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Arbeitspapier

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THE LIFE CYCLE OF INDUSTRIAL CITIES:  
A CASE STUDY OF DORTMUND, GERMANY

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## 0. Introduction

Two centuries after the start of the large-scale urbanization of Europe in the wake of the industrial revolution, the cities in Europe are again in a period of transition. Fundamental shifts in the economic and demographic structure of European societies make conventional concepts of the ever lasting 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 reorganizations of the structure of urban settlements that may be no less dramatic than those of the first urbanization period.

Not all cities are equally affected by these changes. On the one hand, there are very few large metropolitan regions which develop into production, service, and communication 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 by outmigration of population and employment to prospering smaller towns on its periphery, a twofold erosion process leading to severe problems of restructuring and adjustment. To make things even more complicated, there are at the same time, mostly in the Mediterranean countries, cities of all sizes that still continue to grow and hence suffer from the familiar adjustment problems connected with too rapid growth (Cheshire et al., 1986).

There have been various attempts to explain the coexistence of so 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 started out as a mere descriptive theory to classify the diversity of urban growth and decline phenomena (Hall and Hay, 1980; van den Berg et al., 1982), but has since matured into a substantive theory of considerable explanatory power (van den Berg, 1986). Its main achievement is to identify typical phases of urban development from growth to decline, or from 'urbanization' to 'suburbanization' and 'deurbanization', and to relate these to the economic

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and demographic transition in a country (cf. Friedrichs, 1985). Using this framework, it is possible to convincingly 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, and Northwestern Germany, while urban growth can be expected to prevail for some time in Turkey and Greece, Portugal and Spain, and the South of Italy.

So it is the old industrial cities which deserve most interest, because they have progressed further along the urban life cycle than any other type of city. They have first experienced 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, total disappearance or progressive impoverishment of housing, a continuous erosion of the former functional diversity of the inner city rendering fast-food and red-light establishments as the only functions able to survive in the otherwise deserted central area, while at the same time, despite the overall decline of population and employment, the continued growth of car ownership and the still growing number of (ever smaller) households as well as fundamentally changing work, leisure, and travel patterns combine to relentlessly produce sprawl at the urban periphery.

What are the future prospects for this type of cities, which jumped 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, no cultural heritage to rely on, once their economic base dwindles

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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 'reurbanization' phase, in which the trends leading to 'deurbanization' and urban decline are reversed?

The desire to study this question with respect to a typical industrial city in Europe showing all or most of the symptoms of urban decline listed above was the motivation for undertaking the case study of Dortmund presented in this paper. For the study, a computer simulation model of spatial urban development was used to generate various possible continuations of Dortmund's urban life cycle in the form of scenarios based on different combinations of its economic and demographic development. In the following four sections of the paper, first the study area, then the model, and finally the main findings of the simulation experiments are presented.

### 1. The Study Area

Dortmund is the most eastern of the main cities in the Ruhr industrial region of the Federal Republic of Germany. From a small agricultural town with less than 20,000 inhabitants in 1810, it developed rapidly during the 19th century into a major industrial centre with a population of nearly half a million in 1914 due to its coal mining and steel industries. It continued to grow after both wars up to a maximum population of 660,000 in the 1960s, but when after that the demand for coal and steel decreased, it started to lose population and employment. Even today, its economy still strongly depends on heavy industry, as more than one third of its jobs are in the manufacturing sector and the losses of employment there are not compensated for by corresponding gains in the service sector.

With its present population of about 550,000, Dortmund commands a hinterland of still partly rural character with a population of about 450,000, giving the urban area a population of about

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one million. However, due to the polycentric structure of the Ruhr agglomeration, the commuter catchment area of Dortmund has a population of some 2.2 million. This is the study area.

## 2. The Model of Dortmund

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

- (1) a macroanalytic model of economic and demographic development of 34 labour market regions in the state of Nordrhein-Westfalen 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 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 34 labour market regions as well as the migration flows between them are predicted. These results establish the framework for the simulation of intraregional location and migration decisions on the second spatial level, which again serve to provide the framework for the even more detailed simulation of small-scale land use development on the third level. The simulation proceeds from a base year in two-year increments (periods) over a time span of up to 30 years.

The model of Dortmund constitutes the second level of this three-level model hierarchy. On this level, the study area is the commuter catchment area of Dortmund containing Dortmund itself with its twelve urban districts and ten neighbouring communities within its labour market region plus eight zones in four adjacent labour market regions. The twelve urban districts of

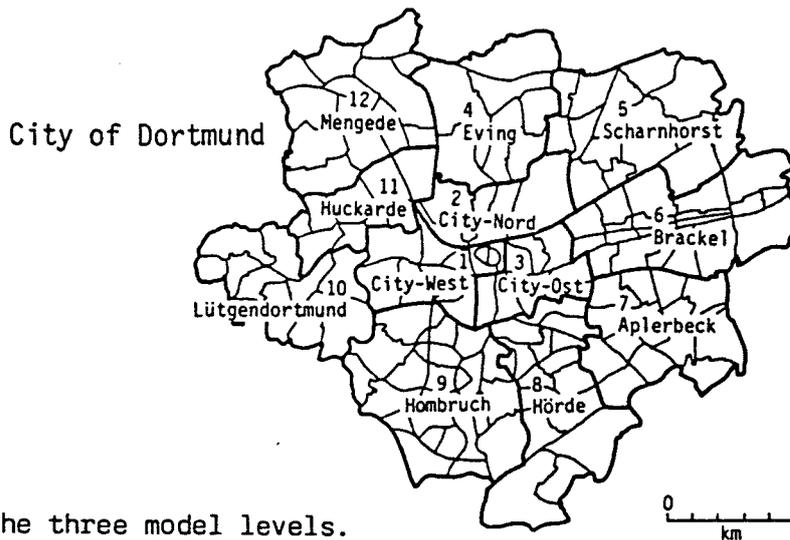
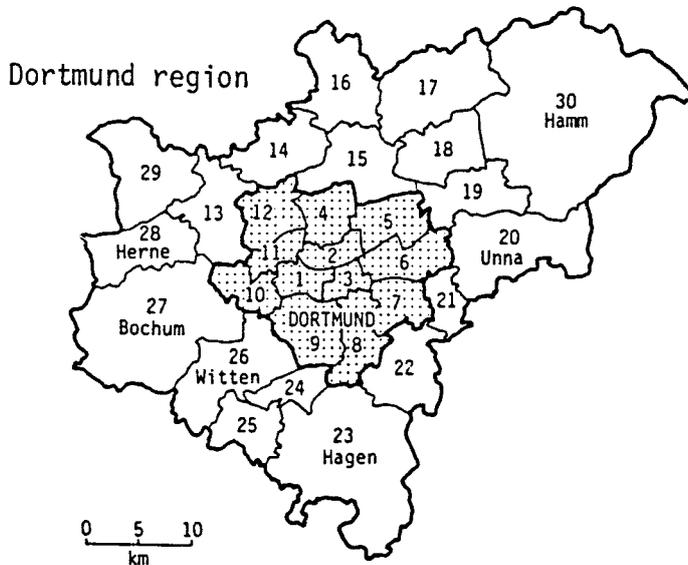
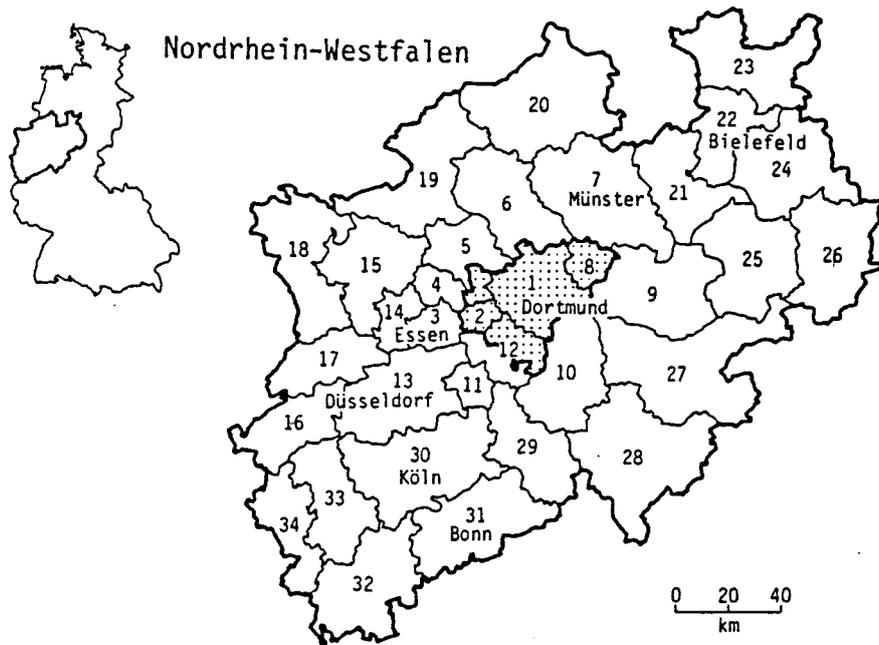


Figure 1. The three model levels.

