PERSPECTIVES FOR URBAN ANALYSES AND POLICIES

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FOREWORD

Declining rates of national population growth, continuing differential levels of regional economic activity, and shifts in the migration patterns of people and jobs are characteristic empirical aspects of many developed countries. In some regions they have combined to bring about relative (and in some cases absolute) population decline of highly urbanized areas; in others they have brought about rapid metropolitan growth.

The objective of the Urban Change Task in IIASA's Human Settlements and Services Area is to bring together and synthesize available empirical and theoretical information on the principal determinants and consequences of such urban growth and decline.

In this report, Professor Peter Nijkamp, of the Department of Economics at the Free University of Amsterdam, discusses a number of methodological approaches to the study of urban changes and their policy implications. In particular, he focuses on the applicability of catastrophe theory and of multidimensional profile analysis.

A list of publications in the Urban Change Series appears at the end of this paper.

Andrei Rogers
Chairman
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ABSTRACT

This paper contains a number of methodological suggestions with respect to the study of urban changes and urban policies. First, attention is devoted to the potentialities of the catastrophe theory framework to be used in the analysis of agglomeration advantages and in urban policy evaluation. Second, a multidimensional profile approach is discussed in detail. The applicability of a number of multidimensional methods, within the context of urban impact analysis, is reviewed. Finally, an attempt is made to identify the role of those approaches in the design of urban quality plans.

CONTENTS

PERSPECTIVES FOR URBAN ANALYSES AND POLICIES

1. INTRODUCTION

The dynamics of postwar societies has also been reflected in the dynamics of urban systems. Although settlement patterns have never displayed a static structure, but have always been in a state of flux, contemporary shifts in cities and in urban systems have demonstrated fluctuations that have profound consequences for the spatial organization of our world. These urban changes are related to both the internal functioning of cities and the position of cities in a total spatial system (including communication networks). Several authors have studied the intricate relationship between changes in spatial structures (for example, in infrastructural networks) and in urban systems (see among others Gauthier 1970, Van der Knaap 1980, and Korcelli 1980).

Some figures may illustrate these rapid changes in urban systems. Approximately one century ago, nearly 1 percent of the total world population lived in cities with more than one million inhabitants, while presently more than 10 percent of the total world population is living in such cities (see Button 1976). In the Organization for Economic Cooperation and Development (OECD) countries, the total number of urban

inhabitants has been increasing at twice the rate of the overall population growth during the 1950-1970 period.

Such a rapid urban concentration has led to many problems: congestion, segregation, decline in quality of life, pollution, unemployment, lack of satisfactory facilities, etc. Equity problems also arise that are relevant at the level of not only interregional inequalities but also intraurban inequalities. (For example, unemployment rates in some urban districts are much higher than in peripheral lagging regions.) It is no surprise that a number of urban inhabitants have made an attempt to avoid the negative externalities of large urban agglomerations by moving to medium-size and smaller towns or to rural areas. Clearly, this movment has been codetermined by shifts in priorities regarding quality of life and leisure time.

In this paper a brief overview of recent changes in urban systems will be given, followed by a critical review of the traditional urban economic analyses. An attempt will be made to provide a more satisfactory framework of analysis based on multidimensional profile methods. From such modern techniques some recently developed contributions to urban policy analysis will be proposed. The paper ends with a plea for introducing urban impact analyses and constructing integrated urban quality plans.

2. URBAN CHANGES: SOME TRENDS

The above-mentioned conflict has mainly been responsible for the large-scale spatial reorganization of people and industry (see Klaassen 1978a). At the present time, two different trends of urban change can be identified. The first is the continued growth of large urban agglomerations (major cities in southern Europe and many urban centers in developing and semideveloped countries--for example, Naples, Mexico City, Seoul, and Bombay). In these countries one often observes accelerated urban growth. Apparently, the net agglomeration advantages in these cities are considered to be more favorable than the socio-economic perspectives in the rural areas. This

continued urban growth has, however, led to many serious urban problems such as lack of employment opportunities, lack of social and medical facilities, lack of adquate dwellings, etc. Given the lack of favorable opportunities elsewhere and given the lower priorities attached to the urban quality of life in economically less-advanced countries, the external diseconomies of the urban climate have been deemed less important. Because of this, major centers have demonstrated a continuing growth process.

The second trend, which can be observed in many industrialized and developed countries, can be characterized as a metropolitan contraction accompanied by counter-urbanization and urban deconcentration. In these countries, economic growth has shaped the conditions for higher priorities to be attached to the quality of life and environmental conditions. These changes in individual and collective locational preferences--and to a lesser extent the shifts in demographic factors--have caused a reversal of historical trends toward larger urban agglomerations. This spatial reorganization has had a dual effect: urban contraction in major cities and expansion of medium-sized and small towns. Apparently, the agglomeration benefits of main centers have not been sufficient to warrant a stable development pattern of cities. The lack of adequate urban facilities has caused an urban deconcentration, although it has to be added that many movers to smaller towns and rural areas continue to use the advantages of nearby major centers (for example, job opportunities, shopping facilities, etc.).

These drastic spatial changes involve many conflicting issues in urban planning and policy, such as:

- socio-psychological benefits of a dispersed settlement pattern versus increased interaction costs (due to increases in transportation and energy costs)
- frictions between various kinds of land use inside and outside the city (for example, residential land use, recreation, industry, etc.)
- social and economic disintegration of the urban space (segregation, separation of working and residential centers, etc.)

- disequilibrium tendencies in the urban and regional housing market
- urban redevelopment and renewal policies versus regional growth policies

All these conflicts appear to be concentrated in the present urban space, while the control of the resulting spatial shifts in settlement systems and in the negative externalities of urban development processes is fraught with difficulties and uncertainties. Even the technological means to tackle such problems are often nonexistent or underdeveloped (for example, technologically advanced rapid transport systems, energy-saving mass transit systems, etc.).

3. A CATASTROPHE THEORY ANALYSIS OF URBAN CHANGES

Generally speaking, one may state that the growth of modern cities has not kept pace with the desires and preferences of urban inhabitants; the utility satisfaction derived from urban facilities (including quality of life goods) has not run parallel to the rise of big cities. Instead, beyond a critical threshold level, the agglomeration advantages (in the broadest sense) of big cities have often decreased, at least when the negative externalities of large agglomerations were not compensated by an adequate supply of satisfactory urban facilities (see Figure 1).

Due to indivisibilities in the supply of urban facilities and due to the lack of flexibility in urban public policy, a stepwise (kinked) shape of the agglomeration curve is fairly plausible (for a representation of such a discrete policy, see Figure 2). Such a stepwise increase in urban facilities can often be observed in several cities in developing countries as well.

The relationship between city size and agglomeration advantages depicted in Figure 1 and Figure 2 demonstrates a different shape (for example, an S-shaped curve) in the case of an adequate compensatory supply of urban facilities during

an urban growth process: this S-shaped curve assumes scale advantages in the supply of facilities (see Figure 3). In the case of indivisibilities and rigidities in urban public policy, this S-curve may again display a stepwise shape (see Figure 4).

