

RESIDENTIAL GROWTH IN DURBAN: A SPATIAL ANALYSIS

by



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Declaration

I hereby declare that the contents of this
thesis are my own work.

Signed: _____ (Jeffery J. McCarthy)

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TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	iii
LIST OF TABLES	vii
LIST OF FIGURES	ix
CHAPTER 1. INTRODUCTION TO THE STUDY	1
The Scope of the Research	
Organization of the Study: An Overview	
PART I	
PATTERNS OF RESIDENTIAL GROWTH IN DURBAN	
A NEOCLASSICAL APPROACH	
CHAPTER 2. THE THEORY OF THE RESIDENTIAL GROWTH --	
A REVIEW AND SYNTHESIS OF THE LITERA-	
TURE	10
Introduction	
A Descriptive Overview of Residential	
Growth -- The Wave Analog Approach	
The Theory of Suburban Development	
The Linkages between Suburban Develop-	
ment and Central City Redevelopment	
Conclusions.	
CHAPTER 3. A FRAMEWORK FOR THE ANALYSIS OF	
RESIDENTIAL GROWTH	28
Introduction	
Locational Variation in the Factors	
Influencing the Investment Decision	
Stages in the Development and Redevelop-	
ment Process and their Implications for	
the Spatial Distribution of the Attri-	
butes of Residential Growth	
Spatial Distribution of the Attributes	
of Residential Growth: Some Hypotheses	

	Page
CHAPTER 4. RESIDENTIAL GROWTH IN DURBAN AS A WHOLE: AN OVERVIEW	41
Introduction	
Rates of Residential Growth in the City of Durban during the Period 1960-1974: Some Basic Facts and Figures	
The Dimensions of Residential Growth: A Factorial Analysis	
Conclusion	
CHAPTER 5. PATTERNS OF SITE PREPARATION IN DURBAN	55
Introduction	
The Spatial Organization of Land Subdivision and Consolidation in Durban	
The Spatial Organization of Demolition Activity in Durban	
Conclusion	
CHAPTER 6. PATTERNS OF RESIDENTIAL CONSTRUCTION IN DURBAN	67
Introduction	
House Construction in Durban	
Flat Construction in Durban	
The Overall Costs of Residential Construction	
The Increment in Dwelling Units	
Summary and Conclusions for Part I	
PART II	
THE POLITICAL ECONOMY OF RESIDENTIAL GROWTH IN DURBAN: AN EXPLORATORY ANALYSIS	
CHAPTER 7. TOWARDS AN ALTERNATIVE CONCEPTUALIZATION OF THE URBAN LAND USE PROCESS	90
Introduction	
The Neoclassical Paradigm and its Critics	
Towards and Alternative Conceptualization of the Urban Land Use Process in Capitalist Societies	
Conclusion	

	Page
CHAPTER 8. THE URBAN LAND USE PROCESS IN DURBAN REVISITED -- APPLYING THE REVISED FRAMEWORKS	114
Introduction	
The Emergence of the 'Apartheid' Urban Form and the Manipulated City Framework	
Residential Differentiation and Residen- tial Growth in Durban: An Empirical Analysis	
Public Housing Projects and the Class Conflict Framework	
Conclusion	
CHAPTER 9. RETROSPECT AND PROSPECT	150
A Review of the Findings	
Towards an Integrated Model of Residential Growth and Change	
Looking Forward: The Questions Remaining	
Planning Considerations: Theory and Practice	
Conclusion	
APPENDIX 1. DISCUSSION OF STATISTICAL TECHNIQUES...	162
APPENDIX 2. MAPS	192
NOTES	199
LIST OF REFERENCES	212

LIST OF TABLES

	Page
Table 4.1 Variables included in the factor analysis of indexes of residential growth	49
Table 4.2 Significant rotated factor loadings for factor 1	50
Table 4.3 Significant rotated factor loadings for factor 2	51
Table 4.4 Significant rotated factor loadings for factor 3	52
Table 6.1 Dependent variables or indexes of residential construction in Durban....	68
Table 6.2 Independent variables employed in regression analyses of patterns of residential construction	69
Table 8.1 Variables included in factor analysis of social differentiation	129
Table 8.2 Factor 1: Table of significant rotated factor loadings	130
Table 8.3 Factor 2: Table of significant rotated factor loadings	131
Table 8.4 Factor 3: Table of significant rotated factor loadings	131
Table 8.5 Factor 4: Table of significant rotated factor loadings	132
Table 8.6 Variables included in the canonical correlation analysis	137

LIST OF TABLES
(continued)

	Page
Table 8.7 Canonical weights for canonical variates 1 and 2	138
Table 8.8 Canonical correlations between pairs of variates and related statistics....	139

LIST OF FIGURES

		Page
Figure 2.1	Population density change with time and distance	13
Figure 3.1	The relative distribution of returns to land and structure	37
Figure 3.2	Hypothetical profile section of land subdivision/consolidation in an urban area	39
Figure 4.1	Durban residential growth 1960-1974..	43
Figure 4.2	Durban grid system	46
Figure 4.3	Generalized land use zoning in Durban, 1975	47
Figure 5.1	Land subdivision and consolidation in Durban	56
Figure 5.2	Transects at 18° intervals radially from the Durban P.L.V.I. showing subdivision and consolidation plotted by distance	58
Figure 5.3	Residential demolition in Durban, 1960-1974	63
Figure 6.1	House construction in Durban, 1960-1974	70
Figure 6.2	Flat construction in Durban, 1960-1974	73
Figure 6.3	Overall costs of residential construction in Durban, 1960-1974	78
Figure 6.4	Net increment in residential units units in Durban, 1960-1974	81

LIST OF FIGURES
(continued)

	Page
Figure 6.5 Generalized model of patterns of residential growth 	86
Figure 8.1 Racial distribution in Durban in 1960 	120
Figure 8.2 Group areas for Durban in 1975	121
Figure 8.3 Generalized distribution of factor scores 	135
Figure 8.4 Displacement and growth associated with apartheid 	147
Figure 8.5 Repulsion of growth from higher status white areas 	147
Figure 9.1 An integrated model of residential growth 	155

CHAPTER 1

INTRODUCTION TO THE STUDY

Nelson (1969) has noted of the American case that:

There has (recently) been an almost frantically rapid building and rebuilding of the structure that form our urban plant. With increasing populations cities have not only expanded in all directions, but urban lands in general, and favoured lands in particular have increased enormously in value, making rebuilding for 'higher use' profitable. Rapid growth has resulted in uncommonly dynamic cities with constant change, sorting out and filtering down in every section of the city.

Nelson (1969) has simplified the causes of "urban restructuring" here, but his characterization of the external manifestations of urban development and redevelopment processes is nevertheless befitting of recent events in the City of Durban. For example, in the space of only fourteen years (1960-1974) almost seventy thousand major changes to the housing stock were recorded, and several thousand lots were newly subdivided or consolidated in accordance with demands for urban growth and change.

The pace of urban growth and change, and the complexity of its external manifestations, has often left planners and public officials with a desire to identify some order in the events which redefine urban form over time. This is not surprising since, on the one hand, planners and public officials are expected to manage and co-ordinate patterns of land use change in accordance

with some criterion of 'the public interest'; yet, on the other hand, years of planning experience have all too often demonstrated that "if public policy is to be effective in guiding patterns of new urban growth, it must be based on a realistic understanding of the development process" (Kaiser and Weiss, 1970).

Unfortunately the social science community has not always proven helpful to the planner's quest for such an understanding. McCann (1975), for example, has recently observed that "despite the obvious reshaping of the patterns and forms of cities, little research has been directed to the problem of understanding the characteristics, processes and causes of urban change." In the past, geographers in particular have tended to focus upon the static form of the metropolis, and not upon the principles by which that form is systematically restructured with time (King, 1969).

It was the recognition of such planning problems in the first instance, and the acknowledgement of such deficiencies in urban theory in the second instance, which provided the point of departure for this study. Specifically, the research was initially motivated by the Natal Town and Regional Planning Commission in view of its concern with patterns of residential development and land subdivision in the Durban-Pietermaritzburg Planning Region. For this reason, the research reported here represents, in part, an

attempt to clarify patterns of residential growth in the principal municipality within that planning region -- the City of Durban. The period of growth under consideration extends from 1960 to 1974. It is hoped that the information reported in this thesis will be of some utility to those concerned with the planning process both in Durban, and the Province as a whole.

More generally, however, the study is concerned with the development of a conceptual model of residential growth which is applicable in the case of the South African city. Thus, the ultimate objective is to contribute towards a growing corpus of urban geographical theory in an area which has, until recently, been relatively poorly researched.

The Scope of the Research

To recapitulate, the principal objective of this study is to provide a theoretical framework for, and an empirical analysis of, patterns of residential growth occurring within the City of Durban for the period 1960-1974. Residential growth is defined here as the net increment in residential space which is added to a city's housing stock during a given period of time. It is of course true that an increment in residential space can be measured in various ways: for instance, it can be measured by the net increase in dwelling units during a period of time,

or it can be measured by the overall costs of residential buildings erected during some period. For the moment such subtleties of definition may be disregarded. What should be noted at this stage, however, is that the study employs more than one variable as an index of residential growth -- a procedure which necessitates the use of a variety of multivariate statistical methods. These techniques may be unfamiliar to some readers, and for this reason a discussion of simple regression, multiple regression and factor analysis is included in an appendix.

Several limitations upon the scope of the research may also be noted here: first, the empirical research is restricted to those areas of Durban which are legally habitable by persons officially designated as Asian, Coloured, or White. The research is not, therefore, concerned with African (or Bantu) housing in any direct way. A second limitation of the research is that it accepts residential growth in Durban as a 'given' factor. The causes of, or the need for, residential growth are not investigated. Thus, the study is not a supply and demand analysis of residential growth. It is rather an analysis of the spatial and temporal distribution of a given level of residential growth. Finally, the study is not directly concerned with residential space which existed in Durban prior to 1960. It is of course true that the pre-existing housing stock in any city influences subsequent patterns of residential growth, and this is a matter

which receives consideration in the course of the study. Nevertheless, it must be emphasized that the sole purpose of the study is to explain patterns of residential growth subsequent to 1960; patterns of development prior to that point in time are important only insofar as they have influenced post 1960 growth.