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Dortmund are relatively homogenous in size ranging in population between 40,000 and 60,000, while the remaining zones vary considerably in population between 15,000 and 400,000.

For these 30 zones, the model simulates intraregional location decisions of industry, residential developers, and households, the resulting migration and travel patterns, the land use development, and the impacts of public policies in the fields of industrial development, housing and infrastructure. This is done in six submodels:

- (a) In the transport submodel, work, shopping, service, and education trips are calculated for four socioeconomic groups and three modes, car, public transport, and walk. The model seeks to determine a user-optimal set of flows where car ownership, trip rates, modal split, and route choice are in equilibrium.
- (b) In the ageing submodel, all changes of the stock variables of the model are computed which are assumed to result from biological, technological, or long-term socioeconomic trends originating outside of the model, i.e. which are not treated as decision-based in the model. 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) In the public programmes submodel, a large variety of public programmes in the fields of employment, housing, health, welfare, education, recreation, and transport specified by the model user are processed.
- (d) In the private construction submodel, investment and location decisions of private developers are modelled, i.e. of enterprises which erect new industrial or commercial buildings, and of residential developers who build flats or houses for sale or rent or for their own use. Thus this submodel is a model of the regional land and construction market.

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- (e) In the employment change submodel, decisions of workers to change their job location in the regional labour market are modelled.
- (f) In the migration submodel, intraregional migration decisions of households are simulated as search processes in the regional housing market. Thus the migration submodel is at the same time a housing market model. The housing search processes are 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 30 zones.

Submodels (b) to (f) are executed once in each simulation period, while the transport submodel is processed at the beginning and at the end of each simulation period. Figure 2 shows the main information flows in the model of Dortmund. A description of the model is given in Wegener (1982).

### 3. The Future of Dortmund

The above model was used to explore alternative futures for the spatial development of the study area under different economic and demographic assumptions. In particular two questions were investigated: (1) What will be the 'most likely' next phase in the urban life cycle of Dortmund if one assumes that the current rate of economic and population decline of its urban region will persist---will Dortmund continue to grow into the surrounding countryside as it has now done for 150 years, or will there be some point in the future where due to lack of growth the outward trend of development is stopped and the city actually starts to concentrate again---a 'reurbanisation' through decline? (2) How much is this 'likely' development determined by the assumed economic scenario---would more optimistic or more pessimistic scenarios produce significantly different results?

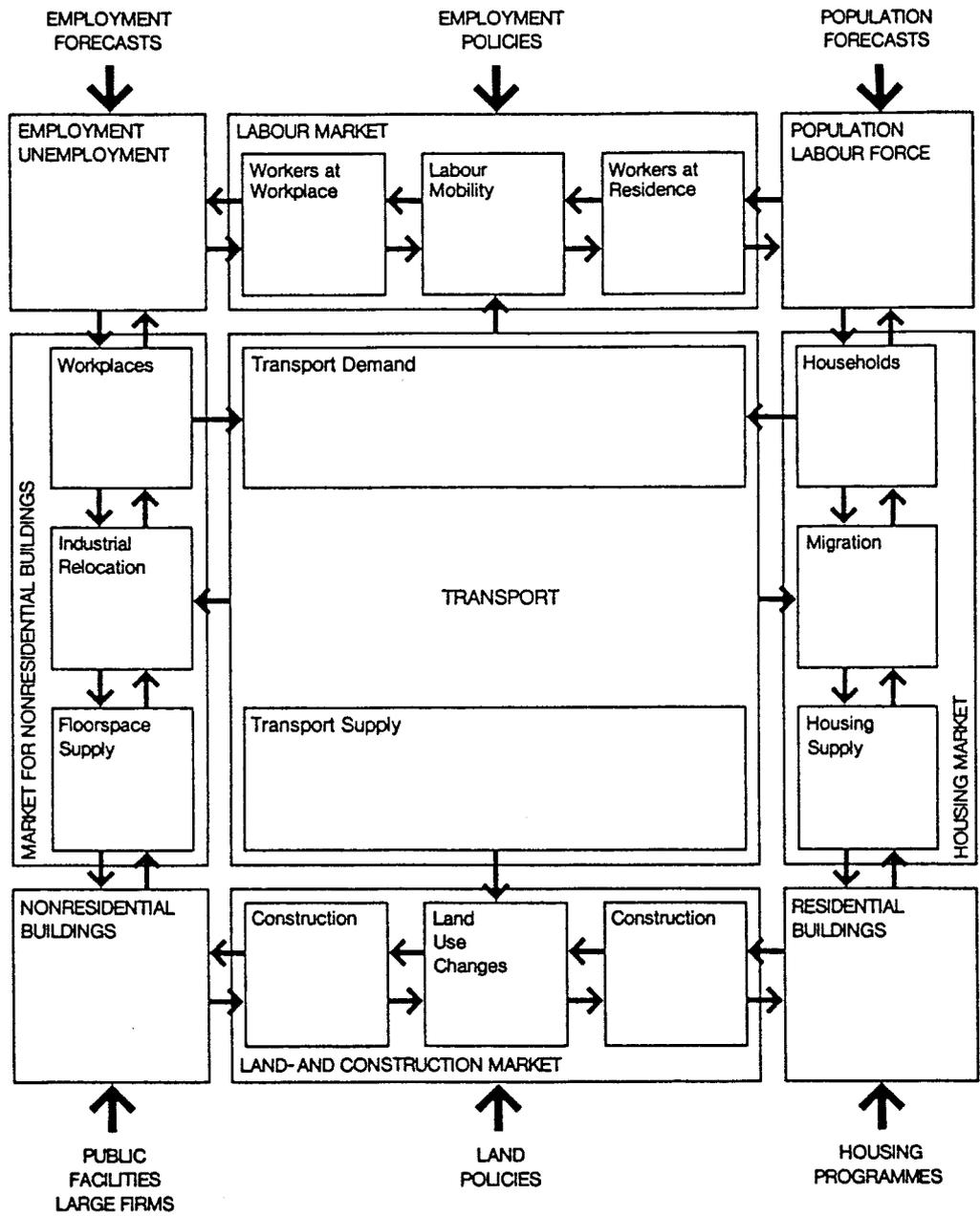


Figure 2. The model of Dortmund.

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To investigate the first question, a base scenario of economic and demographic development of the whole state of Nordrhein-Westfalen linked to various external forecasts of economic growth, growth of productivity, and structural change as well as of population and in- and outmigration to and from the state until the year 2000 was constructed (Schönebeck and Wegener, 1984). For comparison, a known period of the past was to be included in the scenario, so 1970 was taken as the base year, which meant that the scenario consisted partly of observed and partly of projected data. This 30-year scenario was fed into the 'Nordrhein-Westfalen' model referred to above and thus spatially disaggregated down to the five labour market regions constituting the study area (see Figure 1).

For the total study area, the base scenario indicates a loss of 187,000 or 19.4 percent of all jobs over the 30-year forecast period. Until 1982, this follows almost exactly the actual development of employment in the region, however the recently published employment figures for 1984 suggest that even bleaker prospects for the economy of the region may be more realistic. Obviously, most of the loss of employment occurs in manufacturing, mainly in the mining and steel industries, but even service employment, after considerable growth until 1982, actually loses jobs in the 1980s and 1990s and fails to compensate for the decline in manufacturing employment. Table 1 shows the observed and projected development of total employment between 1950 and 2000.

Population declines by 482,000 or 20.0 percent over the forecast period, due in part to natural decline because of low fertility, in part to net outmigration, especially of foreign workers---in close agreement with the actual development of employment from 1970 to the present. It can be seen from Table 1 that in the 1970s population declines less than employment resulting in an increase in unemployment, whereas towards the end of the century a relaxation of the labour market can be expected, mainly because of net outmigration.

Table 1. Employment and Population in the Dortmund urban region: Reality (1950-1982) and Scenarios (1982-2000).

	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

Sources: Employment and population censuses 1960, 1961, and 1970, and Schönebeck and Wegener, 1984.