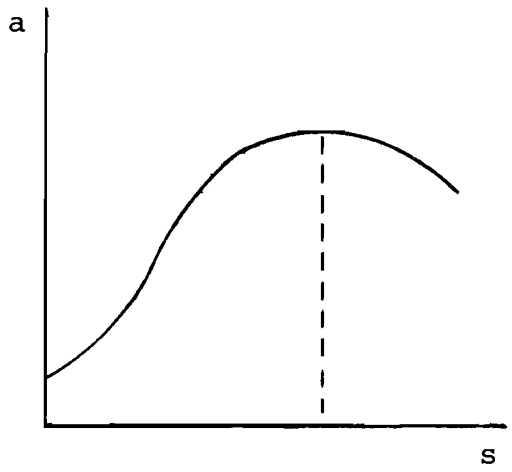


Figure 1. Agglomeration advantages (a) and city size (s) in the case of a continuous inadequate urban policy.

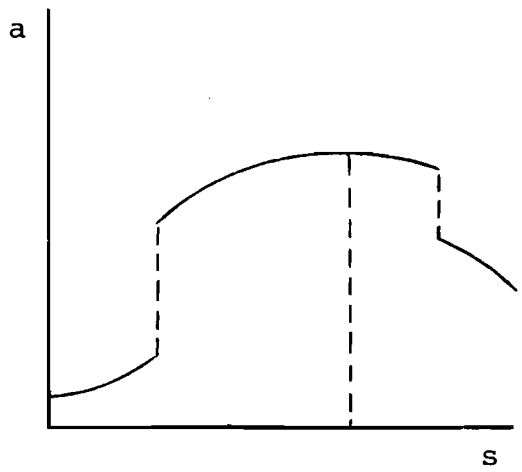


Figure 2. Agglomeration advantages (a) and city size (s) in the case of a discrete inadequate urban policy.

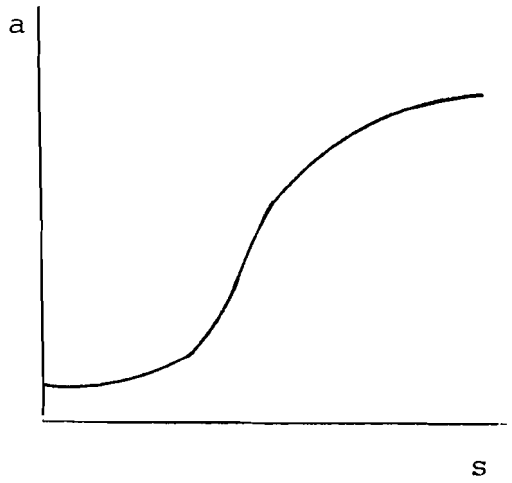


Figure 3. Agglomeration advantages (a) and city size (s) in the case of a continuous adequate urban policy.

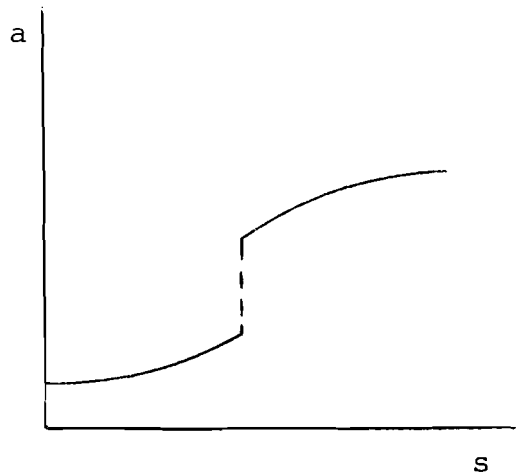


Figure 4. Agglomeration advantages (a) and city size (s) in the case of a discrete adequate urban policy.

Next, one may also assume a situation of urban decline due to shifts in residential and environmental priorities, so that urban inhabitants decide to leave the major agglomerations. In such cases, the urban developments would result in a downward movement along the curves depicted in Figures 1-4.

A conservative and rigid urban policy, however, will try to keep the urban facilities intact--despite a decine in population. Beyond a certain critical threshold level, however, the financial means are no longer sufficient to warrant an adequate supply of urban facilities. At this point a sudden decline in the provision of urban facilities takes place. This gives rise to the asymetric pictures presented in Figures 5 and 6 of an inadquate and an adequate discrete urban policy, respectively.

This asymmetric evolution of the provision of urban services and functions (and hence of agglomeration advantages) leads essentially to the well-known cusp curves from catastrophe theory depicted in Figures 7 and 8 (see Nijkamp 1980a).

By introducing the degree of discreteness (or rigidity) d as a control variable, one can draw the three-dimensional catastrophe surfaces depicted in Figures 9 and 10 for an adequate and an inadequate urban policy, respectively.

These cusp catastrophes reflect several well-known aspects of perturbations in dynamic systems such as divergence, bimodal behavior, and splitting factors. The main characteristic of Figures 9 and 10 is that a stable growth path of an urban system is only guaranteed in the case of a flexible and adequate upward and downward urban supply policy for facilities. Rigidities and indivisibilities may lead to shocks and asymmetric urban development processes. This also implies that many traditional urban and population models may have a smaller relevance than they used to have. The same holds true for traditional planning concepts such as growth poles and innovative urban capacities.

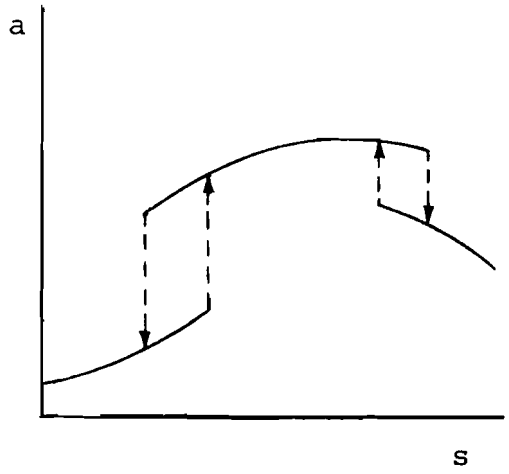


Figure 5. An asymmetric inadequate discrete pattern of agglomeration advantages and city size.

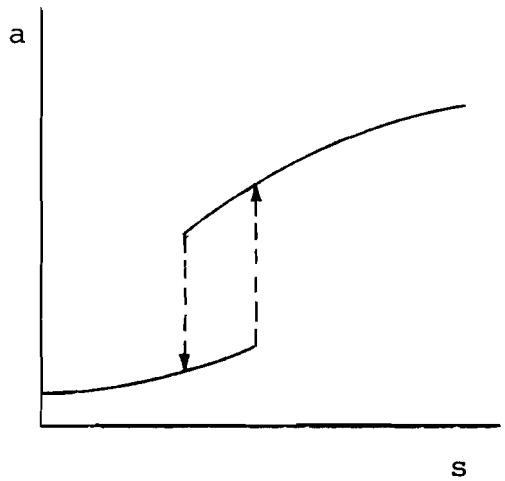


Figure 6. An asymmetric adequate discrete pattern of agglomeration advantages and city size.

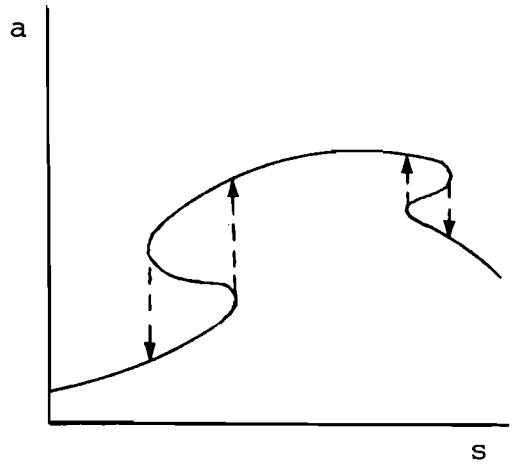


Figure 7. A cusp for agglomeration advantages in the case of an inadequate discrete urban policy.

