# Understanding the City of the Future

A. G. WILSON

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*Introduction*

Thinking about the city of the future is the sort of thing which makes people nervous. The headlines shown in Fig. 1 are typical of those which can be found most days in some newspaper or other. They tell of fears of uncertainties and of conflicts: where will the road go? and 'We shan't be moved say residents'. There is a conflict between residents and planners, and between different sections of the community. For example, we all believe in increased accessibility; we all believe in an improved environment; but one man's increase in accessibility is usually another man's decrease in environmental quality.

Similar fears and conflicts arise in relation to other aspects of the city of the future. Figure 2 shows a mixture of optimism and pessimism about housing problems, and conflicting advice on policy from experts. Figure 3 shows headlines which express concern about the availability of jobs and a description of a rather unusual plea for assistance. Figure 4 expresses some of the problems of affluence: more people can afford to be tourists; London already has enough tourists; some cities do not have enough; some beauty spots – the recreation areas of the urbanites – want it both ways, to have the tourists' trade, but to remain uncrowded!

If I am to talk adequately about the city of the future, then I must confront these kinds of fears and conflicts. I hope to be able to show you that the analytical tools of the urban and regional geographer have a usefulness in relation to the most substantial urban problems. But let me begin, as perhaps every lecturer should, by defining the terms used in my title.

There are many ways of defining a city. The concept is sometimes associated with the administrative unit, such as the city of Leeds. But administrative definitions rarely keep pace with urban growth and territorial expansion, and so we introduce the concept of the city region: let us say Leeds and its surrounding outer suburbs. We

* An Inaugural Lecture delivered on 11 October 1971. Professor Wilson was appointed to the Chair of Urban and Regional Geography in 1970.

might cast our net even more widely in the case of cities which are parts of urbanized regions, and take the whole region – now called a conurbation – as the definition of our concept. However, it is not particularly fruitful to attempt a precise or all-embracing definition of the concept of a city. I am concerned tonight with many aspects of urban life, and hence with the broadest possible definition – the city region or the conurbation, and its connections with surrounding areas and the outside world generally. No city, however defined, can be studied in isolation.

My title refers to 'understanding the city'. The concept of understanding must have a very broad meaning in this context. Urban life, these days, is almost all life in countries like ours. Aldous Huxley and George Orwell may have as much to offer us by way of understanding the city of the future as the scientist. Nor, of course, is the geographer the only scientist to engage in the study of cities, and I am conscious of the work of many of my colleagues in related disciplines. However, I am primarily concerned tonight with the recent development of what are essentially scientific methods in urban and regional geography.

What are the characteristics of such an approach? It must involve the development of hypotheses and theories about how cities work, the testing of these against observation, the continual refinement and search for higher levels of explanation; and ultimately, the development of a predictive capability. Scientists have been conspicuously successful in many fields in the study of complex systems. Whatever else it is, the city is a complex system, and it has been relatively understudied by scientific methods.

Urban and regional geography is a young science. It has passed through the early stages of its quantitative revolution with a primary concern for observation, measurement, statistical analysis and inductive inference. The accumulated pictures are of the greatest importance and perhaps begin to offer students of the city the kind of thing which Tycho Brahe offered astronomers in the sixteenth century. Theory building – or model building if we introduce the notion of a model as a formal representation of a theory – is a more recent activity, and the potential of this application of the hypothetico-deductive part of the scientific method is very exciting. It is this aspect of urban and regional geography, and this concept of understanding on which I shall concentrate this evening.





I entitled this lecture 'Understanding the city of the future' because I wanted to indicate that scientific work in this field could be usefully future oriented. By understanding the city in terms of theories and computer models, we can develop analytical and predictive capabilities which will help us first understand, and then perhaps begin to solve, the sort of problems I mentioned earlier. We are attempting to provide the scientific analytical basis for the planners of the future city. A former honorary vice-president of the Town Planning Institute once said: 'Town Planning is the Art of which Geography is the Science.'[1] It is such a theme which I am attempting to address, and to live up to, tonight.

So much, then, by way of introduction. In the rest of my lecture I want to attempt three things: firstly, to outline the main components of the city, the main directions of change, and the associated problems; secondly, to indicate the kinds of computer models which will help us in our analysis; and thirdly, to attempt a broad assessment of what the city of the future might look like, firstly assuming that present trends in policy continue, and secondly assuming that our developing analytical skills may take us towards something better.

## *Main components, directions of change, and problems*

The most important components of the city are its people. We are interested in the great variety of people's activity patterns, and the relationship of these to the spatial organization of the city. One of our main concerns is to understand this variety, and to use our understanding to ensure that the requisite variety[2] of opportunities is on offer to sustain the present richness where it exists, and to solve problems where possible. We are concerned, then, with population structure – and where people live, work, shop, and find their social and recreational opportunities. We are also concerned with the organizations of the city – that is, the urban economy – its role and position in the national economy, and its spatial organization within the city. We are interested in interactions, many of which reveal themselves as transport flows, and in physical infrastructure, which supports the activities of both people and organizations.

[1] Lord Justice Scott, quoted by Willatts (1965).
[2] This term can be given a technical meaning as well as a colloquial one and related to the law of requisite variety of Ashby (1956).

To illustrate these concepts, I would like to show you some maps. Most of these refer to the Leeds city region – narrowly defined as the city and its surrounding local authorities – though some refer to the conurbation as a whole. The patterns and processes which are revealed by these maps are more or less typical of most British cities, so that although I am taking one city to fix ideas, I hope that my comments and conclusions are reasonably general. The only qualification to this statement is that there has been relatively less growth, in both population and economic terms, in this area than in some other cities.

Figure 5 is a graph of the population of Leeds and of the West Riding County areas. This shows the situation to have been relatively static. (The increase indicated by the dotted line was partly created by a boundary change.) Figure 6 shows the spatial distribution of population, indicating progressively lower densities from the city centre outwards. There is the usual hole in the centre where industrial and commercial land use outbids residential use. This is a base map for subsequent figures in which information is usually presented as a percentage of total population. We can dig a little deeper by looking at population dynamics at a reasonably fine spatial scale. Figure 7 shows percentage net in-migration – in this case for the conurbation – from 1961 to 1966. We can easily see what is popularly called the 'flight to the suburbs'. It is now interesting to dig a little deeper still, and to find out where different kinds of people live. Figure 8 shows the distribution of households by car ownership – which I am taking as a rough index of how well-off people are. The heavily shaded areas of this figure are those in which a high percentage of households do not own a car; the more lightly shaded areas are those in which a higher percentage of households own at least one car. A good range of spatial differentiation is indicated by this figure: less well-off people tend to live nearer the centre, and more in the south than in the north. If we couple this information with that of the earlier map of net in-migration, we see that this degree of spatial polarization may be intensifying.

I am especially interested in building up a picture of particularly disadvantaged groups within the city. I began this process in a rough and ready way with Fig. 8. Figure 9 shows another example of a group which is likely to be particularly disadvantaged – the resident population in 1966 born in Commonwealth countries, shown as a percentage of the total population. We see, then, that disadvantaged groups are





often relatively concentrated spatially. There is a relatively simple explanation for this: the poorer people in the city – and the particularly disadvantaged are likely to be poor whatever else they are – live in the poorer quality housing. To get a rough measure of the quality of housing in different parts of the city, I have produced Fig. 10, which shows the percentage of houses in different parts of the city without a fixed bath – again, for 1966. The figure speaks for itself, and correlates with the earlier maps: poorer housing near the centre, and more in the south than in the north. As a further rough generalization, we might say that the poorest quality housing was likely to be found in the private rented sector, with better housing in the public rented sector, and better still in the owner-occupied sector. The spatial distribution of housing in these three tenure groups is shown in Figs. 11 to 13; in each, heavier shading indicates a higher percentage in that group. The distribution of the private rented sector is shown in Fig. 11; of public rented housing in Fig. 12; and of owner-occupied housing in Fig. 13. We find progressively better housing as we move from centre to suburbs, with the same sector differentiation which we noted earlier between north and south.

