfied

$$\frac{Y_{BC}^i [1/(1-a^i b^i)]}{Y_T^i} > 0.5 \qquad (5)$$

where, Y_{BC}^i represents the wages and salaries of locality i workforce commuting to the BC; a^i is the propensity to spend in locality i by the locality i workforce commuting to the BC; b^i is the income generated in locality i per £ of expenditure by locality i workforce commuting to the BC; and Y_T^i is the total income of locality i—i.e. the 'gross locality product', which includes net factor payments and net transfers to (from) locality i.

The term $1/(1-a^i b^i)$ is the income multiplier for locality i (a fuller discussion of this type of multiplier is given in Tiebout, 1962). There is every reason to expect that the size and shape of the EC would vary according to whether the analysis was in terms of employment or income. In fact, a comparison of the results of the two methods would provide valuable information on the socio-economic characteristics of commuting within a given EC.

The approach may be illustrated (with respect to employment) by a simple example. Suppose that for an outer-area locality i, 20 per cent of the resident workforce is employed in the BC and that a further 25 per cent is employed in local engineering plants, which supply overseas manufacturers, but which have no backward linkages locally. We assume that there is broad comparability between the wages and salaries of the two sources of employment and that the value of k is 0.5 (relatively high for a non-metropolitan economy). In common-sense terms, it would not be appropriate to regard this locality as part of the EC, simply because the local economy is more dependent on overseas demand for goods than it is on the BC's demand for the locality's labour. In more precise terms, a similar conclusion is reached if inequality (4) is applied. This is not satisfied, however, since the workforce employed in the BC, plus the local employment which this supports, amounts to only 40 per cent of the

total locality i employment—i.e. 0.4 on the right-hand side of inequality (4). It is worth mentioning that this locality would almost certainly be included in a functional urban region (FUR), as described in section 2, since the cut-off figure for inclusion in a FUR is usually below 20 per cent of i locality employment. However, since the FUR is intended to define something other than a city, it is perhaps not surprising that its spatial extent should exceed that of the EC.

In labour market terms, the degree of self-containment between workforce and employment (i.e. the correspondence between the supply and the demand for labour) is greater for the EC than for the BC. This would also be reflected in the balance of payments for each type of city. Thus, the sub-balance relating to commuting (the wages and salaries received by the city for external employment of its resident workforce *minus* the wages and salaries paid by the city for employment undertaken by externally resident workers) is likely to be negative for both types of city. In absolute terms, however, the sub-balance will be greater for the BC than the EC. Alternatively stated, the net factor payments for labour made by the BC will be significantly higher than similar payments made by the EC. Finally, it is possible that one of the localities included within the EC may be a BC in its own right. In such a case, this BC is simply treated as part of the EC and thus has no independent existence as an EC.

6. The Workforce City

As with the EC, the final definition of the city is concerned with the daily movement of labour to the BC. This definition, referred to as the 'workforce city' (the WC), represents the area from which a given majority of the BC's labour requirements is drawn. It comprises the territory required to support a particular volume of employment within the BC, at its present level of efficiency. This is not to argue that comparable levels of efficiency would be unattainable with a smaller or larger territory. Whereas the third perspective (the EC) was based on the employment

dependence of the outer areas on the BC, this fourth perspective (the WC) is concerned with the workforce dependence of the BC on the outer areas. The WC bears passing resemblance to the notion of the 'labor shed' proposed by Vance (1960), although his definition was general and was concerned with the labour-supply area for one or more plants rather than for the entire BC. If, for a particular BC, 85 per cent of those employed there are resident within it, the remaining 15 per cent can be assumed to be drawn from the outer-area localities beyond the BC boundary. Starting from the boundary of a BC, it is possible to construct a series of isolines or closed curves, still using outer-area localities. Each isoline encloses an area within which a given percentage of those employed in the BC is resident—91, 92, 93, etc. Obviously, the higher the value of the isoline, the more extensive will be the area involved.