Organization of the Study: An Overview

The first point which should be noted with regard to organization is that the study is divided into two parts. The analysis of patterns of residential growth in Part I reflects the theory and procedures of the predominant traditions in urban geography in the 1960s and early 1970s. That is, there is an emphasis upon the neoclassical conception of the social processes responsible for a given spatial form (1). Part II, on the other hand, is to some extent a critical reflection upon this tradition, and to some extent an attempt at formulating an alternative approach to the geographical analysis of urban residential growth.

Chapters 2 and 6 comprise Part I of the study. The first of these chapters provides a review and synthesis of the (traditional) literature which pertains to the problem of urban residential growth. An important argument of Chapter 2 is that the urban residential growth process should be seen as an integrated whole, and not as a set of dismembered occurrences which include suburban

construction, central city redevelopment, etc.. Chapter 3 provides an outline of a conceptual framework for the analysis of residential growth within the city as a whole. The framework places the individual developer at the centre of theory. It is argued that there are a number of locationally variable factors which will influence the property developer's investment decision, and which lead to specific spatial order in the final outcome of urban residential growth. It is also suggested that, since site preparation and construction are two separate stages in the investment process, patterns of site preparation will tend to be distinct from patterns of construction. Chapter 3 includes a statement of the research hypotheses for Part I of the study.

In addition to providing a brief overview of the absolute quantities and rates of growth occurring in Durban during the period 1960-1974, Chapter 4 provides a summary analysis of the discrete dimensions of residential growth which are evident in the city. It is noted that these dimensions correspond with a conceptual distinction made in Chapter 3: that is, the distinction between patterns of site preparation and patterns of construction. Chapter 5 presents a detailed analysis of patterns of site preparation for residential growth in Durban. Specifically, patterns of land subdivision/consolidation and residential demolition are examined. Chapter 6, on the other hand,

considers residential construction activity in Durban. Specifically, the spatial distributions of several indexes of residential construction are compared with hypotheses predicated upon the theory of residential growth. The relationship existing between patterns of site preparation and patterns of construction are discussed in the conclusion to Chapter 6.

Part II takes its cue, to some extent, from the "unexplained variance" remaining from Part I of the study. Certain areas in Durban -- not least those associated with government apartheid policy -- escape explanation in terms of the theory of residential growth, as presented in Part I. This points to the need for a more overtly political theory of the urban land use process in South Africa. Thus, Chapter 7 provides a critical review of the neoclassical approach to the urban land use process in capitalist societies, and offers a glimpse at two alternative frameworks for the analysis of urban residential growth and change -- the 'manipulated city' framework, and the 'class conflict' framework. In Chapter 8 an initial attempt is made at applying these frameworks to the South African case. Finally, it may be noted that, very often, the questions remaining in a researcher's mind are amongst the more valuable products of a research project. Thus, Chapter 9 -- the last chapter in the study -- poses a set of

questions which would seem to require further attention if social scientists and planners are to learn more of the residential growth process in South Africa.

PART I

PATTERNS OF RESIDENTIAL GROWTH IN DURBAN

A NEOCLASSICAL APPROACH

For much of contemporary location theory the assumptions are microeconomic in character. According to this conception locational decisions are market decisions of men working with an assumed utility function with respect to location; with perfect information about locational alternatives; and within the constraints of a competitive market process in which locational choices are interdependent.

Kevin R. Cox. "American Geography: Social Science Emergent," Social Science Quarterly, Vol. 57, No. 1, June, 1976.

CHAPTER 2

THE THEORY OF RESIDENTIAL GROWTH --

A REVIEW AND SYNTHESIS OF THE LITERATURE

Introduction

This study is concerned with the spatial analysis of patterns of residential growth in Durban. As in any such exercise in spatial analysis, there is a need to provide some a priori theoretical rationale for those processes which are responsible for the patterns under consideration (Amedeo and Golledge, 1975). It should be noted, however, that there is currently no single body of theory which deals with the residential growth process as it occurs within the city as a whole. Previous research has tended to focus exclusively upon either one of two subcomponents of the urban residential growth process: (i) the suburbanization process, and (ii) the central city redevelopment process. Little attention has been paid to the interrelationships between these two processes and seldom, if ever, have other dimensions of the residential growth process (such as the demolition of dwelling units) been integrated into a conceptual framework which is relevant to the analysis of city-wide patterns of residential growth and change.

This chapter attempts to redress this deficiency in urban theory by providing a review and synthesis of a broad body of

literature which, in various ways, relate to the problem of the city-wide distribution of residential growth. In particular, it is to be argued that suburban development and central city redevelopment processes should be seen as mutually interdependent and complimentary aspects of an integrated system of urban residential growth.

In presenting this argument, the chapter is organized into three major subsections. A brief analog model of the urban residential growth process is considered first, and in this section most of the basic terms associated with residential growth are defined. The theory of suburban expansion is the subject of the second section, and the third section provides an analysis of the linkages between the central city redevelopment process, and the process of suburban development.

A Descriptive Overview of Residential Growth --

The Wave Analog Approach

Boyce (1966) has compared the growth of the city to the spread of waves as understood in oceanographic studies. In this analog approach to urban growth and change it is suggested that suburban development is only the most visible end product of a complex chain of growth impulses which diffuse outwards from the city centre.

Boyce (1966) identified three 'waves' of urban expansion:

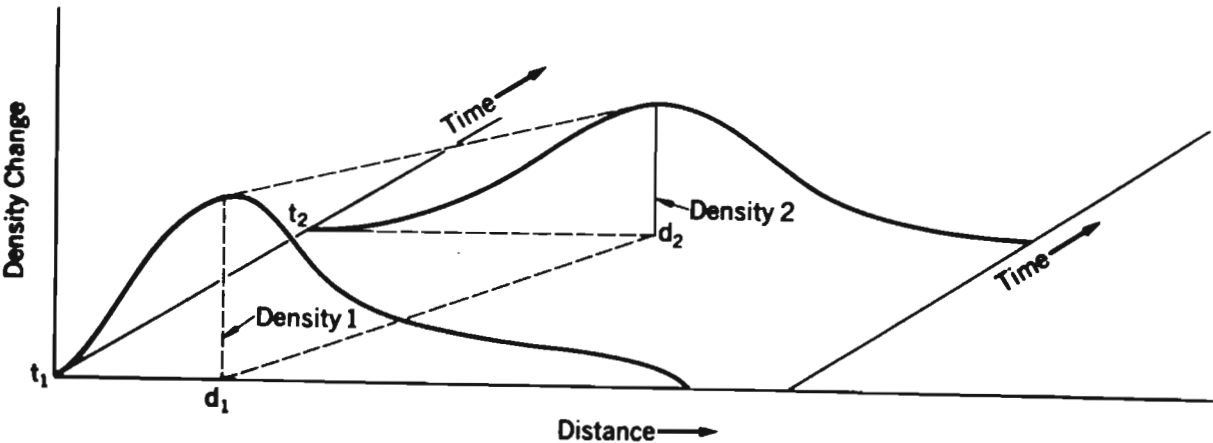
- (i) A tidal wave or 'cutting edge' of the city. This 'edge' separates the developed space of the city from undeveloped space surrounding the city. Boyce (1966) comments that "this is the only wave (of urban expansion) noted by the casual observer and it is the one which has surely received the greatest amount of public attention ... this is the actual front of urban settlement."
- (ii) A precession wave which moves in advance of the tidal wave, and which is characterized by "speculative land holdings, paper land plats, farms falling largely into disuse, and a plethora of real estate agents" (Boyce, 1966). It is this wave which anticipates the advance of the tidal wave of urban settlement, and which is often associated with the problem of land speculation and 'suburban sprawl.'
- (iii) A recession wave, which is the following side of the tidal wave, and which is associated with a decline in the rate of population density increase in the central residential areas.

Boyce's (1966) view is that the process of urban growth is temporally cyclical -- this view being consistent with the

'building cycle effect' documented by urban economists such as Alberts (1962), Break (1961), Guttentag (1961), Maisel (1963) and Page (1967).

At certain times, suppliers build housing at the edge of the city and cause the tidal wave to shift further outwards into the precession zone. This sets in motion a 'ripple effect' which reduces the rate of population increase in central areas, and which extends the precession zone further into the rural area surrounding the city. Figure 2.1 illustrates the implications of the process for the rate of population density change within the city.

FIGURE 2.1
POPULATION DENSITY CHANGE WITH TIME AND DISTANCE
(after Boyce, 1966)



The Theory of Suburban Development

A question arises at this stage as to what causes the tidal wave to shift outwards into the precession zone. It is true, of course, that developers build houses and/or apartments at the edge of the city, but these actions are only part of a much larger suburbanization process. It is for this reason that attention is now turned to several theories of the process of suburban development.

Density Functions and the Transportation Technology Perspective

Many of the so-called 'theories' of the suburbanization process have been descriptive rather than explanatory (Richardson, 1971). Nevertheless, it remains true that some descriptive studies of suburban growth have yielded results which have provoked a more analytical approach to the suburbanization process. For example, studies of longitudinal changes in population density functions such as those provided by Clark (1951), noted that population densities in western cities tended to decline exponentially with distance away from the city centre. That is, it was observed that

$$PD(r) = de^{-yd}$$

Where PD is population density at distance r from the city centre
r is distance from the city centre (the city centre is assumed to be the point of maximum density)
d is the density of population at the city centre
e is the base of the natural logarithm
y is a measure of the rate at which density declines away from the city centre.