Next, we can turn to employment. The plot of total employment in Leeds and in the county over a 15-year period is shown in Fig. 14, and again indicates a relatively static situation. Figure 15 shows the spatial distribution of employment in 1966 – in this case at a somewhat more coarse spatial scale than usual because of data difficulties. Figure 16 shows the gross percentage change in employment between 1961 and 1966 at this spatial scale. Although the decentralization of jobs is not yet on the same scale as the movement of people, the figure does indicate a decentralization process at work.

It would be nice to be able to break down the employment, particularly in the service sectors, so that, along with other indices we could build up a picture of the quality of services on offer in different parts of the city. This is very difficult because of data deficiencies at the present time, and in any case it is always difficult to measure quality of service.

Finally, Fig. 17 shows the road part of the Leeds transport system. The system is highway dominated of course, and the public transport system is mainly the bus system.

Given this background, can we begin to identify the most important problems in cities? Can we produce a systematic analysis of the

newspaper headlines I showed earlier? I want to begin this exercise by distinguishing two kinds of problem, 'important' and 'serious' problems, following, and perhaps paraphrasing, the use of these terms by Banfield.[3] An important problem is a major irritation, but something which we could, at a pinch, live with. If we were talking about health, an important problem would be the common cold. A serious problem is potentially or inevitably destructive in a more basic way. It is a potentially fatal, or actually fatal, disease. It is worth doing a lot of work on important problems, and much of urban planning is rightly concerned with such problems; it is absolutely vital to do a lot of work on, and to solve, serious problems.

The pessimists believe that we are beset with serious problems and that catastrophes are just around the corner. Their predictions may have an ecological (essentially bio-economic) basis, or a socio-economic basis. Events of the past few years, in American cities especially, but also in European cities, have almost convinced even the essential optimists such as myself that the pessimistic view may be the only tenable one. I will assume for the moment that extreme catastrophes will not occur – though I shall add a qualification about this assumption later – but I shall try to identify some of the problems which have generated this pessimism. I shall try to concern myself mainly with what seems to me to be the most *serious* problems, though I do not underestimate the relevance of work on important problems, and I shall refer to these from time to time.

The most serious problems in cities seem to me to be associated with the individual problems of particularly disadvantaged groups. Even worse, perhaps, people in such groups may feel themselves perpetually trapped in their position of disadvantage. They may be identified by their poverty, their ethnic characteristics, their religious characteristics, their age or health, or some mixture of these. (The Women's Liberation Movement might say that they could be characterized by sex.) The groups are usually fairly easily identifiable, and in some cases, as we have seen, they occupy relatively small well defined areas of cities, usually in the poorest quality housing. David Eversley[4]

[3] E. C. Banfield (1968).

[4] D. E. C. Eversley (1971): it is also interesting to relate this to what Galbraith (1958) called 'insular poverty'. Galbraith's concepts are discussed in the urban context by Griesinger and McClintock (1970).





calls such areas 'losing areas', and he contrasts the level of services which might be found there with those in what he calls 'our lusher suburbs'. There is certainly a considerable contrast in the quality of services, private and perhaps public as well, available in different parts of the city – and what I have called the disadvantaged groups usually get the worst of most of these worlds. The services are worse in losing areas because the income is not available to support something better. The income is not available because, for a variety of reasons, the workers in these areas cannot gain access to better jobs and more income. Some public services in losing areas are worse because they are not sufficiently attractive to work in for the providers of services. There are a number of chicken-and-egg questions here of course, but possibly also some vicious circles.

The spatial polarization between less well-off and better off is not as sharp as it might be in British cities because of the development of suburban Council housing estates. But we should then recognize a different kind of serious problem: the relatively poor in the suburbs may not have the command over resources[5] to purchase adequate accessibility to jobs, services, and other needs – especially since this often means buying a car. This problem may also apply to members of better-off households who do not have a car available: they are the old, the young, the sick, those who cannot drive, or those who are married to a car commuter who has taken the car for the day.

A problem which affects everybody is the transport problem in cities. The driver of a Rolls Royce and a passenger on a Corporation bus may share a substantial loss of time as they sit in a traffic jam trying to gain access to a city centre in a peak period. I am not sure whether this is a serious problem, or simply an important problem; I would conjecture that aspects of it are serious, and other aspects simply important. Traffic congestion, of course, has always been present in large cities, and it would be to take an unduly optimistic view to assume that we could be rid of it soon. This aspect of the transport problem is probably simply important. Congestion tends to be self-regulating, and one of its effects in recent years has been to help accelerate the suburbanization process. However, if our transport

[5] Harvey (1971–A) follows Titmuss (1962) in defining a concept of 'income' which relates to 'command over resources'.

policies are helping to create increasing polarization between less well-off and better off, and are creating substantial accessibility deficiencies for some members of better-off households also, then perhaps the associated problems are serious. These problems turn on the reliance on the private car, which is implicit in most transport developments in recent years. The problems I have mentioned are likely partly to worsen and partly to improve, because of increasing car ownership. This is expected to at least double from present levels in the next 20 to 30 years.[6] It will worsen at least marginally for car owners because of increased congestion; it will probably improve for those who buy a car for the first time. At present, in Leeds, it is estimated[7] that 70% of car owners actually use their car for journey to work. It is estimated that, in the future, for comfort, this percentage should be as low as 20. There is a considerable credibility gap between these numbers. I shall return to these issues again shortly.

I could describe many other problems which are of considerable concern, but, at least for the time being I shall consider them to be important but not serious. Others would argue perhaps that I am neglecting a number of other fundamental problems which are serious. I shall return to some of these later with some qualifications to what I have said so far.

*Some models*

I now want to describe some of the models of urban structure and change which have been developed in recent years.[8] We are working with these in both our teaching and research programmes in the Geography Department of this University. At this stage of my lecture, I face the difficulty which many scientists face on occasions of this sort: how to describe in a short time and in relatively non-technical language something which really needs a lot of time and very technical language. What I will attempt is a broad outline of the models needed, a description of some examples of models, and some indication of the state-of-the-art.

Earlier, I outlined the main components of the city. These are summarized in Fig. 18. The left-hand side of this figure refers to population

[6] M. E. Beesley and J. F. Kain (1964).
[7] D. A. Quarmby (1967).
[8] For a broad review, see Wilson (1971–A).





structure and population activities, the right-hand side to economic structure and economic activities. In the centre of the diagram, are the associated demands for infrastructure, and for transport. I have arranged the boxes of this figure to coincide with parts of the urban system for which I would like to be able to construct a mathematical model. In fact, I could present some kind of mathematical model for each of the boxes – though some would be more satisfactory than others.

On the population side, we need models of the structure of regional and sub-regional populations by age and sex, and models of the associated migration flows. At a finer spatial scale, we then have to model this population's choice of residential location and housing consumption, of job, and their utilization of services. We have to show how these different decisions interact with each other, and the extent to which they are made jointly. In order to be able to tackle the kind of problem which I have been discussing, the models need to operate at a level of detail at which different types of people are represented, and disadvantaged people can be identified.

On the economic side of the model we need a spatially aggregated model to represent the overall structure of the urban economy, and a set of models to represent the location of economic activity. Some variables in this sector are controlled by the planners and the city government – public rented housing supply is a good example – and this both eases the modelling problem, and makes the overall model system connect explicitly to variables which are being manipulated by the planners.

Transport flows can be seen as interactions between various activity patterns, and can be modelled as functions of these patterns and the travel costs. The journey to work, for example, represents an interaction between the spatial distribution of workers and the spatial distribution of jobs. Infrastructure models are also connected to activity patterns of course.

