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The End of the Industrial City

Postindustrial Scenarios for a City in Transition

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Preface

Depending on one's perspective, this work is the product of four hectic weeks, two years of effort, five years of good intentions or fifteen years of research.

That time scale has a lot to do with working at IRPUD, an institute permanently understaffed in relation to the number of projects, students and visitors deserving and demanding attention. It also has a lot to do with events in Germany in 1989 and 1990, which, however fortunate they were for the country, were a real disaster for someone involved in forecasting as they turned all familiar trends upside down and required new data collection and a fundamental reappraisal of all conjectures about the future.

That the book nevertheless has been finished is thanks to a great number of people.

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There are no words to express my gratitude for the patience and silent support of my wife Frauke.

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Michael Wegener

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Introduction

The year 1987 marks a turning point in the history of the Ruhr. In this year *Minister Stein* in Dortmund, the last working coal mine in the core of what used to be the largest mining region in Europe, was closed. With this closure the number of mining workers in the Ruhr declined to a quarter of its former size of half a million in the 1950s. During the same time the number of workers in the iron and steel industry in this traditional steel region fell from 200,000 to 100,000. In total, the Ruhr, still the largest industrial region in Europe, has lost one third of its industrial jobs and one fifth of all jobs since the 1960s.

The development in the Ruhr is no exception. Similar losses of jobs could be observed in the north-west of England, the south of Belgium, the north-west of France and the Saar. They all have in common that they are 'old' industrial regions which in the late 18th and early 19th century pioneered the large-scale industrialisation process. They were the centres of the mining, steel, chemicals, textile and machine industries that laid the foundations for modern mass production and the wealth of Europe today.

Industrialisation went hand in hand with urbanisation. Industrial innovation occurred in the cities and, by a streak of luck, coincided with a wave of surplus labour in the countryside, consequently cities grew rapidly by rural-to-urban migration, sometimes from sleepy towns into powerful centres of production, trade and capital in a matter of decades. Rapid growth shaped the form of these cities: pits and factories, canals and railways, waste heaps and excavation sites established a giant network of man-made structures across the natural landscape. In the interstices housing of the simplest kind was hastily erected for the masses of immigrant workers, in most cases without being linked to the existing village cores and freely exposed to the noise, smell and soot of the factories. Names such as 'Black Country' or 'Kohlenpott' (coal pot) characterise the grim image of these man-made environments: the archetype of the *industrial city* was created.

Today, two centuries after the start of the large-scale urbanisation of Europe in the wake of the industrial revolution, the cities of Europe are again in a period of transition. Fundamental shifts in the economic and demographic structure of European societies make conventional concepts of the never-ending growth of agglomerations obsolete and signal a basic change in the relationship between city and countryside. At the same time, new technological developments may bring about further reorganisations of the structure of urban settlements that may be no less dramatic than those of the first urbanisation period.

Not all cities have been equally affected by these changes. On the one hand, there are very few large metropolitan regions which develop into production, service, and communications centres of European or even global importance. On the other hand, a large number of medium-sized cities continue to lose in substance, both on a national or European scale in comparison with those few top regions as well as in their own region, as a result of outmigration of population and employment to prospering smaller towns on their periphery - a twofold erosion process leading to severe problems of restructuring and adjustment. At the same time there are in Mediterranean and in eastern European countries cities of all sizes which still continue to grow, and hence suffer from the familiar adjustment problems connected with too rapid growth. To make things even more complicated, there are the very recent effects of the wave of east-west migration before and after the unification of Germany and the collapse of the communist states in Eastern Europe, which has brought all cities in Germany a new, though probably short-lived, period of population and employment growth

There have been various attempts to explain the coexistence of different patterns of urban development at one point in time by a comprehensive and yet simple theory. One such attempt is the theory of *urban life cycles*, which, being closely linked to the theory of product cycles, started out as a merely descriptive theory to classify the diversity of urban growth and decline phenomena, but which has since matured into a substantive theory of considerable explanatory power. Its main achievement is to identify typical phases of urban development from growth to decline, or from 'urbanisation' to 'suburbanisation' and 'deurbanisation', and to relate these to the economic and demographic transition in a country. Using this framework, it is possible to demonstrate that urban decline is most likely to occur first in the countries with the longest industrial tradition in Europe, that is in England, the Benelux countries, north-western France and Germany, while urban growth can be expected to prevail for some time in Turkey and Greece, Portugal and Spain, and the south of Italy as well as in most eastern European countries.

Therefore, old *industrial cities* are the city type deserving most interest, not because they seem to lag behind the metropolitan areas with a shorter history of industrialisation, but *because they have progressed further along the urban life cycle than any other type of city*.

They have been the first to experience the problems of urban decline, such as loss of employment in the ailing traditional sectors of the economy, without corresponding growth in more modern, high-tech or service industries; mass unemployment and the increasing exodus of economically active, mobile and younger households, leaving the less mobile, poorer, older, and less skilled behind; a growing discrepancy between the dwindling tax base and increasing responsibilities in the fields of welfare, social services, health care and public transport; a declining retail sector, especially in the city centre, contributing to a general decline of the inner city encompassing, depending on the circumstances, symptoms such as abandoned buildings, derelict industrial sites, the total disappearance or progressive impoverishment of housing and a continuous erosion of the former functional diversity of the inner city.

At the same time these cities, too, are subject to the same long-range trends of social and economic change: Changing lifestyles lead to smaller households with the effect that the number of households, despite the overall declining population, continues to rise, and will at least for some time. Reduced working hours lead to a shift of emphasis, and so of household expenditure, towards leisure and recreation. Increasing household budgets for transport and housing result in the continued growth of car ownership and ever higher standards of housing consumption both in quantitative terms leading to further increases in floorspace and number of rooms per capita and in qualitative terms resulting in even greater selectivity with respect to amenities and neighbourhood quality.

All other urban activities also tend to become more specialised. Modern computerised manufacturing and logistics schemes require extensive one-storey buildings that can be accessed and extended on all sides, something hard to achieve in existing built-up areas. Office automation eliminates routinised manual work processes and makes office firms dependent on highly skilled employees; therefore suburban locations close to attractive residential areas compete with traditional inner-city locations for service industries. The same is true for retail locations: rationalisation and increasing competition lead to larger retail establishments with higher turnover and less sales staff, and these are easiest to implement on large and less expensive suburban sites, which, in addition, are more accessible for motorised customers than inner-city locations. Modern transport and telecommunications technologies reinforce these dispersal tendencies by making transport and communications faster and less expensive and thus facilitating spatial division of labour and making firms more footloose.

Taken together, the impacts of social and economic change point in the same direction: they tend to increase the space consumption of all urban activities and reinforce the tendency towards increased spatial division of labour and towards spatial deconcentration of locations from the urban centres to their suburban periphery.

The dilemma of old industrial cities therefore is that they are affected by the consequences of economic restructuring in a twofold manner: on the one hand they are lag behind in the interregional competition with the more successful manufacturing and service centres with a more modern mix of industries, on the other hand they share with them the negative consequences of suburbanisation.

Under conditions of growth, spatial deconcentration may be a welcome relief for the congested city centre. However, under conditions of decline it leads to a dangerous erosion of essential urban functions. In such a situation interregional polarisation and intraregional deconcentration reinforce each other: first the urban core loses its industrial workplaces, then it loses more and more of its residents leave as outmigrants to more successful cities or to the suburbs. Inner-city retail facilities suffer more than suburban shopping centres. Soon investment fails to appear and the city centre lacks the glamour of perpetual new-ness necessary in the market economy to demonstrate prosperity. Once the signs of stagnation start to multiply, it is hard to stop or reverse the decline.

These objective difficulties are aggravated by the psychological problems associated with decline. Lack of faith, resignation, loss of self-confidence and the cry for external help are the symptoms of a decline also in spirit, which in a downward pointing spiral feeds back to and accelerates the external decline - a vicious circle which is hard to overcome even by official public relations endeavours demonstrating seemingly undisturbed optimism.

What are the future prospects for cities of this type, which leapt into industrial prosperity from small agricultural towns 150 or 200 years ago, and which, unlike the great commercial or cultural capitals of Europe, have no thriving service sector or cultural heritage to rely on once their economic base dwindles away? Will they return to where they came from, to oblivion, perhaps finding a niche as quiet, provincial residential towns, the mere shadow of their former size and importance, or will there be a new and fourth phase in their urban life cycle, a 'reurbanisation' phase, in which the trends leading to 'deurbanisation' and urban decline are reversed? Do these cities have a real chance of survival in the murderous competition for capital and markets, jobs and technologies?

These questions will be addressed using *Dortmund* in North-Rhine Westphalia as a case-study city. Dortmund, the centre of the eastern part of the Ruhr, after a spectacular rise as one of the primary coal and steel capitals of Germany in the 19th century, today represents all the symptoms of a declining city, and this is true despite the unexpected return to moderate growth due to the unification of Germany, which only conceals the fact that the gap between the city and the rest of the country is in fact widening. However, Dortmund also provides a good demonstration of how innovative local policy-making can contribute to overcoming the atmosphere of resignation and lack of self-confidence associated with decline.

Using Dortmund as an example, the following questions will be posed: What will be the future of old industrial cities if current megatrends in technology, economy, society and politics prevail? Will they continue to lose population and employment relative to other cities? How will work-places and people be distributed across the urban area? What will happen to redundant industrial sites? What will happen in the housing market? Will the spatial segregation of income groups and ethnic communities in the city continue to increase? Will housing construction decline with a stagnating or only slowly growing population? How will individual urban districts and suburban communities develop? Will spatial disparities increase or be reduced? What will be the future role of the inner city? What will happen to urban transport? Will it be possible to break the vicious circle of increasing automobility and growing spatial dispersal of activities? Is there a post-industrial Dortmund which is at the same time efficient, equitable and environmentally sustainable?

The most likely scenario is easy to describe. If Dortmund is only roughly representative of the archetype of the industrial city, the most likely future for the industrial city is its *spatial dissolution*. Continuing growth of the small and medium-sized towns on the periphery of the urban region leads in the long run to a continuum between city and countryside in which these cities will take over more and more of the functions of the former centre, a dispersed settlement structure which will almost exclusively depend on the private car, with high land consumption, high-level mobility, long trips and frequent road congestion and a city centre serving only a limited set of residual functions.

The spatial and social consequences of this base scenario will be described in this book. In addition, the results of various alternative scenarios will be discussed. Would the spatial development of Dortmund have taken a significantly different course if the economic crisis had been more severe than it really was? To what extent can spatial development be controlled in a city with a declining or only slowly growing economy and population? Are transport policies in a metropolitan region with a highly developed transport network appropriate policies for guiding spatial development? Will the unification of Germany - with all its repercussions - and the opening of Eastern Europe significantly change the spatial development of the region?

The results are unequivocal. They reveal in essence that the life cycle of industrial cities like Dortmund is coming to a close. In the face of the emerging international division of labour, of foreseeable trends in social, economic and technological development and of the associated changes of values and life styles, the industrial city is obsolete as a city type. The centralisation of manufacturing industries in the urban centre will in the future be neither necessary, nor economically profitable, nor environmentally desirable. A long-term reurbanisation or reversal of the suburbanisation trend - i.e. a new increase, if only relative - of the share of the urban core in the region's population, will not occur without massive immigration or a serious economic depression. Against this overpowering trend, the classical

instruments of land-use development controls and transport planning prove to be largely ineffective.

These postindustrial scenarios have been confirmed by reality. For many years the city of Dortmund had to annually revise its much too optimistic population and employment forecasts. Only very recently has Dortmund also benefited from the inflow of people and the economic upswing connected with the unification of Germany and the opening up of Eastern Europe. However, this externally induced growth was less than that of other cities and only concealed the widening gap between the city and the rest of the country.

And this happened to a city that was far from being inactive. In a major programme of public housing construction, the City has put up several hundreds of low-cost flats on and near the site of the former slaughter-house to the north of the inner city - something private capital would have been unlikely to do at this location, and quite exceptional at a time when Federal money for public housing has been practically reduced to zero. Another case of public intervention is the 'technology centre' and 'technology park' near the university, which, according to its management, is consistently overbooked despite repeated expansion. Although it remains to be seen how much of this success is due to the public subsidies connected with this prestige project, and although its actual effects on employment are minimal compared with the simultaneous job losses in the traditional industries of the city, success stories like this one undoubtedly play an important role in transforming the bleak image of the region into one of hope and opportunity.

Nevertheless, the economic prospects of the region remain uncertain. Recent forecasts indicate that the decline of the iron and steel and coal industries is likely to continue at an even more rapid rate than anticipated. The locational advantages a city like Dortmund may have - good road and rail accessibility and a skilled labour force - are almost ubiquitous today, but Dortmund, like all the Ruhr cities, lacks the synergetic factors that have made Düsseldorf, Frankfurt, Stuttgart and Munich attractive to international business services or high-tech manufacturing industries: proximity to an international airport, diversity of communications and services, an exciting city centre, a pleasant climate, attractive housing areas and recreation opportunities in the vicinity.

So it is probably safe to assume that as long as these factors are important, Dortmund - and almost any other industrial city with a heritage of old buildings, redundant infrastructure, polluted environment, and contaminated soils - will be a second-best choice for companies within most growth industries and their highly qualified and highly selective staff. This does not preclude the possibility that Dortmund, to a certain extent, and with the requisite financial incentives, will be successful in attracting such firms, but it makes it likely that the growth thus generated will always be less than that of its more fortunate competitors without such an unfavourable heritage - which means that the 'industrial city' will continue to lose out.

Reflections of this kind suggest a re-evaluation of the goals and objectives of urban planning in a city like Dortmund. If the current process of the deindustrialisation of Dortmund is indeed irreversible, then a different vision of the future spatial structure of the region than the one currently held emerges.

This future spatial system would be a low-density, dispersed network of small and medium-sized towns, in which the industrial cities of the past would probably still play a role as regional centres, but on a much reduced level of centralisation - just provincial cities, the economies of which would be mainly based on the facilities and services they provide for their immediate or wider region after their traditional industries have largely disappeared. Dortmund may thus, for an extended period, remain a university town, a service and retail centre for a wider region and a residential city with a relatively large population of retired people and, thus with comparatively stable incomes.

The most important task of urban planning in such a system would no longer be the 'modernisation' of the region for short-term economic growth by sacrificing its last remaining assets in terms of open space, ecological resources and quality of life in the hopeless attempt to keep pace with the 'winner' cities of today. A more strategic urban policy would be to accept industrial decline as a challenge and opportunity to plan for long-term post-industrial revival. Under that perspective the foremost responsibility of urban planning would be the gradual reclamation of the physical, ecological, and aesthetic destruction left behind by one hundred and fifty years of industrial history - a much more fundamental 'modernisation' than that presently under way.

There are encouraging signs that such ideas are gradually gaining acceptance among decision makers in the region. Paying tribute to a broadly shared sentiment for a better environment in the population at large, decision-makers increasingly acknowledge that ecological concerns may in the long run be more important than short-term economic issues. There has been a fundamental process of re-thinking in transport planning, with the result that a new style of local transport planning has developed which places social and environmental concerns higher than technical efficiency for its own sake. Cities compete, admittedly for perfectly selfish reasons, by polishing up their inner cities and pedestrian shopping precincts, but also put large sums of money into the rehabilitation of run-down inner-city housing areas where the market fails to provide the necessary momentum.

A symbol of this new spirit, but perhaps more than a symbol, is the *Emscher Park International Building Exhibition* (IBA), a ten-year programme for the development of the northern part of the Ruhr. In this programme, eighteen cities and counties, among them Dortmund, collaborate with the state government on a large number of projects for the ecological, economic and social modernisation of the Emscher river basin, where the industrial heritage of the region is most depressing. For each project, the highest standards with respect to ecological sustainability, architectural quality and social acceptability are enforced before the project is

approved as a part of the programme and becomes eligible to receive public funds. It is hoped that such policies will improve the region's comparative advantage in the short- and medium-term, but more importantly make it competitive for the next round of spatial restructuring in a not too distant future, when the life cycle of the present 'winner' cities, due to lack of land, traffic congestion, ecological breakdowns and other consequences of overagglomeration, eventually turns into decline.

1

The End of the Industrial City?

Two centuries after the start of the large-scale urbanisation of Europe in the wake of the Industrial Revolution, the cities of Europe are again in a period of transition. Fundamental shifts in the economic and demographic structure of European societies make conventional concepts of the never-ending growth of agglomerations obsolete and signal a basic change in the relationship between city and countryside. At the same time, new technological developments may bring about further reorganisations of the structure of urban settlements that may be no less dramatic than those of the first urbanisation period.

Current Trends of Urban Development

As perhaps in no other historical period, the current situation in the development of cities in Europe is characterised by counteracting tendencies. At one and the same point in time, even in one and the same country, one can find equalising and polarising tendencies, growth and decline, success and failure side by side. Large-scale international or national processes of spatial reorganisation are superimposed with small-scale intraregional spatial shifts in a complex and sometimes seemingly contradictory pattern. It is therefore not always easy to dissect the change phenomena observed on one particular spatial level into their functional components related to different causes. In a first approximation, therefore, the most important current trends of urban development will be described without any attempt at explanation.

Global Urbanisation

According to UN estimates, towards the end of this century about fifty percent of the global population and eight percent of the population in industrial countries will live in urban agglomerations, two thirds in cities with a population of more than 100,000 and one fifth in cities with a population of more than a million. In the year 1950 only seven cities in the world had a population of more than 5 million; in the year 2000 there will be probably 57 such megalopoles (Myers, 1984).

However, behind these numbers, there are significant regional differences:

- In most industrialised countries large urban agglomerations, after two centuries of continuous growth, see themselves confronted for the first time with a decline in employment and population - at first only in their central cores, then in their inner suburbs and eventually in the whole agglomeration. At the same time small and medium-sized cities on the less urbanised periphery of the agglomeration attract firms and households and report employment and population growth even in countries with stagnating or declining total populations. In some countries even a reversal of the urbanisation process can be observed: while the large agglomerations, despite continued growth on their suburban periphery, taken overall are losing employment and population, the rural regions have been able to increase their share of national employment and population for the first time since the emergence of the European urban system in the 11th century.

- In contrast to this, metropolitan areas in developing countries continue to grow without any limit in sight. It is estimated that in the year 2000 only three of the 20 largest cities of the world will be in industrial countries, and none of them in Europe; the remaining 17 will all have a population of more than 10 million, among them Mexico City with 26 million, Sao Paolo with 23 million and Calcutta, Bombay and Cairo with 16 million each. Another 25 cities will have a population of between 5 and 10 million (Myers, 1984; Cliquet, 1986).

Urbanisation in the developing countries is by no means a mere replication of the earlier experience of cities in the industrial countries (cf. Kunzmann and Wegener, 1991):

- In the industrialised countries the rapid growth of cities in the 19th century was a necessary prerequisite and consequence of industrialisation. A surplus of labour in the countryside (due to progress in agricultural technology) and demand for labour in the cities (due to industrial growth) coincided so that rural-to-urban migration improved the living conditions in both the countryside and the cities, though to different degrees. By the same token the foreseeable end and partial reversal of this process today is based on the wealth created by industrialisation and the increasing equalisation of production technologies and living conditions in all parts of the industrialised countries. This is not to say that this trend reversal does not imply serious adjustment problems, such as declining inner cit-

ies, increasing spatial division of labour and segregation of social groups, waste of energy and environmental pollution through unnecessary mobility and excessive land consumption and urban sprawl on the urban periphery.

- In the developing countries cities are growing *without* the support of industrialisation. The economy develops only slowly; consequently family incomes do not grow and medical care remains insufficient. Hence infant mortality stays high and many children remain necessary for support in old age. The population continues to grow rapidly without a corresponding increase in food and jobs. More and more rural migrants come to the cities to look for work and social opportunity, but despite a large informal labour market the number of jobs is not sufficient for their growing numbers. The consequences are mass unemployment or underemployment, overcrowding and a growing underprovision in the fields of health services, education and transport.

Because of the fundamentally different genesis and context of urbanisation in developing and developed countries, an analysis of the future course of urbanisation is not possible without regional differentiation. This book deals only with the future of industrial cities in Europe. Yet awareness of the fundamental difference between urbanisation in developed and developing countries is necessary. Compared with cities in Africa, Asia or South America, even 'problem cities' in Europe appear immensely affluent, and this difference in living conditions will contribute to the expected mass migration from Third World countries to Europe, which will create yet unforeseeable new problems for the cities of Europe. It is therefore crucial for the future of cities of Europe that living conditions in Third World cities are improved.

Urbanisation and Counterurbanisation

After the decline of the Mediterranean system of cities in the wake of the fall of the Roman Empire, the urban system of Europe re-emerged in the 10th and 11th centuries. New agricultural technology propagated by monasteries made agricultural surplus production possible and hence the division of labour and the manufacturing of commodities. Improved land and sea transport also facilitated the exchange of goods and the division of labour across space. Trade and crafts, the two new activities, developed faster in larger, specialised settlements, *cities*. Migration from the countryside to the city meant liberation from feudal services, economic opportunity and both military and economic security.

Compared with contemporary cities, medieval cities were small. In Germany around the year 1400 there were some 50 cities with populations between 2,000 and 10,000, and some 15 'large' cities with more than 10,000 inhabitants, led by Cologne with 30,000, Lübeck with 25,000 and Strasbourg, Danzig, Nuremberg and Ulm with about 20,000 inhabitants.

This did not change much until modern times. The growth of cities was slow and, apart from devastation by wars, epidemics or natural disasters, so was urban decline, e.g. when trade routes changed as in the case of Venice, the port cities of Flanders or the Hanseatic League. At the outset of the 19th century, that is shortly before the start of industrialisation in Germany, there were only nine cities with populations of more than 50,000 in what later became the German *Reich* (Berlin, Hamburg, Breslau, Dresden, Königsberg, Strasbourg, Munich, Danzig and Cologne) and 17 cities with populations between 20,000 and 50,000 (Reulecke, 1985). These 26 cities together had a population of 1.2 million, less than five percent of the total population. More than 90 percent of the population lived in municipalities of less than 5,000.

The 19th century brought the big thrust of urbanisation. Declining infant and child mortality led to rapid population growth in rural regions - more than could be supported by the land despite growing agricultural production. Rural poverty and hunger led to outmigration to overseas countries - or to the cities. In the cities the new migrants met with the demand for labour from the emerging industry. In Germany, industrialisation was imported from England where it had started half a century earlier. New energy sources and inventions developed in Britain were waiting to be utilised and absorbed by the rapidly growing German market. The demand for steel and steel products for railways, bridges, machines, vehicles and consumption goods exploded. For all this, large numbers of people were needed both as workers and consumers, both in the old cities, where the capital was, and in new *industrial cities* established close to the locations of raw materials and markets.

The result of this early phase of spatial restructuring was an equalisation of the population shares of city and countryside. By 1871, the year of the first German unification, the number of people living in cities with a population of more than 20,000 had already more than quadrupled. In the forty years up to 1910 it quadrupled again. At the beginning of World War I only about 50 percent of the population still lived in municipalities with less than 5,000 people. Today, this share has decreased to 15 percent in western Germany, the former FRG, whereas in eastern Germany, the former GDR, where there had not been a reorganisation of local government in the 1970s, this proportion is still higher.

In order to analyse the urbanisation process, it is therefore necessary to use a higher threshold value for the definition of what is urban. Figure 1.1 shows a comparison of the share of population in cities with more than 50,000 inhabitants in eighteen European countries (OECD, 1986). It is apparent that there are significant differences in the degree of urbanisation in Europe, for instance between the United Kingdom (65 percent) and Portugal (12 percent).

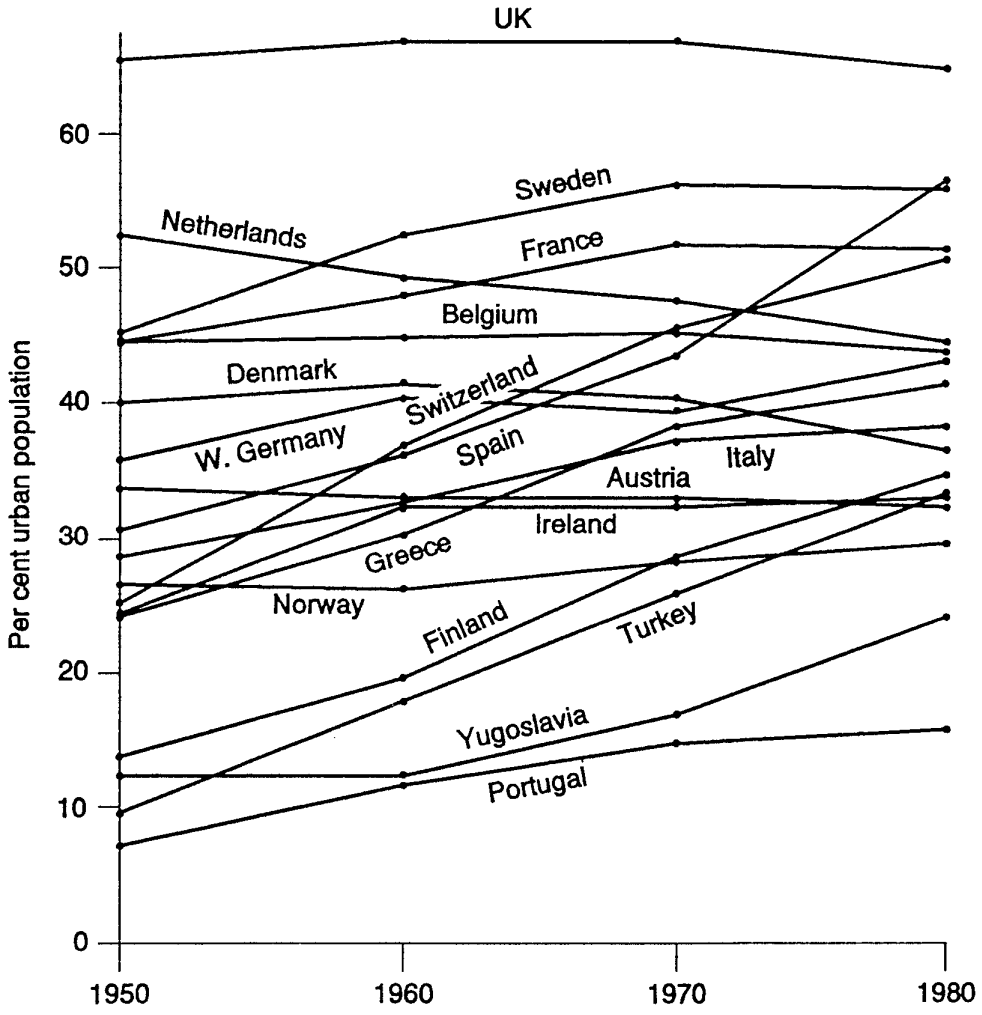

Figure 1.1. Share of population in cities or urban regions with a population of more than 50,000 in eighteen European countries, 1950-1980 (OECD, 1986). *It is apparent that there are significant differences in the degree of urbanisation in Europe, for instance between the United Kingdom and Portugal. There are saturation effects in the United Kingdom, Denmark, Norway, Sweden, France and Italy. In the Netherlands, Austria and the FRG the urban population has declined since the 1950s (The line for the FRG shows the impacts of the reorganisation of local government in the 1970s).*

In general the degree of urbanisation is growing and is growing faster in countries with still little urbanisation, although there are obvious saturation effects visible in some countries in the 1970s, for instance in the United Kingdom, Denmark, Norway, Sweden, France and Italy. In the Netherlands and in Austria the urban population has continuously declined since the 1950s. The line for the FRG is impaired in its information value because of the reorganisation of local government in the 1970s, during which many small municipalities were incorporated by larger cities - this is the reason for the new increase in degree of urbanisation after 1970. In reality, however, the urban population of the FRG started to decline as early as in the 1950s.

This can be seen more clearly if, as in Figure 1.2, the shares of population in different size categories of municipalities after 1975 are compared - after 1975 because administrative boundaries of municipalities in the FRG have remained almost constant since that year. It can be seen that rural-to-urban migration still continued - in the decade after 1975 municipalities under 5,000 lost more than ten percent of their population. However, already the next size category, municipalities between 5,000 and 10,000 inhabitants, grew in population, and this growth increased with population size up to medium-sized cities. Small cities between 20,000 and 50,000 grew most rapidly. Beyond that size, the relationship was reversed: large cities with populations between 100,000 and 500,000 first continued to grow, but started to decline after 1977. The largest cities with a population of over half a million declined by more than ten percent by the mid-1980s.

The second half of the 1980s, however, brought a break in this downward trend. The collapse of the GDR, the unification of Germany and the transformation of the former socialist states in Eastern Europe have spawned a wave of immigration into the former West Germany. Between 1985 and 1989 more than one million people entered the country, mostly from East Germany and Russia. The number of political and economic refugees from developing countries seeking political asylum rose from 57,000 in 1987 to 256,000 in 1991. Although only a very small fraction of them is accepted, the majority is provisionally permitted to stay. Not surprisingly, the new immigrants arrive and for an initial period find shelter and work in large cities, which explains the strong upward trend for these size categories in Figure 1.2. However, this growth has to be seen with caution as many of these immigrants are temporarily housed in makeshift accommodation and may in the long run be redistributed more evenly across the country.

A similar picture emerges if the Federal Republic is not subdivided by size of municipality but by regional characteristics using the classification of the *Bundesanstalt für Landeskunde und Raumforschung* (Table 1.1 and Figure 1.3). It can be seen that the agglomerations in the FRG since 1970 have lost nearly one million people, even if the fast growing suburban fringes are included (*regions with agglomerations*).

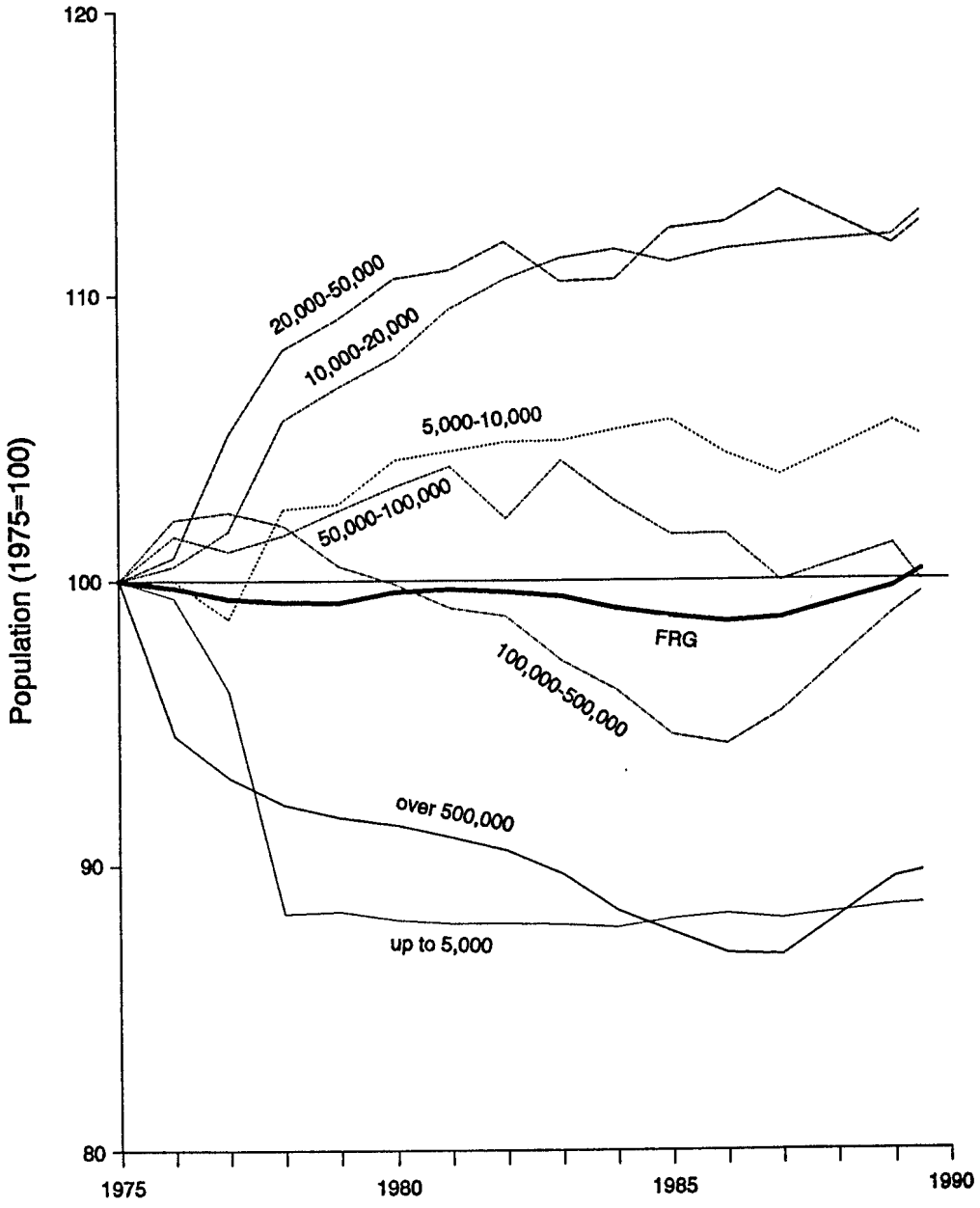

Figure 1.2. Population development in West Germany by size of municipality, 1975-1989 (1975=100). *Rural-to-urban migration still continued in the FRG - municipalities under 5,000 lost more than ten percent of their population. However, small and medium-sized cities grew in population. Larger cities first continued to grow but started to decline after 1977. The largest cities declined by more than ten percent. The renewed urban growth in the second half of the 1980s was due to a wave of immigration from East Germany, Eastern Europe and developing countries, but may not be permanent. Source: Statistisches Bundesamt, 1976-1986.*

Table 1.1. Population in the FRG by region type, 1970-1989.

Region type	Population (million)			Change (%)	
	1970	1986	1989	70-86	86-89
Regions with agglomerations[a]	34.31 *56.25*	33.86 *55.49*	34.40 *55.74*	*-1.33*	*+1.59*
Regions in transition	17.14 *28.10*	17.52 *28.71*	17.61 *28.53*	*+2.23*	*+0.51*
Rural regions[a]	9.55 *15.65*	9.64 *15.80*	9.71 *15.73*	*+0.97*	*+0.72*
Total FRG	61.00 *100.00*	61.02 *100.00*	61.72 *100.00*	*+0.03*	*+1.14*

a following the regional classification of the BfLR (see Figure 1.3)
Source: BfLR (1986), BMBau (1990)

Table 1.2. Employment in the FRG by region type, 1970-1989.

Region type	Employment (million)			Change (%)	
	1970	1985	1988	70-85	85-88
Regions with agglomerations[a]	12.59 *62.08*	11.97 *57.46*	12.54 *58.99*	*-4.86*	*+4.76*
Regions in transition	9.17 *25.49*	5.32 *26.41*	5.67 *26.67*	*+2.89*	*+6.63*
Rural regions[a]	2.52 *12.43*	2.85 *14.13*	3.05 *14.34*	*12.93*	*+7.18*
Total FRG	20.27 *100.00*	20.13 *100.00*	21.27 *100.00*	*+0.67*	*+5.60*

a Dependent employment (except agriculture):
1970 census employment except üublic servants and self-employed,
1985/1988 employment from social security records
b after the regional classification of the BfLR (see Figure 1.3)
Source: BfLR (1986), BMBau (1990)

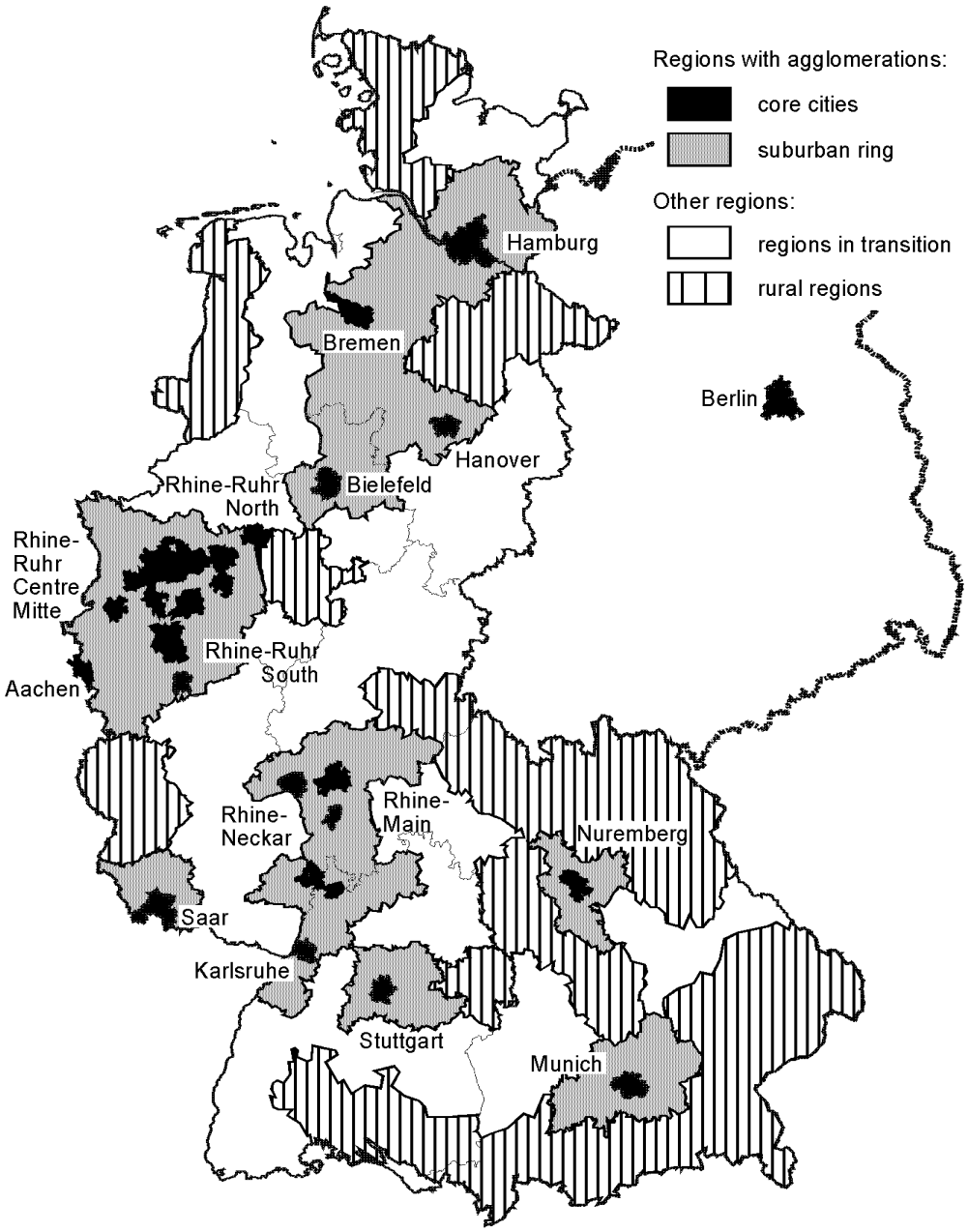

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Figure 1.3. Agglomerations and rural regions in West Germany following the regional classification of the BfLR. *On the territory of the former FRG, only border regions and a few residual areas in the 'grey' zones between the agglomerations have preserved their predominantly rural character. Most of the country is classified either as urban or as regions in transition.*

Until the mid-1980s, with the total national population remaining constant, the main winner regions were the *regions in transition* ('Regionen mit Verdichtungsansätzen') and the *rural regions*. The latter gained population in absolute and relative terms. Though the magnitude of the shift was modest, the trend reversal was unequivocal. Only recently have the regions with agglomerations again started to grow faster as a result of migration, but, for the reasons stated above, it is likely that this growth will in the long run be redistributed more evenly across the country.

The trend reversal in spatial patterns can be demonstrated even more forcefully in the area of employment (Table 1.2). Again, a distinction needs to be made between the period up to the mid-1980s and the most recent period. In the 1970s and early 1980s, the regions with agglomerations lost almost 5 percent of their jobs, while the rural regions gained 13 percent. One might argue that the employment figures for the rural regions would look less favourable if agricultural employment were included, however, similar results were obtained by Bade (1987) using total dependent employment including agriculture. After 1985, employment in all regions started to grow again, but even now rural employment growth has been stronger than in the other regions.

The reversal of the urbanisation trend has come as a surprise to many observers because it conflicts with traditional concepts of the locational advantages of agglomerations. However, similar phenomena are reported from other countries. Butzin (1986) demonstrates that in Sweden in the period from 1970 to 1980 there was a reversal of traditional migration flows between centre and periphery and a consequent employment growth in peripheral regions. Eversley (1986) shows that in England in the 1970s population growth was strongest in the remote rural districts, if some of the 'New Towns' are ignored. More evidence for counterurbanisation tendencies in a wide range of countries in north-western and central Europe is contained in Champion (1989).

It can be concluded that in the industrialised countries of western and northern Europe the urbanisation process as a general process of rural-to-urban migration has come to an end. There is now a tendency for rural areas to stabilise in population and sometimes to grow faster in employment than the agglomerations, though from a much lower level. The recent growth period in West Germany based on massive immigration mostly benefits the large cities, but may not be permanent enough to invalidate the counterurbanisation trend, however this depends on national or European immigration policies. It may be speculated that at the heart of the counterurbanisation trend may be a tendency to equalise the differences in density between city and countryside. If this hypothesis is true, both extremes, the rural village and the metropolis, would lose importance as a form of human settlement. Small and medium-sized cities with good accessibility to the traditional centres would be the winners because they represent the settlement form of the future, the continuum between city and countryside, towards which both city and countryside asymptotically develop.

Urban Growth and Urban Decline

Urbanisation and counterurbanisation, although they are powerful and clearly distinguishable trends, are not sufficient to describe the pattern of spatial reorganisation in the industrial countries of Europe in the last three decades. If one moves from the national to the European scale, it becomes apparent that there is a wide range of cities in different phases of growth or decline coexisting in different countries of Europe.

There have been a large number of studies on this phenomenon (Hall and Hay, 1980; Cheshire and Hay, 1986; 1989; Cheshire et al., 1989; Cheshire, 1990). Cheshire and Hay, in several studies for the Commission of the EC, investigated population change in 122 urban regions in eight EC countries between 1971 and 1981. Their findings show a clear pattern:

- *Growing cities* were found predominantly in the Mediterranean countries including central and southern France, Portugal and Spain and Greece (but not Italy). The most rapidly growing cities were Toulouse, Barcelona, Vigo, Valladolid, Granada, Thessaloniki, Gijon/Aviles, Athens, Orléans, Palma de Mallorca, Malaga, Alicante and Madrid.

- *Declining cities* were found predominantly in the north-west of Europe and here particularly in regions with a pronounced and early industrial history, such as northern and central England, Belgium, northern France, north-western Germany and northern Italy. Examples of declining industrial cities were Sunderland, Glasgow, Essen, Charleroi, Liège, Manchester, Duisburg, Wuppertal, Nottingham, Newcastle, Saarbrücken, Leeds and Turin. Port cities such as Portsmouth, Liverpool, Southampton, Antwerp and Genoa formed another group of declining cities.

In a recent study (Commission of the European Communities, 1991), the Cheshire and Hay study was updated and extended to include eastern European countries. Figure 1.4 shows that in eastern Europe urban growth is dominant. At the end of the 1980s the basic pattern - urban growth in the south and urban decline in the north-west - has remained stable. However, the speed of urban growth in southern and eastern Europe has declined, while in central Europe there is again urban growth due to international migration.

Winner and Loser Cities

The spreading out of counterurbanisation and urban decline in Europe seems to herald a transition into an era of spatial dispersal. However, this is not true on a still higher level of observation. On the top level of the urban hierarchy in Europe the shift from large to small and medium-sized cities is superimposed by a more fundamental process of spatial specialisation, the basic tendency of which continues to be polarisation. basic tendency of which continues to be polarisation.

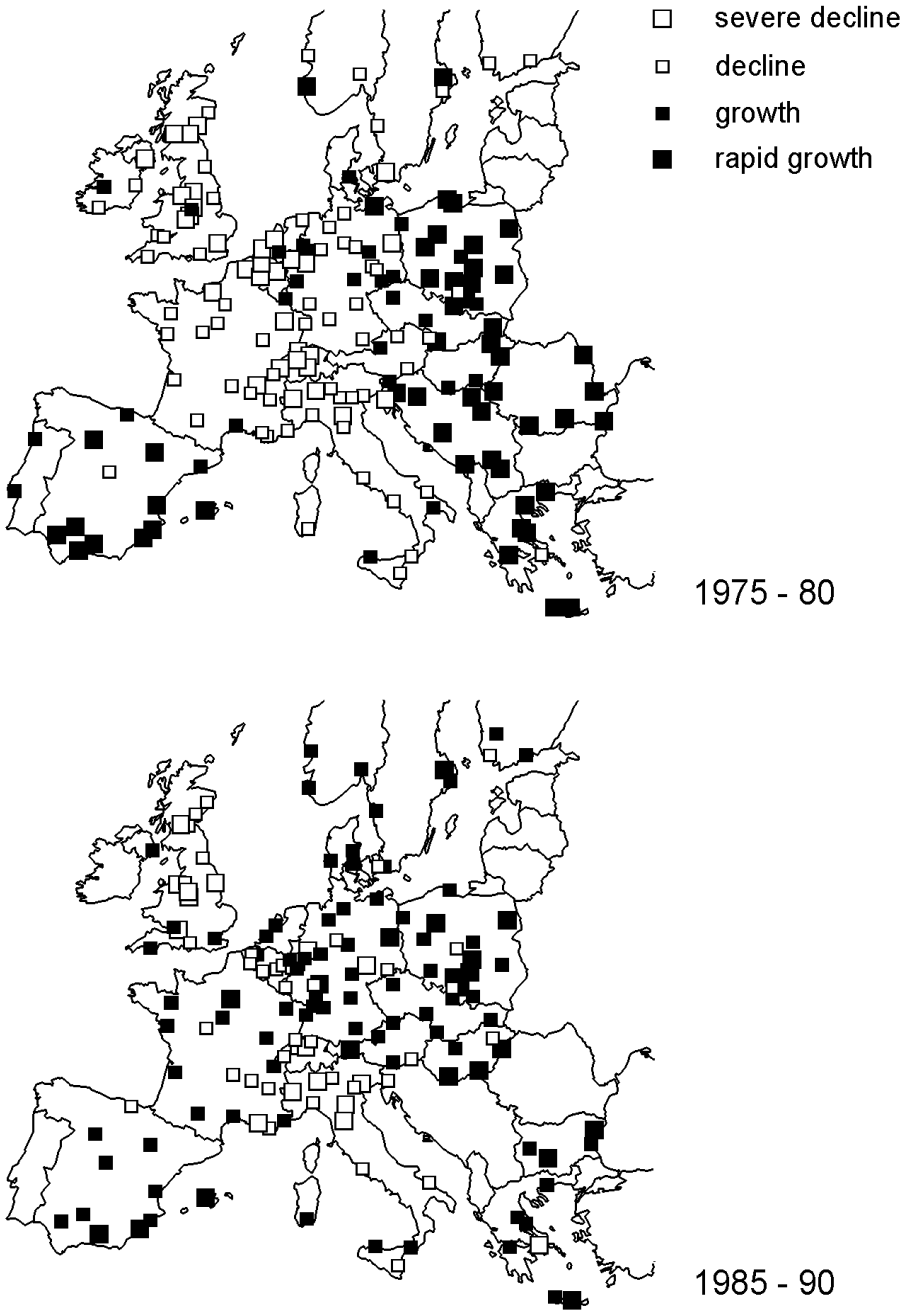

Figure 1.4. Urban growth and decline in Europe, 1975-1990 *(Commission of the European Communities, 1991). Growing cities are found mainly in central and southern France, Portugal, Spain and Greece, declining cities in regions with an industrial history such as northern and central England, Belgium, northern France, north-western Germany and northern Italy. In eastern Europe urban growth is dominant. In the late 1980s the speed of urban growth in southern and eastern Europe declined, while in central Europe there has again been urban growth due to international migration.*

Under the influence of the increasing intensity of international trade and exchange, a new class of communications and service centres of national, European or even global importance has emerged. These new metropoles have developed a growth dynamic far beyond that of other formerly large and prosperous cities. On a global scale such cities are London, New York and Tokyo, on a European scale Paris, Brussels and Frankfurt, and on a lower level cities such as Copenhagen, Stockholm, Zurich, Milan, Düsseldorf and Munich.

An international airport, headquarters of major banks and a stock exchange are the most important prerequisites for taking over this kind of cross-national function. They are the precondition for attracting offices of transnational corporations and for the development of high-level business services. If the city also has good railway and motorway connections, a diversified spectrum of universities and government research institutions, a rich cultural life, good shopping facilities, pleasant residential areas and attractive leisure opportunities in the vicinity, the stage is set for a self-propelling growth process fuelled by an increasing inflow of new growth industries and skilled labour.

This growth takes place at the expense of all other regions that do not have this 'success' mixture of locational factors, and in particular at the expense of the medium level of large cities which, based on their previous population and employment development, believed that they could count on a continuation of the growth of the 1960s and 1970s. Among them are the industrial cities with a traditional economic structure, such as the textile, coal and mining cities of central England, Lorraine and the Ruhr, in which the heavy losses of secondary employment were not offset by corresponding gains in the tertiary industries.

The dominant characteristic of the spatial reorganisation of the urban system in the industrialised countries of Europe is, therefore, the polarisation of cities into 'successful' and 'unsuccessful' cities. However, success and lack of success must not be equated with population growth or population decline. Cheshire and Hay (1989) have also investigated the incidence of population growth and decline with 'problems of urban development' in 103 urban regions in eight EC countries using a 'problem index' composed of indicators such as income per capita, unemployment, net migration and travel. They identified four types of urban regions in Europe:

- *'successful' growing cities* such as Paris, Toulouse, Montpellier, Orléans, Nice, Grenoble, Rennes, Lyon, Dijon, Strasbourg, Wiesbaden, Bonn, Munich;
- *'successful' declining cities* such as Venice, Florence, Brussels, Amsterdam, Stuttgart, Hanover, Frankfurt, Düsseldorf, Berlin, London;
- *'unsuccessful' growing cities* such as Toulon, Marseille, Dublin, Cosenza, Palermo, Naples, Cagliari;
- *'unsuccessful' declining cities* such as Charleroi, Valenciennes, Liverpool, Glasgow, Belfast, Sunderland, Manchester, Newcastle, Liège, Essen.

It is worth noting that some of the most prosperous a7nd clearly 'successful' cities in Europe, for instance Brussels, Amsterdam, Frankfurt and London, have declining populations. Consequently, population decline seems to be a phenomenon related to the internal organisation of the metropolitan region and how the urban region is defined - a topic that will be taken up in the subsequent section. However, it can also be seen that *industrial cities* are almost exclusively found in declining urban regions.

The dichotomy between 'successful' and 'unsuccessful' cities will become even more pronounced in the more homogenous context of the FRG. Here the problem is normally discussed under the heading of the south-north divide. In fact all indicators for the 'success' or the 'failure' of a region, such as population and employment growth or decline, unemployment, gross added value and local income tax, show significantly lower values for the northern part of the FRG compared with its central and southern states (see Table 1.3).

However, if these categories are also subdivided into the region types as in Figure 1.3, it can be observed that the differences between urban and rural regions are still much more pronounced than those between south and north; in other words, urban incomes are everywhere much higher than rural ones (Table 1.3). The south-north divide becomes even less significant if only urban regions are compared: of the five most affluent agglomerations in the FRG, one (Hamburg) is located in the north, whereas the one with the highest unemployment rate and lowest tax income (Saarbrücken) belongs to the centre (Table 1.4). Still, Munich clearly is a class of its own only followed by Stuttgart, though Stuttgart has until recently been losing population and employment.

Old Industrial Regions

What becomes even more visible is that the real losers are the industrial cities, and that the disparity between them and the new winner cities is widening.

In western Germany, six agglomerations are classified as 'old industrial': Duisburg, Essen, Bochum, Dortmund and the Aachen and Saar regions. The first four comprise the heart of the Ruhr (see Figure 1.5). Table 1.5 shows selected demographic and economic indicators for this group of agglomerations.

It can be seen that until the first half of the 1980s the industrial regions lost many more people and jobs than the other agglomerations in West Germany. As mentioned before, the second half of the 1980s brought a return to growth to all regions, however, even in this situation the industrial cities attracted fewer immigrants and created far fewer jobs than the other urban regions.

Table 1.3. Regional indicators in northern, central and southern Germany by region type, 1970-1989.

Region type		Population change	Employment change	Unemployment	Gross value added	Local income tax
		1970/87 %	1970/88 %	1989 %	1986 TDM[a]	1987 DM[b]
Regions with agglomerations[c]	North	-1.6	-6.9	9.5	34.8	534
	Central	-1.3	-2.1	8.7	32.0	517
	South	+1.4	+6.7	4.7	38.6	599
Regions in transition	North	-2.3	+0.2	9.8	26.8	400
	Central	-0.8	-7.0	7.0	26.1	411
	South	+8.5	+15.6	4.4	27.8	460
Rural regions[c]	North	+0.6	+14.0	9.6	24.1	334
	Central	-0.3	+9.4	6.7	23.9	370
	South	+1.4	+22.2	4.7	26.4	417
Total FRG (without Berlin)	North	-1.6	-1.9	9.6	29.8	447
	Central	-1.1	+0.2	8.0	30.1	484
	South	+3.5	+13.3	4.6	31.4	499

a Thousand DM per capita per year
b DM per capita per year
c following the regional classification of the BfLR (see Figure 1.3):
North: SH, HH, NS, HB
Central: NW,HS,RP,SR
South: BW,BY
Source: BfLR (1986, 1989)

Table 1.4. Regional indicators of selected agglomerations in northern, central and southern Germany, 1970-1988.

Agglomeration		Population change	Employment change	Unemployment	Gross value added	Local income tax
		1970/88 %	1970/87 %	1988 %	1986 TDM[a]	1987 DM[b]
Munich	South	+10.1	+14.3	6.2	43.9	648
Stuttgart	South	-1.1	-3.3	4.4	39.3	645
Hamburg	North	-4.7	-10.4	12.3	30.4	632
Rhine-Main	Central	+2.3	+5.0	6.7	40.5	611
Rhine-Ruhr[c]	Central	-2.4	-1.3	11.2	34.7	569
Bremen	North	-4.9	-2.0	15.1	34.4	483
Hanover	North	-4.0	-13.7	13.6	33.8	483
Bielefeld	North	-2.8	+4.9	10.5	28.2	471
Aachen	Central	+8.6	+5.4	11.4	23.2	424
Saar	Central	-7.5	-3.2	15.2	29.6	374

a Thousand DM per capita per year
b DM per capita per year
c Düsseldorf/Cologne
Source: BfLR (1986, 1989)

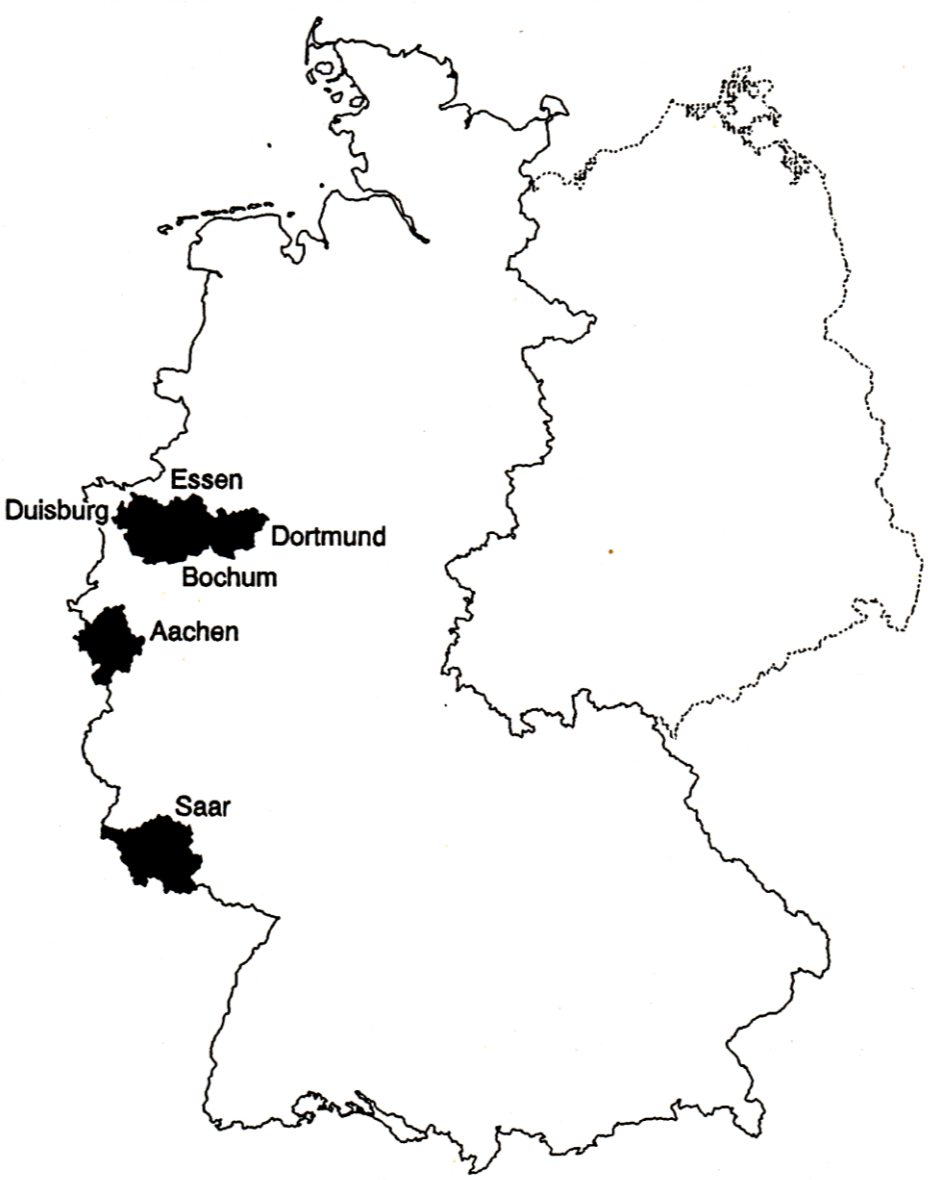

Figure 1.5. Old industrial regions in West Germany. In West Germany, six agglomerations are classified as 'old industrial': Duisburg, Essen, Bochum, Dortmund and the Aachen and Saar regions. The first four comprise the heart of the Ruhr area.

Table 1.5. Regional indicators of old industrial regions and other agglomerations in West Germany, 1970-1989.

	Old industrial regions	Other agglomerations	All agglomerations
Population 1970 (million)	7.03	27.28	34.31
Population 1986 (million)	6.67	27.18	33.86
Population 1989 (million)	6.76	27.63	34.40
Change 1970-1986 (%)	*-5.1*	*-0.4*	*-1.3*
Change 1986-1989 (%)	*+1.3*	*+1.7*	*+1.6*
Employment 1970 (million)	2.19	10.39	12.59
Employment 1985 (million)	2.04	9.93	11.97
Employment 1988 (million)	2.08	10.47	12.54
Change 1970-1985 (%)	*-7.0*	*-4.4*	*-4.9*
Change 1985-1988 (%)	*+1.8*	*+5.4*	*+4.8*
Gross value added 1980 (TDM)[a]	22,020	26,453	25,568
Gross value added 1986 (TDM)[a]	27,670	35,834	34,232
Change 1980-1986 (%)	*+25.7*	*+35.5*	*+33.9*
Local income tax 1980 (DM)[b]	351	411	399
Local income tax 1987 (DM)[b]	452	545	527
Change 1980-1987 (%)	*+28.8*	*+32.6*	*+32.0*
Service employment 1980 (%)[c]	44.4	51.2	50.0
Service employment 1988 (%)[c]	49.8	55.4	54.5
Unemployment 1980 (%)	5.9	3.5	3.9
Unemployment 1986 (%)	15.1	9.4	10.4
>1 year unemployment 1980 (%)[d]	24.8	16.0	18.4
>1 year unemployment 1986 (%)[d]	40.0	31.5	33.7
Welfare recipients 1980 (%)[d]	28	23	24
Welfare recipients 1986 (%)[d]	52	39	42

a Thousand DM per capita per year
b DM per capita per year
c Dependent employment as percent of total employment including agriculture
d Percent of unemployment

Source: BfLR (1989)

The gap between the old industrial cities and the other cities is even more pronounced if monetary indicators such as gross value added and income tax are compared. Both indicators continued to be much lower for the industrial regions. What is worse is that both value added and income grew at a much slower rate than in the prosperous regions, which means that the old industrial regions were not catching up but fell further back. In fact, because both indicators are expressed in nominal terms, the actual growth in the old industrial regions hardly exceeded the inflation rate.

This lag has to be attributed to the failure of the old industrial regions to restructure their economy at the same rate as the more successful regions. The percentage of service employment given in the table testifies that their economy only a few years ago was still largely manufacturing-based, although in this respect the distance to the other regions is becoming smaller.

However, the large differences in unemployment rates between the two types of regions demonstrate the difficulties of the transition from a manufacturing base to a modern service economy. The social consequences of this transition are highlighted by the large and growing proportion of long-term unemployed and of those who have dropped out of the social security system and have to rely on welfare payments.

Suburbanisation and Deurbanisation

In parallel with these shifts in the size and importance of metropolitan regions, similarly fundamental changes occurred with respect to the internal organisation of urban areas. In most simplified form, these changes can be described as a wave-like process of expansion and diffusion of activities from the urban core in outward direction towards the still semi-urbanised fringe of the agglomeration. This process took place in clearly distinguishable phases (van den Berg et al., 1982):

- In the *urbanisation phase* growth occurred almost exclusively in the urban core. This is where nearly all of the work-places and most of the residences were to be found. The suburbs were little urbanised and completely depended on the core city. In Germany the urbanisation period was the pre-war period. After World War II, cities in both parts of Germany were rebuilt largely following the pre-war centralised pattern.
- In the *suburbanisation phase* the city expanded into the suburban municipalities. For lack of space housing construction in the core declined. The majority of jobs was still in the centre, but gradually firms followed their workers and customers, first retail and services, later also manufacturing. Secondary centres appeared which began to compete against the traditional CBD. Eventually the core city began to lose first population and then employment, but the whole urban region still grew. In West Germany this phase was associated with a vast

expansion of urban areas for low-density detached houses and high-rise public housing compounds on the urban periphery in the 1960s.

- In the *deurbanisation phase* construction activity shifted even further out towards the urban periphery, and beyond to the small and medium-sized cities of the still rural hinterland. The core city lost more population and more employment than the suburbs gained; so the urban region as a whole began to decline. In West Germany this phase started in the 1970s and, due to the stagnation of the total national population, has progressed further than in most other European countries.

Figure 1.6 shows what the exodus from the core cities meant for the twelve largest cities in West Germany. Between 1970 and 1987 most of them lost one tenth or more of their population, while the total population of the FRG remained nearly constant. Only Bremen and Munich had small population gains in the early 1970s, but in the 1980s, like the other large cities, lost nearly one percent of their population per year.

The right-hand part of the diagram illustrates the difficulty of discussing population trends in a country in which the 1980 population and employment census was cancelled for fear that it might violate privacy rights. When finally in 1987, after long political debates, a census was conducted, it became apparent that the population register, which the critics of the census had claimed made the census unnecessary, was highly unreliable. The city of Munich had to admit after the census that it had lost 90,000 inhabitants overnight, whereas Berlin could proudly declare that it had gained 130,000.

Despite these irritations almost all large cities in West Germany have grown in population after 1987 reflecting the massive influx of migrants from East Germany and Eastern Europe and the growing number of refugees from Asian and African countries seeking political asylum. As discussed before, these migrants tend to concentrate in the large cities, although it remains to be seen where they in the long run will settle permanently.

Remarkably, there are hardly any differences in suburbanisation between 'successful' and 'unsuccessful' cities. It is true that the 'successful' Munich, even if one makes allowances for the errors in the population register, lost less of its population than Duisburg, a city that suffered severely from the steel crisis. Yet the largest loss of population occurred in the 'successful' Düsseldorf, whereas Dortmund und Frankfurt experienced almost equal population decline. The conclusion is that industrial cities are affected by suburbanisation just like other cities.

The aggregate magnitude of the spatial shift between core cities and suburbs can be seen in Table 1.6. Until the mid-1980s, the core cities in the large agglomerations were the main losers, whereas the main winners were the suburban communities and particularly the small and medium-sized cities at the urban fringe.