More importantly, however, it was noted that, during a given period of time, the value y became smaller in the sample of cities under consideration. That is, the density functions tended to 'flatten' with time (Clark, 1951).

Clark (1951), and most urban geographers, have tended to argue that this 'flattening' of density functions has been due to an increase in the ease of transportation in western cities. The areal expansion of cities, it is said, can be attributed to the increased 'spatial liberty' provided to urban populations by such developments as the railroad, the tram, the omnibus, the private automobile and finally, the intrametropolitan highway (cf. Boal, 1968; Johnson, 1967). In terms of this view, therefore, changing transportation technology is the principal dynamic behind the suburbanization process, and the areal expansion of cities.

The Demand Perspective

The transportation technology view of suburban development has not gone unchallenged in the literature. Mills (1970), for example, has argued that the results of his empirical studies of density functions demonstrate that "the cause of the historical flattening has been the growth of population and income ... if population and income remained constant, cities would be more rather than less centralized." (1).

With specific reference to Clark's (1951) transportation hypothesis, Mills (1970) has argued that "the opportunity cost of time spent in travelling is a large part of commuting costs, and if opportunity cost rises with income, transportation costs may increase with time."

Mills' (1970) work is representative of the demand view of the suburbanization process. In terms of this view, two historical trends have been responsible for the areal expansion of cities: firstly, there has been an increase in demand for the total quantity of housing space available in urban areas. With the centralization of production activity and the increase in non-rural populations after the agricultural and industrial revolutions, the need for more housing units in urban areas was inevitable (2). The second historical trend has been a change in consumer preferences with respect to the quality of housing packages. In particular, the emergence of the fashion of the ranch-style house (located on a large lot) has directed demand for new housing to the suburban areas (3).

In summary, therefore, the demand view proposes that suburban expansion is caused by an increase in effective demand for urban housing, and a geographical concentration of that demand in suburban areas. The much lamented pattern of suburban 'sprawl' merely represents the efficient operation of market forces

in matching supply to demand. Transportation technology does not cause sprawl -- it simply renders it technically feasible.

The Supply Perspective

The supply view of the suburbanization process has tended to focus upon the catalytic role the property developer (cf. Baerwald, 1978; Kaiser and Weiss, 1970). It is assumed here that property developers are individuals with surplus capital, and that these individuals are interested in using this capital to appropriate the speculative profits of land use conversion.

Although this objective has seldom been formalized in the literature, it is clear that these profits result from the developer's ability to appropriate the difference between the 'economic productivities' of two land uses when a site is converted from one use to another (4).

For instance, the economic productivity for a site under farm use will be lower than its potential under single family dwelling use. In formal terms:

$$R_1 \left[\sum_{t=1}^n \frac{1}{(1+i_x + i_r)^t} \right] > R_2 \left[\sum_{t=1}^n \frac{1}{(1+i_x + i_r)^t} \right]$$

Where R_1 = annual returns (Rand) to investment under land use 1 (e.g., housing)
 R_2 = annual returns (Rand) to investment under land use 2 (e.g., farming)
 n = term of investment (years)
 i_r = capitalization rate for riskless investments -- approximated by the rate applicable to government bonds (%pa. expressed as a decimal fraction of 1).
 i_x = additional capitalization rate associated with business risk (defined by the probability that R will not be received either in whole or in part).

Given that this is the case, it is possible to specify the property developer's objective as an attempt to maximize the expected profits of land use conversion. In formal terms, it may be said that the developer seeks to maximize $E (P_{u2 \rightarrow u1})$ where

$$E [P_{u2 \rightarrow u1}] = \left[R_1 \left(\sum_{t=1}^n \frac{1}{(1 + i_r + i_x)^t} \right) - R_2 \left(\sum_{t=1}^n \frac{1}{(1 + i_r + i_x)^t} \right) \right] + (V_{pr1} - V_{pr2}) - (C_{d2} + C_{c1})$$

and where

V_{pr1} = the property reversion value of use 1 (e.g., housing) at end of holding period n

V_{pr2} = the property reversion value of use 2 (e.g., farmland) at end of holding period n .

C_{d2} = the costs of demolition of capital improvements of type 2.

C_{c1} = the cost of construction of capital improvements for use 1.

In view of the above definition of the property developer's objective, proponents of the supply view of the suburbanization process have argued that the concentration of developer activity in suburban areas is to be explained principally in terms of the relative magnitudes of R_1 and R_2 .

In suburban or peri-urban locations, R_1 will typically apply to single family residential use (houses), whereas R_2 will generally apply to rural use (farmland). In this case, the ratio R_1/R_2 is particularly large(5). Moreover, C_{j2} values are minimal when rural land is converted to residential use.

To summarize, therefore, the supply view of suburban expansion argues that the principal process behind the growth of the capitalist city is the search by property developers for the speculative values of land use conversions. Since these values are highest in suburban areas, it follows that property developers will concentrate their efforts in these areas.

Synthesis

In terms of neoclassical economic theory, each of the three theoretical positions discussed above should be seen as mutually supportive and complimentary perspectives on the suburbanization process. For, clearly, innovations in transportation technology and changes in patterns of accessibility do play a role insofar

as they transform the spatial constraints applicable to the urban growth process. On the other hand, Mills (1970) does seem justified in arguing that transportation is merely a constraint, and that demand forces are a necessary prerequisite for any process governed by the market. Finally, it is also reasonable to anticipate that supply considerations will play an independent role in the production of urban housing (Baerwald, 1978).

The Linkages Between Suburban Development and Central City Redevelopment

As indicated in the introduction to this chapter, a central problem for this study is to provide an integrated view of the urban residential growth process. Of particular importance here is the need to link the theory of suburban development to that of central city redevelopment. As Bourne (1967) has noted of the literature on urban residential growth, the conspicuous manifestations of suburbanization processes have often distracted attention from parallel events within the city. Thus, "many studies are incomplete in that they ignore or treat incidentally complex patterns of growth in the central areas of cities in preference for more simplistic suburban patterns" (Bourne, 1967).

The linkage between suburban residential development and central city redevelopment of the housing stock may be explained at several levels, and three different conceptualization of these linkages are to be considered shortly. It may be noted, however, that in each case the essential point is that the metropolitan housing market is a relatively open system. Thus, whereas it may be analytically convenient to distinguish between patterns of urban redevelopment and suburban development, it is crucial to recognise that both entail the supply of housing to a single, integrated urban system; and, as such, they are mutually inter-dependent.

Density Function Analysis

One conceptualization of the linkage between the suburbanization process and the redevelopment of the central city is implicit within the density function models of what is now termed as the 'new urban economics' (cf. Richardson, 1976). It is assumed here that the quantity of urban housing, and the size of the population which inhabits that housing, is measured by the integral of the population density function (or the area under the curve).

It should be clear that for any given area under the curve (or total population), many different density function shapes

are possible. Thus, in theory at least, it is equally possible to increase the housing stock (and the population), within a city by raising the intercept and increasing the slope of the density function as it is for growth to occur by decreasing the slope of the function and increasing the extent of the urbanized area.

In effect, this means that a city can accommodate an increase in population through an increase in central densities, rather than through an extension of the urbanized area. Central city redevelopment, therefore, functions in a similar way to suburban development -- it increases the total amount of residential space available within a city.

The Demand Perspective

A second perspective on the linkages between the suburbanization process and central city redevelopment is offered in the models of urban growth and structure postulated by demand oriented urban economists such as Alonso (1964), Mills (1972) and Muth (1969).

It is assumed in these models that there is a household utility function in which the most important factors are housing capital, land and the journey to work. For a given level of income, a household chooses that combination of housing capital,

land and transportation which best suits its preference structure. Thus, for example, a household which places a high premium on a small amount of transportation will tend to choose a centrally located housing unit with a smaller lot area over a peripherally located unit on a large lot. Alternatively, if the urban population is differentiated with respect to income, but is homogeneous with respect to preference structure, it can be shown that lower income individuals will live in higher density units in the central city, whilst lower density units near to the urban periphery will be occupied by higher income individuals (Muth, 1969).

Although the details of these models of urban growth and structure are unimportant at this stage, it should be noted here that both Mills (1972) and Muth (1969) have demonstrated that the relative progress of the suburbanization process vis a vis the central city redevelopment process (as reflected in changes in population density functions over time) is strongly dependent upon changes in the relative prices of housing capital, land and transportation. Thus, for example, if the price of land and transportation rises relative to housing capital, the redevelopment process will be favoured over the suburbanization process. Alternatively, if the price of housing capital rises relative to transportation and land, the suburbanization process is more likely to be favoured.

The Supply View

Perhaps the most coherent view of the linkages between central city redevelopment and suburban development is offered by an extension of the supply perspective on the suburbanization process. It will be remembered that, in terms of this perspective, the property developer seeks to realize the speculative profits of land use conversion through an investment decision which leads, ultimately, to the transformation of the land use of certain sites.

A point which should be noted here, however, is that the basic investment objective (i.e., to maximize $E (P_{u2} \rightarrow u_1)$) is not specific to the case of suburban development. The economic principles responsible for the supply of new housing remain the same irrespective of location, and irrespective of whether development or redevelopment is entailed. The provision of new housing is not, after all, a simple process of filling up as yet unoccupied 'holes' in the urban landscape -- these 'holes' being most common at the urban fringe. The mere presence or absence of vacant land means little in itself to developers. What is important is that, for a given outlay of capital, $E (P_{u2} \rightarrow u_1)$ should be maximized, and this is contingent upon several factors apart from the cost of demolition of pre-existing structures.

A hypothetical example will serve to illustrate how the investment (defined by the maximization of $E (P_{u2} \rightarrow u_1)$, and discussed under the supply view of the suburbanization process), may be generalized to the case of central city redevelopment.