I would now like to show you one or two of the models in more detail. We can make a lot of progress simply by using the mathematician's facility of abstraction. This provides an economy which permits effective analysis in what would otherwise appear to be very complicated situations. Consider, as a simple example, the task of estimating the sales in the shopping centres of a large city, assuming that we are

given the spatial distribution of the population and its spending power. We would divide our city up into zones – say into 100 zones – and then the main concept which would enable us to solve our analytical problem would be that of the interaction between the population of a residential zone and the shopping centre of another zone. The interaction is a flow of money, and measures the amount of the spending power of that particular residential zone which is allocated to that particular shopping zone. If we sum all the flows of cash into any one shopping zone, then we can obtain an estimate of the total turnover there. The only difficulty with this analysis so far is that if there are 100 zones, there are 100 × 100 (which is 10,000) interactions. Do we map each of these individually, and then try to forecast how each will change over time? This is clearly much too clumsy, and we find that the mathematical model of this situation reduces the complexity to a single equation:[9]

$$S_{ij} = A_i (e_i P_i) W_j^{\alpha} \exp(-\beta c_{ij}) \qquad (1)$$

In this equation, $S_{ij}$ is the flow of cash from any zone $i$ to any zone $j$, and it is estimated in the equation as a function of the purchasing power of the residents of zone $i$, $e_i P_i$, and the attractiveness of shops in zone $j$, $W_j$, and the cost of travelling from zone $i$ to zone $j$, $c_{ij}$. Not only have we now made the problem manageable – for this sort of model can be represented on the computer very easily – but also we have a model, a theory, which will predict for us how the pattern of retail flows will change if something else changes, whether this be the distribution of population, the relative attractiveness of the shopping centres or the transport network. Since all of these things are changing all of the time, it is not surprising that this model has become an extremely useful planning tool.

In terms of problem solving, it is useful at two levels. It is most commonly used to solve what I earlier called important problems, such as where best to site a new shopping centre, or to check the size of a shopping centre is such that it gets a good turnover per square foot for the developer or the local authority. There is also a possibility that the model can be used to explore serious problems. A measure of accessibility of residents to shops can be derived from the model.[10]

[9] This model was first used in this form by Huff (1964) and Lakshmanan and Hansen (1965).
[10] W. G. Hansen (1959).





This enables us to begin to measure the accessibility to shops of different kinds of people, and in particular of disadvantaged people. It might also aid the calculation of the *incidence* of costs and benefits. The same method of analysis could be used for other services. This illustrates an important principle, and is near the heart of my earlier distinction between important and serious problems. At the level of the important problem, we can use the model to check that a new shopping centre generates a good rate of return on its capital. This can be done for private or public investment and is clearly very important indeed. It is possible to do this, however, without ever being aware that it does nothing for some minority disadvantaged group, and at the level of the serious problem, that is what we have to explore.

Note that this kind of model can be understood by anyone familiar with such a process of abstraction, and a knowledge of elementary algebra and the concept of a function. There is a whole family of spatial interaction models which can be understood at this level. Another similar model is the transport flow model:

$$T_{ij} = A_i B_j O_i D_j \exp(-\beta c_{ij}) \qquad (2)$$

This model predicts the number of trips for some purpose between zone $i$ and zone $j$. It would predict the journey to work, for example, as a function of the spatial distribution of workers, the spatial distribution of jobs, and the cost of travelling between each pair of zones.[11]

These models can be understood at a much deeper level if we are prepared to dig deeper with our mathematical tools. The interactions which we measure in these kinds of models each consist of a bundle of individual trips. We could say that there are a very large number of ways in which all the individuals in the city decide to locate themselves, and hence to determine the trip pattern. It is then possible to see the number of trips in a bundle as a statistical average over all the possible ways of making up the bundle. This kind of statistical averaging can be carried out by maximizing an entropy function, defined in terms of the trip matrix as follows:[12]

$$S = -\sum_i \sum_j T_{ij} \log T_{ij} \qquad (3)$$

[11] See, for example, Wilson, Hawkins, Hill and Wagon (1969) for an example of such a model used in a disaggregated way, distinguishing car-owners and non-car-owners and different transport modes.
[12] A. G. Wilson (1970–A).

We maximize it subject to the constraints on trip ends – that is, total origins and destinations being assumed given – as follows:

$$\sum_j T_{ij} = O_i \tag{4}$$

$$\sum_i T_{ij} = D_j \tag{5}$$

and subject to a constraint on total expenditure on travel:

$$\sum_i \sum_j T_{ij} c_{ij} = C \tag{6}$$

We can maximize this entropy function subject to these constraints using the calculus in the usual way, and introducing a Lagrangian multiplier for each constraint. The result is:

$$T_{ij} = A_i B_j O_i D_j \exp(-\beta c_{ij}) \tag{7}$$

and this, of course, is the simple transport flow model which I introduced earlier. This shows that some of these simple models have hidden depths, and a more sound theoretical basis than may appear at first sight. This example also allows me to indicate how prediction is possible at all in this field. We all, as individuals, would strongly assert that our decisions were our own, and were not very predictable! In fact, of course, individual behaviour *is* pretty unpredictable, but the statistical averages, such as the flows between pairs of zones in a city, are bundles of trips which are quite stable and predictable.

I wish I had the time available for me to be able to describe some more models to you in detail, but I am afraid that this is not the case. What I will do therefore is to summarize the kinds of models which are currently being developed and are in use. This I have attempted to do in Table 1. This table is far from exhaustive, and the examples given have been chosen to illustrate the range of approaches and techniques which are being applied in the development of these models. You will see that they include the spatial interaction models which I used as my illustration, and a whole range of other techniques, from matrix operator models, such as the demographic model and the input–output model, linear programming models, econometric models, various kinds of simulation models, differential equation models, and so on. The technique chosen in a particular case depends to some extent on the interest and expertise of the model builder, and to some extent on the problem which he is trying to solve. Some of the models which





TABLE 1
EXAMPLES TO ILLUSTRATE THE RANGE OF MODEL BUILDING TECHNIQUES

| *Model* | *Techniques used* | *Examples in the literature* |
|---|---|---|
| POPULATION | | |
| Single and multi-region demographic | Matrix operator | Rogers (1966) |
| | Simultaneous differential equation | Wilson (1971–B) |
| Migration | Log-linear regression | Lowry (1966) |
| | Spatial interaction | Masser (1969), Donovan (1971) |
| Residential-job location | Spatial interaction | Wilson (1969) |
| | Linear programming | Herbert and Stevens (1960) |
| | Economic theory | Alonso (1964), Muth (1969), Wingo (1961) |
| | Econometric | Kain (1962), Leathers (1967) |
| | Simulation | Chapin (1965), Taylor (1971) |
| Retail/service usage | Spatial interaction | Cordey Hayes (1968) and National Economic Development Council (1970), Chapter 3 |
| | Central place theory | National Economic Development Council (1970), Chapter 2 |
| ECONOMY | | |
| Single region input–output | Matrix operator | Artle (1959) |
| Multi-region input–output | Matrix operator/ spatial interaction | Leontief and Strout (1963), Wilson (1970) |
| Economic activity location | Econometric | Hill (1965), Lakshmanan (1968), Massey (1969), and Putman (1967, 1970) |
| | Economic theory | Smith (1971) |
| TRANSPORT | | |
| Generation | Regression analysis | Greater London Council (1966) |
| | Category analysis | Wootton and Pick (1967) |
| Distribution | Spatial interaction | Wagon and Wilson (1971), Ch. 4 |
| Modal split | Diversion curve | Wagon and Wilson (1971), Ch. 4, Wilson, Hawkins, Hill and Wagon (1969) |
| | Discriminant analysis | Quarmby (1967) |
| Assignment | Network analysis | Wagon and Wilson (1971), Ch. 5 |
| INFRASTRUCTURE | | |
| | Spatial interaction | Swerdloff and Stowers (1966) |
| | Simulation | Robinson, Wolfe and Barringer (1965) |
| COMPREHENSIVE | | |
| | Lowry | Lowry (1964) |
| | EMPIRIC | Hill (1965) |
| | Urban Dynamics | Forrester (1969) |

have been developed represent a mixture of techniques. The demographer and the economist, respectively, tend to focus primarily on population structure and economic structure in the demographic model and the input–output model; the geographer's contribution in this situation can be, and in this case has been, to develop multi-region versions of the models by integrating them with interaction concepts, and thus developjng a model which has a significant spatial dimension.