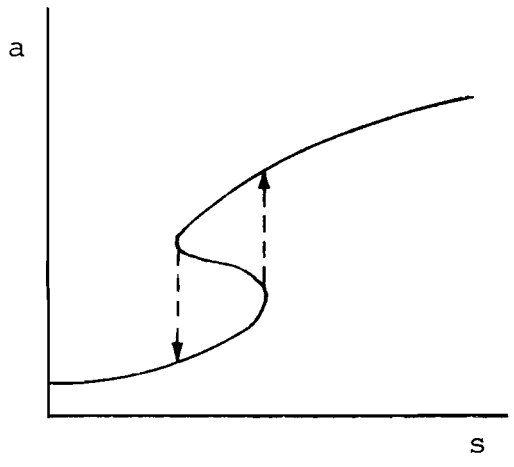


Figure 8. A cusp for agglomeration advantages in the case of an adequate discrete urban policy.

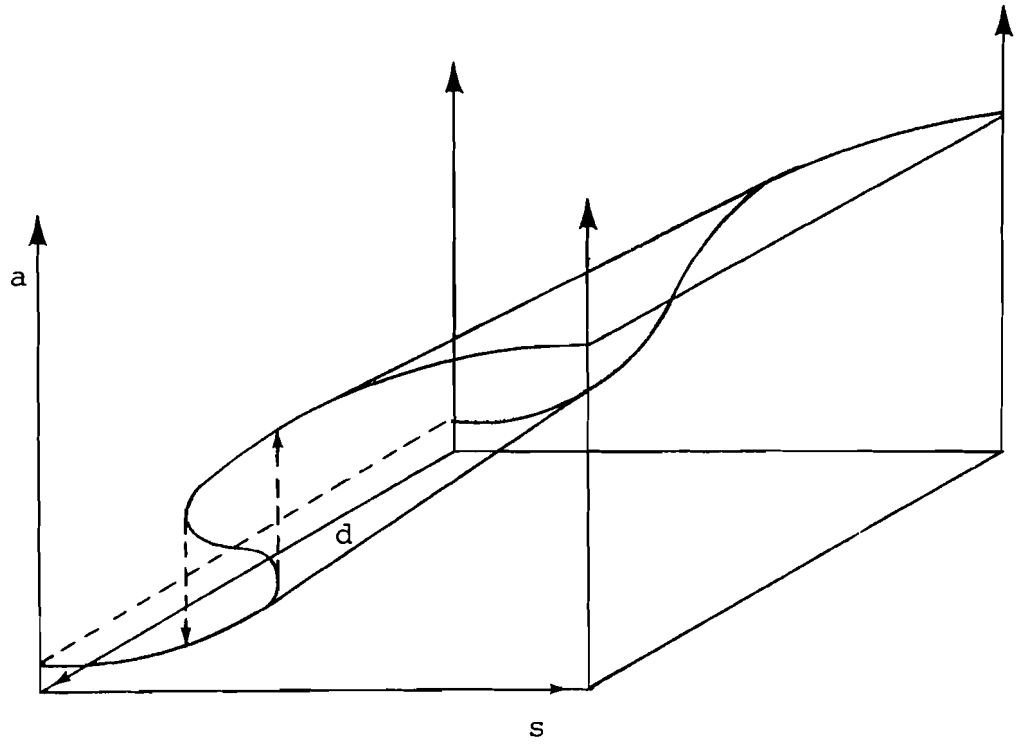


Figure 9. A cusp catastrophe for agglomeration advantages in the case of an adequate urban policy.

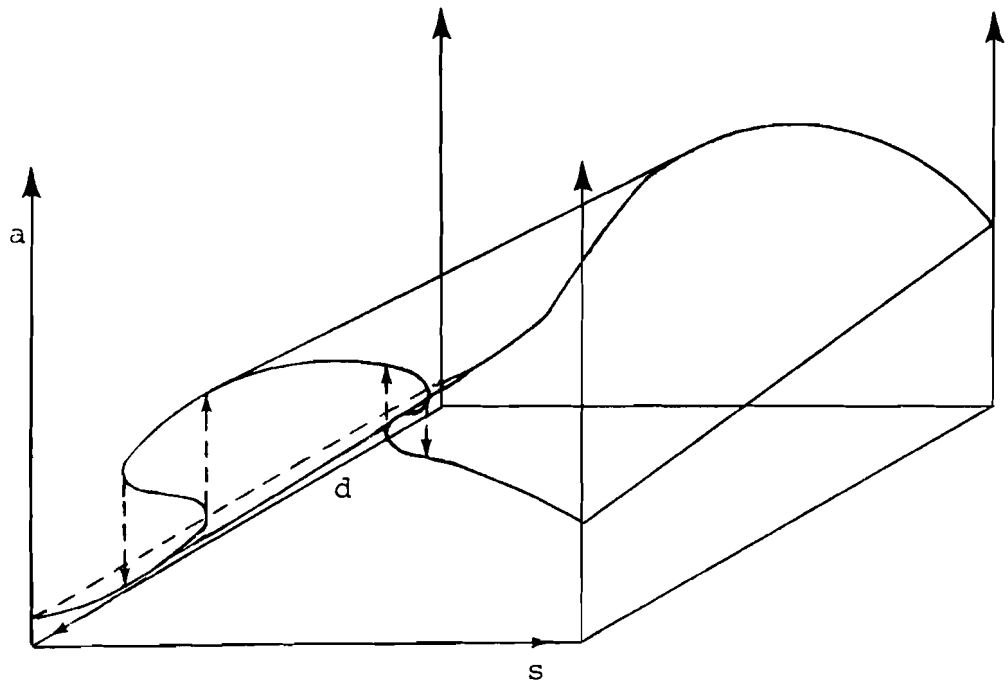


Figure 10. A cusp catastrophe for agglomeration advantages in the case of an inadequate urban policy.

4. SPATIAL REORGANIZATION OF HUMAN SETTLEMENT PATTERNS

Huge urban agglomerations can be regarded as the result of large-scale concentration tendencies of many resources in an industrial society: specialized service sectors, information centers, large and varied labor markets, innovative research and development, varied shopping facilities, differentiated commodity markets, etc.

This large-scale concentration has, however, led to many negative external impacts (decay of environmental quality, lack of adequate and comfortable housing, lack of recreation areas, etc.) resulting ultimately into the above-mentioned counter-urbanization movements (see Vonk 1978). Furthermore, the conditions for this spatial reorganization have also been provided by our technologically advanced societies; high-speed infrastructure networks for public and private transport and extensive communication networks make physical proximity less important and erode the urban agglomeration advantages. Next, it also has to be mentioned that large-scale urban concentrations have caused substantial increases in urban cost structures, so that ultimately cities are becoming relatively more expensive for their inhabitants (see also Van den Berg et al. 1978) and Klaassen 1978b). Finally, many urban policies have not been very successful and have sometimes even led to many unintended negative consequences (for example, urban labor markets), especially because of a lack of coordination with regional policies.