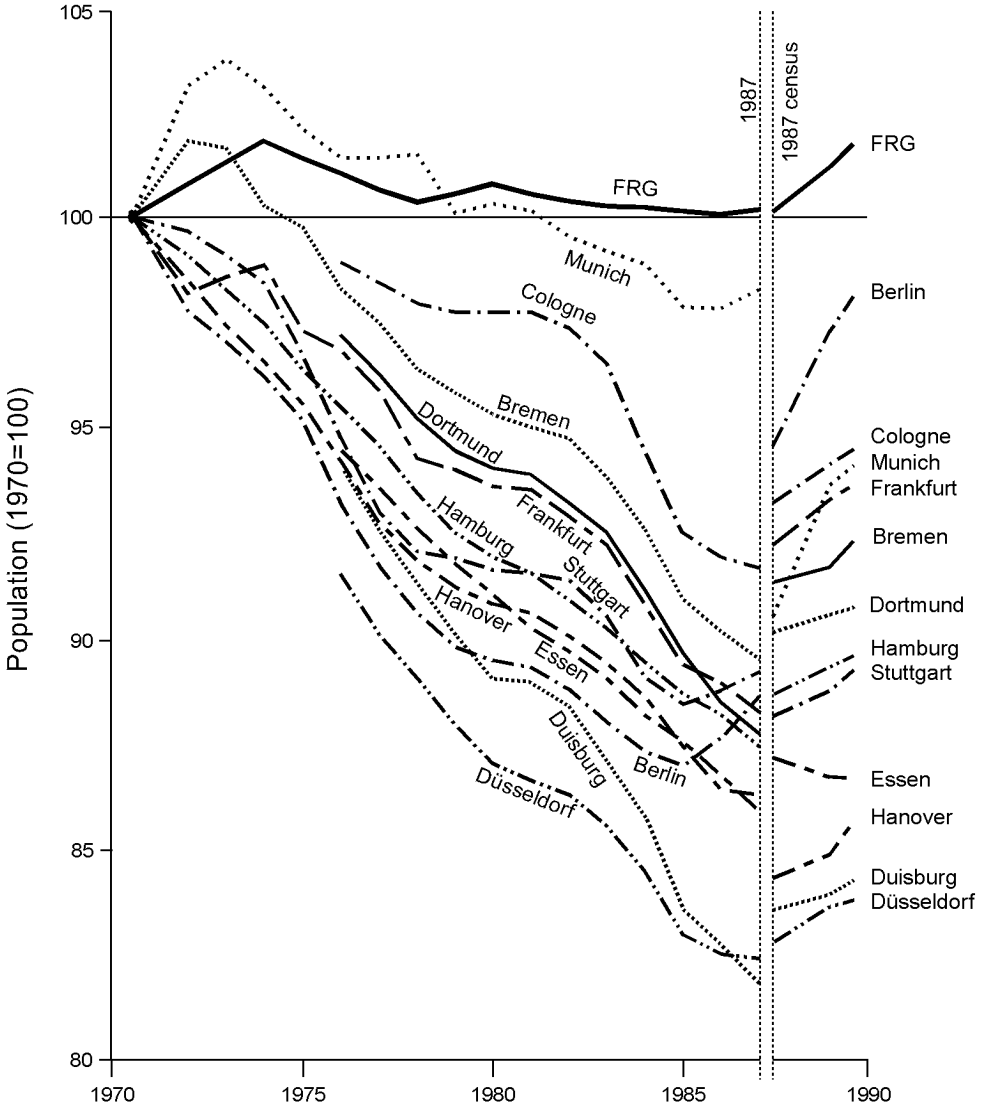

Figure 1.6. Population development in 12 core cities in the FRG and in the total FRG, 1970-1985. *Between 1970 and 1987 most large cities in West Germany lost one tenth or more of their population, while the total population of the FRG remained nearly constant. Only Bremen and Munich had small population gains in the early 1970s, but in the 1980s, like the other large cities, lost nearly one percent of their population per year. These losses were not offset by the recent population gains due to immigration from East Germany and eastern Europe before and after the unification of Germany. The break in the data illustrates the inconsistency between the 1987 census and the population register.*

Table 1.6. Change of population, employment and built-up land in the FRG, 1980-1989.

Region type[a]	Population change		Employment[b] change		Land consumption	
	80/86 %	86/89 %	80/85 %	85/88 %	81/85 %	85/89 %
Regions with agglom.	-1.4	+1.6	-3.4	+4.8	+5.6	+5.1
- Core cities	-4.0	+1.1	-5.0	+3.5	+3.9	+4.4
- Inner suburbs	+0.8	+2.0	-1.0	+6.7	+6.1	+6.3
- Rural suburbs	+1.6	+1.3	-0.7	+6.9	+6.6	+4.4
Regions in transition	+0.2	+0.5	-1.9	+6.6	+7.3	+4.8
- Core cities	-2.0	+0.5	-4.5	+5.3	+4.4	+4.8
- Rural suburbs	+0.7	+0.5	-0.8	+1.6	+7.6	+4.8
Rural regions	+0.5	+0.7	-0.6	+7.2	+5.1	+5.4
Total FRG	-0.7	+1.1	-2.6	+5.6	+6.1	+5.1

a following the regional classification of the BfLR (see Figure 1.3)
b Employment from social security records
Source: BfLR (1986), BMBau (1986, 1990)

Table 1.7. Land consumption in the FRG compared with population change, 1950-1989.

Land-use type	Change (%)				
	1950-60	1960-70	1970-80	1981-85	1985-89
Built-up area	+13.0	+19.8	+10.5	+6.1	+5.1
Agriculture	+8.5	-3.0	-2.0	-1.6	-1.7
Open land uses	-3.0	+0.6	-0.2	+0.4	+1.1
Population	+10.9	+9.4	+1.5	-0.7	+1.5

Source: BfLR-Mitteilungen, Statistisches Bundesamt

There was overall decline of employment in all types of regions, however, here too the core cities lost the greatest percentage of jobs, whereas the municipalities at the suburban fringe suffered least. In the second half of the decade the core cities, for the reasons stated above, started to grow again. However, except for smaller and medium-sized cities in the *regions in transition*, growth in the cores remained below that in the suburbs.

In all regions, however, the amount of land used for buildings, transport infrastructure and other facilities grew, and this growth tended to be strongest in the suburbs. Land consumption in urban areas is one of the ecologically most critical consequences of the current trends in urban development. Table 1.7 provides an overview of land conversions in the FRG since 1950. One can see that land consumption peaked in the 1960s, slightly declined in the 1970s and has recently started to grow again. The early 1980s show that there was a tendency for the built-up area to continue to grow even though the population in that period declined.

Here, too, the old industrial regions are no exception. In fact land consumption in old industrial regions was only slightly less than the average of all agglomerations. The main reason for this is that industrial land released by plant closures, for instance sites of former coal mines or collieries, is only rarely utilised again because of its contaminated soil or poor locational attractiveness, or because the cost of removing the existing buildings on the site is prohibitive. Furthermore, even in cities with high unemployment there is still demand for high-quality residential land as the social burdens of decline are not equally distributed across all groups of the population. In other words, industrial cities, though the victims of economic change, are affected by the consequences of suburbanisation like other cities.

In more recent years the core cities have started to grow again. The most important external reason is the unanticipated wave of immigration from East Germany and Eastern Europe before and after the unification of Germany, which was directed overproportionally towards the large cities. However, as it has already been discussed, it would be wrong to count these migrants as permanent residents of the core cities. It is much more likely that after an initial period of adjustment they will adopt the locational behaviour of the majority of the native population and in the short or medium term will also leave the city.

Another reason for the recent upswing in inner city populations is a certain revival of inner-city life styles by the increasing number of single or two-person households. However, this trend, too, should not be overestimated since, for lack of vacant land in the inner cities, it can only proceed by displacement of poorer residents, who tend to consume less housing space than the new invaders ('gentrification'), and hence in the long run will lead to declining rather than growing inner-city populations. In summary, until further evidence, the prospect for a reversal of the direction of urban development in the sense of a true 'reurbanisation phase' seems to be rather low

The Divided City

Just as on the national and European scale, also within regions polarising and equalising tendencies are superimposed upon each other. On the one hand the density gradient of population and jobs is flattening through the exodus of households and firms from the centre. On the other hand existing disparities between different parts of the region are becoming deeper. Just as there are 'successful' and 'unsuccessful' cities, so there are favoured and disadvantaged districts or suburban municipalities.

The unequal spatial distribution of living conditions and opportunities in cities dates back to the period of their creation. Even in the medieval city, different crafts already lived in separate quarters, though in close proximity to each other. In the industrial city, however, the spatial separation of the underclass, the workers, becomes the rule. Friedrich Engels (1844) describes how in early industrial Manchester the shopping arcades along the main roads were designed to hide the misery of the workers' districts from the eyes of the bourgeoisie commuting from the suburbs to the central factories. The industrialists lived outside the industrial city "in free, healthy country air" and came to the city only in pursuit of their business. The spatial order of the medieval city, in which the urban upper class, the merchants, had their stately town houses at the market square in the centre, had been reversed to the social gradient from outside to inside familiar today. From that time on industrial city has contained zones of advantage and zones of disadvantage: the green suburbs at the outskirts and the workers' districts in the shadow of the smoke stacks.

The novel feature in the present urban development is that these contrasts threaten to heighten in an unprecedented dimension. There is depressing evidence of increasing social cleavage in the cities of one of the wealthiest countries in the world (see, for instance, Breckner and Schmals, 1986; Rommelspacher and Oelschlägel, 1986; Ache et al., 1987; Schoch et al., 1988; Breckner et al., 1989).

For the 'successful' large cities, Siebel (1984) observed a division into three different 'cities'. The most visible city is the 'international' city with airport, hotels, banks and office buildings, luxury apartments and a prosperous city-centre shopping zone, but also high-class residential areas usually in the western part of the city. Hidden behind the international city is the 'normal' city for the native middle class in the low-density suburbs and high-rise housing areas on the urban periphery. In the shadow remains the 'marginalised' city for the old, the poor and the unemployed and the migrant workers in the run-down inner-city housing areas, in most cities to the east of the traditional centre, and in devalued underutilised transition zones at the urban fringe.

For the industrial city, which lacks the 'international' component, the trisection becomes a bisection. Here the effects of industrial decline are added to those of the exodus of the middle and upper class from the core city into the suburbs. The

losers are the inner-city working-class districts. Their neighbourhood and environmental quality, housing stock and social and recreational infrastructure are no longer adequate for the rising expectations of people with 'normal' salaries. So the only ones to remain are those with no alternatives: people without jobs, people supported by social security, and foreigners.

The consequences for the willingness of landlords to invest in the run-down housing stock are obvious. Local governments, already heavily burdened with rising welfare payments and with a tax base eroded by industrial decline, hardly have the means to effectively combat the gradual disintegration of vast parts of their territory. Without much choice, they prefer to concentrate their efforts and limited resources on the still more attractive parts of the city, because only here can they hope to attract new firms or new residents, and by doing so they unwillingly help to increase the spatial disparities in the city.

The End of the Industrial City?

In summary, the situation of cities in the industrialised countries of Europe is characterised by the superposition of several long-term trends that affect cities at different spatial scales and have partly equalising and partly polarising effects.

On the large-scale national or European level in particular, the following three tendencies are in effect:

- *Counterurbanisation*. On the one hand the century-long urbanisation process seems to be coming to its end. In the countries with the highest levels of urbanisation most agglomerations have ceased to grow, and in some countries they have started to decline even relative to the peripheral rural regions.

- *Urban decline*. There are large regional differences in the distribution of urban decline in Europe. Urban decline is concentrated in countries with the longest history of industrialisation in Europe: northern and central England, Belgium, northern France, north-western Germany and northern Italy.

- *Winners and losers*. On the other hand, cities are polarising. A small number of international high-tech manufacturing, service and communications centres stand out against the large number of cities that are less able to cope with rapid economic change.

Among the cities most affected are the formerly prosperous industrial cities. As a rule, these cities have failed to rid themselves of their industrial heritage and turn into modern high-tech or service economies, and so are decoupled from the economic development of their country.

On the intraregional and urban level, two counteracting tendencies are at work:

- *Suburbanisation*. On the one hand, nearly all core cities have lost population and employment in the last two decades, while the suburbs and suburban municipalities have gained with the effect that the differences in density between centre and periphery in urban regions are declining.

- *Spatial disparities*. On the other hand, the social disparities between different parts of the urban regions are increasing. As a rule, the losers are the run-down workers' housing areas in the core cities, the winners are the suburbs and suburban municipalities.

The dilemma of old industrial cities, therefore, is that they are affected by the consequences of economic restructuring in a twofold manner: on the one hand they lag behind in the interregional competition with the more successful manufacturing and service centres with a more modern mix of industries, on the other hand they share with them the negative consequences of suburbanisation - which here has turned into deurbanisation.

Under conditions of growth, spatial deconcentration may be a welcome relief for the congested city centre. However, under conditions of decline, decentralisation leads to a dangerous erosion of essential urban functions. In such a situation interregional polarisation and intraregional deconcentration reinforce each other: first the urban core loses its industrial workplaces, then it loses more and more of its residents as outmigrants to more successful cities or to the suburbs.

Inner-city retail facilities suffer more than suburban shopping centres under the loss of purchasing power of the region. Soon investment fails to appear and the city centre lacks the glamour of perpetual new-ness necessary in the market economy to demonstrate prosperity. Once the signs of stagnation start to multiply, it is hard to stop or reverse decline.

These objective difficulties are aggravated by the psychological problems associated with decline. Lack of faith, resignation, loss of self-confidence and the cry for external help are the symptoms of a decline also in spirit, which, in a downward pointing spiral, feeds back to and accelerates the external decline - a vicious circle which is hard to overcome even by official public relations endeavours demonstrating seemingly undisturbed optimism.

What are the future prospects for cities of this type, which leapt into industrial prosperity from small agricultural towns 150 or 200 years ago, and which, unlike the great commercial or cultural capitals of Europe, have no thriving service sector or cultural heritage to rely on once their economic base dwindles away?

- Will they return to where they came from, to oblivion, perhaps finding a niche as quiet, provincial residential towns, the mere shadow of their former size and

importance, or will there be a new and fourth phase in their urban life cycle, a 'reurbanisation' phase, in which the trends leading to 'deurbanisation' and urban decline are reversed?

- Do these cities have a real chance of survival in the murderous competition for capital and markets, jobs and technologies?

2

Dortmund: Industrial City in Transition

When one thinks of industrial cities in Germany, immediately the Ruhr comes to mind. There are other substantial industrial areas such as the Saar, the Upper Rhine valley or the mining areas of Saxony. Berlin was once the largest industrial city of the continent. However, no region has been so much shaped, in fact created, by its industrial history as the Ruhr, and no other cities have so much right to be called industrial cities as the large urban centres of the Ruhr: Duisburg, Oberhausen, Essen, Bochum and Dortmund. And no other cities in Germany are better suited to illustrate the rise and fall of the industrial city and its eventual transformation to a new type of urban agglomeration, the precise character of which is still difficult to define.

Therefore, Dortmund serves as a case study for the analysis and projections in this book. This chapter introduces the case study region, the metropolitan area of Dortmund. It starts with a brief description of the Ruhr, of which the Dortmund region is a part. After that Dortmund itself and its industrial heritage will be presented in terms of infrastructure, educational facilities, environment, land use and government structure. It will be shown how the city grew from a sleepy country town to one of the mightiest industrial centres of the country and how, after World War II, it declined with the decline of the mining and steel industries. Finally, it will be shown how the city, after a period of strong government strategies, developed its own programme of regional economic restructuring. The chapter closes with preliminary speculations on how postindustrial Dortmund might develop and which current problems have to be overcome to arrive at that future.

The Ruhr Area

The Ruhr Area is the largest industrial region in the Federal Republic of Germany: on an area of 4,400 square kilometres, which is 1.8 percent of the total area of the country, a population of 5.3 million, or 8.5 percent of the national population, produce 8.3 percent of the national income (see Figure 2.1).

The growth and decline of this region are closely related to the development of the coal mining and steel industries, which with one third of all industrial employment today still dominate the Ruhr economy (Hay and Wegener, 1985). Based on the large coal deposits in the area, industrialisation in the Ruhr region started in the 1830s and transformed this once rural region in less than a century to one of the largest industrial areas in the world with a highly diversified economic structure centred around coal mining and steel production. With the advent of cheaper and more convenient forms of energy, the demand for coal started to decline in the 1960s with the result that employment in the region's mining industry has dropped from its peak of 470,000 in the 1950s to less than 100,000 today. During the same period, the world-wide decline in demand for steel and steel products caused employment in the region's steel industry to drop from its peak of 200,000 in the 1960s to 110,000 today.

The impacts on the rest of the Ruhr economy have been severe: total employment in the region declined from 2.4 million in the 1960s to 2.1 million today and is expected to continue to decline (see Figure 2.2). What makes the losses of jobs in the traditional industries so serious is that they are only partly offset by new jobs in the service sector: between 1970 and 1987 service-sector jobs increased by only 30 percent compared with 42 percent nationwide. Service jobs today account for 59.4 percent of all jobs compared with 60.2 percent in the whole of western Germany; however, this 'tertiarisation' is only due to the rapid decline of mining and manufacturing jobs.

As a consequence, the unemployment rate in the Ruhr in the 1980s rose to 15 percent of the labour force and has since always stayed significantly higher than the national average. Unemployment would have been even higher if there had not been massive outmigration. To a large extent this outmigration was due to foreign workers who, for lack of work opportunities, returned to their home countries in southern Europe (foreigners constitute eight percent of the region's population). However, there was also a strong migration movement to the more prosperous regions in southern Germany. Since the 1970s, there has also been a natural decline due to a drop in birth rates.

As a result of this, the population of the Ruhr declined from 5.75 million in the 1960s to 5.3 million in 1987 (see Figure 2.2), and this decline would undoubtedly continue without the new flow of immigration from former East Germany and Eastern Europe.

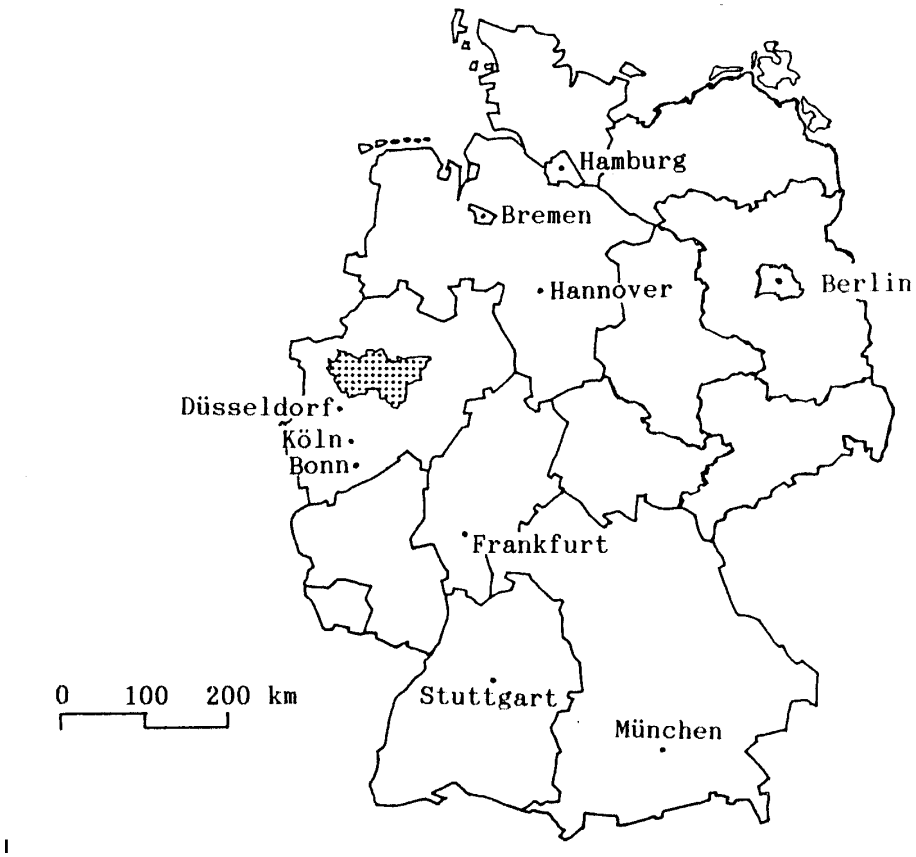

Figure 2.1. The Ruhr and its location in Germany. *The Ruhr is still the largest industrial region and urban agglomeration in the Federal Republic of Germany.*

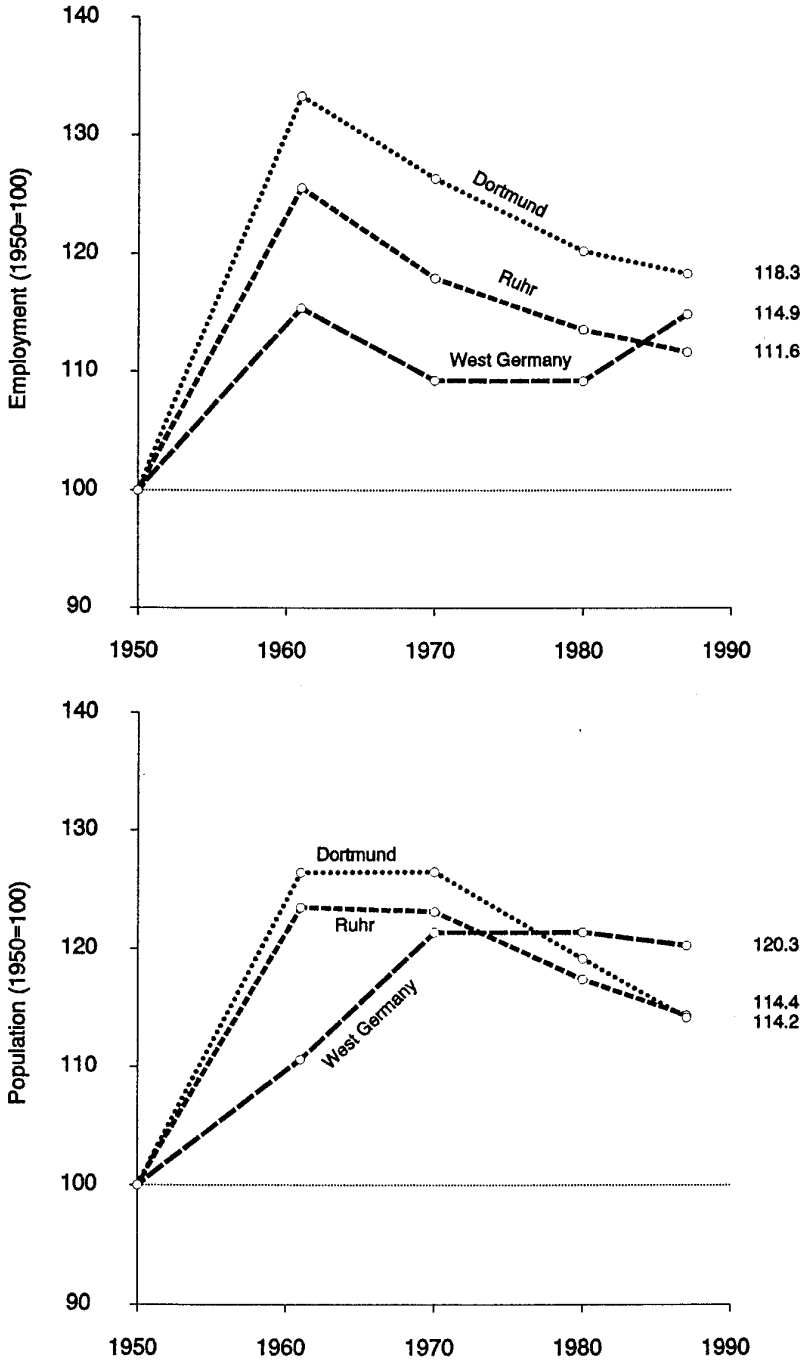

Figure 2.2. Development of employment (top) and population (bottom) in Dortmund, the Ruhr and West Germany, 1950-1987. *Total employment in the region declined from 2.4 million in the 1960s to 2.1 million in 1987 and is expected to continue to decline. From its peak of 5.75 million in the 1960s, the population of the Ruhr declined to 5.3 million.*

Dortmund

Dortmund is the most easterly of the large cities along the Ruhr valley. It developed rapidly from a small rural town in the early 19th century into a major industrial centre. Coal mining, steel making and breweries were the major industries of the city. Of these coal mining disappeared in 1987 when the last pit within the boundaries of the city closed down. Steel making in Dortmund has always been synonymous with the Hoesch corporation. After its amalgamation with the Dortmund-Hörder Hüttenunion in 1966, Hoesch had a workforce of nearly 40,000 workers in its three steel works in the city. Today one of these three has been closed down and the second will be closed soon. In the long term there will be between 5,000 and 7,000 workers left in the last one, which, however, will be heavily modernised. The recent takeover of Hoesch by the Krupp corporation marks the end of Dortmund's role as a leading steel city.

It is, therefore, not surprising that most economic indicators for Dortmund are no better than for the Ruhr as a whole. From its maximum of 300,000 in the 1960s, total employment in the city dropped to 233,000 in 1985 and has only recently recovered to 260,000 (see Figure 2.2). In that period, the city lost 90,000 jobs in non-service industries, but gained only 50,000 new service jobs. Between 1980 and 1985 even employment in the service sector declined and unemployment in the city rose to 18 percent. Only the last years have brought a moderate growth in service employment, with employment in manufacturing continuing to decline.

Dortmund's population development reflects its economic difficulties. From its maximum population of 660,000 in the 1960s, it declined to 570,000 in 1985 and has only recently increased to 600,000 because of massive immigration before and after German unification (see Figure 2.2). During the 1980s half of the decline was due to employment-related long-distance outmigration, partly by foreign workers returning home, partly by outmigration to more prosperous southern regions in Germany, and the remaining half to natural decline and suburbanisation. Compared with its former size and importance, the city is a mere shadow of its past.

The Rise of the Industrial City

Dortmund was founded in the 9th century as an imperial castle at a crossroads of the *Hellweg*, the important trade route linking the Rhine cities with eastern Europe and the Baltic Sea. During the Middle Ages it prospered as a trading centre and principal member of the Hanseatic League until the collapse of this early European trade network under competition from British and Dutch merchant ships in the late 15th century. The devastations of the 30 Years War completed the decline of the once powerful city. By 1815, when Dortmund became a part of Prussia following the Napoleonic wars, its population of 10,000 had been reduced to 4,000.

The city at this time must have been a curious sight. Within the vast expanse of its medieval fortifications only two main roads were lined with houses, and apart from the towering churches the rest of the medieval city was used for gardens and pastures (von Petz, 1991). However, this sleepy peace did not last long.

When in the early 19th century the demand for iron for bridges, ships, industrial machinery and later railways grew rapidly, the city started a second life. Within a few decades Dortmund became one of the continent's most dynamic industrial centres. Coal from the deposits in the Ruhr valley to the south of the city and iron ore found in the adjacent Siegerland and Sauerland hills established the basis for its dominant position as a centre of steel production. With the Hoesch family the city had its dynasty of industrial entrepreneurs whose furnaces and steel mills still dominate the cityscape today, although local iron ore has long been replaced by imports. Dortmund also became a centre of metal processing and breweries and an important transport node.

The growth of the city was spectacular. In 1850, the area which is now Dortmund had a population of 40,000. Only sixty years later, before World War I, it was a metropolis of nearly 500,000 people (though still divided into several smaller municipalities) employing a work-force of 120,000. In between there were two successive periods of rapid expansion interrupted by the economic crises of the 1870s (the 'founders' crash').

The first growth period was linked to technological change in the mining industry: the introduction of deep-level mining (below ground water) made possible by steam-driven water pumps facilitating the establishment of much larger mines with several hundreds of miners. The second growth period of the 1880s and 1890s was due to the expansion of the iron and steel industries benefiting from the quickly growing demand for steel products in construction, transport and for arms. In both periods much of the population growth consisted of immigrants both from the rural countryside and from Eastern Prussia and Upper Silesia, which gave the Ruhr its distinctly Polish ethnic flavour still traceable today.

During this process, coal mining moved north closer to the city centre (cf. Hay and Wegener, 1985). The Ruhr coalfield comprises five main basins with varying types of coal, but all of high quality. The first mining was located in the hilly areas on both sides of the Ruhr river, where the coal seams came close to the surface. However, the major geological feature is that the seams dip to the north so that as they were mined the workings became deeper and deeper.

Technological developments in the coal mining industry kept pace with the increasing depth and difficulty of extraction and output per worker has increased over five times since 1850. At the same time, the number of mines has fallen dramatically: from 281 in 1860 to 22 today; and so has the number of miners: from 470,000 to 99,000. Absolute output has fallen more slowly from a peak of 130 million tonnes per year in 1940 to 55 million tonnes today.

Coal mining and steel production had a profound impact on the settlement structure of the region. With the opening of the first large coal mines in Dortmund around 1850, the sudden influx of labour necessitated hastily constructed, cheap housing. This tended to be located around the pits rather than in the existing settlements, so that an unplanned mixture of mines, mining infrastructure, spoil tips and miners' housing settlements ('*Zechenkolonien*') developed. It is characteristic of this early period of urban development in the Ruhr that transport infrastructure such as canals and railways was built to meet the needs of industry, if not by industry itself. The result is the maze of industrial railways criss-crossing large parts of Dortmund still today (see Figure 2.3). Though many of them have now been abandoned, these railways, most of them built on high dams with infrequent and narrow underpasses, form severe barriers between the pockets of huddled workers' housing they divide. Figures 2.4 and 2.5 show the evolution of the built-up area within the present city limits.

In 1860 development had hardly exceeded the medieval city. The first mines appeared to the south of the city centre. In 1847 the first railway station was opened just north of the still existing city walls, and this locational decision has influenced the spatial development of Dortmund ever since. Now the fields to the north of the city became favourable industrial locations, and it is here that the first steel mills were established: the predecessors of the *Union* and *Westfalenhütte* plants of the Hoesch company. Between them in the 1850s and 1860 workers' housing consisting of three or four-storey tenement blocks was erected: the *Nordstadt* (North City), which will play a role later in this book. Between 1860 and 1874 the medieval walls around the city centre were razed.

In the map for 1886 a satellite town appears to the south-west of the city: Hörde, where as early as in 1841 the *Hermannshütte* had been established, the predecessor of the Hoesch company's present *Phoenix* steel works (Hörde was not incorporated into Dortmund until 1928). The first zoning plan for Dortmund of 1908 established the social geography of the city still valid today: the old city and the southern suburbs were zoned as 'factory-free' and medium or low-density residential areas, whereas the Nordstadt was classified as a 'factory zone' in which besides housing all kinds of industrial activities were permitted (Walz, 1989).

Through this distinction, the haphazard mixture of incompatible land uses characteristic of the industrial cities of the Ruhr ('*Gemengelage*') was legitimised. In addition, the social division between the low-density, attractive and affluent residential areas of the south and the working class character of the northern parts of the city was introduced which has remained in effect until today.

Between the wars, Dortmund went through a deep economic depression followed by hectic industrial expansion for the National Socialists' rearmament of Germany. In 1929, after incorporations in 1914 and 1918, the city incorporated a wide ring of formerly independent municipalities and became one of the largest cities in terms of area (fourth) and population (eighth) in Germany.

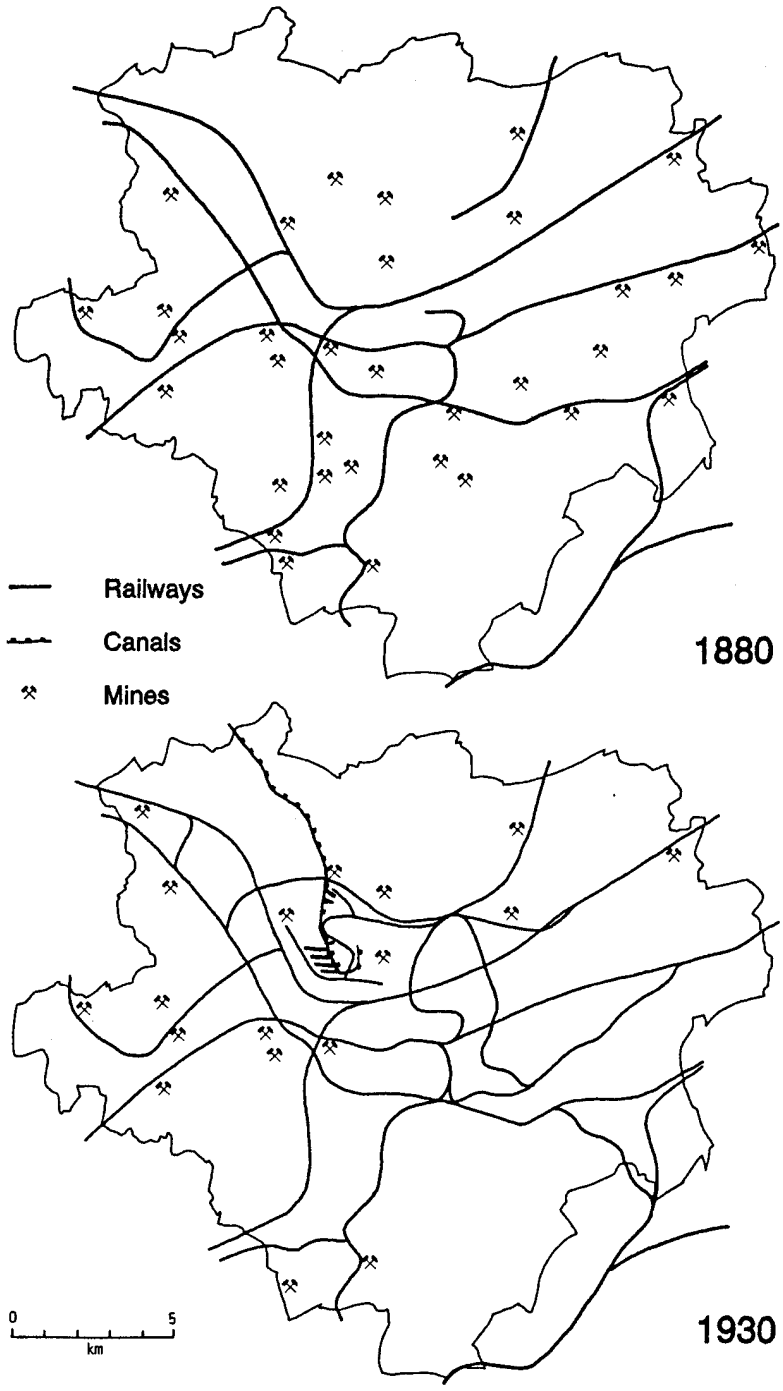

Figure 2.3. The evolution of railways in Dortmund, 1880-1930. *It is characteristic of the early period of urban development in the Ruhr that transport infrastructure such as canals and railways was built to meet the needs of industry, if not by industry itself. The result is the maze of industrial railways criss-crossing large parts of Dortmund still today. The map also shows the shift of coal mining from south to north and the Dortmund-Ems Canal and port opened in 1899 (Source: Leushacke and Bleja, 1984).*

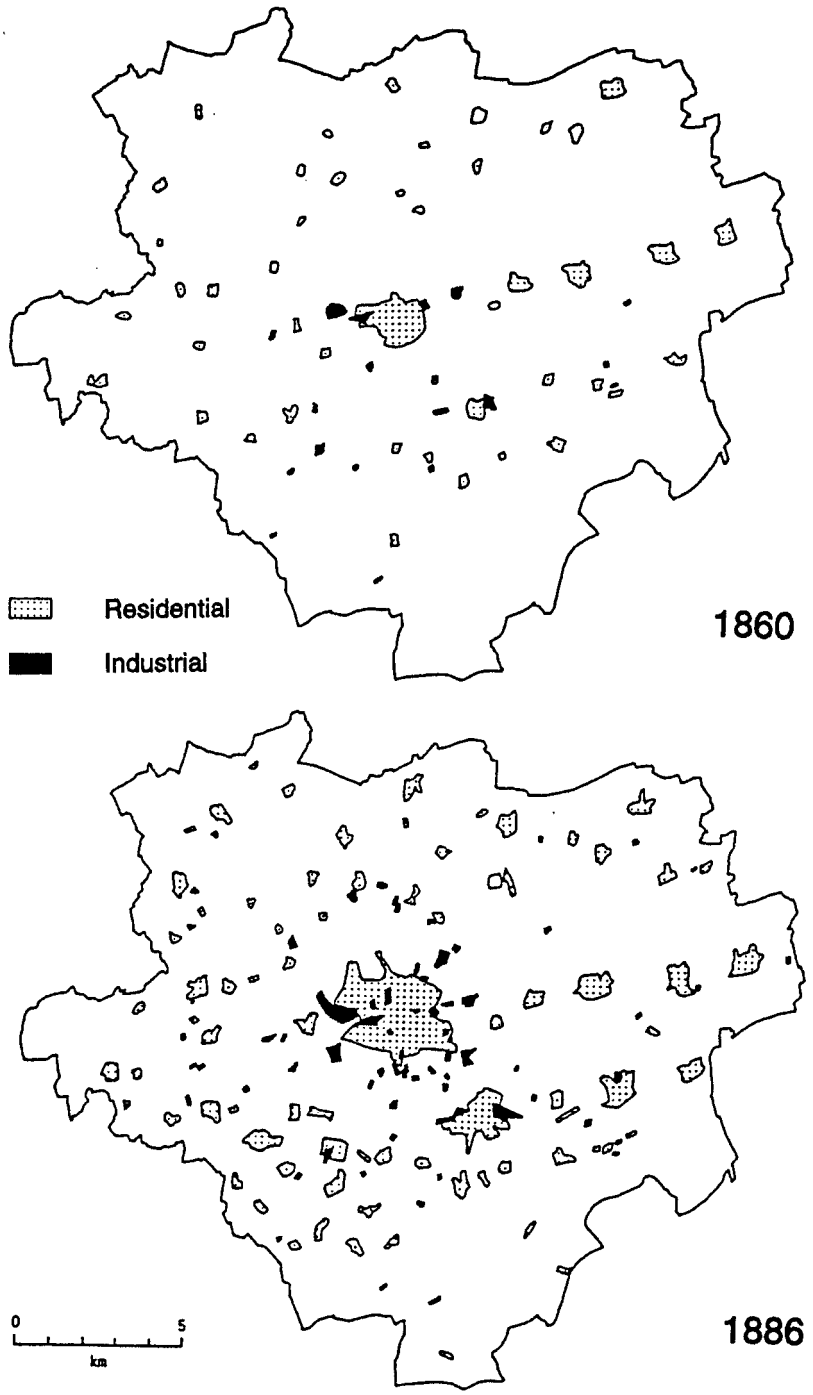

Figure 2.4. Evolution of the built-up area in Dortmund, 1860-1886. *In 1860 development had hardly exceeded the medieval city. The first mines appeared to the south of the city centre. In 1886 a satellite town appeared to the south-west of the city: Hörde, where as early as in 1841 the Hermannshütte had been established, the predecessor of the Hoesch company's Phoenix steel works (Source: Leushacke and Bleja, 1984).*

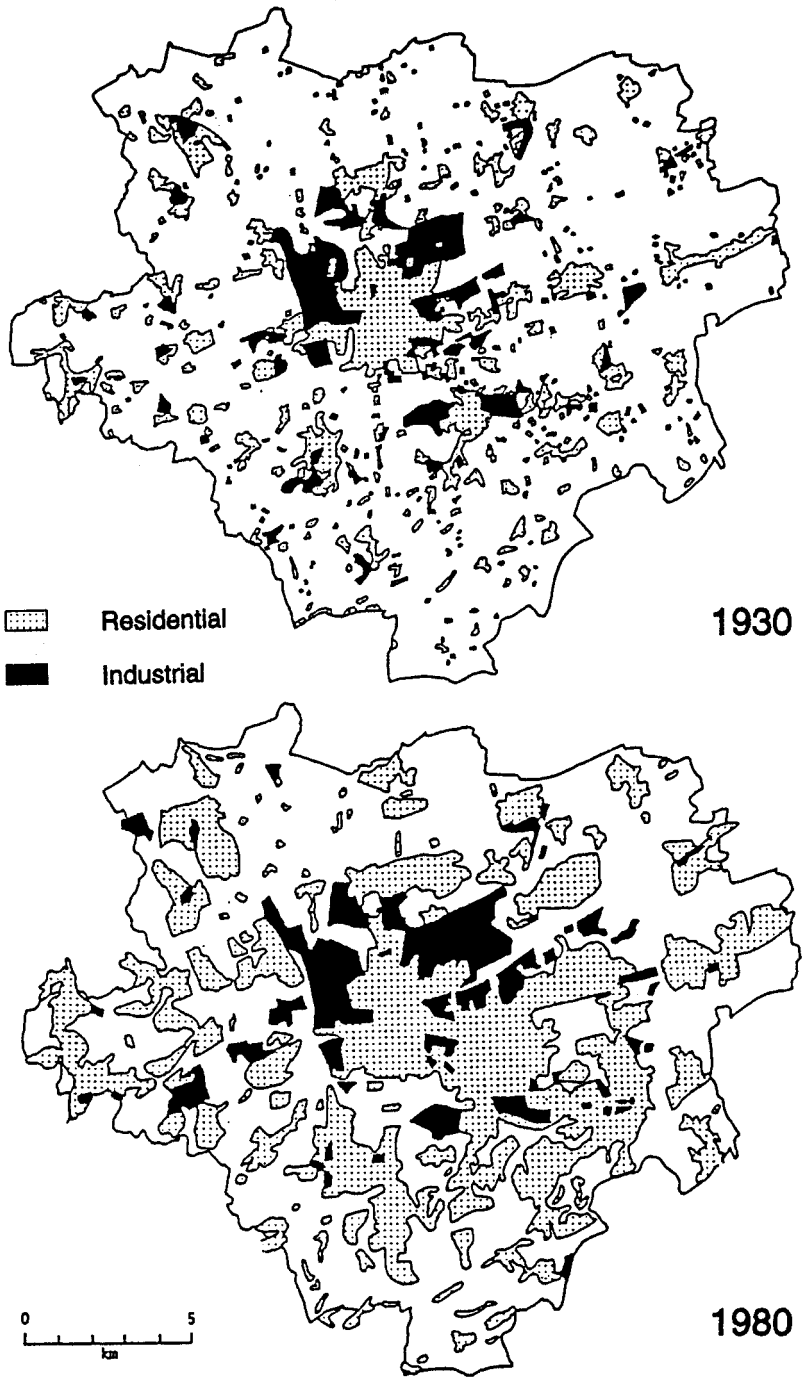

Figure 2.5. Evolution of the built-up are in Dortmund, 1839-1980. *The map for 1930 shows the industrial areas around the city centre considerably expanded and the dispersed residential settlements partly growing together to form clusters of housing areas. In 1980 wide areas of the city are covered by contiguous residential settlements (Source: Leushacke and Bleja, 1984).*

The map for 1930 (Figure 2.5) shows the industrial areas around the city centre considerably expanded and the dispersed residential settlements partly growing together to form clusters of housing areas. However, it is still clearly visible why Dortmund used to be described as a 'spacious, decentralised industrial metropolis' (von Petz, 1989).

The concept of the polycentric metropolis has been a recurrent theme of urban planning in Dortmund ever since. Ambitious plans to separate industrial from residential land, to restrict housing densities in the central area, to develop a network of parks and green spaces, encourage decentralised development in the incorporated municipalities and improve the rail and road network were not implemented because of the Nazis coming to power.

The new rulers commissioned a new plan, which featured elaborate road and rail networks and the monumental axis mandatory for the period, but which retained the designation of the northern part of the city for factories and workers' housing, the city centre for services and the south for middle-class housing (von Petz, 1991). None of these proposals were implemented because of the war.

Because of its strategic importance, damage to the settlement and industrial structure of Dortmund during World War II was particularly extensive with many of the basic industries put out of action and the central part of the city virtually obliterated (85 percent of the centre was destroyed).

Final Boom and First Decline

The post-war years brought a final period of growth and prosperity to Dortmund's mining and steel industry. The reconstruction of Germany and the Korean War pushed the demand for coal and steel beyond pre-war levels. The miner and the steel worker, the figureheads of the German 'economic miracle', were the most highly-paid group of workers in the country and the Ruhr the most prosperous and fastest growing region in Germany, and everyone believed that this growth would continue forever.

Under these conditions, post-war urban planning was planning for growth. The large housing demand from people who had fled the city during the bombing and now returned, from prisoners of war returning from camps and refugees from East Germany led to massive housing construction. In the 1950s, this was largely reconstruction and so occurred mainly in the bombed inner city; only in the 1960s did it spread to the suburbs where it filled gaps between the existing built-up areas. The map for 1980 (Figure 2.5) shows large parts of the city covered by contiguous residential settlements. Nevertheless, even today Dortmund boasts of having more than 50 percent of open space within its territory.

The central city was rebuilt following the old street pattern, but on a much coarser scale with many of the narrow roads abolished and the main roads widened to accommodate modern traffic, and with a pedestrian precinct along the *Hellweg*, the historical thoroughfare. This gave Dortmund a strong centre well suited for large-volume department stores and office buildings, but lacking the charm of other historical cities which retained the human scale of their medieval centre, even where most of the buildings are in fact new.

Despite the actual concentration of the settlement structure, the official urban planning policy continued to pursue the idea of the decentralised industrial city already formulated before the war. The first land-use plan (*Flächennutzungsplan*) following the new Planning Act (*Bundesbaugesetz*) of 1960, issued in 1964, demonstrated the continuity between post-war and pre-war planning in West Germany. It reconfirmed the south-north divide through the city by placing a large public workers' housing area north-east of the *Westfalenhütte* steel works and paid tribute to the ideal of the 'car-efficient' (*'autogerechte'*) city by providing for two north-south and two east-west motorways tangential to the city centre cutting through the entire municipal territory.

However, the plan turned out to be oversized. By the late 1950s the competition from oil and imported coal had already turned the coal mining industry in the Ruhr into decline. Between 1958 and 1964, 35 mines with a capacity of 12 million tonnes per year and employing 53,000 miners were closed down (Schlieper, 1986), six of them in Dortmund (Harenberg, 1987). Despite mass rallies by miners, the Federal government refused to curb energy imports to protect the domestic coal mining industry, but agreed to cooperate with the state government of North-Rhine Westphalia in a major effort to modernise the Ruhr economy and to overcome its dependency on coal mining. Federal and state governments, labour unions and mining companies worked together to cushion the social impact of pit closures and mass redundancies, improve the productivity of the remaining mines and attract non-mining industries to the Ruhr. The most spectacular success in this direction was the decision of General Motors (Opel) to build a large new car assembly plant in Bochum in 1962.

However, it soon became obvious that the industrial heritage of the region was a serious obstacle to the diversification of the Ruhr economy. The most important factors of that heritage were identified as:

- *An outdated infrastructure*: Roads, railways and canals in the Ruhr region were mostly built during the period of rapid industrialisation and primarily served the purpose of heavy industry. As most freight traffic in Germany had moved onto the roads, the canals in the Ruhr were underutilised but expensive to maintain. So were the many industrial railways which cut through the region on high dams or viaducts, but were unsuitable for passenger transport because they did not serve the population centres.

- *Lack of educational facilities*: Traditionally, the Ruhr had no institutes of higher education - for well-known reasons: the Prussian kings did not want knowledgeable workers for fear of revolution. Consequently; the only institute of technology in the western provinces of Prussia was established not in the rising industrial Ruhr region, but in far-away Aachen in 1870.

- *A devastated environment*: More than a century of industrial activity had thoroughly exhausted the natural resources of the Ruhr region. Rivers were polluted, the soil contaminated, industrial emissions, in particular of sulphur dioxide and dust, were extraordinary. The image of the Ruhr as the 'black country' throughout the rest of West Germany was notoriously bad.

Since these problems fell partly within the responsibility of the Federal government, the first period of revitalising strategies for the Ruhr was largely determined by strong government initiatives, with most of the money coming from Bonn.

To understand this, it is important to know that due to the federal organisation of Germany, there is no national planning in a strict sense in the Federal Republic. While regional planning is the responsibility of the federal states, the role of the Federal government is restricted to monitoring regional development and coordinating the planning activities of the federal states. However, national railways, highways and waterways are in the Federal domain, as are the construction of state universities and environmental legislation. Consequently; it was in these fields that the CDU (right of centre) Federal government in the 1960s started to assist the Ruhr - hoping to avoid direct subsidies to the mining industry, which it abhorred as a violation of free market principles.

With this Federal support, the state government of North-Rhine Westphalia in 1968 announced the *Entwicklungsprogramm Ruhr* (Ruhr Development Programme), a DM 25 billion five-year programme to create new jobs, improve the transport network, stimulate housing construction, revitalise inner cities and reduce industrial air pollution.

The programme addressed the three problem areas indicated above with the following policies:

Transport

- The Ruhr was given preferential treatment in plans for expanding the Federal motorway (*'Autobahn'*) system. A huge grid of five east-west and six north-south autobahns was to provide the region with an efficient intraregional transport network linking it to all parts of the country and western Europe. Today this system of motorways has been largely completed (see Figure 2.6), with the exception of a few links which were to cut through existing residential areas, and therefore met with heavy local opposition (see Figure 2.11).

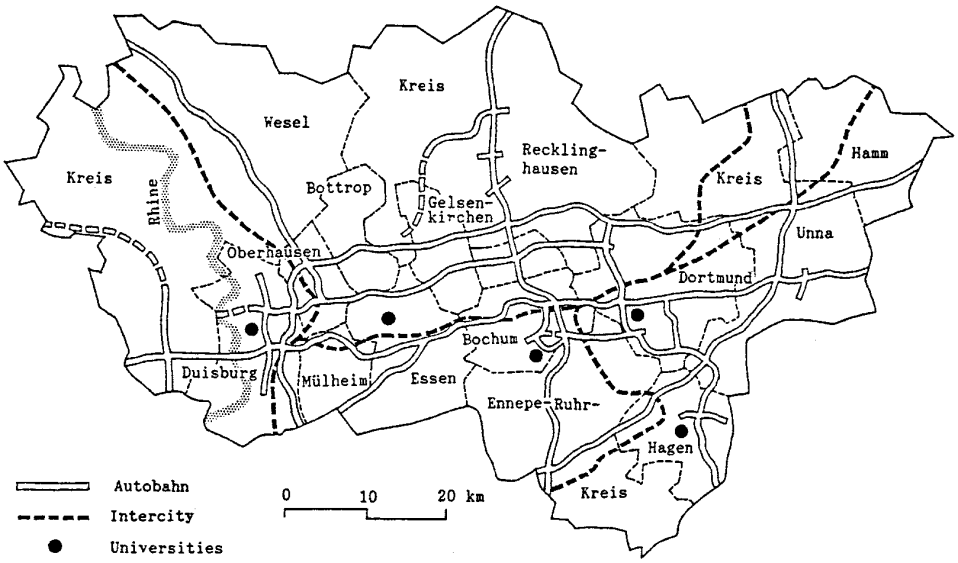

Figure 2.6. Autobahns, Intercity lines and universities in the Ruhr. *A huge grid of five east-west and six north-south autobahns was to provide the region with an efficient intraregional transport network linking it to all parts of the country and western Europe. Three of the new high-speed, high-comfort Intercity lines of the German Railways (Deutsche Bundesbahn), Cologne-Düsseldorf-Hamburg, Cologne-Wuppertal-Hamburg and Cologne-Hanover, were to pass through the Ruhr meeting at a common node in Dortmund. The Intercity service has proved to be one of the major locational advantages of the region.*

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- The region was to get a modern, intraregional system of commuter railways (*S-Bahn*) operated by the *Deutsche Bundesbahn*. In addition, subsidies were offered to the cities to transform their tramway systems into - partly underground - light-rail transit (*'Stadtbahn'*) systems. The integrated network of public rail transport thus created, which is now almost complete, provides good accessibility throughout the region. However, due to growing car ownership, it is insufficiently utilised and produces large deficits, a severe burden for the cities.

- The waterways serving the region, mostly canals built more than a hundred years ago for the transport of iron ore, and the canal ports were to be deepened and modernised to accommodate the 3000 tonnes freight barges used throughout Europe.

Universities

- The Federal government agreed to finance five new universities planned by the state government in the Ruhr: Duisburg, Essen, Bochum, Dortmund and Hagen (see Figure 2.6). These five universities, which (together with some smaller colleges) today have a student enrolment of more than 100,000, may have been the most effective of all government measures. They have attracted a large number of students from other parts of the country and abroad, and have added an intellectual component to the predominantly working-class population of their host cities. More importantly, as will be described later, they have greatly contributed to the economic transformation of the region.

Environment

- As early as in the election campaign of 1961, "a blue sky over the Ruhr" was an important issue. Subsidies were given to collieries, steel works and power stations to reduce the emissions they produced. In 1974, the Federal Control of Pollution Act (*Bundesimmissionsschutzgesetz*) for the first time set rigid standards for air, water and ground pollution. Today the environmental situation in the Ruhr has much improved, though in part only because the worst polluters went out of business. However, the negative image of the region is still strong and hard to dispel.

Other policies in the *Entwicklungsprogramm Ruhr* included a DM 90 million programme to improve inner-city housing and a programme to establish a region-wide network of parks with playgrounds and swimming pools to overcome the notorious lack of recreation facilities in the Ruhr Area.

Planning for the Industrial City

Local governments during this period of economic crisis remained largely passive. Economic development had not yet become a major area of local-policy making as it is today, so if the local economy was ailing, cities looked to Düsseldorf (the state capital) or Bonn for support. In Dortmund there was the feeling that Dortmund's time as a mining city was coming to an end, but that there would always be the iron and steel industry as the cornerstone of the city's manufacturing base. Consequently; the task of planning was to prepare Dortmund for its future as a modern industrial city.

The 1970s were a time of long-range comprehensive planning in German cities, and so Dortmund, too, decided to embark on a major effort of stock-taking and looking ahead by setting up a comprehensive urban development programme for the period up to the year 1990. The *Entwicklungsprogramm Dortmund 1990* (Stadt Dortmund, 1976) realistically envisaged further losses of employment and population. Ironically, the population forecast of 570,000 for 1990, criticised by many (including this author) as far too optimistic, has in fact turned out as too low due to the explosive rise in immigration before the unification of Germany and the collapse of the socialist states of Eastern Europe.

The document, one of the most comprehensive of comparable programmes developed in German cities during those years, provided local decision-makers with a thorough inventory of assets, problems, potentials and objectives in policy fields such as population, housing, economy, transport, welfare, education, sports, green space and utilities (environment was not included). Perhaps the most interesting feature of the programme is that it officially endorsed, after evaluation of six other competing models, the *polycentric model* as the *Leitbild* of future spatial development in the region (Figures 2.7. and 2.8).

The evaluation ranked the seven spatial models in the order shown in Figure 2.7, from worst to best (Stadt Dortmund, 1972):

(1) The *Ring Model* consists of the central business district in the core city surrounded by a green belt and a suburban ring of secondary centres and an outer ring of 'urban villages'.

(2) The *Dislocated Model* promotes a dispersed settlement structure, with the CBD as one among many equal small centres based on the large number of small settlement cores in the region.

(3) The *Star Model* is based on development axes along historical trunk roads fanning out from the historical city centre.

(4) The *Linear Model* consists of three parallel linear cities in east-west direction, the middle one of which, containing the city centre, follows the historic *Hellweg*.

(5) The *Grid Model* is a directionally neutral grid of development axes, partly coinciding with the new motorways, with multiple centres at the intersections of the axes.

(6) The *Comb Model* has a main development axis along the *Hellweg* and minor axes branching out from it at regular intervals.

(7) The *Polycentric Model* retains the leading role of the city centre and the core city, but promotes decentralisation by fostering district centres.

The Polycentric Model (Figure 2.8) was selected because it was judged to be most suited to provide the population with goods and services and strengthen the role of Dortmund in the central-place system of North-Rhine Westphalia (Stadt Dortmund, 1976). However, it also happened to be the model which most closely resembled the actual development in the region.

North-Rhine Westphalia's central-place system is laid down in the State Development Plan (*Landesentwicklungsplan*). This plan, published in 1976, classifies Dortmund as a highest-level centre ('*Oberzentrum*') serving a region of between one and two million population, connected by 'development axes' with its eastern and western and southern and northern neighbours (Figure 2.9). It is worth noting the east-west bias of the spatial structure of the Ruhr and the peculiar position of its major cities *between* two axes representing two major east-west motorways (Nordrhein-Westfalen, 1977).

The *Landesentwicklungsplan* today is only of historical interest. If at all, the regional centres play a minor role when cities lobby for funds for improving or expanding their central facilities. However, its major objective, the concentration of development along the development axes and in particular around public transport nodes, could not be achieved against the overpowering suburbanisation trend caused by the incessant rise in car ownership. Nevertheless, its separate plans on the protection of open spaces and greenbelts, on airports and on large-scale industrial locations have, to a certain extent, proved effective in restricting development in ecologically sensitive areas.

In addition, the State Development Plan, in conjunction with the State Development Programme (last updated in 1984), at least formally acts as the framework for all plans of lower-level territorial units. North-Rhine Westphalia has a three-tier system of administrative districts, counties and municipalities (with larger cities acting as counties). The State Planning Law (*Landesplanungsgesetz*) requires that for each district a regional development plan (*Gebietsentwicklungsplan*), usually subdivided into a number of subregional plans, is compiled by the district planning office in cooperation with the affected counties and/or municipalities, and that all local land-use plans are approved by the district only if they comply with the *Gebietsentwicklungsplan*. However, this three-level system of planning documents was still under preparation when the next economic crisis hit the cities of the Ruhr Area.

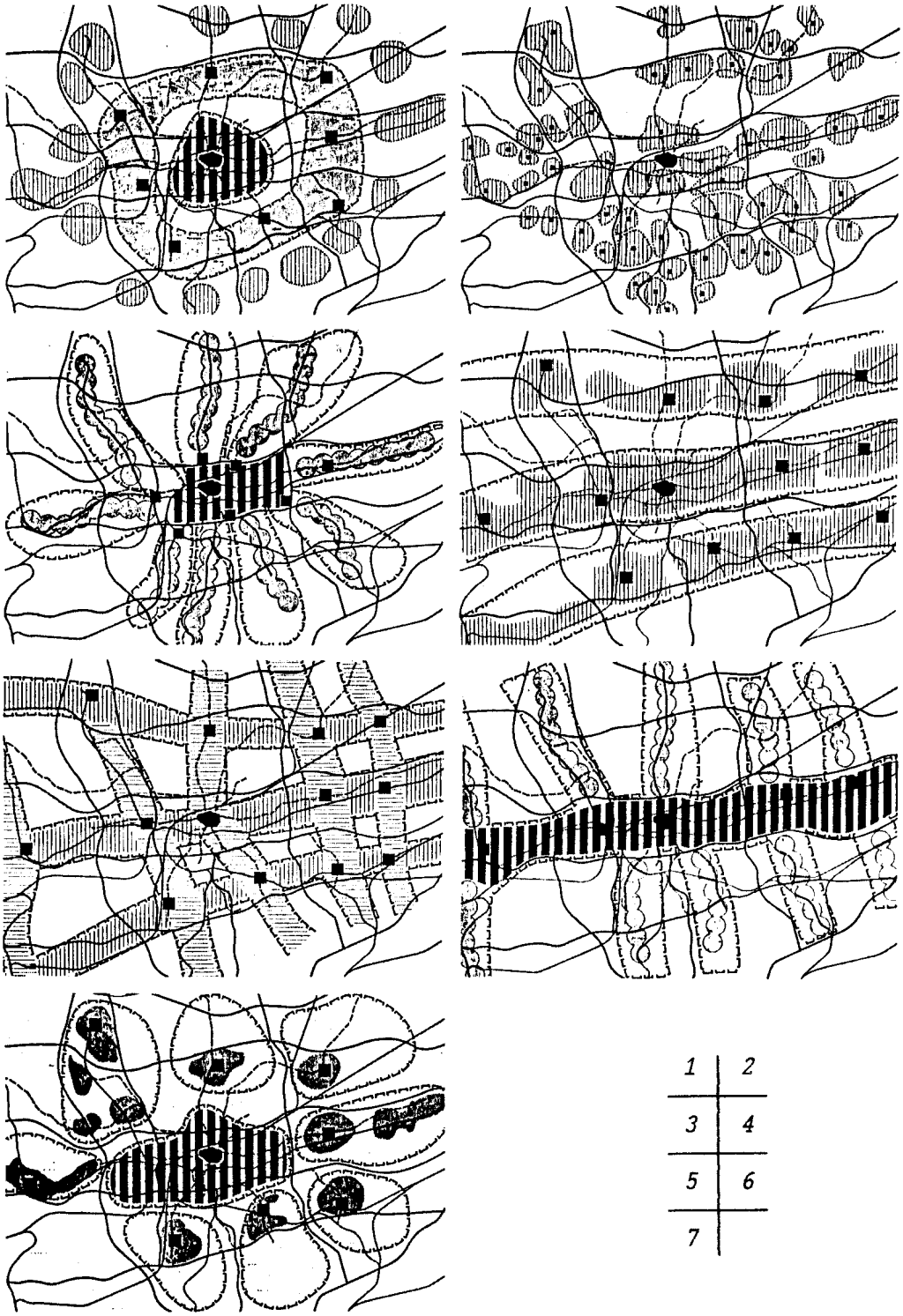

Figure 2.7. Models of spatial development in the Dortmund region. *In 1972, the city planning department evaluated seven models of urban structure: (1) Ring Model, (2) Dislocated Model, (3) Star Model, (4) Linear Model, (4) Grid Model, (6) Comb Model and (7) Polycentric Model (Source: Stadt Dortmund, 1972).*

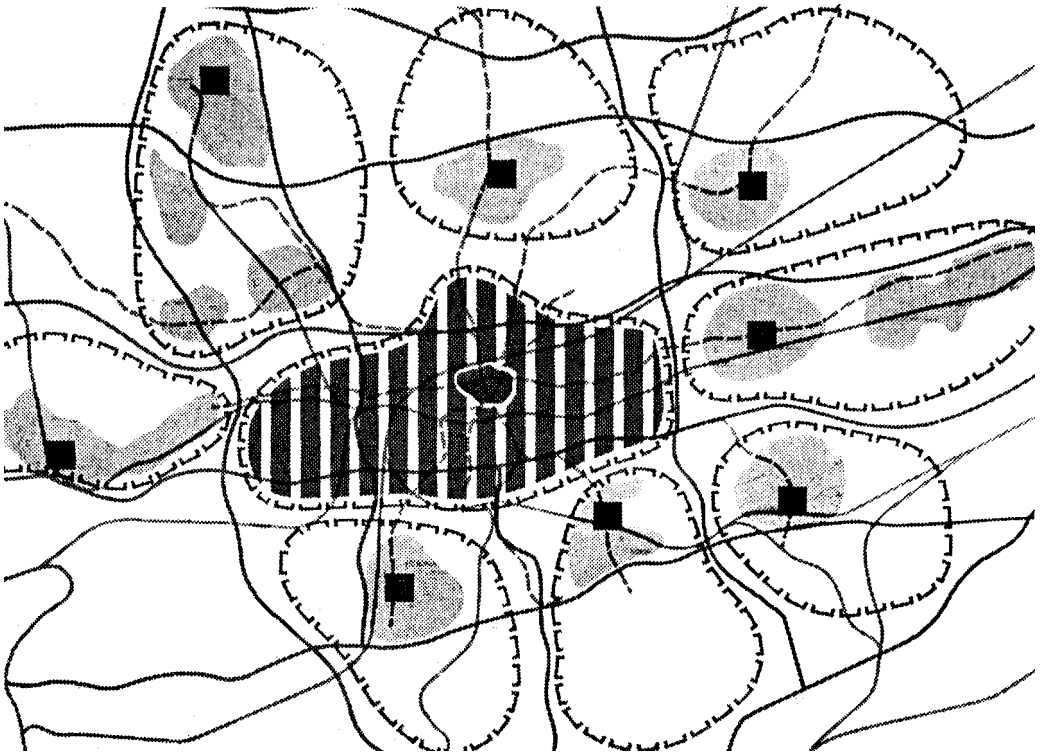

Figure 2.8. The Polycentric Model of spatial development for the Dortmund region. *The Polycentric Model retains the leading role of the city centre and the core city, but promotes decentralisation by fostering district centres. The Polycentric Model was selected because it was judged to be most suited to provide the population with goods and services and to strengthen the regional role of Dortmund as a highest-level centre in the central-place system of Nordrhein-Westfalen (Source: Stadt Dortmund, 1972).*

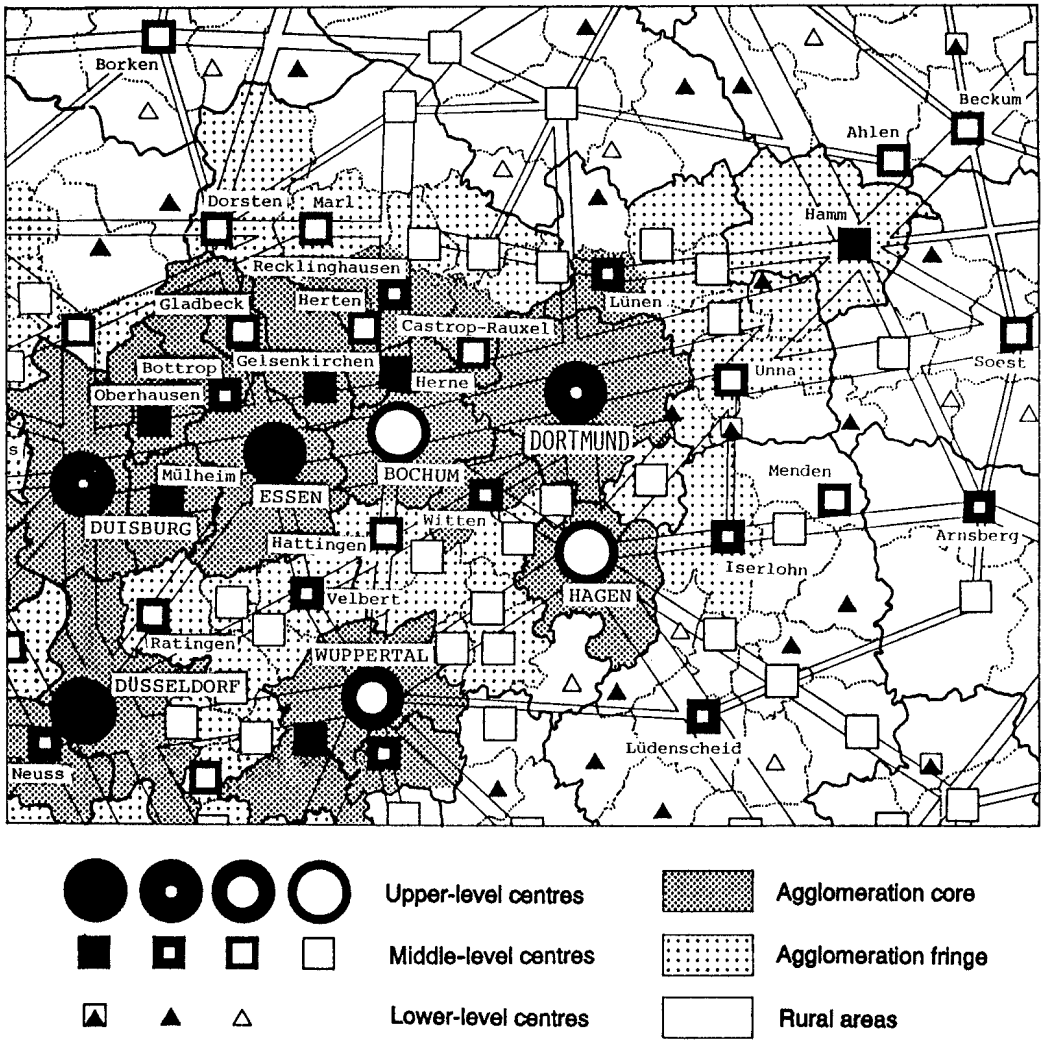

Figure 2.9. The Ruhr in the State Development Plan of North-Rhine Westphalia. *The central-place system of the state of North-Rhine Westphalia classifies Dortmund as a highest-level centre ('Oberzentrum') serving a region of between one and two million population, connected by 'development axes' with its eastern and western and southern and northern neighbours. Note the east-west bias of the spatial structure of the Ruhr and the peculiar position of its major cities between two axes representing two major east-west motorways (Source: Nordrhein-Westfalen, 1977).*

The Steel Crisis

In the mid-1970s the steel industry joined the ailing mining industry in the global recession following the energy crisis. World-wide overproduction of steel, rising competition from steel makers in newly industrialising countries and declining demand by the car and construction industries brought steel production in the Ruhr down by one third. After a small upswing in 1980, the regional economy plunged into its worst crisis. Between 1980 and 1986 total employment declined by 12 percent, non-service employment by 26 percent and even employment in the service sector, instead of compensating for the loss in manufacturing, dropped by one percent. In 1980, the Hoesch company was close to bankruptcy after suffering severe losses and the plan to erect a new steel work on a large site north-west of the city was withdrawn under heavy public protest; in Dortmund 10,000 jobs in the steel industry were at stake.