One of our main research tasks at the present time is to consider how to fit all these models together. All of the models described so far are partial models, and they should be fitted, if possible, into a general model framework. The predictions of such a general model may not coincide with the predictions of a set of partial models because of what Forrester[13] has called 'the counter-intuitive behaviour of complex systems'. This means that we should continue to try to build a general model, but it will be clear from what I have been saying that many combinations of the sub-models are possible, and the problem is a very complicated one. The last three rows of Table 1 show that examples of comprehensive models do exist – I have chosen the Lowry model, the EMPIRIC model, and Forrester's *Urban Dynamics* model as examples – the first being a set of interaction models, the second an econometric model, the third a simulation model. These particular models are interesting tools, but a considerable price by way of simplification has been paid in their development, and they can only be used in planning contexts with considerable caution.

I will conclude this section of my lecture, on the models themselves, by commenting briefly on the state of the art.[14] Most of the models of population structure and the location of population activities are operational, and some at least work very well. On the economic side, the models are cruder, they are more difficult to test than the population models because of lack of data, and these models are less satisfactory. The transport model is one of the best developed of the urban models, and works very well, given a distribution of other activities as inputs. But as I said at the outset, urban and regional geography is a young science. The transport model has been used since the mid 1950s, the other models mostly since the early 1960s only. Relatively rapid progress is still being made in their development. However, the

[13] J. W. Forrester (1969).
[14] For a review of the state-of-the-art at greater length, see Wilson (1971–C).





models are already sufficiently well developed to be useful. The demographic models tell us about the changing demand for housing, jobs and services, something about the spatial distribution of these demands, and the migration flows which result from disequilibrium in the system. The population activity models tell us about the spatial structure of this demand at a finer spatial scale. The transport model gives a good account of the flows by different modes; it gives us a sufficiently good understanding of the mechanism of modal choice that we can easily tell, for example, whether forecast levels of usage on proposed public transport systems, or new transport modes, are realistic. All of these models offer tools for the planner which at least help him in the solution of what I called important problems, and are just beginning to contribute to the solution of serious problems. On the economic side, at the urban and regional scale, we obtain some insights from our models, but we do not yet understand the nature of agglomeration economies in cities[15] – the way in which the overall rate of growth at the regional, or even the national, scale may be determined in part by urban structure.

We are currently using the sort of model system which I have described in an analysis of the geography of West Yorkshire in a project sponsored by the Social Science Research Council.[16]

### *The city of the future*

For the last part of my lecture I want to talk more directly about the city of the future, and the way in which urban and regional analysis may have an impact on that future. I shall do this as follows: firstly, I shall outline the tools of policy which planners and government have available to them; secondly, I shall outline present policies as I see them and describe the city of the future which I think will result from these; thirdly, I shall make some guesses about how our tools of analysis may help identify what is wrong with such a future, and what an alternative might look like.

I have to begin with a number of assumptions. Several tiers of government, from national to very local, have policies which have an impact on urban development. I will firstly make the admittedly large

[15] See, for example, the discussion inJacobs (1970).
[16] At present, two research assistants work full time on the project, three members of staff, another research assistant and six research students are associated with it at least in part, making a sizeable research team.

assumption that the form of government itself is up to the job. I will also assume adequate fiscal and economic policies. On the fiscal side, it will be necessary to ensure either by some machinery of equalization, or by boundary changes, that what the Americans would call the central city does not lose its tax base to the faster growing suburbs.[17] On the economic side, I will assume that we can maintain an adequate rate of economic growth which matches an appropriate rate of population growth, and that in so doing we are not overtaken by eco-catastrophes. Many would argue that I would not be justified in making this assumption at the present time.[18] It may be that there will be a range of social and economic, and above all ecological problems, which I have not considered in any detail tonight and to which we shall have to turn our attention with increasing urgency in the near future. But with this qualification, I will make this assumption for the present, and will concentrate on the traditional tools of policy available to the city planner and to urban governments – public expenditure and regulation.

Public authorities can spend money on housing, public services, transport systems, and even, to some extent, economic development. They can regulate, at least partially, land use and spatial organization in the city. They can regulate the modes of operation of parts of the housing system, parts of the transport system, the public services, and part of the urban economy. These policy instruments form a very powerful set of controls. We should note, however, that private decisions have a major impact in the form of urban development – there are strong extra-governmental forces at work – and this means that there are considerable constraints on the way in which the planning controls are exercised, and on their effectiveness.

How can I best summarize present policies in the exercise of these instruments of control? We can say as an approximate description of a very complex process that the planner and the city government attempt to manipulate the resources of the city, and to develop these resources, so that social goals can be most effectively achieved.[19] So the planning policies are stated in terms of resources – in relation to housing, public services, transport and so on – and the test of these policies is their effectiveness in relation to social goal achievement. The

[17] D. E. C. Eversley (1971).
[18] See, for example, B. Commoner (1963), P. Ehrlich (1968), and S. R. Eyre (1971).
[19] A more detailed description of these concepts can be found in Wilson (1971–D).





discussion of social goals in this context is a complex subject which I cannot attempt to deal with in any depth tonight. I will look at planning policies in resource terms, and try to draw some conclusions about the social impacts of these policies, and hence talk about social goals rather indirectly.

Let me try to summarize existing policies very briefly – though I am afraid that in trying to be brief I might present something of a caricature. In the housing field, there is much encouragement of private investment in owner-occupied housing; a substantial programme of public housing for rent; and a declining private rental sector – with the decline being permitted, apart from the minor encouragement of some housing society developments. Admittance to the owner-occupied and public rental sectors is regulated in various ways. This makes the decline in the stock of private rental housing particularly serious for those who cannot gain admittance to the other sectors.

The main objectives of policy in relation to the public services could perhaps be summarized as a concern to maintain, and where possible to improve, standards in an inflationary world. The kind of inflation we have experienced in recent years puts considerable pressure on urban public services, and slows down their rate of development.

In the transport sector, there is substantial public investment in highways, and relatively modest public expenditure on public transport. The transport system, of course, has a major impact on the spatial organization of the city in general.

It is perhaps in the regulation and planning of spatial organization, which involves relatively little public expenditure in itself though it may have a large impact on private costs, that the urban planner – as distinct from the housing manager or chief education officer, or whatever – comes into his own. In the housing field, new developments tend to be concentrated on very large estates. There is an attempt to form neighbourhood units, and to plan most public services on this basis, though some services are provided centrally on a city-wide basis. In the field of economic development, there is often some attempt to provide land, mostly in the form of industrial estates.

In all this, there often seems to be an attempt on the part of the planner to generate a high degree of tidiness – not to mix land uses where possible, to control untidy urban sprawl with green belts, and so on. Some of the motivation for this kind of tidiness is good;

sometimes there is a danger that it may be a method of reducing a complicated problem – the task of urban planning – to an over-simplified form.

This city of the future is already recognizable. If the planners have not been too tidy, and have somehow managed to foster fundamentally untidy things such as innovation, then the city economy will grow and *per capita* income will rise. It will be a city of suburbs, each more or less self-contained in its basic retail and public services, each with basically sound housing. There will be plenty of local suburban jobs. An efficient highway system will provide good access to a wider variety of jobs across the city as a whole, and to these services and social and recreational opportunities which could not be obtained locally. There will be some congestion, both in the city most of the time, and in the countryside and other places of recreation at weekends. Looked at this way, this is perhaps not too bad a future for us to look forward to. What could be wrong with it?