In this example, it is assumed that at t_1 , the market value of site X -- near to the city centre -- was PV_1 . Its use as a stand for a pair of maisonettes provided a reasonable rate of return, considering the PV_1 value at that time. At t_2 , however, the market value of site X is increased to PV_2 (i.e., $PV_2 > PV_1$). This increase in value is not due to inflation, but is accounted for in terms of the inelastic nature of the supply of central land when compared to elasticities of demand under conditions of rapid urban growth between t_1 and t_2 . At t_2 , therefore, the rate of return provided by maisonette use may become unsatisfactory. Thus, if the capital is available, the landowner should redevelop site X to the new optimum -- perhaps by building a multistory block of flats.

It should be noted that what has been accomplished in this example is no different from a situation in which rural lands are converted to residential use. In consequence, central city redevelopment should not be distinguished from suburban development in terms of the social process responsible for each. In both cases the search for speculative profits initiates a land

use conversion process which, in turn, results in an increase in the overall supply of urban housing. The principal catalytic agent in both instances is the property developer who does not first consider location, and then investment factors. Recent behavioral analyses of the property investment decision process indicate that developers first decide upon the investment specifications of a particular project, and only subsequently survey the urban landscape for an appropriate site (Baerwald, 1978). The city is simply regarded as a matrix for the realization of the expected profits of land use conversion. Consequently, it is the variation in $E(P_{u2} \rightarrow u_1)$ values within this urban matrix which will, in the final analysis, determine the locational attributes of the residential growth process within the city as a whole.

Conclusion

This chapter has provided a review and synthesis of the literature which pertains to the problem of urban residential growth. Hopefully, two points will have emerged with some clarity from this review. The first is that urban residential growth may legitimately be regarded as a single, integrated process, and that suburban development and central city redevelopment are simply different manifestations of this process. The second point is that the different theoretical perspectives on

the residential growth process are not mutually exclusive.

It is true that there are differences in emphasis but, if the neoclassical paradigm is accepted, they may be regarded as providing complimentary insights into the problem of urban residential growth.

CHAPTER 3

A FRAMEWORK FOR THE ANALYSIS OF RESIDENTIAL GROWTH

Introduction

Whilst the previous chapter provided a review and synthesis of a body of literature pertaining to the problem of urban residential growth, it remains to be demonstrated in simple, logical terms how the social processes associated with residential growth become translated into a particular spatial form. It is for this reason that the first objective of this chapter is to provide a brief conceptual framework which will explain the relationship between residential development and redevelopment as a social activity on the one hand, and the manifestations of this activity in terms of geographical patterns of residential growth on the other hand. A second, and equally important, objective of this chapter is to derive a set of specific research hypotheses from the conceptual framework. These hypotheses will then be subject to empirical verification procedures in subsequent chapters of this study.

It should be noted that the conceptual framework proceeds upon the assumption that the residential growth process, as a social process, is most appropriately understood from the standpoint of the individual property developer. This assumption

is, of course, open to debate, but recent research in urban geography and city planning -- particularly that of the so-called 'North Carolina School' -- seems to indicate that the simplest, and most coherent conceptual approach to the dynamics of urban change begins with the individual developer at the centre of theory (1).

The organization of this chapter, therefore, is as follows: the first section considers a number of variables which have a definite locational component, and which effect the property developer's investment decision. A second section considers the stages in the property developer's investment process, and how these stages are associated with different attributes of the residential growth process. A third and final section postulates a number of hypotheses which are concerned with the spatial distribution of the various attributes of residential growth.

Locational Variation in the Factors

Influencing the Investment Decision

As Baerwald (1978) has noted, the property developer's investment decision often takes place without direct reference to locational considerations. That is to say, the developer rarely formulates a cognitive map of the city as a first guide

to his investment behavior. His first guide is more usually a mental balance sheet of the relative constraints, advantages and disadvantages of a variety of alternative investment projects (Baerwald, 1978).

Nevertheless, it remains true that when a developer comes to choose amongst alternative sites for a given project, there will be certain constraints and advantages to these sites which do vary systematically with location. Some of the more important of these are considered below.

Locationally Variable Constraints

The investment decision by a property developer will be subject, in the first instance, to a set of constraints imposed by the spatial structure of urban land values. Thus, for example, a low density residential development project would be unlikely to occur in areas where urban lands fetch very high market values. By the same token, even high density residential redevelopment projects will be constrained in the choice of site by competition from commercial and office use in particular.

The investment decision will also be influenced by the pattern of land use zoning within the city. It is true, of course, that patterns of zoning may be modified through the rezoning process (cf. Natoli, 1971) but, in general, the zoning map tends to

define the limit to that set of sites within the city which may be legitimately considered for a given use (Bish and Nourse, 1975).

Locationally Variable Advantages

Within the constraints imposed by patterns of land values and zoning there will, of course, be certain locations which are more likely to attract development or redevelopment projects than others. Specifically, it is hypothesized that

$$p(d_{ij}) = f(E(P_{u2 \rightarrow u1}) / A_{ij})$$

where

$p(d_{ij})$ = the probability that the site at the ij^{th} coordinate of the urban matrix will be designated for development/redevelopment;

$E(P_{u2 \rightarrow u1})$ = the expected profits of land use conversion for the site at the ij^{th} coordinate;

A_{ij} = sale price of the site at the ij^{th} coordinate.

It should be evident from the above proposition that several factors may influence the probability distribution of development and/or redevelopment projects within the city. For example, all of the variables on the right hand side of the equation which defines $E(P_{u2 \rightarrow u1})$ (see Chapter 2) will be able to influence the distribution of $p(d_{ij})$ values. Of particular importance here, however, are those considerations which affect the R_1 and R_2 values.

For example, if a developer can supply housing with locational attributes which afford particularly high levels of utility to prospective residents, he might anticipate that the R_1 value for his project will be especially large. Thus, ceteris paribus, $p(d_{ij})$ values will also be large when a particular location affords prospective residents with high levels of utility. In most traditional monocentric models of urban land use it is assumed that residents discriminate between locations only on the basis of relative distance to the city centre (cf. Wheaton, 1977). However, it should be noted that this assumption is not a particularly valid representation of reality, for clearly the inputs into the total housing package consists of more than a parcel of land, a quantity of structure and a certain distance to a city centre (cf. Harvey, 1972; Wheaton, 1977). Thus, it might be anticipated that spatial variations in levels of "general accessibility" (Richardson, 1971) (2) and/or "environmental quality" (cf. Troy, 1973; Whitbread and Bird, 1973; Wingo, 1971) (3) will enter into the developer's calculus of comparative locational advantage, and will thereby influence spatial variations in $p(d_{ij})$ values.

Factors which influence R_2 values are also subject to spatial variability. For instance, relatively new dwellings or structures which have a fairly long 'economic life' tend to be located in

specific areas within the city. Since sites which have long economic lives will also have high R_2 and n values in the equation which defines $E (P_{u2} \rightarrow u_1)$, it may be argued that, ceteris paribus, locations of this kind will have low $p (d_{ij})$ values. Conversely, those areas in the city with older structures and which have smaller R_2 and n values, will tend to have higher $p (d_{ij})$ values.

Stages in the Development and Redevelopment Process
and their Implications for the Spatial Distribution
of the Attributes of Residential Growth

Research has demonstrated that the residential development and/or redevelopment process tends to occur in two distinct stages: (i) the site preparation stage, and (ii) the construction stage (4).

Site preparation inevitably preceeds construction activity in time. Thus, for example, a property developer who intends to build a block of flats at a central location within the city will first acquire some parcel or parcels of land, and then consolidate these into a single stand. The consolidation process may necessitate demolition of certain structures. After a period of time has elapsed during which the appropriate permission is obtained, the developer may begin construction of the block of flats.

Alternatively, if a property developer intends to build a set of single family dwellings in a suburban location, he will first acquire some farmland and then subdivide this land into smaller plots suited to individual dwelling units. At a later stage, construction of the dwelling units may begin.

It should be noted that the time lag between the site preparation stage and the construction stage may vary. For instance, some subdivision and consolidation activity (particularly in the so-called 'precession zone') entails the search for purely speculative gains, and there may be little intention to begin construction in the foreseeable future (5). This practice has often been a source of consternation to urban planners since the 'holding' of lands which are contiguous with the city leads to 'leap frog' development, and this exacerbates the problem of suburban 'sprawl' (cf. Archer, 1973; Clawson and Hall, 1973; Gaffney, 1958; 1969; Kolasar and Scholl, 1972). Such planning considerations are of less concern at this stage of the study, however, than the implications of the time lag factor for the spatial distribution of the attributes of residential growth. For instance, it should be clear that, if the time lag factor is sufficiently pronounced, patterns of land subdivision and consolidation may not necessarily be associated with patterns of construction, within a given period of time. Indeed, patterns of subdivision and consolidation should

generally be considered as distinct from patterns of construction occurring during some time period t_1 to t_2 , since the former patterns are essentially anticipating construction which is to occur in some future period t_2 to t_3 .

The Spatial Distribution of Attributes of the

Residential Growth Process: Some Hypotheses

Construction

Two types of construction tend to be associated with the residential growth process -- the construction of houses, or single family dwellings, and the construction of flats, or multifamily dwellings.

For reasons described earlier in this chapter, both house construction and flat construction will tend to be concentrated near to areas of high general accessibility (e.g., near to free-way access points). House construction and flat construction should also gravitate towards areas of high environmental amenity (e.g., near to beaches in a city such as Durban).

On the other hand, neither house construction nor flat construction will be associated with areas of the city in which there are structures with relatively long economic lives (and high R_2 and n values). These areas -- which might be termed as the 'stable zones' of the city -- tend to exist at intermediate distances between the city centre and the urban fringe (6).