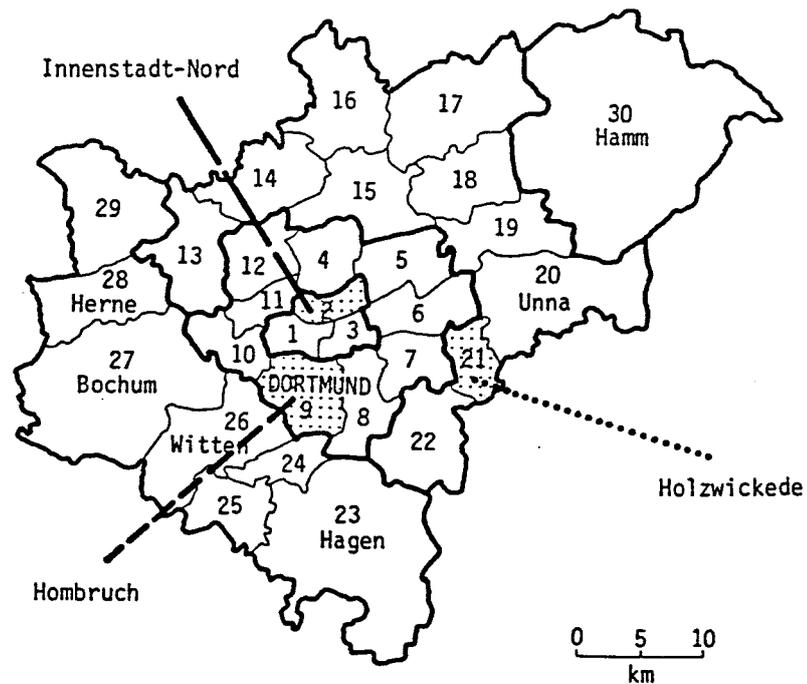


Figure 3. The three sample zones in the study area.

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The above base scenario, besides being of interest by itself as the 'most likely' development, served as the benchmark for comparison between the other scenarios, in which contrasting possible developments of the regional economy were to be tested. Three contrasting scenarios were constructed (S1 is the base scenario):

S2 Further reductions in the demand for steel and increasing international competition result in additional 86,000 jobs being lost in the steel and related industries of 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 more than proportionate share of 78,000 jobs are lost in the Dortmund region.

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

In all three contrast scenarios, the same assumptions with respect to fertility and statewide net migration as in the base scenario were made. Table 1 shows the four scenarios in comparison.

### 3.1 The Most Likely Future: The Base Scenario

For illustrating the results, three representative zones of the study area were selected and their development traced over the 30-year forecast period: Innenstadt-Nord (Zone 2) is 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 from a former mining village into a favourite residential location for the upper middle class having an attractive village core and the campus of the new Dortmund University. Holzwickede (Zone 21) is a still partly rural

outer suburb which thanks to its ample land supply, its pleasant environment, and its yet good accessibility to the city centre as well as to the nearby Sauerland hills has attracted many, especially younger and economically active, households as residents. Figure 3 shows the location of the three zones in the study area.

The following diagrams present selected results of the base scenario. 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.

Figure 4 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 employment specified for base scenario S1 in Table 1 has been reproduced by the model. The three other lines indicate how this decline was distributed over the study area. Clearly the largest loss of employment occurs in Innenstadt-Nord, mainly because two of the three major steel works of Dortmund 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 shows, Innenstadt-Nord has lost also in service employment and is likely to continue to do so as a consequence of the continuing decline in population (see below)---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---it will be interesting to see whether recent efforts to attract high-tech firms to a 'technology park' near the university will be able to reverse this trend. Total employment growth in Holzwickede was somewhat overestimated by

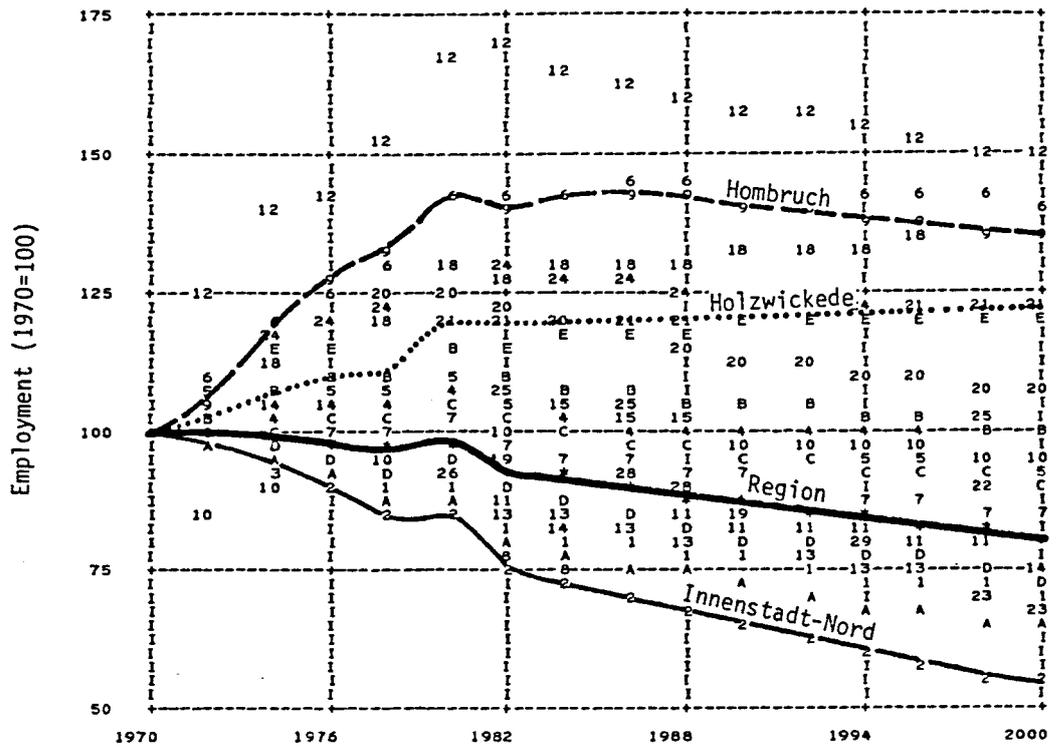


Figure 4. Total employment, base scenario, 1970-2000.

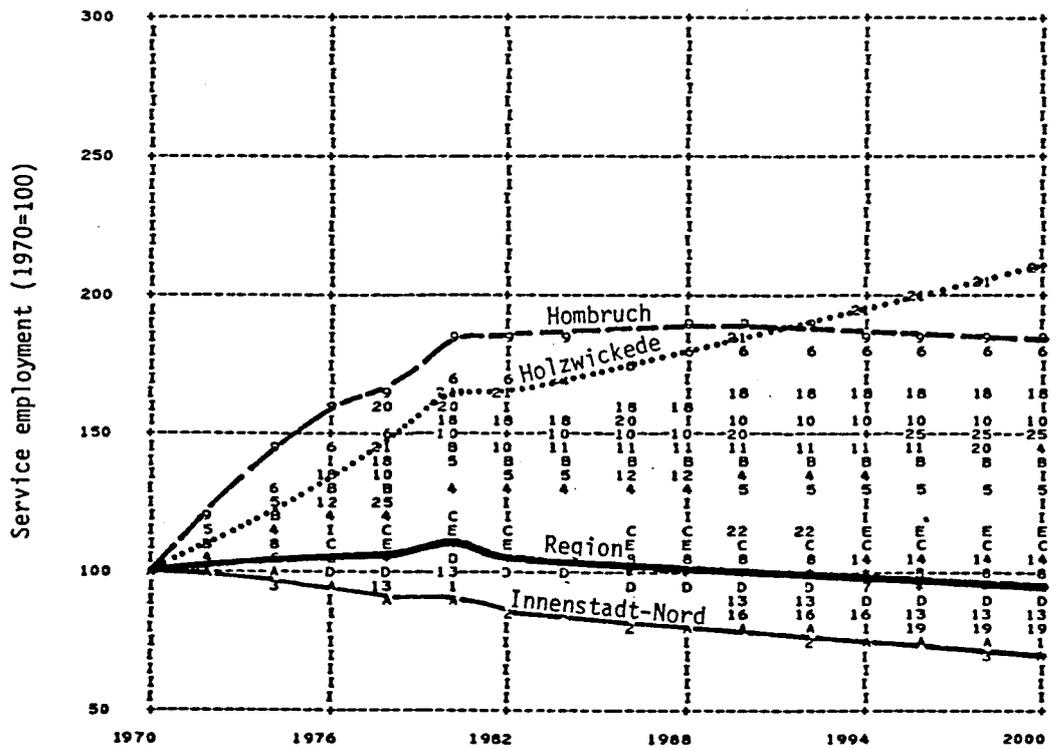


Figure 5. Service employment, base scenario, 1970-2000.