There was a general feeling of despair. It was becoming obvious that the decline in demand for coal and steel was not a temporary phenomenon but permanent and required a fundamental restructuring of the Ruhr economy. Clearly the main cause of the economic difficulties facing industrial cities like Dortmund was that their major industries were among those suffering most from structural change in the economy. However, it was felt that there were other factors related to their industrial past which made it more difficult for them to restructure their economies in response to new technological challenges and market demands.

Yet compared with the coal crisis, this time the causes were different. Fifteen years earlier, transport, education and the environment were seen as the main obstacles to structural change in the economy, but in these respects the region had made enormous progress. Now other factors were discussed as inhibiting the restructuring of the region into a modern industrial region:

- *An obsolete land-use system*: During the industrialisation period the cities of the Ruhr grew almost without any planning control. Collieries, factories, waste tips and workers' housing, hastily erected, formed a disorganised, but rigid patchwork of incompatible land uses and scattered property rights. Many former industrial sites turned out to be heavily contaminated (*'Altlasten'*) and could be reclaimed and cleaned up only at great expense if at all (Kahnert, 1987). Housing areas in mixed-use areas (*'Gemengelagen'*) close to noisy and polluting factories were less and less acceptable on the housing market.

- *Lack of urban ambience*: The Ruhr cities were never elegant or charming. The few historic buildings that survived the industrialisation period were destroyed by wartime bombing. After the war, unimaginative, commercialised architecture prevailed in the city centres largely dominated by the car, while urban sprawl made the suburbs virtually indistinguishable from each other.

- *Lack of a regional government*: For historical reasons the region never had a unified regional government. The Ruhr consisted of 53 autonomous municipalities organised in 15 counties under three district governments, all of which were located outside the region (see Figure 2.10). In particular the large core cities of the Ruhr, rather than working together, jealously pursued their own interests more often than not against each other. This meant that for any project regarding more than one municipality, extensive and time-consuming negotiations and coordination procedures were required. Ironically, the only public agency in charge of planning for the whole Ruhr, the *Siedlungsverband Ruhrkohlenbezirk*, founded in 1920, was in 1975 renamed *Kommunalverband Ruhrgebiet* (KVR) and deprived of its planning functions.

- *Traditional management structures*: Pampered by long periods of stable demand for its products and limited competition through stable government contracts and subsidies, both corporate management and labour unions in the Ruhr's industry had developed attitudes and patterns of political behaviour not conducive to innovation and change. In periods of slackened demand for coal and steel, management quickly called for government subsidies, while labour representatives insisted on the privileges and higher wages granted to their members in better times. Some companies actively obstructed economic change by withholding industrial land no longer used from the market.

There was another difference between the two crises. In the coal crisis, the conservative Federal government assisted the Ruhr, even though most policies initiated by the Christian Democrats were carried out by the Social Democrats in the 1970s. When the CDU returned to power in 1979, they were not willing to do very much more for the once again depressed region with its majority of Social Democrat voters.

Consequently; the Social Democrat state government of North-Rhine Westphalia was left with the responsibility for the Ruhr. Its *Aktionsprogramm Ruhr* (Ruhr Action Programme) of 1979 for the first time focused on the need to restructure the Ruhr economy towards new technologies and products rather than on stabilising the existing industrial structure. Although a large part of the DM 7 billion programme was directed at reducing unemployment by job creation and training programmes, the programme emphasised the importance of research and development in new technologies and products by subsidising university and private sector R&D institutes. Later the *Aktionsprogramm* was complemented by the *Zukunftsinitiative Montanregionen* (Future Initiative for Mining Regions), a programme to support technology-oriented R&D projects and to finance the modernisation of R&D infrastructure in the Ruhr. Yet it was all too obvious that government programmes could only give first incentives for the fundamental restructuring of the region's economy, which was required. In the final analysis the cities and regions most affected by the crisis had to rely on their own initiatives and resources.

Figure 2.10. Administrative boundaries in the Ruhr. *For historical reasons the Ruhr area never had a unified regional government. Even today it consists of 53 autonomous municipalities organised in 15 counties under three district governments, all of which are located outside the region. This means that for most project initiatives extensive and time-consuming negotiations and coordination procedures are required.*

Dortmund's Strategies

This was a new experience for the cities. Although local governments in the Federal Republic enjoy a high degree of autonomy, in the past they had not seen economic development as an important part of their responsibility, except where land use and transport planning were concerned. In fact there had not been much need for promoting economic development in the days of economic prosperity. In the good times the role of the cities had been to allocate land and infrastructure. This was predominantly an administrative and civil engineering activity. Now *entrepreneurial* action was required.

Most cities responded to this new challenge by setting up new, or upgrading existing economic development departments and vastly increasing their personnel and financial resources. So did Dortmund. In 1983, the city formulated in an 'Economic Development Programme' the principal goals for its future economic development:

- to transform the local economy away from the formerly dominant coal and steel industries towards modern technology-intensive growth industries with a large proportion of small and medium-sized enterprises;
- to promote modern retail, business, administration, health care, education and cultural facilities;
- to improve the quality of the environment for living and recreation, including education and culture.

To achieve these goals, the new *Wirtschaftsförderungsamt* (Economic Development Department) of the City of Dortmund was to engage in the following activities (Hennings et al., 1987):

- developing new and reactivating vacated land for enterprises willing to locate in Dortmund;
- improving financial aid for new enterprises by better utilising existing funding programmes and developing new forms of private and public financing;
- removing infrastructure bottlenecks to attract enterprises willing to locate in Dortmund;
- developing consultancy and advisory services for new and existing enterprises.

The years since this programme was put into effect, represent a new era in Dortmund's local economic policy. The new era can be characterised as the transition from passive response to active initiative towards the economic crisis of the city. But it was also a transition towards a new style of urban management which accepted the fact that municipalities have to compete for jobs and people in a highly competitive market where innovation and flexibility are essential

Most importantly, however, it was a transition into a new style 7of cooperation between the public and private sectors. Traditionally in Dortmund the major groups of the power structure - local government, large companies, labour unions and small businesses -had pursued their own particularist interests more often than not fighting against each other, although there had also been periods of involuntary cooperation in the economic crises of the past. Now there was a consensus that only joint action by local, regional and state governments, industry, trade unions and public and semi-public agencies could solve the problems of the city. This change in the political climate was influenced by reports on similar developments in American cities (Duckworth et al., 1986), in particular by the example of Pittsburgh, which became the destination of frequent visits by politicians, journalists and scholars. The new spirit was emphatically termed the 'Dortmund Consensus' by its promoters and the media.

In the first years of implementation of the programme the following policy fields turned out to be most important (see Hennings and Kunzmann, 1990):

(1) Innovation-Oriented Local Economic Policy

These policies have the highest priority of all activities under the new economic policy. They aim at stimulating the establishment of new, or at attracting existing firms in the field of high-tech or information-based manufacturing or services, but also at supporting innovation within existing local firms. Special attention is given to the needs of small and medium-sized companies.

The University of Dortmund, which is in fact a technical university, plays an important role in this process. Its computer science and electrical, mechanical and chemical engineering departments have developed strong ties with local firms in terms of joint projects and job placement of graduates. However, the main results of the cooperation between the university and the region are the new Technology Centre (*'Technologiezentrum Dortmund'*) and Technology Park set up on a vast expanse of land adjacent to the university campus, a choice location only five kilometres from the city centre with excellent autobahn access, an S-Bahn station and an intra-campus monorail (see Figure 2.11).

The Technology Centre, opened in 1985, offers laboratory and office space for lease to firms wishing to engage in R&D in cooperation with university researchers. So far logistics, material sciences, electronics and software development have been the main fields of activity. Demand for space in the Centre soon vastly exceeded capacity, and it had already to be extended twice. Jointly financed by the Regional Development Fund of the European Community, the state of North-Rhine Westphalia, the city and local banks and industrial firms, the Technology Centre is considered to be the first successful example of a public-private partnership originating from the new 'Dortmund Consensus'.

Although the actual employment effects of the Technology Centre are small, its spin-offs for the region are substantial. It has certainly contributed much to dispelling the negative image of the region and giving it a fresh, progressive appeal. As a consequence, there is an increasing inflow of firms or subsidiaries and research laboratories of large companies wishing to locate in Dortmund.

To accommodate some of these new arrivals, an area of 37 hectares adjacent to the Technology Centre was designated as a 'Technology Park' with high architectural design and landscaping standards. Most buildings on this area have been completed, others are under construction; a further enlargement of the park is already in the planning stage. Many of the new firms moving into the Technology Park are small electronics, software or consultancy companies founded by graduates of the nearby university.

An important part in establishing and maintaining contacts between research institutions and industry in the region is played by *transfer agencies* established at the university, the local polytechnic (*Fachhochschule*) and the Chambers of Commerce and Trade.

Besides these activities directed at the private sector, the city and the university successfully lobbied for the establishment of new government-financed research facilities such as large institutes for logistics, robotics and synchrotron research. These new institutes are either part of or closely linked to the university and draw most of their research staff from among its graduates.

A special kind of innovation-oriented economic policy in Dortmund was the ingenious idea of the city to secure one of the few state licences for a gambling casino. The new Casino, much to the chagrin of local environmentalists located on one of the most scenic hills of the Ruhr valley (see Figure 2.11), has been an enormous success and is highly profitable for the city through its share of the gambling tax.

(2) Employment Initiatives

Pressed by high local unemployment and the powerful labour unions, the city has ventured into a new policy field aimed at creating job opportunities outside established firms in the so-called 'informal' sector of the local economy.

These efforts have resulted in the establishment of a number of small private companies mostly working in recycling and moving services. The city supports them by seed money from various sources, such as the EC Regional Fund or the Federal Job Creation Programme (*'ABM'*), and/or by providing them with cheap space in vacated industrial buildings. However, the results of these initiatives have so far been inconclusive. Although they have provided badly needed jobs, in general they have so far failed to establish for themselves a secure place in the market.

(3) Industrial Land Policy

Despite a growing stock of vacated former industrial land, the city finds it difficult to offer suitable and attractive sites to firms deliberating on locating or relocating in Dortmund. Among the reasons are the unwillingness of land owners, in particular of the former mining companies, to sell their property, or real or potential ground contamination (*'Altlasten'*). Moreover, former industrial land is not always accepted by the market. Most firms prefer virgin land without restrictions through adjacent land uses or existing infrastructure, ample expansion space and good highway access. However, environmental considerations and sometimes local citizen opposition prevent unlimited rezoning of agricultural land at the urban fringe for industrial use.

To resolve this dilemma common to all Ruhr cities, the state government in 1982 set up a special fund for land acquisition, regeneration and resale (*'Grundstücksfond Ruhr'*). With money from this fund, Dortmund was able to purchase more than 80 hectares of former industrial land which, after regeneration, has been made available for new or relocated firms.

(4) Transport Policy

Although, as was shown above, the Ruhr was given an efficient regional transport system in the 1960s and 1970s, several improvements to the regional transport infrastructure are still necessary. All are controversial.

As mentioned earlier, some links of the regional motorway system were not completed because of local opposition. Two of these 'missing links' are located in Dortmund, leaving the city with only one east-west motorway, the 'B 1', which is not a real motorway as it has level intersections and which is notoriously congested (see Figure 2.11). Dortmund's industrial lobby represented by the Chamber of Commerce has always insisted that at least one of the two 'missing links' needs to be built, and this view has recently been backed by the Federal Transport Ministry. However, under environmentalist pressure, the city has in the meantime rezoned the land for the motorway and much of it has already been developed, so building the motorway today would involve enormous sacrifices. ,It is now being discussed whether a tunnel under the existing B 1 could provide the necessary capacity.

A similar conflict of lesser scale arose when the Hoesch company demanded a direct motorway access to its *Westfalenhütte* steel works. Against considerable citizen protest, this motorway has recently been completed. More ironic is the following case. When, as mentioned above, in the late 1970s Hoesch considered building a new steel works on a large site in the north-western part of the city (see Figure 2.11), it set as one of its conditions that a new road link from the site to the southern autobahn be built by the city. Today the plan for the new steel works has long been abandoned, but the requested highway is almost finished.

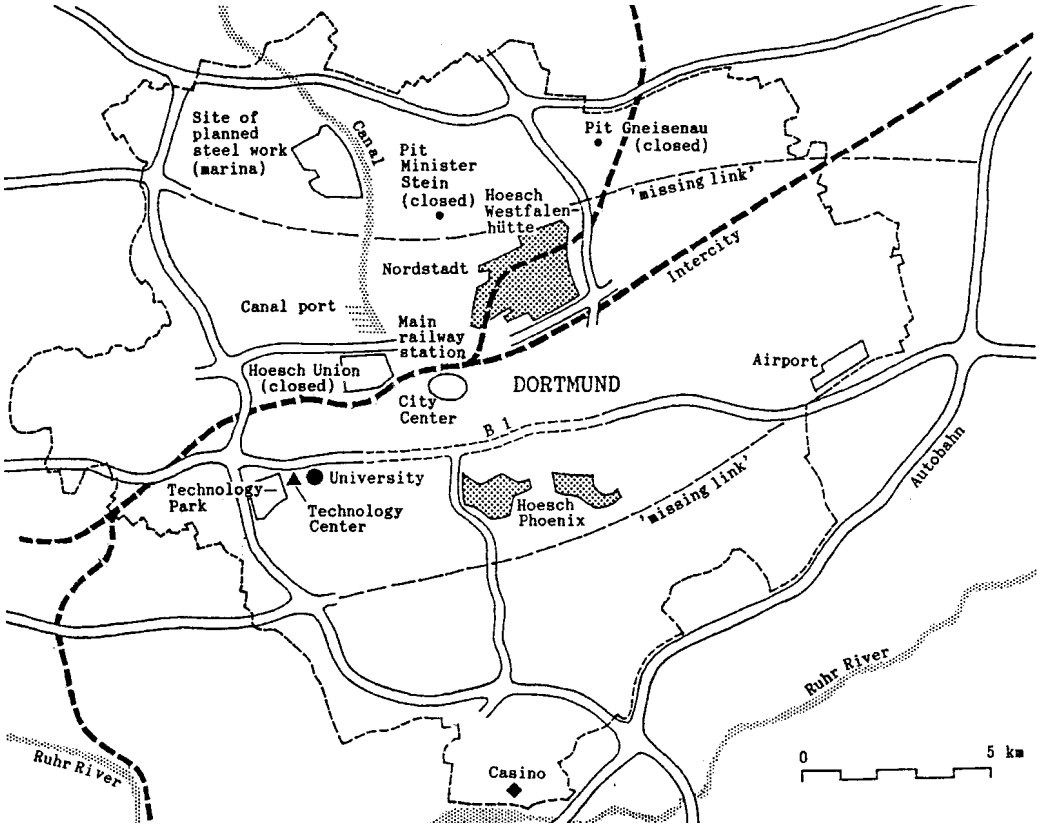

Figure 2.11. Large-scale developments in Dortmund. *Two 'missing links' of the Autobahn network are located in Dortmund, leaving it with only one east-west motorway, the 'B 1'. When in the late 1970s Hoesch considered building a new steel work on a large site in the north-western part of the city, it set as one of its conditions that a new road link from the site to the southern autobahn be built by the city. Today the plan for the new steel works has long been abandoned, but the requested highway is almost finished.*

The special relationship between the city and its still largest employer is further illustrated by the controversy about the modernisation of the canal connecting Dortmund with the Rhine and Dortmund's canal port (see Figure 2.11). Hoesch has always insisted that the canal and the port must be deepened to accommodate the 3000 tonnes standard European barge, although today the firm ships only eight percent of its total freight volume by water. Construction on the canal is now underway, but the company has so far declined to commit itself to shifting a larger share of its shipments to the canal.

It has always been a disadvantage for the Ruhr that the nearest international airport is Düsseldorf, 60 km from Dortmund. In the light of this, Dortmund has greatly benefited from the recent rise of regional air traffic. Dortmund's small airport now has turboprop connections to Berlin, Munich, Stuttgart, Leipzig, Dresden and London, and a link to Paris is being considered. One important factor of Dortmund's airport is its right to issue 'through-tickets' for connecting flights from larger airports such as Munich or Stuttgart, giving long-distance passengers the feeder flight from Dortmund practically free.

However, the future of the airport is jeopardised by its unfortunate location in a densely populated area where citizens vehemently oppose any further expansion of its flight operations (see Figure 2.11). Moreover, it remains open to question whether in a relatively small country like Germany domestic air traffic has great prospects compared with the high-speed trains of the future. Given Dortmund's excellent position in the Intercity network, even today only on long journeys such as Dortmund-Munich can significant time savings be achieved by air travel. When in the future Dortmund is included in the high-speed ICE network, these savings will be further reduced. Only recently Dortmund was selected as the location for the maintenance terminal for the ICE/TGV route leading to Brussels and Paris via Cologne. In addition, Dortmund has successfully lobbied in Bonn for a new Intercity line linking it to the new high-speed ICE route Hamburg-Munich at Kassel.

(5) Environmental Policy

Many other activities can be summarised under this heading. They are not or not directly aimed at promoting economic development, but are part of a comprehensive long-term strategy of modernising the region.

One set of policies is directed at restoring the natural environment from damage suffered during its industrial past, wherever possible by 'renaturating' streams or planting trees. One major project is the ecological 'landscape park' planned to link the two parts of the university campus with the new Technology Park. This project requires the removal of a four-lane highway built only twenty years ago. Another project is the large artificial lake and marina planned for the site where Hoesch is *not* going to build the new steel work mentioned earlier (see Figure 2.11).

Another set of policies is concerned with making the city safer and more convenient for pedestrians through various measures aimed at traffic restraint. The city is in the process of thoroughly remodelling the city-centre pedestrian shopping area in connection with several large underground car parks and its new town hall (Schulze, 1986). Similar smaller projects are underway for suburban shopping centres. In addition, traffic restraint measures for residential areas are being implemented piece by piece. Traffic restraint in West Germany originally followed the Dutch *'woonerf'* model, but has developed into a comprehensive philosophy of improving the quality of public spaces in residential neighbourhoods. New developments include area-wide speed limits of 30 km/h and the redesign of trunk roads to speed up public transport at the expense of car traffic and to give more space to pedestrians and cyclists.

Neighbourhood improvement, which is closely related to traffic restraint, concentrates on the older workers' housing areas close to industrial plants (*'Gemengelagen'*) where the neighbourhood quality is lowest. One notable example is the DM 62 million Nordstadt Programme directed at improving the living conditions in the 19th century housing area to the north of the city centre mentioned earlier, one of the oldest and most depressed parts of Dortmund.

Statutory Planning

Compared with these new developments in local planning, the traditional instruments of statutory planning applied during the same period lagged somewhat behind the events. This is not surprising as the efforts to produce a consistent system of spatial plans, both for the region and the city, as specified in the Planning Law of North-Rhine Westphalia to be extremely time-consuming.

In 1984 the regional development plan for the eastern part of the Ruhr (*Gebietsentwicklungsplan Dortmund-Unna-Hamm*) was published after extensive consultation with the affected municipalities and counties (Regierungspräsident Arnsberg, 1984).

The plan essentially translated the system of central places and development axes of the State Development Plan to the regional scale and reiterated the provision that residential development should be restricted to areas around designated centres called *Siedlungsschwerpunkte* ('settlement poles') with good public transport access. The selection of settlement poles was the responsibility of the municipalities, however a map containing the settlement poles already defined was included (see Figure 2.12). In order to promote development at the settlement poles, the plan called for the promotion of higher residential densities, strict controls against urban sprawl and the limitation of residential areas in local land-use plans to the absolute minimum required by the foreseeable population development.

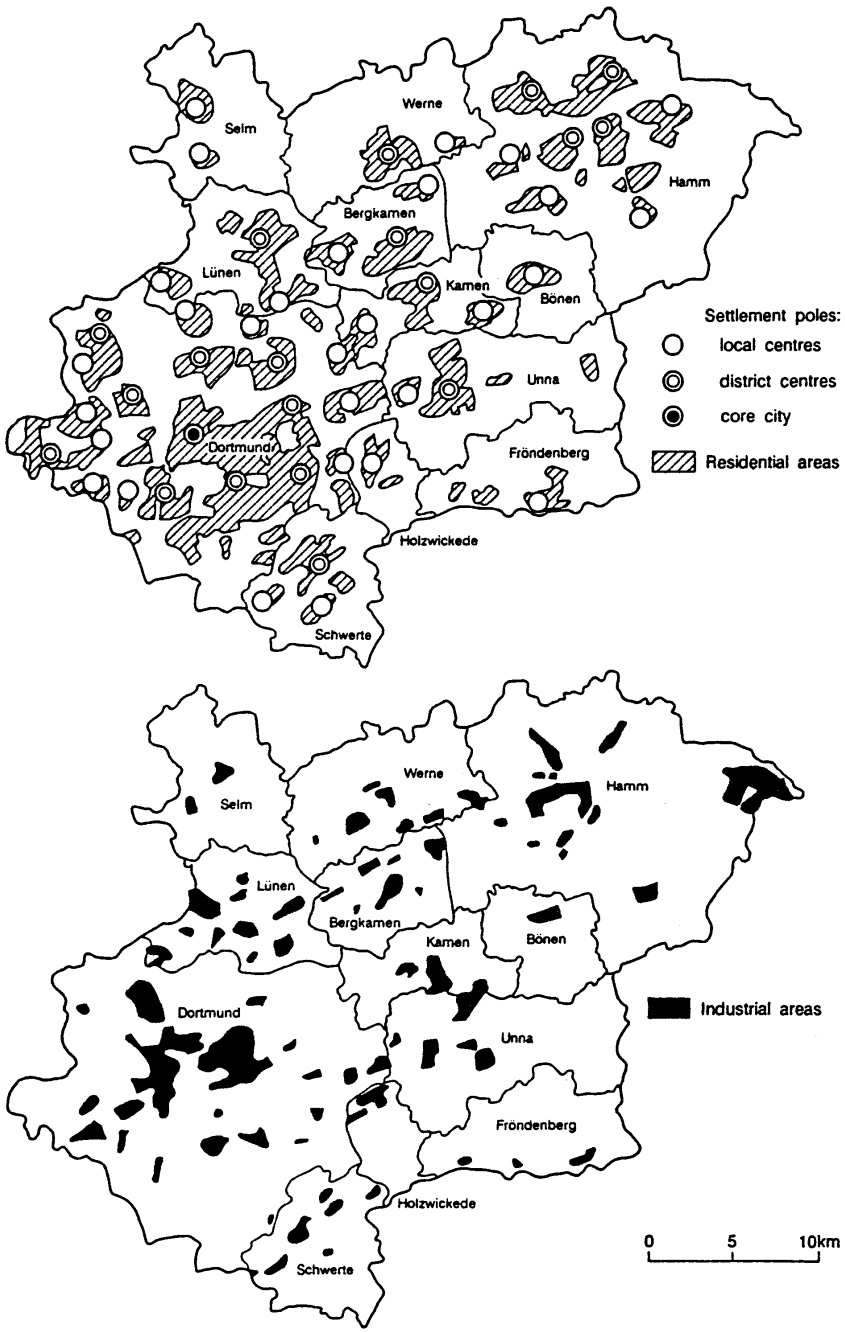

Figure 2.12. Residential (top) and industrial (bottom) areas in the Gebietsentwicklungsplan Dortmund-Unna-Hamm. *The regional development plan reiterated the provision that development should be restricted to residential areas around designated centres with good public transport access. Although the plan assumed a further decline of jobs in the region, it called for the provision of sufficient industrial areas to attract new or relocating high-quality industries (Source: Regierungspräsident Arnsberg, 1984).*

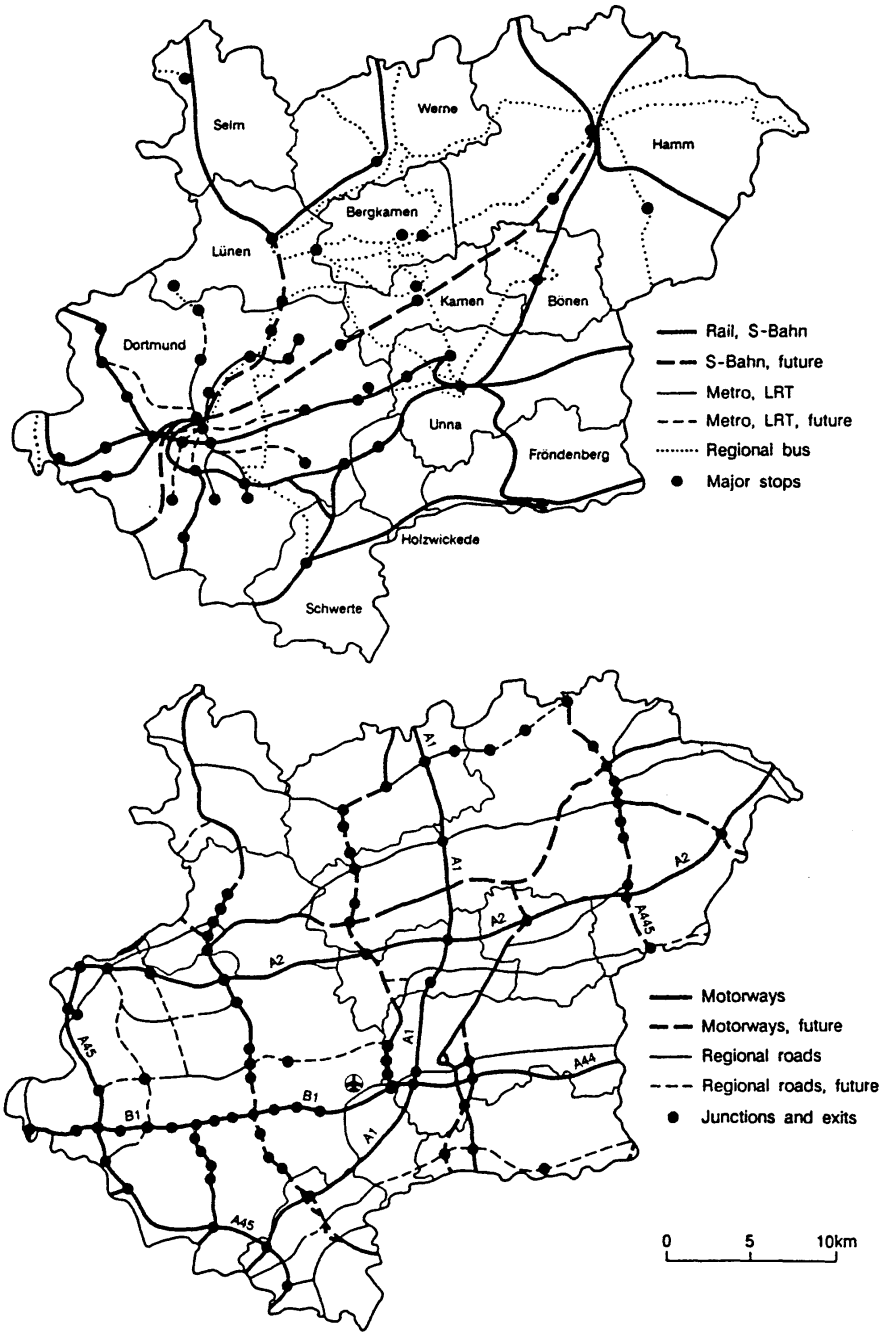

Figure 2.13. Public transport (top) and road (bottom) networks in the Gebietsentwicklungsplan Dortmund-Unna-Hamm. *The plan confirmed the projects of the State Development Plan to complete the S-Bahn and Stadtbahn networks and proposed a network of park-and-ride facilities at suburban railway stations. It also more or less confirmed the highway improvements, except that the two east-west motorways links cutting through Dortmund were now missing (Source: Regierungspräsident Arnsberg, 1984).*

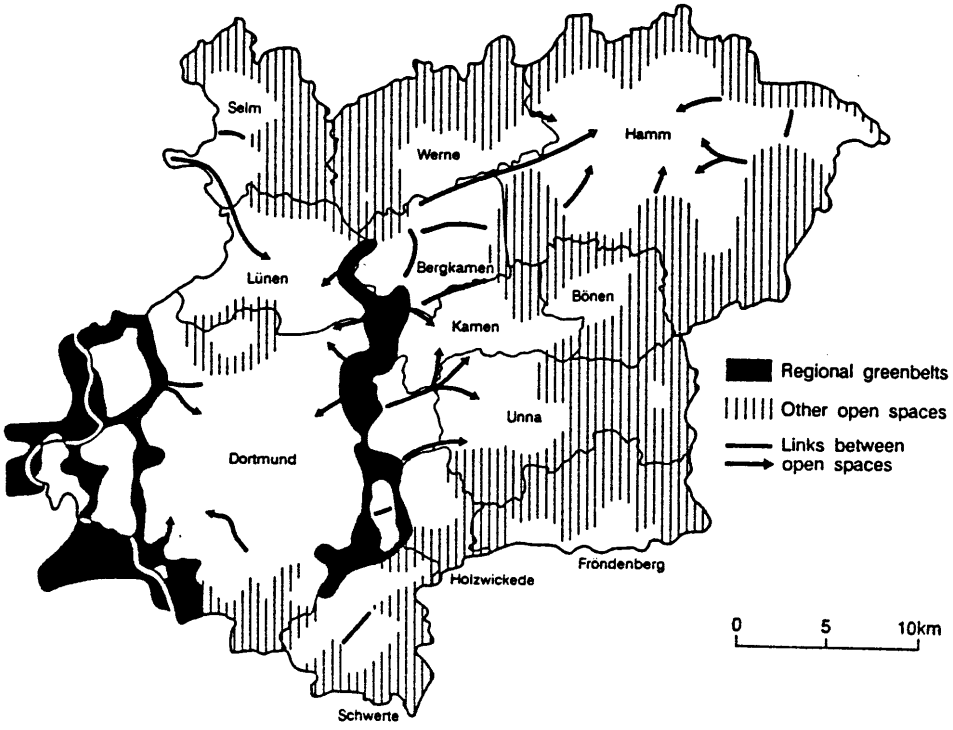

Figure 2.14. Greenbelts in the Gebietsentwicklungsplan Dortmund-Unna-Hamm. *The plan placed particular emphasis on the preservation of regional greenbelts linking neighbourhood green spaces with the open landscapes surrounding the built-up area. These greenbelts, proposed already between the wars, have since been infringed upon in too many places by uncontrolled development and transport infrastructure (Source: Regierungspräsident Arnsberg, 1984).*

In that respect the plan was even more pessimistic for Dortmund than Dortmund's projections of 1976 in that it assumed a further decline to 563.000 by 1995, but postulated as a target halving the net migration loss to the city by fighting suburbanisation. Taking account of foreseeable redundancies in the mining and steel industries, the plan assumed a further reduction of jobs in Dortmund to 247.000 by 1995 indicating that no relaxation of unemployment in the region could be expected. Nevertheless, the plan called for the provision of sufficient industrial areas to attract new or relocating high-quality industries (see Figure 2.12).

In public transport the plan confirmed the plans of the State Development Plan to complete the *S-Bahn* and *Stadtbahn* networks mentioned earlier, although the time schedule originally envisaged had to be extended repeatedly, and proposed a network of park-and-ride facilities at suburban railway stations (see Figure 2.13). Similarly, the plan more or less confirmed the highway improvements contained in the State Development Plan, except that the two east-west motorway links cutting through Dortmund referred to above were now missing (cf. Figure 2.11). In line with the growing public awareness for environmental issues, the regional development plan contained extensive sections on energy, water, waste disposal and green spaces (but not on air pollution and noise). The plan placed particular emphasis on the preservation of regional greenbelts linking neighbourhood green spaces with the open landscape surrounding the built-up area (see Figure 2.14). These greenbelts had already been proposed between the wars by the *Siedlungsverband Ruhrkohlenbezirk* but have since been infringed upon in too many places by uncontrolled development and transport infrastructure.

Only a year later Dortmund presented its new *Flächennutzungsplan* (Stadt Dortmund, 1985). The new preparatory land-use plan, which of course had to be consistent with the *Gebietsentwicklungsplan*, differed from its 1964 predecessor mainly in three respects:

- Based on much more pessimistic assumptions about the population and employment prospects of the city, it was more restrictive in terms of new residential and industrial land. Only 600 ha of new residential land, at existing densities equivalent to some 25,000 dwellings, was considered to be sufficient for the declining population (see Figure 2.15). In addition, major parts of the existing low-density suburban residential areas were rezoned as agricultural and 'of special recreational value' and so protected from further development. For industrial development only areas adjacent to already existing industrial areas were added, however the large new area originally set aside for the new steel works not built by Hoesch to the north-west of the city centre was retained for future use (see Figure 2.16).

- Responding to changing attitudes towards the role of the private car and to mounting citizen protest against much smaller road-building projects, the city decided to abandon the two autobahn projects planned to cross its territory in an east-west direction north and south of the city centre, even though they would

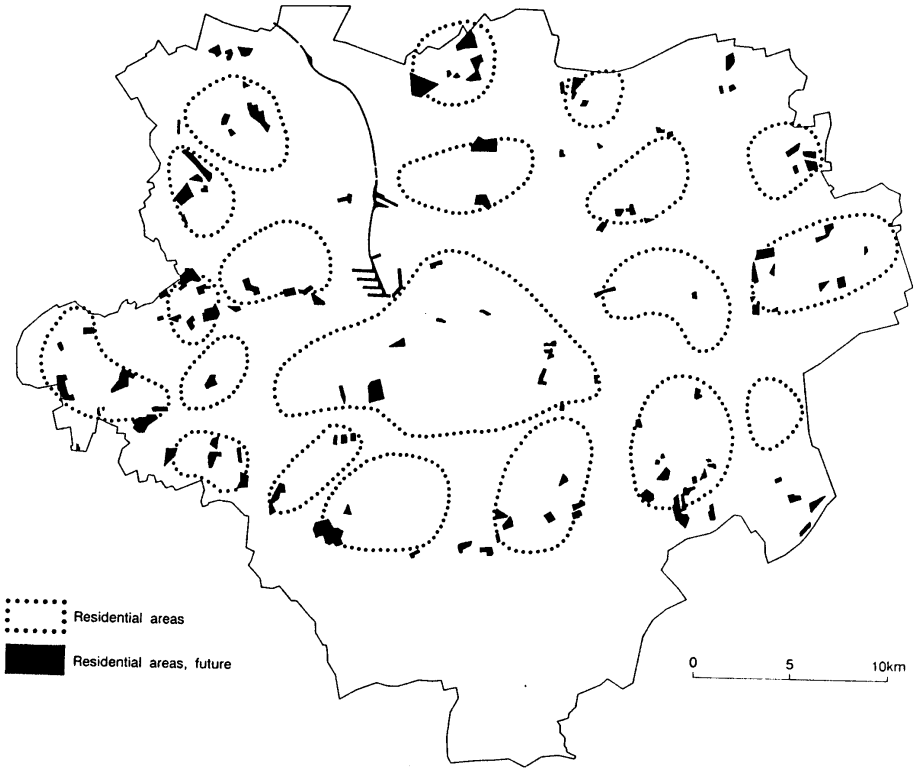

Figure 2.15. Residential areas in the Flächennutzungsplan Dortmund. *The new Dortmund land-use plan was much more restrictive in terms of new residential land. Only 600 ha, equivalent to some 25,000 dwellings, was considered to be sufficient for the declining population. In addition, major parts of the existing low-density suburban residential areas were rezoned as agricultural and 'of special recreational value' and so protected from further development (Source: Stadt Dortmund, 1985).*

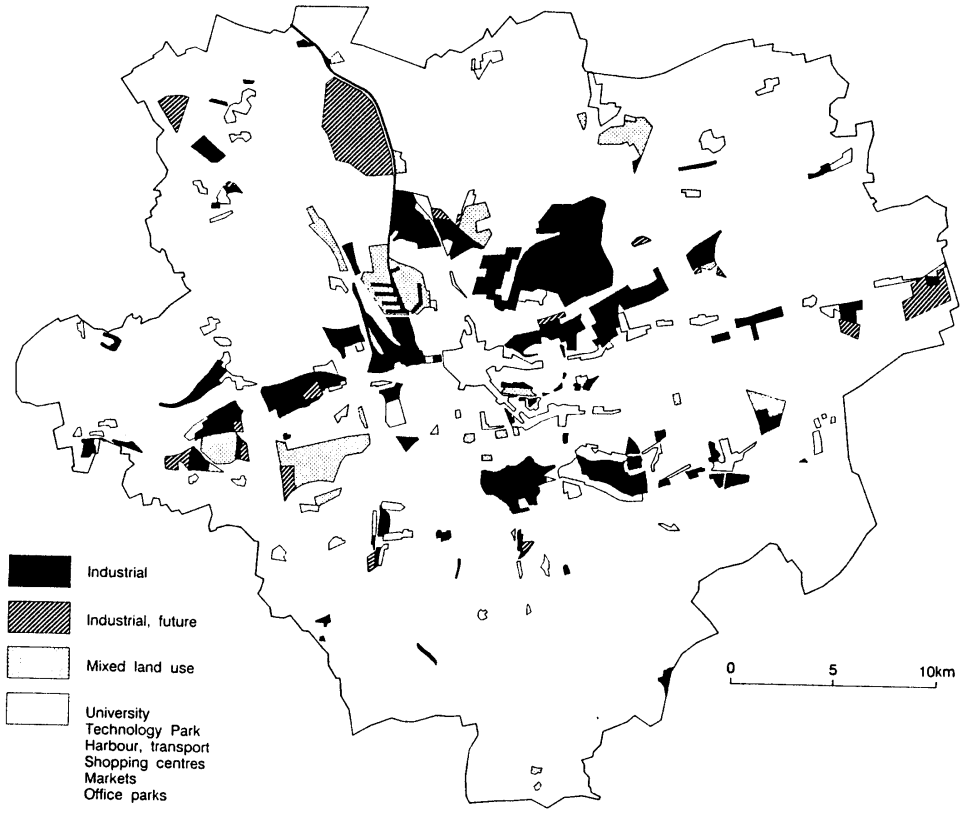

Figure 2.16. Industrial areas in the Flächennutzungsplan Dortmund. *For industrial development only areas adjacent to already existing industrial areas were added, however, the large new area originally set aside for the new steel works not built by Hoesch to the north-west of the city centre was retained for future use (Source: Stadt Dortmund, 1985).*

have been entirely financed by the Federal government, and specified tunnel solutions for other links contained in the 1964 land use plan (see Figure 2.17).

- The new plan put much more emphasis on environmental issues by protecting ecologically important areas, permanently securing large contiguous open spaces as recreational areas and trying to link existing neighbourhood parks and local green areas to larger greenbelts in order to develop an interconnected network of small and large green spaces and fresh-air ventilation corridors (see Figure 2.18).

Despite these undisputable achievements, the land-use plan is far from being a reliable charter for the future spatial development of the city:

- Its restrictive land-supply policy is already today at odds with the growing demand caused by changing life styles, recent population growth and the increasing space requirements of industry and services. Nor all attempts to enforce space-conserving, compact building forms have been honoured by the increasingly competitive land market. Hopes to satisfy a substantial share of the demand for land by recycling former industrial sites have turned out to be premature as frequently their decontamination has proved to be too costly or impossible, and even where it has been achieved, the recycled sites have been rejected by the clients in favour of greenfield sites on the periphery.

- The clear position it takes against the car in favour of the environment is already today under heavy attack from proponents of a more efficient transport infrastructure. Faced with continuing growth in car ownership and expected further increases in road traffic, in particular goods traffic due to the Single European Market, near-permanent congestion on the only east-west motorway in the region (the B 1) is predictable, and this will inevitably revive the discussion about the two abandoned 'missing links'. In fact; one of them has recently been reinserted in the National Road Building Plan by the Federal Transport Minister. However, since the new land-use plan has rezoned the land originally reserved for the two links as residential, a resurrection of the abandoned plans would be extremely controversial and costly.

Thus the statutory plans, although they did succeed in establishing a stable framework for spatial development in the region, have not been able to respond to all issues connected with regional change. In their effort to promote a space-conserving and sustainable development, they have failed to provide answers to the still growing demand for suburban living caused by changing life styles and new population growth. From an industrial perspective, they have failed to adjust flexibly enough to the rapidly changing needs of industrial restructuring. Therefore attempts to change or circumvent the plans are increasing. Fortunately, these take time and so the plans may be most effective not by enforcing desirable, but by inhibiting undesirable developments.

Figure 2.17. Road network in the Flächennutzungsplan Dortmund. *The city decided to abandon the two autobahn projects planned to cross its territory in an east-west direction to the north and south of the city centre, even though thy would have been entirely financed by the Federal government, and specified tunnel solutions for other links contained in the 1964 land-use plan (Source: Stadt Dortmund, 1985).*

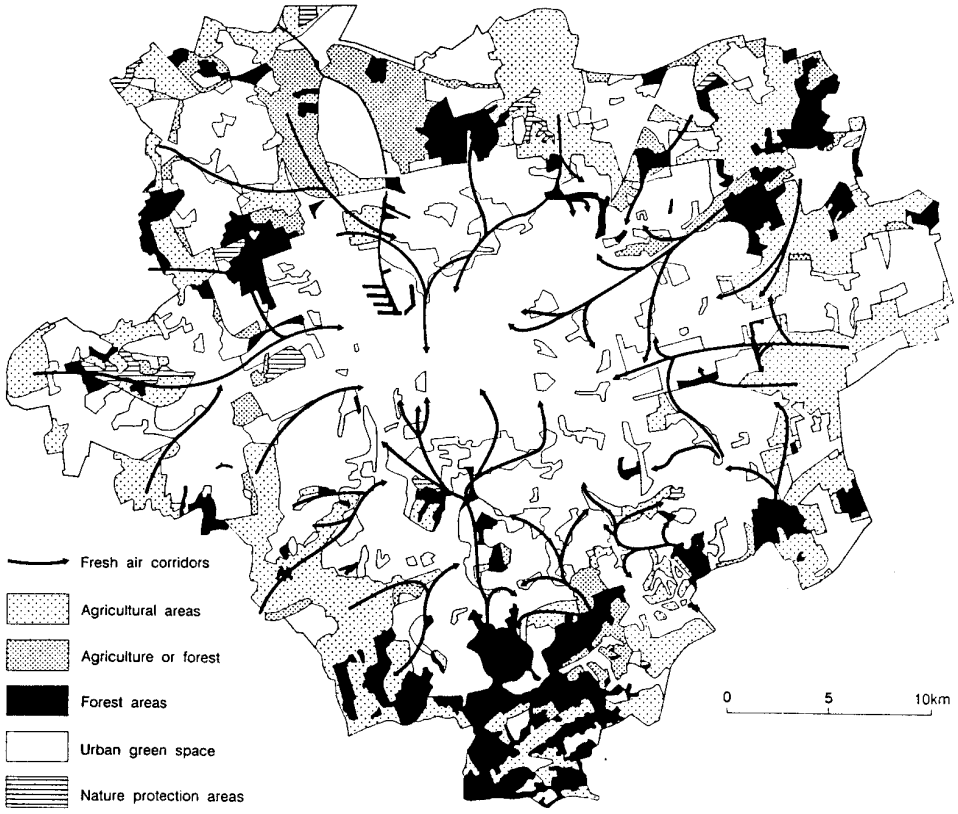

Figure 2.18. Green spaces in the Flächennutzungsplan Dortmund. *The new land-use plan put much more emphasis on environmental issues by protecting ecologically important areas, permanently securing large contiguous open spaces as recreational areas and trying to link existing neighbourhood parks and local green areas to larger greenbelts in order to develop an interconnected network of small and large green spaces and fresh-air ventilation corridors (Source: Stadt Dortmund, 1985).*

The Emscher Park International Building Exhibition

Besides local economic development and statutory planning, there exists a third approach to modernising the Dortmund region: the *Internationale Bauausstellung Emscher Park* ('IBA') launched in 1988 by the North-Rhine Westphalia state government.

Despite its name it is not really an exhibition, but an ambitious long-term programme to fundamentally remodel an area 75 km long and 10 km wide on both sides of the Emscher river between Duisburg in the west and Dortmund in the east: a longitudinal section through the Ruhr where its industrial legacy is most depressing, its environment most polluted, and its land-use system most disorganised (see Figure 2.19).

Seventeen cities and one county have cooperated to produce a joint strategy for the ecological, economic and social development of the Emscher region organised around seven 'guideline projects' (IBA Emscher Park, 1989):

- the recreation of green areas and the creation of the *Emscher Landscape Park*, an uninterrupted ribbon-like greenbelt between Duisburg and Dortmund (see Figure 2.19);
- the ecological improvement of the Emscher system, the most polluted river in the Ruhr, by decentralised high-performance water purification plants;
- the conversion of the Rhine-Herne Canal zone into a water-based 'experience zone' with educational, leisure, sports and ecological attractions;
- the restoration and preservation of industrial and technological monuments as 'bearers of culture' for innovative and economically viable new functions;
- the creation of industrial, commercial, service, office and science parks with high-quality landscaping, urban design and architecture ("Working in the Park");
- the development of new forms of houses and flats for new life styles and living patterns under social and ecological aspects with the active involvement of the residents;
- the promotion of new opportunities for social and cultural activities at the neighbourhood and local community level enhancing self-help and local provision of goods and utilities.

The Gesellschaft IBA Emscher Park, a limited-liability company entirely owned by the state government, has no budget of its own except to support a small staff and finance studies and urban design and architectural competitions. However, all state subsidies directed at the Emscher region are bundled with top priority given to projects approved by the IBA. In addition, the IBA makes every effort to attract private developers and to persuade them to submit their projects to IBA standards of architectural quality, ecological sustainability and social equity.

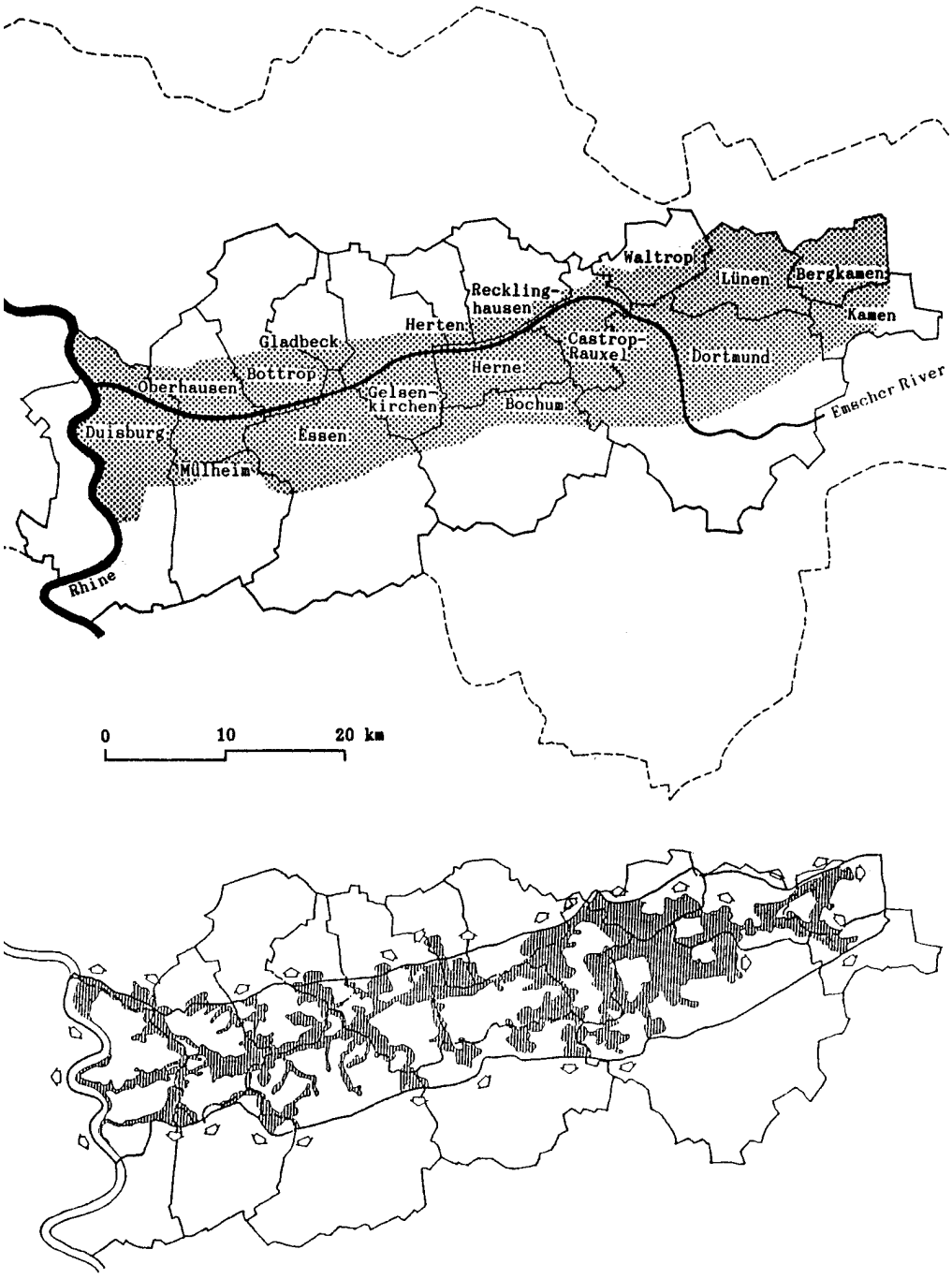

Figure 2.19. The Emscher Park International Building Exhibition *is an ambitious programme to fundamentally remodel an area 75 km long and 10 km wide on both sides of the Emscher river between Duisburg in the west and Dortmund in the east: a longitudinal section through the Ruhr where its industrial legacy is most depressing, its environment most polluted, and its land-use system most disorganised (top). One of its seven guideline projects is the creation of the Emscher Landscape Park, an uninterrupted ribbon-like greenbelt between Duisburg and Dortmund (bottom).*

The state government hopes, with seed money of only DM 35 million, to attract private investment of DM 3 billion by 1994.

After the first four years of its existence, the IBA is currently carrying out more than 70 projects ranging from housing projects and social facilities to the ecological renaturation of industrial sites. It is true that many of these projects might also have been carried out without the IBA. What makes all the difference is that, through intensive negotiations, the IBA has been able to persuade the investors to observe standards with respect to architectural, social and environmental quality which they might not have even thought of without its intervention. To achieve this, the IBA has to rely entirely on than voluntary cooperation. However, it has been shown that the IBA's 'quality seal' has become important even to profit-oriented investors.

The IBA will present the first results of its work in 1994 and after that will continue to operate until 1999. Whether by that time it will have succeeded in actually turning round the Emscher region remains open to speculation. What counts is its forward-looking spirit, which encourages people to take a more optimistic view of the future of their region.

Postindustrial Dortmund?

Although great progress towards the restructuring of the regional economy of Dortmund has been made, structural change has not yet been completed. The decline of the city's core industries, coal mining and steel making, seems to be continuing, but its transformation into a modern high-tech and services city is still underway. The most recent economic indicators do not predict a bright future. Coal mining has now moved out of the city following the coal deposits to the flatlands north of Dortmund, yet many miners continue to live in Dortmund and outcommute to the new pits (Figure 2.20).

But even the highly modernised new mines are threatened by a new coal crisis. After 1995, the guarantee by German utility companies to buy Ruhr coal at above-world-market prices will end and this will mean a further reduction of 13,000 mining jobs in the region - a regional crisis only insufficiently cushioned by a new DM 3 billion emergency programme of state and EC funds.

The prospects in the steel industry seem even bleaker. Early in 1992 Krupp AG of Essen announced its takeover of the Hoesch company, notwithstanding vehement protests by the Hoesch management and encouraged workers. This implies that in a few years the Hoesch name will have disappeared from Dortmund and that in the long run steel production in Dortmund is likely to disappear ending one hundred and fifty years of steel-making tradition.

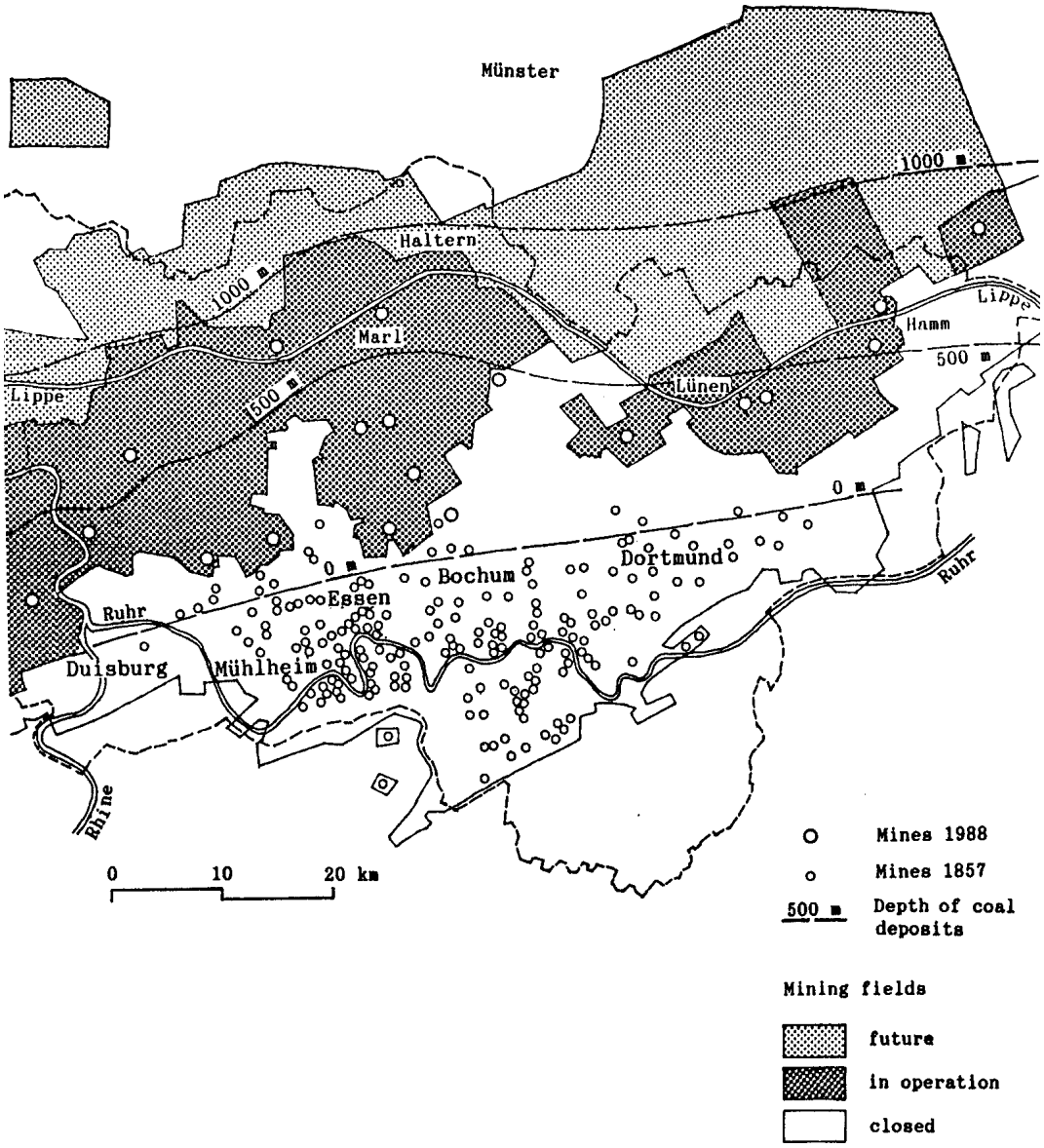

Figure 2.20. Northward migration of Ruhr coal mining. *Coal mining has now moved out of Dortmund following the coal deposits to the flatlands north of the city, yet many miners continue to live in Dortmund and outcommute to the new pits. But even the highly modernised new mines are threatened by a new coal crisis with an expected further reduction of 13,000 jobs in the mining industry.*

The coup by Krupp is only the latest in a series of takeovers by means of which traditional Dortmund companies have come under outside control. Hoesch itself from 1972 to 1982 suffered from an ill-advised liaison with the Dutch steel-maker Hoogovens. Most of the famous Dortmund breweries, once the pride of the 'German Beer Capital', have long been swallowed up by national beer conglomerates. Private banks once owned by local bankers are now subsidiaries of nation-wide banking trusts. Pohlschröder, once a synonym for office furniture, today is a subsidiary of the US Steelcase Corporation. Klönne and Wagner, once renowned bridge and engineering firms, are now remote-controlled from the Thyssen headquarters in Duisburg.

On the positive side, the employment gains in high-tech production, such as in the Technology Centre and Technology Park, are promising though numerically insignificant. Nevertheless, there has been a substantial restructuring within the manufacturing sector from unfinished products and mass production towards more complex and sophisticated products. A good example of this is again Hoesch, which today earns more than fifty percent of its income from non-steel products.

There has been a notable growth in service employment, although this growth has never been sufficient to offset the losses in manufacturing. Between 1970 and 1987 service employment in Dortmund grew by 30 percent, almost exactly the same rate as in West Germany as a whole. However, due to the steel crisis, in the early 1980s even service employment in Dortmund declined and only slowly started to grow again towards the end of the decade. Between 1980 and 1987 service employment in Dortmund grew by only 0.8 percent compared with 4.2 percent in Düsseldorf, 5.3 percent in Frankfurt and 7.9 percent in Munich, while service employment in ‚West Germany increased by 8.2 percent (Kampmann, 1991).

Surprisingly, the 1987 employment census revealed a much larger increase in service jobs than previous forecasts had predicted. The best explanation for this is the substantial growth in part-time work, which does not show up in the employment statistics of the Federal Labour Agency. According to recent estimates, fifteen percent of all jobs in West Germany are already part-time jobs. This suggests that this growth in service employment should be evaluated with caution as it may in part be based on the fact that jobs that used to be counted as one are now counted as two, without any additional income being generated.

But this fallacy is common to all cities. Therefore, it is possible to compare the level of tertiarisation across cities. In this comparison, Dortmund, with 68.2 percent service jobs ranks way above other Ruhr cities such as Duisburg (56.8 percent), Oberhausen (59.5 percent) or Bochum (59.7 percent) and comes close to being in one class with service-oriented cities such as Cologne (71.3 percent), Essen (71.7 percent) or Düsseldorf (74.4 percent). Only a few cities such as Frankfurt and Hamburg have still higher percentages of service employment, if predominantly administrative cities such as Bonn are excluded (cf. Kampmann, 1991).

With less than a third of non-service, and less than a quarter of manufacturing employment, Dortmund can hardly be called an industrial city any longer. In other words, by virtue of the rapid decline of its manufacturing base, even though its growth in service employment has been slower than that of other cities, Dortmund is being in the process of *deindustrialisation*, i.e. being passing from an industrial city to a postindustrial city.

Current Problems

As has been shown, this transition has not always been smooth, and despite the successes of its local economic policy, the city still bears heavy burdens left over from its industrial past. In addition, it has to face the same problems as any other city of its size. Below is a list of a few of the problems most frequently discussed in the Dortmund media:

- *Unemployment*. Although unemployment has been greatly reduced, Dortmund is still among the Ruhr cities with the highest unemployment level. Its present unemployment rate of 11.3 percent means that 38,000 men and women are excluded from the economic upswing of the region. What this number does not reveal is that almost 25 percent of them have been out of work for more than two years and are no longer eligible for social security benefits.

- *Urban poverty*. Long-term unemployment tends to turn into poverty. A growing number of households in Dortmund subsists on welfare. Also migrants from astern Germany and eastern Europe receive financial assistance. Both types of aid are a heavy burden on the city budget.

- *New immigrants*. The collapse of the GDR and the other socialist states in eastern Europe has brought a sudden increase of immigration. Between 1988 and 1991 more than 20,000 immigrants came to the city, by the year 2000 a further 30,000-40,000 migrants are expected. These new citizens need jobs, housing, health care and education.

- *Housing shortage*. The new immigration wave, in conjunction with smaller households and growing per-capita consumption of housing space, has put the housing market out of balance. According to a recent study, there is today a deficit of 10,000 dwellings; 25,000 dwellings need to be built by the year 2000 to satisfy the expected demand.

- *Spatial disparities*. Urban poverty and unemployment are concentrated in old workers' housing areas in the northern part of Dortmund, such as the Nordstadt. Housing scarcity and rising rents and land prices in the attractive southern parts of the city increase the spatial segregation between the poor northern and the affluent southern areas. More than 30 percent of the population of the Nordstadt are foreigners.

- *Urban renewal*. Even the Nordstadt Programme has not succeeded in stopping the progressive deterioration of living conditions in this problem neighbourhood of Dortmund. Moreover, the programme is increasingly being criticised for neglecting its original ecological and bottom-up principles in favour of large, top-down projects. Because of the concentration of the programme on the Nordstadt, no substantial urban renewal activities in other districts of Dortmund are possible.

- *Land policy*. In its effort to fight excessive land consumption and curb urban sprawl, the city has failed to provide sufficient land for residential and industrial development. Attempts to enforce medium-density terrace housing in inner-suburb locations are rejected by clients, who insist on detached houses. Similarly, industrial clients prefer virgin, greenfield sites instead of recycled former industrial land in the inner area. For fear of losing potential households or firms to neighbouring communities, the city in most cases is forced to make concessions.

- *Soil contamination*. Soil contamination on former industrial sites has turned out to be one of the most difficult problems to solve. In the 1980s a whole neighbourhood erected on the site of a former colliery had to be evacuated. Today it is doubtful whether contaminated sites can be recycled for residential use. The city is still in the process of compiling an inventory of all contaminated areas; already more than 300 contaminated sites have been identified.

- *Waste disposal*. None of the large Ruhr cities has a concept for solid waste disposal after 1995 when the land-fills now used will be full. Dortmund plans to inaugurate a new huge land-fill area, and in addition, build a large incineration plant. However, both projects are under heavy attack as the site for the new dump and five out of seven sites considered for the incineration plant are, as one might expect, in the northern part of the city.

- *Transport*. There are more than one million cars in the Dortmund region today (440 cars per 1,000 population), and their number is still growing by 2 percent per annum. In the light of this situation even the efficient public transport system in the Ruhr during the 1980s was losing passengers every year and has only in the last years attracted slightly more passengers due to the region's recent growth in population and a policy of massive ticket discounts. The city's efforts to constrain the car (essentially speed limits and neighbourhood car restraint) show only little effect, while the large deficits incurred by public transport make significant improvements in service difficult. At the same time road congesting is rising beyond all expectations. The city government is torn between the pressure for more roads by local industrialists and the resolute opposition of the Green Party, many citizens' action groups and a substantial part of the population against any further concessions to automobility. Currently there is a strong movement fighting for the complete ban of private cars from the city centre, against the vehement opposition of the inner-city shop-owners. The upcoming new discussion about the southern 'missing link' is likely to bring a new escalation to the debate on transport issues.

- *Inner city*. The inner city of Dortmund is facing a slow but visible erosion process. Retail turnover is stagnating while greenfield shopping centres and retailing in surrounding smaller towns are flourishing. Vacant shops in prime locations waiting for many months for occupants are evidence of the lack of attractiveness of Dortmund's city-centre to retailers. High floorspace rents and lack of inner-city parking as well as a general lack of ambience in Dortmund's inner city are named as the primary reasons. In fact the inner-city modernisation programme launched by the city many years ago has been implemented with too many delays, and even today the central square of the city has the vintage charm of the 1950s.
- *Image*. Perhaps the greatest problem for the city is its persistently negative image. Despite extensive public relations campaigns, Dortmund again and again scores worst in opinion polls asking questions such as "Which is the best city to live in?", "Which is the city with the best environment?" or "Which is Germany's most child-friendliest city?". When in a recent survey in southern Germany people were asked "Would you like to move to Dortmund?" nine out of ten people answered "No".

The list shows that Dortmund's problems are those of a typical, 'normal' German city and that those of its industrial past are gradually fading out of sight. Only the last problem demonstrates that perceptions change more slowly than reality. For the people living in Dortmund the city has long ceased to be the black industrial city. Indeed, if one enters the city from its pleasant southern hills, it is hard to believe that this used to be one of the mining and steel capitals of the continent - if it were not for the last two rusty blast furnaces of Hoesch's *Phoenix* steel work. However, they, too, will have disappeared in a few years, and another chapter in the history of the industrial city will be closed.

Scenarios for Postindustrial Dortmund

What will postindustrial Dortmund be like? The notion of the postindustrial society (Tourraine, 1969; Bell, 1973) goes far beyond simply indicating a time in which manufacturing is no longer the dominant mode of production but comprises a broad range of changes in life styles, mobility patterns and cultural and political values. It must, therefore, be expected that the end of the industrial city will also bring about changes beyond those expressed by economic data. What will these changes be?