Its problems could be the problems of the city of today writ large. There is likely to be a substantial section of the community who remain particularly disadvantaged – those who could not afford adequate housing or adequate accessibility. They will live in areas which we can already recognize today as being of poor quality or of potentially poor quality for the relatively near future. These areas will still tend to be near city centres or in the inner suburbs. The services in these areas will be of relatively poor quality, there may be relatively poor access to jobs, and to facilities of all kinds, and perhaps above all, poor access to opportunities for upward mobility. There is a strong possibility that the disadvantaged people of this city of the future will feel more trapped than the corresponding people today, in part since their position may have worsened relatively if not absolutely.

There will also be a large number of suburbanites from relatively well-off households whose salvation will not have been provided by the private car and who will suffer from accessibility deficiencies. Life in low density suburbs may not be so good for them.

It is much easier to state all these problems than it is to solve them. If we think of alternative futures to the one I have described, and especially if we allow ourselves to think of less tidy ones, then we must contemplate a very large number of alternatives.[20] For this reason alone,

[20] This is the combinatorial problem of 'design' – see Harris (1967) and Scott (1971).





and because of the complexity of the problem, there is no easy answer. And I should perhaps remind us at this stage that the problems which I have just been describing assume that we can maintain a substantial rate of economic growth, that the population explosion can be kept under control, and the eco-catastrophes can be avoided. There is a fair chance that we shall have to face some of the additional problems resulting from at least some of these assumptions proving to be unsound.

What can the tools of analysis which I have been describing tell us about all our problems? Essentially, our models will predict how the population will respond to what is on offer. People make their choices as a package of choices: home location, job location, school location, and so on all interact with each other and are chosen as a package. Our tools must be sensitive enough to tell us how different kinds of individuals make their choices, and also something about the way in which people value the choices which they have made.[21] This enables us to use the understanding thus gained to deploy the city's resources in the best way – to ensure that a sufficient variety of packages is on offer,[22] and, given the enormous constraints, to ensure that the resources are used most efficiently. Within all this, the tools of analysis will enable us to pay special attention to the problem of identifying particularly disadvantaged groups. We would attempt to obtain a detailed and quantitative statement of the ways in which they are disadvantaged. Our definitions of disadvantaged in this context should include not only those defined by the characteristics I mentioned earlier – and usually characterized by relative poverty at least, but also those adversely affected by the process of urban development itself – those who find that their homes lie in the path of a motorway, or in a renewal area, and so on. We should be able to use our models to assess the problems of people with that kind of disadvantage, and perhaps assess the level of compensation, monetary or otherwise, which would help facilitate solutions which were good for them and good for the community.

[21] The results can then, in principle, be used in a cost-benefit analysis – see Wilson and Kirwan (1969); it is also appropriate to consider notions of territorial justice – Harvey (1971–B) following Davies (1968) – at this point, and other fundamental questions on the distribution of income (as in Bowen, 1970).

[22] A method for measuring the lack of this kind of variety is described in Wilson (1971–E).

When the problems are identified at this level of detail, and our analysis includes an account of the way in which different problems interact, then we can begin to think about adequate solutions. How would the city of the future based on this kind of analysis differ from the one I outlined earlier – the one which would develop in a 'let present policies continue' world. I would be able, I hope, to answer this question more effectively when some of our present research work bears fruit. Meanwhile, I can only make some guesses.

Firstly, I would say that the distribution of people would be more heterogeneous spatially. This could be achieved in part by ensuring that the spatial distribution of new housing contributes to this objective, and in part by careful management of the access to different kinds of housing stock. These two branches of policy would work hand-in-hand to provide a broader range of opportunities for those who find their housing choices very heavily constrained at the present time. We can already see, as I noted earlier, the spatial concentrations of some potential problem areas of the future: high blocks of flats are a good example. Imaginative management could help solve these problems by ensuring that such stock was utilized for those for whom it was most appropriate – for young people and students for example – while ensuring that families with children, or older people, had opportunities available to them for some other kind of accommodation. I am not sure at what spatial scale this degree of heterogeneity would be appropriate but I would conjecture that it ought to be at least so arranged that all kinds of people shared the various services which are provided at the neighbourhood scale. This is probably one of the best mechanisms for ensuring a levelling up of standards in this respect.

Another feature of the tools of analysis which I have been describing is that they should be capable of measuring accessibility deficiencies in more detail than hitherto. This could result in there being relatively more investment in public transport facilities, although I would still expect the car to be the dominant mode of transport unless it was overtaken by some new technology. There would be scope for experimenting with alternative public transport modes, especially with demand responsive systems which would help provide accessibility for those who do not have a car available to them, especially in the suburbs, and especially for non-centrally oriented trips.





In this city of the future, fears would be reduced by the existence of a better informed planning process with maximum public participation, serviced by the kinds of analytical skills which I have been talking about. More options would be explored and discussed than is customary at present. Fear and conflict, however, could probably only be effectively reduced if this improved understanding and debate were coupled with a more effective compensation procedure for those who stood to lose in some way from ongoing development.

To assert that the city of the future might look like this, essentially so that there are relatively few disadvantaged groups, and no closed doors, is to take a very optimistic, and some may say over optimistic, view. But I do believe that we should *attempt* to achieve such a city of the future. The problems to be solved are some of the most complex which have ever been faced. The most refined tools of analysis will be needed if there is to be any chance of success. I hope that we have already achieved significant strides in this direction, and we must now continue to try to make further progress.

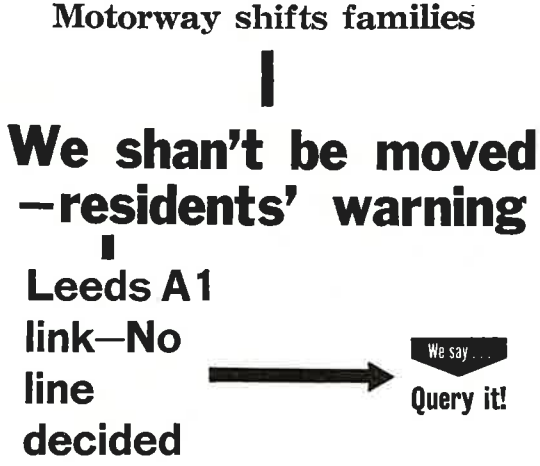


FIG. 1. Concern about roads. Sources: *Evening Post*, 19 March 1971; *The Guardian*, 19 March 1971; *Evening Post*, 30 March 1971

The danger of an immigrant ghetto in Leeds

Houses for everybody –in theory

Suicide in the suburbs

'Twilight' housing defended

FIG. 2. Concern about housing. Sources: *The Guardian*, 24 March 1971; *Evening Post*, 25 March 1971; *Yorkshire Post*, 27 March 1971; *Yorkshire Post*, 30 March 1971

Cathedral prayers for wool textile industry

Sheffield goes for diversification

Jobless total nears 800,000

FIG. 3. Concern about jobs. Sources: *The Guardian*, 17 March 1971; *Yorkshire Post*, 19 March 1971; *Yorkshire Post*, 25 March 1971





**Beauty spot with a big problem**

City lists ways to attract tourists

Tax mooted to control London's tourist boom

FIG. 4. Concern about tourism. Sources: *The Guardian*, 20 March 1971; *Yorkshire Post*, 6 April 1971; *Evening Post*, 11 April 1971