It should be noted, however, that the process of spatial reorganization of people and economic activities has not been a random process based on a select sample of actors. On the contrary, the above-mentioned spatial processes have been very selective. For example, the first suburbanization movement in the fifties was induced by higher income groups of those who could afford to cover the higher transportation costs from peripheral (sub)urban areas. The same holds true for the sixties, when a large-scale suburbanization movement took place leading

to a sudden growth of medium-sized and small towns around big urban centers. According to Masotti and Hadden (1972), this large-scale suburbanization might even be called an "urbanization of the suburbs". These movers--just like the stayers--were still oriented to the facilities provided by the big agglomerations, however. Especially medium and high income classes could afford a location outside urban centers, thus resulting in the drastic structural changes of the urban population that stayed in the traditional inner cities. The stayers included primarily elderly people, foreign workers, students, and low income groups. This social and spatial segregation caused many frictions, as well as affected the financial basis of the city (especially in those countries where the urban financial resources were based on local taxes).

The seventies have demonstrated a continuation of the mobility picture from the past decades; long-term commuting became a usual phenomenon, while the population size of many big cities drastically decreased. This change in settlement systems was also increasingly shared by people with a less-than-average income. The negative consequences of this process are evident: a high energy consumption, environmental decay, congestion, decrease of urban quality of life, segregation, emergence of a dual urban labor market, etc.

It is not surprising that the negative consequences of the counter-urbanization trend have also evoked a counter-movement, namely, a reurbanization process. Urban policies are increasingly oriented to revitalizing the urban economy and to compensating the stayers for the negative externalities of city life in big agglomerations. Urban renewal policies are presently an integral component of urban social economic and physical policies.

This reurbanization process is again a selective one; it is oriented to providing lower income groups with better housing, educational, and social facilities, although it has to be added that many urban renewal policies are also aiming at improving all facets of the urban structure. In addition, high income groups are attracted toward renovated urban districts. Only these groups can afford to live in luxury and expensive

apartments in such renovated areas. Evidently this also involves several conflicting equity problems.

It is important to note that these reurbanization trends are insufficient to compensate the loss of urban inhabitants during the last decades (see Nijkamp and Soffer-Heitman 1979). Urban renewal will, in general, lead to lower densities. Urban renewal policy--based on average urban population densities--will not be very helpful, therefore, to combat the urban sprawl process. If the standards for population densities in urban renewal districts are revised, then urban renewal may be a meaningful tool to restore the traditional urban agglomeration process. This will, however, pose a high demand on urban architecture, because in the present circumstances a high population density is often being regarded as a negative element to the quality of life.

Our conclusion is that the drastic changes in human settlement systems is closely related to the changes in the supply of and demand for high-ranking commodities associated with the general urban quality of life, so that a purely traditional economic analysis will be insufficient to study these spatial developments (see also Nijkamp 1979a). The next section will be devoted to a broader multidimensional analysis.

Clearly, in addition to residential changes, shifts in location patterns of industries can also be observed. Several urban agglomerations appear to substitute their industrial function for an orientation toward the tertiary and quarterny sector, although also the latter activities often demonstrate an outward drift from the city center. In addition, the innovative role of large cities is steadily decreasing in favor of a more innovative-oriented process in medium-sized cities.

Despite the loss of several urban functions such as housing and recreation, the majority of the large cities has still kept a substantial part of its functions: shopping facilities, cultural and educational facilities, social and medical facilities, and employment facilities (see Bak 1977). Consequently, urban revitalization policy should also be oriented to a maintenance

and extension of urban symbiosis for both residential and entrepreneurial activities. This will require an urban policy that warrants a synthesis of urban quality of life preferences and entrepreneurial locational preferences. Such a *planning for urban balance* requires a selective urban growth process in which the positive externalities of urban agglomerations are favored and the negative externalities are avoided or compensated. In the next section, an analytical framework for analyzing the above-mentioned trends in human behavior will be proposed.

5. A MULTIDIMENSIONAL PROFILE APPROACH TO URBAN CHANGES

The analysis of changes in settlement patterns and in land use requires much insight into the mobility motives of people. Consequently, phenomena like congestion, industrial and residential (re)locations, and environmental quality are to be related to spatial interactions emerging from distance behavior in a spatial system. In this respect, it is useful to make a distinction between a supply and a demand of urban functions.

Urban functions have displayed an increasing divergence between supply and demand. As mentioned above, the general decline in urban functions (e.g., in terms of job opportunities, residential functions, social and medical facilities, etc.) is a typical *supply* phenomenon. One may make a distinction between main categories of urban functions and include them in a *multidimensional supply profile* $\underline{x}^S$ (see Nijkamp 1979b, 1980b). An example of such a supply profile is:

$$\underline{x}^S = \begin{bmatrix} \text{quantity of dwellings} \\ \text{quality of dwellings} \\ \text{general accessibility} \\ \text{cultural facilities} \\ \text{shopping facilities} \\ \text{medical facilities} \\ \text{educational facilities} \\ \text{job opportunities} \\ \vdots \end{bmatrix} \qquad (1)$$

Beside the supply side, one may also take account of the *demand* side by specifying a *demand profile* $\underline{x}^d$ which reflects the aggregate demand for various kinds of urban services. As set out previously, the discrepancy between supply and demand may also be due to shifts in priorities of urban inhabitants regarding urban services and amenities. Clearly, this will also lead to a shift in the demand profile.

It should be noted that the supply profile can be subdivided into specific profiles for urban districts, whereas the demand profile can be subdivided according to various socio-economic groups. The analysis presented in the previous sections indicates that unbalanced spatial developments and urban decline are more likely to emerge as the divergence between the supply and demand profile becomes higher. When the free market system does not guarantee the fulfilment of an equilibrium between $\underline{x}^s$ and $\underline{x}^d$, the local, regional, or national government may be willing to regard the urban quality of life as a merit good, so that it may be improving the supply profile. It is evident that urban policies of local, regional, or national governments should especially be oriented toward a reduction of the above-mentioned divergence. Many urban policies, however, have not been successful in this due to the limited role and competence of local governments, the complicated structure of municipal systems, the lack of insight into impacts of urban policies, and the absence of an adequate evaluation framework for urban development plans.

Discrete urban policies (in the sense of a stepwise and discontinuous supply of urban services) give rise to the jumps in urban development described in section 2. Inadequate policies that do not compensate the negative consequences of urban growth lead to the curves described in Figure 1, while intertia in the supply of urban services ultimately causes the type of developments set out in section 2.

In general terms, one may state that urban policies aim at (1) restoring original functions of a city, (2) improving its present functions, and (3) adding new functions so as to accommodate the wishes of the urban community. This implies formally, that urban policies should attempt to reduce the divergence between $\underline{x}^s$ and $\underline{x}^d$ for all urban districts and all socio-economic groups.

The divergence between the supply and demand profile can be measured *inter alia* by means of a generalized distance metric such as the Minkowski p-metric:

$$\delta_p = \left\{ \sum_{i=1}^{I} \left| \frac{x_i^d - x_i^s}{x_i^s} \right|^p \right\}^{1/p}$$

where elements x_i^d and x_i^s of the demand and supply profile $\underline{x}^d$ and $\underline{x}^s$, respectively, are measured according to the principle "the higher, the better". It may be expected that a district or a place will attract more residents as δ_p is smaller, since a low value of δ_p corresponds more closely to the needs and desires of the people. Clearly, δ_p should be distinguished according to geographical areas and socio-economic groups. It should also include the costs of realizing a certain desired profile (such as movement costs and daily commuting costs). Also, different groups may attach different weights to the successive elements of the above-mentioned profiles, so that any urban policy that attempts to reduce the gap between $\underline{x}^d$ and $\underline{x}^s$ inevitably includes equity elements. The same holds true for the spatial distribution of the improved supply profiles over urban districts. This problem of urban plan evaluation will be touched upon later.