It is indicative of the transitional situation in which Dortmund finds itself that this question has increasingly attracted the attention of regional analysts and political decision-makers. There has been a growing number of speculative, critical or normative scenarios on the future of the city after deindustrialisation. The following selection gives an impression of the range of ideas, fears and hopes expressed in these scenarios:

- *Dortmund: Victim of Crisis.* At a conference commemorating the 40th anniversary of the Social Democrats in the City Council in 1986, Afheldt of Prognos AG painted a bleak picture of how Dortmund would look in 2010 if industrial decline continued. With a population of 400,000 and only 100,000 jobs remaining (but a burgeoning informal sector), Dortmund would be stricken by poverty, disinvestment, ecological degradation and crime. Declining tax income and exploding welfare payments would combine to cripple the city budget with the effect that public services would deteriorate and public facilities would have to be closed down. Vacant buildings and derelict industrial sites, crumbling infrastructure and neglected public spaces would be the visual signals of decline (Afheldt, 1986).

- *Dortmund: City of Innovation*. The same speaker also painted a contrasting picture of a 'neoindustrialised' Dortmund based on medium- and high-tech industries located along the 'B1 high-tech corridor'. Hoesch still exists but has changed into a diversified high-tech conglomerate specialising in new materials, space technologies and jet engines. The successful economic transformation was made possible by a local economic policy acting as if the city were an enterprise operating in a highly competitive and increasingly international market. Systematic city marketing has dispelled the negative image of the city and has made the 'new Dortmund' known to potential investors. Housing conditions and the environment have been vastly improved, and with the help of private sponsors Dortmund has acquired a reputation as a city of the theatre and arts (Afheldt, 1986).

- *Dortmund: Multicultural City*. Klaus R. Kunzmann, professor of planning, envisages Dortmund in 2039 as part of a larger Rhine-Ruhr Eurometropolis benefiting from the growing agglomeration diseconomies of the high-tech capitals of the south. The city found a new economic role as a centre of logistics research and production. The Emscher Park International Building Exhibition, he speculates, succeeded in transforming the Emscher Basin into an ecological woodland and park region. Three generations of immigrant workers have transformed the Ruhr into a multicultural society. However, north of the Emscher live the marginalised new immigrants doing the low-skill and dirty work which robots cannot do - a new social and spatial cleavage (Kunzmann, 1989).

- *Dortmund: Science City*. Franz-Joseph Kniola, a local politician who later was to become State Planning Minister, sees Dortmund's future based on research and high-tech production centred around the fast growing university. Chemical engineering, biotechnology and environmental engineering are Dortmund's specialties. R&D has become the largest industry in the city. Research laboratories, software companies and components manufacturers locate in the 15-km long technobelt linking Dortmund's Technology Park with the campus of the neighbouring Ruhr University and along the B 1 motorway (which is now a tunnel). New residential areas are springing up near the university and the city centre has been turned into a glass-covered pedestrian shopping mall (Kniola, 1989).

- D*ortmund: City of Harmony*. In 1990, the City of Dortmund produced an update of its Development Programme of 1976. The new *Entwicklungsprogramm Dortmund 2000*, in contrast to its predecessor, refrains from stating detailed quantitative objectives but lists broad guidelines for political action. However, due to its high level of abstraction, the programme postulates everything: growth in future-oriented industries and a good environment, attractive neighbourhoods and a lively city centre, an efficient public transport system and a balanced city budget. Conflicts certain to arise from the simultaneous implementation of these goals are not addressed (Stadt Dortmund, 1990).

- *Dortmund: City of Inequity*. There are only few critical commentators of the 'Dortmund Consensus'. Horst Arenz, a sociologist working for the Dortmund branch of the DGB, the German Association of Trades Unions, shows that the negative impacts of the economic restructuring process are very unevenly distributed. He points to the growing number of long-term unemployed workers in Dortmund and criticises the exclusive orientation of Dortmund's economic policy towards high-tech industries with small employment effects and the neglect of retraining and adult education opportunities addressing the needs of workers most affected by economic change (Arenz, 1991).

The common feature of all these scenarios for Dortmund is that its postindustrial future will have a significant industrial component, though not of the old smokestack type but rather of the new kind in which highly skilled workers assemble sophisticated products in designer laboratories placed in park-like settings. The rest of the economy will be research and development and services, preferably 'producer services' catering to the prospering business community. Unemployment and poverty will have been overcome, environmental pollution will be a thing of the past, traffic problems will be solved and ethnic communities will coexist peacefully.

All this is possible, but may also be wishful thinking. It may be that the transition from smokestack to high-tech industries will take much longer. After Hoesch has been taken over by Krupp, the city will not be the home to headquarters of nationally-operating manufacturing enterprises, except for a few medium-sized engineering companies. Compared with other West German cities, producer services are still below average. Despite Dortmund's excellent location and transport system, its skilled workers and modern education facilities and its great improvements in environmental quality, the city's industrial heritage is still a heavy burden. Thus for every new job created in Dortmund, many new jobs will be created in Stuttgart or Munich because the former industrial regions will for a long time continue to be a second-best location for high-tech companies.

This means that other futures than the high-tech city are possible. Dortmund may remain for an extended period a university town, a service and retail centre for a wide region and a residential city with a relatively large population of retired people and, thanks to that, comparatively stable incomes. Or, less pleasantly, postindustrial Dortmund may start to grow again, but pay a high price for it. Rapid

growth inevitably means more demand for industrial land and housing and that will invalidate the city's efforts to conserve land and curb urban sprawl. Growth will also mean more traffic, more congestion and more pressure on the urban environment. Rapid economic restructuring also creates new social and spatial disparities: between on the one hand, the young, skilled and flexible and on the other, the old and low-skilled unable to adjust to the new requirements, or between the affluent residential areas in the southern, and the concentrations of unemployment and urban poverty in the northern parts of Dortmund. The new influx of immigrants from eastern Germany and eastern Europe and the growing number of economic migrants and political refugees from outside Europe may exacerbate these disparities in the future beyond current imagination.

Open Questions

These scenarios serve an important function of stimulating the debate on desirable and undesirable futures. However, they are too general to answer specific questions about the postindustrial urban future.

In particular they remain vague about the *spatial* impacts of the envisaged economic developments. What will be the future of old industrial cities if current megatrends in technology, the economy, society and politics prevail? Will they continue to lose population and employment relative to other cities? How will work-places and people be distributed across the urban area? What will happen to redundant industrial sites? What will happen in the housing market? Will the spatial segregation of income groups and ethnic communities in the city continue to increase? Will housing construction decline with a stagnating or only slowly growing population? How will individual urban districts and suburban communities develop? Will spatial disparities increase or be reduced? What will be the future role of the inner city? What will happen to urban transport? Will it be possible to break out of the vicious circle of increasing automobility and growing spatial dispersal of activities? Is there a postindustrial Dortmund which is at the same time efficient, equitable and environmentally sustainable?

Some of these questions will be addressed in the following chapters.

3

Why and How Do Cities Develop?

The pattern of urban development emerging from the previous two chapters is of bewildering complexity. Depending on the country or region, study period or spatial scale of the analysis, urban growth and decline, concentration and dispersal, polarisation and equalisation, prosperity and deprivation coexist in an intricate spatio-temporal web of partly interdependent and partly autonomous processes. It is very difficult to detect regularities within this complexity, let alone a major unifying principle.

In this chapter, nevertheless, an attempt is made to assemble components of a theoretical framework which may be able to bind together the partly counteracting spatial tendencies and relate them to long-range technological, economic, social and political trends. Without such a framework a discussion of the postindustrial future of an industrial city like Dortmund is not possible.

Theories of Urban Development

The spatial sciences are still far away from a comprehensive theory of urban development. There exist a large variety of observations and partial hypotheses about individual phases and aspects of urban development, but there is still no *general* theory of why and how cities develop. Coexisting there is rather a multitude of incompatible theories proposed by various disciplines which attempt to explain one and the same phenomena of reality under entirely different assumptions and using different explanatory variables.

As a first step towards a unifying framework for understanding and forecasting the development of industrial cities, this chapter will present the major current directions in urban development theory. With some risk of generalisation, four 'paradigms' of urban development theory can currently be distinguished:

Technical Theories: Urban Mobility Systems

Cities appeared in human history at a time when technological innovation required the division of labour, i.e. when specialised crafts separated from agricultural labour (Sombart, 1907). The concentration of specialised skills in larger settlements released a 'tremendous expansion of human capabilities' and called for protection and exchange: the citadel and the market became the primeval urban functions (Mumford, 1961).

Based on this paradigm, the first explanations for the location, growth and decline of cities are technical: cities were established on trade routes, ports or river crossings. Classic examples of transport-generated cities are Venice and Genoa, the wealth of which was based on their sea routes, or the many cities in Europe with names ending in -ford or -furt, such as Hereford or Frankfurt. These cities declined once their locational advantage disappeared, as Venice and Genoa when the discovery of the sea passage to India took their sea trade away.

Andersson (1986) speaks of 'four logistical revolutions' that have shaped the European urban system. In the Middle Ages, *safe highways* made possible the long-distance trade which led to the enormous prosperity of cities in northern Italy and Germany. Safe *money exchange* facilitated international trade and the rise of London and Paris as banking capitals in the 17th and 18th centuries. The *industrial revolution* brought the railways and the explosive growth of industrial cities like Manchester and Essen in the 19th century. Today, the *integration of transport and telecommunications* (the 'real' logistical revolution) is creating the 'global' city and, in the European context, again favours London and Paris.

The technical paradigm of urban development is at the base of many theories of why some cities flourish and some stagnate or decline. Törnqvist (1968) developed the idea of city systems built on *contact networks* describing interactions of people and information between cities. A similar understanding of the importance of spatial interactions lies behind the concept of *employment* or *population potentials* as factors to explain the growth of centrally located cities compared with peripheral ones. On a European scale, potential analyses (e.g. Keeble et al., 1986 and Bruinsma and Rietveld, 1992) demonstrate the dominance of the high-accessibility corridor between north-west England and northern Italy, including the 'three-capital region' (London-Brussels-Paris) and the Randstad, Ruhr and Rhine-Main metropoles, a result confirmed using different data as the 'Blue Banana' (Brunet, 1989).

The technical paradigm of urban development has gained new impetus from the appearance of new transport systems, such as high-speed rail travel and advanced telecommunications such as ISDN or satellite communication:

- One school of thought sees them as essential ingredients of 'knowledge networks', in which telecommunications carry (routine) information and high-speed rail and air (non-routine) knowledge in the form of human experts (Batten, Kobayashi and Andersson, 1988). Being linked to the new networks is becoming vital for the success of a city; successful cities are 'network cities'.

- Hypotheses about the likely impacts of advanced telecommunications on spatial development point to the provision of high-capacity data transmission in only the largest business centres, a fact which creates zones of informational advantage around nodes of telecommunications trunk lines (Gillespie, 1991).

- Castells (1989) envisages a fundamental restructuring of spatial relations from a 'space of locations' to a 'space of flows', in which spatial interactions *between* places become more important than activities *within* places.

As the real spatial impacts of the new technologies are yet largely unknown, it is difficult to sort out myth from fact among these hypotheses. It may well be that once the new technologies become more widely available, their discriminating effect may dissipate. For instance; it is possible that the evolving technology of satellite communication may make *all* locations equivalent in terms of high-speed data transmission. On the other hand, it is likely that centrally-located cities will already be adopting the next innovation while the first innovation is being diffused to the periphery, and so maintain their advantage. There is, however, sufficient evidence that the potential of telecommunications to substitute physical transport is limited. In as much as face-to-face contacts remain important, so will the importance of high-speed rail and air transport. This speaks for the hypothesis that being a node in the high-speed rail and air networks will remain an important locational asset for successful cities.

In the technical paradigm of urban development, technical conditions also determine the internal organisation of cities. The high density or crowdedness of the medieval city resulted from the need for fortifications and from the fact that most trips had to be made on foot. When these two constraints disappeared in the 19th century, urban development, following this paradigm, largely became a function of transport technology.

The workers' housing areas of the early 19th century were still built in the immediate vicinity of the factories, and, after the introduction of the railways, the *Mietskasernen* ('rent barracks') of the large cities were the most efficient way to concentrate large numbers of workers around the commuter railway stations.

Consequently, large cities expanded on both sides along the railway lines fanning out from the traditional city centre in a star-like pattern. With the diffusion of the private automobile, first in America and after World War II also in Europe, the areas between the railway lines could also be used for housing, and so the expansion of urban areas became less directed and more dispersed ('urban sprawl').

In the 1950s first efforts were made in the USA to study systematically the interrelationship between transport and the spatial development of cities. Hansen (1956) was able to demonstrate for Washington, DC, that locations with good accessibility had a higher chance of being developed, and at a higher density, than remote locations ("How accessibility shapes land use"). The recognition that trip and location decisions codetermine each other and that therefore transport and land-use planning needed to be coordinated, quickly spread among American planners, and the 'land-use transport feedback cycle' became a commonplace in the American planning literature.

The set of relationships implied by this term can be briefly summarised as follows (see Figure 3.1):

- The distribution of *land uses*, such as residential, industrial or commercial over the urban area determines the locations of human *activities* such as living, working, shopping, education or leisure.
- The distribution of human *activities* in space requires spatial interactions or trips in the *transport system* to overcome the distance between the locations of activities.
- The distribution of infrastructure in the *transport system* creates opportunities for spatial interactions and can be measured as *accessibility*.
- The distribution of *accessibility* in space codetermines location decisions and so results in changes to the *land-use* system.

This simple explanation pattern is used in many engineering-based and human-geography derived urban development theories:

The theories based on this paradigm start from observed regularities of certain parameters of human mobility, such as trip distance and travel time, and from these try to infer those trip origins and destinations that best reproduce the observed frequency distributions. It had long been observed (e.g. Ravenstein, 1885; Zipf, 1949) that the frequency of human interactions such as messages, trips or migrations between two locations (cities or regions) is proportional to their size, but inversely proportional to their distance. The analogy to the law of gravitation in physics is obvious.

The gravity model was the first *spatial interaction* (or in short *SIA*) model. Its straightforward physical analogy has later been replaced by better founded formulations derived from statistical mechanics (Wilson, 1967) or information theory (Snickars and Weibull, 1976),

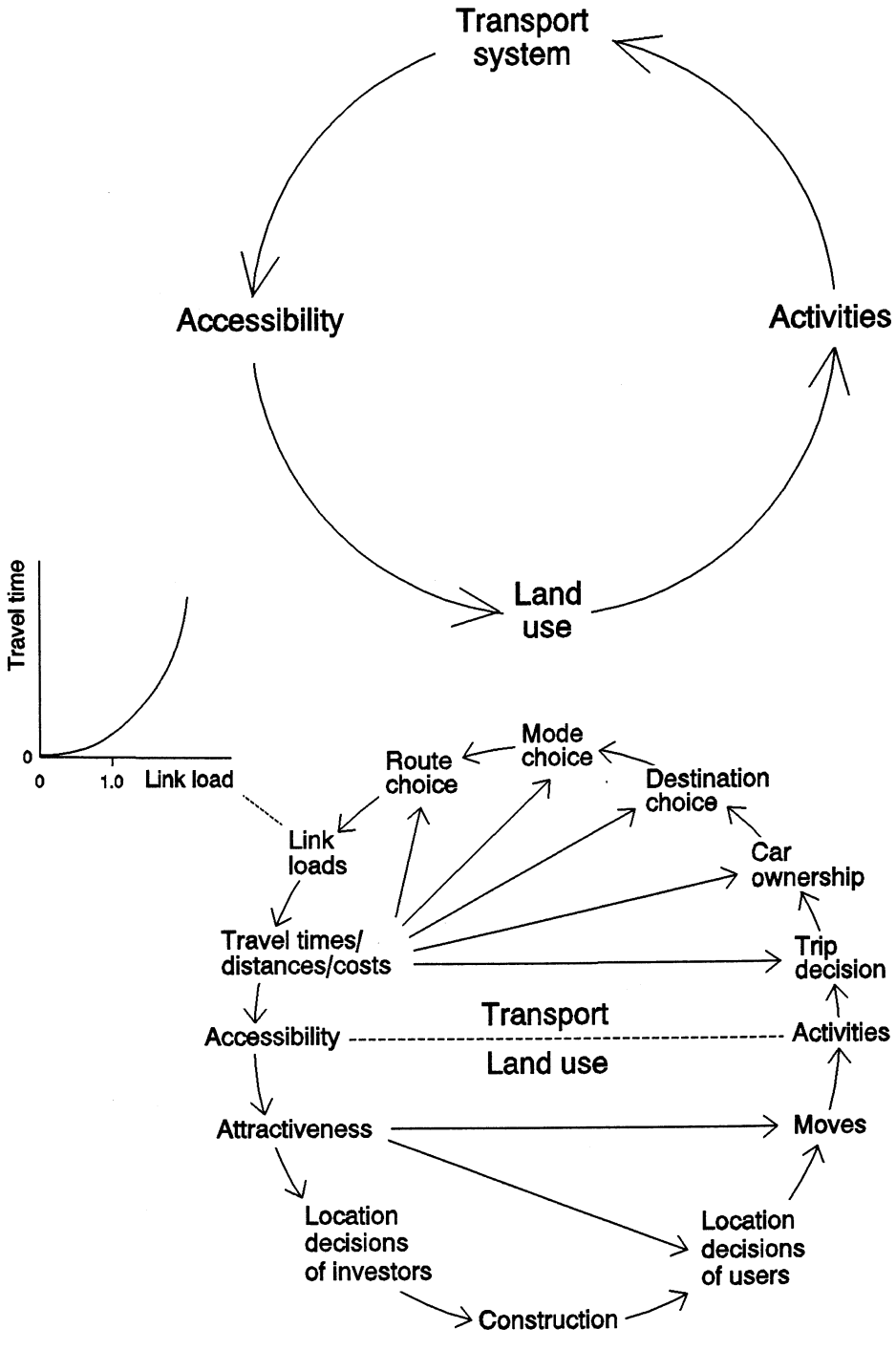

Figure 3.1. The 'land-use transport feedback cycle'. *The distribution of land uses determines the locations of human activities, which in turn give rise to trips in the transport system; transport infrastructure creates opportunities for spatial interactions and these in turn codetermine location decisions. The lower part of the figure shows the same cycle in more detail.*

yet even after these substitutions the SIA model did not provide any *explanation* for the spatial behaviour modelled. Only later did it become possible (Anas, 1983) to link it via random utility theory (McFadden, 1973) to psychological models of human decision behaviour (Luce, 1959).

From the SIA model it is only a small step to its application as a location model. If it is possible to make inferences from the distribution of human activities to the spatial interactions between them, it must also be possible to identify the location of activities giving rise to a certain trip pattern. Wilson (1970) distinguishes four types of urban *spatial interaction location models* (see Table 3.1):

Table 3.1. Wilson's four spatial interaction location models.

Type	Constraints	Residence	Workplace
1	unconstrained	predicted	predicted
2	production-constrained	predicted	known
3	attraction-constrained	known	predicted
4	doubly constrained	known	known

Source: Wilson (1970).

Model type 1 deals with households having neither residence nor work place, model type 2 with households looking for a residence and model type 3 with households looking for a job. Model type 4 is actually not a location model but the familiar transport model. The column 'constraints' refers to the marginal totals of the interaction matrix, which act as constraints to its elements if they are known.

Table 3.2 is an extension of Wilson's classification incorporating not only trips but also moves and changes of job, thus taking account of the fact that locational choices in general are choices between *two* locations, the old and the new residence or work-place (Wegener, 1987a). Table 3.2 covers the majority of all SIA location models, including the seminal urban model by Lowry (1964).

Lowry's *Model of Metropolis* essentially consists of two singly-constrained SIA location models, a service and retail employment location and a residential location model, nested into each other. The Lowry model stimulated a large number of increasingly complex modelling approaches such as the work by Goldner (1971), Echenique (Geraldes et al., 1978), Putman (1983), Mackett (1983) and Webster et al. (1988). Boyce et al. (1981) developed combined equilibrium models of residential location, mode and route choice.

Table 3.2. Types of spatial interaction locations models.

Model type	Constraints	Residence		Workplace		Interactions		
		old	new	old	new	Trips	Migration	Labour mobility
Traffic models	doubly constrained	known	-	known	-	predicted	-	-
Migration models	doubly constrained	known	known	-	-	-	predicted	-
Employment change models	doubly constrained	-	-	known	known	-	-	predicted
Residential location models	singly constrained	-	predicted	known	-	predicted	-	-
Employment location models	singly constrained	known	-	-	predicted	predicted	-	-
Housing market models	singly constrained	known	predicted	-	-	known	predicted	-
Housing location models	singly constrained	-	predicted	known	-	-	-	-
Job location models	singly constrained	known	-	known	predicted	-	-	-
Residential/job location models	un-constrained	-	predicted	-	predicted	predicted	-	-

The limits of location models based on the SIA paradigm lie on two levels:

- First, the SIA location model in principle assumes equilibrium between transport and location. In reality, however, this equilibrium does not exist. Urban processes have very different speeds and response times. For instance, the behaviour of transport users very quickly adjusts to changing conditions in the transport system. Conversely, transport investment takes a long time from planning to final implementation. In a similar way the distribution of activities reacts only very slowly to changes in accessibility. Even a simple change of residence or work-place may take months or even years between planning and realisation, whereas the planning and implementation of housing, offices or work places as a rule requires several years (Wegener, 1985a; 1986a; Wegener et al., 1986). This kind of disequilibrium, however, cannot be represented by the SIA location model.

- The second criticism is that the SIA location model lacks any economic content. The only variable explaining location behaviour in the model is transport costs and even these only in so far as they are necessary to model the choice between mobility alternatives. In particular, there is no link between transport costs and other expenditure by households and firms. This makes the SIA location model incapable of considering wider choices than that between transport modes or destinations, such as choices involving trade-offs between transport and location or between housing and work-place location - unless it is embedded into a more comprehensive framework of factors determining the decision behaviour.

It is unfortunate that the mainstream of urban theory-building and modelling adopted this most restricted, engineering-based perception of the urban system as a system of movements. The spatial interaction model, after some twenty years of refinement and generalisation (Williams and Senior, 1978; Coelho and Williams, 1978; Leonardi, 1981; Anas, 1983), is essentially still the atemporal equilibrium model it always was and with each advance in mathematical rigour and elegance seems to move farther away from reality.

In particular the spatial interaction paradigm itself (the myth that workers choose their place of residence on their way home from work) turned out to be a veritable straitjacket which forces things together which should be analysed separately, i.e. the decision to move, to choose a job, to make trips, etc. - although of course these are interrelated, but only in a time-lagged and indirect way. Moreover, there are no people in this paradigm, no households, no entrepreneurs, no landlords, no developers; there are no distorted perceptions, no incomplete information, no uncertainty, no biases, no heuristics, no adaptation, no learning. There are no real change processes, no construction, no upgrading, no demolition, no real supply and demand variables, no rents and land prices, no interaction between supply and demand, no markets, no market distortions such as oligopolies, price controls, legal constraints, public interventions.

Some of these issues have been taken up by more recent approaches. Their common characteristic is their interest in dynamics. The rediscovery of time was motivated partly by new results in the biosciences with respect to the behaviour of complex ecosystems, such as the theory of dissipative structures (Allen et al., 1981), and partly by the availability of new mathematical instruments such as catastrophe and bifurcation theory (Wilson, 1981; Dendrinos and Mullaly, 1985) or the theory of nonlinear dynamic systems (Weidlich and Haag, 1983; 1988; Nijkamp and Reggiani, 1992). However, the application of these new concepts and tools to urban systems still faces serious empirical difficulties.

Nevertheless, the spatial interaction paradigm has led to a better understanding of important dimensions of individual mobility and location behaviour and their interrelationships. Figure 3.2 portrays these interrelationships in a format proposed by Brotchie (1984). The 'Brotchie Triangle' represents the universe of possible constellations of spatial interaction and spatial structure. Spatial structure is represented on the horizontal axis as spatial dispersal (for instance, mean travel distance of employment from the centre of the region), spatial interaction on the vertical axis as some measure of total travel such as mean travel distance to work. Any city will lie between three hypothetical points in the diagram: point A represents a situation in which all jobs are at the centre, i.e. dispersal is zero. Both points B and C represent regions in which all jobs are as dispersed as the population. Point B represents a situation in which all workers maximise travel, point C a situation in which they walk to work. SIA models may answer the question in which direction the real city, point D, will move.

Economic Theories: Cities as Markets

A second set of theories focuses on the *economic* foundations of city growth. Following this paradigm, it is the market function that distinguishes the city from the countryside (Weber, 1921; 1925). Other authors define trade and crafts as the two activities constituting a city (Sombart, 1907): cities come into being if craftsman and farmer are different persons. Thus the city is a product of specialisation and the division of labour. Historically city growth in Europe has been closely linked to economic structural change as, during the first industrial revolution, rural-to-urban migration went hand-in-hand with the reduction in agricultural and the growth in industrial employment.

Jacobs (1969) explains city growth as a three-step process of (1) developing exports and producers' goods and services, (2) converting producers' goods and services into exports and (3) replacing imports by goods and services produced locally, which may lead to more exports, and so on. If this self-reinforcing process fails, i.e. the city is unable to develop new exports, it starts to stagnate or decline.

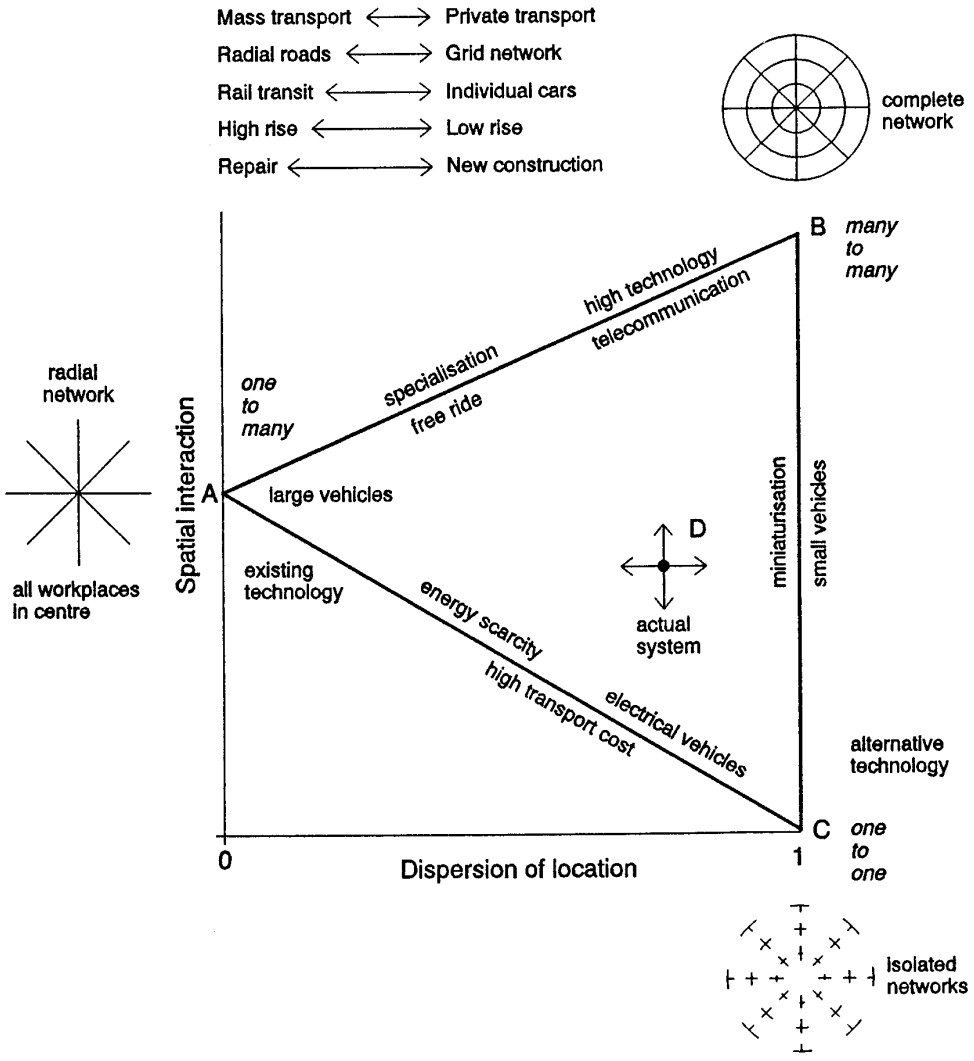

Figure 3.2. The 'Brotchie Triangle'. *The triangle in the diagram represents possible constellations of spatial interaction (y-axis) and spatial structure (x-axis). Point A represents a situation in which all jobs are at the centre, i.e. dispersal is zero. Points B and C represent regions in which all jobs are as dispersed as the population. Point B represents a situation in which all workers maximise travel, point C a situation in which they walked to work. SIA models answer the question in which direction the real city, point D, will move. Source: Brotchie, 1984.*

In regional economics this is called the *economic base* theory, which implies that the regional income, and hence the number of people a region can support, depends on its exports. In its dynamic form, the economic base theory comes in two versions, one equalising and one polarising. The theory of *spatial economic equilibrium* assumes perfect competition and perfect factor mobility and hence predicts equal factor prices, productivity and commodity prices in all regions (Ohlin, 1933). The theories of *growth poles* (Perroux, 1955) or *circular cumulative causation* (Myrdal, 1957), however, predict polarisation between central and peripheral regions because of economies of scale and enhanced possibilities of innovation in the larger industries at the centre.

If transport costs are explicitly taken into account, a hierarchical pattern of market areas around *central places* emerges (Christaller, 1933; Lösch, 1940). Central places of higher levels have all the functions of lower levels, which explains the existence of small and large cities. Manufacturing industries tend to locate close to the locations of raw materials and other inputs, or close to their markets, depending on transport cost differences (Weber, 1909); if they also take account of economies of scale or labour cost, agglomeration or dispersal may occur (Isard, 1956).

Economic location theory becomes more complex if location costs in the form of land prices are taken into account. In this case firms look for the optimum constellation of size (economies of scale) and location (agglomeration economies) given their specific mix of products, technology and pattern of suppliers and customers, whereas households try to match their space needs and location preferences with their budget restrictions. Both firms and households trade off accessibility for space or vice versa.

A fundamental assumption of all spatial economic theories is that locations with good accessibility are more attractive and have a higher market value than peripheral locations. This fundamental assumption goes back to von Thünen (1826) and has since been varied and refined in many ways. In macroanalytic approaches spatial development is the result of spatial production functions incorporating among labour and capital spatial factors such as agglomeration advantages, transport costs and land prices, and it is still disputed under which conditions spatial equilibrium (von Böventer, 1962) or spatial polarisation (Pred, 1966) will occur, or whether there is a cyclical sequence of agglomeration and deglomeration phases (van den Berg et al., 1982). Microanalytic approaches, on the other hand, start from the locational behaviour of individual actors such as firms, landlords or households in the urban land or housing markets.

Probably the most influential example of the latter kind is the model of the urban land market by Alonso (1964). The basic assumption of the Alonso model is that firms and households choose that location at which their bid rent, i.e. the land price they are willing to pay, equals the asking rent of the landlord, so that the land market is in equilibrium.

The bid rent of firms results from the cost structure of their production function, i.e. sales price minus production costs plus profit divided by size of land. A firm with higher added value per unit of land is therefore able to pay a higher price than a firm with less intensive land utilisation, everything else being equal, so it is not surprising that, say, jewellers are found in the centre, whereas trucking companies have their yards on the periphery. Under the simplifying assumption that all goods are sold in the city centre (and need to be transported there), the bid rents of different types of firms follow curves sloping outward from the centre with different degrees of slope; their envelope curve is the equilibrium asking rent (see Figure 3.3, top). The optimum location for a firm is where its bid rent curve is tangential to the envelope curve.

As households have no cost functions like firms, it is necessary in their case to use indifference curves indicating their trade-off between land consumption and distance to the centre (see Figure 3.3, bottom). Each household type has a linear budget restriction, i.e. has to divide its expenditure between land and transport costs. The optimum location for a household is where its budget line and indifference curve are tangential.

Alonso's model was the point of departure for a multitude of urban economics model approaches (see Nijkamp and Mills, 1987). In more advanced variations of the model, restrictive assumptions such as perfect competition and complete information or the monocentric city have been relaxed (e.g. Anas, 1982). More recent extensions include models to deal with land speculation (Seo, 1989) or the behaviour of landlords in neighbourhoods undergoing gentrification (Smith and Williams, 1986). Another important development is the incorporation of intersectoral and interregional factor and commodity flows into the model (Williams and Echenique, 1978).

Another group of theoretical contributions have drawn attention to the importance of *innovation* for urban development. These approaches refer to the *theory of long waves* first proposed by Kondatrieff (1926) and Schumpeter (1939). According to this theory, economic history is a succession of growth phases triggered by 'basic innovations' such as the steam engine, the railway or the automobile. Each of the earlier technologies went from invention through take-off and rapid growth to saturation and was eventually superseded by a more advanced technology. The technology of the 'Fifth Kondratieff' is information technology. The fourth 'logistical revolution' has fundamental implications for the spatial organisation of society (Marshall, 1987).

Many authors have observed that cities and regions develop in a wave-like fashion (Blumenfeld, 1954; Pred, 1966; Korcelli, 1970; Gottlieb, 1976). Now, following the theory of long waves, cities and regions, just like industries, have their life cycles to the degree that they are associated with a certain technology. If they are linked to a declining technology, they decline; if they are associated with a growing technology, they grow (Hall, 1981).

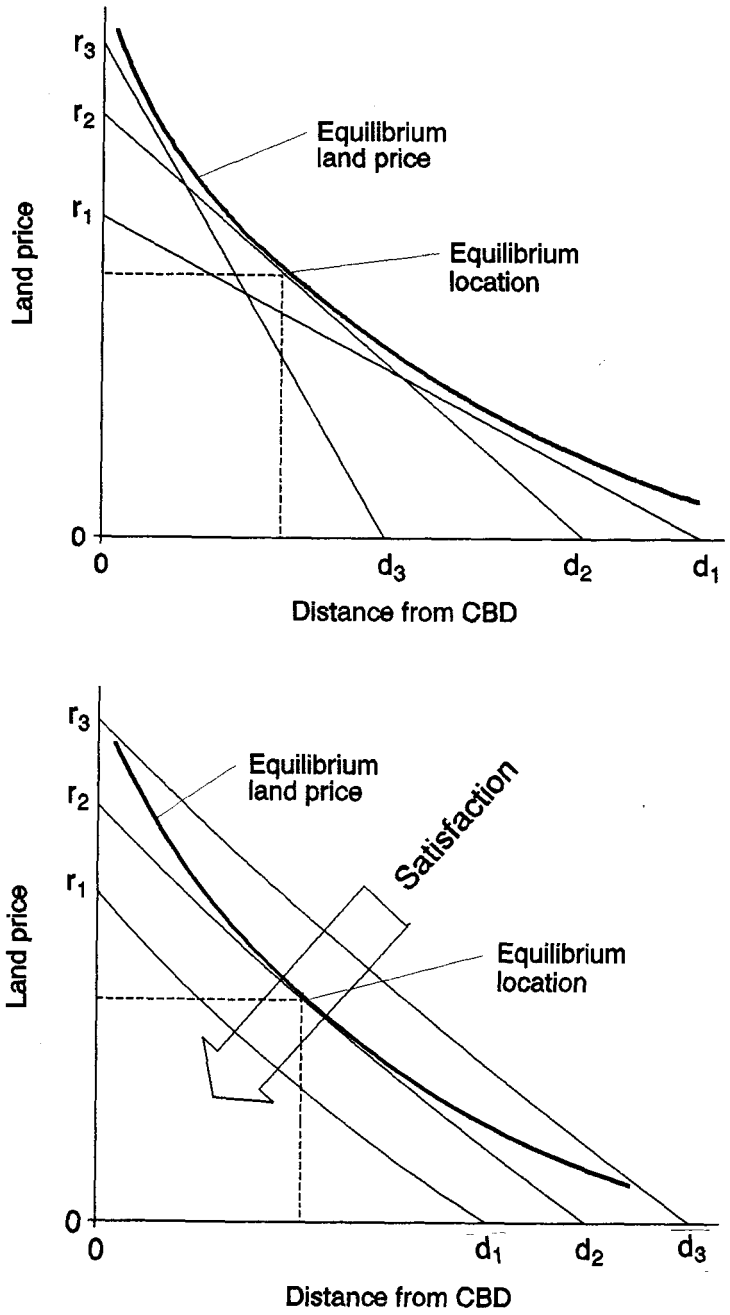

Figure 3.3. The model of urban land markets by Alonso (1964). *The bid rents of firms follow curves sloping outward from the centre; their envelope curve is the equilibrium rent. The optimum location for a firm is where its bid rent curve is tangential to the envelope curve (top). The optimum location for a household is where its budget line and the indifference curve indicating its trade-off between land consumption and distance to the centre are tangential (bottom).*

The product-cycle theory applied to urban development explains why in the history of cities powerful and prosperous cities went into decline: Florence, Venice, the Hanseatic League, Lisbon, Amsterdam and Liverpool declined because innovations in transport technology shifted trade flows away from them to other regions or cities. This was discussed above under the heading of technical theories of urban development, but here the argument goes further: even cities with excellent transport links decline if they stick to older products and production technologies, and this explains why industrial cities in the heart of Europe are declining, while new centres of electronics and other high-tech production are rising.

However, today these shifts signal more fundamental changes in the economic environment (see Scott and Storper, 1986; Läpple, 1986; 1989; Bremm and Danielzyk, 1991):

- The most advanced industrial sectors are undergoing what is described as the transition from 'Fordism' to 'post-Fordism': Fordism indicates the era of mass production dominated by economies of scale. In the post-Fordist economy a new flexibility of the production process is achieved in response to increasingly selective tastes in more and more saturated markets: economies of scale are complemented or replaced by 'economies of scope', made possible by vertical integration of all steps of the production process from supply to delivery by computer control and telecommunications in 'logistic chains'. Earlier steps in the assembly chain are contracted out to outside suppliers, who have to synchronise their operations with the production schedule by 'just-in-time' delivery, thus making large inventories redundant.

- Advances in transport technology and disappearing trade barriers have brought an enormous increase in international trade. Telecommunications and low freight rates have made logistic chains between production processes on different continents and their control from any point in the world feasible. Commodity and capital markets are becoming increasingly global, leading to a separation of production and financial transactions.

This theoretical framework helps to explain the current pattern of urban growth and decline found in many countries. As industrial cities are linked to the Fordist production system, they lack the flexibility to respond to rapidly shifting market demands, and this explains why deindustrialisation in these regions continues. Advanced industries given the choice prefer other regions not associated with the negative image of the smokestack industries; this explains the appearance of specialised high-tech regions such as Silicon Valley, the M4 corridor west of London or the success of Munich or Stuttgart, and why in some countries urban growth and urban decline exist side by side.

The theory also explains the rise of the global metropolis as a corollary of the global economy and the emergence of a new hierarchy of cities based on high-level service functions not related to production.

Similarly, the theory helps to explain the spatial polarisation observed within urban regions. Flexible production and distribution systems require extensive, low-density sites with good access to the regional and local road network, and this explains why new manufacturing firms prefer suburban locations. Retail facilities tend to follow their customers to the suburbs and similarly prefer large suburban sites with good road access. High-level services, however, continue to rely on face-to-face contacts and, despite fax machines and electronic data interchange, remain in the city centre. The result is the spatial dispersal of all economic activities except high-level services and the progressive erosion of activities in the city centre.

Social Theories: Society and Urban Space

In social sciences theories of urban development the spatial development of cities is the result of individual or collective appropriation of space.

Since Durkheim and Simmel there are in sociology traditions in which the city is a fundamental dimension of human existence. Other authors have defined the city as the interface between public and private society (Bahrdt, 1969), the stage for social interaction and self-expression (Goffman, 1959), the medium for the world of daily life (Lefebvre, 1968) or the field of action of social movements (Harvey, 1973; Castells, 1977). However, as a rule, these approaches remained essentially social theories and failed to deal explicitly with the spatial and temporal dimensions of urban development.

The study of the urban past remained the domain of urban historians like Mumford (1938; 1961) or Gutkind (1964-72). Their method was essentially hermeneutic, i.e. aimed at understanding individual processes as unique constellations of specific causes and effects. Beyond the observation of similarities in different places at different times, no regularities or law-like covariations of variables were sought.

This changed when, between the wars, the Chicago school of urban sociologists looked more closely into processes of social change on the neighbourhood and urban levels. Based on an adaptation of evolutionist thoughts from philosophy (Spencer) and biology (Darwin), they interpreted the city as a multi-species ecosystem, in which social and economic groups fight for 'ecological positions' (Park et al., 1925; 1936).

In spatial terms the ecological position is a territory such as a neighbourhood or a region. Appropriation of space takes place as invasion of different ethnic or income groups or tertiary activities in a residential neighbourhood and uses concepts of animal and plant ecology such as 'invasion', 'succession' or 'dominance' to describe the phases of such displacement.

These concepts were empirically testable and could be used for generalisations and theory building. Consequently, a number of qualitative theories of urban development were put forward to explain the spatial expansion of American cities, such as the concentric (Burgess, 1925), sector (Hoyt, 1939), or polycentric (Harris and Ullman, 1945) theories of city growth. However, despite their spatial labels, these theories, too, were essentially social theories. Space and time were included in them only in categorial terms, since analytical methods for treating intervals in space and time were only rudimentarily developed. Moreover, all urban ecology theories were in effect anti-evolutionist in that they assumed, in a questionable analogy to biological systems, an inherent tendency of social systems to converge to a stable equilibrium.

Despite these shortcomings, concepts from social ecology continue to be useful for understanding the mechanisms of social change in cities beyond the economic processes on the land market. For instance, in recent years they have been used to explain 'gentrification' processes, the invasion of upper-middle-class households into inner-city or suburban working-class neighbourhoods (Smith and Williams, 1986).

Social geography theories are related to social ecology concepts, but go beyond their macro perspective by referring to age-, gender- or social-group-specific activity patterns which lead to characteristic spatio-temporal behaviour, and hence to permanent localisations. Action-space analyses (e.g. Chapin, 1965; Chapin and Weiss, 1968) identify the frequency of performance of activities reconstructed from daily space-time protocols as a function of distance to other activities and draw conclusions from this for the most appropriate allocation of housing, workplaces, shopping and recreation facilities or the optimum level of spatial division of labour in cities.

Hägerstrand (1970) made these ideas operational through the introduction of 'time budgets', in which individuals, according to their social role, income and level of technology (e.g. car ownership) - subject to various types of constraints ('capacity constraints', coupling constraints' and 'institutional constraints') - command *action spaces* of different size and duration. Only locations within these action spaces can be considered for choice. It is the achievement of the 'time geography' of the Hägerstrand school to have drawn attention to the various kinds of captiveness caused by a land-use and transport system designed for the needs of the affluent and able: the restricted mobility of women with children, the elderly and the handicapped.

Making the public aware of the inequity and deprivation found in contemporary cities has always been a commitment of many urban sociologists, and this has become more urgent in a time when neo-liberal policies threaten to weaken the social network of the welfare state in the interests of economic growth. Each country has its own tradition of socially-conscious writing, so it may suffice here to refer back to the section on the divided city in Chapter 1.

It is worth noting that social science tends to be good at reporting disparities, but weak at pointing to the underlying causes of injustice unless it borrows from political science (see below).

In one way or another all sociological urban theories referred to so far are reductionist in that they highlight certain aspects of reality at the expense of a more holistic view of urban society. In contrast to these reductionist views, there continue to be sociological approaches in which urban space is more than an ecological position or action space, but an object of local attachment and belonging (Treinen, 1965, see Figure 3.4). Spatial appropriation then is not only the confirmation of locational choices once made but a process directed towards self-determination in dealing with one's physical environment and thus a part of a larger process of democratisation of the use of space and of spatial planning (Obermaier, 1980).

Political Theories: The Corporate City

Unlike economic and social theories of urban development, political-science or political-economy theories focus on the role and function of the state versus the private actors of urban development.

Where this is done on the basis of Marxist theory of economy and society, the state is predominantly an instrument for the avoidance of conflict in the interests of private capital accumulation (see, for instance, Harvey, 1973; Castells, 1977 or Scott, 1980). It is the achievement of theoretical writers of this school to have exposed the darker sides of capitalist spatial development, the recklessness of its exploitation of spatial resources and the environment and its inherent insensitiveness to the social inequities and spatial disparities it tends to create in its relentless pursuit of economic growth. These warnings are at risk of being forgotten after the failure of the socialist model of planning in Eastern Europe.

In non-Marxist theories of political economics, however, the state itself becomes the entrepreneur who, through infrastructure and property rights, 'produces' locations (Bökemann, 1982) and so actively intervenes in the urban development process. In more recent popular 'theories' it is postulated that "a mayor must run his city like a business else he has no business to deal with" (Duckworth et al., 1986). City marketing, polishing the city's image and creating a *milieu* favourable for innovation (Andersson, 1985, Aydalot and Keeble, 1988) are the prime objectives of successful 'urban managers'.

There is much evidence that this view has largely replaced the traditional understanding that local government has, in the first instance, to take a neutral, mediating position between the conflicting interests and, when conflict exists, to stand for the rights of the underprivileged.

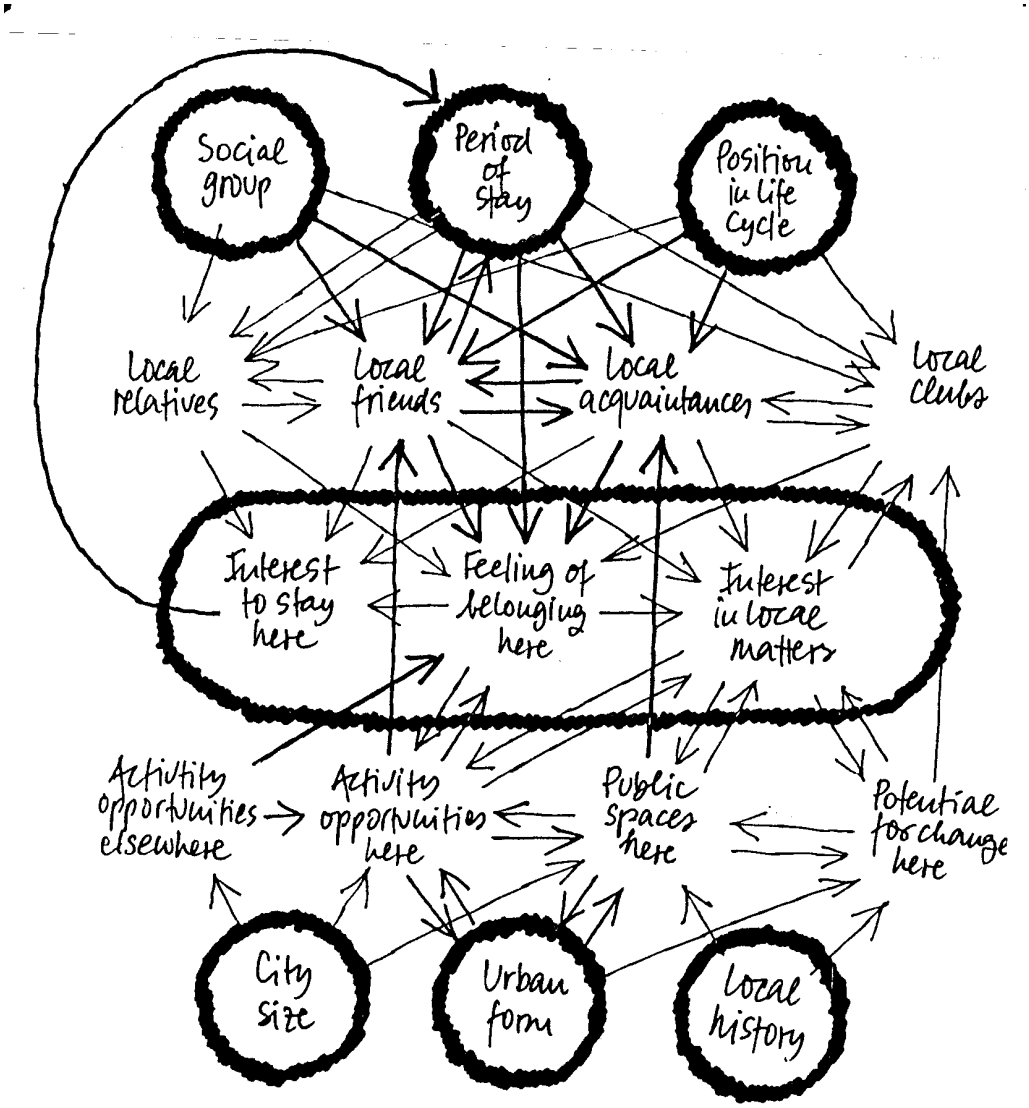

Figure 3.4. Non-reductionist theories of spatial appropriation. *There continue to be sociological approaches in which urban space is more than an ecological position or action space, but an object of local attachment (Treinen, 1965). Spatial appropriation then is not only the confirmation of locational choices once made but a process directed towards self-determination in dealing with one's physical environment and thus a part of a larger process of democratisation of the use of space and of spatial planning" (Obermaier, 1980).*

The new corporate city, in its efforts to promote economic growth, is more interested in seeking alliances with the economically powerful in so-called 'public-private partnerships', even if it means giving up some part of its constitutional sovereignty.

A novel view of these developments has recently been suggested by the 'regulationist' school. This post-Marxist political-economy theory, which from its French origin (Aglietta, 1979) diffused to America and more recently to Germany, has been readily adopted by urban theorists as a new paradigm for studying capitalist cities (Krätke et al., 1990; Krätke, 1991; Bremm and Danielzyk, 1991).

The principal theorem of the regulationist school is that economic history is a sequence of *accumulation regimes*, or different modes of organisation of production and distribution, and that each accumulation regime is associated with a different *mode of regulation*. A mode of regulation is the totality of institutional forms, networks and standards shaping the expectations and behaviour of the relevant actors. With the transition from Fordism to post-Fordism, the mode of regulation changes from a highly regulated 'Keynesian' system, with a strong interventionist state, towards a deregulated liberalised system in which the state retreats from all activities the market is believed to perform better, rewards entrepreneurial behaviour and is willing to accept a certain amount of inequality in favour of economic growth.

The implications for urban development are of three kinds. First, the theory explains the weakening role of local governments in the face of the growing power of private-sector investors or business interests, the privatisation of public services and the mushrooming of public-private partnerships. Second, it signals an ultimate ceiling for all second- or third-class cities, which have to give up their dreams of competing with the first league of cities with international headquarters or financial functions. Third, it indicates that social and spatial disparities in cities are likely to increase.

A critique of regulationist thinking would address its underestimation of the stability of institutional structures, especially in old industrial regions with a solid Social-Democrat power structure. Ironically, public-private partnerships with overpowering private actors have always been the rule in 'company towns' like Dortmund.

By the same token the theory can be criticised for underestimating the importance of the large number of 'little' private actors, such as small and medium-sized firms or households, for urban development, although these can be shown by their sheer numbers to significantly determine the course of urban development. Most importantly, however, the regulationist view completely neglects the existence of *social* conflict leading to social movements, citizens' action groups, environmental protests and the like, which have demonstrated their power to change, and sometimes completely halt, the course of local decision-making.

The countervailing power of these movements is addressed by theoretical approaches which investigate the potential of 'planning from below' through self-organisation on the assumption that "only by the cooperation of enlightened citizens" (Offe, 1969) can the mechanisms of private competition for the best locations be transcended. People associated in grassroots organisations articulate their resistance against the destruction of quarters which have evolved in the course of centuries and of the few remaining urban ecosystems.

In the recent past the resistance has usually crystallised around large projects involving transport infrastructure such as urban motorways or bypasses, the benefit of which is increasingly being called into question. In particular younger people and transport planners are coming to suggest alternative, socially and environmentally more acceptable forms of urban mobility in which through better spatial co-ordination of activities and the promotion of slower modes of transport such as walking or cycling, a lower level of urban mobility and spatial division of labour is achieved (see, for instance, Whitelegg and Holzapfel, 1992). It is difficult to assess whether these movements will be sufficient to convince society to break out of the vicious circle of increasing mobility and spatial division of labour and to return to a closer spatial integration of urban activities.

A Unifying Theory of Urban Development

Each of the above theoretical approaches captures important aspects of the origin, growth and decline and changing internal organisation of cities, yet none of them is general enough to explain the coexistence of different patterns of urban developments at one point in time on both the macro and micro level in a comprehensive and yet simple theory.

In this section an attempt is made to suggest a way how such a theory might be composed from the elements discussed in the previous section cutting across disciplinary boundaries and perspectives. The theory is *eclectic* in that it utilises ingredients from the engineering, economic, social and political schools of thought sketched out above. The theory can be expressed in macro and micro terms.

Macro Level: Urban Life Cycles

On a macro level of explanation, the unifying theory is based on the theory of *urban life cycles*, which was used above for the description of the phases of urban development in Europe in Chapter 1. To recapitulate, this theory identifies typical phases of urban development from growth to decline in terms of differential growth in the core and periphery of metropolitan areas (Hall and Hay, 1980; van den Berg et al., 1982 and van den Berg, 1987):

- In the *urbanisation phase* urban growth occurs predominantly in the core, where nearly all jobs and most residences are located. The lower-density suburbs wholly depend on the core.

- In the *suburbanisation phase* the suburbs grow faster than the core. Residential development in the core declines for lack of space. The majority of work places is still in the centre, but gradually jobs follow people. Eventually the core starts to lose population and later jobs, but the metropolitan region overall still grows.

- In the *deurbanisation phase* development shifts further out to the urban periphery and beyond. The core loses more people and jobs than the suburbs gain, i.e. the metropolitan region overall declines.

These phases are related to the economic and social development of a country (cf. Friedrichs, 1985):

- *Urbanisation* is the consequence of the *economic transition* from an agricultural to an industrial society. Mechanisation of agriculture makes rural labour redundant and leads to rural-to-urban migration, while in the cities the growing industries develop an increasing demand for labour.

- *Suburbanisation* begins when the country also enters the *demographic transition*, i.e. the sequence of declining mortality and subsequent declining fertility, which in its first phase results in rapid population increase which cannot be accommodated within the core cities.

- *Deurbanisation* is the result when both the economic and the demographic transition have completed their course, i.e. when natural population decline continues without a major economic upswing attracting immigration.

Theses phases of urban development are experienced by *all* cities irrespective of their economic growth or decline. However, economic success retards the transition to deurbanisation or leads the city into a new phase of urbanisation, whereas economic decline does the converse. *Reurbanisation*, i.e. a reconcentration of the population in the core during a period of total population decline, is a rare phenomenon because it implies one or a combination of the following unlikely events: (a) massive housing construction in the core, (b) a recession or rising housing costs leading to overcrowding, (c) restrictions on mobility such as drastic price increases for petrol making suburban living unaffordable.

The most likely scenario of urban development, therefore, is continued spatial dispersal. In the absence of effective public intervention, the same trends in socio-economic context and life styles that were also responsible for suburbanisation in the past, such as rising incomes, more women going out to work, smaller households, more leisure time and a consequential change in housing preferences, will continue to create a demand for more spacious living in attractive neighbourhoods,

and this will continue to be easier to realise on the urban periphery, preferably in the vicinity of small towns with attractive town centres and up-market shopping facilities. Retail and service facilities will continue to follow their clients to the suburbs, as will the new 'clean' industries which depend on the highly skilled middle-class labour living in the suburbs. The result will in the best case be a park-like rural-urban continuum, and in the worst case a nightmare of urban sprawl.

From a social and environmental point of view the results of the deconcentration process are generally considered to be negative: longer journeys to work and shopping trips, more energy consumption, pollution and accidents, excessive land consumption and problems of public transport provision in low-density areas. A dispersed settlement structure relies on access to car travel as a prerequisite for taking advantage of employment and service opportunities, and thus contributes to social segmentation. Inner cities, except for the largest and most successful metropoles with a prosperous, 'international' central area, are victims of the exodus of people and jobs and can at best hope to survive as one among several regional centres. Inner-city housing areas will continue to become marginalised as the younger and more active segments of the population leave because of the run-down housing stock, traffic noise and lack of parking space, unless the total existing population is displaced by gentrification or tertiarisation - though these are themselves signs of economic prosperity and hence occur predominantly in successful cities.

The chances that national, regional or local governments might make serious efforts to halt or even reverse these tendencies are not very high. On a national scale, there would hardly be a majority in the population to significantly restrict automobility by higher petrol taxes. Regional and local governments have hardly any choice to opt out of the murderous economic competition between regions and cities for subsidies, investment and jobs, a competition certain to become even fiercer with increasing European integration. This makes it unlikely that policies that might impair the attractiveness of a city for investors, such as measures to enforce stricter environmental standards or to curb land speculation or escalation of housing rents, will be implemented. The likely consequence is that social segregation and spatial disparities in cities will continue to increase.

Micro Level: Actors, Choices, Transitions

On a micro level of explanation, urban development is understood as a subprocess of total societal development, which is the result of thousands or millions of human decisions, many small and some large, occurring over time as a broad stream of concurrent, unrelated or interrelated, individual or collective choices (Wegener, 1986a). A microanalytic theory of urban development therefore has to decompose the total process into subprocesses, and within these identify the main actors and their decision behaviour.

Following Snickars et al. (1982), urban *change processes* can be classified with respect to their temporal characteristics as in Table 3.3 (Wegener et al., 1986). It can be seen that the average response time of urban change processes ranges from less than a year to a human lifetime, and that the duration of the response can be even longer:

- Slow processes. Human settlements evolve over a long time span by the cumulative efforts of many generations. The resulting physical structure of cities displays a remarkable stability over time prevailing even after major devastations such as wars, earthquakes or fires, and changing only in small increments in normal times. *Non-residential construction* is concerned with capital-intensive industrial or public buildings with an average life span of well over fifty years. Planning, land development and construction may take several years, hence a delay of between three and five years from the first decision to invest and the completion of the building is not uncommon. Similar, but somewhat shorter delays are normally associated with *residential buildings*, which also have a slightly shorter life span. However, major *transport networks* tend to be the most durable and also involve the longest time lags between planning and completion. The long life spans of the physical stock is reflected in the low rates of change: normal replacement amounts to only between one and two percent of the existing stock each year.

- Medium-speed processes. There are more rapid fluctuations or cycles affecting a city. *Economic changes* reflect the response of the economic system to cycles of prosperity and recession, exports and imports, resources and prices. In general, the response is immediate but frictions on the labour market or union power and government controls may delay the adjustment process. *Demographic changes* comprise a variety of changes affecting population and households, hence there is a large variation in response time and duration. Birth, ageing and death affect the number and age distributions of population and households. Their impact on the total size of population and number of households is small, but spread out over a long duration due to the long lifetime of individuals. *Technological change* has strong impacts on all aspects of urban life, in particular on transport and communications. Technological innovations, like new generations of automobiles, buses, underground carriages, new schemes of public transport operation or new telecommunication services, are introduced within a few years and have a technical and economic lifetime of between ten and twenty years. The common characteristic of medium-speed changes is that they do not affect the physical structure of the city but only the way it is used.

- Fast processes. Finally there are even more rapid phenomena of urban change that occur in less than a year's time. They refer to the mobility of people, goods and information. These changes range from job relocations and moves to the daily pattern of trips and messages. A distinction has to be made between relocations and daily movements. Firms relocate into vacant buildings, workers accept a vacant job or households move into vacant dwellings.

Table 3.3. Urban change processes.

Level	Change process	Stock affected	Response time (years)	Response duration (years)
1 Slow	non-residential construction	non-residential buildings	3-4	50-100
	residential construction	residential buildings	2-3	60-80
	transport construction	transport networks	5-10	>100
2 Medium speed	economic change	employment/ unemployment	2-5	10-20
	demographic change	population/ households	0-70	0-70
	technological change	transport equipment	3-5	10-15
3 Fast	labour mobility	work-place occupancy	0-1	5-10
	residential mobility	housing occupancy	0-1	5-10
	daily mobility	traffic	0	2-5

Source: Wegener, 1987a

These types of mobility involve substantial costs and effort and are, therefore, normally undertaken only every five or more years. They do not change the distribution of activities, but affect the composition of vacant and occupied stock. In contrast to this, daily trips have no impacts on distributions in the urban system because they start and end at the same place. They are subordinate to relocation decisions in the short term, although in the long term they play an important role through the accessibility they generate. Daily trips, especially journeys to work, have an ambiguous temporal structure: they are completed within hours, but when seen in a longer time frame they form habitual patterns that do not change much faster than work-place and household locations.

A second dimension to classify urban change processes is with respect to causation. Most of them are the outcome of a more or less rational decision by some sort of actor. However, some processes are not decision-based, but simply the result of time, such as ageing and death. Figure 3.5 decomposes the urban change processes of Table 3.3 into domains and atomistic process modules. Three types of process modules are distinguished:

- *Choice modules (C)*. A choice module represents a choice process in a given context. A typical choice module represents, for instance, the behaviour of a household looking for a dwelling in the housing market (Wegener, 1984b; 1985a). Its propensity to move depends on its satisfaction with its present dwelling. It first chooses a neighbourhood in which to look for a dwelling and this is not independent of its present residence and place of work. The household then looks for a dwelling in that neighbourhood guided by the attractiveness and price of vacant dwellings there. Finally, the household decides whether to accept an inspected dwelling or not. It accepts the dwelling if it can significantly improve its state of housing. If it declines, it enters another search phase.

- *Transition modules (T)*. A transition module represents a transition from one state to another in a given context. A typical transition module, for instance is the evolution of a household during a certain period of time during which it is promoted to another household category with respect to nationality, age, income or size, conditional on the relevant transition probabilities for events such as naturalisation, birth of child, ageing/death, marriage, divorce, relative joins or leaves household (Wegener, 1984b; 1985a). Note also that choice-based events such as marriage or divorce may be treated as transitions if the causal chain behind them is of no interest.

- *Policy modules (P)*. Choice modules in which the decision-maker is a public authority represent decisions by which the public authority directly intervenes in the process of urban development. Note that only policies resulting in physical changes are included in this diagram.

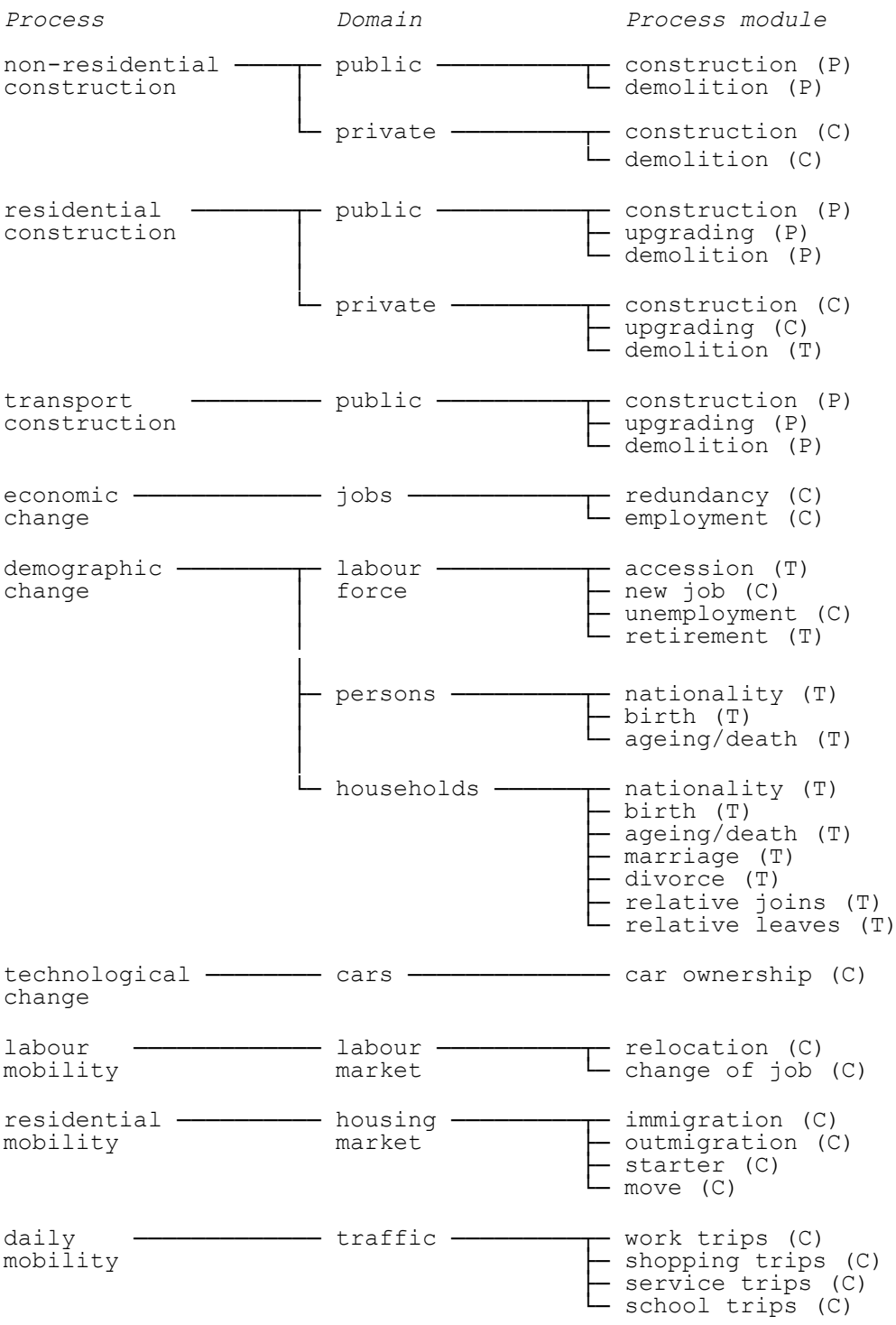

Figure 3.5. Process modules of urban change*. Urban change processes are either the outcome of a decision or simply the result of time. The figure decomposes the urban change processes of Table 3.3 into domains and atomistic process modules. Choice-based modules are indicated by (C), transition-based modules by (T), policy modules by (P).*

The *actors* involved in choice processes of urban development may be either public or private:

- *Public actors* in urban development are governments and government agencies from the local to the national level. Public policy decisions relevant for urban development are direct investment or construction decisions of local governments or other public or semi-public bodies as well as indirect government policies implemented through legislation or regulations regarding taxation, land development, construction, transport or the environment. These public interventions constitute the *planning* component of urban development.

- *Private* actors in urban development are firms, households or individuals. Private decisions relevant for urban development are location, migration and travel decisions which cannot, or can only indirectly, be influenced by public planning decisions. The private actors in urban development interact on spatial markets such as the land and construction market or the housing market. Hence the decisions of private actors constitute the *market* component of urban development.