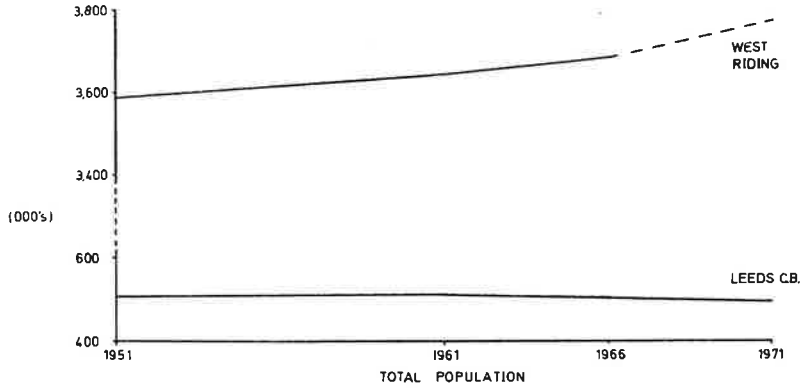


FIG. 5. Total population. Sources: Census of Population, 1951, 61, 66, 71

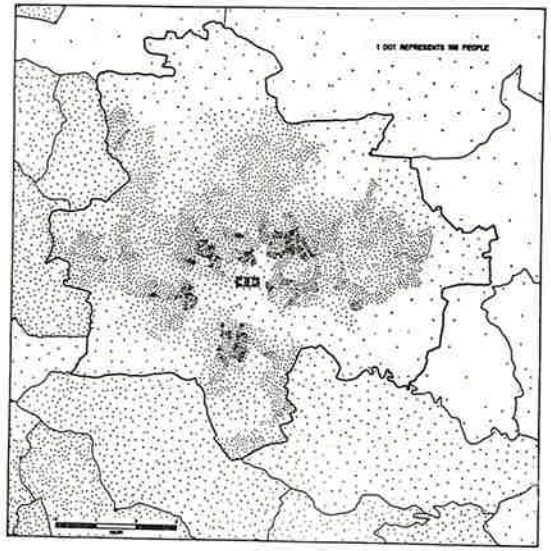

FIG. 6. Population distribution, Leeds city region.
Source: Census of Population, 1966

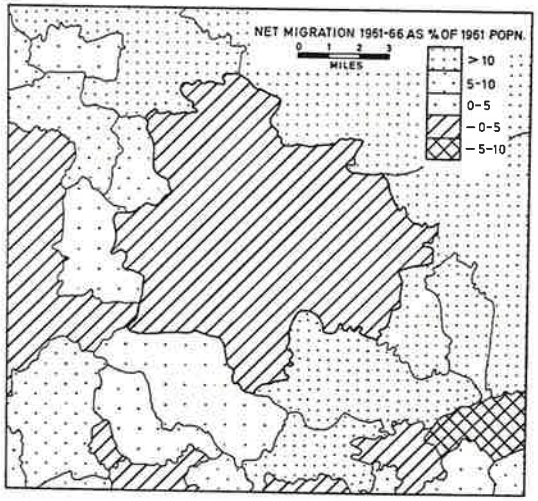


FIG. 7. Net migration.
Sources: Census of Population, 1961, 66





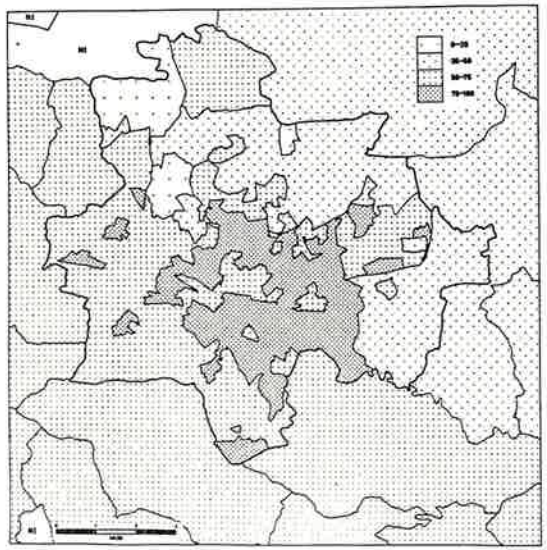

FIG. 8. Percentage of households with no car.
Source: Census of Population, 1966

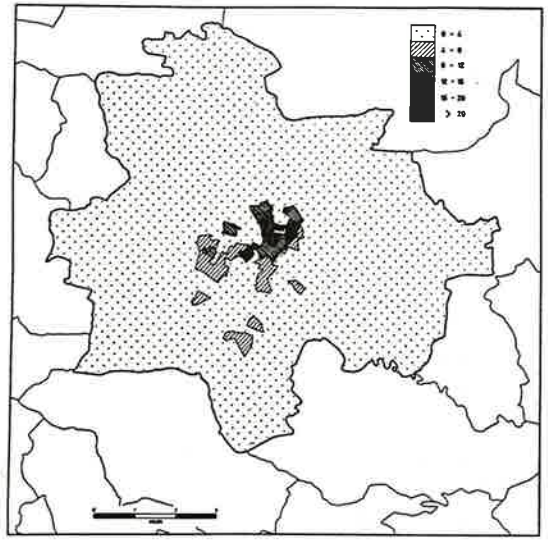

FIG. 9. Percentage of residents born in Commonwealth countries.
Source: Census of Population, 1966

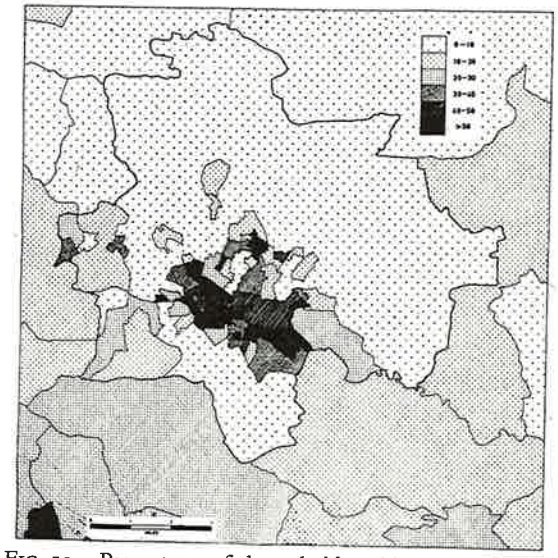

FIG. 10. Percentage of households without fixed bath.
Source: Census of Population, 1966

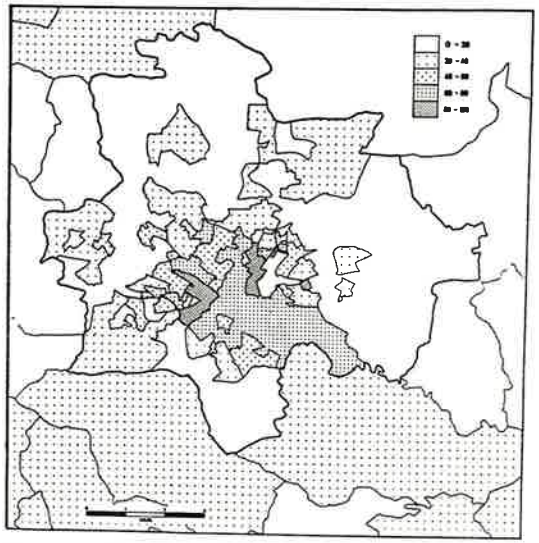

FIG. 11. Percentage of dwellings privately rented.
Source Census of Population, 1966





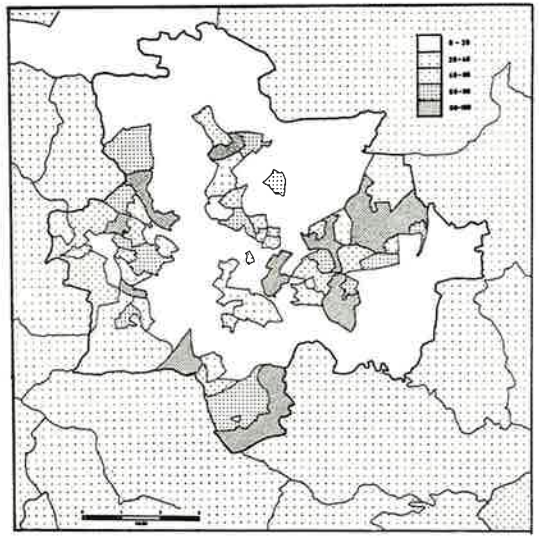

FIG. 12. Percentage of dwellings Council rented.
Source: Census of Population, 1966