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.

The next two diagrams (Figures 6 and 7) present population and households in the base scenario. Again, the heavy line in Figure 6 merely restates the assumptions about overall population decline in the region (more precisely, about total migration into and from the region) specified for Scenario S1 in Table 1. Everything else has been 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 be halved, according to the model. Indeed the decline predicted for the 1970s by the model did occur in reality, since then it has slowed down somewhat through a few public housing projects especially intended to improve the negative image of the district, yet in spite of this, Innenstadt-Nord continues to lose population at a much faster rate than the rest of the city.

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 about equal rate. In contrast in Figure 7, which shows the development of households in the study area, Hombruch does not begin to decline before the mid-1990s, and Holzwickede does not seem to decline at all during the forecast period. The reason for this is, of course, the continuing reduction in average household size, which from a starting value of 2.58 persons per household in 1970 is expected to fall to about 2.1 in the year 2000, region-wide, and even below 2.0 in the central areas.

Figures 8 and 9 show two aspects of population development not visible if one looks only at total population or households. 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. The foreigners in Dortmund are mostly workers and their families from

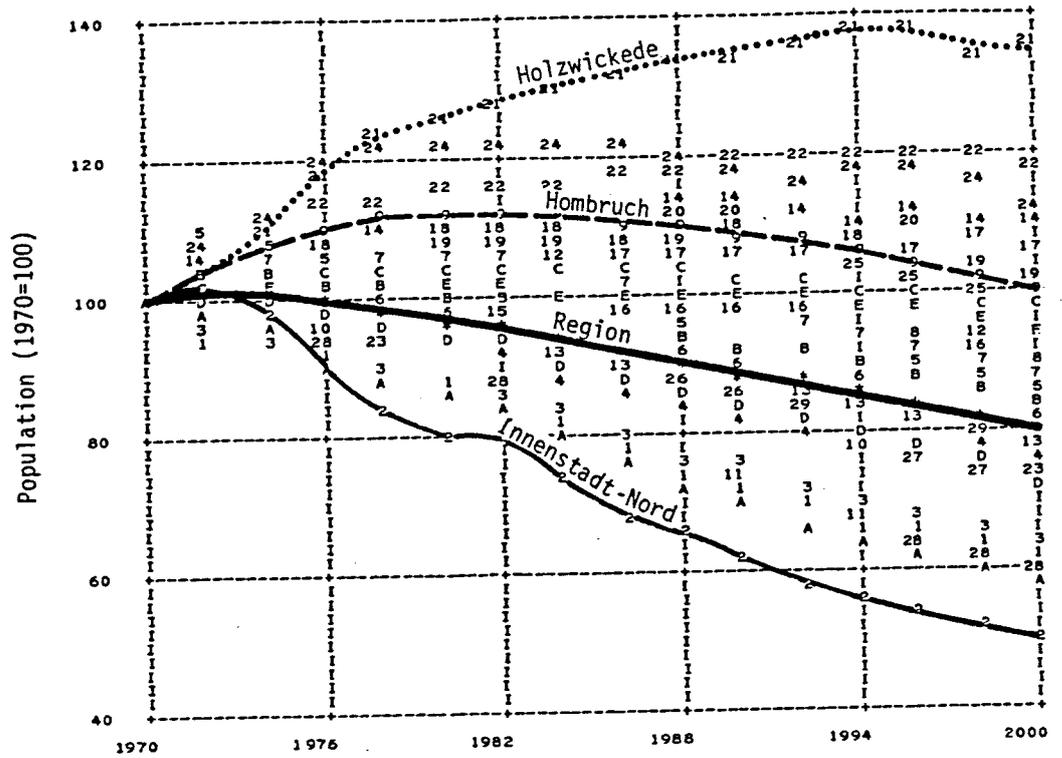


Figure 6. Population, base scenario, 1970-2000.

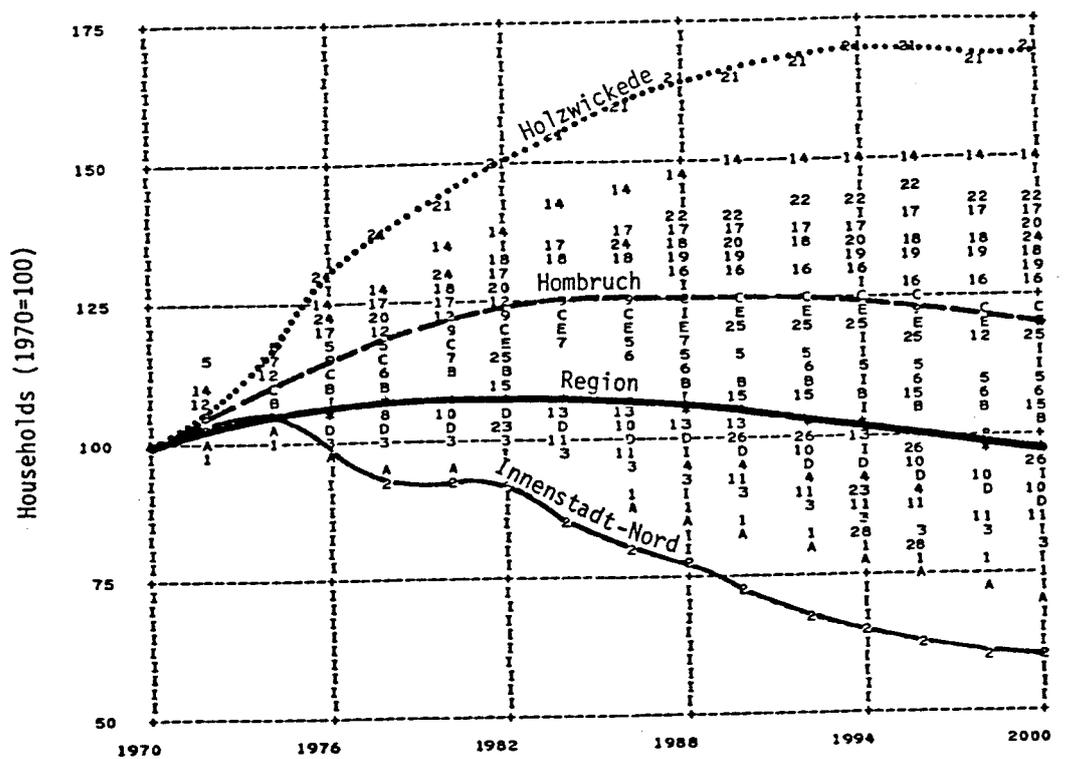


Figure 7. Households, base scenario, 1970-2000.

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mediterranean countries such as Greece and Turkey who were attracted to the region in the prosperous 1960s and 1970s, but now grow mostly through natural increase as they have not (yet) adjusted to the world-record low fertility level of the native 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 component of the model: As more and more especially 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 a third, the growing foreign community itself becomes an attraction factor, 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 enroll more foreign than native children.

With overt signs of discrimination and hostility against foreigners absent or at least infrequent in Germany, this process of ghettoization goes on in an unspectacular and almost unnoticed way. Yet the remaining native population, while still a solid majority, may eventually see themselves to be on the retreat. Already now it consists to a large part of old people, as Figure 9 shows, and this proportion will further increase in line with the expected general over-ageing of the German population. The proportion of old people in Innenstadt-Nord would appear to be much higher if Figure 9 had been drawn for the native and the foreign population separately, as the much younger foreign population pulls the curve down---compare it for instance with Scharnhorst, a district with extensive worker housing constructed in the 1960s.