Thus *planning* and *market* are two fundamental categories of urban development which are contingent upon each other. Public planning sets the framework for the behaviour of private actors or directly intervenes in the market. Conversely, public planning is often merely a reaction to prior market developments or becomes instrumental for the achievement of economically powerful market forces. In many cases the role of public planning has been reduced to the provision of compensatory measures to alleviate spatial disparities caused by market developments.

Depending on the economic and social system, the relative importance of planning and market forces in urban development differ. Here the coexistence of market behaviour and public intervention characteristic of most Western European countries is assumed, i.e. it is assumed that *the majority of decisions relevant for urban development are made by private actors within a decision framework set by public decisions*.

Both public and private actors pursue their possibly conflicting goals. However, it is mainly the behaviour of the private actors which is of interest. The following basic assumptions about the behaviour of private actors are made:

- Actors *attempt* to act *rationally*, i.e. to perceive and accomplish their *preferences*.
- In doing so, they are subject to group-specific economic, institutional and informational *constraints*.
- In response to these constraints, they act as 'satisficers', i.e. are content with obtaining suboptimum *aspiration levels*.
- The aspiration levels are determined by the *experiences* of the actors.
- Actors with low income are forced to *reduce* their aspiration levels.

The *preferences* of actors are multi-attribute. For instance, the attractiveness of a dwelling for a household is a function of its quality and size, the quality of its neighbourhood, its proximity to work-places and to other activities in the region and of its rent or price in relation to the household's income. The attractiveness of a site as a location for a firm is a function of its size and zoning category, the quality of its neighbourhood, its location in the region and its land price. The attractiveness of a given route in the transport network for a traveller is a function of the travel time, travel distance and travel cost it requires compared with alternative routes and to the traveller's perceived travel time and money budgets. The preferences of different groups of actors are different because of their different needs and financial means such as housing or travel budgets.

Constraints are circumstances narrowing the decision margin of actors. Economic constraints are limits to the ability or willingness to pay. Institutional constraints are restrictions of access to services or facilities. Informational constraints are restrictions of the collection of decision information due to lack of time or money. Just like the preferences, the constraints are different for each group of actors because of their different income, social status, education or occupation.

Preferences and constraints determine the behaviour of actors in *decision situations* in which they choose between action alternatives. It is assumed that actors in their daily decision-making use heuristic choice rules such as 'satisficing' (March and Simon, 1958) or 'elimination by aspects' (Tversky, 1972), which means that the results of their decisions are not normally optimum in terms of individual utility maximisation, but represent systematic deviations from the optimum, the distribution of which can be estimated.

This microanalytic framework of individual decision behaviour is necessarily more abstract than the macro theory of urban development presented in the previous section. In Chapter 4 an attempt will be made to bring the two levels together.

4

The Dortmund Model

"What will postindustrial Dortmund look like?" was the question posed at the end of Chapter 2. Several answers were given by the scenarios quoted, each of which painted one possible future for an industrial city like Dortmund.

However, qualitative scenarios, although they have an important function as catalysts for a discourse about desirable and undesirable futures, have their limitations. Usually they are based on only a very restricted selection of data and can address only a small set of aspects; hence they have to work with metaphors leaving it to the reader or audience to fill in the areas not covered. Furthermore, they depend, for good or bad, on the experience and insight, but possibly also prejudices, of their authors. Most importantly, they do not show how the future described can be linked to the present.

Is it possible to do better? Forecasting comes to mind as the traditional way of exploring the future. However, forecasting, at least in its conventional meaning, presupposes a predictable world in which the future is a smooth extrapolation of the past - and this is clearly not the case in urban development. Cities are open systems, i.e. are in continuous exchange with their environment, and are highly indeterministic in their inner structure. To capture this openness and indeterminism, more sophisticated ways of forecasting are required.

One way of exploring the behaviour of open and indeterministic systems is to replicate their essential features in *mathematical models* and use these for *experiments simulating conditions under which the likely behaviour of the system is of interest*.

Simulation as Method

Simulation is a scientific experiment in which the object of the experiment is not reality, but a model of it. Simulation is applied in situations in which experiments with reality are too expensive, too dangerous or impossible (cf. Wegener, 1979).

Models used for simulation can be physical or mathematical or a combination of both (see for instance flight simulators in which aircraft pilots are trained). The discussion here will focus on mathematical models.

Mathematical models consist of *equations* which specify the relationships between model *variables*. The equations contain *exogenous* variables, which represent the environment of the modelled system, and *endogenous* variables, the values of which are determined in other equations. If it is possible to transform a system of simultaneous (interdependent) equations in such a way that all endogenous variables are expressed in terms of exogenous variables, an *analytical* solution is possible. Analytical models have many advantages. One is that it is possible to reverse the model's explanatory direction and infer from its output back to its input, i.e. answer the question which inputs are needed to produce a certain output. In other words, analytical models are capable of prescribing strategies.

However, in many cases analytical solutions are not possible if the number of equations or variables and their degree of interdependency is large. In that case simulation can help. In simulation models the equations are processed sequentially and iteratively. In each iteration the endogenous variables have the values they received in the previous iteration. In this way simulation can be used to solve iteratively equation systems that are too complex to be solved analytically. However, this is not why simulation models are of interest here. Simulation as a method for futures exploration comes into play *if the iterations are interpreted as time periods in each of which new exogenous information can be entered into the system*. In this case the model never comes to an equilibrium but moves from one state of disequilibrium to the next. The sequential operation of simulation models implies that it is not possible to work them backwards. In other words, simulation models do *not* generate strategies.

Instead simulation models have other important advantages. They permit the representation of highly complex systems with all conceivable kinds of numerical and logical interdependencies in mathematically straightforward terms. Neither nonlinearities nor discontinuous functions are a problem. Simulation models are especially suited to reproducing the interplay between fast and slow processes in the modelled system. If time is divided into equal time periods, the output of each period becomes the input for the next period. This is called a *recursive* model. In recursive models the period length serves as the implicit delay of all model responses. In addition, for slower processes longer delays can be specified by using the output of two, three or more time periods previous as input. Of course, recursive models may also contain sets of simultaneous equations embedded within

their time structure. In summary, simulation models impose practically no restrictions in adjusting a model to a modelled system. *Any dynamic structure that can be described in language terms can, in principle, be modelled in a simulation model*.

This explains why simulation techniques have an established place in disciplines where complex systems are under investigation, such as in physics, chemistry, or engineering. Application fields such as weather forecasting, particle physics or ecosystems research today could not exist without large-scale simulation modelling using the largest and fastest computers.

It is suggestive to think of the social sciences, and in particular of the spatial sciences, as a field for simulation modelling. After all, cities and regions are complex socioeconomic, technical and ecological systems which consist of multiple subsystems connected by a large number of interactions and which change continuously subject to changes in their political, social, economic and technical environment. Moreover, real-world experiments are rarely possible where large-scale, indivisible, physical structures and the living and working conditions of real people are at stake. Consequently, it seems only natural that urban and regional planners should apply sophisticated simulation models to explore corridors of future development for their city or region and anticipate the likely impacts of possible planning interventions.

In fact, there is a long history of ambitious efforts to introduce simulation techniques into planning since the appearance of the first digital computers in the late 1950s. However, almost thirty years after Lowry's (1964) pioneering work, it can be said that with very few exceptions (Putman, 1983; 1992; Echenique et al., 1990), none of these models has made a permanent impact on planning practice and only few of them have survived as research tools in university departments.

The reasons for this general failure have been analysed elsewhere (Wegener, 1979; 1983a; 1985b; 1987b; 1988). Certainly it was not due only to the limitations of early computers or to the imperfection of data or to the lack of theory about the processes modelled. The deeper reasons had to do with the change of planning paradigm from the ideal of synoptic rationalism to the incremental planning model based on negotiation and mutual adjustment. The new style of planning needed different types of information which the models were not designed to provide.

A full discussion of these issues would exceed the scope of this book. Whatever the potential merit of simulation techniques for planning practice, as *research tools* they can provide information available neither through traditional forecasts nor through qualitative scenarios. An attempt will be made to demonstrate this in the following chapters. The simulation model used will be the *Dortmund Model* developed by the author and his colleagues at the Department of Spatial Planning of the University of Dortmund.

Model Overview

The Dortmund model is part of a system of models of regional development organised in three spatial levels:

(1) a macroanalytic model of economic and demographic development in 34 *labour-market regions* in the state of North-Rhine Westphalia in the Federal Republic of Germany,

(2) a mesoanalytic model of intraregional location and migration decisions in 30 *zones* of the urban region of Dortmund,

(3) a microanalytic model of land-use development in any subset of 171 *statistical tracts* within Dortmund.

Figure 4.1 shows how the study areas of the three model levels are related to each other.

On the *first* spatial level, employment by industry and population by age, sex and nationality in each of the 34 labour-market regions of North-Rhine Westphalia as well as the migration flows between them are predicted (Schönebeck, 1983). These results establish the framework for the simulation of intraregional location and migration decisions on the *second* spatial level, which in turn provide the framework for the even more detailed simulation of small-scale land-use development on the *third* level (Tillmann, 1985).

The above multilevel model structure has, however, been implemented in only few model applications. At present only the second level of the three-level model hierarchy is operational. This level is the *Dortmund* model.

The following model description is a qualitative summary without equations. More extensive information on the model is contained in Wegener (1981a; 1981b; 1981c; 1982a; 1982b; 1982c; 1983a; 1983b; 1983c; 1983d; 1984a; 1984b; 1985a; 1986b).

The Study Region

The study region of the Dortmund model is the commuter catchment area of Dortmund containing Dortmund itself and eighteen neighbouring communities. The commuter catchment area was defined as all communities with at least 200 daily commuters to Dortmund in 1970 (see Figure 4.2). The resulting urban area is relatively compact; most of its settlements lie within the 30-minute travel-time isochrone by car from central Dortmund. The grey area in Figure 4.2 (A+B) is the urban area of Dortmund in the narrower sense; these municipalities are exclusively oriented towards Dortmund. The dotted areas (C) are larger self-contained cities or communities oriented towards more than one centre.

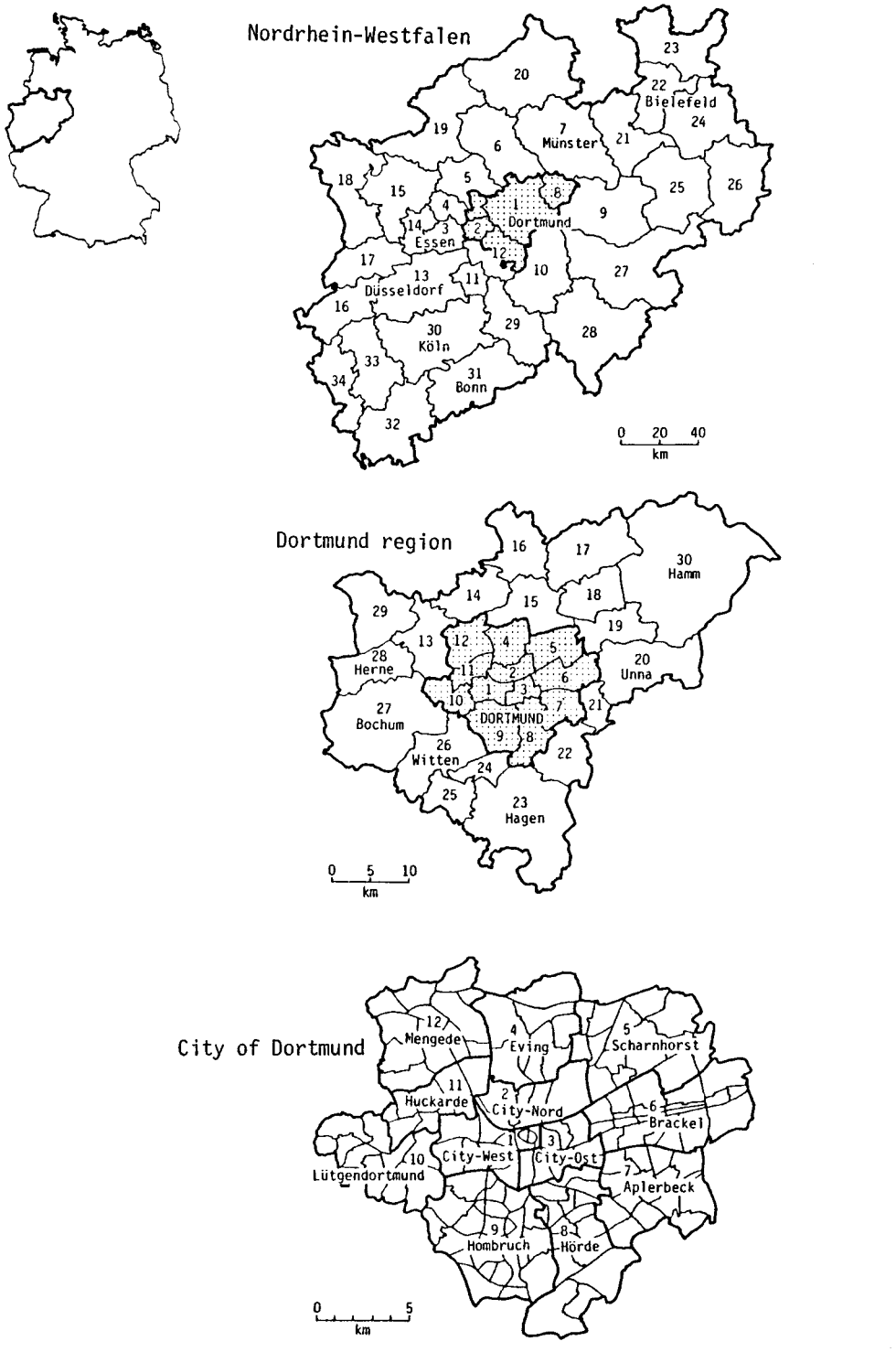

Figure 4.1. The three model levels*. The Dortmund model is part of a system of models of regional development organised in three spatial levels: (1) the state of North-Rhine Westphalia, (2) the metropolitan region of Dortmund and (3) the city of Dortmund.*

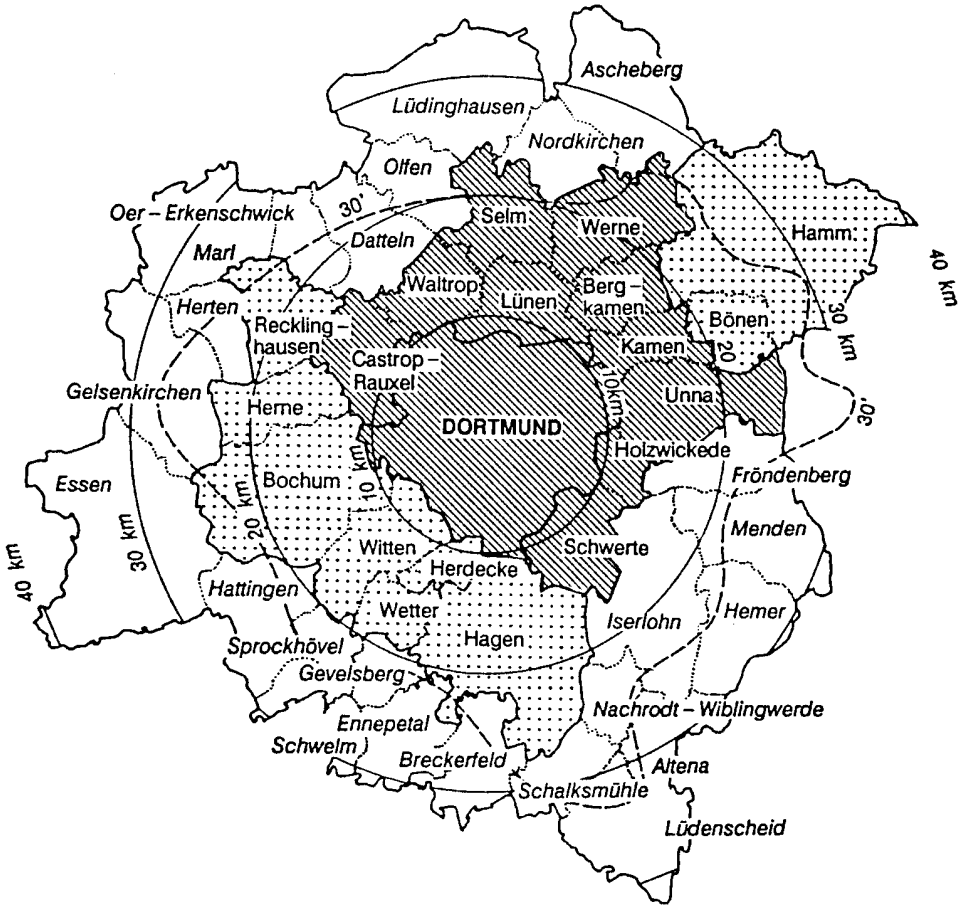

***Figure 4.2. Definition of the study region**. The study region of the Dortmund model is the commuter catchment area of Dortmund containing Dortmund itself and eighteen neighbouring communities. The commuter catchment area was defined as all communities with at least 200 daily commuters to Dortmund in 1970. The resulting urban area is relatively compact; most of its settlements lie within the 30-minute travel-time isochrone by car from central Dortmund.*

Dortmund itself was subdivided into its twelve urban districts. The twelve districts are relatively homogenous in size ranging in population between 40,000 and 60,000, while the municipalities outside Dortmund vary considerably in population between 15,000 and 400,000. The whole region has a population of approximately 2.3 million.

For the analyses in this book, the study region was in addition subdivided into the following five subregions (Figure 4.3):

CA The *Central Area* (Zones 1-3) includes the urban core of Dortmund with Dortmund's central business district (Zone 1), high density inner-city housing areas (Zones 2 and 3) and one of the two steel works still in operation within the city limits (Zone 2).

IS The *Inner Suburbs* (Zones 4-12) comprise the inner ring of mostly residential suburbs still within Dortmund. Dortmund's second steel works is in Hörde (Zone 8). The University of Dortmund, which was founded in the 1960s, is in Hombruch (Zone 9). The urban districts in the south of Dortmund (Zones 7, 8 and 9) are the preferred residential locations.

OS The *Outer Suburbs* (Zones 13-22) contain the incomplete ring of small and medium-sized municipalities north, east and south of Dortmund. Some of them are still partly rural, some have some industry, some are little towns, but all are still very much oriented towards Dortmund. Here, too, the southern communities are preferred as residential locations.

EX The remaining parts of the region are classified as *External Zones*. The chain of small and medium-sized towns between Hagen (Zone 23) and Recklinghausen (Zone 29) serves as a transition area to delimit the region from the rest of the polycentric Ruhr region. Hamm (Zone 30) is a self-contained medium-sized town at the eastern fringe of the agglomeration.

The study region receives its *spatial* dimension through the inter-connection of the zones by transport networks. For this purpose the most important links of the region's public transport network (railway, S-Bahn, U-Bahn, tramway and bus) and the road network were coded in machine-readable form. Both networks were coded together as an integrated, multimodal network including walking and cycling. In addition all changes to both networks between 1950 and the present, and all expected improvements until the year 2000 were incorporated in the coding with time labels indicating the year of opening, change or closure. Figures 4.4 and 4.5 show parts of the regional transport network as it looked in 1990.

The study region receives its *temporal* dimension by the subdivision of time into up to fifteen equal time periods. Simulation periods typically run over two or three years. Depending on the length of the simulation period, the development of the study region between thirty and forty-five years can be simulated.

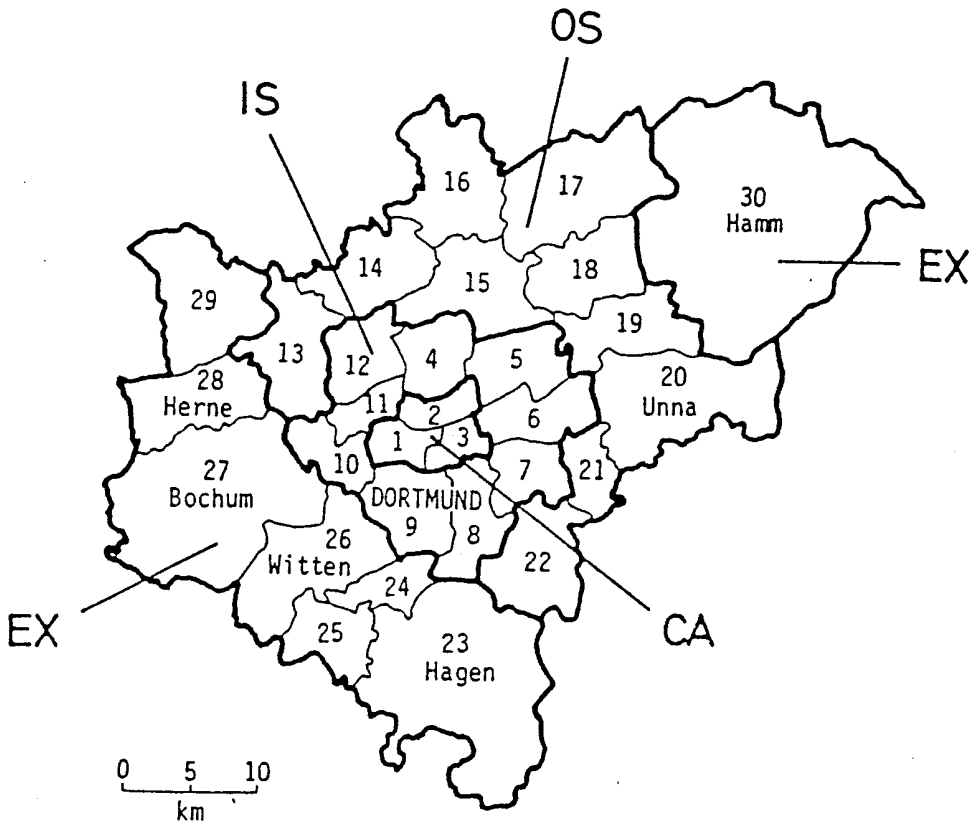

Figure 4.3. The study region with subregions. For the analyses presented in this book, the study region was subdivided into the following four subregions: CA, the *Central Area* (Zones 1-3), IS, the *Inner Suburbs* (Zones 4-12), OS, the *Outer Suburbs* (Zones 13-22) and EX, the *External Zones* (Zones 23-29 and 30).

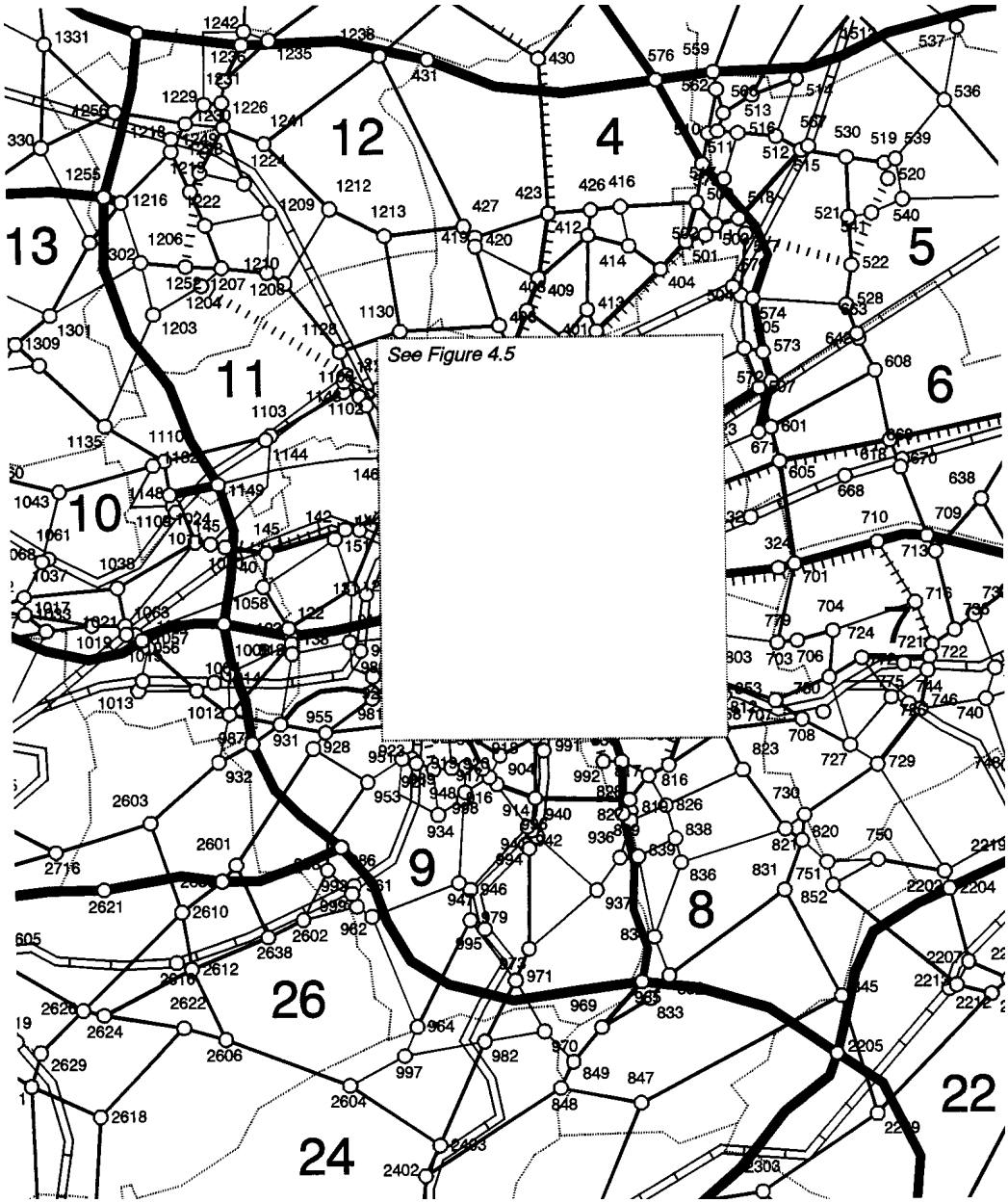

Figure 4.4. Transport network 1990: Dortmund*. The study region receives its spatial dimension by the connection of the zones by transport networks. For this purpose, the most important links of the region's public transport network (railway, S-Bahn, U-Bahn, tramway and bus) and the road network were coded in machine-readable form.*

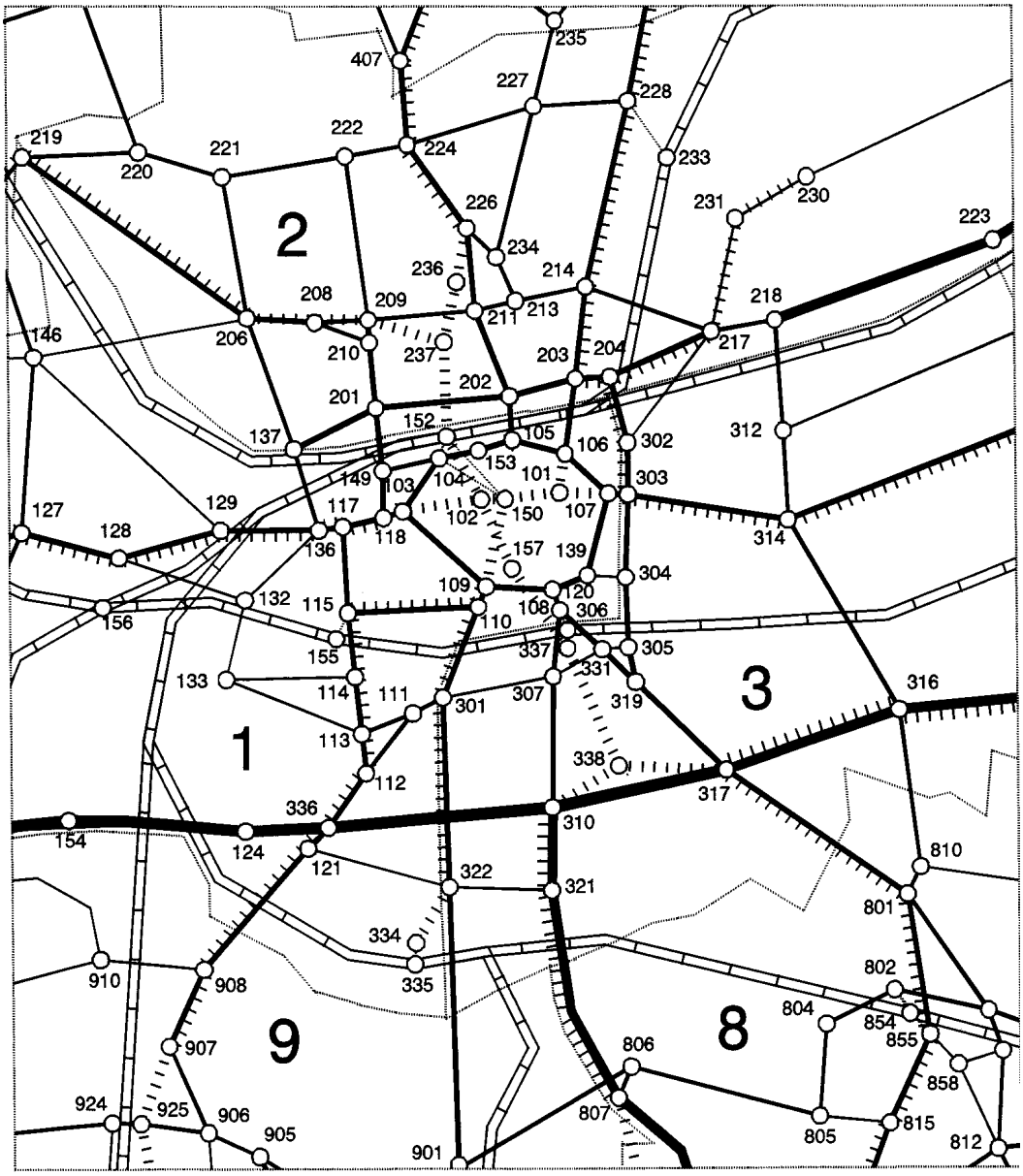

Figure 4.5. Transport network 1990: Dortmund central area. *Both the public transport and the road network were coded together as an integrated, multi-modal network including walking and cycling. In addition, all changes to both networks between 1950 and the present, and all expected improvements until the year 2000 were incorporated in the coding with time labels indicating the year of opening, change or closure.*

Model Structure

For the 30 zones of the study region, the model predicts for each simulation period:

- intraregional *location decisions* of industry, residential developers and households,
- the resulting *migration* and *travel* patterns,
- *construction* activity and *land-use* development,
- the impacts of *public policies* in the fields of industrial development, housing, public facilities and transport.

Figure 4.6 is a schematic diagram of the major subsystems considered in the model and their interactions and of the most important policy instruments.

The four square boxes in the corners of the diagram show the major stock variables of the model: *population*, *employment*, *residential buildings* (housing) and *non-residential buildings* (industrial and commercial workplaces and public facilities). The actors representing these stocks are *individuals or households*, *workers*, *housing investors* and *firms*.

These actors interact on five *submarkets* of urban development. The five submarkets treated in the model and the market transactions occurring on them are:

- the *labour market*: new jobs and redundancies,
- the *market for non-residential buildings*: new firms and firm relocations,
- the *housing market*: immigration, outmigration, new households and moves,
- the *land and construction market*: changes of land use through new construction, modernisation or demolition.
- the *transport market*: trips.

For each submarket, the diagram shows *supply* and *demand* and the resulting *market transactions*. Choice in the submarkets is constrained by supply (jobs, vacant housing, vacant land, vacant industrial or commercial floorspace) and guided by attractiveness, which in general terms is an actor-specific aggregate of *neighbourhood quality*, *accessibility* and *price*.

The large arrows in the diagram indicate exogenous inputs: these are either *forecasts* of regional employment and population subject to long-term economic and demographic trends or *policies* in the fields of industrial development, housing, public facilities and transport.

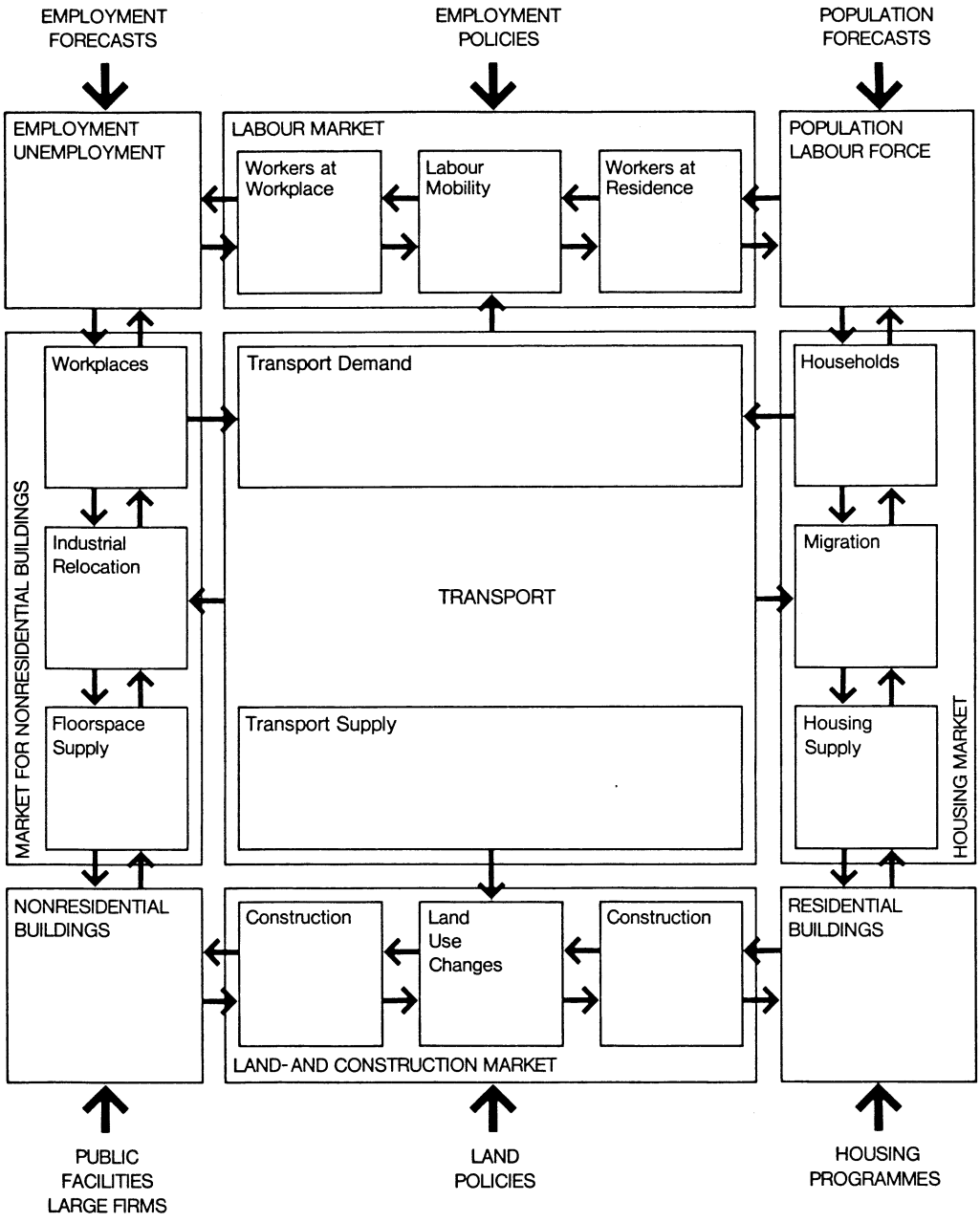

Figure 4.6. Major subsystems of the Dortmund model. *The four square boxes in the corners of the diagram show the major stock variables of the model: population, employment, residential buildings and non-residential buildings. The actors representing these stocks are individuals or households, workers, housing investors and firms. These actors interact on five submarkets: the labour market, the market for non-residential buildings, the housing market, the land and construction market and the transport market.*

Submodels: Overview

The Dortmund model has a modular structure and consists of six interlinked submodels operating in a recursive fashion on a common spatio-temporal database:

(a) The *transport submodel* calculates work, shopping, service, and education trips for four socioeconomic groups, and three modes, walking/cycling, public transport and car. The model seeks to determine a user-optimum set of flows where car ownership, trip rates, modal split and route choice are in equilibrium subject to congestion in the network.

(b) The *ageing submodel* computes all changes of the stock variables of the model which are assumed to result from biological, technological or long-term socioeconomic trends originating outside the model (i.e. which are not treated as decision-based). These changes are effected in the model by probabilistic ageing or updating models of the Markov type with dynamic transition rates. There are three such models, for employment, population and households/housing.

(c) The *public programmes submodel* processes a large variety of public programmes specified by the model user in the fields of employment, housing, health, welfare, education, recreation and transport.

(d) The *private construction submodel* considers investment and location decisions of private developers, i.e. of enterprises erecting new industrial or commercial buildings, and of residential developers who build flats or houses for sale or rent or for their own use. Thus the submodel is a model of the regional land and construction market.

(e) The *employment change submodel* models intraregional labour mobility as decisions of workers to change their job location in the regional labour market.

(f) The *migration submodel* simulates intraregional migration decisions of households as search processes in the regional housing market. Thus the migration submodel is at the same time a housing market model. Housing search is modelled in a stochastic microsimulation framework. The results of the migration submodel are intraregional migration flows by household category between housing by category in the zones.

Figure 4.7 visualises the recursive processing of the six submodels. The transport submodel is an equilibrium model referring to a *point in time*. All other submodels are incremental and refer to a *period of time*. Submodels (b) to (f) are executed once in each simulation period, while the transport submodel (a) is processed at the beginning and the end of each simulation period. Each submodel passes information to the next submodel in the same period and to its own next iteration in the following period.

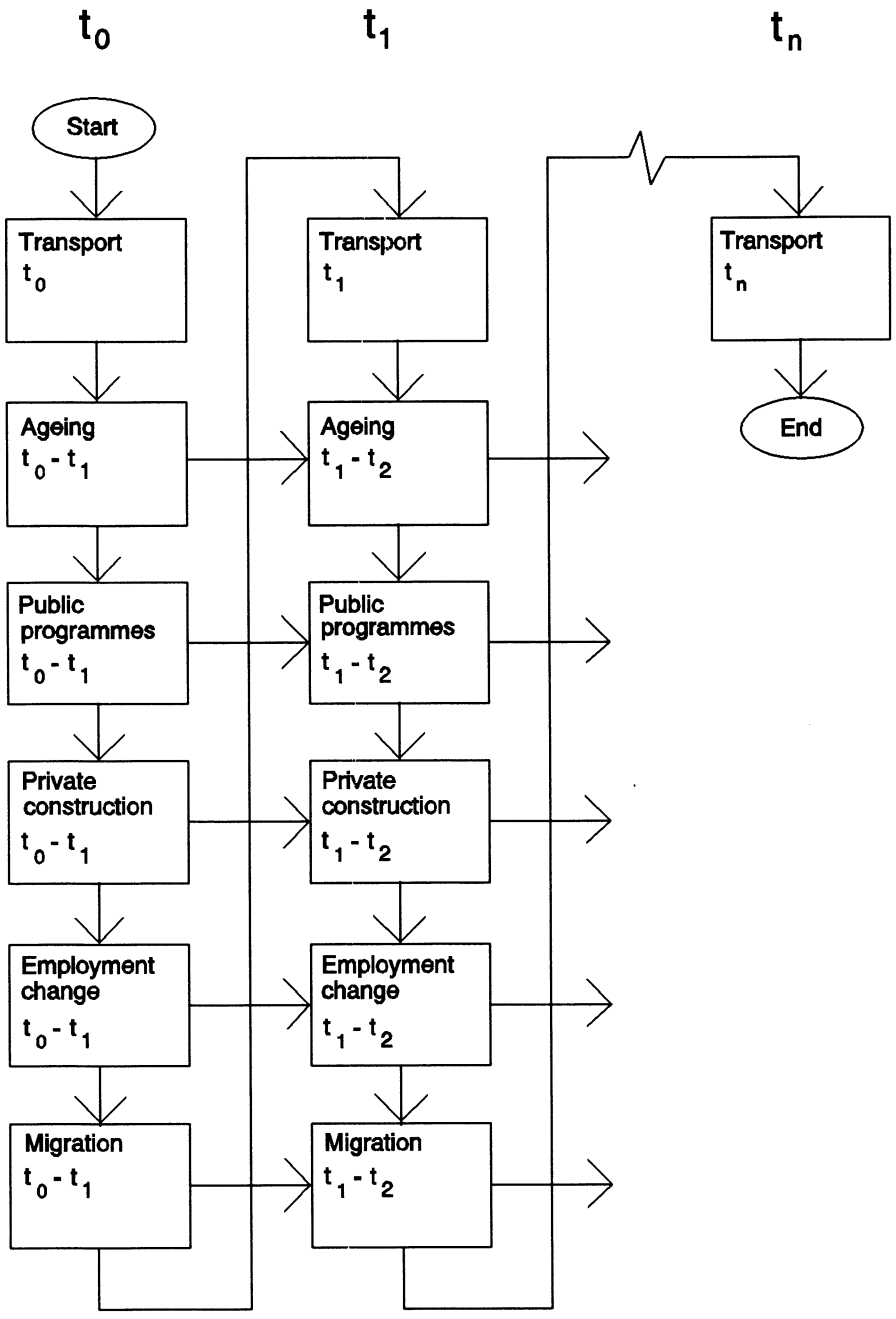

Figure 4.7. Recursive operation of the Dortmund model*. The transport submodel is an equilibrium model referring to a point in time. All other submodels are incremental and refer to a period of time. They are executed once in each simulation period, while the transport submodel is processed at the beginning and the end of each simulation period. Each submodel passes information to the next submodel in the same period and to its own next iteration in the following period.*

Model Assumptions

The Dortmund model is an operationalisation of the unified theory of urban development presented in Chapter 3 or more precisely of its micro-level specification. It follows that it has to be consistent with the macro-level specification of the same theory. In other words, the model is an attempt to reconstruct the aggregate processes postulated in the macro theory from the micro choice and transition processes postulated in the micro theory. It will be examined later in this chapter to what extent this objective has been achieved.

To recapitulate, the micro theory of urban development distinguishes between slow, medium-speed and fast processes:

Slow processes:	· non-residential construction
	· residential construction
	· transport construction
Medium-speed processes:	· economic change
	· demographic change
	· technological change
Fast processes:	· labour mobility
	· residential mobility
	· daily mobility

The response time and duration of these processes vary between a few hours and a human lifetime or more (see Table 3.3). The differences in speed are taken account of in the model by inserting different delays between their stimulus and response.

In addition, urban change processes can be classified by causation and type of actors (see Figure 3.5):

- *Choice* processes are the outcome of location or mobility decisions by private actors.
- *Transition* processes are changes from one state to another in the course of time.
- *Policy* processes are the result of regulatory or investment decisions by public authorities.

Public actors in urban development are governments and government agencies from the local to the national level. Public interventions constitute the *policy* component of urban development. *Private* actors in urban development are firms, households or individuals. Their decisions constitute the *market* component of urban development. In the model only market choices and time-dependent transitions are modelled endogenously; public policies are entered exogenously. However, 'large' decisions by private actors, such as decisions by the Hoesch company to build a new steel work or to close an existing one are included under policies, even though they are not in the strict sense public decisions

Accordingly, the model predicts primarily the behaviour of private actors. It is assumed that private actors

- *attempt* to act *rationally*, i.e. to perceive and accomplish their preferences;
- are subject to group-specific economic, institutional and informational *constraints*;
- act as 'satisficers', i.e. are content with suboptimum *aspiration levels*.

These assumptions are operationalised as follows:

- The *preferences* of actors are modelled as multi-attribute utility functions. A multi-attribute utility function specifies how attributes of a choice alternative contribute to its attractiveness or utility relative to other alternatives in the choice set.

The *constraints* are operationalised in a variety of ways:

- *Economic* constraints are usually expressed as monetary budgets such as the housing or travel budgets of households. Sometimes they are defined as thresholds. For instance, firms are assumed not to select a location if the land or building costs exceed a certain percentage of their turnover.
- *Institutional* constraints in general restrict the choice set. For instance, households above a certain income are not eligible to move into public housing. Those without a driving licence, such as children, cannot drive a car.
- *Informational* constraints also restrict the choice set. One example is that households looking for a dwelling inspect only a limited number of dwellings before making a choice. In other choice contexts, uncertainty and lack of information is implied in the choice model.

Preferences and constraints are different for each group of actors because of their different income, social status, position in the life cycle, education or occupation.

Preferences and constraints are used to model *decision situations* in which actors choose among options under constraints. It is assumed that the choice pattern conforms to the principles of random utility maximisation. Random utility maximisation suggests that the utility of a choice alternative is composed of a deterministic and a random component.

The deterministic component is the utility calculated in the attractiveness function. The random component takes account of factors preventing a completely rational choice such as uncertainty, lack of information or factors which are not specified in the attractiveness function or have to do with the dispersal of preferences among the individual actors in a group of actors. Choices can themselves be alternatives in a choice set, i.e. can be hierarchically nested.

Model Data

The data required for the Dortmund model can be divided into four groups: *model parameters, regional data, zonal data* and *network data*. They are explained below.

Model Parameters

Model parameters are defined as all model input data required to specify the level and shape of model equations. Model parameters can be classified into six groups:

(1) *Demographic parameters*. The demographic parameters essentially consist of survival and birth rates needed for the projection of population development in each zone in the ageing submodel. They are disaggregated by age, sex and nationality, and are forecast separately for each category.

(2) *Household parameters*. The household formation model in the ageing submodel is based on probabilities for events affecting the composition and number of households, such as marriage, divorce, separation of children from their parents, joining of relatives, etc. In addition, the demographic parameters apply also to household members. The event probabilities are forecast for each household age group.

(3) *Housing parameters*. These parameters control the ageing of the housing stock in the ageing submodel, i.e. changes which are only time-dependent. Demand-generated changes to the housing stock such as new construction and modernisation are forecast in the private construction submodel.

(4) *Technical parameters*. The technical parameters include land-use parameters such as the relationship between gross and net floorspace, the land requirements of roads and public facilities and regulations on the provision of parking space, as well as transport parameters such as road capacity by road type and petrol consumption per car-kilometre.

(5) *Monetary parameters*. A large part of the model parameters are monetary parameters. *Income parameters* comprise all parameters necessary to determine the expendable income of households in terms of separate household *budgets* for *housing, transport* and *other purposes and savings* by household income group. For the housing budget, also housing subsidies such as housing allowances, tax benefits, savings bonuses, direct subsidies and loans with their respective regulatory framework are entered. *Cost parameters* encompass all information needed to determine prices in the housing and transport markets such as housing construction, modernisation and maintenance costs and the costs of petrol, car ownership, parking fees and public transport fares. During model execution, all monetary parameters are inflated by their

appropriate inflation rate to yield current budgets and prices for each point in time; in addition most prices are adjusted up or down in response to local demand and supply conditions.

(6) *Preference parameters*. The preference parameters are the parameters of the multi-attribute attractiveness functions of the model. Six different kinds of attractiveness indicators are calculated for sites and dwellings:

- attractiveness of zones as locations for firms,
- attractiveness of zones as locations for housing investors,
- attractiveness of land-use categories for firms,
- attractiveness of land-use categories for housing investors,
- attractiveness of zones as locations for households,
- attractiveness of dwelling types for households.

These attractiveness indicators are combined to overall measures of attractiveness as follows:

- The attractiveness of a site for a firm or housing investor is composed of the attractiveness of the zone in which it is located, the attractiveness of its land-use category and of its land price in relation to expected profit.

- The attractiveness of a dwelling for a household is composed of the attractiveness of the zone (neighbourhood) in which it is located, the attractiveness of the dwelling itself and of its rent or price in relation to the housing budget.

Figure 4.8 shows as an example the hierarchical structure of housing attractiveness with its three main attributes and the lower-level attributes of which they are composed.

In addition, there are preference parameters specifying the perceived utility (or disutility) of transport modes, travel times or travel costs and the trade-offs between them.

Regional Data

As the model is concerned with *intraregional* change processes, it requires information on the overall economic and demographic development of the total urban region. This information may be the output of a higher-level, multiregional, demo-economic model or may be entered exogenously.

The model accepts forecasts for employment by sector in the whole urban region for each point in time between the base year and the simulation horizon, as well as forecasts of total immigration into and outmigration out of the region by age, sex and nationality for each simulation period.

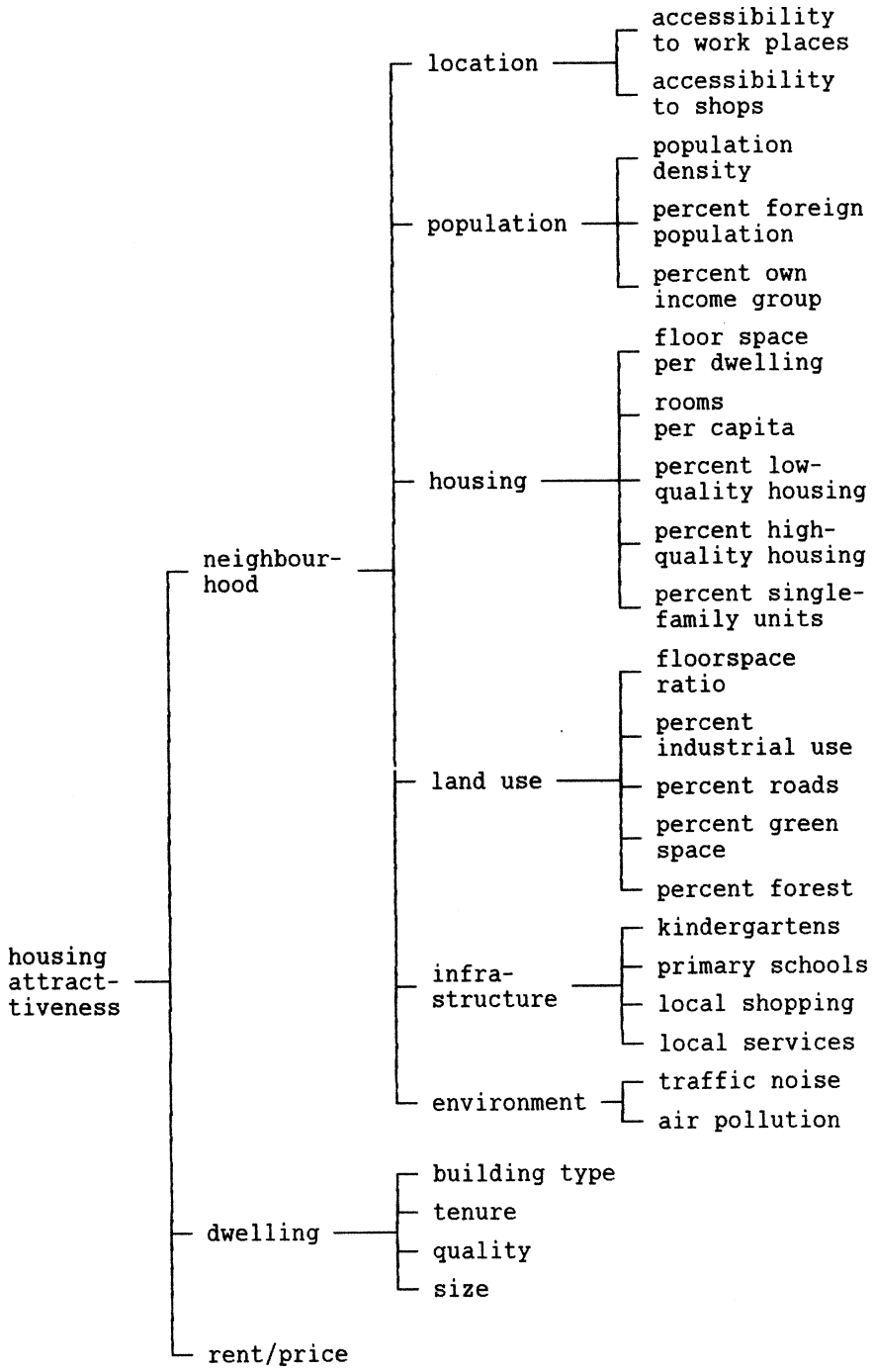

***Figure 4.8. Components of housing attractiveness**. Housing attractiveness is composed of attributes evaluating the neighbourhood, the dwelling and the rent or price in relation to the household's housing budget.*

Zonal Data

The zonal data describe the distribution of urban stocks and activities in the urban region in the base year of the simulation. For each zone the following data are required:

- population
  - nationality (2)
  - sex (2)
  - age (20)
- labour force/unemployed
  - nationality (2)
  - sex (2)
  - skill/income (4)
- households
  - nationality (2)
  - age of head (3)
  - income (4)
  - size (5)
- dwellings
  - type of building (2)
  - tenure (3)
  - quality (4)
  - size (5)
- households/housing
  - households (30)
  - dwellings (30)
  - housing occupation (30x30)
- employment/work-places
  - industries (40)
- public facilities
  - facility type (40)
- land use
  - land use/zoning types (30)
- rents/prices
  - dwelling types (30)
  - land use/zoning types (10)

The numbers in parentheses indicate the number of categories by which the data are classified. Tables 4.1 and 4.2 show the classifications of industries and land-use categories. Tables 4.3 and 4.4 show the more aggregate of the two classifications of households and housing. The 30-type classification of households and dwellings and their cross-classification in the occupancy matrix is required for the microsimulation of the housing market in the migration submodel.

Table 4.1 Classification of industries

No.	WA[a]	Industry
1	0	agriculture, fishery
2	10	energy
3	11	mining
4	200	chemical industry
5	205	mineral oil processing
6	210	synthetics processing
7	215	rubber, asbestos
8	220	stones and minerals
9	224	ceramics
10	227	glass
11	230	iron and steel
12	232	non-ferrous metals
13	234/236	foundries
14	238/239	cold rolling
15	240	steel and metal construction
16	242	machine manufacturing
17	2425/25071	EDP, office equipment
18	244/246/248	vehicle manufacturing
19	250	electrical products
20	252/254	precision ,mechanics
21	256	sheet metal products
22	258	musical instruments, toys
23	260	lumber, sawmilling
24	261	wood processing
25	264	pulp, paper
26	265	paper processing
27	268	printing, copying
28	270/271/272/276	leather, clothing
29	275/279	textile industry
30	28/29	food and rugs
31	from 2	small industry and crafts
32	3	construction industry
33	40/41	wholesale
34	42	trading, brokering
35	43	retail
36	5	transport, telecommunications
37	6	banks, insurances
38	700	restaurants, hotels
39	7 except 700	other services
40	8/9	non-profit organisations, state

[a] Industrial classification of the Statistisches Bundesamt (Federal Statistical Office)

Table 4.2 Classification of land uses

No.	FA[a]	Land use category
1	01	residential, up to 3 floors
2	02	residential, up to 5 floors
3	03	residential, high-rise
4	04	residential and commercial
5	05	commercial and light industry
6	06	industrial
7	07	vacant industrial
8	08	public facilities
9	09	farm buildings
10	21-24	utilities
11	11	motorways
12	12	other limited-access roads
13	13	four- and six-lane roads
14	14	two- and three-lane roads
15	15	residential and access roads
16	16	pedestrian areas
17	17	parking lots
18	18	railways
19	19	airports
20	20	other public land
21	10	construction sites
22	25-26	excavations and land fills
23	27-28	public parks, cemeteries
24	29	private gardens
25	30	playgrounds and sports fields
26	31-32	camping areas, recreation areas
27	33-35	water
28	36-38	agricultural
29	39	waste land
30	40-44	forest

[a] Land classification of the Kommunalverband Ruhrgebiet (Association of Ruhr Area Local Governments)

Table 4.4 Classification of households

No.	Nation-ality	Age of head	Income group	Persons
1	native	16-29	low	1
2				2
3				3
4				4+
5		30-59		1
6				2
7				3
8				4+
9		16-59	medium	1
10				2
11				3
12				4+
13			high	1
14				2
15				3
16				4+
17			very high	1
18				2
19				3
20				4+
21		60+	low	1
22				2
23				3+
24			medium	1
25				2
26				3+
27			high/ very high	1-2
28				3+
29	foreign	all	all	1-2
30				3+

very low

Table 4.4 Classification of dwellings

No.	Type of building	Tenure	Quality group	Rooms
1	single family	all	all	1-3
2			medium	4+
3			high	
4	multi-family	owner-occupied	medium	1-3
5				4+
6			high	1-3
7				4+
8		rented	very low	1-2
9				3
10				4
11				5+
12			low	1-2
13				3
14				4
15				5+
16			medium	1-2
17				3
18				4
19				5+
20			high	1
21				2
22				3
23				4
24				5+
25		medium	owner-occupied	1-2
26				3
27				4+
28			medium/high	1-2
29				3
30				4+

Network Data

The network information is coded link by link using a multimodal coding scheme. For each *link* the following information is coded:

- link type
- from-node,
- to-node,
- link length,
- link travel time (public transport),
- base speed (road).

In addition, for each *line* of the public transport network, the following information is coded:

- list of nodes,
- peak-hour headway.

The network analysis part of the transport submodel automatically separates the road network and the public transport network and synthetically generates a third network for walking and bicycle trips.

Public transport lines are automatically assigned to the links of the network; the headways of lines using the same route are amalgamated to allow for synergies between lines. Transfer connections are automatically established during route-search taking account of transfer waiting times and the inconvenience of transfer.

The zones' centroids are connected to the three networks by non-physical pseudo links.

Model Policies

The Dortmund model was designed to study the impacts of policies from the fields of industrial development, housing, public facilities and transport.

In all cases, the first simulation is the so-called *base forecast*, which is defined as the most likely development of the region if all trends in effect in the base year also prevail during the forecasting period. Sometimes the base forecast is also called the do-nothing alternative, but this is misleading as policies which are already in effect or which are 'in the pipeline', i.e. which are certain to become effective soon, are included in the base forecast.

There are two kinds of policies in the model: global and local. Policies can be specified in the model in a variety of ways depending on the type of policy:

Global policies affect the economic or institutional environment of urban development in the whole region:

- *Global economic policies*. National policies such as changes in tax laws or subsidisation policies are entered by making changes to the respective parameters. If it is assumed that such policies also affect the forecasts of employment and immigration and outmigration made for the total region, these may also be changed. One example would be the effects of a change in immigration policy on the inflow of foreign workers into the region.

- *Global housing policies*. National policies affecting taxation and subsidies in the housing sector or new or changed regulations governing land use or construction activity can be entered by changing the respective model parameters. Policies changing the volume and type of public housing construction or renewal may be entered either globally or locally targeted to specific zones.

- *Global transport policies*. Policies affecting the whole transport system may be changes in transport-related taxes or subsidies resulting in changes to petrol prices, parking fees or public transport fares. Other policies such as general speed limits or road pricing schemes addressing particular types of roads require changes to the network data.

Local policies may be either regulatory or direct investment projects. In either case they are zone-specific:

- *Local land-use planning* is reflected in the model in the form of a land-use or zoning plan for each zone. A land-use or zoning plan is actually a special file containing permitted land-use changes specified by origin-category and destination-category, area and year. An entry in the land-use or zoning plan does not imply that the land-use change specified will actually take place; However it *may* take place if there is sufficient demand for construction activity of the specified kind. Without specification in the land-use or zoning plan, construction activity can only take place on vacant sites or after demolition of the existing buildings.

- *Local economic policies* may result in new industrial locations, relocations of firms, or plant closures. If the change involves only one or a few major employers of the region, the model cannot be expected to predict such decisions (even if they are made by private actors). In such a case the change of employment is coded just as a public policy in a particular zone in a particular year. In the case of a new industrial location, the model tries to find the necessary land in the zoning plan of the specified zone and constructs the specified work-places with buildings, access roads and parking. In the case of a plant closure, the vacant industrial land is either released for new construction or retained by the firm depending on the specification by the model user.

- *Local housing policies* may result in new housing projects or urban renewal projects in specific zones. These projects, too, can be phased in volume and

composition of dwelling types over any time period. Housing projects may be publicly or privately financed; what matters is only that they are explicitly specified by the model user and not generated by investment decisions in the private construction submodel. With all housing projects, the model checks whether the necessary land is available in the land-use or zoning plan and provides access roads and parking facilities.

- *Local public facilities*. The user may specify a wide range of public facilities to be constructed in particular zones and in particular years, such as schools, hospitals, recreation facilities etc. In each case the necessary land is obtained in the land-use or zoning plan and the required access roads and parking facilities are built.

- *Local transport policies*. The model user can specify any time-sequenced program of additions, deletions or modifications of network links. Modifications may be changes of link type (e.g. number of lanes), of travel time (public transport), of base speed (road) or of public transport lines or headways. There may be several changes for one link; as each change is identified by a time label (year of completion), the model is able to assemble the current state of the network for each point in time. In fact even the network for the base forecast contains numerous network changes reflecting the foreseeable network improvements already under way.

Data Collection and Model Calibration

The main data sources for the Dortmund model were the 1950, 1961, 1970 and 1987 population, housing and employment censuses. For the 1970 census (and the associated 1968 housing census), tapes with household-by-household, dwelling-by-dwelling and firm-by-firm information were made available by the City of Dortmund with the data made anonymous for privacy reasons. For the other census years and for the municipalities outside Dortmund only aggregate tabulations were available. In these cases the required multi-dimensional distributions, such as the household-type and housing-type distributions and the household/housing occupancy matrix, had to be approximated by biproportional estimation techniques (see Gnad and Vannahme, 1981).

The transport networks in the region were coded from public transport timetables and road maps. Approximately 2,000 links in the public transport network with 300 public transport lines and 1,500 road links were coded for the Dortmund region. As mentioned above, the coding included all network changes between 1950 and 2000.

The term *calibration* implies the specification of the parameters of the model equations with the objective that the model output should resemble the observed reality as closely as possible. Calibration therefore requires a past observation period for which sufficient data are available.

In the *calibration* of the Dortmund model, two kinds of model parameters have to be distinguished:

The *first* kind includes all parameters that can be expressed in physical-technical, monetary or similar dimensions such as rates, coefficients, prices etc. Examples of such parameters are:

- demographic parameters,
- household parameters,
- housing parameters,
- technical parameters,
- monetary parameters.

Their specification and projection are performed on the basis of published statistics and other external sources:

b) Demographic parameters

Birth rates and survival rates are well documented for the past and can be retrieved from published statistics. However, there is always some speculation about the future development of birth rates. Recently the falling tendency of birth rates in the Federal Republic has slowed down, but will this be a permanent phenomenon or only a minor perturbation? Assumptions about future births rates are crucial because minor differences in birth rates will have relatively large impacts on the size - and hence on the housing demand - of households already in the near future. With increasing immigration the reproductive behaviour of foreign residents becomes a major factor for the future size and age distribution of the population. Will foreign families continue to have more children than German families, or will they adjust quickly to the general tendency to smaller households?

b) Household Parameters

Data for household events such as marriage, divorce, new household of child or relative joins household are only partly available and not for specific household types. The probabilities generating these events in the model had therefore to be synthesised from fragmentary information. Even more uncertain is the projection of these parameters in the future: Will the tendency of falling marriage and rising divorce (and remarriage) rates continue? Will young people continue to separate from their parents' households as early as possible? Will the three-generation family continue to gradually disappear? The answers to these questions are critical for the projection of the future composition of households and thus for forecasting housing demand.

c) Housing Parameters

Changes to the housing stock, such as deterioration, demolition or conversion to offices etc., occur largely unrecorded by any statistics. Therefore relatively broad assumptions about these rates had to be made.

d) Technical Parameters

Technical parameters such as the land required for residential buildings at a given density or for access roads and parking, or road capacities and petrol consumption per car-km, are well defined in engineering terms and either will remain stable over time or are relatively easy to forecast.

e) Monetary Parameters

Specifying the income parameters such as household budgets for housing, transport and other expenses and the relevant subsidies such as housing allowances, tax benefits etc. in general presented no problems, except that the immense number and variety of relevant legal regulations required some simplification. Also the information on housing and transport costs could be extracted from published statistics. For future years, all monetary parameters were inflated by appropriate inflation rates. Much of the dynamics of the model is due to the differences in inflation rates. For instance, if housing costs rise faster than transport costs, households will tend to choose more peripheral housing locations with lower rents, and vice versa.

The *second* kind of parameters to be specified are the preference parameters, i.e. the parameters of the behavioural equations of the model. These equations model the choices of the model actors among options subject to their attractiveness and to the constraints restricting the choice. To specify the preference parameters, ideally data on past decision behaviour must be available, and there must be reasonable confidence that the decision patterns observed in the past will also be valid in the future.

The majority of the behavioural equations used in the Dortmund model are spatial choice functions of the multinomial logit type. The parameters of such models can be estimated using the maximum-likelihood criterion if appropriate data are available (Wegener and Graef, 1982). Where this was the case, maximum-likelihood estimation was performed using only data of the first simulation period (1970-1972). The calibration process is described in detail in Gnad et al. (1983) and Wegener (1985a).

In many other cases, however, it was necessary to select parameter values without statistical estimation based on plausibility considerations and expert judgment. In these cases, the next step in the modelling process, *validation*, becomes important.

Model Validation

Although a completely specified model for which *all* parameters of *all* model equations can be estimated from observed data remains the ideal, in the social sciences it can rarely be achieved in practice or only at the price of severe reduction of complexity. The Cartesian paradigm that ultimately everything is measurable is in contradiction with more recent insights into the indeterministic character of open, non-equilibrium systems. In the new world not even the belief in structural stability - that functional relationships, if they are correctly specified, remain stable over time - can be maintained. Systems undergo 'parametric shifts' (Casetti, 1991) and may with only small changes of parameters experience a 'catastrophe', i.e. switch to fundamentally different dynamics (Wilson, 1981).

One consequence of these insights would be to refrain altogether from any attempt to make forecasts for socioeconomic, and hence also spatial systems. This postmodern attitude explains in part the low standing of forecasts in planning practice. However, there are good reasons to take another view. First, spatial systems, because of their inherent and multiple feedbacks, are not likely to experience as many structural shocks as are mathematically possible - if it were otherwise, they would not have survived for so long. Second, catastrophes such as civil wars or natural disasters are not of much interest for everyday planning, which is concerned with 'normal' events and processes of change, so a better understanding of these continues to be useful.

Following this second view has significant implications for dealing with models and forecasts. First, statistical estimation of parameters based on short observation periods is losing its status as the best way to calibrate a model. Instead it is becoming much more important that a model captures the essential *dynamics* of the system under investigation. The second lesson is that the 'single best forecast' should be replaced by *multiple scenarios*.