The foregoing remarks also have important implications for the concepts of agglomeration advantages and of optimal city size (see e.g., Alonso 1971 and Richardson 1973). These concepts take for granted the fact that the scale advantages in urban agglomerations can be translated into monetary units.

In this way--on the basis of an economic efficiency principle--an optimal size of an urban agglomeration can be identified. The practice of urban research, however, has demonstrated much confusion concerning urban costs, especially as far as the inclusion of general infrastructure costs, of spatial spillover costs,and of urban production benefits is concerned. Therefore, it is no surprise that in the literature the optimal city size appears to vary between 100,000 and 5,000,000 inhabitants.

There are two reasons for this variety in results and views. First, the concept of optimal city size is an aggregate concept that incorporates the various preferences and perceptions of thousands of people regarding residential locations, environmental goods, and general urban services. There is no guarantee that a mainly theoretically determined and monetary based optimal city size is in agreement with the desires of urban inhabitants. From the point of view of the utility satisfaction of urban inhabitants and groups, the concept of optimal city size is less meaningful. In this respect, disaggregated preference and perception analyses may provide a more adequate contribution to the analysis of agglomeration advantages. Such analyses, which have proved to be already very useful for the analysis of shopping behavior, may link a less ambitious concept of "satisfactory city size" to socio-psychological and micro-economic research. In this way, distributional impacts can also be integrated in a more adequate manner. Examples of such disaggregated behavioral methods are multidimensional scaling techniques, logit analysis, and probit analysis (see e.g., Blommestein et al. 1980, Nijkamp 1979b, Van Lierop and Nijkamp 1979, 1980).

A second objection to the concept of "optimal city size" is the narrow monetary basis of this concept. The wide variety of facets of urban life (including equity, segregation, environmental quality, production, and scale advantages) cannot be reliably translated into monetary units in order to arrive at an unambiguous efficiency measure (see also Nijkamp 1979c). Such a neoclassical approach, which also neglects the components

of various urban policies is less useful compared to an attempt to use a multidimensional profile analysis. Such a profile analysis may be based on a synthesis of demand and supply profiles in order to identify for a given spatial system and social context which urban structures (i.e., which components of the urban life including city size) are favored by the inhabitants. In this respect, the above-mentioned disaggregated choice methods may be very helpful (see also section 7).

6. URBAN ECONOMIC THEORY REVISITED

Urban dynamics, shifts in priorities regarding urban services, qualitative and quantitative shortage on the housing market, financial aspects of urban renewal, disintegration of the urban structure, and urban inequality pose serious problems to urban economic theory. One may rightfully question the relevance of traditional theories on urban economies.

Especially in the Anglo-American world, urban land-use models have become very popular. These models, however, are based on rather stringent, stylized, and abstract conceptions of urban structures, such as the frequently adopted assumption of a homogeneous surface and of equal locational potentials for economic activities in the urban territory.

As far as the location of firms is concerned, the well-known Von Thünen model is often being used as an explanatory and analytical tool (see Alonso 1964 and Richardson 1973). This model takes for granted that (1) firms buying land in a certain urban area want to get a maximum profitability for their economic activities, (2) sellers of urban land want to get the highest prices, and (3) the accessibility of a certain location of the firm will decline with increasing distance from the city center. Given a certain cost structure of the firm and given a certain price gradient for urban land, each firm will ultimately choose its optimal location.

This traditional Von Thünen analysis rests upon unrealistic assumptions. In fact, the neoclassical competition and equilibrium framework hardly reflect reality; the homogeneity of urban land is often a fiction; and the city center is by far not the only concentration point of economic activities. Richardson (1977) rightly claims that it is almost impossible to derive an integrated theory that describes and explains all kinds of locational problems in the city. In his opinion, the best locations are normally already occupied, and a new firm has to accept a suboptimal location.

Such a partial equilibrium is closely related to the static nature of urban land use models, which ignore dynamic processes such as demographic changes, spatial relocations, improvement of transport infrastructure, spatial transformations, structural economic changes (e.g., the growth of the tertiary and the quarternary sector) and technological innovations. Consequently, recent urban changes are very hard to explain by means of traditional land-use models.

Urban land-use models also play a role in explaining locational behavior of households. Especially in the recently developed New Urban Economics (NUE) such models constitute an essential ingredient (cf. Richardson 1977). Normally in these models the bid price curve has a declining slope from the center, given a concentric zonal structure (the Von Thünen model). Adjustments via the so-called multinuclei model and the radial sector model are also possible. Due to competition among functions of urban land on the demand side, the actual land use will ultimately be determined by the highest bid price. Hence, residential locations may shift to less accessible urban areas, when an entrepreneur can afford to pay more for a central or favorable location. This may imply that low income will ultimately be located at the worst locations, because unfavorable residential areas will normally be characterized by lower land prices. In this way, one may also analyze filtering processes on the housing market.

The advantage of the above-mentioned theories is that they regard the competition principle as a source of frictions occurring in the urban housing market, but these theories also have many shortcomings. The assumption that the role of the city center is dominant hampers an adequate insight into the intricate relationships between the urban housing, labor, and commodity markets within the urban agglomeration. The postulate of the homogeneity of households precludes an adequate explanation of conflicts within the housing market caused by qualitative changes on the demand side. The role of land speculation in land use competition is mainly overlooked in the above-mentioned theories, and the severe conflicts in urban renewal problems are often left aside. Models based on these theories do not usually provide an operational framework of analysis. Consequently, for urban land-use policy and urban renewal policy, these models have a limited value. In this respect, a more integrated and dynamic systems approach based on dynamic urban models and extended with disaggregated choice elements would probably provide a broader, more complete and more operational framework for urban economic analyses (see Botman 1974, and Veldhuisen and Kapoen 1979).

The limitations of the land-use models become also apparent from a social point of view, since equity problems are mainly left aside. Consequently, the frequently occurring social segmentation in cities (dual labor markets, residential segregation, etc.) has hardly been studied in this framework (see Harvey 1975, Pahl 1971, and Vipond 1974).

The foregoing remarks lead to the conclusion that the intricate pattern of urban locations of entrepreneurs and households is hard to explain by means of simplified land-use models. Socio-psychological perceptions and priorities play a dominant role in locational decisions, while in addition to quantifiable parameters many qualitative and soft elements may also influence locational behavior. In this respect, it may be more adequate to use a multi-attribute utility theory in order to obtain a more complete and operational analysis of urban location patterns

and processes. Here again the above-mentioned multidimensional scaling methods based on disaggregated choice models may be helpful (see also Van Lierop 1980).

Finally, it should be noted that many current urban economic models have not been very successful (see for criticism among others Lee 1973 and Sayer 1976). In our view, there is a need for operational, less complicated, and more innovative urban economic models that are able to describe the main urban processes. For specific urban sectors (e.g., housing and transportation) more detailed submodels may then be built. Urban econometrics is still an underdeveloped discipline--mainly due to lack of accurate data--although the recently developed "soft econometrics" (Nijkamp 1980c) will probably offer more favorable perspectives, especially when they are combined with appropriate multidimensional methods. In the following section, several multidimensional methods that may be helpful for the analysis of urban economic structures and processes will be briefly discussed.