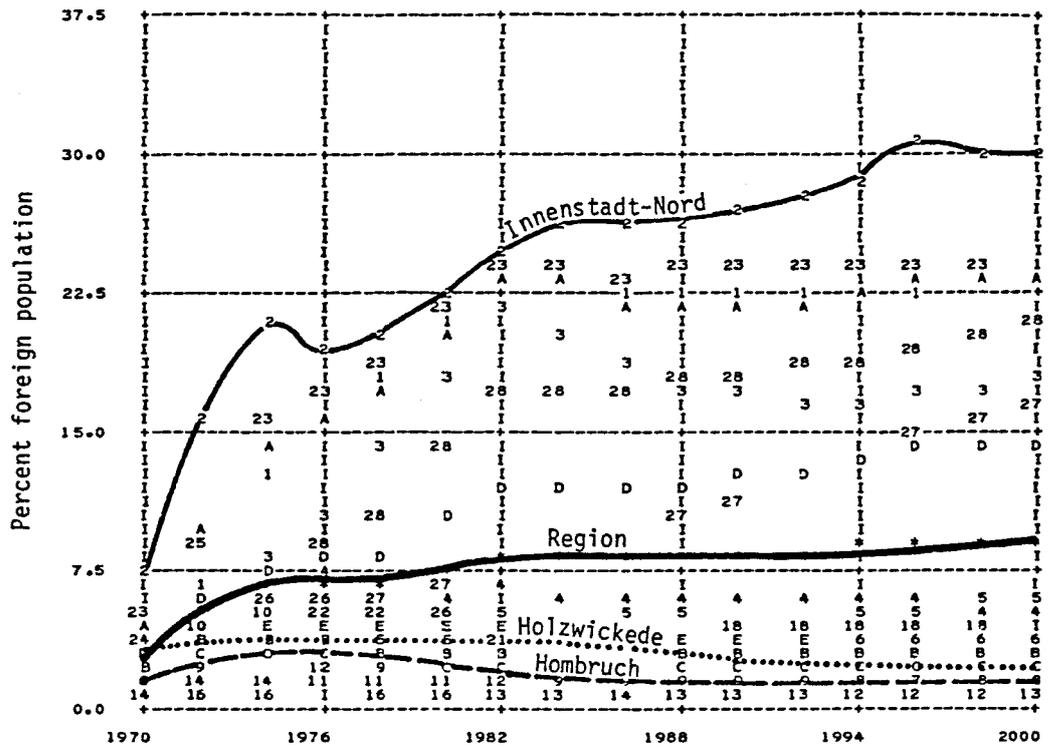


Figure 8. Percent foreign population, base scenario, 1970-2000.

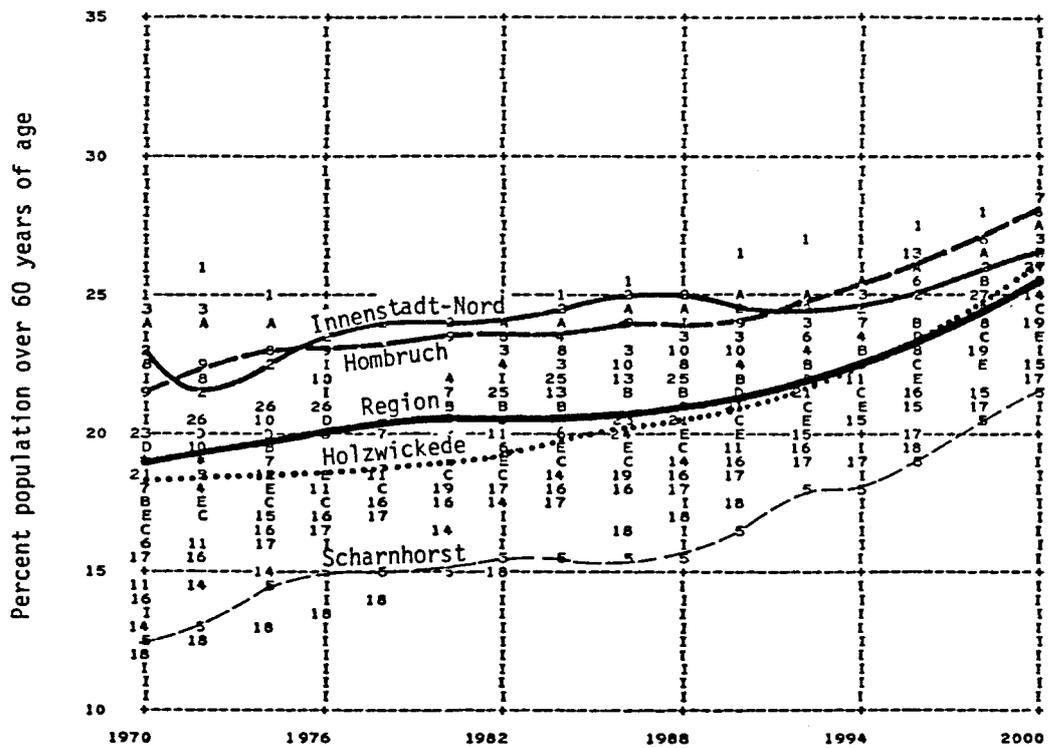


Figure 9. Percent population over 60, base scenario, 1970-2000.

Innenstadt-Nord is also the poorest district in the whole region. Figure 10 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 having 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. Figure 11 is an attempt to translate this kind of information into average zonal household incomes. The diagram indicates that until the economic crisis of 1981, mean household incomes (in real terms) increased rapidly in the region, but have since stagnated or even slightly declined due to the continuing loss of employment. However, the diagram also shows the great differences in income between different parts of the region and how these differences change over time. Initially, the households with the highest incomes lived in inner suburbs such as Hombruch, but in the course of time new outer suburbs like Holzwickede catch up and at the end of the forecast period have surpassed their older predecessors. Remarkably, even when the average real income in the region declines, these two zones both continue to gain in income if at a lesser pace. The inner-city worker districts like Innenstadt-Nord have always been at the bottom end of the income range. But now, in the period of decline, they fall even farther behind their luckier competitors in a rapid process of impoverishment. If the model is right (and these are rather crude estimates as small-area income data are hardly available in Germany), the average household in Innenstadt-Nord will earn 30 percent less than its counterpart in Hombruch at the end of the forecast period---a difference which only inadequately conveys the likely accumulation of unemployment and poverty in this disadvantaged district.

The next four diagrams illustrate the development of the housing stock of an industrial city in decline like Dortmund. On first thought one would expect that with a population declining so rapidly, no further housing construction would be needed. However, the model predicts, as Figure 12 indicates, that in Holzwickede and in other outer suburbs new dwellings continue to be

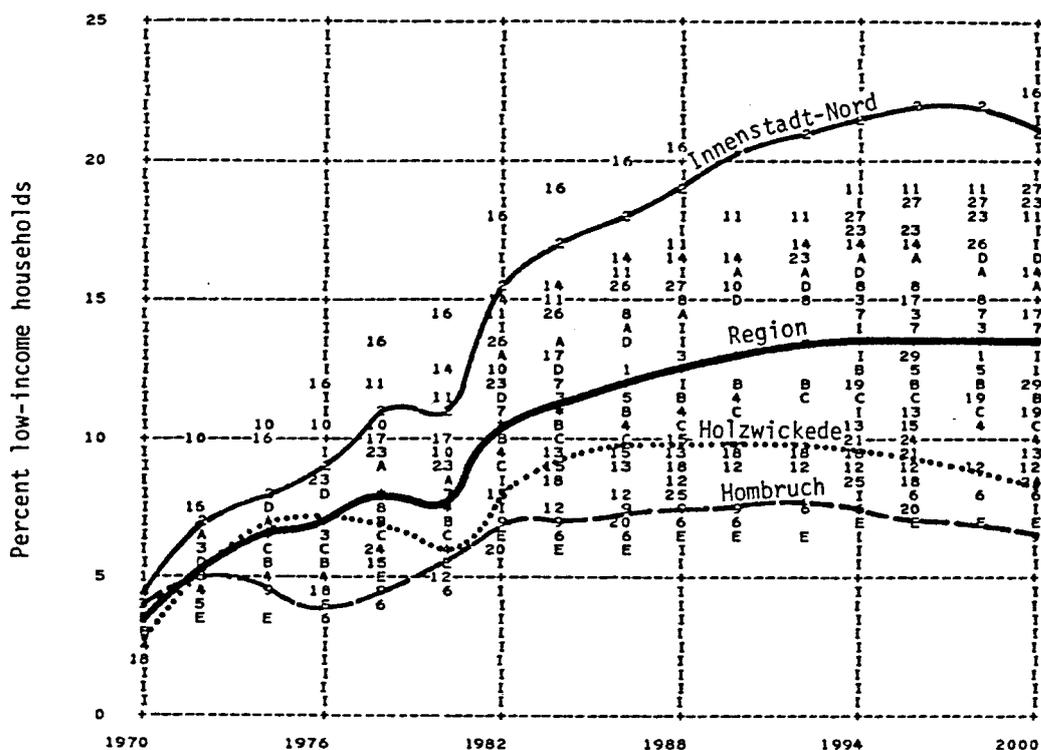


Figure 10. Percent low-income households, base scenario, 1970-2000.