There are only first attempts to develop techniques for estimating dynamic macro models (see Weidlich and Haag, 1988). For such a highly disaggregate model as the Dortmund model, there exist neither the necessary time-sequenced micro data nor statistical techniques to estimate it dynamically. Consequently, the only way to calibrate the model is to compare its aggregated micro results with macro time-series data available from published statistics. This test is called *validation* and was implied by the earlier suggestion that the model is an attempt to reconstruct the aggregate processes postulated in the macro theory from the micro choice and transition processes postulated in the micro theory.

In formal terms, *validation* of a model means to test the results of its *calibration* by comparing the model output with different data than those used for the calibration. In the remainder of this section, some examples of such validation will be given.

Validation 1970-1986

Tables 4.5-4.7 show selected results of the validation of the model against aggregate employment, population and housing data collected for the time between 1970 and 1986. Two measures are presented as indicators for the correspondence between model predictions and reality: the coefficient of determination r^2 and the 'mean absolute percentage error' (MAPE) - the higher (closer to one) the former and the lower (closer to zero) the latter, the better is the correspondence (see Wegener and Graef, 1982).

It can be seen that the model predictions very closely resemble the real development:

- If only the coefficient of determination r^2 is taken into account, the correspondence between model and reality seems to be almost perfect in terms of population and dwellings and only slightly less so in terms of employment. However, it has to be considered that r^2 can be seriously distorted by a few large observations, therefore MAPE is generally a better indicator for the correspondence between spatial data, which tend to be not normally distributed.
- The comparison becomes more significant if size effects are eliminated, as has been done on the right-hand side of the table by looking only at the rates of change of employment, population and dwellings in the 30 zones. Now also the r^2 values give a realistic picture of the predictive power of the model. It can be seen that the model explains between 60 and 90 percent of the variation between the zones. However, because the changes in general are small, the mean prediction error remains in the range of a few percent and only slighly larger in the case of employment.

If one considers that these results were achieved using only data from the first simulation period (1970-1972), the results are very satisfactory. They indicate that it is possible to predict the spatial distribution of population and employment in an urban region like Dortmund over a time span of sixteen years within an error margin of only a few percent.

Validation 1950-1980

A second validation experiment attempted an ex-post forecast over a much earlier period in which the conditions of urban development were significantly different from those in the 1970s and 1980s. For this experiment the model was applied with only minor changes to the period 1950-1980. It may be recalled that this period included the transition from urbanisation to suburbanisation in the region and that urban development was determined by rapid growth. The objective of the experiment was to find out whether the model even under these totally different conditions would be able to correctly 'predict' the major tendencies of spatial development, i.e. the transition from urbanisation to suburbanisation.

Table 4.5. Validation: employment, 1970-1984

		Employment		Employment in % of 1970	
Year	n	r^2	MAPE[a]	r^2	MAPE[a]
1976	30	0.9974	5.1	0.6704	7.5
1978	30	0.9992	4.7	0.6286	7.3
1980	30	0.9993	4.0	0.6780	8.2
1982	30	0.9984	3.9	0.6755	8.0
1984	30	0.9981	4.0	0.6528	9.7

Table 4.6. Validation: population, 1970-1986

		Population		Population in % of 1970	
Year	n	r^2	MAPE[a]	r^2	MAPE[a]
1972	30	0.9998	1.4	0.7764	1.7
1974	30	0.9997	2.2	0.8126	1.9
1976	30	0.9991	2.5	0.8101	2.3
1978	30	0.9994	2.8	0.8437	2.7
1980	30	0.9987	3.2	0.8336	3.1
1982	30	0.9991	3.9	0.7737	3.9
1984	30	0.9974	4.3	0.7513	4.5
1986	30	0.9962	5.0	0.7384	5.4

Table 4.7. Validation: dwellings, 1970-1986

		Dwellings		Dwellings in % of 1970	
Year	n	r^2	MAPE[a]	r^2	MAPE[a]
1972	30	0.9993	7.0	0.6060	1.2
1974	30	0.9992	8.2	0.8383	1.0
1976	30	0.9991	9.6	0.8738	2.2
1978	30	0.9987	8.5	0.8901	1.7
1980	30	0.9982	7.9	0.8840	2.0
1982	30	0.9979	7.5	0.7493	3.1
1984	30	0.9986	6.8	0.8721	2.5
1986	30	0.9969	5.7	0.8276	3.5

a Mean absolute percentage error

The changes to the model included, of course, changes to the data base to represent the conditions of the new base year 1950 and of all demographic, household, housing, technical and monetary parameters to represent the period 1950-1980. Initially the preference parameters were left unchanged under the assumption that although the decision *situation* of the model actors may have changed since 1950, their decision *behaviour* should have remained the same.

The first tests showed, however, that in the 1950s the housing market in the model was unable to cope with the massive immigration attracted by the rapid reconstruction of industry, while the private housing investors were not sufficiently inclined to invest in new housing. Consequently, the population of the region in the model grew less than in reality. The reasons for this were the housing preference functions, which were geared to the higher aspiration levels of the 1970s and 1980s and hence rejected small dwellings and sub-tenancy.

This problem was overcome by lowering the aspiration levels for tenure and dwelling size in the housing attractiveness functions and having them rise over time. In addition, most housing construction in the 1950s was publicly financed, which justified entering some new housing exogenously. Similarly, it became necessary to enter exogenously policies to reconstruct inner-city industrial plants. However, these changes to the model were restricted to the 1950s; no similar modifications were applied to the 1960s and 1970s.

Figure 4.9 shows the results of the ex-post forecast for employment, population and housing for the three subregions CA, IS and OS (see Figure 4.3). The diagram compares the model results (broken lines) for the three subregions with the actual development (solid lines). The following observations can be made:

- *Employment*. For employment, only data for Dortmund as a whole (CA+IS) can be compared. The model underestimates economic growth in Dortmund and its suburbs during the reconstruction period, but correctly predicts the decline of employment in Dortmund and only slightly overestimates the growth in the outer suburbs (OS) in the 1960s and 1970s.

- *Population*. Even with the modifications referred to above, the model underestimates the degree of overcrowding in the inner city (CA) during the 1950s but correctly models population development of the inner (IS) and outer suburbs (OS). In the 1960s and 1970s the reverse is true: the model matches the decline in the inner city but underestimates the growth in the suburbs.

- *Housing*. These differences are not due to the housing construction submodel, which with high precision predicts housing growth in the suburbs and only slightly underestimates the number of dwellings built in the inner city in the 1950s.

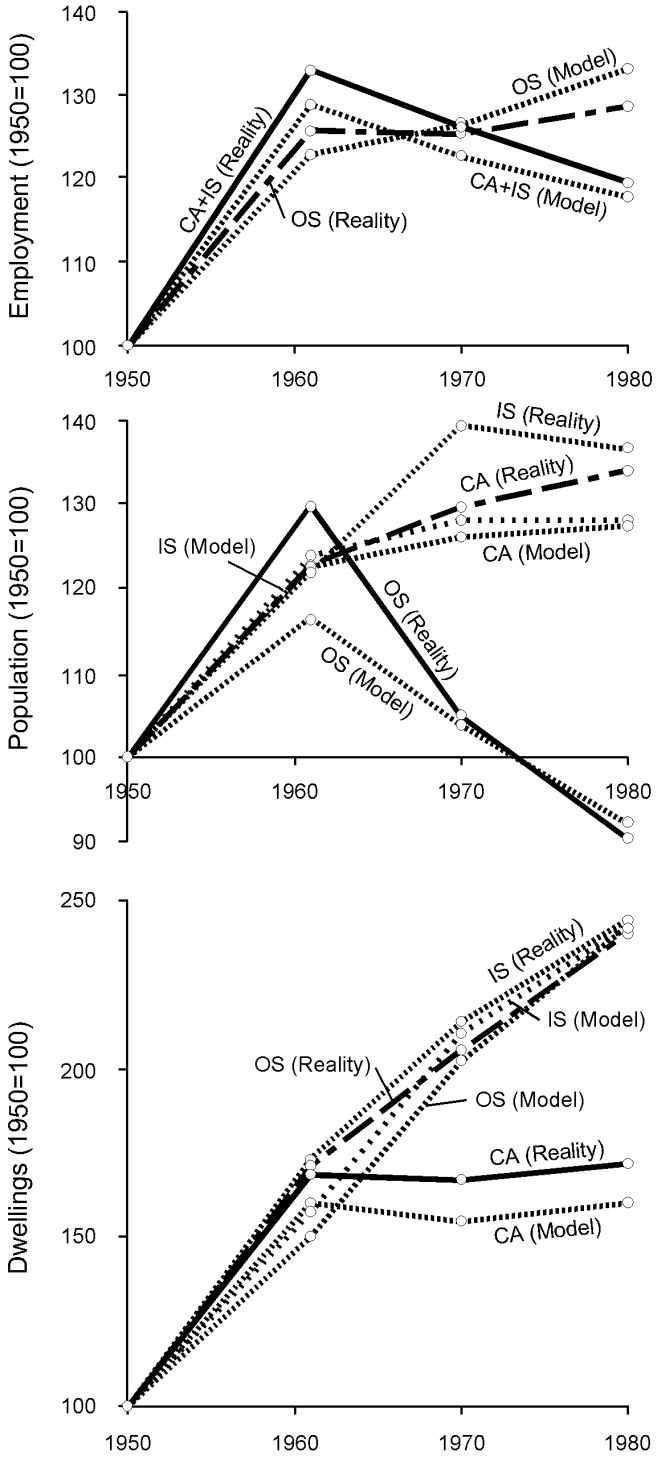

Figure 4.9. Ex-post forecast 1950-1980. *The results of the ex-post forecast for employment (top), population (centre) and housing (bottom) are shown for the three subregions CA, IS and OS (see Figure 4.3). The diagram compares the model results (broken lines) with the actual development (solid lines).*

In summary, the experiment showed that the model is able to predict a major structural break such as the transition from urbanisation to suburbanisation solely from its microanalytic behavioural assumptions. However, behind this basic correspondence many deviations of detail remained. The statistical measures of correspondence such as r^2 and MAPE were in general inferior for the 1950s and 1960s than those for the time after 1970. In particular the housing market model performed poorly in a tightly regulated housing market with rigorous rent controls. This may not be surprising, but makes it more difficult to identify time-invariant patterns of spatial behaviour

One City, Three Models

As a final validation example, a unique experiment will be reported in which three different models were applied to the same city, Dortmund.

The experiment was part of the work of the *International Study Group on Land-Use/Transport Interaction* (ISGLUTI). Between 1981 and 1991 this group, under the direction of the UK Transport and Road Research Laboratory, examined existing land-use/transport computer simulation models with respect to their capability to represent the interaction between land use and transport in metropolitan regions (see Chapter 6). During a final phase of ISGLUTI, three of the nine models tested were applied to Dortmund.

The comparison of the results of several models for one city, is in a certain sense the ultimate model test: given identical data and similar model assumptions, any differences in the results can only be attributed to differences in the models themselves, i.e. in their theoretical background and their structural properties or in the techniques used for data collection, calibration and validation.

The three models applied to Dortmund were: the Dortmund model described in this chapter, the LILT model being used at University College London, and the MEPLAN package developed by Marcial Echenique and Partners in Cambridge. The two latter models are briefly described below.

- LILT, the *Leeds Integrated Land-use/Transport Model* (Mackett, 1983) represents the relationship between transport supply (or cost) and the spatial distribution of population, housing, employment, jobs, shopping, and land use by linking the trip distribution and modal split stages of the four-stage transport demand model with a land-use model of the Lowry type. Accessibility factors derived from the journey-to-work component in the transport model mechanism are used to locate housing and economic activity. The model allocates exogenously specified totals of population, new housing and jobs to zones taking into account the existing land-use pattern and the cost of travel and any constraints on land use. In addition, the model predicts trips by mode and purpose. Housing

development can be located exogenously or is distributed by the model as a function of available land, the existing level of development and accessibility. Residential and employment location occur simultaneously with the forecasting of transport flows. The pattern of shopping trips follows from the allocation procedure for retailing activity, which calculates the spatial distribution of flows of cash from residential areas to shops.

- MEPLAN (Echenique et al., 1990) the model used by Marcial Echenique & Partners for ISGLUTI, organises all urban activities in a multi-activity, multi-regional input-output framework. Their quantities are calculated by applying a given input-output matrix to exogenously determined levels of 'basic' employment: this generates non-basic employment and population. The model requires only exogenous forecasts of changes in total basic employment to predict future changes in the patterns of non-basic employment, residential location and travel. The land-use submodel predicts the physical development of land, the total level of activity and functional relationships between the activities. As the competition for space increases, prices are raised until an equilibrium is reached between the supply of floorspace and the demand from the various activities. The transport submodel turns the current functional relationships into a pattern of trips split between modes and assigned to the networks. As congestion occurs in the transport system, the generalised costs assumed in the modal split are increased until they are consistent with those imposed by the congestion.

The two foreign models were set up with the same data as the Dortmund model and calibrated by their authors. After that all three models were used to produce a 'base forecast' as defined earlier, i.e. a status-quo forecast under the assumption that all current technological, socioeconomic and political trends stay in effect, and a set of jointly defined 'policy tests', each involving a certain combination of assumptions about changes in the background trends and/or explicit policies such as land-use control, traffic management or transport investment.

All simulations started in 1970 and ended in 1990. In all cases the model inputs were made as equal as possible given the different philosophy and construction of the three models. The full results of the experiment are reported in Wegener et al. (1991). Here only the base forecasts produced by the three models will be compared.

Figure 4.10 summarises the main results of the land-use parts of the models. It shows for each model a trajectory of three points in a three-dimensional coordinate space, where the three dimensions indicate the shares of the subregions CA, IS, and OS in terms of population (top), and employment (bottom). In addition, in both diagrams the actual development of the population and employment shares, respectively, are indicated by a thinner line labelled 'Reality'. The trajectories of the three models are labelled D (Dortmund), F (LILT) and G (MEPLAN).

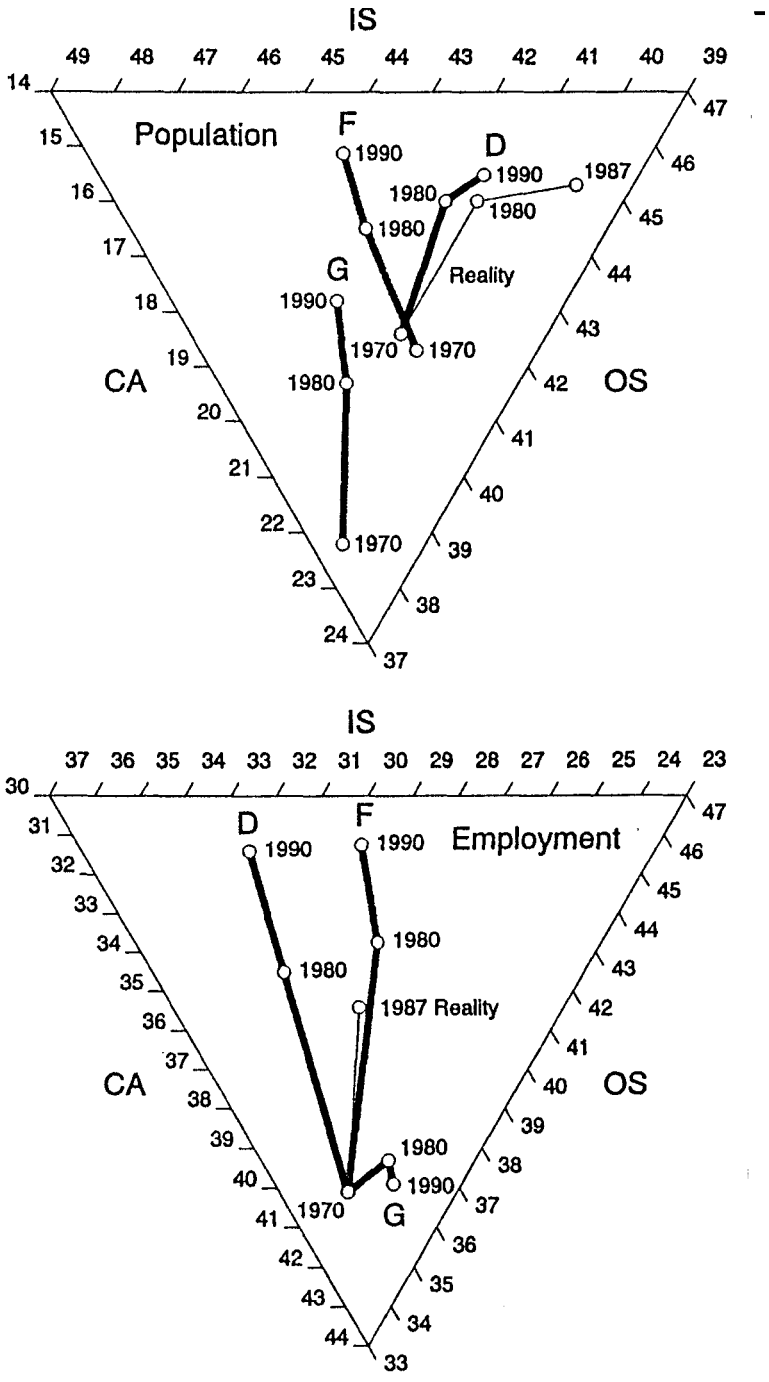

Figure 4.10. One city, three models: population and employment. *The heavy lines are trajectories of the three models D (Dortmund), F (LILT) and G (ME-PLAN) in a three-dimensional coordinate space, where the three dimensions indicate the shares of the subregions CA, IS, and OS in terms of population (top) and employment (bottom). In addition, the actual development of the population and employment shares, respectively, are indicated by a thinner line labelled 'Reality'. Source: Wegener et al. (1991).*

It can be seen that all three models correctly predict the decentralisation of population. Model D comes closest to the actual development, while Model F places too much population in the Inner Suburbs. After 1980 all three models show some slowing down of the decentralisation, but not sufficient to cope with the observed stabilisation of population in the Central Area. Model G starts from a different base year point because the version of MEPLAN used here does not take the initial distribution of population from the input data, but tries to reproduce it in its floorspace market equilibrium mechanism. The small deviation between the 1970 values of models D and F is due to the fact that the two models used slightly different base-year data.

Figure 4.11 displays the development of the most important travel parameters in the base forecast of each model. In this case the figures for the base year also differ in the three models as they are not taken from input but are calculated in the transport submodels. There is considerable agreement among the models with respect to average travel times, distances and costs (no time data were available for Model G). All three models correctly reproduce the trend to more car trips at the expense of public transport and to longer and more expensive trips consistent with the decentralisation trend in the land-use results. Travel distances and costs increase rapidly in line with the increase in car ownership and road congestion, whereas travel times grow only very little.

In summary, the three base forecasts show a reasonably good correspondence with the most significant trends of spatial urban development in the region, but there are also substantial deviations from actual development. In particular the models overestimate the speed of decentralisation of population in the region and insufficiently recognise the stabilisation of central area population. With respect to employment, two of the models produce too much decentralisation, while the third model does not produce any. However, the predictions of transport parameters such as modal choice and travel times, distances and costs are very similar and in excellent correspondence with the limited information available for the region.

Validation: Summary

The three validation examples demonstrate that it is possible to reproduce the essential spatial dynamics of a contemporary metropolitan region in a simulation model built on the micro-level decision behaviour of households and firms.

However, the examples may have also given a glimpse of the immense difficulties encountered in this task. The results presented here could only be produced in a relatively long and patient process of analysis and adjustment. The three validation experiments show that the hope of capturing the individual features of a large city in a quick and efficient calibration process are, at least at the present state of the art, premature.

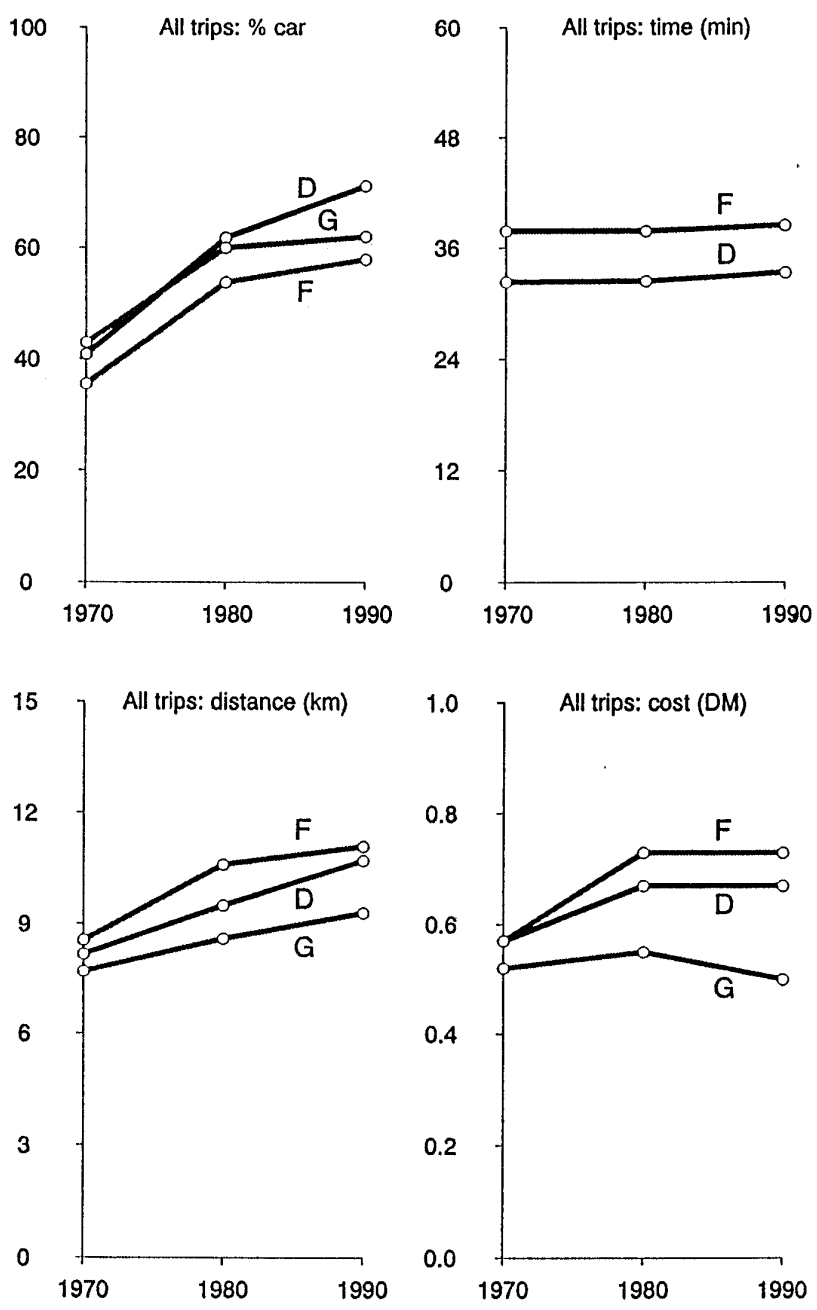

Figure 4.11. One city, three models: transport indicators. *There is considerable agreement among the models with respect to average travel times, distances and costs (no time data were available for Model G). All three models correctly reproduce the trend to more car trips at the expense of public transport, and to longer and more expensive trips. Travel distances and costs increase rapidly in line with the increase in car ownership and road congestion, whereas travel times grow only very little. Source: Wegener et al. (1991).*

Only after a painstaking iterative process of fine-tuning and validation can a serious discussion about the advantages and disadvantages of alternative model designs really start.

It will have been observed that none of the three examples covered the most recent period of rapid immigration to the Dortmund region before and after German unification and the collapse of the socialist states in Eastern Europe. These issues will be taken up in Chapter 7.

5

Economic Scenarios

The Dortmund model as described in the previous chapter was used over the past years to explore a variety of possible futures for the Dortmund urban region. In this and the following two chapters some of these exploration experiments will be reported.

In this chapter a group of experiments will be presented in which alternative *economic* scenarios for Dortmund were examined. These experiments were conducted in 1984 shortly after the steel crisis and the region's worst economic depression. All economic indicators were pointing downward; employment, after a short upswing in 1980, had been declining every year. There was a common feeling of uncertainty about the future of the region among planners and policy-makers. Dortmund's new economic policy (see Chapter 2) was in its infancy and had yet to demonstrate its effectiveness. Hence there were serious considerations as to whether the city would have to live permanently with economic decline and what the consequences this would have for spatial planning. In this situation in particular two questions were investigated:

(1) What will the 'most likely' next phase in the urban life cycle of Dortmund be if one assumes that the current economic decline of its urban region will persist? Will Dortmund continue to grow into the surrounding countryside as it has done for 150 years, or will there be some point in the future where, due to lack of growth, the outward development is halted and the city starts to concentrate again - reurbanisation through decline?

(2) To what extent is this 'likely' development determined by the assumed economic scenario - would more optimistic or more pessimistic scenarios produce significantly different results?

To investigate the first question, a *base scenario* of economic development in the state of North-Rhine Westphalia linked to various external forecasts of economic growth, growth in productivity and structural change as well as of population and in- and outmigration to and from the state up to the year 2000, was constructed (Schönebeck and Wegener, 1984). For purposes of comparison, a known period from the past was to be included in the scenario and 1970 was taken as the base year; this meant that the scenario consisted partly of observed and partly of projected data.

This 30-year scenario was fed into the North-Rhine Westphalia model referred to in Chapter 4 and thus spatially disaggregated down to the five labour-market regions constituting the study area in Figure 4.1. This was one of the few occasions where the multilevel model organisation described in Chapter 4 was actually implemented, at least with respect to the upper two levels.

It is interesting to compare the results of the base scenario of the North-Rhine Westphalia model from the perspective of today:

- *Employment*. For the total study area, the base scenario indicated a loss of 187,000 or 19.4 percent of all jobs over the 30-year forecast period between 1970 and 2000. During the 1970s this followed the actual development of employment in the region, but underestimated the decline of employment due to the steel crisis in the first half of the 1980s. However, seen from the perspective of today, the base scenario failed to predict the massive growth in employment in the second half of the 1980s: the 837,000 jobs predicted for 1990 fall 78,000 short of the 915,000 jobs counted in the 1987 census! The Nordrhein-Westfalen model correctly predicted loss of employment in manufacturing, mainly in the mining and steel industries, but got caught out by the fact that service employment in the region, after considerable growth until 1980, in the first half of the 1980s actually declined and failed to compensate for the decline in manufacturing employment. It has been commented in Chapter 2 that the rapid growth in service employment after 1985 may in part be an artefact of increasing part-time employment. Nevertheless, the failure to anticipate this development - which was a common feature of many studies of that time - remains a reminder of the ultimate limits of socioeconomic forecasting.

- *Population*. The Nordrhein-Westfalen model predicted a decline of population over the forecast period by 482,000 or 20 percent, due in part to natural decline because of low fertility, and in part to net outmigration, especially of foreign workers - in close agreement with the actual development of population up to the mid-1980s. However, in good company with all demographic projections of the 1980s, the Nordrhein-Westfalen model did not foresee the wave of immigration before and after the unification of Germany and the changes in Eastern Europe. It is therefore not surprising that the regional population predicted for 1990 in the base scenario is 190,000 less than the actual figure of 2.33 million.

The Most Likely Future: the Base Scenario

Using the regional totals of employment and immigration and outmigration of the Nordrhein-Westfalen model just discussed, the Dortmund model was used to simulate the spatial development in the urban region of Dortmund. On this spatial level, too, the first simulation is the *base scenario*. Following Chapter 4, the base scenario is defined as the most likely development of the region if all trends in effect in the base year also prevail during the forecasting period; in other words the Dortmund model is used as is without any additional parameter or policy changes.

In this section, the results of the base scenario are presented. to illustrate the results, three representative zones of the study area were selected and their development traced over the 30-year forecast period. Figure 5.1 shows the location of the three zones in the study area. The three sample zones are:

- *Innenstadt-Nord* (Zone 2), a rather depressed housing area close to the city centre with poor housing conditions and above average proportions of low-income, old-age, and immigrant worker population,

- *Hombruch* (Zone 9) is a prospering inner suburb grown out of a former mining village into a favourite residential location for the upper middle class with an attractive village core and the campus of the new Dortmund University,

- *Holzwickede* (Zone 21), a still partly rural outer suburb which thanks to its ample land supply, pleasant environment, and yet good accessibility to the city centre as we ll as to the nearby Sauerland hills has attracted many, especially younger and economically active, households as residents.

The following diagrams present selected results of the base scenario (cf. Wegener, 1987c). Each diagram contains trajectories of one variable over the 30-year forecast period for all zones and various aggregates of zones, but the results for the three sample zones are highlighted by different line styles. A fourth, thicker solid line indicates the development of the total urban region. Only a few aspects of the spatial development in the region can be discussed.

Employment

Figure 5.2 (top) shows the development of total employment in the region and in the three sample zones. The heavy solid line, in this case, is no more than a reassurance that the 19.4 percent decline of regional employment specified for the base scenario by the Nordrhein-Westfalen model has been correctly reproduced by the Dortmund model. The three other lines indicate how this decline was distributed over the study area:

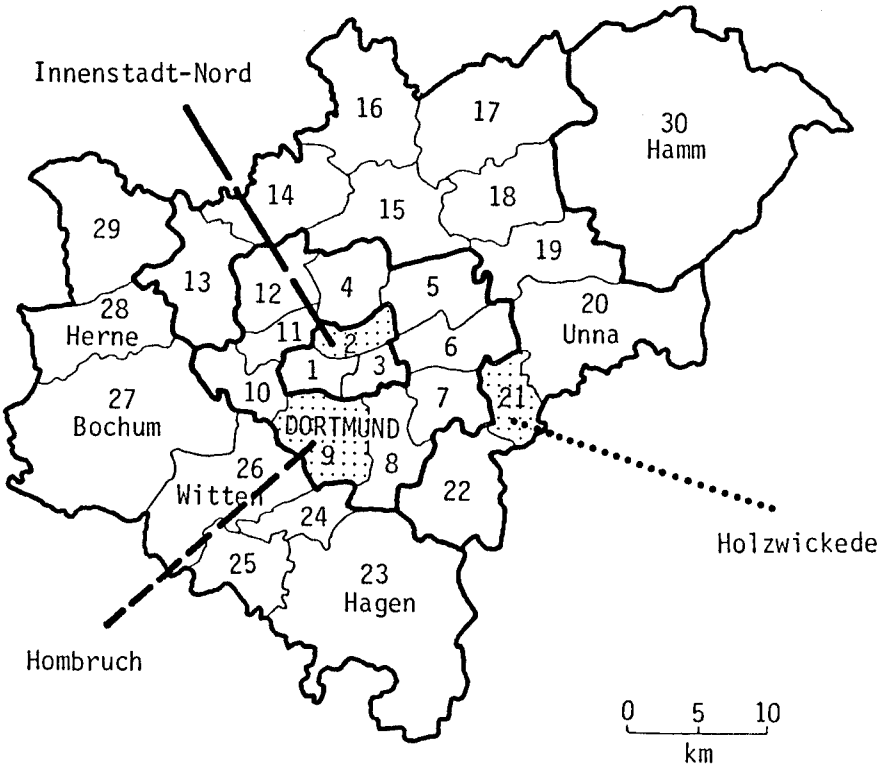

Figure 5.1. The three sample zones in the study area. *Three representative zones of the study area were selected and their development traced over the 30-year forecast period: Innenstadt-Nord (Zone 2), a depressed housing area close to the city centre, Hombruch (Zone 9), a prospering inner suburb and favourite residential location, and Holzwickede (Zone 21), a still partly rural suburb.*

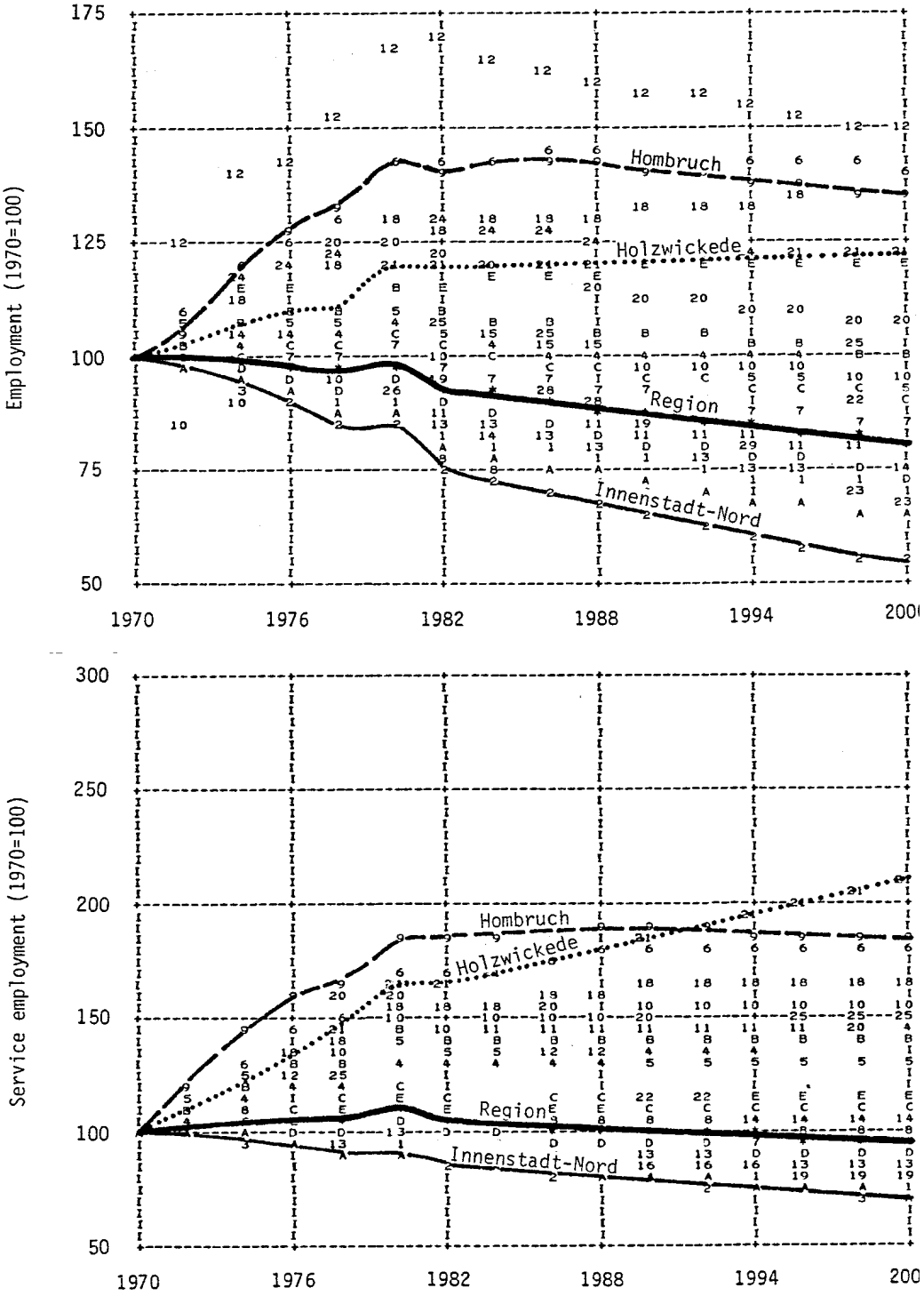

Figure 5.2. Base scenario: total employment (top) and service employment (bottom), 1970-2000*. The heavy solid line indicates that the 19.4 percent decline in regional employment specified by the Nordrhein-Westfalen model has been correctly reproduced. The three other lines indicate how this decline was distributed over the sample zones.*

Clearly the largest loss of employment occurs in Innenstadt-Nord, mainly because two of three major steel works Dortmund's are located here, one of which has been closed down in the 1970s, and because a number of other manufacturing firms have relocated to more spacious peripheral locations. However, as Figure 5.2 (bottom) shows, Innenstadt-Nord has also lost in service employment and is likely to continue to do so as a consequence of the continuing decline in population (see below). Note that even in the adjacent central business district (Zone 1) service and retail employment declines.

In sharp contrast, Hombruch and Holzwickede grow in both total and service employment. The fast employment growth in Hombruch in the 1970s was to a large part caused by the rapid expansion of the new Dortmund University; after 1980, employment in Hombruch starts to decline - only the recent efforts to attract high-tech firms to the technology park near the university (see Chapter 2) have reversed this trend. Total employment growth in Holzwickede was somewhat overestimated by the model, but the increase in service and retail employment predicted clearly reflects Holzwickede's fast growth in population (see below) and is in good agreement with recent employment figures.

Population and Households

The next six diagrams (Figures 5.3-5.5) present population and households in the base scenario.

Again, the heavy line in Figure 5.3 (top) merely restates the assumption about overall population decline in the region (more precisely, about total migration into and from the region) specified for the base scenario. Everything else was predicted by the model.

It can be seen that Innenstadt-Nord loses even more population than employment: by the year 2000 its population of 1970 will have been halved according to the model. Indeed the decline predicted for the 1970s by the model did occur in reality but in the 1980s it slowed down by a number of public housing projects especially intended to improve the negative image of the district. Nevertheless Innenstadt-Nord continued to lose population at a much faster rate than the rest of the city. Only in the most recent years has the population of the district started to grow again due to the inflow of mostly foreign immigrants. The probably nonpermanent character of this increase in population growth has been discussed earlier, nonetheless it remains to be noted that the model forecasts are too pessimistic for Innenstadt-Nord.

Whatever growth there is occurs in Hombruch and Holzwickede, but in Hombruch population starts to decline after 1982 and even in Holzwickede it does so towards the end of the forecast period, when all parts of the region appear to decline at an equal rate.

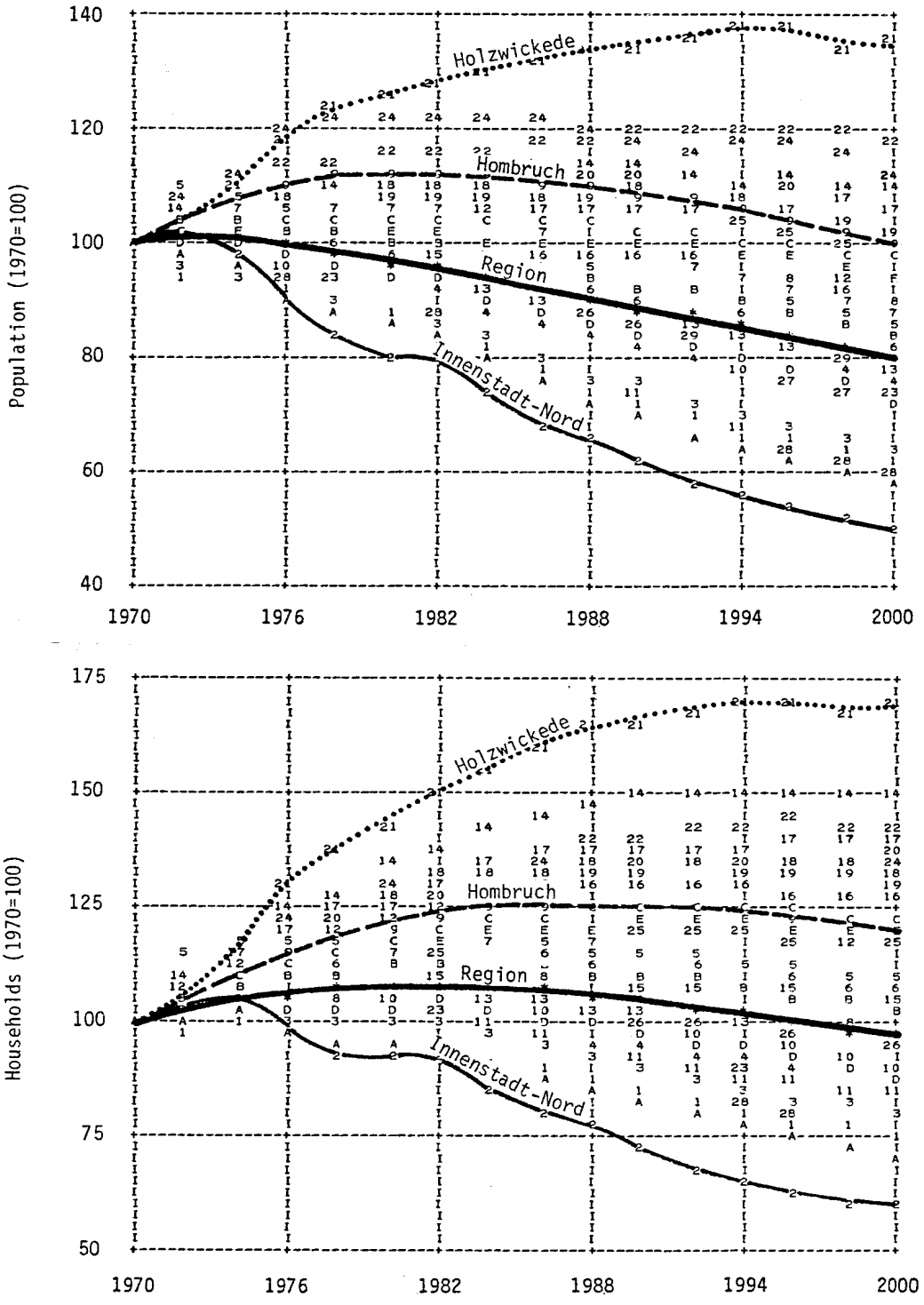

Figure 5.3. Base scenario: population (top) and households (bottom), 1970-2000*. In the base scenario, up to the year 2000 the population of the region declines by 20 percent compared with 1970. Most of this decline occurs in the inner city, whereas growth occurs in the periphery. Households start to decline later because of the continuing reduction in household size.*

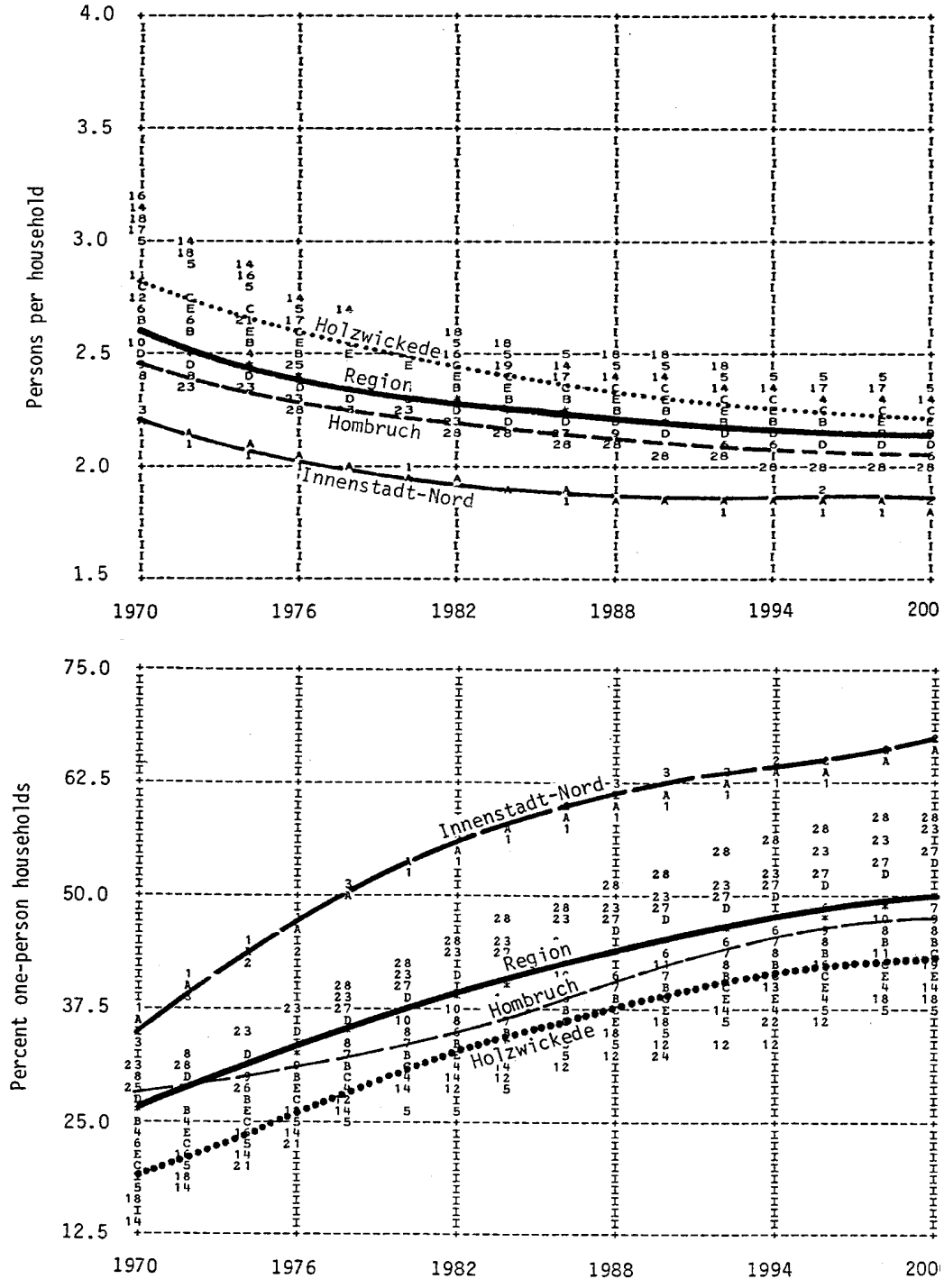

Figure 5.4. Base scenario: average household size (top) and share of one-person households (bottom), 1970-2000. *The average household size in the region falls from 2.58 in 1970 to about 2.1 in the year 2000 and even below 2.0 in the central areas. Accordingly towards the end of the century two out of three households in Innenstadt-Nord, and every second in the total region are single-person households.*

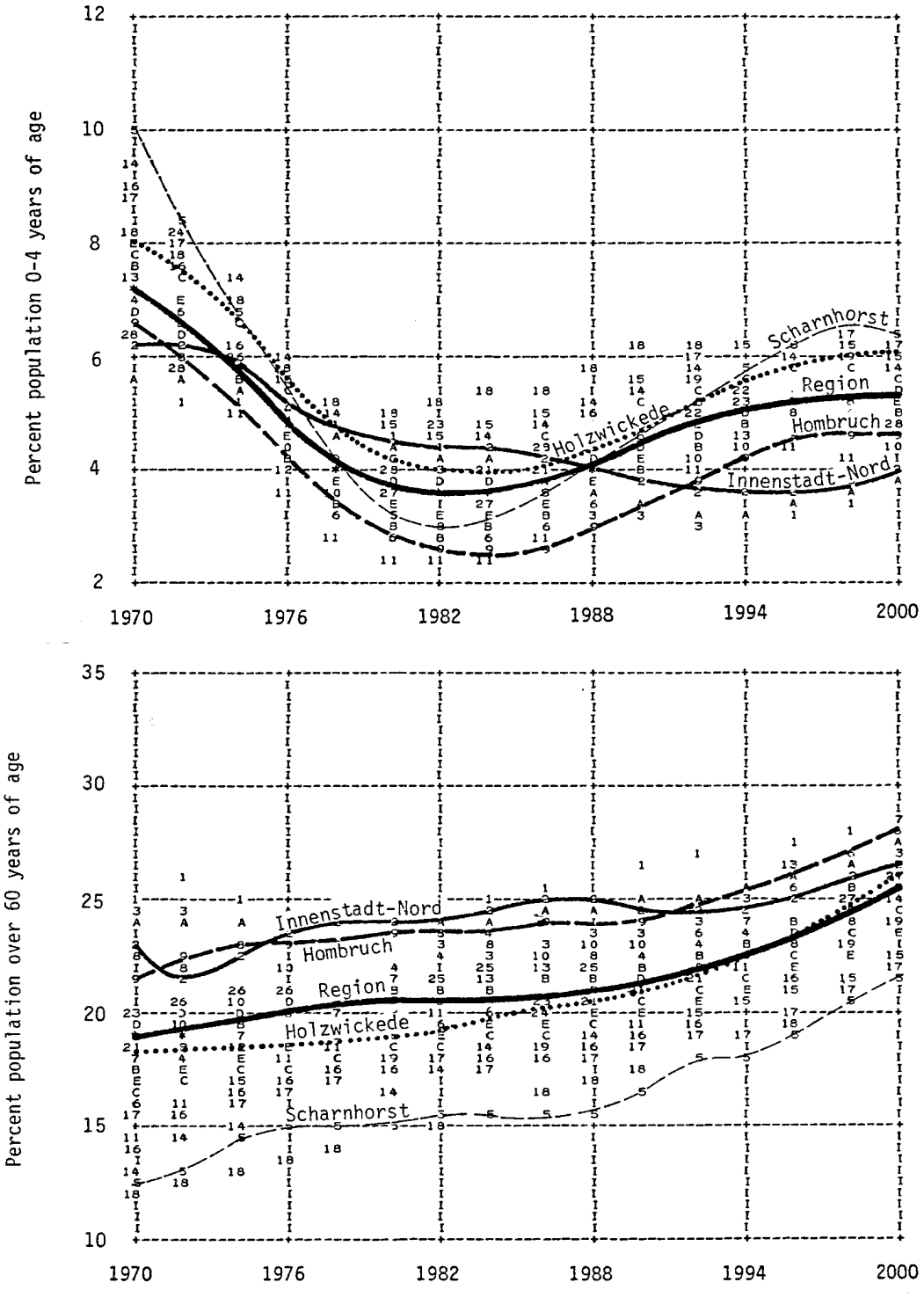

Figure 5.5. Base scenario: share of population 0-4 (top) and over 60 (bottom) years of age, 1970-2000. *The largest shares of young children are in peripheral zones, whereas inner suburbs such as Hombruch have the fewest children. The top diagram illustrates the echo effect of the baby boom of the 1960s. In the year 2000 more than 25 percent of the population in the region will over 60.*

In contrast, in Figure 5.3 (bottom), which shows the development of households in the study area, Hombruch does not begin to decline before the mid-1990s, and Holzwickede does not decline at all during the forecast period.

The reason for this is, of course, the continuing reduction in average household size. Figure 5.4 (top) shows this phenomenon. From a starting value of 2.58 persons per household in 1970 the average household size in the region falls to about 2.1 in the year 2000 and even below 2.0 in the central areas. Accordingly, as Figure 5.4 (bottom) shows, towards the end of the century two out of three households in Innenstadt-Nord are single-person households and every second one in the total region. In Holzwickede, on the other hand, there are more families with children, so the average household is larger and the proportion of single person households smaller.

Figure 5.5 demonstrates that the age composition of the population differs widely across the region. Figure 5.5 (top) confirms that the largest proportions of families with young children are in peripheral zones like Holzwickede, whereas older inner suburbs such as Hombruch have the fewest children. The diagram illustrates the effect of the dramatic fall in birth rates after 1970 and the wave-like echo effect of the baby boom of the 1960s. Innenstadt-Nord's trajectory is atypical because of its large foreign population component.

The differences between the zones are even more pronounced with respect to the older generation. Inner-city zones and inner suburbs have the largest proportion of old people and, as Figure 5.5 (bottom) shows, this proportion will further increase in line with the general ageing of the German population. In the year 2000 more than 25 percent of the population in the Dortmund region will be over 60. The proportion of old people in Innenstadt-Nord would be even higher if the diagram had been drawn for the native and the foreign population separately, as the much younger foreign population pulls the curve down.

In these two diagrams one additional zone is highlighted: the thin broken line represents Scharnhorst (Zone 5), a large high-rise public housing estate to the north-east of Dortmund's inner city completed in the late 1960s. The steep initial decline of the trajectory for Scharnhorst in the top diagram indicates the homogeneity of its first inhabitants consisting mostly of young families with children who grew up together and will produce the next local baby boom in the late 1990s. These fluctuations in demand will pose a serious challenge to the authorities in charge of social and educational infrastructure.

Spatial Segregation

Figures 5.6 and 5.7 show two aspects of population development not visible if one looks only at total population or households.

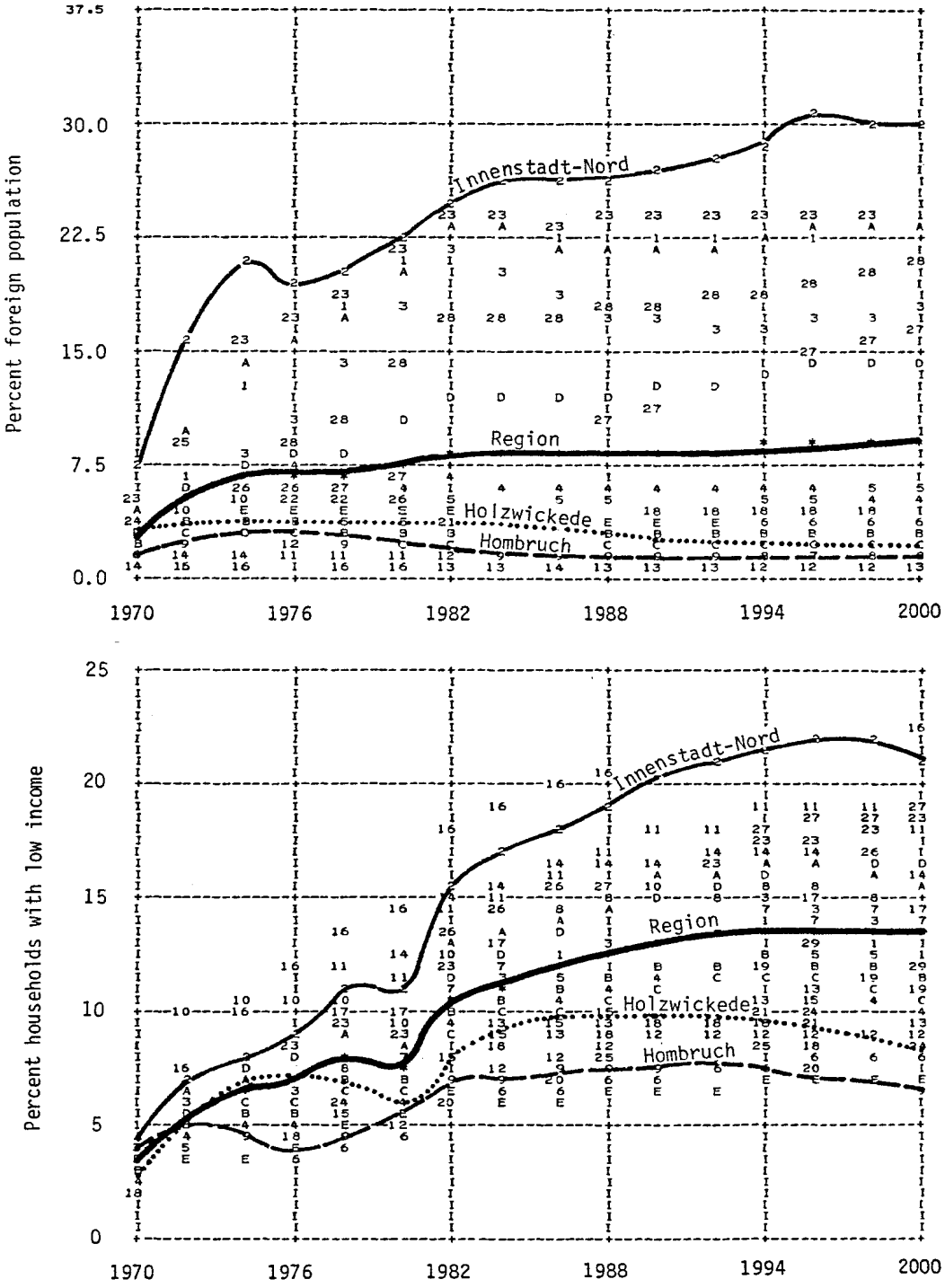

Figure 5.6. Base scenario: percent foreign population (top) and households with low income (bottom), 1970-2000*. The number of foreign nationals in the region increases in absolute and relative terms. Foreigners tend to live in the inner city, most notably in Innenstadt-Nord which is on the brink of becoming a ghetto. Innenstadt-Nord is also the poorest district in the region.*

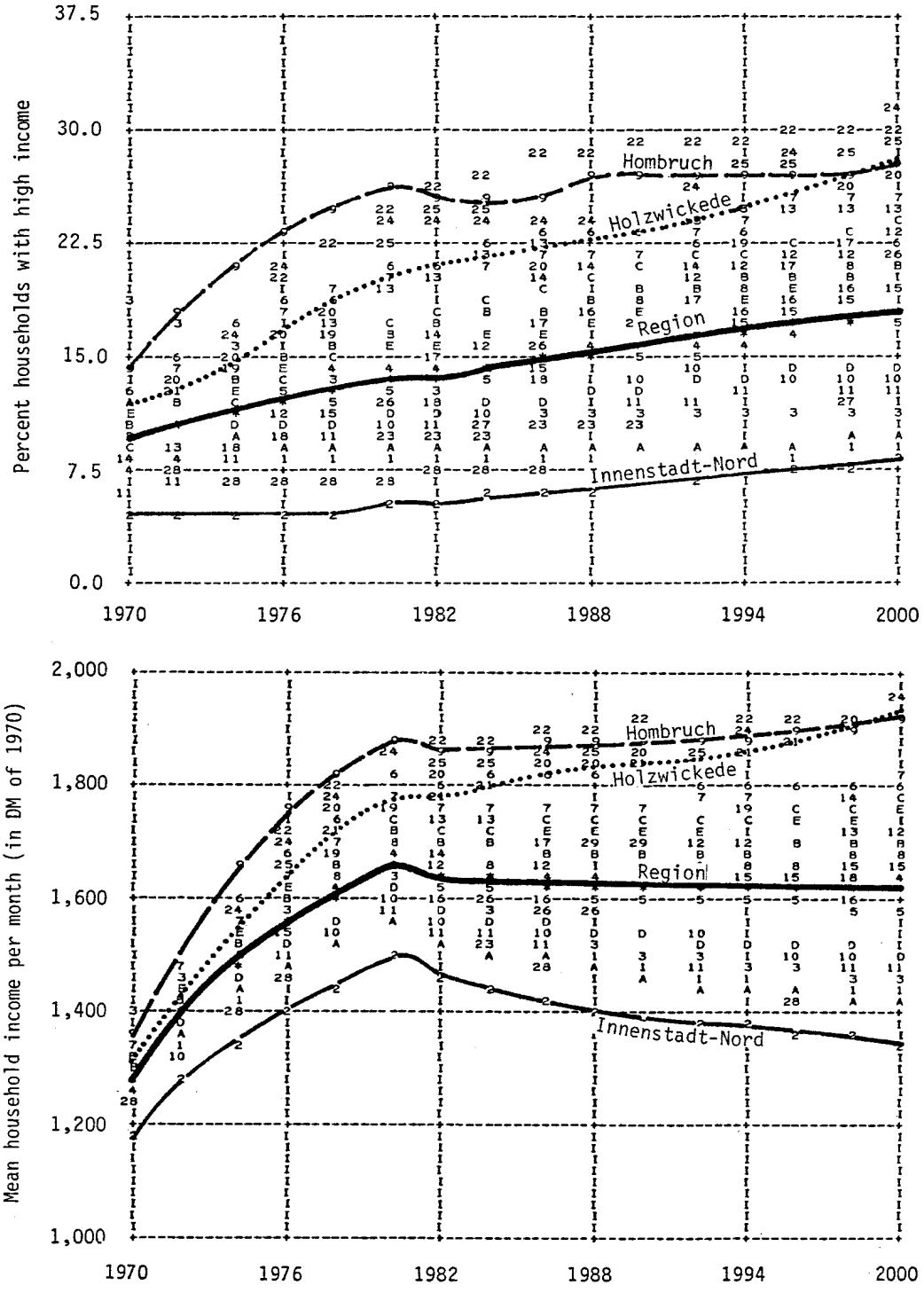

Figure 5.7. Base scenario: percent households with high income (top) and mean household income per month (bottom), 1970-2000*. The concentration of wealth in the southern part of the region confirms the traditional south-north divide existing in Dortmund. At the end of the century the average household in Innenstadt-Nord will earn 30 percent less than its counterpart in Hombruch.*

From Figure 5.6 (top) it is apparent that while the total population of the region declines by about 20 percent, the number of foreign nationals in the region increases in absolute and relative terms. Until the recent new wave of immigration the foreigners in Dortmund were mostly workers and their families from Mediterranean countries such as Greece and Turkey, who were attracted to Germany in the prosperous 1960s and 1970s, but in the 1980s grew mostly through natural increase as they had not (yet) adjusted to the much lower fertility level of the German population. Moreover it can be seen that the nationalities in the region tend to become more spatially segregated. Increasingly, the foreigners tend to live in the inner city areas, most notably in Innenstadt-Nord which is on the brink of becoming a ghetto.

What happens can be traced in the housing market: as more and more younger German households can afford to move to more peripheral and more attractive residential locations, housing rents in Innenstadt-Nord remain relatively low compared with other parts of the region and thus affordable for the foreign workers, who either save whatever they can for their eventual return to their home country or because of their large household size have to look for cheap housing. With the share of the foreign population approaching one third, the growing foreign community itself becomes an attraction factor for new arrivals, more foreign households move in and gradually a foreign local culture develops. Pubs, restaurants and shops specifically addressing the foreign population open up and the schools enrol more foreign than native children. This process of ghettoisation goes on in an unspectacular and almost unnoticed way. Yet the remaining native population, while still a majority, may eventually see themselves on the retreat.

Innenstadt-Nord is also the poorest district in the whole region. Figure 5.6 (bottom) shows the proportion of low-income households in the region and in the three sample zones, i.e. the proportion of households living on welfare or social security benefits or with no income at all. The model calculates this proportion as a function of the redundancies occurring and job opportunities available to the labour force of each zone on the regional labour market for different skill groups. Again it can be seen that the affluent and disadvantaged parts of the region are drifting further apart, with Innenstadt-Nord becoming progressively marginalised. Figure 5.7 (top) showing the share of households with high incomes is a mirror of the previous diagram. Now the upper-middleclass inner suburbs like Hombruch are the leaders with peripheral suburbs like Holzwickede catching up. The concentration of wealth in the southern part of the region confirms the south-north divide established more than a century ago by the decision to build the first steel works north of the railway (see Chapter 2).

Figure 5.7 (bottom) translates this kind of information into average zonal household incomes. The diagram indicates that until the steel crisis mean household incomes (in real terms) increase rapidly in the region, but in the 1980s and 1990s stagnate or even slightly decline due to the continuing loss of employment. However the diagram also shows the large disparities in income between different parts

of the region and how these change over time. Initially the households with the highest incomes are found in inner suburbs such as Hombruch, but over time new outer suburbs such as Holzwickede catch up and at the end of the forecast period have overtaken their older predecessors. Remarkably, even when the average real income in the region declines, these two zones continue to gain in income though at a lesser pace.

Inner-city working-class districts like Innenstadt-Nord have always been at the bottom end of the income range. But in a period of decline they fall even farther behind their more fortunate competitors in a rapid process of impoverishment. If the model is right - and here it needs to be recalled that these experiments were conducted *before* the 'unification boom' - the average household in Innenstadt-Nord towards the end of the century will earn 30 percent less than its counterpart in Hombruch - a difference which only inadequately conveys the likely accumulation of unemployment and poverty in this disadvantaged district.

Housing

The next four diagrams (Figures 5.8 and 5.9) illustrate the development of the housing stock of an industrial city in decline like Dortmund.

On first thought one would expect that, with a declining population no further housing construction would be needed. However, the model predicts, as Figure 5.8 (top) indicates, that in Holzwickede and in other outer suburbs new dwellings continue to be built at a rapid if gradually decreasing rate, while in inner-city zones such as Innenstadt-Nord the housing stock declines through demolition and conversion to offices (see below). This tendency has been confirmed by reality, though construction in Holzwickede has not been quite as fast as envisaged by the model and decline in Innenstadt-Nord somewhat slower.

The phenomenon that housing construction continues despite a declining population is caused by filtering in the housing market in which households with high incomes continue to demand more spacious houses in the more attractive outer suburbs irrespective of less desirable vacancies in other parts of the region. By this mechanism households of all income levels and in all zones are able to improve their housing condition in qualitative as well as in quantitative terms.

Figure 5.8 (bottom) demonstrates this for housing floorspace per head, which increases by about 50 percent in the whole region. The general increase in housing consumption goes on even when real incomes stagnate or decline, because decreasing costs of other goods (in real terms) permit the expansion of the share of incomes spent on housing and because of the declining population oversupply in the housing market allows rents to become relatively cheaper. Consequently even the households in Innenstadt-Nord can afford larger flats although they have less money to spend.