7. A BRIEF SURVEY OF SOME MULTIDIMENSIONAL ANALYTICAL METHODS

Introduction

The pluriform nature of urban structures and processes can be represented in an adequate manner by means of a multidimensional profile analysis. In the previous sections some examples of such an analysis have already been given such as the supply and demand profiles for urban services and a multiattribute utility approach. In general, a multidimensional analysis may be a useful approach with a great potential for numerous applications in both the field of data analysis and policy analysis. Examples are residential location decisions, evaluation of urban renewal projects, analysis of urban inequalities, environmental quality analysis, and spatial interaction analysis.

Formally, the multidimensional approach took for granted that the attributes of a certain phenomenon could be described by a vector profile $\underline{x}$ with elements x_i (i = 1,...,I). Usually, the elements of $\underline{x}$ are measured in different dimensions, so that a translation into a common denominator (a "numeraire" like money) was not necessary.

Let us now assume that we want to characterize a set of observations or data on a given multidimensional phenomenon (for example, the supply profiles of different urban areas, the demand profile of different socio-economic groups, the impacts of a set of alternative urban renewal projects, the residential preferences of a group of households, etc.). In that case, a multidimensional matrix representation X arises:

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1K} \\ \vdots & & \vdots \\ x_{I1} & \cdots & x_{IK} \end{bmatrix} \qquad (2)$$

Several ways are open now to deal with the information contained in matrix X in greater depth. A sample of such multidimensional methods will be given below (see for more details Nijkamp 1979b).

Interdependence Analysis

Interdependence analysis is an optimal subset selection on the basis of statistical correlation techniques by means of which a limited subset of variables can be selected from the original total set of variables. In this way, the multidimensional data set is reduced to an optimal subset that reflects the original data at a maximum degree. The advantage of interdependence analysis--compared to other techniques such as principal component techniques--is that the smaller subset is

composed of *original* variables and not of transformed variables, which prevents an arbitrary or subjective interpretation of the components. These features of interdependence analysis make it very valuable for urban economic analysis.

Canonical Correlation

Canonical correlation may be useful in urban analyses in order to identify structural patterns between two multidimensional sets of variables (for example, the relationships between the elements of supply profiles of urban districts and demand profiles of socio-economic groups). Correspondence analysis may be a complementary tool for identifying links between sets of variables.

Partial Least Squares

Assume that we want to analyze three urban phenomena simultaneously: the housing market, the transportation infrastructure, and the urban quality of life. For each urban district, these three phenomena can be characterized by means of a multidimensional profile. Partial least squares analysis attempts to quantify the cross correlations between all these three sets of data as well as between combinations thereof.

Multidimensional Scaling

Multidimensional scaling methods are usually based on ordinal or qualitative rankings of similarities (or dissimilarities) among alternatives (such as objects, items, attributes, etc.). These methods aim at generating a geometric representation of the positions of alternatives in Euclidean (metric) space of a given dimensionality by employing a certain geometric scaling algorithm. By means of this operation, metric conclusions can be inferred regarding the relative distances (discrepancies or differences) between items, attributes, or judges.

The positions of the items, attributes, and judges can be represented via the Euclidean coordinates. They are determined in such a way that the interpoint distances between the points in a geometric space do not contradict the original conditions implied by the ordinal input data. In other words, this monotonicity condition should guarantee a maximum correspondence between the original ordinal rankings (either similarities or dissimilarities) and the Euclidean distances in a geometric space with a lower dimensionality.

Multidimensional scaling techniques used in urban analyses make it possible to deal with individual (disaggregated) data, such as perceptions and preferences. Moreover, these methods can be used to deal with soft information by transforming it into cardinal data. Consequently, these techniques may be powerful tools for urban economic analyses. They can, for example, be used to draw quantitative inferences from soft data on differences between urban supply and demand profiles.

Spatial Autocorrelation

The autocorrelation analysis is useful not only to identify average spatial impact patterns between variables, but also to examine the presence of spatio-temporal autocorrelation among the disturbances of a regression model for dynamic and spatial impacts. Such a spatial econometric analysis may be useful to identify spillover effects in an urban system.

Finally, it should be noted that several regression models are not suitable for treating soft (ordinal or qualitative) information. In the case of such soft information, it may be better to carry out first a multidimensional scaling technique in order to obtain cardinal information, after which normal regression and correlation procedures can be employed (so-called "soft econometrics").

Our final conclusion is that there are several appropriate multidimensional techniques for urban data analysis. Several of these techniques can also be combined with disaggregate

choice methods (such as logit and probit analysis). This multidimensional framework offers a good perspective for analyzing urban structure patterns and developments.

8. URBAN POLICY IN A SPATIAL CONTEXT

During the seventies, local and regional governments became increasingly aware of the problems of urban decay and of the inadequateness of urban policies to combat the negative developments of urban agglomerations. In general, urban policies are pluriform in nature, as far as both targets and instruments are concerned. In general terms, one may state that urban policies should aim at realizing a supply profile of urban services that is in agreement with the perceptions and priorities of the people with whom it is concerned. Furthermore, account must be taken of the position of cities in the totality of a spatial structure.

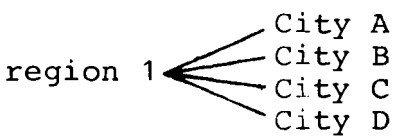
There is, in general, a wide variety of objectives of urban policy, which may sometimes be operationalized by means of a target profile. Normally, there are also several instruments (both revenues and expenditures such as taxes and subsidies, prohibitions, etc.); these instruments may relate to various urban sectors, such as industry, the housing market, the transportation system, the quality of life, social welfare programs, the energy system, etc. It should be noted that the urban policy objectives and instruments should relate to both residential and entrepreneurial activities, as well as to mobility. Such a pluriformity of urban developments leads again to a multidimensional view of urban policies that is much broader than a purely efficiency-oriented, monetary-based policy analysis. In the following section a brief survey of some multidimensional urban policy analyses will be given, but first urban policy analysis will be placed in a more general spatial context.

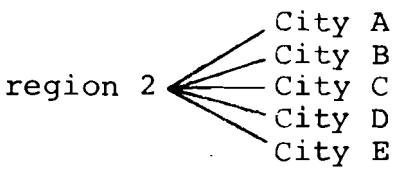
It should be noted that there are many interactions between the developments of cities and of regions as well as between urban and regional policies. Regional growth policy, for

example, may have considerable impacts on the urban system in the region concerned; regional industrial incentives may have serious impacts on the urban labor markets; a growth center policy may, on the other hand, exert an influence on regional growth, etc. Therefore, the interwovenness of the urban economy and the regional economy has to be taken into account, so that several scales (e.g., intraurban, interurban, intraregional, interregional, and national) may be observed in urban policy analysis. Under these circumstances the coordination and integration of regional and urban policies is a complex matter. Due to spatial spillover effects, dynamic interactions, and increasing uncertainties, a spatial system of regions and cities shows an intricate and often unpredictable pattern. The control of the development of this pattern via public policy measures is fraught with difficulties. Furthermore, one has to take into account the effects of different systems associated with bottom-up or top-down policies.