House construction and flat construction will tend to be markedly differentiated with respect to distance from the city centre. The reason for this is that urban land values are negatively correlated with distance to the city centre (cf. Brigham, 1965). It therefore follows that the set of sites to be considered for single family developments (i.e., developments with relatively low R_1 values) will be those which are near to the edge of the city. On the other hand, redevelopment to multi-family use will be considerably less constrained in terms of the set of potential sites, since these projects usually have high R_1 values. Thus, to the extent that the city centre is a point to which access is desired, it may be anticipated that flat construction will be concentrated near to the city centre.

Demolition

Residential growth is not a simple matter of adding units to the housing stock through residential construction. The residential growth process also entails demolition of a substantial quantity of dwelling units. Thus, for example, the net amount of residential growth during a given period may be said to be equal to the number of flats constructed, plus the number of houses constructed and minus the number of dwelling units demolished.

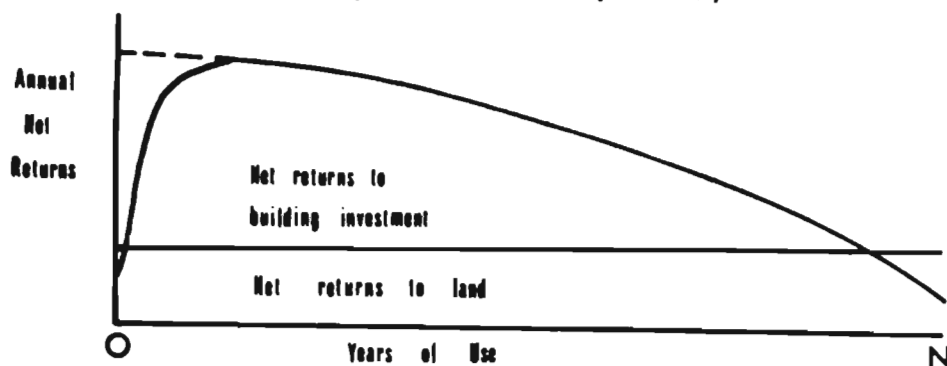
The spatial distribution of demolitions will, of course, be associated with the site preparation stage of the urban redevelopment process. Bourne (1967) has described the workings of this process as follows:

Through time buildings have a tendency to depreciate in value, while land tends to appreciate. With age and abuse, the value of any building, measured by net returns on investment or net capitalized income, declines steadily following an initial period of increase and equilibrium. (Figure 3.1 refers). In contrast, urban land values tend to increase as the city grows and land use zones expand into areas of less intensive use.

Assuming, amongst other things, the ubiquitous availability of capital for redevelopment and the 'economic rationality' of the landowner, Bourne (1967) then postulated that "demolition (and redevelopment) will occur, ceteris paribus, when anticipated income exceeds the cost of replacement and original investment lost."

Figure 3.1

The Relative Distribution of Returns to Land and Structure
(after Bourne, 1967)



This hypothesis may be translated into a spatial context if it is accepted that the age of the housing stock is inversely proportional to distance from the city centre (7). Thus, it is postulated here that demolitions of dwelling units will be (i) inversely proportional to distance from the city centre, and (ii) concentrated in areas anticipating redevelopment activity.

Land Subdivision and Consolidation

Land subdivision occurs when large tracts of lands are subdivided into a set of small plots. Land consolidation, on the other hand, occurs when several smaller subdivisions are amalgumated into a larger parcel.

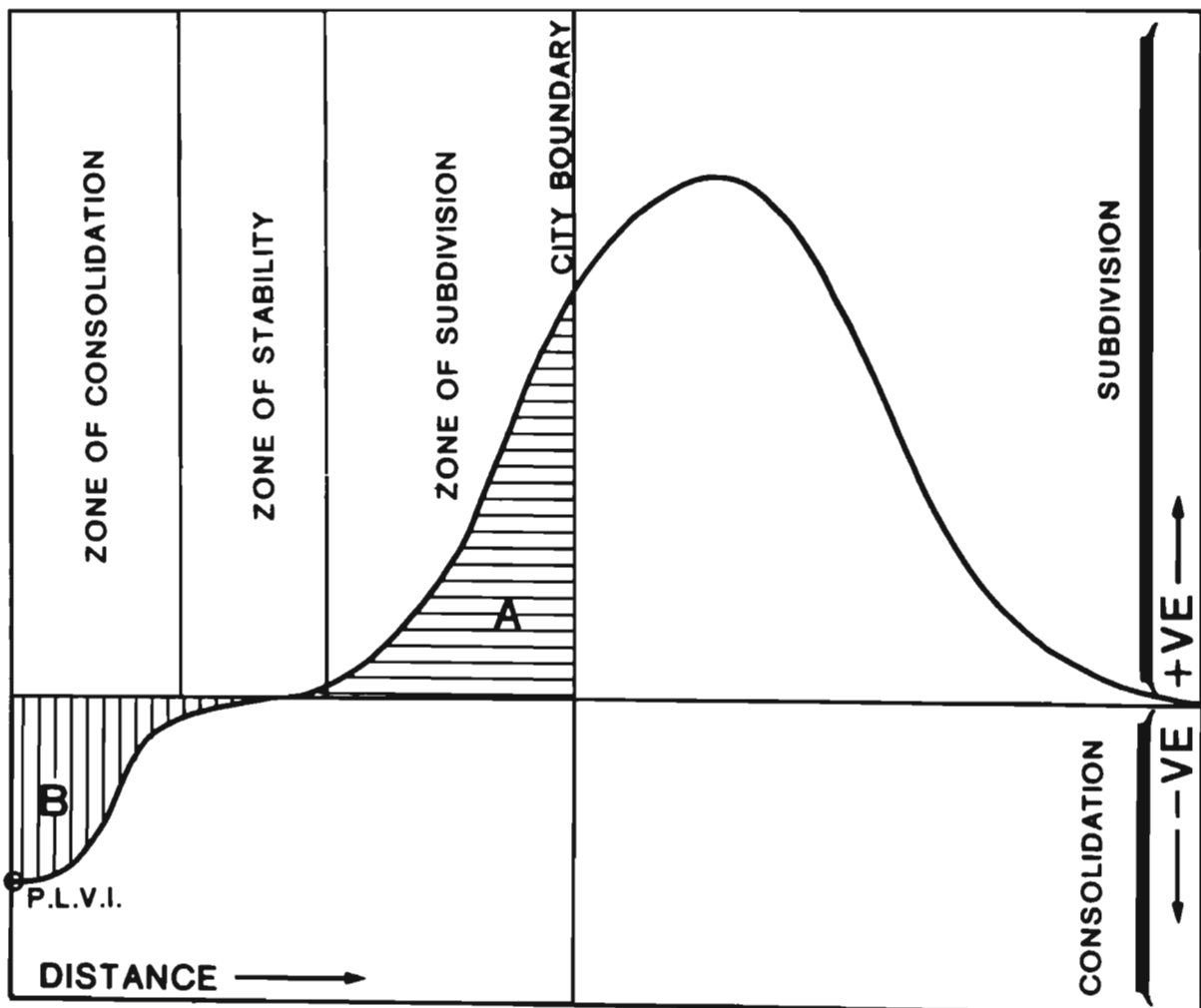
As has already been noted, patterns of subdivision and consolidation are to a large extent anticipatory patterns. In particular, patterns of subdivision tend to anticipate future patterns of development and house construction (8). This means that land subdivision tends to occur at the extremeties of the city, whilst consolidation remains centralized in areas anticipating high levels of redevelopment and flat construction.

For the city as a whole, therefore, it is possible to envisage a transition from an inner zone of consolidation to an outer zone of subdivision, where these areas are buffered

FIGURE 3.2

HYPOTHETICAL PROFILE SECTION OF LAND
SUBDIVISION/CONSOLIDATION IN AN URBAN AREA

In the case of a city such as Durban the profile may vary to a certain degree for different directions from the P.L.V.I., but, in general, the above shape applies.
(AREA A - AREA B = NET INCREMENT)



by an intermediate region of 'stability' (i.e. where the R_2 and n values of existing use determine that neither development nor redevelopment is anticipated in the immediate future). In consequence, it is hypothesized that, for some time period t_1 to t_2 , a profile of the relationship of net subdivision and consolidation to distance from the city would be as in Figure 3.2.

CHAPTER 4

RESIDENTIAL GROWTH IN DURBAN AS A WHOLE -- AN OVERVIEW

Introduction

Before proceeding to an examination of the empirical validities of the hypotheses postulated in the previous chapter, it will be useful to provide a brief overview of the extent of residential growth which occurred during the study period for the City of Durban as a whole. Moreover, since the behavior of the various indexes of residential growth (subdivision, demolition, construction, etc.) can appear quite complex when examined on an individual basis, it will also be advantageous if certain discrete dimensions of residential growth in Durban can be established at this early stage in the presentation of empirical results.

The first section of this chapter, therefore, provides an overview of the absolute quantities and rates of residential growth which occurred within the City of Durban during the period 1960-1974, whilst the second section provides a factorial analysis of the dimensions of residential growth evident within the same city.