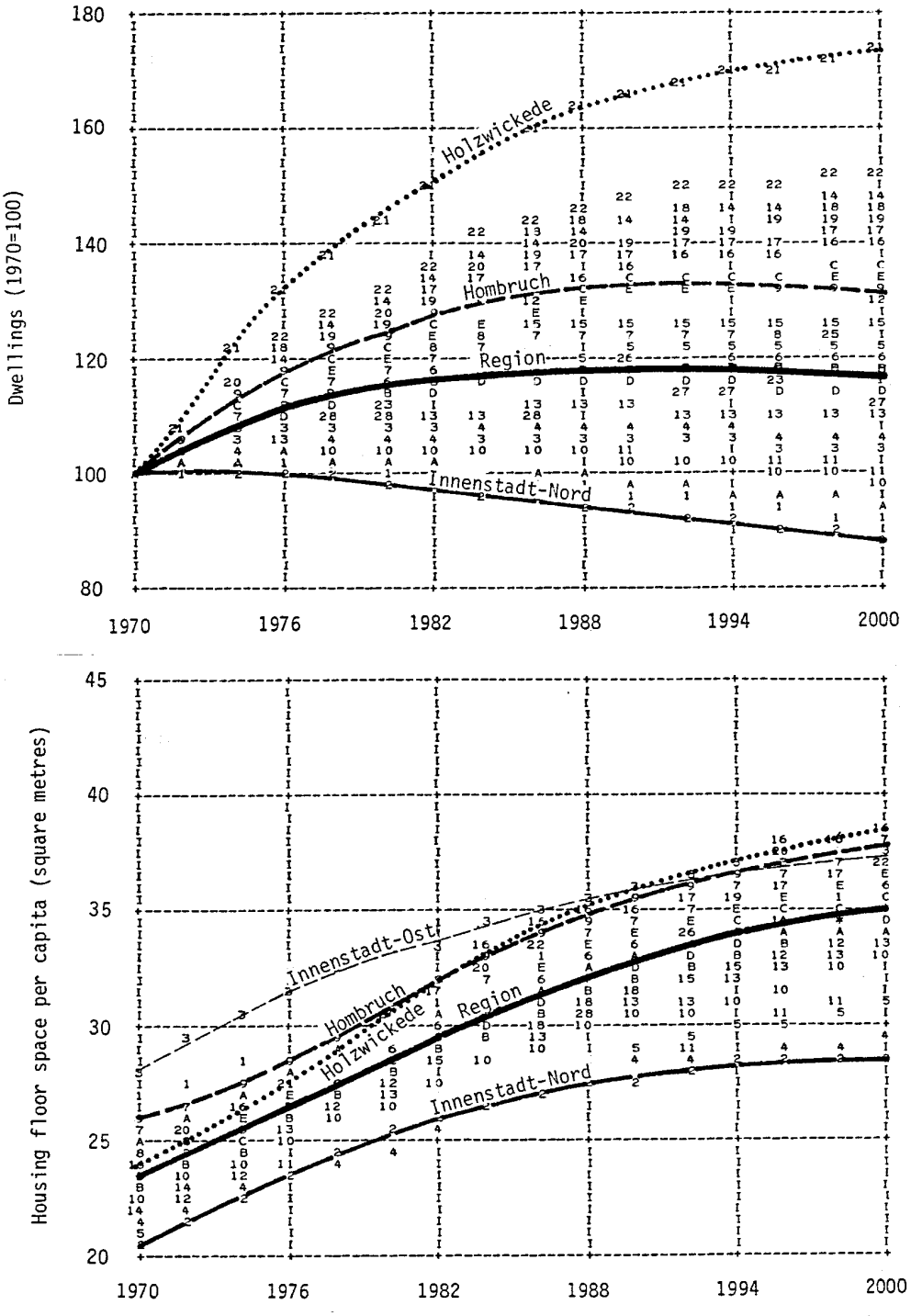

Figure 5.8. Base scenario: dwellings (top) and housing floorspace per capita (bottom), 1970-2000*. In the outer suburbs new dwellings continue to be built though at a gradually decreasing rate, while in inner-city zones the housing stock declines through demolition and conversion to offices. The general increase in housing consumption goes on even when real incomes stagnate or decline.*

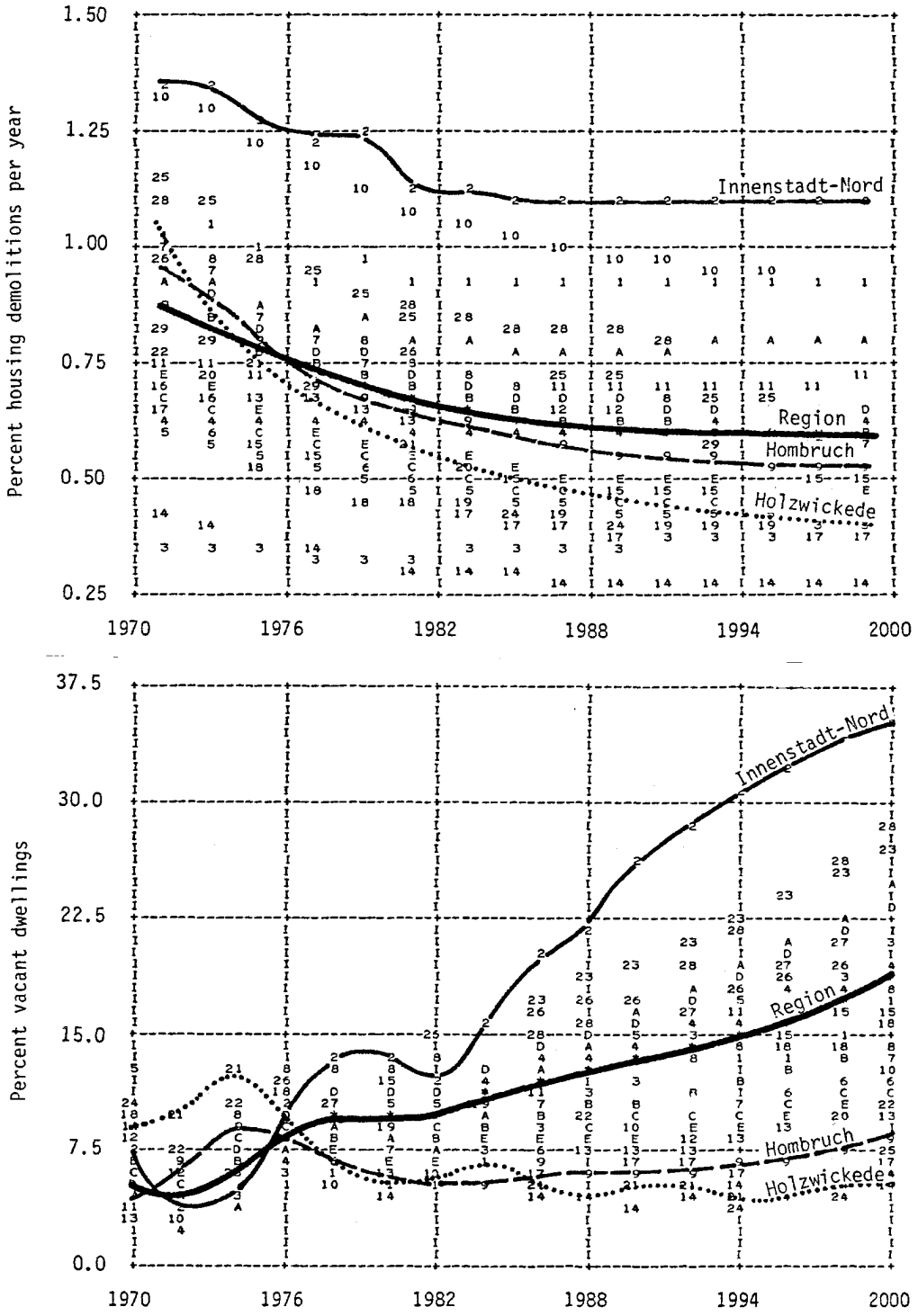

Figure 5.9. Base scenario: percent housing demolitions (top) and vacant dwellings (bottom), 1970-2000. *Demolition of dwellings is most likely to occur in inner-city housing areas where the housing stock is old and of low quality. A large part of the dwellings in these areas will remain vacant unless large-scale rehabilitation and modernisation programmes are undertaken.*

After the 30-year forecast period, there are some 20 percent or 190,000 more dwellings than households in the region because the number of dwellings has increased while the number of households has declined. This number would have been twice as high if a similar number of dwellings had not been torn down or converted to other uses such as offices over the years.

Figure 5.9 (top) suggests that large-scale demolition of dwellings is most likely to occur in the inner-city housing areas where the housing stock is old and of low quality and where there is demand for land for offices and shops, but least likely in the outer suburbs where the housing stock is new and attractive. However, the model assumes that the total amount of demolition in the region declines over time in conjunction with the decline in construction activity, as the incentive to demolish buildings is low unless there is demand for land.

Consequently, under these assumptions there will be a vast supply of vacant dwellings in the region. Figure 5.9 (bottom) suggests that by the turn of the century nearly 18 percent of all existing dwellings could be unoccupied. That percentage may give a somewhat wrong impression since an increasing number of households may choose to have two dwellings, a flat in the city centre and a house in the outer suburbs (this is not accounted for in the model) and because the percentage also includes the significant number of short-term vacancies between moves in the housing market.

Whatever the total level of vacancies, they are likely to be very unevenly distributed over the region, and a very large proportion of them will probably be found in the less attractive parts of the region such as Innenstadt-Nord unless large-scale rehabilitation and modernisation programs are undertaken.

This prediction of the model seems at odds with reality today at a time when according to the City of Dortmund authorities there is a shortage of 10,000 dwellings in Dortmund alone. However this shortage is partly due to the suddenness of the recent flow of immigration. Even small fluctuations in the number of households can cause severe housing shortages because of the long gestation period of housing investments.

In addition, it is not housing in general which is lacking, but *affordable* housing - a consequence of the deregulation of housing markets and the almost total abandonment of public housing subsidies by the Federal government during the last decade.

Land Consumption and Urban Dispersal

A final group of diagrams (Figures 5.10 and 5.11) illustrates the continuing trend to land consumption and urban dispersal in the region.

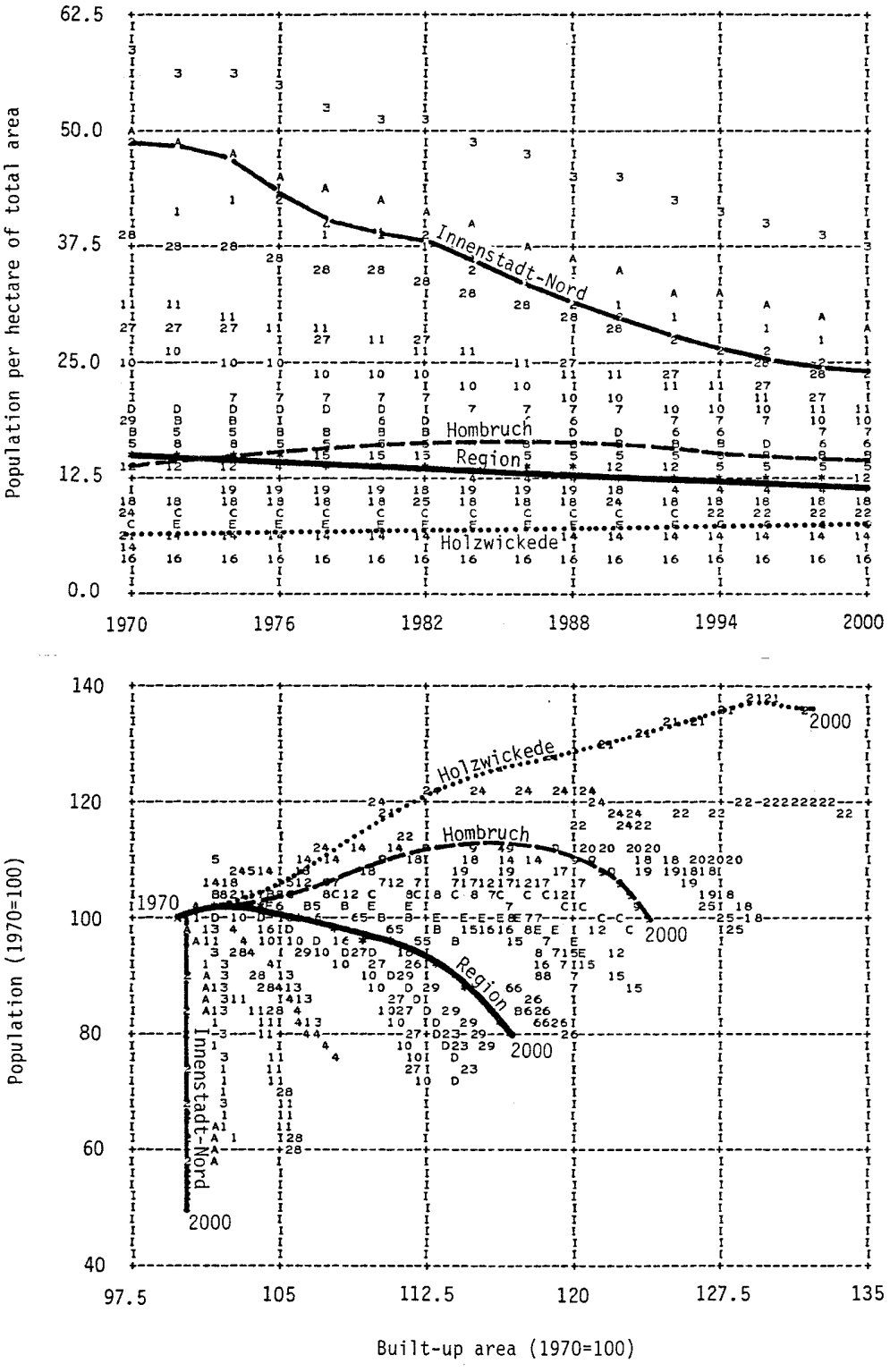

Figure 5.10. Base scenario: population density (top) and population and land use (bottom), 1970-2000*. Population density rapidly declines in the inner areas and grows in the suburbs, while the built-up area increases despite the declining population.*

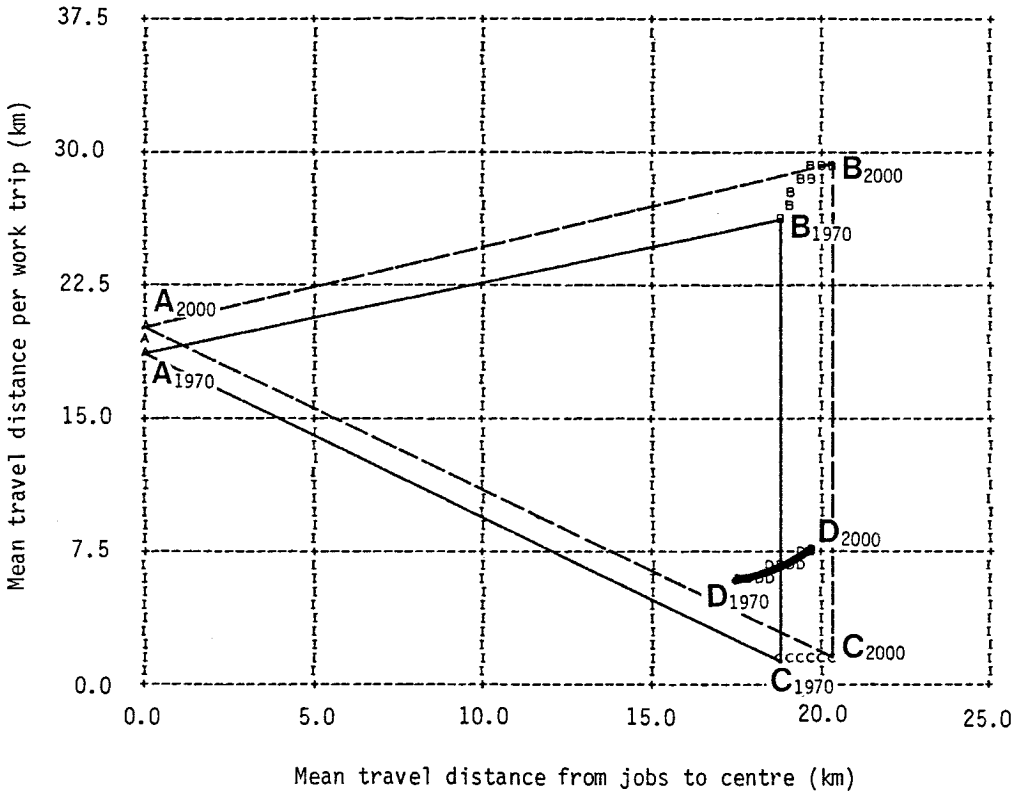

Figure 5.11. Base scenario: decentralisation in the Dortmund region, 1970-2000. *The 'Brotchie Triangle' introduced in Chapter 3 illustrates the spatial dispersal in the Dortmund region between 1970 and 2000. Point D, representing the region, moves upwards (more travel) and to the right (more dispersal) under the influence of increasing car mobility and space consumption.*

If the prediction of the model is realistic, i.e. that people who can afford to build a new house will do so even though there is a large supply of cheap but run-down vacant flats available in the older parts of the city, this means that the decentralisation of population observed in the region during its growth years, i.e. in the sub-urbanisation phase, will continue in the final stage of the urban cycle, the deurbanisation phase, in which the population of the region declines.

Figure 5.10 (top) displays how the density gradient of the urban region gradually flattens: in 1970, population density in Innenstadt-Nord was almost eight times as high as in Holzwickede, but at the end of the forecast period it has been halved, whereas density in Holzwickede continues to rise. Overall the diagram suggests a tendency of all parts of the region to arrive, in a very distant future, at an equal, and extremely low, density: the dissolution of the city into the albeit urbanised countryside.

Figure 5.10 (bottom) shows how this affects land use in the region. Unlike the previous diagrams, this diagram plots two variables against each other, population and built-up area, i.e. the growth of residential, commercial and industrial land (including access roads, but excluding land for trunk roads, motorways, railways, etc.) in the different parts of the region. Over the 30-year forecast period, the built-up area in the total region increases by 17 percent, although both population and employment decrease.

Because more land is available on the periphery of the region, the consumption of land there is much higher: In Holzwickede the developed area grows by one third, practically in proportion to its population growth. Hombruch still expands its developed area by nearly a quarter despite its decline in population since the early 1980s and even in dwellings since about 1990. Here two processes are at work. First, the resident population in Hombruch is getting older than almost anywhere else in the region, yet with relatively cheap rents the well-to-do pensioner households in Hombruch have little incentive to move into smaller dwellings when their households become smaller. Second, the demolition of dwellings in the older parts of Hombruch and the conversion of dwellings to other uses exceed new housing construction since residential land in Hombruch is scarce and expensive, yet most of the new construction takes place on virgin formerly agricultural land rather than on the many vacant lots within the built-up area. There is practically no extra land available in Innenstadt-Nord.

The final diagram, Figure 5.11, uses the 'Brotchie Triangle' introduced in Chapter 3 (see Figure 3.2) to illustrate the spatial dispersal taking place in the Dortmund region between 1970 and 2000. The diagram shows that not only the hypothetical corners of the triangle A, B and C move upwards (more travel) and to the right (more dispersal), but that also point D representing the actual region, under the influence of increasing car mobility and space consumption, moves into that direction. In Chapter 6 it will be discussed whether it will be possible to halt this trend.

Summary

In summary, the base scenario showed some surprising but on second thought quite plausible developments. Although during the 30-year forecast period the region experiences a decline in population and employment of about 20 percent, it continues to expand its built-up area into the open countryside.

The reason for this phenomenon is that even in a declining industrial city there are not only many losers, but also a few winners - prospering firms and well-to-do households - and these prefer and can afford to settle on virgin land on the attractive outskirts of the urban area, rather than in the run-down neighbourhoods of the old city with their pollution, noise, and traffic problems inherited from their industrial past.

This leads to the extreme differences in development between peripheral 'winner' zones such as Holzwickede and the progressive decline of inner-city 'loser' zones such as Innenstadt-Nord; to the simultaneous existence of large parcels of vacant land in the old parts of the city *and* urban sprawl on the periphery; to the coexistence of large numbers of vacant dwellings in inner-city housing areas *and* new housing construction at the urban fringe. It appears as if the industrial city, in the final phase of its life cycle, is destined to suffer the worst of both decline and growth: erosion of its inner core as well as erosion of its outer environment through uncontrolled growth.

Alternative Futures: Contrast Scenarios

It may be asked how much the developments of the base scenario are a function of the assumptions made about the economic decline of the industrial city. Would Dortmund in the year 2000 look different to the Dortmund of the base forecast if its economy were to develop more favourably than postulated there or if it declined even more? To investigate this question, three 'contrast' scenarios were simulated with the model under exactly the same conditions as the base forecast (Schönebeck and Wegener, 1984). The three contrast scenarios were defined as follows (S1 is the base scenario):

S2 Further reductions in the demand for steel and increasing international competition result in a further 86,000 jobs being lost in the steel and related industries in the state, half of which, or 43,000, are lost in the Dortmund region.

S3 Due to a recession, the decline in employment in the state is increased by 210,000. Because the mining and steel industries are most affected, a disproportionate share of 78,000 jobs are lost in the Dortmund region.

S4 Through government subsidies employment in the steel industry is maintained at the 1982 level. Taking account of interindustry linkages, this results in some 40,000 jobs being saved in the whole state, 17,000 of which are in Dortmund.

Table 1 shows regional employment and population totals for the four scenarios in comparison. All four scenarios are identical until the year 1982 but differ in total regional employment and population for the years 1990 and 2000 with S3 being the most pessimistic and S4 the most optimistic scenario. The difference between these two is nearly 100,000 jobs and more than 100,000 people at the end of the forecast period, thus the four scenarios cover a wide corridor of possible economic futures of the region. It is interesting to note that even the most optimistic Scenario S4, which in 1984 under the fresh impression of the steel crisis seemed the most favourable of all conceivable developments, remained below the actual development by 60,000 jobs and 180,000 people - and this was not the singular view of notorious pessimists but one widely shared by many contemporary observers.

The base scenario served as the benchmark for comparison between the scenarios. In all three contrast scenarios, the same assumptions with respect to fertility and state-wide net migration as in the base scenario were made.

Table 2 summarises the results of the three contrast scenarios S2 to S4 compared with the base scenario S1 for the same three sample zones as in Figures 5.2 to 5.8.

Not surprisingly, the employment results reflect the economic assumptions made for the whole region in the three scenarios. In the most severe recession scenario S3 employment in Innenstadt-Nord is reduced to less than 40 percent of its base year volume because a large part of the iron and steel industry of Dortmund is located here, while employment in Holzwickede, even in this scenario, continues to grow, although at a much reduced rate.

However, on the population and housing side the response of the spatial system is more complex. Here the recession reduces the share of income available for housing, consequently fewer new dwellings are built, and this primarily affects peripheral zones like Holzwickede, where housing construction is reduced considerably, especially when compared with the optimistic scenario S4.

Innenstadt-Nord, on the other hand, 'benefits' from the recession: since more people are unemployed, households have less income to spend, so fewer households can think of leaving Innenstadt-Nord in order to settle in a more attractive neighbourhood, which means that the decline of population and households in Innenstadt-Nord is slowed down. In Hombruch, population and households continue to decline under all conditions, but the pattern is as in Holzwickede, with recession (S3) resulting in lower and prosperity (S4) in higher densities, although housing construction, which in Hombruch is largely controlled by land-use constraints, is hardly affected.

Table 5.1. Scenarios S1-S4: total regional employment and population, 1950-2000.

	Reality				Scenarios		
	1950	1961	1970	1982		1990	2000
Employment	781	1,015	965	901	S1	837	778
					S2	790	735
					S3	756	700
					S4	855	795
Population	1,973	2,423	2,403	2,316	S1	2,139	1,921
					S2	2,103	1,860
					S3	2,081	1,827
					S4	2,151	1,941

Source: Schönebeck and Wegener, 1984

Table 5.2. Scenarios S1-S4: employment, population and housing in the sample zones, 1970-2000.

		Innenstadt-Nord		Hombruch		Holzwickede	
		1990	2000	1990	2000	1990	2000
Employment (1970=100)	S1	63.8	53.9	140.8	134.8	119.2	123.0
	S2	46.9	41.0	131.4	125.4	117.7	118.8
	S3	45.7	39.8	127.1	120.5	116.2	116.5
	S4	67.1	56.2	140.3	135.5	123.8	127.0
Population (1970=100)	S1	61.3	50.0	108.1	100.1	135.9	135.7
	S2	62.6	51.4	106.6	98.9	135.1	135.8
	S3	61.9	52.0	105.0	96.6	136.1	130.8
	S4	62.7	51.2	108.0	101.4	136.5	135.7
Households (1970=100)	S1	72.5	59.1	124.4	119.6	164.3	170.6
	S2	75.2	62.5	122.6	116.9	165.5	167.6
	S3	74.6	62.8	121.7	115.9	166.4	166.4
	S4	73.8	59.4	124.8	121.0	167.1	170.4
Dwellings (1970=100)	S1	93.5	88.1	132.0	131.1	165.5	173.2
	S2	93.4	88.1	131.5	130.1	165.8	172.2
	S3	93.5	88.1	131.6	130.1	165.9	171.9
	S4	93.4	88.1	131.8	130.9	166.6	175.0
Housing floorspace (m^2/head)[a]	S1	27.6	28.7	35.3	37.7	36.2	38.5
	S2	28.2	29.3	35.2	37.3	36.0	37.7
	S3	28.3	29.2	35.5	37.8	36.2	38.6
	S4	27.7	28.3	35.2	37.5	36.1	38.7
'Vacant' dwellings (percent)[b]	S1	25.9	35.2	6.3	8.5	5.3	5.3
	S2	23.0	31.6	7.4	10.1	4.9	6.4
	S3	23.7	31.4	8.1	11.0	4.0	7.7
	S4	24.4	34.4	6.0	7.4	4.4	6.6
Built-up area (1970=100)	S1	100.2	100.2	121.5	123.6	126.7	132.2
	S2	100.2	100.2	120.9	122.7	127.0	132.0
	S3	100.2	100.2	120.9	122.6	127.1	131.8
	S4	100.2	100.2	121.1	123.2	127.2	132.7

a Mean regional floorspace per head in 1970 was 23.5 m^2

b Mean regional vacancy rate in 1970 was 5.6 percent

The two indicators of housing provision, housing floorspace per capita and percent vacant dwellings, change in accordance with the above observations. The large differences found between the 'poor' and the 'rich' parts of the region remain in all scenarios, but in the two recession scenarios S2 and S3, due to a more relaxed housing market, the low-income population in Innenstadt-Nord are able to increase their floorspace consumption, even though more people stay in Innenstadt-Nord. Vacant dwellings increase considerably in number when the recession is more pronounced: now Hombruch is most affected, whereas, in line with the larger number of households remaining in the inner city, fewer vacant flats than in the base forecast are found in Innenstadt-Nord.

Whatever the impacts of the different economic scenarios on employment, population and housing, the effects on urban sprawl are negligible. It is true that land consumption is slowed down in the recession scenarios S2 and S3 and accelerated in the relatively prosperous scenario S4, but the differences to the base forecast are within fractions of one percent in Hombruch and Holzwickede and practically zero in Innenstadt-Nord - an indication that land prices in the model are quite effective in encouraging more economical higher-density land uses when demand for land is high. This means however that the spatial decentralisation process observed in the Dortmund region is likely to continue irrespective of the economic development of the region; in fact in no scenario did a trend reversal, i.e. the beginning of a 'reurbanisation' phase, become visible.

6

Transport Scenarios

Transport is rapidly reappearing as a fundamental urban question. As societies become more affluent, they adopt a lifestyle based on dispersed patterns of activities and high levels of mobility, most of which takes place by car. However, as the expected saturation in car ownership fails to materialise, the negative sides of the car society become visible: congestion, traffic noise, air pollution, road accidents and an incessant demand for new roads.

In the 1960s transport ranked equally high on the list of urban issues, but today the problems seem to be more urgent and the consequences to be drawn more radical. The construction of new roads is no longer a cure to relieve road congestion: it is necessary to apply a complex mix of 'synergetic' policies drawing on a variety of fields such as traffic management and regulation, taxation and pricing, street design and pedestrianisation in order to discourage undesirable or unnecessary movements while supporting a reasonable level of accessibility.

Yet as long as the trend to more dispersed patterns of activities prevails, all these efforts will at best maintain a fragile equilibrium between fundamentally limited transport supply and artificially constrained demand. That the spatial division of labour enforced by the present land-use system is at the origin of the current dilemma of urban transport planning has now become a commonplace, however, much less is known about the reverse impact of transport supply on land-use patterns. Clearly, without mass motorisation the dispersed settlement pattern of contemporary metropolitan areas would not have developed, but does this mean that curbing the use of the automobile would bring about a new period of urban concentration or 'reurbanisation'?

The ISGLUTI Project

To investigate questions such as these in a collaborative comparative study has been the purpose of the *International Study Group on Land-Use/Transport Interaction* (ISGLUTI)already referred to. ISGLUTI set itself the task of assessing existing land-use/transport computer simulation models with respect to their capability to represent the interaction between land use and transport in metropolitan regions. Between 1981 and 1991 this group, under the direction of the UK Transport and Road Research Laboratory, examined nine different models in seven countries. In a first phase these models were applied to a wide range of policies and scenarios in the fields of population, employment, retail facilities, land-use regulations, transport pricing and transport infrastructure in seven metropolitan areas in six countries: Amersfoort (Netherlands), Tokyo (Japan), Dortmund (FRG), Leeds (UK), Bilbao (Spain), Osaka (Japan) and Melbourne (Australia). The results of this first phase were published in Webster et al. (1988) and in summary form in Webster and Paulley (1990).

The model used for Dortmund in Phase 1 was the Dortmund model. In a second phase two other models were also applied to Dortmund (see Chapter 4). In this chapter some results for Dortmund of Phase 1 relevant for the issues discussed in this book are presented.

The Policy Tests

The principle of the ISGLUTI project was that each model was calibrated for its specific city to produce a *base forecast* comparable to the Base Scenario presented in Chapter 5, i.e. a status-quo forecast of the study area under the assumption that all technological, socioeconomic and political trends observed in the region at the time of the base year stayed in effect until the simulation horizon. The calibrated models were then used to simulate a number of *policy tests*. Each test involved a certain combination of assumptions about changes in the background trends such as population development or of explicit policies such as land use control, traffic management or transport investment. These base forecasts served as a neutral reference for comparison between the policy tests.

Altogether 39 policy tests were performed (not all of them for all cities). There were seven categories of tests:

- *Population changes*. Alternative scenarios for the population development of the region between zero and rapid growth in combination with different degrees of land use control.
- *Economic changes*. Alternative scenarios for the economic development of the region such as a general depression.

- *Relocation of manufacturing employment*. Various policies to decentralise non-service jobs from the inner city.
- *Relocation of retailing*. Scenarios assuming the decentralisation of inner-city shopping facilities to peripheral locations.
- *Travel cost changes*. Policies to influence transport behaviour by changing transport related taxes or subsidies affecting car travel costs, parking fees or public transport fares.
- *Travel speed changes*. Regulatory or investment policies affecting travel speeds such as increasing the level of service provided by public transport, bus priority lanes, speed limits as well as new public transport lines and urban motorways.
- *Timing of investment*. Various policies as in the above categories but with different timing.

In this chapter only the effects of one category of tests, *travel cost changes*, will be discussed.

Transport Policies

There is a growing consensus that automobile traffic is vastly underpriced if external costs such as congestion, traffic accidents or environmental pollution are taken into account, and that this is one of the fundamental causes of the explosive growth in personal mobility observed in the last decade. There have been innumerable proposals to make the use of the car relatively more expensive by changing either taxes or transport subsidies, or by levying user charges such as by road pricing or vignette schemes, etc. In several countries such schemes have been implemented experimentally in recent years.

A number of transport cost policies were tested in the ISGLUTI project. These experiments are of interest here because they shed light on the question as to whether the decentralisation of activities observed in the Dortmund region might be slowed down or reversed by policies affecting mobility.

Five policies changing the relative costs of trips in the urban region by changing transport taxes or levels of transport subsidy were selected for the following discussion:

Test 30 *Petrol price quadrupled over 15 years*. It was assumed that the government decided in 1970 to increase petrol taxes gradually so that in 1985 the price of a litre of petrol is four times as high as in 1970. In addition, petrol prices, as all prices in the model, are prorated over time to reflect the effects of inflation.

Test 32 *CBD parking costs increased*. In this policy it is examined whether car trips to the city-centre area of Dortmund can be discouraged by increasing hourly parking charges in the central area (Zones 1-3). It is assumed that central-area parking charges are increased by a factor of ten, which makes average city-centre parking approximately three times as expensive as the average car trip to the city-centre area. It is assumed that the policy goes into effect immediately, i.e. in 1970, and that parking charges go up with the costs of trips. Note that parking charges do not only apply to trips ending in the central area, but are also a part of the costs of owning a car in these zones.

Test 33 *Public transport free*. All public transport fares are reduced incrementally so that public transport is free after five years, i.e. in 1975.

Test 35 *Public transport fares doubled*. To test the opposite effect, it is assumed that public transport fares are incrementally increased so that after five years public transport is twice as expensive as in the base year after five years. In addition public transport fares are regularly increased with inflation.

Test 37 *Costs of all transport doubled*. In this policy the combined effect of making car travel and public transport more expensive is examined. It is assumed that at all times within the simulation public transport fares and petrol prices are twice those of the base forecast, i.e. in contrast to Tests 30 and 35 the price increases go into effect immediately.

In the following Figures 6.1 to 6.6 the development of selected transport and land-use indicators between 1970 and 2000 are shown for these five tests. The trajectories of each test are identified by its number. In addition the trajectory of the base forecast is shown as a heavy line with the number 00.

Car Ownership and Trips

Figure 6.1 confronts the development of two fundamental indicators of mobility: car ownership and number of trips.

Figure 6.1 (top) shows the unbroken rise of car ownership over the whole forecasting period approaching the ratio of one private car per every two persons towards the end of the century. It has been frequently discussed at what level saturation in car ownership can be expected. The US American experience indicates that in an affluent society the limit may be in the range of one car per adult person able to drive, unless regulation or heavy taxation constrain car ownership.

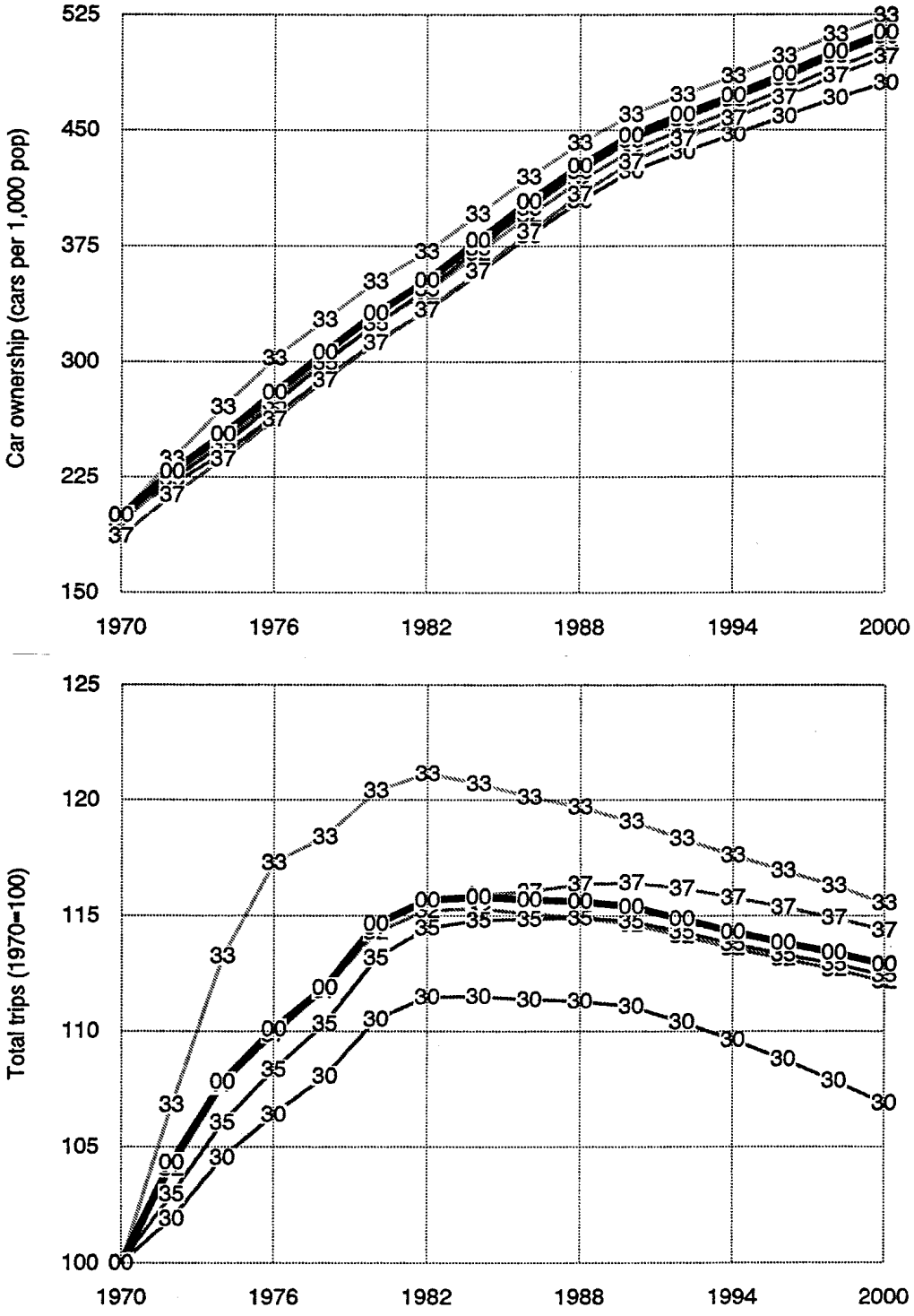

Figure 6.1. Transport scenarios: car ownership (top) and total trips (bottom), 1970-2000*. Car ownership approaches the ratio of one private car per every two persons towards the end of the century. With declining household size and rising car ownership the number of daily trips made in the region increases but then starts to decline because of the declining population.*

Several tendencies help to sustain the growth in car ownership such as the continuing decline in household size, and the growing labour force participation of women and the fact that in real terms the cost of owning a car has remained stable and the costs per kilometre travelled have in fact gone down since 1970.

None of the transport cost policies discussed does much to change this growth in car ownership. As one might expect, rising travel costs such as in Tests 30 (petrol costs quadrupled) and 37 (all travel costs doubled) slow car ownership growth down but not very much - an effect confirmed after the energy crisis of the 1970s. Ironically, a policy meant to promote public transport against the car, Test 33 (free public transport), seems to result in more cars being around.

This result of the model has been criticised on the grounds that if public transport is made free people will switch from car to public transport and sell their cars. Obviously this is not the rule because cars are used not only for local trips but also for other kinds of travel which are not as sensitive to travel cost changes, such as holiday or leisure trips. Consequently even if people switch to public transport because it is free, some of them will use the savings in their transport budget to - buy cars.

However, as Figure 6.1 (bottom) shows, there is a saturation with respect to trips. The diagram reflects the well-known fact that the number of daily trips per person in industrialised countries changes only within relatively narrow margins subject to income, household size and car ownership. This leads to the result that in the 1970s, with declining household size and rising car ownership the number of daily trips made in the region increases but starts to decline thereafter because of the declining population. Note that these simulations, too, were made before the wave of immigration due to the unification of Germany and the opening of the borders to eastern Europe, so the total population in the region develops as in Figure 5.1 (top).

However, the diagram shows that transport cost changes, although they do not much affect car ownership, have significant impacts on the level of mobility. If the out-of-pocket costs of driving increase substantially, fewer car trips are made, and if public transport becomes free, people take advantage of it and change to public transport - however, it will be seen below from which modes they change.

At first sight the increase of the number of trips in the 1990s in Test 37 (all travel costs doubled) may seem counterintuitive. As will be argued later, this increase is due to the shift in locational behaviour induced by that policy. Because all kinds of travel are much more expensive, people move close together and hence can make much shorter and hence more frequent trips - most of them walking or cycling trips for shopping or social purposes. However, because relocations in the housing market take time, this effect is considerably delayed.

Car Trips

Although the increase in the total number of trips may come to an end, this is not the case for car trips. Figure 6.2 demonstrates this.

Figure 6.2 (top) shows that the number of car trips per day more than doubles during the 30-year forecasting period, even though the population decreases by 20 percent and the total number of trips grows by only 13 percent. This growth is induced by rising car ownership and increasing spatial separation of activities and largely takes place at the expense of public transport and the 'softer' modes walking use and bicycle.

The growth in car trips is not much affected by most transport cost policies except Test 30, which affects car travel cost directly. Here the impact is substantial. With fuel costs quadrupled, the number of car trips still grows but the increase is nearly halved. Test 37 (all travel costs doubled) again produces counterintuitive results. This is the only policy that enforces a significant shift in locational and mobility behaviour with the effect that trips become much shorter and travel budgets allow some additional trips by car. Initially free public transport is counterproductive as the savings it affords permit additional trips by car. Only in the latter half of the forecasting period is the pull of free public transport stronger than this budget effect.

The diagram in Figure 6.2 (bottom) confirms that the growth of the car largely takes place at the expense of public transport and walking. Car trips accounted for little more than 40 percent of all trips made in the region in 1970 but for nearly eighty percent in the year 2000. Again it can be seen that the only effective policy to discourage the use of the car is to make it more expensive as is done in Test 30. Merely making the competing modes more attractive will not do. Even free public transport (Test 33) can persuade only few drivers to switch modes; many may have no real choice because of their residential location.

Public Transport, Walking and Cycling

The two diagrams in Figure 6.3 present the loser modes. In the base forecast the share of public transport trips (top) declines from 32 to 15 percent of all trips, whereas the 'soft' modes walking and cycling (bottom) decline from 27 to 8 percent; all non-car modes together, which in 1970 accounted for 58 percent of all trips, are reduced to a marginal 23 percent in 2000.

Indeed this was the trend in public transport use in the 1970s and 1980s and still is in most metropolitan areas in Germany. However, there are counter-examples where cities, through service improvements and fare reductions, have stabilised or even increased their public transport patronage.

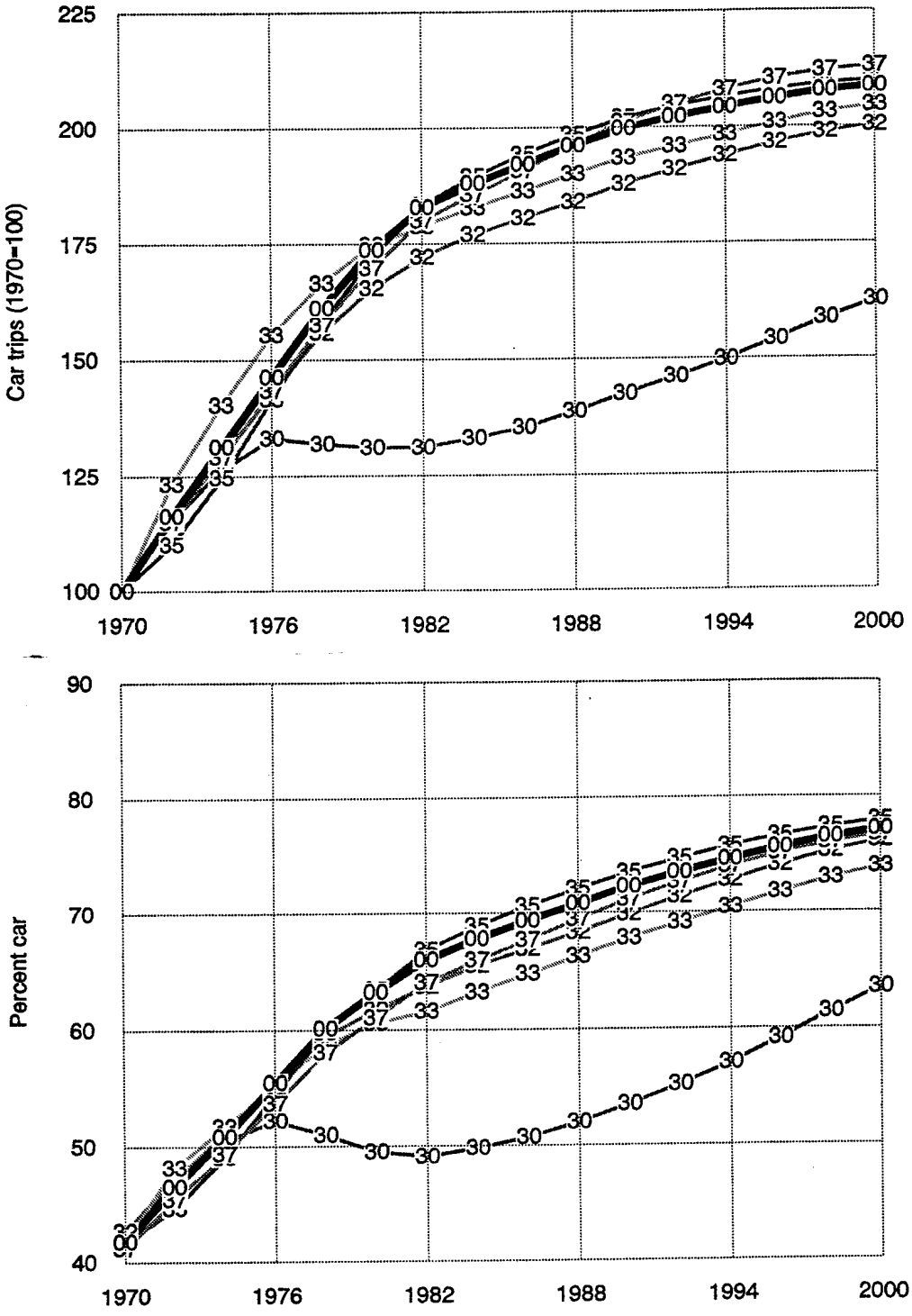

Figure 6.2. Transport scenarios: car trips (top) and percent car trips (bottom), 1970-2000*. The number of car trips per day more than doubles during the 30-year forecasting period, even though the population decreases by 20 percent. The only effective policy to discourage the use of the car is to make it more expensive, as is done in Test 30.*

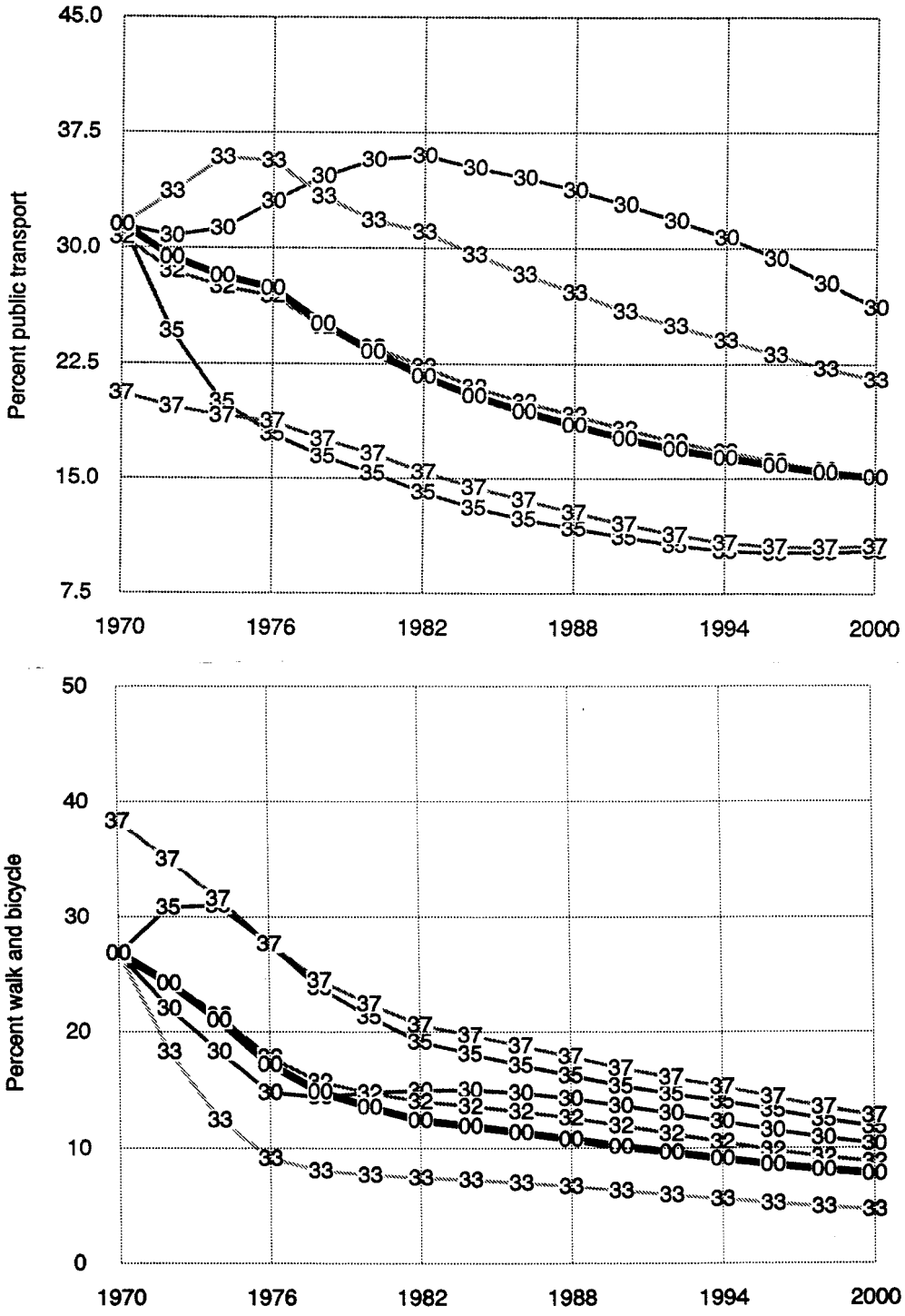

Figure 6.3. Transport scenarios: percent public transport (top) and walking and cycling trips (bottom), 1970-2000*. In the base forecast the share of non-car modes declines from 56 to 23 percent. Free public transport (Test 33) attracts only few former drivers but mostly people who used to walk or cycle. Making driving more expensive (Test 30) draws people onto trains and buses.*

The problem is that the new passengers, as Test 33 in the two diagrams shows, only to a small part are former drivers but mostly people who used to walk or cycle. However making driving more expensive (Test 30) draws people onto trains and buses. Making public transport more expensive, not surprisingly, means losing customers; walking and cycling are the beneficiaries. Interestingly, making city-centre parking more expensive hardly increases the number of public transport passengers; people who used to drive into the city to shop now rather drive to greenfield shopping centres where parking is free.

The initial small reduction in walking and bicycle trips in Test 30 (petrol price quadrupled) reflects a probably perverse logic of the model. Because long car trips are becoming too expensive, some workers switch to public transport and leave their cars at home. However, in the model all cars not used for work trips may be used for other trips. Therefore other members of the household take advantage of the available car and use it for shorter social or shopping trips formerly made on foot or by bicycle. However, in the end even short car trips become too expensive.

Travel Distance and Travel Time

Figure 6.4 shows travel distance and travel time averaged over all kinds of trips in the region.

Between 1970 and 2000 the average trip length in the region grows by one half, from 8 to 12 kilometres in the base forecast (top). Mean travel time (bottom) grows much less, from 32 to 36 minutes. This is in line with the expectation that spatial dispersal calls for longer trips, but that the shift to (faster) car trips makes travel times grow only relatively little.

Among the travel cost scenarios again three scenarios stand out. The fuel cost scenario (Test 30) keeps distances at the 1970 level; because after 1982 the shift to car continues, this results in gradually shorter travel times. If all mechanised modes are made more expensive (Test 37), average distances are more than two kilometres shorter than in the base forecast, but continue to grow with time; travel times are more than six minutes shorter. If only public transport is made more expensive (Test 35), the effect is only very small. Free public transport results in longer trips both in distance and in time because fewer people shift to the faster car mode.

Effects on Land Use

If travel distances are reduced by more expensive travel, does this mean that the spatial dispersal of urban areas can be slowed down or halted by policies increasing transport taxation or reducing transport subsidies?

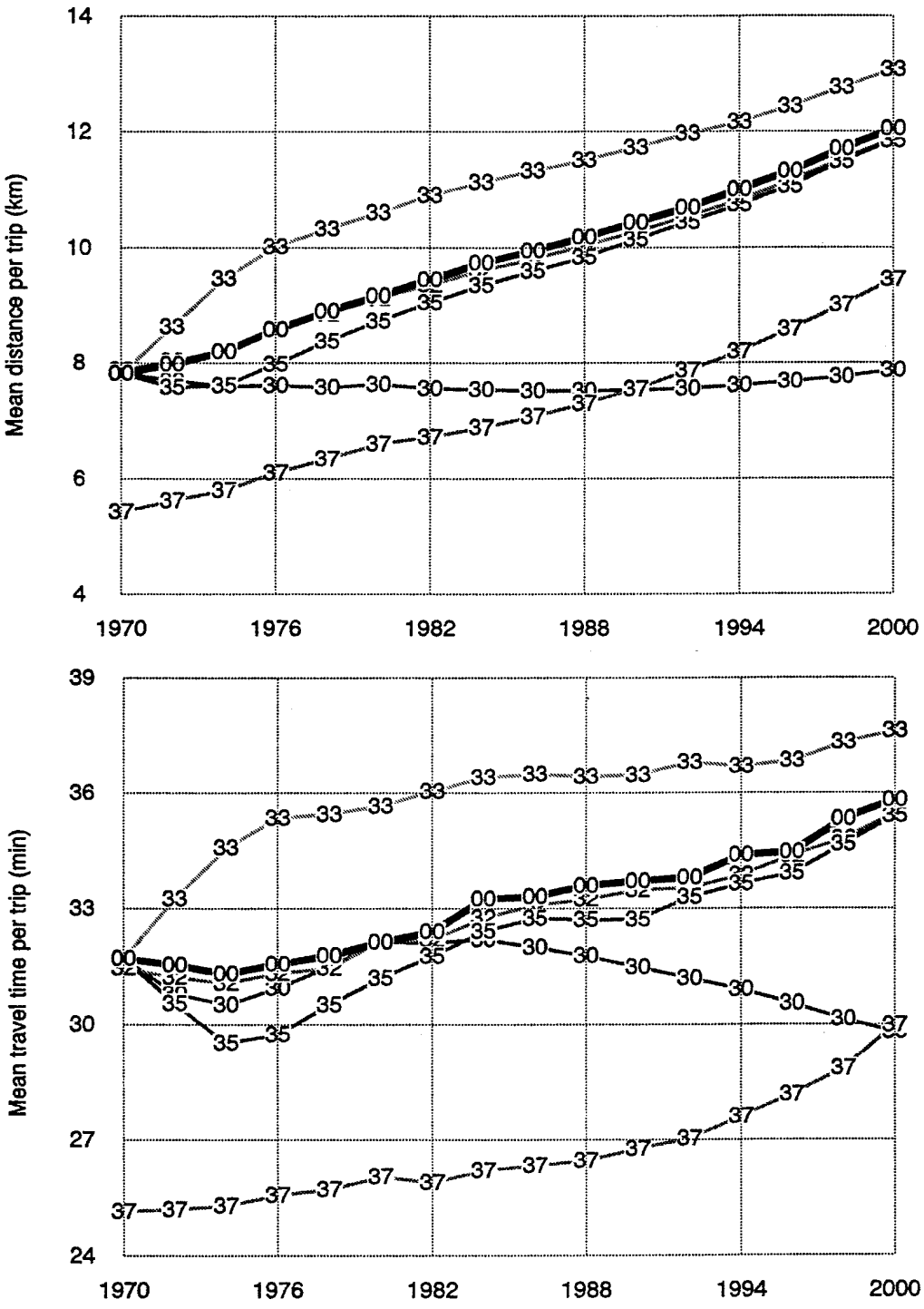

Figure 6.4. Transport scenarios: mean distance (top) and mean travel time (bottom) per trip, 1970-2000*. Between 1970 and 2000 the average trip length in the region grows by one half, mean travel time by much less. Higher travel costs (Tests 30, 35 and 37) reduce average trip distances, free public transport results in longer trips both in distance and in time.*

Figures 6.5 and 6.6 provide an answer. Figure 6.5 (top) shows how many percent of the population of the urban region (in its narrower definition, CA+IS+OS, see map in Figure 4.3) live in the core city of Dortmund (CA+IS). Figure 6.5 (bottom) shows the same for the inner city of Dortmund (CA) in relation to Dortmund as a whole (CA+IS). Figure 6.6 uses the 'Brotchie Triangle' explained in Chapter 3 (see Figure 3.2) to illustrate impacts of the travel cost scenarios on spatial dispersal and travel distances.

The top diagram of Figure 6.5 highlights the continuing decentralisation of population in the region under all circumstances. From 1970 to 2000 in this base scenario Dortmund's share of the regional population drops from 59.6 to 56.8 percent, and no reversal of this trend is visible. The travel cost policies do very little to change this. As expected, making transport more expensive has a concentrating effect but it is very small. Increasing inner-city parking charges may make the inner city more pleasant to live in but also much more expensive for people who need to have a car, so some people leave.

The effects are more pronounced if only the inner city is examined (bottom diagram). Its share of Dortmund's population in the base forecast first drops from 30.9 percent to 27.1 percent but in the 1990s starts to grow again - in relative, not absolute terms as the whole city declines. In other words, the model predicts true 'reurbanisation' in the sense of relative re-concentration under decline. Spiekermann (1990) found that this has indeed happened in reality.

The diagram confirms that making transport more expensive keeps more people in the inner city, but the effect is still small. Free public transport is detrimental to the central area because it induces people who previously could not afford to live far from their place of work to move out to the suburbs. As already noted, higher inner-city parking charges have a similar effect, though now the people moving out are car owners.

The top part of Figure 6.6 recapitulates Figure 5.11 and shows how the region is drifting apart. The trajectory shown belongs to the ISGLUTI base forecast. The lower diagram is a blow-up of the area of interest in the top diagram with the trajectories for the five transport cost scenarios added. It can be clearly seen that the spatial structure of the region moves towards more dispersal and more travel. Increasing the travel costs of only one mode does not change this pattern because travellers can always use the mode not affected.

Doubling the cost of transport leads to a more compact city in terms of employment and significantly shorter work trips. Making public transport free leads to slightly longer work trips, but to a more compact distribution of employment. The explanation for this is that the incentive for firms to decentralise from the city centre in order to follow their employees and customers has disappeared. The city centre's accessibility and hence attractiveness for retailing and services is vastly increased, hence there is a revitalisation of the central area in economic terms.

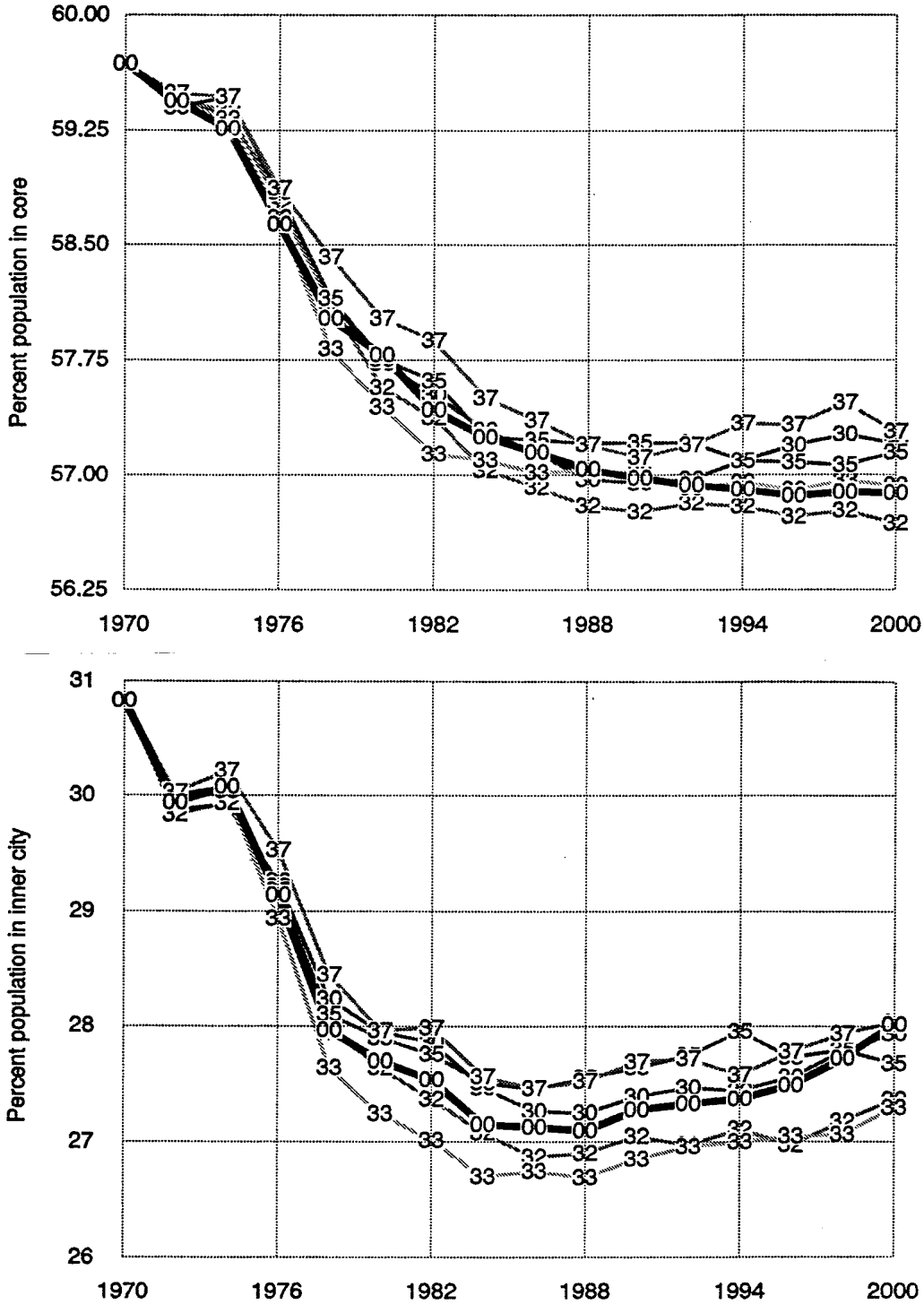

Figure 6.5. Transport scenarios: percent population in core (top) and in inner city (bottom), 1970-2000*. The top diagram highlights the continuing decentralisation of population in the region; the travel cost policies do very little to change this. The effects are more pronounced if only the inner city is examined. Here the model predicts true 'reurbanisation'.*

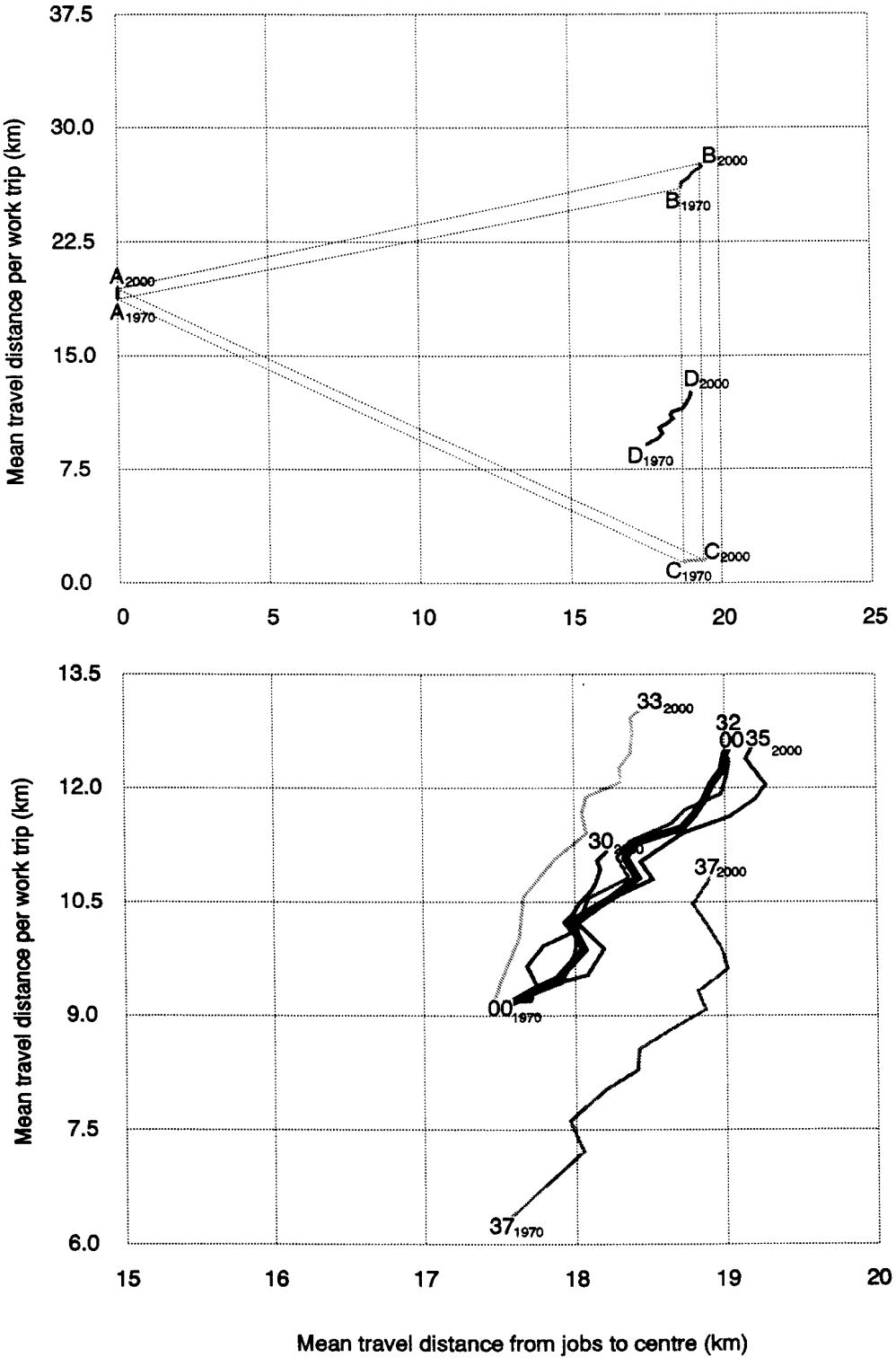

Figure 6.6. Transport scenarios: spatial dispersion and travel distances in the 'Brotchie Triangle', 1970-2000. *The diagrams show how the region is drifting apart (see text)*

Summary

This chapter has shown that transport cost policies can have significant impacts on the spatial structure and mobility behaviour in an urban region. However. the effects are complex.

The strongest impacts are on the number and length of trips. In general, making travel more expensive leads to fewer and shorter trips. Making driving more expensive is much more effective than increasing public transport fares because of the much larger number of car trips. Making public transport free (or less expensive) results in more and longer public transport trips.

The impacts on modal choice follow from the above. If a mode is made more expensive, it loses passengers, if it is made cheaper, it gains. Unfortunately, in the case of cheaper public transport the gains are largely not from car use but from walking and cycling.

The impacts on urban structure are much weaker and cannot compensate for the general trend to spatial dispersal in the region. In general more expensive travel leads to a more compact city in terms of population or, more precisely, slows down the decentralisation of population. Free or cheaper public transport *decentralises* population but *centralises* retail and service employment.

Needless to say, transport cost policies are only one instrument in the toolbox of modern travel-demand management. Improving the level of service of public transport, better passenger information, the creation of bicycle lanes and measures to make car driving less attractive by means of pedestrianisation, speed limits and parking restrictions are other necessary components of an environment-conscious local transport policy.