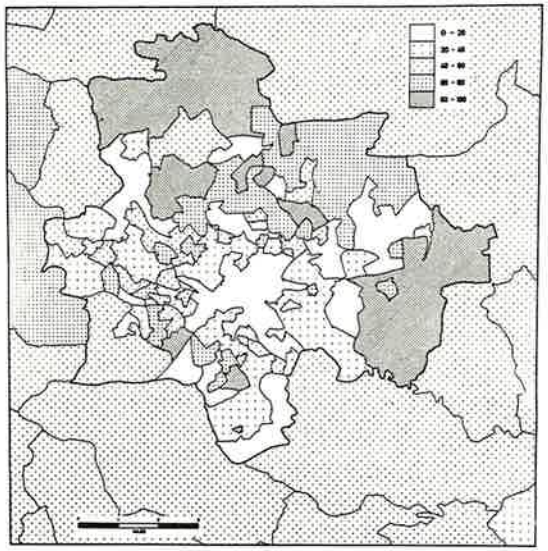

FIG. 13. Percentage of dwellings privately owned.
Source: Census of Population, 1966

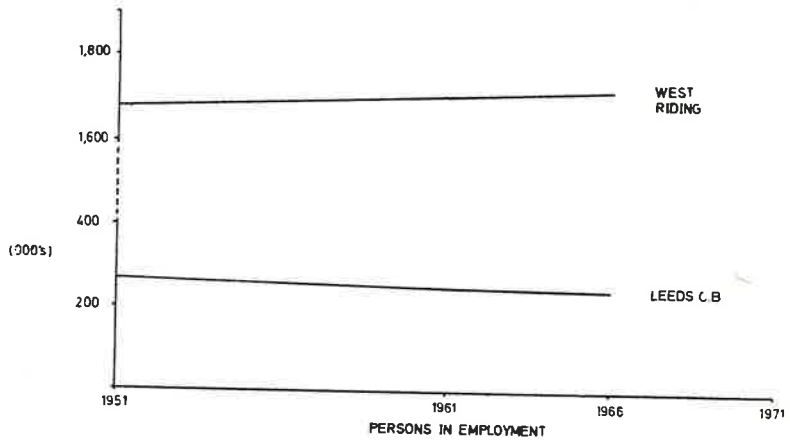


FIG. 14. Total employment. Sources: Census of Population, 1951–66

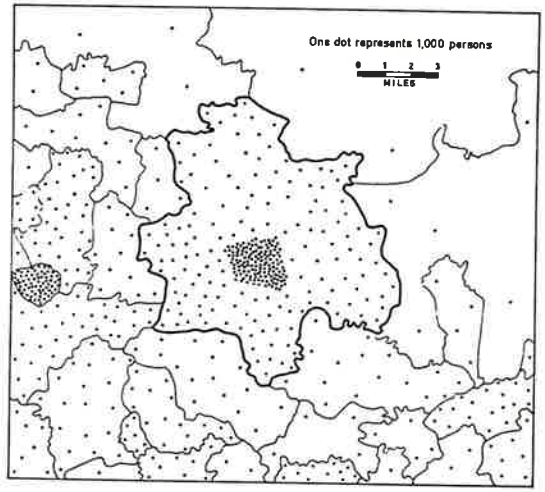


FIG. 15. Employment distribution.
Source: Census of Population, 1966





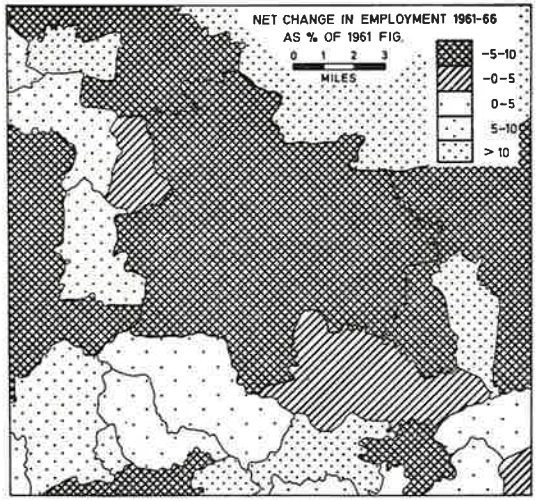


FIG. 16. Net change in employment.
Sources: Census of Population, 1961–6

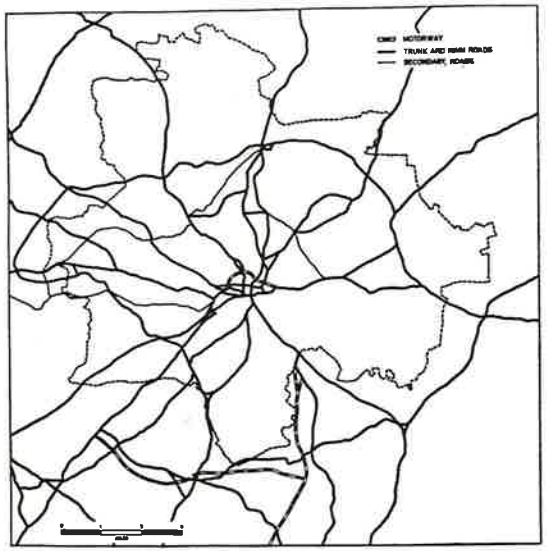


FIG. 17. Roads

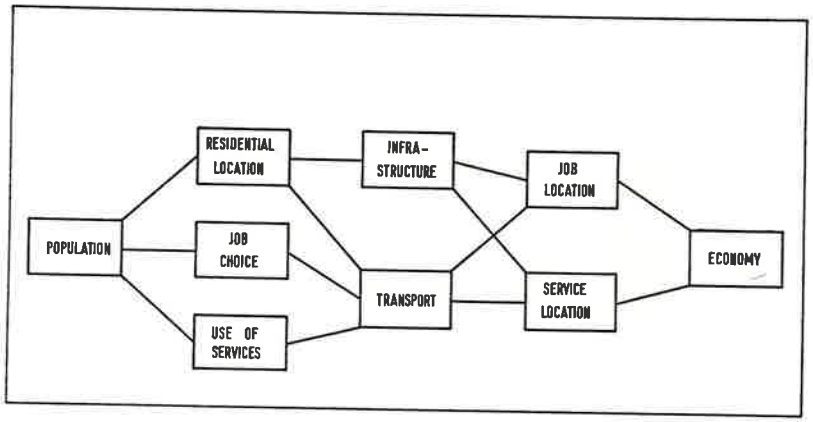


FIG. 18. The main sub-models of an urban model system

## ACKNOWLEDGMENTS

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## REFERENCES

ALONSO, W. (1964). *Location and land use: towards a general theory of land rent*, Harvard University Press, Cambridge, Mass.
ARTLE, R. (1959). *Studies in the structure of the Stockholm economy*, Business Research Institute of the Stockholm School of Economics; reprinted in 1965 by the University of Columbia Press, New York.
ASHBY, W. ROSS (1956). *An introduction to cybernetics*, Chapman and Hall, London.
BANFIELD, E. C. (1968). *The unheavenly city*, Little, Brown, Boston.
BARNA, T. (ed.) (1963). *Structural inter-dependence and economic development*, Macmillan, London.
BEESLEY, M. E. and KAIN, J. F. (1964). Urban form, car ownership and public policy: an appraisal of *Traffic in Towns*, *Urban Studies*, *1*, pp. 174–203.
BOWEN, I. (1970). *Acceptable inequalities*, Allen and Unwin, London.
CHAPIN, F. S. (1965). A model for simulating residential development, *Journal of the American Institute of Planners*, *31*, pp. 120–5.
CHISHOLM, M., FREY, A. E. and HAGGETT, P. (eds) (1971). *Regional forecasting*, Butterworths, London.
CHORLEY, R. J. and HAGGETT, P. (eds) (1965). *Frontiers in geographical teaching*, Methuen, London.
COMMONER, B. (1963). *Science and survival*, Ballantine Books, London (British edition, 1971).