It is from such a family of isolines that the 'critical isoline' is selected and it is this isoline that defines the WC. Ideally, the 100 per cent isoline would be selected, but this is unrealistic, since there is inevitably a relatively small number of persons working in the BC who reside at a very long distance. An isoline having a smaller percentage value must therefore be selected. Note that for very high values of the critical isoline, the WC begins to resemble the FUR or even a broader scale of city-region. An important variant of this perspective (and one which is clearly linked to it) involves undertaking the analysis in terms of wages and salaries rather than employment. Thus each isoline would now enclose an area containing a given percentage of the resident employment-based income generated within the BC. The family of isolines based on income could be expected to display significant differences from the family of isolines based on employment, so that a comparison between the two sets of isolines would be illuminating.

Whether the approach is in terms of employment or income, this fourth perspective on the city has certain problems. Most important perhaps is the fact that the selection of the critical isoline is largely arbitrary.

There is no reason why the 95 per cent isoline, for example, should have a greater significance than the 94 per cent or the 96 per cent isoline. Selecting a critical isoline is therefore likely to be a difficult assignment, although the nature of the research question under consideration may help to determine this. One means of avoiding the problem is for the critical isoline to represent that isoline enclosing an area within which the employed resident workforce is equal to the total level of employment in the BC, so that the following equation holds

$$M_T^{BC} = E_T^{BC} + \sum_{i=1}^{n} E_T^i \qquad (6)$$

where, M_T^{BC} is the total employment in the BC; E_T^{BC} is the total employed workforce resident in the BC; E_T^i is the total employed workforce resident in locality i; and n is the number of outer-area localities within the isoline.

Given the actual structure of locality boundaries, expression (6) is likely to represent an approximation. In terms of incomes, the equivalent critical isoline would refer to that isoline which enclosed an area containing a resident employment-based income equal to the total employment-based income generated within the BC. This method of defining the WC is not entirely satisfactory, since it reflects neither where the resident workforce is actually employed, nor where the resident incomes are generated, nor indeed whether there is a matching between the supply of and demand for occupational skills. Nevertheless, such a method indicates a benchmark or a hypothetical limit for the extent of the WC and is also less arbitrary than selecting an isoline having a particular percentage value.

Another problem associated with the WC involves the construction of the isolines around the BC. The use of concentric circles is perhaps the easiest approach, but this is only valid if the in-commuting labour is evenly distributed over the outer area with respect to distance from the BC. In most instances, however, this is not the case, because the housing preferences of commuters are stronger in certain directions than others and/or because the lines of communication (highways and public transport routes) are not developed to the same extent in all directions. The problem does not arise if each successive isoline beyond the BC boundary is constructed in such a manner that the incremental area enclosed is minimised, in which case the isoline is likely to be neither circular nor symmetrical. One further problem arises in relation to neighbouring BCs. In certain cases, the critical isoline defining the WC may wholly enclose the critical isoline of a neighbouring (BC-based) WC. In other cases, the critical isoline may intersect (at two points) the corresponding isoline for another WC. The problem here is not simply one of cartographic representation. Since a particular territory (and the population therein) may belong to two (or possibly more) WCs, certain adjustments are necessary, in order to avoid double (or even multiple) counting. In the case of a WC that is wholly enclosed by a larger WC, the former simply becomes part of the larger WC. For two WCs whose respective critical isolines intersect, the bisector connecting the two intersection points may be taken as the approximate boundary.

The problem of identifying the critical isoline and the problem of neighbouring WCs both disappear, if each WC is considered on an individual basis. The focus now turns away from the critical isoline to the family of isolines for the WC in question and to the manner in which the isolines are positioned in relation to each other, whether these are based on employment or income. This treatment of the WC on an individual basis has a strong justification where the neighbouring WCs are located at a considerable distance, as in Australia and the western areas of the US and Canada.

7. Linking the Definitions

The preceding discussion has been concerned with an important, although neglected, aspect of the city—namely, its spatial extent. This has been approached in terms of four different definitions, with one of these (the BC) forming the core of each of the other three.