Of course, from the perspective of today all five transport cost scenarios are contra-factual since in the 1970s no politician would have seriously discussed any of them. Today, at a time of heightened ecological awareness, policies like the ones discussed are not at all inconceivable any more. Although free public transport has disappeared from public discussion, various discount ticket schemes have been introduced by many local or regional public transport companies. Drastic increases in fuel taxes are on the agenda of not only the Green Party, but also of many concerned policy-makers among the Social Democrats.

Analyses like the ones presented in this paper can help to guard against illusions and overly optimistic expectations. If the assumptions underlying the simulation experiments are only approximately correct, there are no prospects of a revival of the compact city with lower levels of mobility, unless unprecedented levels of coercion are accepted.

7

Long-Term Scenario

All simulation experiments presented in the two previous chapters were based on projections of the North-rhine Westphalia model (see Chapter 4) conducted *before* the unification of Germany and the opening of the countries of Eastern Europe. This implied that the sudden wave of immigration from East Germany and eastern Europe was not accounted for in the simulations with the Dortmund model. The degree to which the Nordrhein-Westfalen model underestimated the actual development in the region was documented in the section on validation in Chapter 4.

The changes arising from the new wave of immigration for the Dortmund region have been substantial. Long-held beliefs about the decline of the city and its central area had to be revised: Dortmund has started to grow again. At the same time the region is experiencing an economic upswing fuelled by the opening up of new markets in East Germany and Eastern Europe.

This chapter gives an idea of the extent to which these events are likely to change the *spatial* development of the region. It will be a very preliminary impression - a glimpse of future work rather than a full picture. Only one scenario will be presented, a first *base scenario* taking account of the new developments. In addition, the forecasting horizon is extended to the year 2015 using a simulation period of three years.

The Dortmund model has already once been used for long-term projections. Gnad (1987) studied the likely impacts of new telecommunication technologies on the spatial structure and mobility patterns in the region up to the year 2030. However, these experiments were also still based on pre-unification data.

Model Assumptions

In a time of sudden changes and unanticipated events forecasts are more difficult than in normal times. The unification of Germany and its repercussions have brought sudden population growth and new economic prosperity to the Dortmund region. Which of the new developments will be permanent and which will be only temporary fluctuations?

In order to make a long-term projection of the spatial development of the Dortmund region, projections about the likely development of employment by sector and immigration and outmigration into and out of the region are required. For the purpose of this simulation experiment very crude assumptions about these regional totals were made. They are not based on a serious economic or demographic analysis and were prepared only for this demonstration.

For the time between the base year 1970 and the 1987 census, the actual development of employment and interregional migration was taken from published statistics. For the period between 1987 and 2015, the following assumptions were made:

- *Employment*. It was assumed that manufacturing employment in the region continues to decline until the year 2000 and after that stabilises at a level about ten percent lower than today. Service employment continues to grow but also stabilises after the year 2000 at a level about ten percent higher than today. In other words, the scenario implies a postindustrial society.

- *Migration*. It was assumed that the wave of immigration from East Germany was a one-time phenomenon and that the tendency to lower levels of interregional migration within Germany will continue. Accordingly, immigration and outmigration of Germans nationals was assumed to stabilise after 2000 at a lower level than today with slightly more outmigrants than immigrants. Foreign immigration and outmigration are also assumed to stabilise after 2000, but there are more foreign immigrants than outmigrants so that total net migration for the region after 2000 is zero.

Figure 7.1 illustrates the above assumptions. Note that for these simulations time is divided into three-year simulation periods.

All other required model inputs were extended to the new forecasting horizon 2015. Model parameters such as demographic, household, housing, technical and monetary parameters (see Chapter 4) were extrapolated based on assumptions about future fertility levels, household formation behaviour, inflation rates, etc. However, the preference parameters were left unchanged until 2015; in other words, no major shifts in attitudes or behaviour were envisaged. That is not to say that such changes are not possible, only that they have not been examined at this time. Neither were changes in land- use policies a subject of this study, nor large construction projects or transport investments after the year 2000.

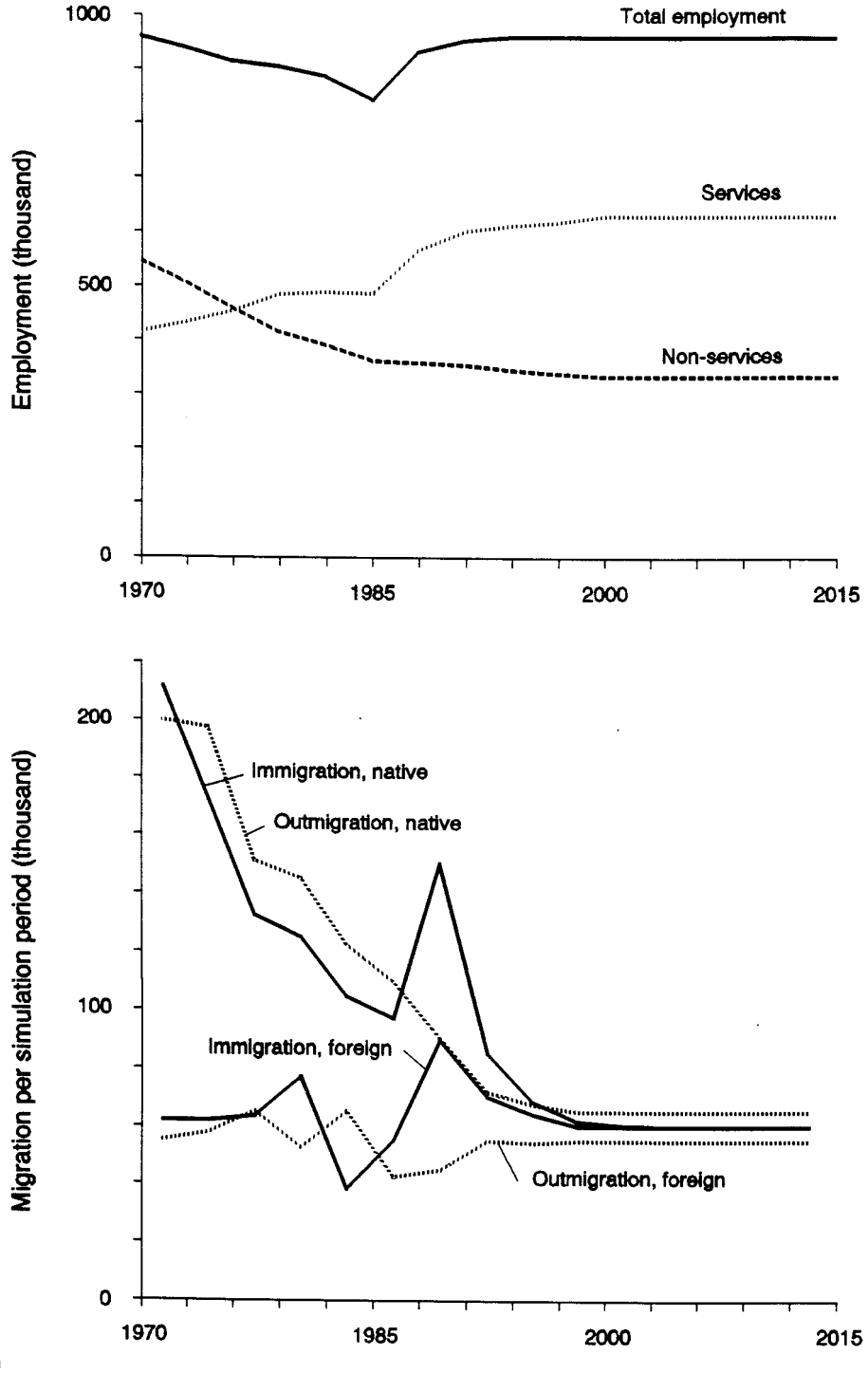

Figure 7.1. Assumptions for the long-term scenario: employment and migration, 1970-2015. *The scenario implies a postindustrial society with a low level of manufacturing and high level of service employment. It is assumed that there will be net outmigration of Germans and net immigration of foreigners and total net migration of zero.*

Recent Changes in Spatial Development

As indicated, the new wave of immigration has also brought about a trend change in the internal spatial development of the region. Figure 7.2 shows what we know about the recent spatial shifts in the region (IRPUD, 1991). The subregions are defined as in Chapter 4.

Between-census employment data in Germany cover only persons registered in the social security system, and with increasing part-time employment these are becoming less reliable and in addition are not available for spatial units below the community level. The top diagram in Figure 7.2 therefore only shows the development between 1950 and the 1987 employment census. The diagram clearly conveys an impression of the decline of manufacturing (non-service) employment in all parts of the region and the rapid growth and suburbanisation of service employment. Suburbanisation means here that service industries grow fastest in the inner suburbs, less quickly in the outer suburbs and hardly at all in the central area. More recent employment data indicate that the new economic prosperity is likely to reinforce these trends.

Population data are more recent. The lower diagram of Figure 7.2 shows that all parts of the region have returned to growth, most significantly the central area where most of the immigrants find their first, but not always permanent accommodation. As may be expected, housing development, because of the long planning and construction periods, has not yet responded to the new developments; this has led to a serious housing shortage (see below).

The question to be answered by the following simulation experiment is how, under the assumptions stated in the previous section, these trajectories will continue into the future. This will be discussed in the subsequent subsections with respect to some of the indicators already used in Chapter 5.

Note that in the following diagrams the trajectories for the subregions are labelled using the acronyms defined in Chapter 4, where CA stands for the Central Area (Zones 1-3), IS for the Inner Suburbs (Zones 4-12), OS for the Outer Suburbs (Zones 13-22) and EX for the remaining External Zones (Zones 23-30). The total region is indicated by a heavy solid line and the label TR.

Employment

Figure 7.3 shows the long-term development of total employment and service employment in the above subregions in a way comparable to Figure 5.2. The heavy solid line in the top diagram simply repeats the assumpti7ons on total regional employment (see Figure 7.1, top) reflecting the spectacular growth in employment between 1985 and 1987. Some critics argue that part of this growth is a statistical

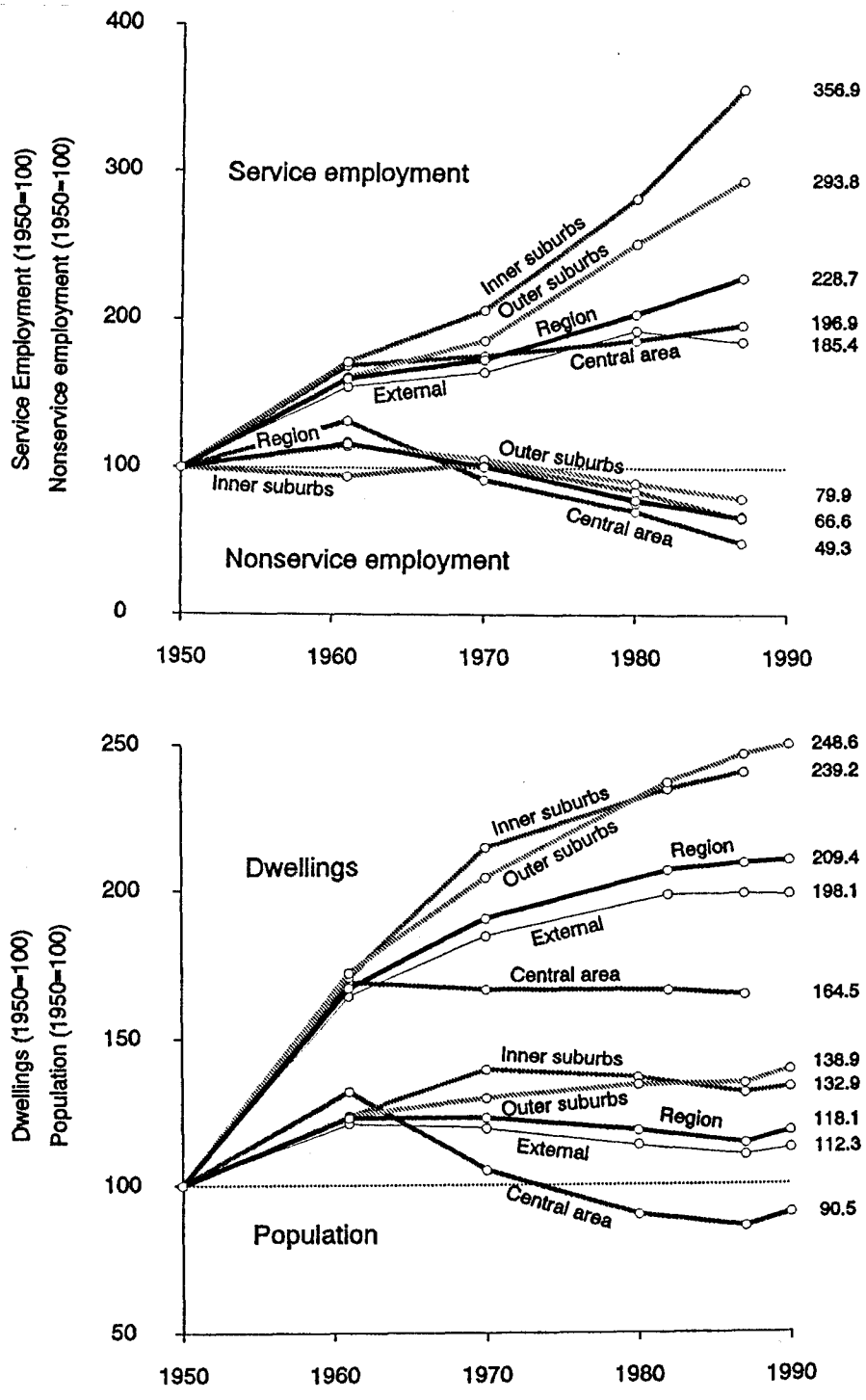

Figure 7.2. Spatial shifts in the Dortmund region, 1950-1990*. The top diagram conveys an idea of the decline of manufacturing (non-service) employment in all parts of the region and the rapid growth and suburbanisation of service employment. All parts of the region except the central area have returned to population growth.*

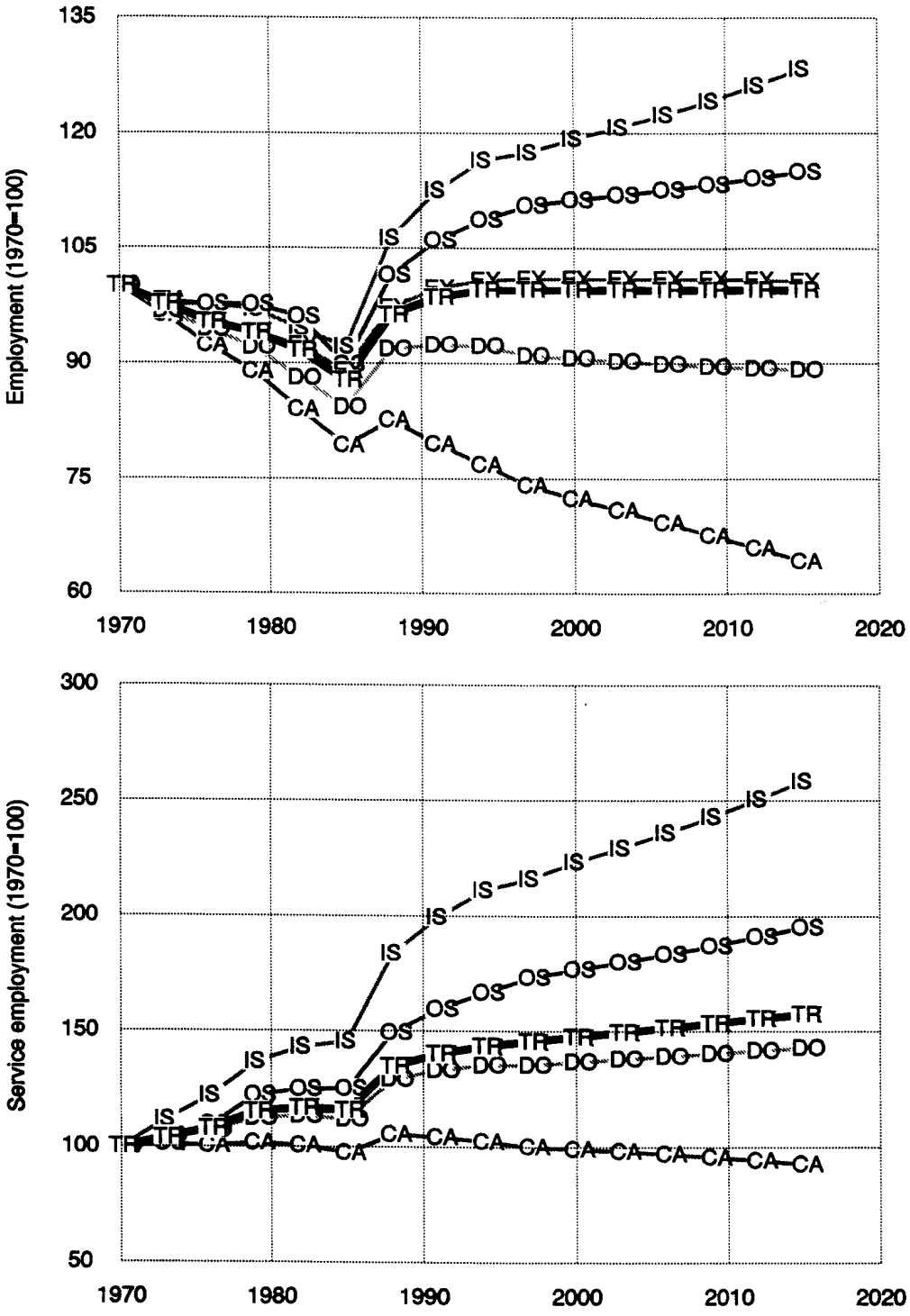

Figure 7.3. Long-term scenario: total employment (top) and service employment (bottom), 1970-2015*. The diagram shows the strong decentralisation of employment in the region. The industrial core of the region deindustrialises. The rapid growth of service employment in the inner suburbs includes staff working at the university and the nearby Technology Park.*

artefact because the data published before the 1987 employment census were estimates to compensate for the deficiencies of the between-census employment statistics and grossly underestimated the amount of part-time employment, especially in services, which was, however, included in the census. Whichever definition of employment one prefers, either the recession was less severe than it appeared or the new growth is less spectacular than the figures say. Nonetheless there *is* growth, as decreasing unemployment rates indicate, and it is likely to continue for some time as the true beneficiary of unification has so far been the West German economy.

The diagram clearly shows the strong decentralisation of employment in the region. Even when total employment remains constant, employment shifts from the central area to the inner suburbs and to a lesser degree to the outer suburbs. The processes are obvious. Manufacturing industries, which in an industrial city like Dortmund were traditionally located in the centre, decline or go out of business or relocate to more spacious sites on the periphery with good motorway access and a more pleasant work environment. Modern high-tech industries willing to locate in the region reject vacant industrial sites in the central area because of the negative image associated with old industrial environments and the ubiquitous risk of soil contamination. Thus the industrial core of the region deindustrialises.

That employment growth is most rapid in the inner suburbs is due to the growth of service employment, as the bottom diagram shows (note the different vertical scale). This growth includes, for instance, the approximately 10,000 staff working at the university and the software houses and consulting firms of the nearby Technology Park. However, also service firms catering to local firms and households prefer attractive and yet affordable locations with good accessibility in the inner suburbs to expensive sites in the run-down and congested inner city. As long as land in the inner suburbs is available, there is no need for them to move to more remote locations on the periphery. Service employment in the central area declines in the long run due to relocations and the continuing trend to reduce sales staff in the retail industry.

Population and Households

The next four diagrams (Figures 7.4 and 7.5) present information on population and households in the long-term scenario. Compare this to Figures 5.3 and 5.5 of the earlier base scenario.

Figure 7.4 (top) confirms the assumption made for this scenario that the recent immigration wave will not persist. Nevertheless the assumption about long-term zero net interregional migration results in slight total population growth after the year 2000 due to the increasing share of foreign population who only slowly adopt the low fertility of the native population.

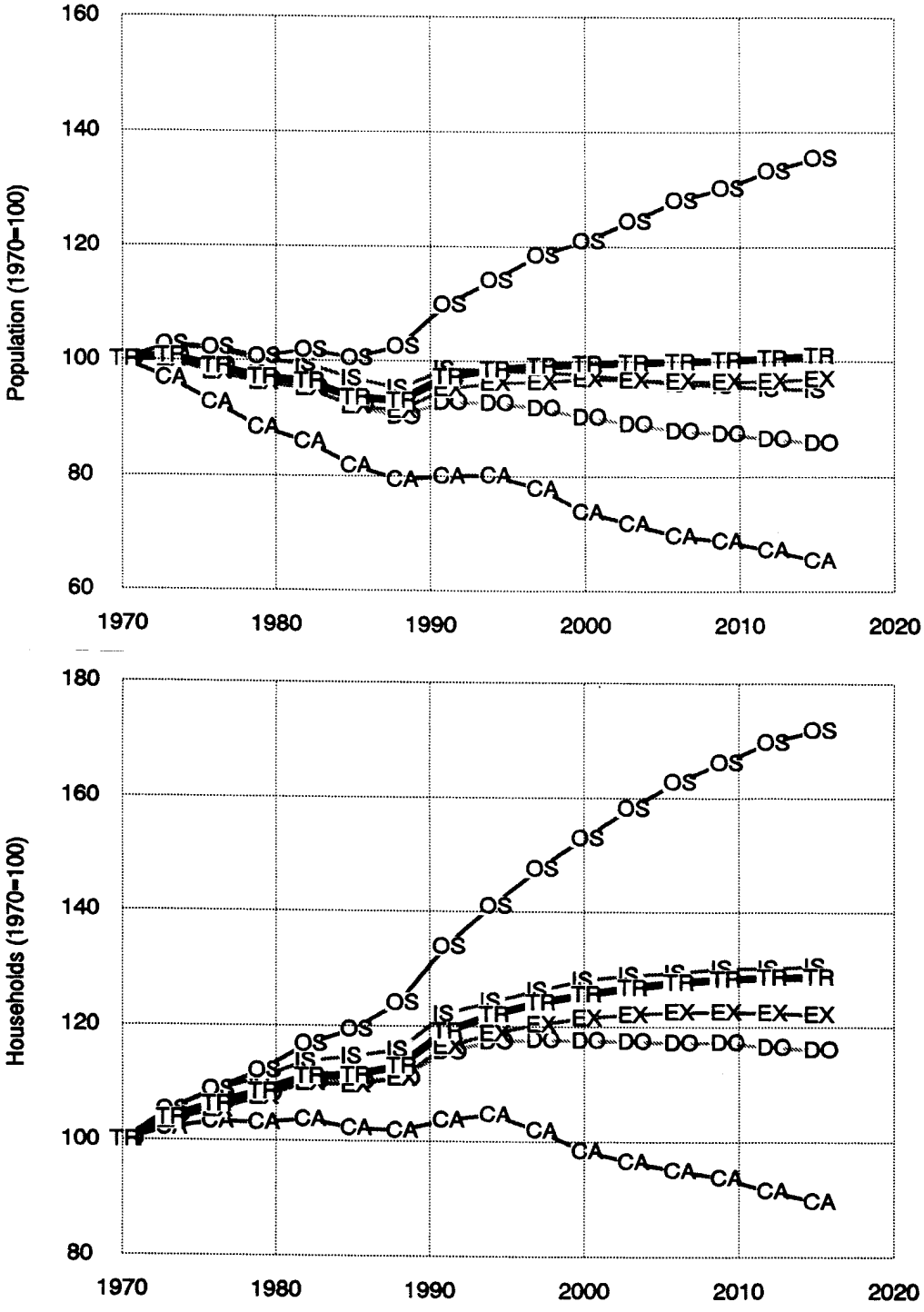

Figure 7.4. Long-term scenario: population (top) and households (bottom), 1970-2015*. Zero net interregional migration results in slight total population growth after the year 2000. Almost all population growth will occur in the outer suburbs. Dortmund will return to population decline in the mid-1990s, after 2000 also in terms of households.*

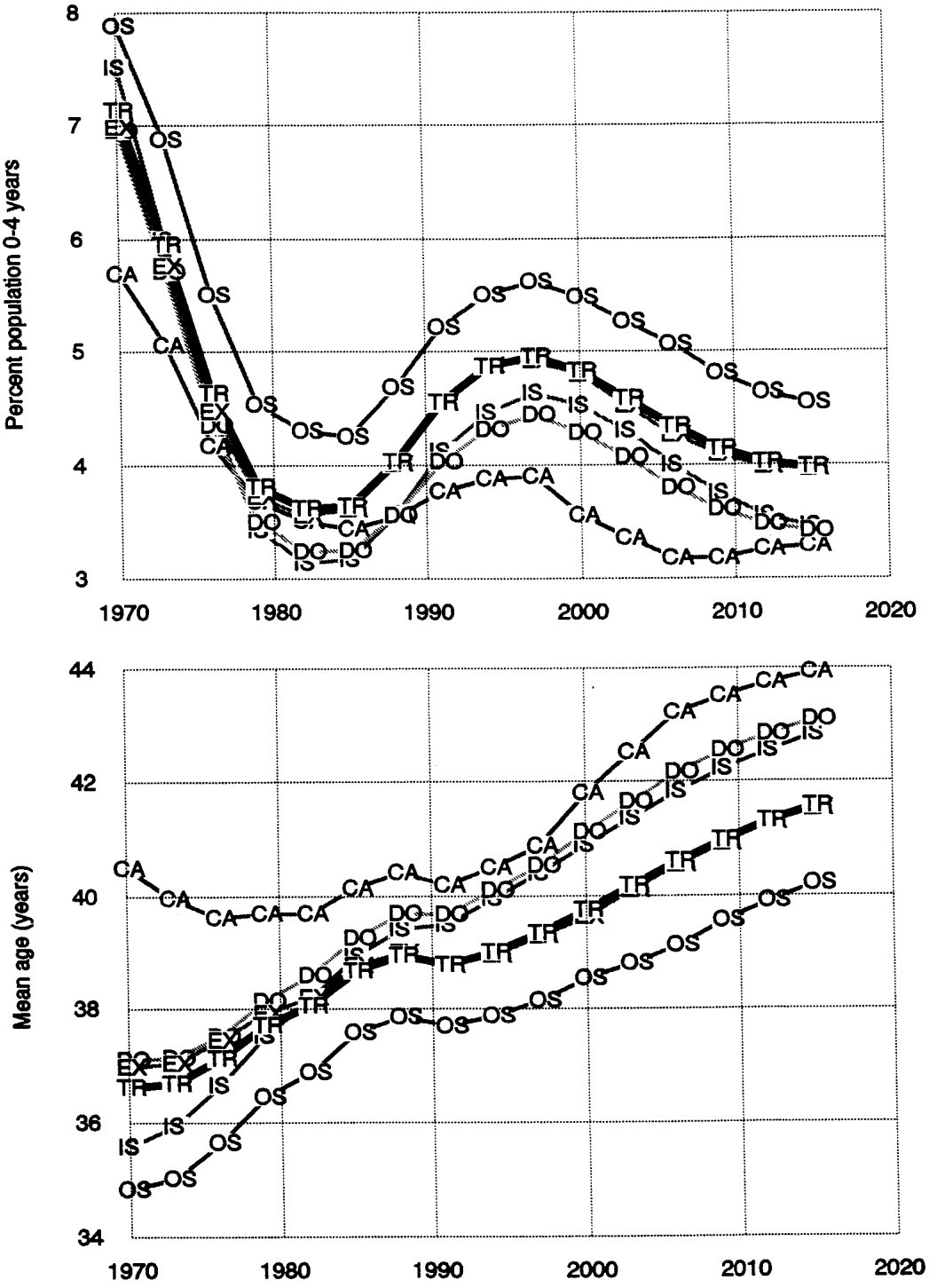

Figure 7.5. Long-term scenario: share of population of 0-4 years of age (top) and mean age (bottom), 1970-2015. *Now the end of the 'echo' baby boom becomes visible. The ageing of the population will continue despite foreign immigration. Old people will increasingly live in the centre and families with children increasingly in the suburbs.*

Behind this rather moderate population scenario, significant interregional shifts become visible. Already in the 1970s the wave of suburbanisation passed beyond the inner suburbs to the periphery of the region. In the future almost all population growth will occur there. After the immigration wave, the inner suburbs and the central area of Dortmund will return to decline; though the estimate here is less radical than in the pre-unification scenario (compare Figure 5.3 (top), towards the forecasting horizon the central area of Dortmund will have lost one third of its population. Dortmund as a whole will, therefore, return to decline in the mid-1990s in this scenario.

Household size continues to decline in the region. Accordingly, in terms of households growth in the outer suburbs is more pronounced and decline in the central area less dramatic. Only after 2000 does the number of households in the central area start to decline by some ten percent. The corollary is that two thirds of all households in the central area will be single-person households. In terms of households the inner suburbs will continue to grow and Dortmund will start to decline only after 2000.

Figure 7.5 (top) shows how Figure 5.5 (top) will continue. Now the end of the 'echo' baby boom becomes visible signalling a new wave of closures of kindergartens and primary schools in the 2010s. The consequences for the age structure of the population are menacing. Figure 7.5 (bottom) shows that the ageing of the population will continue despite foreign immigration. Between 1970 and 2015 the average age of the population in the region will rise by almost five years, and this will imply a growing discrepancy between the number of economically active people and the number of old people they have to support (compare Figure 5.5, bottom). Both diagrams highlight the uneven distribution of age groups in the region with old people living increasingly in the centre and families with children increasingly in the suburbs.

Housing

The next group of diagrams (Figures 7.6 and 7.7) shows some long-term housing trends. Related diagrams of the earlier base scenario are Figures 5.8 and 5.9.

The development of total housing supply predicted by the model as displayed in Figure 7.6 (top) presents no surprises. As this scenario assumes stable economic growth, household incomes will continue to rise, as will the demand for more housing floor-space per capita, just as in the past. However, as the bottom diagram shows, demand seems to stabilise at about 37 square metres per capita towards the end of the forecasting period. This is a rather low level compared with the rest of the Federal Republic, but housing in Dortmund has always been comparably smaller than in other regions due to its working-class history.

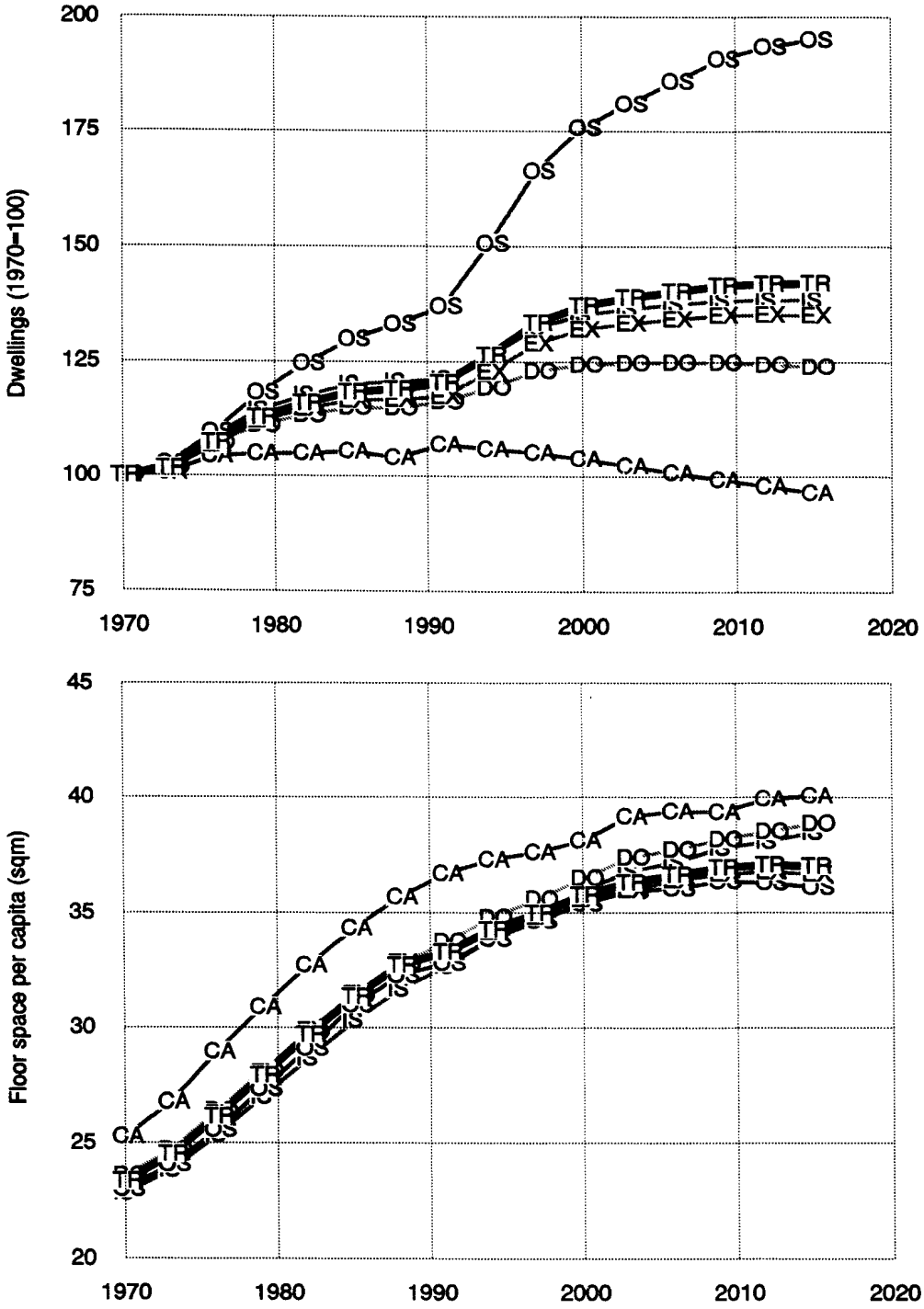

Figure 7.6. Long-term scenario: dwellings (top) and housing floor-space per capita (bottom), 1970-2015*. With rising incomes households will continue to demand more housing floor space per capita; however, demand seems to stabilise at about 37 square metres per capita. This translates into a 40 percent increase of dwellings in the region, twice as much as between 1970 and today.*

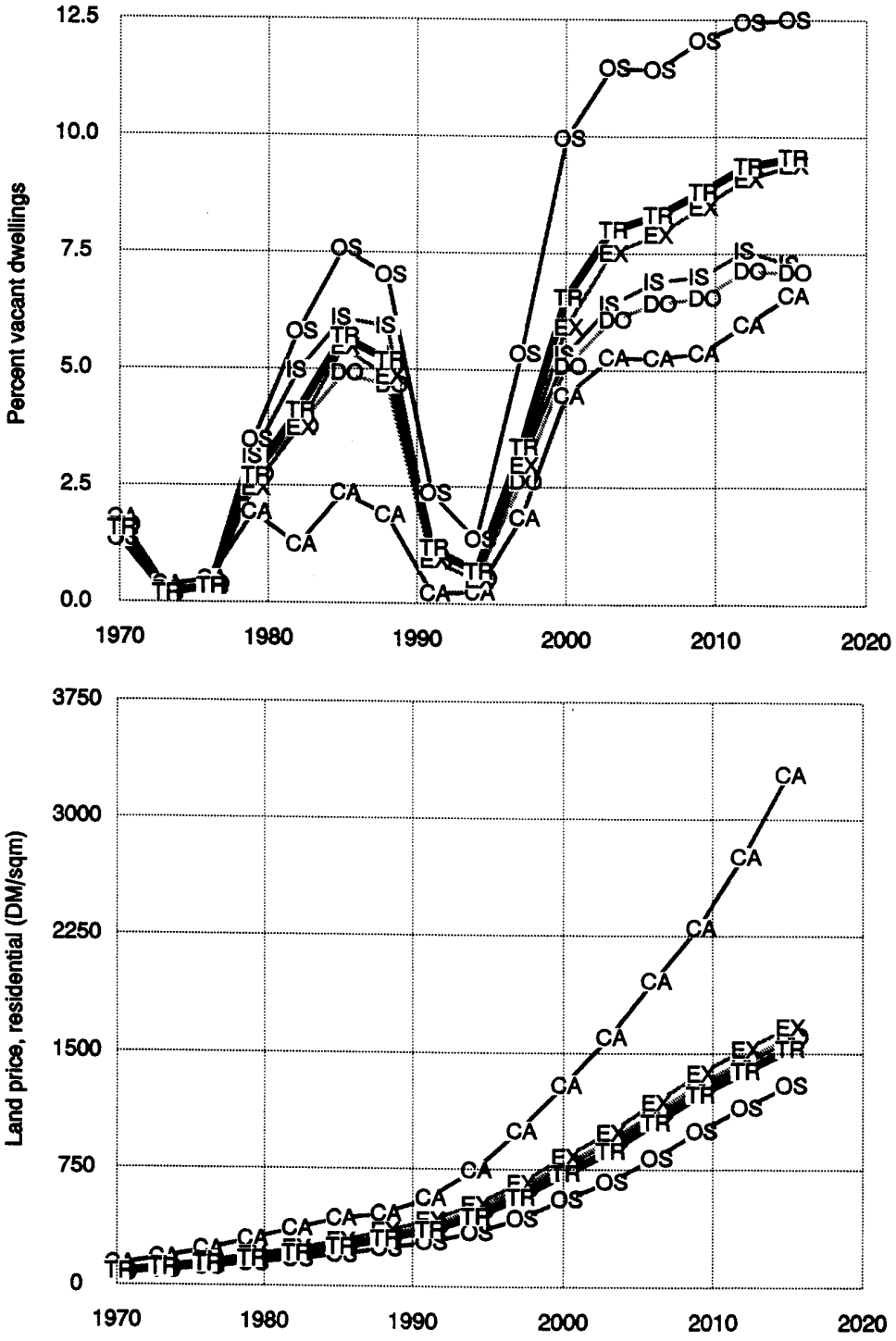

Figure 7.7. Long-term scenario: percent vacant dwellings (top) and residential land price (bottom), 1970-2015. *The response of housing investors to the immigration wave overshoot. There may again be large vacancy rates in the late 1990s. However, due to high land prices and construction costs the profitability of housing investments may be too low to attract investors.*

The growth in housing floor-space translates into a 40 percent increase of the number of dwellings in the region over the whole forecasting period, twice as much as between 1970 and the present. As has to be expected, housing supply does not respond immediately to the unanticipated immigration wave, but with a five-year delay; the 1990s may see a new housing construction boom.

The model suggests that it may come too late and may overshoot. Figure 7.7 (top) confirms the earlier observation that vacancy rates in the housing market can fluctuate violently due to only moderate shifts in demand. The diagram shows the large vacancy rates of the 1980s (which were wrongly extrapolated into the future in the pre-unification base scenario) and the abrupt present housing shortage caused by the immigration wave. However, if the model's conclusion about the behaviour of housing investors is correct, there will again be large vacancy rates once these new dwellings are completed.

Just as in the discussion of the earlier base scenario, a note of caution is appropriate. The model is not well informed about the really important determinants of housing investment, such as the level of interest rates or the attractiveness of other investment opportunities. Experts warn that due to rapidly rising land prices and high construction costs the profitability of housing investments may at present be too low to attract large investors.

That the contagious disease of exaggerated land prices is also infecting a city as Dortmund, which cannot be said to be in the limelight of the increasingly international real-estate industry, can be seen from Figure 7.7 (bottom). The figure needs some explanation because it is expressed in nominal terms, so in order to appreciate the rate of land price increases, the average rate of inflation needs to be deducted. If that is done, the average price for a square metre of residential land in the whole region almost quadruples and increases five-fold in the central area, according to the model. If this forecast were to come true, it would make any housing construction in the central area prohibitively expensive and even in the inner suburbs unaffordable for most people, and this is one of the factors to explain why new housing goes up almost exclusively in the outer suburbs according to Figure 4.6 (top).

The negative aspects of exaggerated urban land and housing prices are obvious. They are negative from a *social* point of view because they lead in the long run to the elimination of affordable housing in the inner city, and hence to the displacement of poor and even middle-class households by tertiarisation or gentrification. This can already be observed in parts of Dortmund (see Spiekermann, 1990). As discussed earlier, the present housing shortage is not really a shortage of housing but of *affordable* housing for the large number of new residents who still have to find their position in the market economy. Exaggerated land prices are also negative from an *ecological* point of view because they reinforce the already strong trend to spatial dispersal and hence increased mobility.

Travel

The final group of diagrams (Figures 7.8-7.10) gives an idea of future mobility in the Dortmund region under the assumptions of this scenario. The regional trajectories (the heavy lines labelled TR) in the following diagrams may be compared with the base forecasts (the heavy lines labelled 00) in the ISGLUTI experiments in Chapter 6 (Figures 6.2-6.4).

It may be useful to recapitulate the assumptions underlying this scenario: no changes in transport policy; all transport prices continue to rise with normal inflation rates as in the past, no principal changes in travel choice behaviour and no major transport investment after 2000. Under these assumptions the scenario holds no surprises but is not pleasant:

- Car trips within the region continue to rise during the forecasting period, but at its end seem to stabilise at a level which is two and a half times as high as in 1970 and still about thirty percent higher than today (see Figure 7.8, top). Most of this growth occurs in the outer suburbs, whereas in the central area car trips start to decline because of congestion.

- By the end of the forecasting period 78 percent of all daily trips including walks are by car, and this applies equally to all subregions except the central area (Figure 7.8, bottom).

- Public transport declines to a marginal mode for captive groups such as children, the elderly and the disabled persons attracting only about 18 percent of all trips in the year 2000 (see Figure 7.9, top). After that time Public transport use picks up slightly as it attracts some drivers frustrated by increasing road congestion. The highest level of public transport use is found in the inner suburbs as they are well served by public transport but distances are too long to walk.

- Walking and cycling, except of course for recreation, is on the retreat (see Figure 7.9, bottom). Of the trips included in the model eventually only four percent are made on foot or by bicycle. This is different in the central area where twelve percent of all trips are still walking or cycling trips.

- Average trip distances continue to rise without any sign of saturation (Figure 7.10, top). However, there are large differences between the different parts of the region: trips by people living in the central area are less than half as long as trips by residents of the outer suburbs.

- Average travel times per trip at first rise less than trip distances reflecting the shift to the faster car mode. However, already in the 1990s travel demand by far exceeds the road capacity with the effect that there is large-scale, network-wide road congestion at all times of the day.

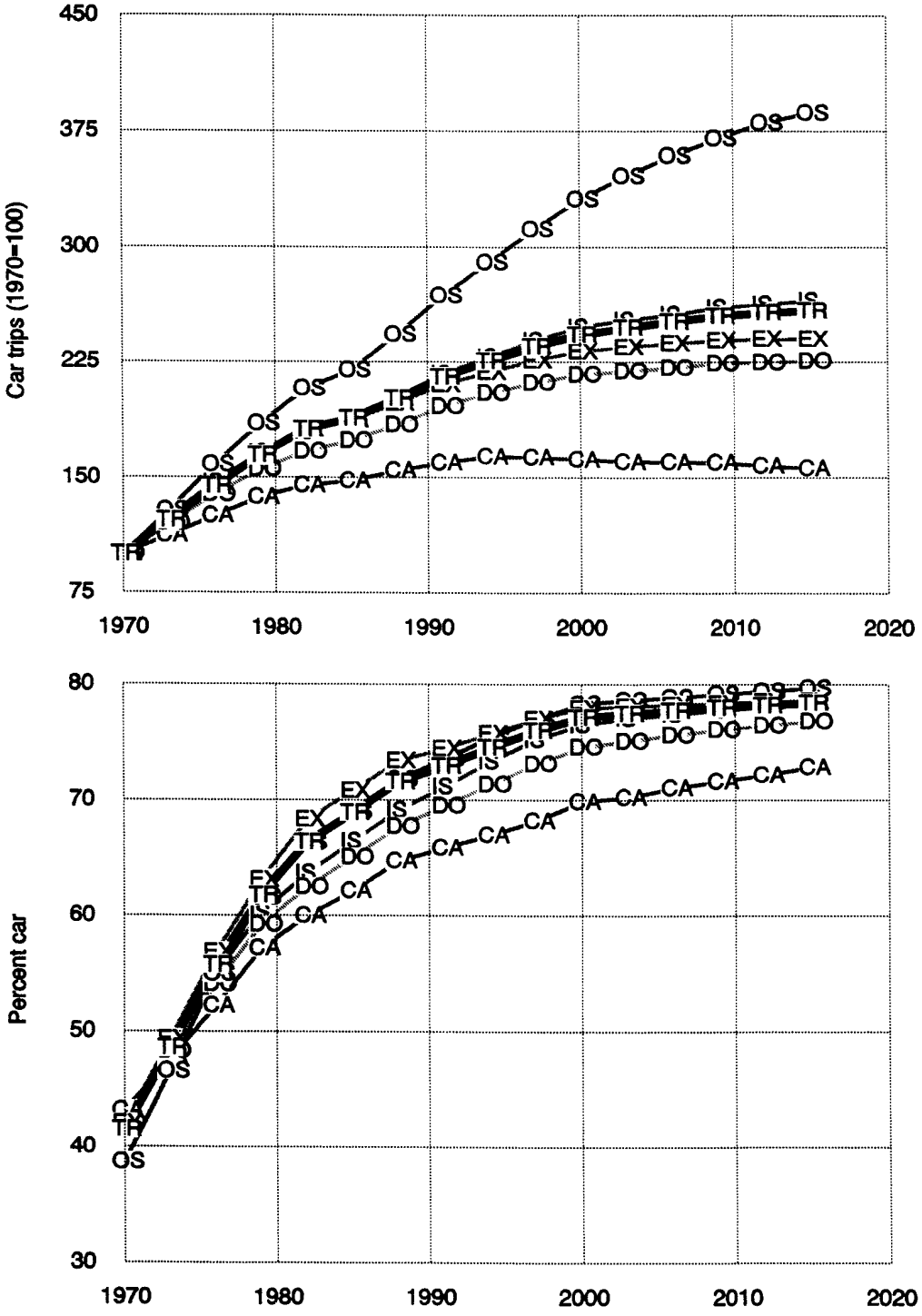

Figure 7.8. Long-term scenario: car trips (top) and percent car trips (bottom), 1970-2015. *Car trips within the region will rise by thirty percent compared with today. Most of this growth occurs in the outer suburbs, whereas in the central area car trips start to decline because of congestion. Eventually nearly eighty percent of all daily trips are by car.*

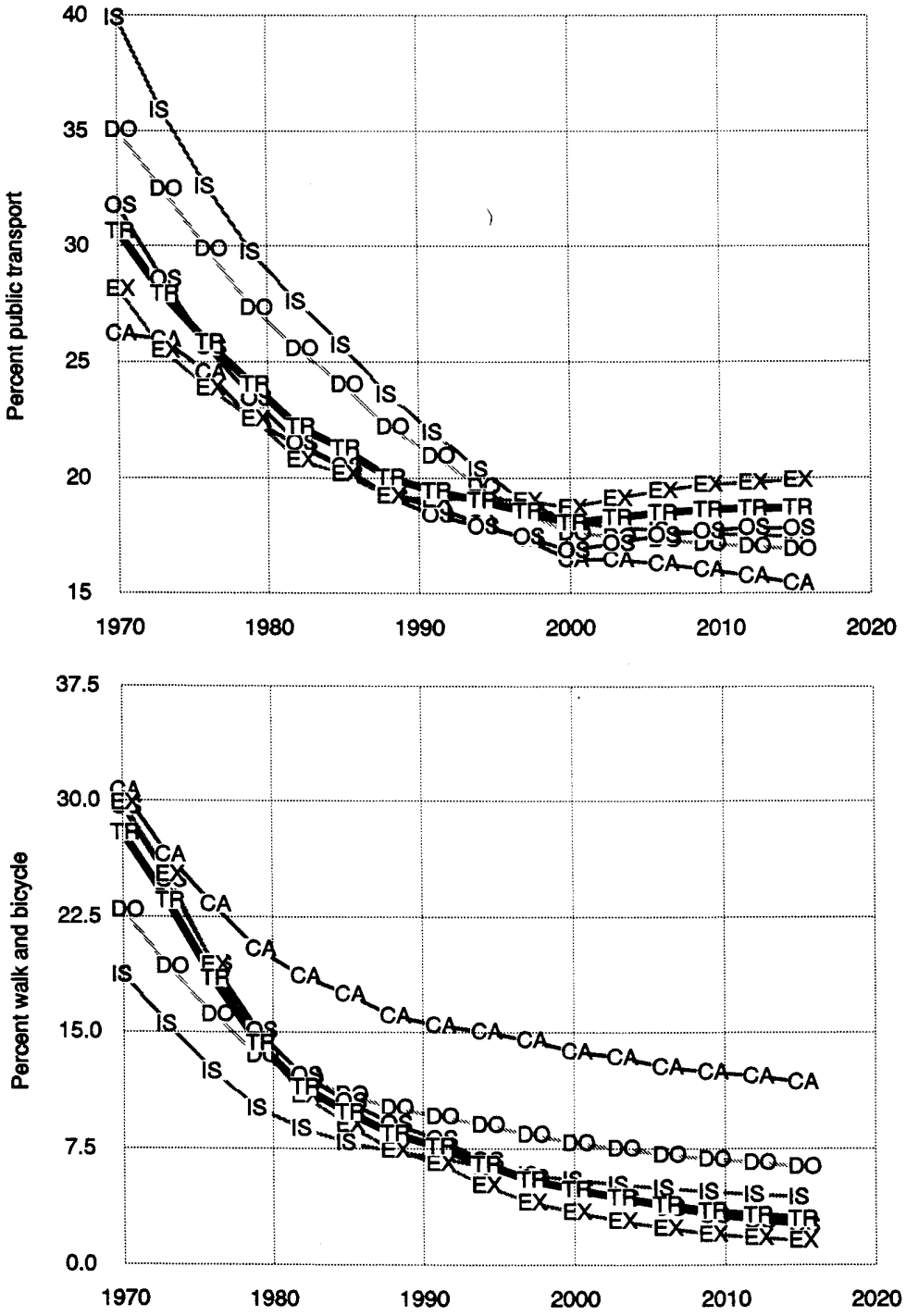

Figure 7.9. Long-term scenario: percent public transport (top) and walk and bicycle trips (bottom), 1970-2015*. Public transport declines to a marginal mode for captive groups such as children, the elderly and the disabled persons. Walking and bicycling, except for recreation, is on the retreat, except in the central area where twelve percent of all trips are still walking or cycling trips.*

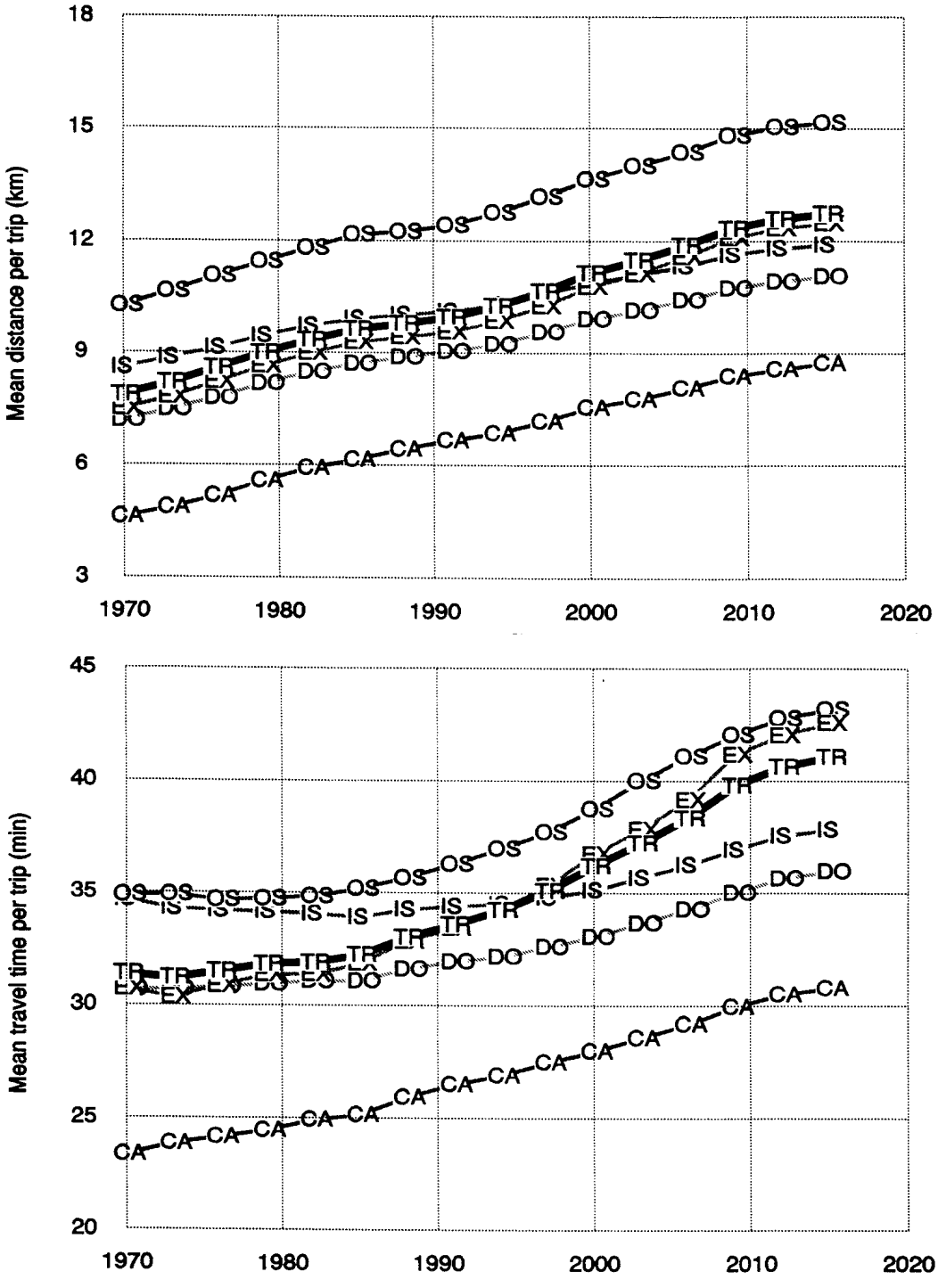

Figure 7.10. Long-term scenario: mean distance (top) and mean travel time (bottom) per trip, 1970-2015*. Average trip distances continue to rise without any sign of saturation. Average travel times first rise less than distance, however already in the 1990s travel demand by far exceeds road capacity with the effect that there is large-scale, network-wide road congestion at all times of the day.*

There are good reasons for believing that this scenario of mobility is too negative. One might point to the fact the Federal government is committed to a substantial reduction of total carbon dioxide emissions during the forecasting period of this scenario and that it will not be able to keep its promise without a substantial increase of the petrol tax. One might equally point to the growing awareness in the population that a livable urban environment will not be possible without some constraints on car use and to the increasing number of people of all ages who use bicycles out of a sense of environmental responsibility.

Nevertheless, it useful to show that the warnings of transport planners who are fighting for a more ecological urban transport policy are by no means exaggerated. It would be interesting to examine their proposals using the methodology demonstrated in Chapter 6 and to compare the results with this laissez-faire scenario.

Summary

The long-term scenario presented in this chapter is a first attempt to reconsider the spatial trends identified in the region after the external shock of unification and its repercussions. The question was whether the new economic and demographic situation in Germany will fundamentally change the internal restructuring process in the Dortmund region.

The answer is yes and no. Yes because the region has experienced a fresh injection of young people and economic opportunities which have lifted it out of its gloomy state of self-pity and despair to a new level of normality. No because it is obvious that from this new level the same processes of deindustrialisation and spatial reorganisation which had not completed their cycle when the shock occurred, will become dominant again once the repercussions of the events have calmed down.

With the new starting position and with some of the overly pessimistic assumptions corrected, the postindustrial future of Dortmund reveals even more a 'normal' city with 'normal' problems. The scenario has suggested some of these problems: a rapidly ageing population, imbalances on the housing market, progressive erosion of the functions of the city centre and continuing spatial dispersal coupled with increasing levels of mobility and the associated environmental problems such as congestion, noise, air pollution, waste of energy and land.

Is this the future of Dortmund? This question leads to the concluding chapter.

8

The Future of the Industrial City

The concluding question of the previous chapter will now be generalised to include all former industrial cities: Will this be the future of the industrial city?

Summary of Scenarios

To summarise, the simulation experiments presented in this book concluded that the most likely future of industrial cities like Dortmund is their gradual *spatial dissolution* into the surrounding countryside - unless they find an entirely new role and justification for their existence.

As the deindustrialisation process continues, the centre of the former industrial city is more and more hollowed out and deprived of its leading functions. Void of important historical or cultural landmarks, lacking the spatial quality of a medieval town centre, devastated by the air raids of World War II and hastily rebuilt in the commercialised architectural style of the 1950s, their city centres are nothing more than receptacles for mass consumption and services which might be delivered equally well or even better closer to their already dispersed clients' places of residence.

New industries, if they come, or the few surviving existing industries settle at more attractive locations in the suburbs with good access to the regional road and motorway system. Efforts to decontaminate and reuse former industrial sites in the centre

are fraught with technical problems and require heavy public subsidies. Even if these sites can be recycled, their 'black country' image is hard to dispel. Thus the typical former industrial city consists of a fragmented, nondescript centre surrounded by vast areas of derelict former industrial structures, waste heaps and transport lines.

At the same time the industrial city is reborn in its suburbs. Here are the former workers' settlements where the redundant miners and steel workers live from their modest social security payments or pensions. Here are the low-density housing areas where the white-collar workers from service industries, from the few new high-tech manufacturing industries and of the universities and government institutions practise the same comfortable suburban lifestyle as in all cities in Germany. Here are the thriving small shopping and services centres catering to the needs of the new middle class which have developed in the former village cores. Here, finally, are the *new* industries that did *not* move to one of the old industrial sites, but preferred the pleasant work environment of the office parks or converted farm houses.

The process of suburbanisation of the former industrial city is therefore not simply a spatial spill-over as in other cities, but a spatial shift *where one part of the region is abandoned while others are taken into use.*

In its present form this process is both socially and environmentally undesirable. In *social* terms it leads to the marginalisation and spatial discrimination of the left-over population in the run-down centre after the younger and economically more active households have moved away. In *environmental* terms it leads to a dispersed settlement structure relying almost exclusively on the private automobile with unacceptable levels of car traffic noise, air pollution and waste of energy and land.

With this scenario in mind, the question is repeated: Will this be the future of the industrial city? The answer is: yes, *if nothing happens to change the assumptions made in the scenario*.

Alternative Scenarios

There are many possible ways to modify the assumptions underlying the last scenario - not the economic assumptions because if the former industrial city had a new future as, say, a high-tech city or a financial centre, it would not be what it is. But the other assumptions are open for experimentation. If, for instance, there were to be a large and permanent inflow of foreigners, the resulting cultural diversity might set new premises for spatial transformation. Or if by some change of the *Zeitgeist* the preferences of travellers, households and firms were gradually be reoriented towards traditional lifestyles, family life and local consumption and communication, then the urban region might look different in 2015. It would be interesting and possible to model these or any of the scenarios quoted in Chapter 2.

Another possibility is to change the *policy* assumptions made in the scenarios. The spatial organisation of society is, despite apparently powerful megatrends, not an autonomous process which has to be accepted like a law of nature, but can at least in principle be changed by public consensus and policy action.

There are basically two ways to influence the internal spatial organisation of a region, i.e. the spatial distribution of activities and the spatial interactions between them: *land-use* policies and *transport policies*:

- *Land-use policies* try to influence the location of activities directly (through regulations) or indirectly (through incentives). Several examples of land-use policies applied in the Dortmund region to influence the spatial distribution of activities towards a more compact, space-conserving pattern were presented in Chapter 2:
  - The *Regional Development Plan* attempted to confine development to areas adjacent to already existing settlement poles.
  - The *Land Use Plan* restricted development to a very limited number of areas and protected agricultural land by restrictive zoning.
  - The *IBA Emscher Park* promotes a scheme of high-quality model projects located in a future 'landscape park' in the former industrial heart of the Ruhr.
- *Transport policies* attempt to influence the mobility patterns in the region by promoting desirable and discouraging undesirable forms of mobility. Examples of transport policies applied in the Dortmund region to arrive at environmentally more desirable mobility patterns presented in Chapter 2 were:
  - The government and the Ruhr cities have invested in large-scale rail and light-rail *public transport* systems.
  - Cities have applied extensive *car restraint* schemes including policies such as pedestrianisation, area-wide speed limits and reduction of road capacities.
  - Several cities oppose the completion of Federal *motorway projects* on their territory.

Similar and other policies were examined in the ISGLUTI study with respect to their effectiveness to guide land use development and travel behaviour in urban regions. The transport cost scenarios presented in Chapter 5 gave an idea of the range of options that might be applied to influence mobility behaviour. The conclusion of all these experiments was that only a synergetic mix of regulatory and fiscal policies can help and that this mix must include *measures to make automobility less attractive* by regulation or monetary disincentives.

A New Paradigm?

Policy-makers in charge of urban and regional systems today face a difficult choice between the three major policy objectives of *growth*, *equity* and *environment* (see Masser et al., 1992):

- The *growth* objective requires keeping up with the 'winner' regions on the national and European scale in order to survive in the competition for investment capital and jobs.

- The *equity* objective requires adopting policies which reduce social and spatial disparities.

- The *environment* objective requires searching for solutions which protect the environment and improve the quality of life.

For a long time policy-makers in the Ruhr have exclusively followed the growth paradigm. The result of one hundred and fifty years of growth orientation is the Ruhr area of today: a devastated landscape full of poorly designed settlements, obsolete infrastructures and vast areas of industrial ruins and contaminated soils. Today, as the deindustrialisation of the region is irreversible, a re-evaluation of the goals and objectives of urban and regional planning in the Ruhr is necessary.

In a more balanced urban policy addressing all three goals the most important task of regional and urban spatial planning would no longer be the 'modernisation' of the region for short-term economic growth by sacrificing its last remaining assets in terms of open space, ecological resources and quality of life in the hopeless attempt to keep pace with the 'winner' cities of today. A more strategic urban policy would be to accept industrial decline as a challenge and opportunity to plan for long-term postindustrial revival. Under that perspective the foremost responsibility of urban planning would be the gradual reclamation of the physical, ecological and aesthetic destruction left behind by one hundred and fifty years of industrial history - a much more fundamental 'modernisation' than that currently under way.

In Chapter 2 it has been shown that such ideas are gradually gaining acceptance among decision-makers. They increasingly acknowledge that ecological concerns may in the long run be more important than short-term economic issues. A new style of local transport planning places social and environmental concerns higher than technical efficiency. Cities compete by polishing up their inner cities and pedestrian shopping precincts and put large sums of money in the rehabilitation of run-down inner-city neighbourhoods. The IBA Emscher Park has explicitly stated the ecological, economic and social modernisation of the Emscher river basin as its goal. The hope is that this change of awareness will make the region competitive for the next round of spatial restructuring when the life cycle of the present 'winner' cities, due to lack of land, traffic congestion, ecological breakdowns and other consequences of overagglomeration, eventually turn into decline

A Leitbild *for the Industrial City*

With these building blocks a *Leitbild* for the future of the industrial city can be envisaged:

(1) It is only appropriate that industrial cities, after completing their life cycle as manufacturing centres are reduced in size unless a significant new function for them is found. Indeed, just as in the 19th century the land was reclaimed from agricultural use for mines and factories, it could now be returned to nature once the reasons for its use have disappeared. Sites no longer used for mining or manufacturing should be cleared and decontaminated and renaturalised by being converted into woodlands, green fields, or where there is need for it to small-scale gardens or urban parks.

(2) Any city should provide a broad range of living environments, from high-density urban to low-density suburban, to allow for different life styles and stages in the life cycle and for cultural diversity. There is nothing wrong with the preferences of households to live in low-density settlements close to nature. In fact, suburban settlements with ecologically maintained gardens may be environmentally more desirable than monofunctional agricultural use.

(3) Telecommunications may make possible urban lifestyles in low-density suburban settlements with environmentally acceptable levels of mobility. To discourage undesirable forms of mobility, car travel and goods transport by road need to be made significantly more expensive.

The spatial system resulting from these principles is a low-density, dispersed network of small and medium-sized towns in which the industrial cities of the past would probably still play a role as regional centres, but on a much reduced level of centralisation - just provincial cities, the economies of which will be mainly based on the facilities and services they provide for their immediate or wider region, after their traditional industries have largely disappeared. Dortmund may thus become for an extended period a university town, an administrative centre, and certainly a residential city with a relatively large population of pension age, and thanks to that a comparatively stable income.

The *rural-urban continuum* has always stimulated the imagination of urban reformers such as Ebenezer Howard, Le Corbusier or Frank Lloyd Wright. The 'middle landscape' (Rowe, 1991), which has its ultimate model in the eighteenth-century British country park, is built on the dream that man and nature need not be in antagonism. It is not inconceivable that thanks to modern telecommunications this ideal can be realised for the first time without sacrificing essential urban qualities of life. However, the new *Leitbild* must not be associated with the present car-based form of mobility - the result would be the American-style suburbia.

It would be a challenge to explore whether there are combinations of small-scale polycentric forms of settlement *and* mobility constraints which reduce the undesirable spatial division of labour *without* constraining desirable social or cultural interactions - a settlement structure which under today's conditions is at the same time efficient, equitable and environmentally sustainable. A project to search for such an ideal settlement structure with a model of human mobility behaviour more advanced than that used for this book is currently under preparation.

Epilogue

This book has addressed many issues and yet has been deficient in at least two respects.

It most glaring defect has been that it has treated cities predominantly though not exclusively as systems of locations and spatial interactions. This paradigm has its merits, and in the search for the sustainable, energy-conserving city with acceptable levels of mobility it is, in fact, one essential view. However it is only *one* view and even in its more sophisticated economically interpreted versions it neglects important social and political dimensions. This has been discussed in Chapter 3.

The second deficiency has been that *people* appear in it only as travellers, members of households, workers or investors, but not as *citizens* who actively take part in local decision making. The reason is that in the epistemology of modelling only phenomena are permitted which in principle can be *predicted*. Urban movements, however, continuously *change the rules*. If it were otherwise, they could be modelled. I have sometimes been tempted to do just that, but have so far resisted for fear of succeeding. This accounts for the fact that the scenarios in this book are only variations of one limited theme as the real utopias lie in a space outside the dimensions of this model.

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