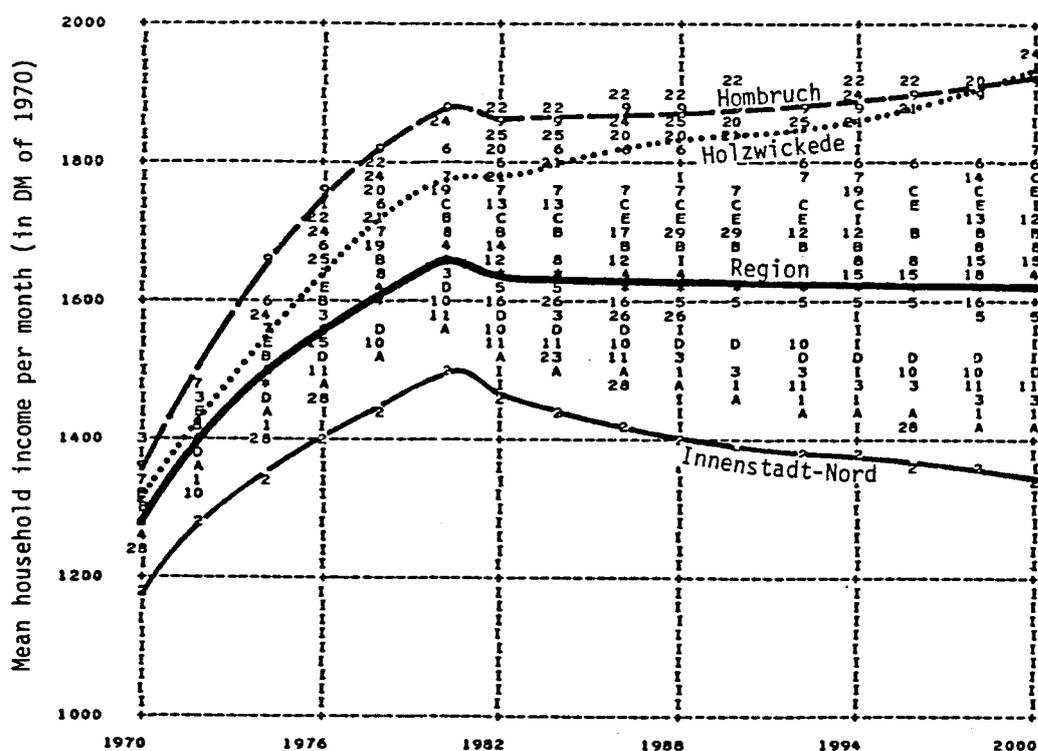


Figure 11. Mean household real income, base scenario, 1970-2000.

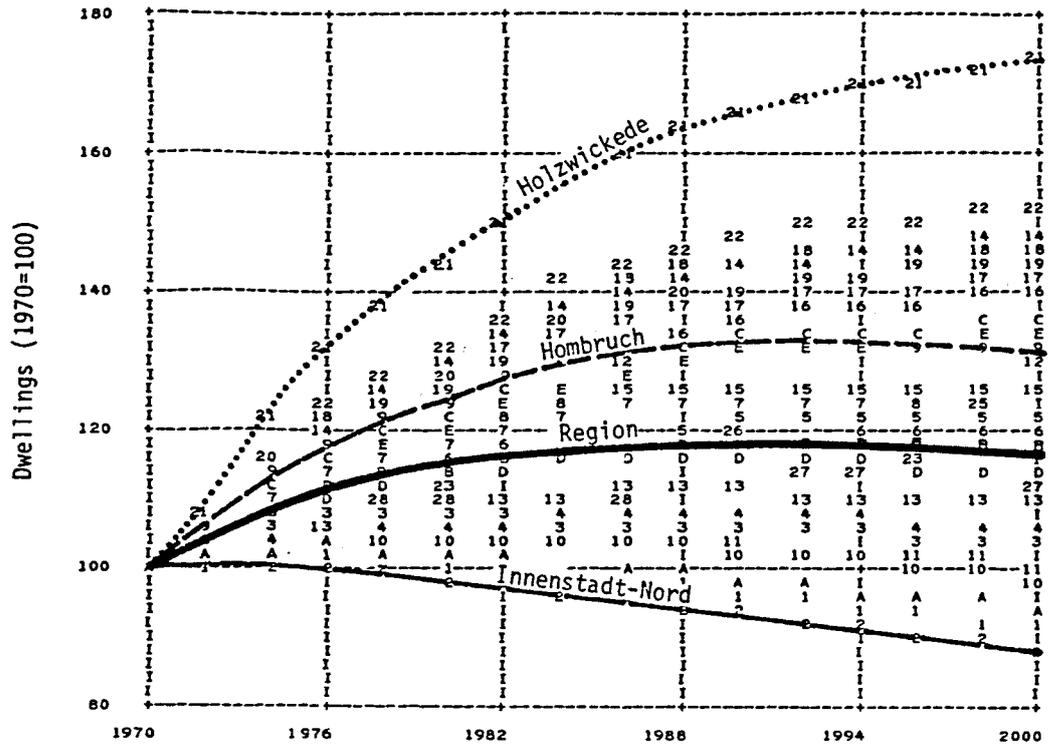


Figure 12. Dwellings, base scenario, 1970-2000.

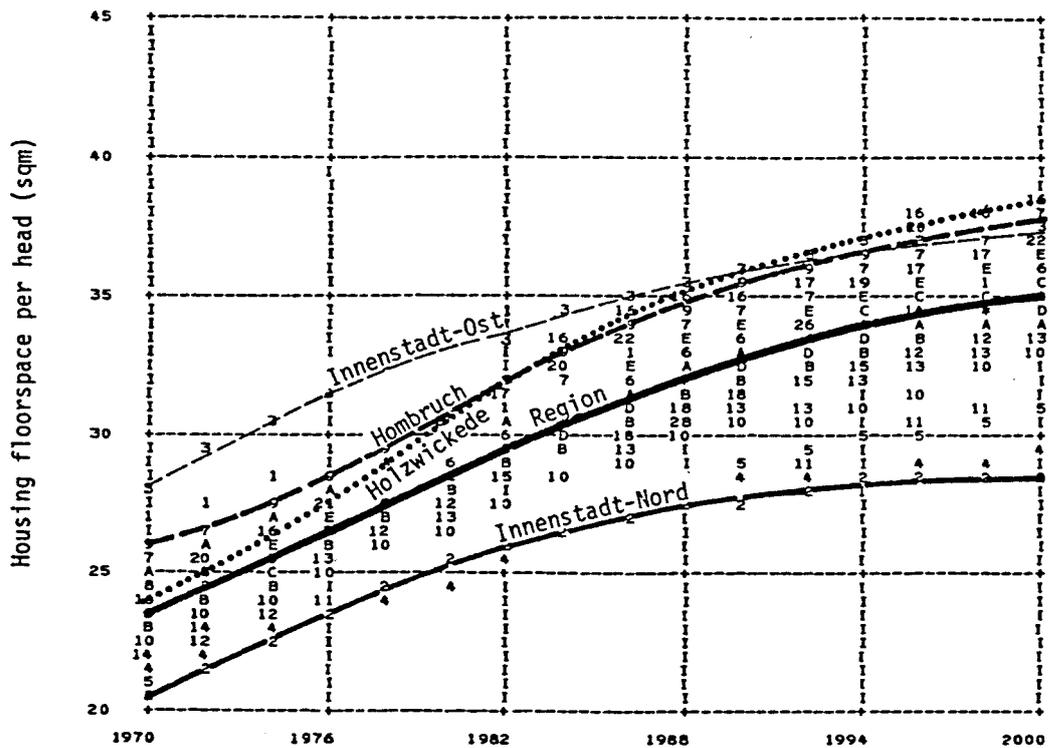


Figure 13. Housing floorspace per head, base scenario, 1970-2000.

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built at a rapid if gradually decreasing rate. This is caused by the filtering mechanism in the housing market part of the model where 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, as Figure 13 demonstrates for housing floorspace per head, which increases by about 50 percent in the whole region. This 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 oversupply in the housing market lets rents become relatively cheaper. So even the households in Innenstadt-Nord can afford larger flats although they have less money to spend.

Still, after the 30-year forecast period, there are some 21 percent or 190,000 more dwellings than households in the region, because the number of dwellings has increased while the number of households declined. This number would have been twice as high if not a similar number of dwellings had been torn down or been converted to other uses such as offices over the years. Figure 14 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 still some demand for land for office and retail purposes, 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 declines over time in conjunction with the declining construction activity in the region, because the incentive to tear down buildings is low unless there is demand for land.