The following profile approach may be regarded as a first attempt to provide an operational framework for a more general analysis and to synthesize the elements of policy making in a spatial context. Define the following successive profiles:

- a *spatial* profile
  This profile represents the spatial demarcation of cities and regions in a spatial system. For example:





  This spatial profile can be used in both a top-down and a bottom-up spatial policy.

- a *sectoral* profile

  This profile reflects the fields of public urban and regional policy making. Examples of such policy fields are:

  labor market
  education
  public facilities
  urban renewal
  transportation
  housing

- a *facet* profile

  This profile represents the aspects and judgment criteria of a given public urban sector policy. For example:

  financial aspects
  land use aspects
  environmental impacts
  employment effects

The profiles of sectors and facets can be incorporated in a combined sector - facet table:

facet \ sector	1	2	.	.	.	.
1						
2						
.						
.						
.						
.						

This sector - facet table can be constructed for each region and each city separately. The spatial aspects of the sector and facet profiles can be described by constructing a three-dimensional block with sectors, facets, and regions/cities on the main axes.

Thus far, the sectors have been treated independently from each other. This is, however, often outside of reality. Sectors have often a mutual influence (for example, transportation policy and urban renewal policy will exert an impact on the labor market). In addition there are spatial impacts. (For example, urban renewal in the one city will have an influence on the transportation system of the whole region and maybe on that of surrounding regions.) This interwoven pattern of spatial entities, sectors, and facets requires an integrated and co-ordinated spatial policy.

The best way to describe such a complex pattern of regions, cities, sectors, and facets would be to construct an integrated model. As this is usually impossible--at least in the short run--one may try to assess the effects of certain facet policies to be implemented in certain regions or cities. It is clear that this can only be done for discrete policy measures, although the impact assessment can be carried out for both bottom-up and to-down policies.

It is almost impossible to prescribe a set of uniform guidelines for regional and urban policies; the institutional framework in various countries demonstrates significant differences (for example, a "bottom-up" versus a "top-down" policy). In general, however, some criteria for coordination and integration at different levels of policy making can be given.

- It is reasonable to treat a certain sector of public policy making at a higher level in the spatial hierarchy as its spatial impacts become larger.
- It is reasonable to delegate a certain sector of public policy making to lower decision levels (deconcentration) as its frequency becomes higher. (This is a learning principle.)
- It is reasonable to treat a certain sector at a higher level as its facets (implications) become more substantial. (This depends on the range of the policy at hand.)

The above-mentioned multilevel coordination problems of urban and regional policies can be tackled by means of recently developed hierarchical multiprofile methods (see next section). These methods are also capable of taking into account the dynamics of urban change (e.g., metropolitan changes) and its implications for urban and regional policies. A well-known example is the suburbanization and counter-urbanization movement caused by mobility preferences and lack of adequate housing in major cities.

An important issue that has to be studied by means of this multilevel, multiprofile approach is the equity problem between central and peripheral regions and its relationships with urban developments in these regions (e.g., growth center policy). The current economic recession makes this problem even more urgent, since reduced growth also implies less growth opportunities for lagging regions. Instead of location policies for new investments much more attention has to be paid to relocation policies for the existing capital stock. This problem is also extremely relevant at a higher level of international coordination (e.g., the development of lagging regions in EEC countries).

The foregoing notions also require a systematic judgment of various policy instruments:

- monetary (e.g., subsidies and charges)
- economic (e.g., labor market stimuli)
- authorization (e.g., prohibitions and standards)
- public investment (e.g., public facilities and infrastructure)
- indirect stimuli (e.g., favorable entrepreneurial climate)

On the basis of a judgment of these instruments one may analyze the intricate interrelationships between urban and regional policies in both directions. The judgment of alternative policy options *per se* will be discussed in the next section.

9. A BRIEF SURVEY OF MULTIDIMENSIONAL URBAN POLICY ANALYSES

The impact patterns of decisions and actions in urban and regional space are often intricate, far-reaching, and conflicting. In the recent past, this has evoked the need for many kinds of assessment analyses, for instance, environmental assessment, socio-economic assessment, and technology assessment. Especially the field of urban and regional policy making is often faced with difficult judgment problems regarding the feasibility and desirability of new plans and projects.

The emphasis on a broader judgment framework for policy decisions--based on private economic, socio-economic, environmental, energy, equity, and spatial-physical criteria, among others--is a logical consequence of the interwoven structure of advanced societies. These societies often have interest conflicts and social interactions at different levels. Consequently, the welfare of countries, cities, or groups should be represented by a *vector profile* instead of by a scalar. In this way, unpriced impacts of human activities can be taken into account as well.

If public policy has to judge the social meaning of a new plan or project, it should be kept in mind that "the public decision maker" usually does not exist. Due to diverging preferences and lack of concensus within a public decision committee, therefore, the emergence of conflicting options cannot be avoided. No evaluation framework will solve such policy problems. Thus the meaning of evaluation for urban and regional decision making is *not* primarily the identification of *the optimal* and *unambiguous* solution, but rather the rationalization of the decision problem at hand. This means that an evaluation should focus on the provision of all relevant *information*. This information includes such topics as judgment criteria, including opportunity costs and uncertainties (e.g., costs, employment effects, energy use, pollution effects), relevant *alternatives* (e.g., various locations of a shopping center), *interest conflicts* (e.g., environmental versus supporters of economic growth), and different *priorities* for various

impacts (e.g., employment versus quality of life), the development of procedures and *techniques* that guarantee the *best use* of the available information, given the institutional framework (e.g., process planning, multilevel planning, interactive policy making). Thus the following steps have to be undertaken:

information on criteria
|
identification of alternatives
|
identification of conflicts
|
estimation of priorities
|
use of suitable procedures/techniques

In this respect, modern multicriteria techniques and multiobjective programming methods may be very useful.

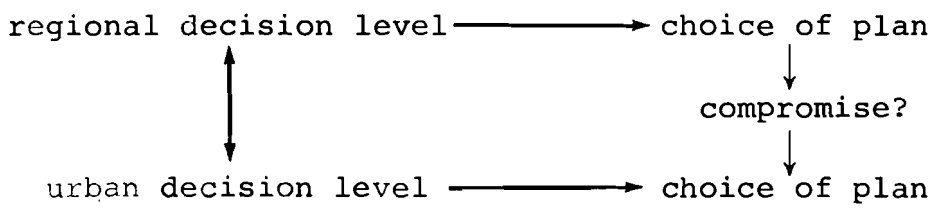
If urban and regional policy analysis has to be based on political priorities or weights regarding the decision criteria, several methods can be employed to assess political priorities:

- derivation of priorities on the basis of an *ex post* analysis of decisions taken in the past. Clearly, this approach is not useful for unique decision problems.
- derivation of priorities on the basis of official documents and statements from the side of the responsible decision committee. This approach is sometimes very useful to gather information regarding general issues and policy objectives, but normally it is less useful to assess precisely preferences for refined policy criteria.
- direct assessment of priorities on the basis of interviews or questionnaires among the decision makers.
- "fictitious" assessment of priorities on the basis of consistent policy scenarios reflecting hypothetical but otherwise reasonable priorities for the policy criteria at hand. This is often a very useful and practical method, because it does not commit directly

the policy maker, whereas on the other hand, the consequences of such fictitious policy priorities can easily be traced. Such scenarios may also be derived from official documents.