Rates of Residential Growth in the City of Durban

During the Period 1960-1974:

Some Basic Facts and Figures

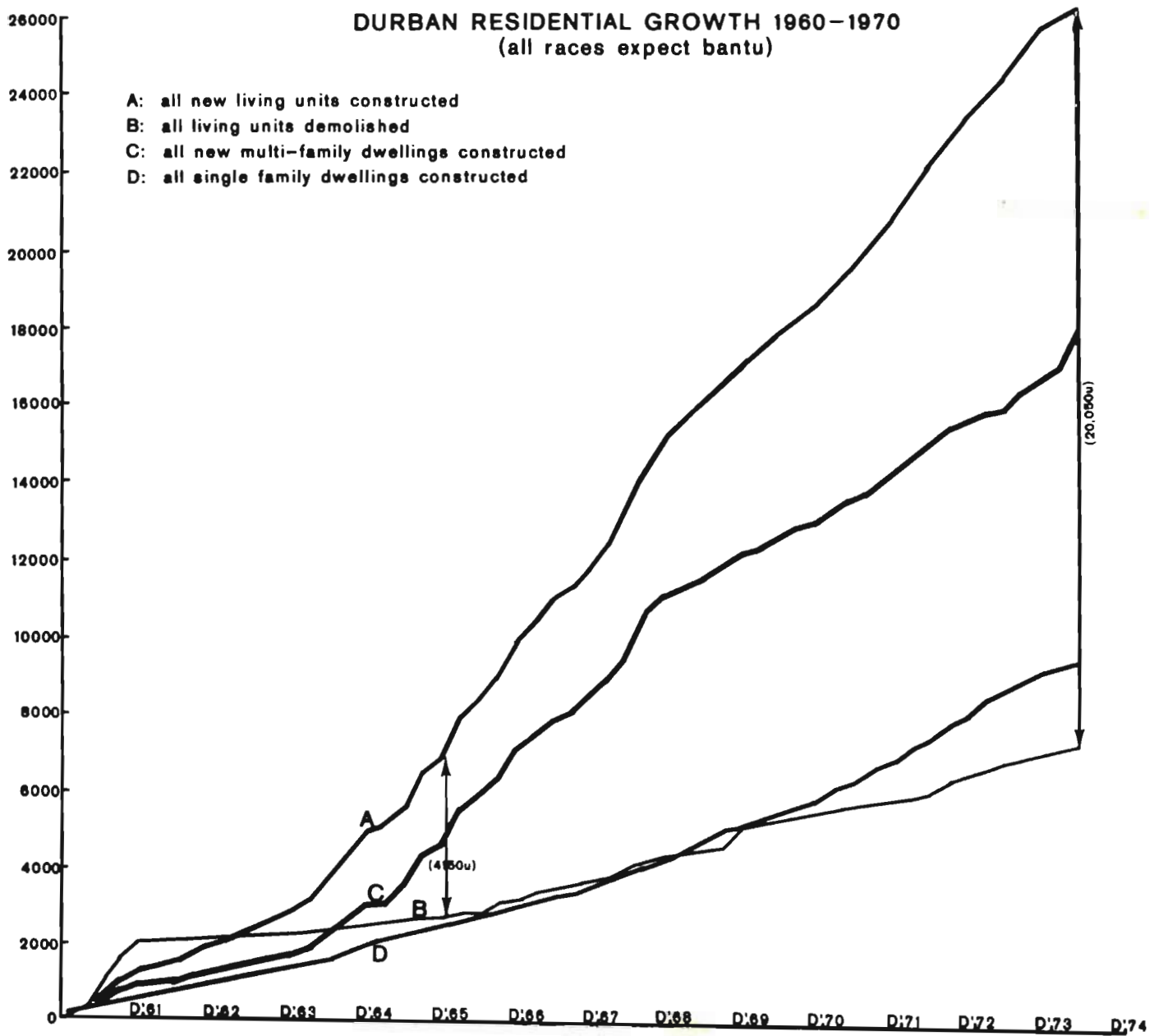
Land Subdivision and Consolidation

In the period between 1960 and 1974 land subdivision and consolidation activity resulted in a net increment of approximately seven thousand lots for the city as a whole (1).

Residential Construction

Because the largest proportion of new residential construction between 1960 and 1974 was of the multifamily dwelling (flat) type, many more dwelling units were added to the city's housing stock during this period than is reflected in the net increase in lots (2). Indeed, over twenty five thousand new dwelling units were constructed in Durban between 1960 and 1974. This represents a thirty percent increase over the original 1960 housing stock as defined by the 1960 census, or an annual average growth rate of 2.1 percent. Figure 4.1 reveals that flat construction was by far the major contributor to this growth, particularly after 1964. For the study period as a whole, flat construction outpaced house construction by a factor of 2.75 (3).

FIGURE 4.1



Demolitions of Dwelling Units

Demolition activity played a very significant role in the determination of the net growth of the city's housing stock, especially prior to 1963 (4). Indeed, in the period 1960-1962, demolitions actually exceeded units constructed. Consequently, 'net growth' was negative (5). Nevertheless, as Figure 4.1 demonstrates, for the study period as a whole, demolitions resulted in a dwelling unit loss rate which was only twenty five percent of the rate of new construction. Thus, the net increment in dwelling units between 1960 and 1974 in Durban (i.e., units constructed minus units demolished) amounted to just over twenty thousand (Figure 4.1 refers).

The Dimensions of Residential Growth in Durban:

A Factorial Analysis

Subsequent chapters will provide a formal analysis of the spatial distribution of the growth described in the paragraphs above. Prior to this, however, there is some advantage to knowing whether the various indexes of residential growth are clustered into relatively discrete patterns, or dimensions of common variance. For this reason, the results of a factorial analysis of the indexes of residential growth in Durban are presented here. By submitting a matrix containing the broad

array of indexes of growth to S.P.S.S. common factor analysis (version PA2), patterns of common variance in this matrix may be identified (6).

These patterns of common variance, or 'factors', should conform to some degree with the conceptual distinctions made in Chapter 3. It may be anticipated, for example, that indexes of growth associated with construction activity (e.g., levels of flat construction, levels of house construction, etc.) will form a relatively discrete pattern of common variance. On the other hand, those indexes of growth associated with site preparation (or the anticipation of future patterns of construction) should be part of a quite separate pattern of common variance. This is because each set of indexes is indicative of a different stage in the residential growth process, and each also has its own distinct type of spatial logic

Most importantly, however, the isolation of patterns of common variance within the total set of growth indexes should serve as an a priori guide to the distinctive types of growth evident within the City of Durban -- whether or not these happen to be the same as those postulated in Chapter 3. Such an a priori typology will be an invaluable aid to the organization of subsequent chapters of this study, in which the spatial distribution of growth is examined on an attribute by attribute (or index by index) basis.

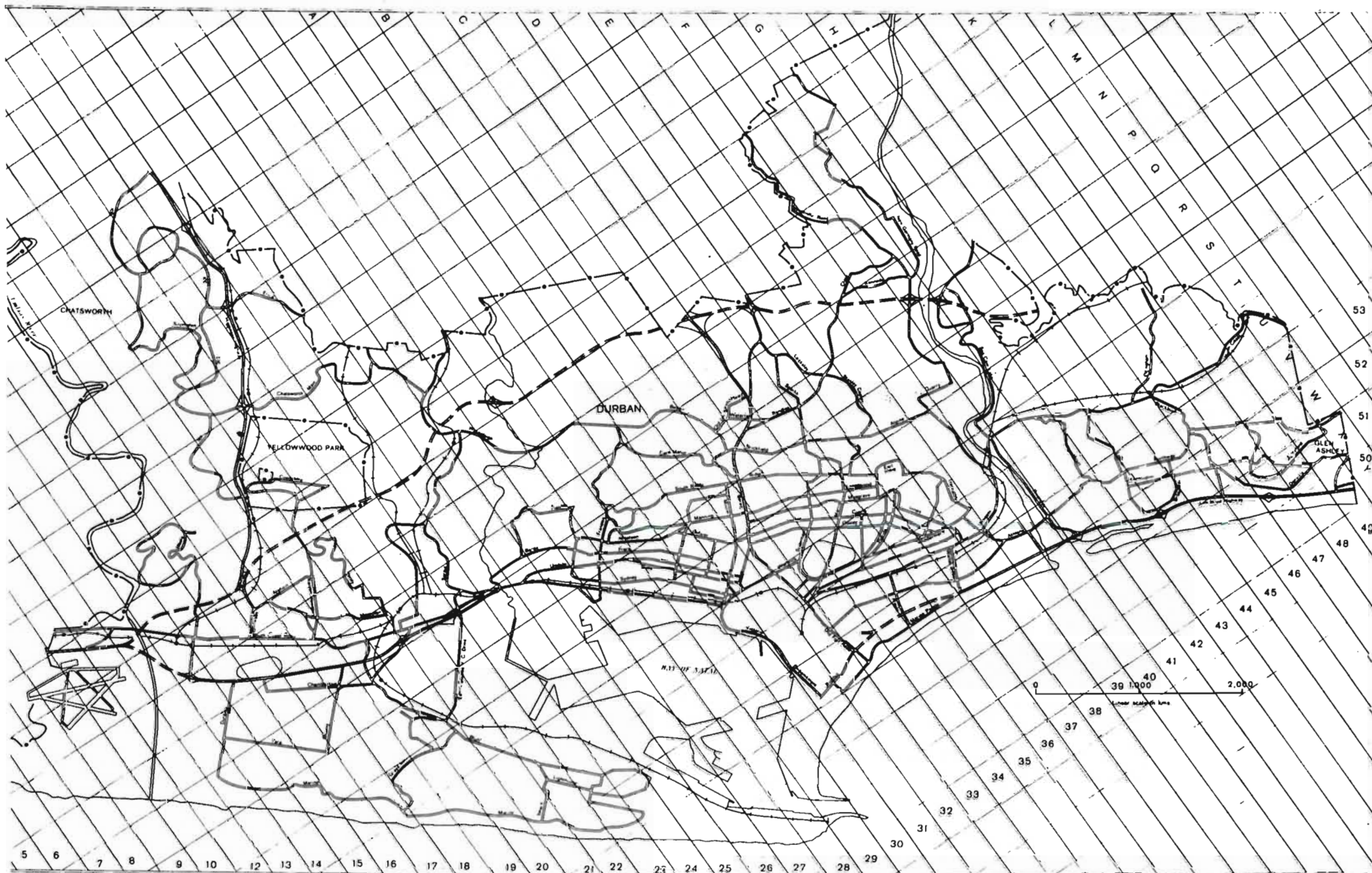


FIGURE 4.2: DURBAN GRID SYSTEM



FIGURE 4.3: GENERALIZED LAND USE ZONING IN DURBAN

The Data to be Analyzed

The data to be analyzed were collected from the records of the Building Inspectorate of the Durban City Engineers Department (7). In coded form, the data set was reduced to a matrix in which the observations were the grid cells illustrated in Figure 4.2, and in which the variables were those measures listed in Table 4.1. The set of variables includes eight different measures of the level of residential growth (1960-1974) which occurred within each observation. Also included are four 'spatial' variables which describe the locational attributes of the various observations. The inclusion of these variables allows for clearer interpretation of the tables of factor loadings (to follow), and adds a spatial component to the factorial analysis.