CORDEY HAYES, M. (1968). Retail location models, Working Paper 16, Centre for Environmental Studies, London.
DAVIES, B. (1968). *Social needs and resources in local services*, Michael Joseph, London.
DONOVAN, S. (1971). The calibration and testing of some models of migration, M.Sc. Thesis, Department of Computational Science, University of Leeds.
EHRLICH, P. R. (1968). *The population bomb*, Ballantine Books, London (British edition, 1971).
EVERSLEY, D. E. C. (1971). *Cutting down our cities to size*, Institute of Municipal Treasurers and Accountants, London.
EYRE, S. R. (1971). Population, production and pessimism, Presidential Address to Section E (Geography) at the Swansea Meeting of the British Association.
FORRESTER, J. W. (1969). *Urban dynamics*, M.I.T. Press, Cambridge, Mass.
GALBRAITH, J. K. (1958). *The affluent society*, Hamish Hamilton, London.
GREATER LONDON COUNCIL (1966). *London Traffic Survey*, *Volume 2*, G.L.C., London.
GRIESINGER, D. W. and MCCLINTOCK, C. G. (1970). Planning social change, *Genera Systems*, 15, pp. 123–37.
HANSEN, W. G. (1959). How accessibility shapes land use, *Journal of the American Institute of Planners*, *25*, pp. 73–6.
HARRIS, B. (1967). The city of the future: the problem of optimal design, *Papers*, *Regional Science Association*, *19*, pp. 185–95.
HARVEY, D. (1971-A). Social processes, spatial form and the redistribution of real income in an urban system, in Chisholm, Frey, and Haggett (eds) (1971), op. cit., pp. 267–300.
HARVEY, D. (1971-B). Social justice in spatial systems, paper presented to the 67th Annual Meeting of the Association of American Geographers.
HERBERT, J. and STEVENS, B. H. (1960). A model for the distribution of residential activity in urban areas, *Journal of Regional Science*, *2*, pp. 21–36.
HILL, D. M. (1965). A growth allocation model for the Boston region, *Journal of the American Institute of Planners*, *31*, pp. 111–20.
HUFF, D. L. (1964). Defining and estimating a trading area, *Journal of Marketing*, *28*, pp. 34–8.
JACOBS, J. (1970). *The economy of cities*, Jonathan Cape, London.
KAIN, J. F. (1962). The journey to work as a determinant of residential location, *Papers*, *Regional Science Association*, *9*, pp. 137–60.
LAKSHMANAN, T. R. (1968). A model for allocating urban activities in a state, *Socio-Economic Planning Sciences*, *1*, pp. 283–95.
LAKSHMANAN, T. R. and HANSEN, W. G. (1965). A retail market potential model, *Journal of the American Institute of Planners*, *31*, pp. 134–43.
LEATHERS, N. J. (1967). Residential location and mode of transportation to work, *Transportation Research*, *1*, pp. 129–55.
LEONTIEF, W. and STROUT, A. (1963). Multi-regional input–output analysis, in T. Barna (ed.) (1963), op. cit.
LOWRY, I. S. (1964). *A model of metropolis*, RM–4035–RC, Rand Corporation, Santa Monica.
LOWRY, I. S. (1966). *Migration and metropolitan growth: two analytical models*, Chandler, San Francisco.
Masser, I. (1969). A test of some models for predicting inter-metropolitan movement of population in England and Wales, University Working Paper 9, Centre for Environmental Studies, London.
MENS EN RUIMTE (1971). *The mastery of urban growth*, Brussels.
MUTH, R. (1969). *Cities and housing*, Chicago University Press, Chicago.
NATIONAL ECONOMIC DEVELOPMENT COUNCIL (1970). *Urban models in shopping studies*, N.E.D.C., London.
PUTMAN, S. H. (1967). Intra-urban industrial location model design and implementation, *Papers*, *Regional Science Association*, *19*, pp. 199–214.
PUTMAN, S. H. (1970). Developing and testing an intra-regional model, *Regional Studies*, *4*, pp. 473–90.
QUARMBY, D. A. (1967). Choice of travel mode for the journey to work: some findings, *Journal of Transport Economics and Policy*, *1*, pp. 1–42.

ROBINSON, I. M., WOLFE, H. B. and BARRINGER, R. L. (1965). A simulation model for renewal programming, *Journal of the American Institute of Planners, 31*, pp. 126–34.
ROGERS, A. (1966). Matrix methods of population analysis, *Journal of the American Institute of Planners, 32*, pp. 40–4.
SCOTT, A. J. (1971). *Combinatorial programming, spatial analysis and planning*, Methuen, London.
SMITH, D. M. (1971). *Industrial location*, John Wiley, London.
SWERDLOFF, C. N. and STOWERS, J. R. (1966). A test of some first generation residential land-use models, *Highway Research Record, 126*, pp. 38–59.
TAYLOR, J. L. (1971). Urban gaming simulation systems, *Progress in Geography, 3*, pp. 135–71.
TITMUSS, R. M. (1962). *Income distribution and social change*, Allen and Unwin, London.
WAGON, D. J. and WILSON, A. G. (1971). The mathematical model, Technical Working Paper 5, SELNEC Transportation Study, Town Hall, Manchester.
WILLATTS, E. C. (1965). Geographical techniques in physical planning, in Chorley and Haggett (eds) (1965), op. cit., pp. 266–93.
WILSON, A. G. (1969). Developments of some elementary residential location models, *Journal of Regional Science, 9*, pp. 377–85.
WILSON, A. G. (1970–A). *Entropy in urban and regional modelling*, Pion, London.
WILSON, A. G. (1970–B). Inter-regional commodity flows: entropy maximizing methods, *Geographical Analysis, 2*, pp. 255–82.
WILSON, A. G. (1971–A). *Papers in urban and regional analysis*. Pion, London, in the press.
WILSON, A. G. (1971–B). Models of population structure, and some implications for dynamic residential location models, to be published in A. G. Wilson (ed.) (1972), op. cit.
WILSON, A. G. (1971–C). On some problems in urban and regional modelling, in M. Chisholm, A. E. Frey and P. Haggett (eds) (1971), op. cit., pp. 179–220.
WILSON, A. G. (1971–D). Metropolitan growth models, in Mens en Ruimte (1971), op. cit., pp. 73–98.
WILSON, A. G. (1971–E). Recent developments in micro-economic approaches to modelling household behaviour with particular reference to spatio-temporal organization, to be published in A. G. Wilson (1971–A), op. cit.
WILSON, A. G. (ed.) (1972). *Patterns and processes in urban and regional systems*, Pion, London, to be published.
WILSON, A. G., HAWKINS, A. F., HILL, G. J. and WAGON, D. J. (1969). Calibrating and testing the SELNEC transport model, *Regional Studies, 3*, pp. 337–50.
WILSON, A. G. and KIRWAN, R. (1969). Measures of benefits in the evaluation of urban transport improvements, Working Paper 43, Centre for Environmental Studies, London.
WINGO, L. (1961). *Transportation and urban land*, Resources for the future, Washington D.C.
WOOTTON, H. J. and PICK, G. W. (1967). A model for trips generated by households, *Journal of Transport Economics and Policy, 1*, pp. 137–53.