The BC is essentially a physical view of the city, although it also has an important economic significance. The BC is an obvious perspective to adopt in the planning of infrastructure systems as well as in the provision and co-ordination of local services and is also relevant when land use concerns are being addressed, especially at the margins of the BC. The CC, by contrast, is an area within which most consumption takes place in the BC. Such a view of the city is likely to assume significance where the concern is with retailing, marketing and distribution. In the case of the EC, this represents an area which looks to the BC as the dominant source of employment. This perspective has an obvious resonance where the focus is on public transport and regional economic development. Finally, the WC views the city as a labour supply area (or alternatively a series of labour supply areas). It emphasises the fact that the workforce of the BC is not confined to the BC itself. In this sense, the WC reflects the demands made by the BC on the outer area, most obviously in terms of labour but also with respect to housing and infrastructure.

It is apparent that each definition of the city has particular strengths and weaknesses, and each should therefore be seen as complementary to the others, as well as to alternative conceptions of the city. Clearly, there is no 'all-purpose definition' and the definition selected will depend on the problem being investigated. After the four definitions for a given city have been established, it is possible in each case to determine city size, whether this is measured in terms of population, employment or income.

The four definitions can be drawn together, in a manner that reveals their interrelations. We let R_t represent the average radius of city type t, where t refers to one of the four types of city. As a starting-point, we may consider the following set of inequalities for a given case

$$R_{BC} < R_{CC} \leq R_{EC} \leq R_{WC} \qquad (7)$$

It is reasonable to assume that R_{CC} is greater than the R_{BC}. Also, it is likely that R_{EC} is

greater than R_{CC}, since (in developed nations, at least) household travel to the BC for work appears to decline with distance at a slower rate than household travel there for the purpose of consumption. Nevertheless, the possibility that $R_{EC} < R_{CC}$ cannot be ruled out. In expression (7), R_{WC} is indicated as greater than R_{EC}. This will certainly be so, if the critical isoline has a high value. For very low values of the critical isoline, however, the R_{WC} may be less than R_{EC}.

In view of these possibilities, an alternative ordering of values for R_t might be as follows

$$R_{BC} < R_{WC} \leq R_{EC} \leq R_{CC} \qquad (8)$$

Note that a strict equality between two values for R_t in expression (7) or (8) is probably best regarded as a coincidence, being of some interest but having no particular significance. The actual ordering within the inequality expression is, of course, a matter for empirical determination. Once this has been undertaken, however, the form of the individual city can be characterised, using all four perspectives described, this being an additional advantage of the approach defining the city presented above. Furthermore, this ordering of values for R_t provides a basis for establishing a typology of city forms. The term R_{BC} in expressions (7) and (8) necessarily occupies the left-hand position, so that six general categories of the city form are possible.

8. Closing Comments

There appear to be at least two areas where the analysis could be extended, to good effect. The first involves the pattern of movement within each type of city and, more generally, its overall spatial structure. The pattern of movement (both consumption-related and employment-related) would be concerned with flows to and from the BC, as well as cross-flows, both within the BC and within the outer area. As to the overall spatial structure of each type of city, an obvious starting-point would be the application of population density functions (and the less familiar population functions), which both tend to display a

high degree of regularity. The negative exponential function proposed by Clark (1951) has been found to provide a reasonable description of the structure of the BC, although the quadratic exponential function, which incorporates the crater phenomenon near the centre, is generally more precise (Newling, 1969). Attention has also been directed to the lognormal function (Mogridge and Parr, 1997). This is able to describe densities very accurately within the BC (Parr *et al.*, 1988), but also situations where the radius is larger, as would be the case with the CC, the EC and the WC (Parr and O'Neill, 1989). The spatial structure of employment within various types of city also lends itself to characterisation in terms of density functions.