Consequently there will be a vast supply of vacant dwellings in the region. Figure 15 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 because an increasing number of households may choose to have two dwellings, a flat in the city centre and a house in the outer suburbs

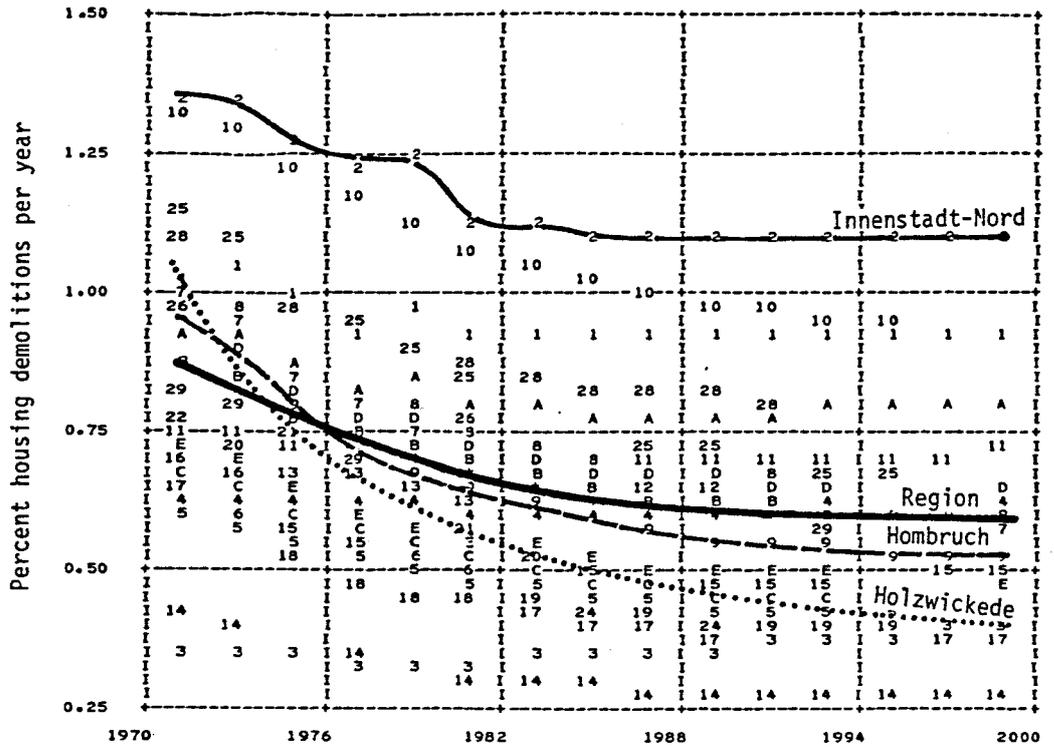


Figure 14. Percent housing demolitions, base scenario, 1970-2000.

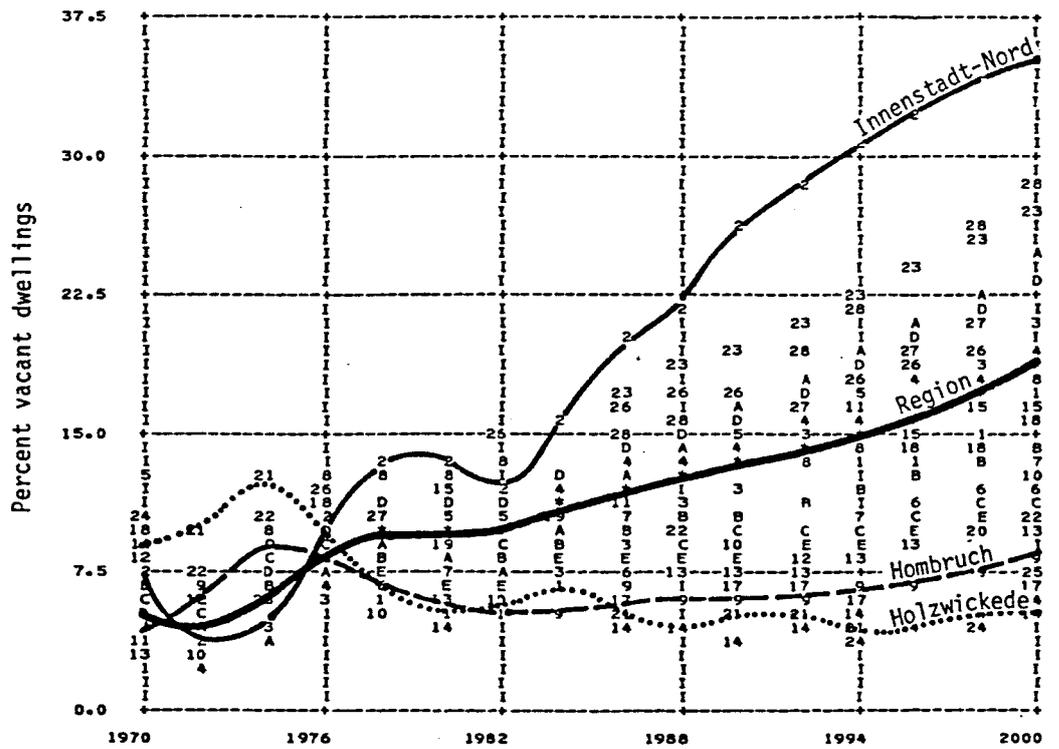


Figure 15. Percent vacant dwellings, base scenario, 1970-2000.

(this is presently not accounted for in the model), and because the percentage also includes the 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 less attractive parts of the region such as Innenstadt-Nord, where, according to the model, every third dwelling will be vacant.

If the prediction of the model is realistic 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 decentralization of population observed in the region during its growth years, i.e. in the suburbanization phase, will continue in the final stage of the urban cycle, the deurbanization phase, in which the population of the region declines. Figure 16 shows 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 is 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 final dissolution of the city into the, however urbanized, countryside.

The final diagram, Figure 17, shows how this affects the land use in the region. Unlike the previous diagrams, Figure 17 plots two variables against each other, population and built-up area, i.e. the growth of residential, commercial, and industrial land, including access roads, in the different parts of the region (but excluding land for trunk roads, motorways, railways, etc.). Over the 30-year forecast period, the built-up area in the region increases by 17 percent, although both population and employment decrease. However, because more land is available at 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 growth in population. Hombruch still expands its developed area by nearly a quarter

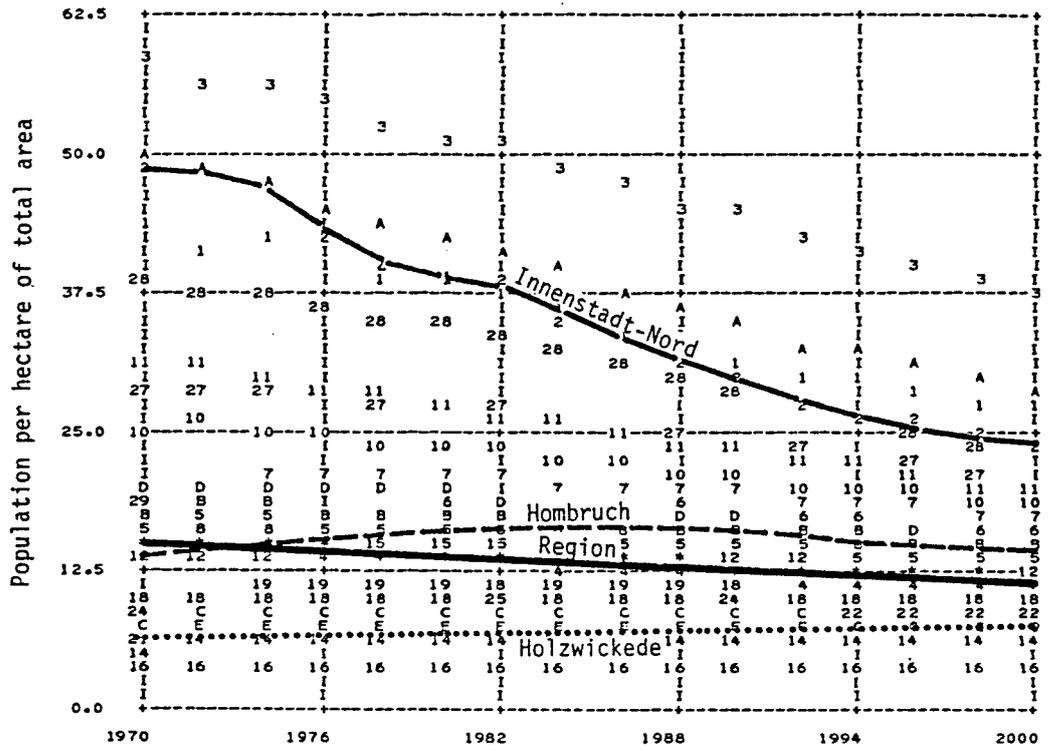


Figure 16. Population density, base scenario, 1970-2000.