It should be noted that, for purposes of analysis, a twenty five percent stratified random sample of observation was selected (8). This procedure allowed the researcher firstly to reduce the somewhat cumbersome dimensions of the analysis and secondly to circumvent the much neglected problem of spatial autocorrelation (9).

The Results of the Analysis

The analysis yielded three varimax rotated factors which together accounted for 61.3 percent of the total variance present within the input matrix. The first two of these factors are the

TABLE 4.1

VARIABLES INCLUDED IN THE FACTOR ANALYSIS
OF INDEXES OF RESIDENTIAL GROWTH

No.	Code Name	Variable Description	Communality
1	HOUSE	No. of houses constructed 1960-1974	0.41
2	FLAT	No. of flats constructed 1960-1974	0.92
3	ALTS	No. of major residential altera- tions, 1960-1974	0.76
4	COSTCON	Cost of all residential build- ings constructed, 1960-1974	0.79
5	DEM	No. of units demolished 1960-1974	0.65
6	UNITS	<u>Net</u> increment in units 1960-1974	0.99
7	SUBS	<u>Net</u> increment in lots 1960-1974	0.61
8	OTHER	Cost of 'other residential' construction, 1960-1974	0.52
9	DISTPLVI	Distance from P.L.V.I. in Durban	0.64
10	DISTB	Distance from nearest beach	0.49
11	ZONRES	Percent land zoned residential	0.34
12	DISTFRE	Distance to nearest freeway access	0.24

most important from both statistical and conceptual points of view, but all three are considered below.

TABLE 4.2

SIGNIFICANT (> 0.5 to < -0.5) ROTATED FACTOR LOADINGS FOR FACTOR 1

Positive Loadings			Negative Loadings		
No.	Variables	Loading	No.	Variable	Loading
2	FLAT	0.96	--	--	--
3	ALTS	0.83			
4	COSTCON	0.86			
6	UNITS	0.93			
8	OTHER	0.69			

Variance Explained by Factor 1 = 37.15% Total

Factor 1 is described by high positive loadings on nearly all of the variables which measure some form of residential construction (i.e., FLAT, ALTS, COSTCON, UNITS, OTHER). It is noteworthy, however, that whilst flat construction (FLAT) loads most heavily on this factor, house construction (HOUSE) is not particularly strongly associated with the factor construct. (The factor loading for HOUSE on factor 1 was 0.40). Moreover,

the factor appears to be unrelated to any of the 'spatial' variables (i.e., DISTPLVI, DISTB, ZONRES and DISTFRE).

TABLE 4.3

SIGNIFICANT (> 0.5 to < -0.5) ROTATED FACTOR LOADINGS FOR FACTOR 2

Positive Loadings			Negative Loadings		
No.	Variables	Loading	No.	Variables	Loading
7	SUBS	0.77	5	DEM	-0.53
9	DISTPLVI	0.77	--	--	--
10	DISTB	0.51			
Variance Explained by Factor 2 = 18.75% Total					

The second factor is characterized by high positive loadings on the variable SUBS (the level of subdivision/consolidation). It is also negatively associated with demolition activity (DEM). The latter association seems quite reasonable if it is recalled that demolition activity does not occur in areas where subdivision takes place, but that it is concentrated in areas of consolidation (i.e., negative SUBS) where older, economically obsolete structures are removed in accordance with the demands of the redevelopment process.

Unlike factor 1, factor 2 tends to be associated with certain spatial variables -- especially distance from the peak land value intersection. Again, this association seems reasonable in view of the fact that both subdivision and demolition activity tend to be distributed systematically with respect to the city centre (11).

TABLE 4.4

SIGNIFICANT (> 0.5 to < -0.5) ROTATED FACTOR LOADINGS FOR FACTOR 3

Positive Loadings			Negative Loadings		
No.	Variable	Loading	No.	Variable	Loading
11	ZONRES	0.55	--	--	--

Variance Explained by Factor 3 = 5.40% Total

The third factor is relatively insignificant, in statistical terms, with only 5.4 percent of the total variance explained. Moreover, apart from the association with the proportion of land zoned for residential use (ZONRES), the meaning of the factor (or the conceptual status) remains ambiguous (12).

Interpretation and Discussion of Results

The results of the factor analysis provide several important clues for understanding patterns of residential growth in Durban.

Firstly, it is evident from factor 1 that there is a tendency for almost all residential construction activity to be inter-correlated. Flat construction, major alterations to residential properties, total dwelling units constructed, the cost of all residential construction and, to a lesser extent, house construction are all found to be part of a distinct pattern of common variance.

On the other hand, it is clear from factor 2 that land subdivision and consolidation patterns, and patterns of demolition, are identifiable as a separate pattern of common variance. This pattern, it would seem, is associated with the site preparation stage of the urban residential growth process.

Most importantly, however, the identification of these two orthogonally related (uncorrelated) factors would imply that an important assumption of Chapter 3 -- namely, the assumption that site preparation patterns are distinct from construction patterns -- is one which is justified in the Durban case.

A second implication of the analysis is that whilst patterns of subdivision, consolidation and demolition are quite strongly associated with certain 'spatial' variables (e.g., distance to

the city centre), the same is not true for patterns of construction. ('Spatial' variables did not load strongly on factor 1, but they did on factor 2.) The rationale for this may not be clear at this stage, but it is a matter which will receive consideration in the chapters to follow.

Conclusion

This chapter has served as an introduction to the empirical realities of residential growth in Durban. The results of the second part of the chapter, in particular, will serve as a basis for ordering discussion in subsequent chapters, in which hypotheses concerning the spatial distribution of residential growth are subject to empirical verification procedures. Thus Chapter 5, for example, deals with the spatial organization of those indexes of residential growth which are associated with factor 2 -- the site preparation factor. Chapter 6, on the other hand, considers the locational ordering of those indexes of growth associated with factor 1 -- residential construction.

CHAPTER 5

PATTERNS OF SITE PREPARATION IN DURBAN

Introduction

The purpose of this chapter is to examine the spatial distribution of patterns of residential site preparation in Durban. More specifically, the intention is to compare patterns of residential site preparation evident in Durban with hypotheses predicated upon the theory of residential growth (as presented in previous chapters). The appropriateness of theory may thus be evaluated and, at the same time, the specifics of the Durban case may be better understood.

Two indexes of site preparation are chosen for analysis: (i) the level of land subdivision/consolidation (net increment or deficit in lots, 1960-1974), and (ii) the level of demolition activity (dwelling units demolished, 1960-1974). These two indexes are examined separately in the first and second sections of the chapter.

The Spatial Organization of Land Subdivision and Consolidation in Durban

It was hypothesized in Chapter 3 that the distribution of land subdivision and consolidation should be as in Figure 3.2. That is, the profile depicting the transition with distance,