The second area in which the analysis could be extended concerns the question of change. The general emphasis of the paper has been static, and deliberately so. Nevertheless, it is important to consider the manner in which each type of city becomes modified, over time (for example, from one census date to another). Each of the four values for R_t can be expected to change in response to such general factors as improvements in transport technology, locational shifts in employment, modified housing and amenity preferences, and reconfigurations of the spatial pattern of consumption. Although the change in R_{BC} may be relatively slight (especially if strong land use controls are in place), changes in the values of R_{CC}, R_{EC} and R_{WC} are more volatile, usually (although not inevitably) in an upward direction. A major factor influencing R_t involves changes in the level of employment within the BC. Apart from affecting R_{BC} directly, such changes are likely to exert an influence on R_{CC}, R_{EC} and R_{WC}. This will be less true, however, if employment in the BC remains stationary or decreases, as has occurred in certain major cities in western Europe over the past four decades, and in these cases it is the general factors mentioned above that will influence the values of R_t. Actual or anticipated changes in the values of R_t for an individual city may well involve a reordering in the values for R_t. And information on this intertemporal reordering can assist in the formulation of testable hypotheses relating to the past, present and future development of the city.

One final point concerns the role of census authorities in various nations. These are charged *inter alia* with the responsibility of recording population, employment and other socioeconomic data (originally by legal or administrative units, although later in terms of other types of unit), often in support of official research relating to planning and other facets of public policy. For some time now, however, census authorities have seen part of their function as assisting private (non-official) researchers, both academic and commercial. This welcome trend, coupled with the developments in GIS and data processing, suggests that serious consideration might be given to alternative perspectives on the city, including those of the kind outlined above.

References

BERRY, B. J. L. with GOHEEN, P. G. and GOLDSTEIN, H. (1968) *Metropolitan area definition: a re-evaluation of concept and statistical practice*. Working Paper No. 28, Bureau of the Census, Washington, DC.

BRUNEL, D. (Ed.) (2002) *Economic Performance of the European Regions*. Papers of the Institut à Aménagement et d'Urbanisme de la Région Ile de France (IAURIF), No. 135, Paris

CEBR (CENTRE FOR ENVIRONMENT BUSINESS RESEARCH) (2005) *Symbiosis or sibling rivalry: future links between London and the South East.* Centre for Environment Business Research Ltd, London.

CHAMPION, T. (2004) Lest we re-invent the wheel: lessons from previous experience, in: T. CHAMPION and G. HUGO (Eds) *New Forms of Urbanization: Beyond the Urban–Rural Dichotomy*, pp. 25–42. Aldershot: Ashgate.

CITY OF NOTTINGHAM (2005a) *City regions: a guide to the accompanying maps*. Policy and Information Team.

CITY OF NOTTINGHAM (2005b) *The misrepresentation of Nottingham and the need for a national dataset on urban areas or strategic sub-partnerships*. Policy and Information Team.

CLARK, C. (1951) Urban population densities, *Journal of the Royal Statistical Society, Series A*, 114, pp. 490–496.

COOMBES, M. (2004) Multiple dimensions of settlement systems: coping with complexity, in: T. CHAMPION and G. HUGO (Eds) *New Forms*

of Urbanization: Beyond the Urban–Rural Dichotomy, pp. 307–324. Aldershot: Ashgate.

DICKINSON, R. E. (1964) *City and Region: A Geographical Interpretation*. London: Routledge & Kegan Paul.

EECKHOUT, J. (2004) Gibrat's law for (all) cities, *American Economic Review*, 94, pp. 1429–1451.

Employment & Productivity Gazette (1968) Review of travel-to-work areas, July, p. 554.

EUROPEAN COMMISSION (2004) *Urban Audit 2004: Key Indicators on Living Conditions in European Cities*. Brussels: European Communities.

FREY, W. H. and ZIMMER, Z. (2001) Defining the city, in: R. PADDISON (Ed.) *Handbook of Urban Studies*, pp. 14–35. London: Sage.

GEDDES, P. (1915) *Cities in Evolution*. London: Williams and Norgate.

GENERAL REGISTRY OFFICE (1956) *Census 1951 for England and Wales. Report on Greater London and Five Other Conurbations*. London: HMSO.

GENERAL REGISTRY OFFICE, EDINBURGH (1954) *Census 1951 Scotland, Vol. II*. Edinburgh: HMSO.

GIBRAT, R. (1931) *Les Inégalités Economiques*. Paris: Receuil Sirey.

GOODMAN, J. F. B. (1970) The definition and analysis of local labour markets: some empirical problems, *British Journal of Industrial Relations*, 8, pp. 179–196.