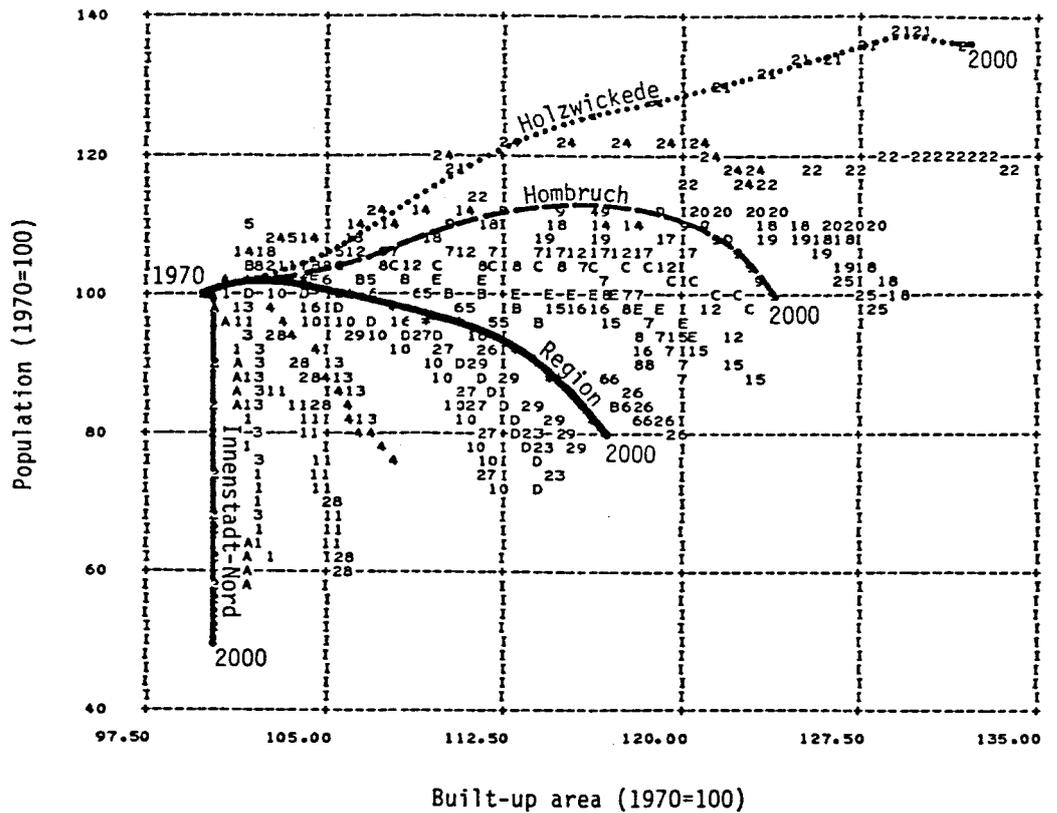


Figure 17. Population and land use, base scenario, 1970-2000.

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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 everywhere 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, demolitions of dwellings in the older parts of Hombruch and conversion of dwellings to other uses exceed new housing construction, because 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.

In summary, the base scenario showed some surprising, but on a 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 losers, but also a few winners---prospering firms as well as 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 of the region 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 at the periphery, of large numbers of vacant dwellings in inner-city housing areas and new housing construction on the urban fringe. It appears as if the industrial city, in the final phase of its life cycle, is destined to suffer the worst from both decline and growth: erosion of its inner core as well as erosion of its outer environment through uncontrolled growth.

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### 3.2 Alternative Futures: Contrast Scenarios

It may be asked how much these developments are a function of the assumptions made about the economic decline of the industrial city. Would Dortmund in the year 2000 would look different from the Dortmund of the base forecast, if its economy developed more favourably than postulated there or if it declined even more? To investigate this question, the three 'contrast' scenarios defined earlier were simulated with the model under exactly the same conditions as the base forecast.

Table 2 summarizes the results of the three contrast scenarios S2 to S4 compared with the base scenario S1. As can be seen from Table 1, 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, so the four scenarios cover a wide corridor of possible economic futures of the region.

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 most 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 less households can think of leaving

Table 2. Employment, population, and housing in the sample zones: Scenarios S1-S4, 1970-2000.

		Innenstadt-Nord		Hombbruch		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 (sqm/head) <sup>a</sup>	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) <sup>b</sup>	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 sqm.

b Mean regional vacancy rate in 1970 was 5.6 percent.

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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 constraints, is hardly affected.

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 relatively more relaxed housing market, the low-income population in Innenstadt-Nord is even able to increase their floorspace consumption, even though more people remain living in Innenstadt-Nord. Vacant dwellings increase considerably when the recession is more pronounced, now Hombruch is most affected whereas, in line with the larger number of households staying in the inner city, less 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 to encourage more economical higher-density land uses when demand for land is high. This means, however, that the spatial decentralization process observed in the Dortmund region is likely to continue irrespective of the economic development of the region; in fact in no scenario a trend reversal, i.e. the beginning of a 'reurbanization' phase, became visible.

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#### 4. Conclusions and Policy Implications

The investigation of the impacts of different assumptions about economic and demographic trends showed that there is a strong relationship between economic prosperity and the speed of spatial deconcentration in an urban region like Dortmund, with growth accelerating the process of decentralization and decline slowing it down. The largest differences between the scenarios are seen in the outer parts of the region, where both employment and population increase considerably faster under favourable economic conditions. In the inner parts of the region employment and population may even develop in opposite directions as prosperity encourages and decline discourages the exodus of people from the inner city. Due to price adjustments in the land market, the differences in land consumption between the scenarios are relatively small.

A more important observation is that all differences between the scenarios are small in relation to the changes taking place in the region during the forecast period in the base scenario. Even though the four scenarios cover a very wide corridor of possible economic futures for the region, none of them is able to change the course of the process of spatial restructuring taking place by more than a few percent. In fact, no realistic scenario could be found in which a reversal of the dominant deconcentration trend, i.e. an indication of a 'reurbanization' phase, occurred. In particular the inner parts of the city, once the centre of employment and population of the region, seem to experience an erosion of their former importance of historical dimension, and there are presently no tendencies in sight to halt or even reverse this process.

This is, of course, no final verdict that the life cycle of an industrial city like Dortmund has come to an end. The spatial organization of society is, despite apparently powerful 'mega-trends', 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.

Indeed, during the time in which this research was conducted, first effects of policies to slow down the decline of the inner areas of Dortmund have become visible: 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 of Dortmund in Innenstadt-Nord---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 park' in Hombruch mentioned earlier which, according to its management, is already now crowded with young high-tech firms and planning for expansion. Although it remains to be seen how much of this success is due to the public subsidies connected with this prestige project, although its actual effects on employment are minimal compared with the simultaneous employment losses in the traditional industries, and although this development consumes virgin land of potential ecological and recreational value in a prime central location of the urban area, 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 trained 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 the 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 will be important, Dortmund and almost any other industrial city in Germany with its heritage of old buildings, redundant infrastructure, polluted environment, and wasted soils will be a second-best choice for firms

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of most growth industries, and their highly qualified and highly selective staff. This does not preclude that Dortmund to a certain extent, and with the requisite financial incentives, will be successful in attracting or even 'breeding' such firms, but it makes it likely that the growth thus generated will always be less than that of the luckier competitors without such 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 de-industrialization of Dortmund is indeed irreversible, and if the spatial decentralization of employment and population in the region is bound to continue whatever decline scenario is adopted, 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 centralization---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 most important task of regional and urban spatial planning in such a system would no longer be the 'modernization' 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 decline as a challenge and opportunity to plan for long-term revival. Under that perspective the foremost responsibility of urban planning would be the gradual reclama-

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tion of the physical, ecological, and aesthetic destructions left behind by 150 years of industrial history---a much more fundamental 'modernization' than the one presently under way. Such a policy would improve the region's comparative advantage in the short- and medium-term, but more importantly it would 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 over-agglomeration, eventually will turn into decline.

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