It is evident that in many choice situations the information about policy preferences is fairly weak. In such cases it is always necessary to carry out a sensitivity analysis with respect to the values of the policy weights. Alternatively, in case of soft information one may also employ (multidimensional) scaling methods.

It should also be mentioned that different decision groups (for instance, in an urban-regional structure) may have different priorities, so that the definition of a unique set of priorities is not always possible. In that case, it is more appropriate to assess several priority sets for the policy criteria and to calculate successively the consequences of each separate set. The results can then be further analyzed, for example, regarding the possibility of finding compromise choices:



Depending on the problems at hand and on the precision of the data used, several classes of multicriteria and multiobjective methods can be distinguished:

- *discrete* versus *continuous* policy problems
- *soft* versus *hard* policy problems (Soft problems include qualitative or ordinal information on impacts of alternatives or on priorities/weights, whereas hard problems are based on quantitative, i.e., mainly cardinal, information.)

- *static* versus *dynamic* policy problems
- *multi-person* (or multi-committee) versus *single-person* (or single-committee) policy problems (In the case of multi-person or multi-committee problems one has to take into account the variation in preferences, while one may also consider the possibility of a multilevel decision structure.)
- evaluation problems based on the *generation of efficient alternative solutions* versus those based on the *selection of one ultimate alternative* (In the first case the procedure aims at identifying only nondominated solutions, i.e., solutions for which the value of any policy objective cannot be improved without reducing the value of a competing objective. In the second case the procedure aims at finding one alternative that is considered as satisfactory after the articulation of preferences. An intermediate problem is the one based on a ranking of alternatives or on the identification of a set of dominating alternatives.)
- *single-step* versus *process* evaluation problems (The first category aims at finding the most satisfactory solution immediately at a certain point in time. The second category considers policy making as a process during which one may add successively more information so that the ultimate solution is identified in a series of successive steps.)

The notion of process planning requires the use of interactive policy procedures. Interactive evaluation procedures are based on an information exchange between the analyst and the decision committee, especially for situations in which the decision committee has not specified its preferences or weights.

In many decision situations one has to take into account a hierarchical decision structure. For example, a state government may influence the maximum share of a city budget spent for urban renewal. Such multilevel decision problems have received much attention in the past, but thus far have not

often been applied in the framework of multicriteria and multi-objective models.

It is clear that multilevel, multiobjective models involve a double choice conflict: namely, (1) among the policy objectives, and (2) among the different policy bodies in the hierarchical policy structure. For example, let us assume that the state government has to decide on the city budgets, but that the allocation of these resources depends on the efficiency of allocating such funds and on the relative power of these cities.

In principle, such complicated decision problems can be tackled by letting the cities provide information about the shadow-prices to the state government. On the basis of this information, the state government may adjust the allocation of resources, and so forth. Clearly, the problem of multiple shadow-prices has to be tackled in such bases (see Nijkamp 1980b). It appears that especially interactive procedures are extremely fruitful tools to structure such complex decision situations in a systematic and meaningful manner.

Thus, our final conclusion is that the multicriteria and multiobjective approach offers a great variety of operational methods for urban and regional policy analyses.

10. URBAN IMPACT ANALYSIS AND URBAN QUALITY PLANS: A PERSPECTIVE

After the discussion of the intricate and complex pattern of urban developments in a spatial system and of the multi-dimensional nature of urban and regional policies, attention should be focused on the ways the above-mentioned theories and methods can be used to provide a better perspective for urban and spatial developments. In our view, the design of urban impact assessment systems and of urban quality plans may offer a fruitful approach. These two elements will now be discussed successively.

It has already been pointed out that modern urban developments are characterized by a wide variety of unsatisfactory processes. Urban processes are pluriform in nature, while their interwovenness is often hard to understand for both analysts and urban policy makers. Consequently, urban research has very often an *ad hoc* character, while urban policies are often less coherent and sometimes even contradictory. There appears to be a serious lack of integrated spatial, social, economic, and physical dimensions of urban developments.

In light of the latter situation, the need for *urban impact assessment* becomes more urgent. Such urban impact analyses may relate to three different categories:

- the impacts on the urban welfare profile (labor market, social amenities, quality of life, income, equity, etc.) as a result of autonomous urban developments
- the impacts on the urban welfare profile as a consequence of urban policies (housing policy, infrastructure policy, etc.)
- the impacts on the urban welfare profile caused by external spatial and regional development processes (regional growth and labor market policy, energy policy, regional budget policy, etc.)

In general, urban impact analyses should contain an assessment of all foreseeable and expected consequences of a change in one or more stimuli that exert effects on the urban welfare profile (including indirect effects): for instance, "free rider" effects on the housing market. In this way, one might assess the direct and indirect, short term and long term, monetary and nonmonetary, construction and operation consequences of changes in the urban territory. In this respect, urban simulation models may be very helpful. Such effects may include *inter alia*: monetary aspects (costs, economic feasibility, changes in land prices, etc.), spatial aspects (shifts in urban residential and location patterns, distributive aspects, etc.), transportation aspects (congestion, accessibility, etc.), labor

market aspects (unemployment, duality, etc.), housing aspects (demand and supply on housing, submarkets, etc.), amenity aspects (social and medical facilities, etc.), environmental aspects (recreation facilities, noise annoyance, etc.) and energy aspects (energy-saving physical planning, etc.), uncertainty aspects, and distributional aspects.

Urban impact analyses are a fruitful tool for the use of evaluation methods for urban plans and projects. In this respect, one may judge a whole set of alternative urban developments (or development plans) on the basis of a systematic urban welfare profile. It is clear that a more thorough analysis of such sets of profiles will require the use of the multidimensional techniques discussed in section 7. Similarly, the use of urban welfare profiles in integrated urban policies will require the application of multicriteria and multiobjective programming methods referred to in section 9.

In this way, urban impact assessments may provide an indispensable contribution to more coherence in integrated urban-spatial policies (see also Glickman 1980), especially because in this case urban impact analysis can be linked in a systematic way to urban evaluation analysis.

The design of *integrated urban quality plans* (see Nijkamp and Soffer-Heitman 1979) by urban policy makers is a next step. On the basis of an urban impact assessment system, urban policy makers may want to develop an urban development plan in which the desired welfare profiles (either for urban districts or for the city as a whole) are quantified. The meaning of such an urban quality plan is not to prescribe the urban development process, but to indicate the politically desirable and feasible limits within which the urban process should take place. Such urban quality plans are relevant not only for urban renewal projects, but also for the total urban structure (including transportation, industrial activity, social structure, etc.).

It should be emphasized that such a quality plan is not an urban blueprint, but rather a frame of reference for judging actual developments and alternative urban policies. Clearly, such a plan would also include various threshold levels for urban development processes (e.g., maximum pollution and noise standards, maximum densities, tipping points on the housing market, etc.). In this way, the design of urban quality plans may lead to more coherent and integrated urban policies in a spatial context. Clearly, in this respect the above-mentioned multidimensional techniques and multicriteria and multiobjective programming methods may play an important role.

A necessary complement to any urban quality plan is evidently a set of financial accounts and means to finance urban plans. It is clear that the design of urban quality plans is far from easy, but the positive aspects of urban symbiosis should be treated in an integrated and coherent way. This latter is a prerequisite for creating cities that really form the "Home of Man".

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