HALL, P. G. and HAY, D. G. (1980) *Growth Centres in the European Urban System*. London: Heinemann Educational.

INTERNATIONAL URBAN RESEARCH (1959) *The World's Metropolitan Areas*. Berkeley, CA: University of California Press.

MOGRIDGE, M. and PARR, J. B. (1997) Metropolis or region: on the structure and development of London, *Regional Studies*, 31, pp. 97–115.

MUMFORD, L. (1938) *The Culture of Cities*. New York: Harcourt, Brace and World.

NEWLING, B. (1969) The spatial variation of population densities, *Geographical Review*, 59, pp. 242–252.

ONS (OFFICE FOR NATIONAL STATISTICS) (2003) *Census 2001: Key Statistics for Local Authorities in England and Wales*. London: The Stationery Office.

ONS (2004) *Census 2001: Key Statistics for Urban Areas in England and Wales*. London: The Stationery Office.

O'SULLIVAN, A., YOUNG, G., MACLENNAN, D. ET AL. (2004) *Local housing systems analysis: a good practice guide*. Communities Scotland, Edinburgh.

OXFORD ECONOMIC FORECASTING (2004) *London's Linkages with the Rest of the UK*. London: Corporation of London.

PARR, J. B. (2005) Perspectives on the city-region, *Regional Studies*, 39, pp. 555–566.

PARR, J. B. and O'NEIL, G. (1989) Aspects of the lognormal function in the analysis of regional population distribution, *Environment and Planning A*, 21, pp. 961–973.

PARR, J. B., O'NEIL, G. and NAIRN, A. (1988) Metropolitan density functions, *Regional Science and Urban Economics*, 18, pp. 463–478.

PIRENNE, H. (1936) *Economic and Social History of Europe*. London: Routledge & Kegan Paul.

PUMAIN, D., SAINT-JULIEN, T., CATTEN, N. and ROZENBLAT, C. (1991) *The Statistical Concept of City in Europe*. Luxembourg: Statistical Office of the European Communities.

RATCLIFF, R. U. (1949) *Urban Land Economics*. New York: McGraw-Hill.

ROBINSON, G. W. S. (1953) British conurbations, *Sociological Review*, New Series, 1, pp. 15–26.

SMART, M. W. (1974) Labour market areas: uses and definition, *Progress in Planning*, 2, pp. 239–283.

SOMBART, W. (1902) *Der Moderne Kapitalismus*. Leipzig: Duncker & Humblot.

TIEBOUT, C. M. (1962) *The community economic base study*. Supplementary Paper No. 16, Committee for Economic Development, New York.

TUROK, I. (1997) Introduction, in: I. TUROK (Ed.) *Travel-to-work areas and the measurement of unemployment*, pp. 1–5. Occasional Paper No. 38, Centre for Housing Research and Urban Studies, University of Glasgow.

UN-HABITAT (UNITED NATIONS CENTRE FOR HUMAN SETTLEMENTS) (1996) *An Urbanizing World: Global Report on Human Settlements, 1996*. Oxford: Oxford University Press.

VANCE, J. E. (1960) Labor-shed, employment field, and dynamic analysis in urban geography, *Economic Geography*, 36, pp. 189–206.

WEBER, A. F. (1899) *The Growth of Cities in the Nineteenth Century*. New York: Macmillan.

WEBER, M. (1921/1958) *Die Stadt* [The City], trans. and ed. by D. Martindale and G. Neuwirth. Glencoe, IL: Free Press.

WEBSTER, D. (1997) Travel-to-work areas and local unemployment statistics: a Glasgow view, in: I. TUROK (Ed.) *Travel-to-work areas and the measurement of unemployment*, pp. 33–75. Occasional Paper No. 38, Centre for Housing Research and Urban Studies, University of Glasgow.

WIRTH, L. (1938) Urbanism as a way of life, *American Journal of Sociology*, 44, pp. 1–24.

WRIGLEY, R. L. (1950) Urbanized areas and the 1950 decennial census, *Journal of the American Institute of Planners*, 16, pp. 66–70.

ZUKIN, S. (1995) *The Cultures of Cities*. Oxford: Blackwell.