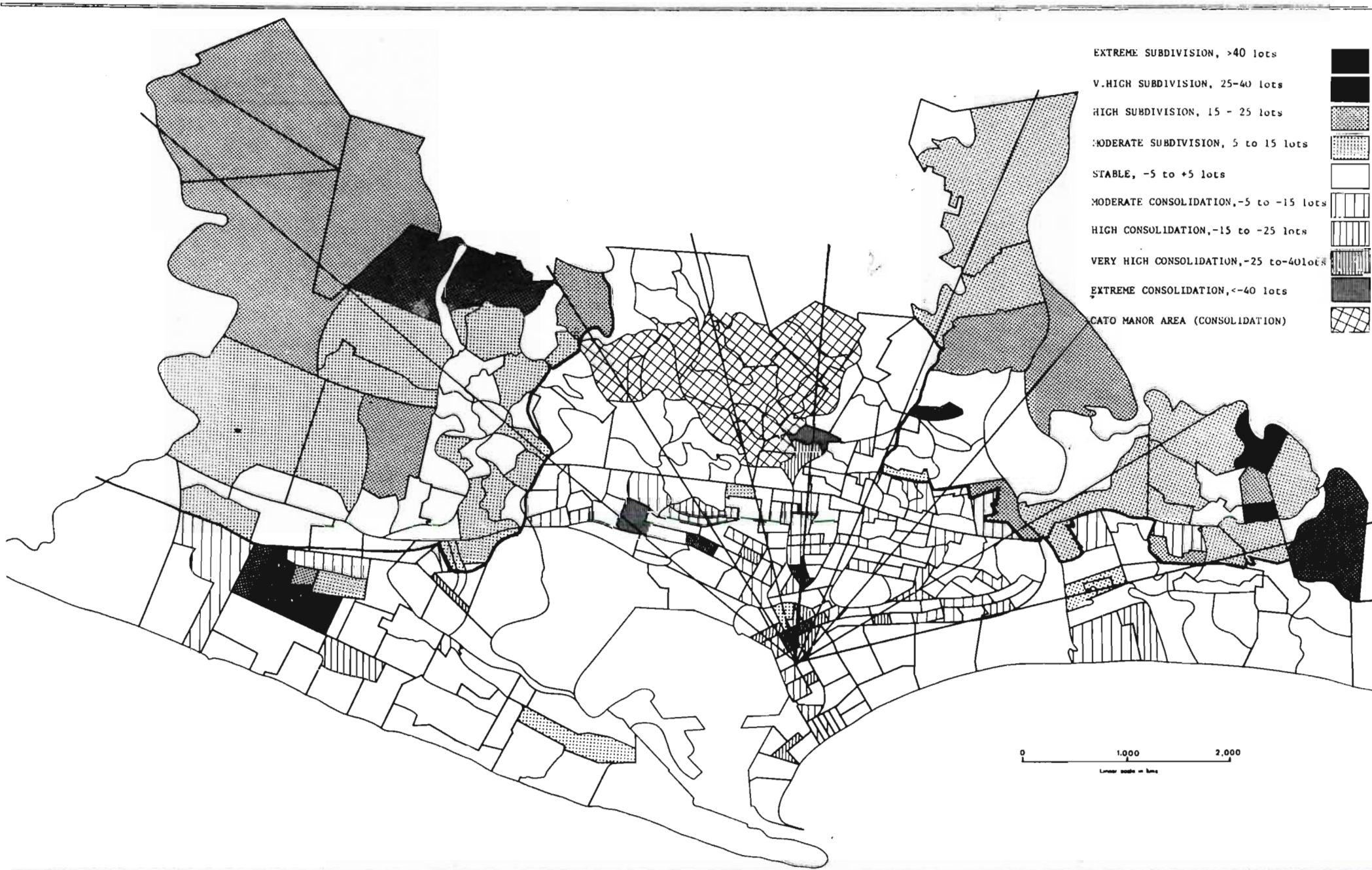


FIGURE 5.1: LAND SUBDIVISION AND CONSOLIDATION IN DURBAN

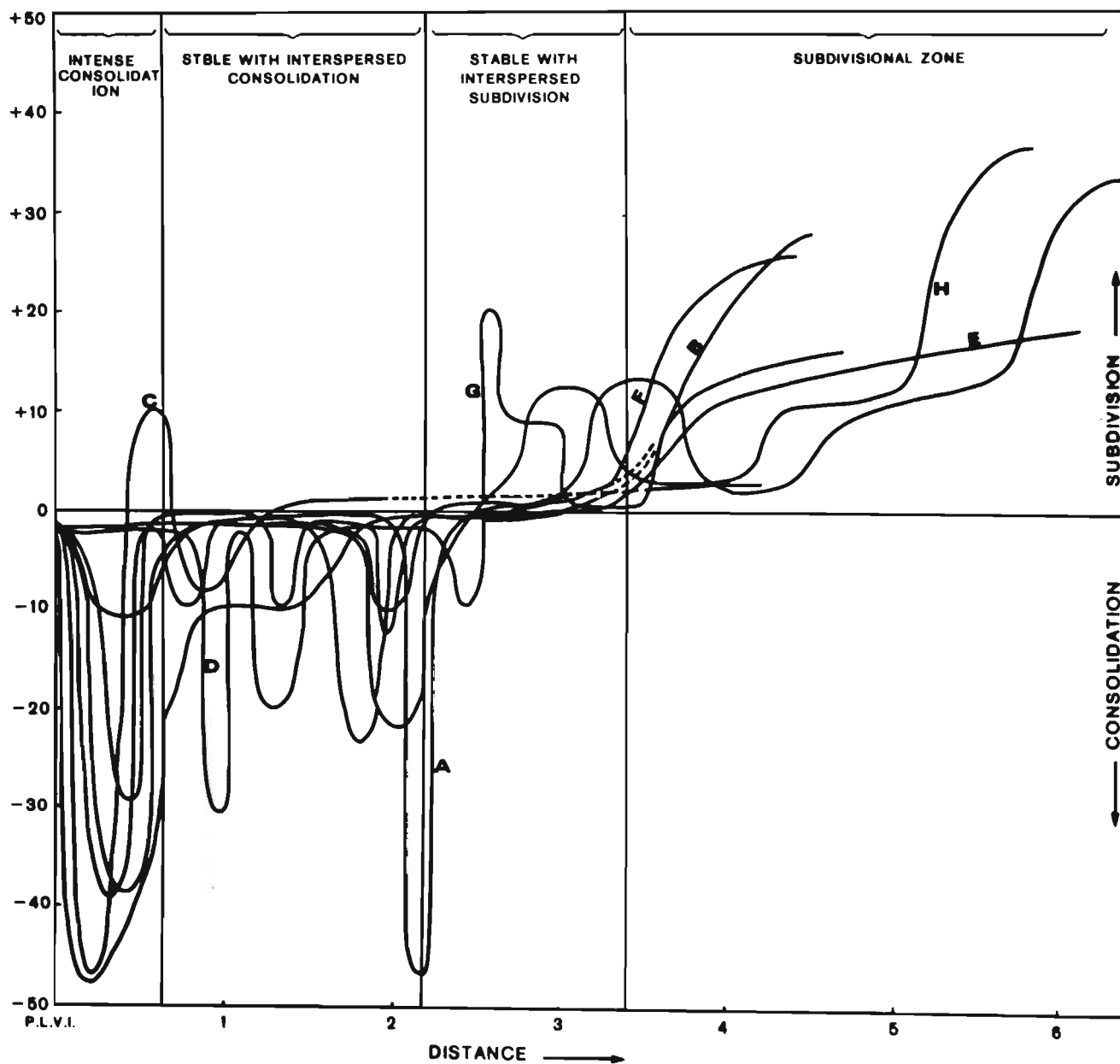
from areas of consolidation to areas of subdivision will be in the form of an 's-shaped' curve.

To investigate the validity of this hypothesis in the Durban case, a simple map analysis was conducted. The data employed in the analysis were derived from a comparison of two cadastral maps produced by the City Engineers Department for 1960 and 1974 respectively. The net 1960-1974 increment (or deficit) in lots was recorded for each 1960 census enumerator subdistrict, and this quantity was divided by the subdistrict's area. The derived scores were then mapped to indicate varying levels of subdivision and consolidation within the city. In addition, eight profiles or transects of subdivision/consolidation intensity were constructed so as to provide a graphical representation of the variation of subdivision/consolidation intensity with respect to distance from the peak land value intersection (1).

The map of subdivision/consolidation intensity is reproduced in Figure 5.1, and the eight transects referred to above are illustrated in Figure 5.2. It may be noted that, despite some obvious deviations (especially the 'consolidation island' in the Cato Manor area), both the map and transects exhibit the hypothesized configuration. Net consolidation is most intense near to the peak land value intersection, whilst net subdivision is

FIGURE 5.2

: TRANSECTS AT 18° INTERVALS RADially FROM THE DURBAN P.L.V.I.
SHOWING SUBDIVISION AND CONSOLIDATION PLOTTED BY DISTANCE



at a maximum near to the extremities of the city.

It is of some interest, however, that the hypothesized 'stable zone' may be subdivided into two sections: a zone of stability interspersed with subdivision and a zone of stability interspersed with consolidation (Figure 5.2 refers). That is, the so-called 'stable zone' is not completely stable at all, and tends to be associated with consolidation nearer to the city centre, and with subdivision near to the city's outskirts. Indeed, if Figure 5.2 is regarded as analogous to a scattergram of subdivision/consolidation and distance to the P.L.V.I., it might well be argued that, in the Durban case, there is an almost linear (straight line) relationship between the two variables.

In order to explore the effects of distance to the P.L.V.I. on subdivision/consolidation intensity in a more formal manner, a stepwise regression analysis was conducted (2). The sample of observation for this analysis is the same as that which was employed in the factor analysis (reported in Chapter 4). The variables included in the analysis, however, are limited to the dependent variable SUBS (the net increment/deficit in lots registered in a grid cell observation during the period 1960-1974) and the four independent variables DISTPLVI (distance of the observation to the peak land value intersection), DISTB (distance of the observation to the nearest beach), DISTFRE (distance of

the observation to the nearest freeway access point) and ZONRES (the proportion of an observation's area zoned for residential use).

All four of these independent variables were hypothesized to have some influence on either anticipated or actual patterns of residential growth in Chapter 3. The independent variables DISTPLVI and ZONRES, for example, are measures of locationally variable constraints upon developer behavior. DISTPLVI acts as a surrogate for land values, and the ZONRES variable defines the proportion of an observation in which the probabilities of growth may possibly occur. (When ZONRES = 0, $p(d_{ij})$ should also be zero; as ZONRES approaches 100, $p(d_{ij})$ values should increase). The independent variables DISTFRE and DISTB are included as surrogate measures of locationally variable advantages within the urban land market. DISTFRE, for example, is assumed to vary inversely with respect to the "general accessibility" of a place, and DISTB is employed as an index of the "environmental amenity" of a location (3).

The objective of the stepwise regression analysis is to establish which linear combination of the four independent variables best predicts the variation in the variable SUBS. In this case, the 'best fit' equation contained two independent variables -- DISTPLVI and DISTB. (The other two independent variables were excluded from the best fit equation because of

their low additional contribution to multiple r). This best fit equation may be written as:

$$\text{SUBS} = -12.26 + 0.09 \text{ DISTPLVI} + 0.05 \text{ DISTB} + E$$

A two tailed test of significance for the B_i coefficients in this equation revealed that the null hypothesis $B_i = 0$ may be rejected at the 95% level of confidence.

A summary of statistics for steps one and two in the step-wise procedure is provided below.

Step	X_i 's included	Multiple r	Δ Multiple r	Partials
1	DISTPLVI	0.62	--	DISTB=0.31
2	DISTPLVI, DISTB	0.66	0.04	--

The predominant influence of distance from the peak land value intersection is strongly evident in this analysis. Indeed, of all the independent variables, DISTPLVI is overwhelmingly the most significant contributor to explaining variation in the dependent variable SUBS. The second most important variable, DISTB, only raised multiple r by 0.04 when it was added at step two, and the additional contributions of DISTFRE and ZONRES at steps three and four were statistically insignificant.

Examination of residuals revealed that one area in particular was markedly 'over predicted' by the best fit equation. Cato Manor was expected to have some positive value for the variable SUBS, but instead the actual values were negative. As will be argued in subsequent chapters, this kind of marked deviation is illustrative of the impact of the political process on patterns of urban growth and change in South African cities.

The Spatial Organization of Demolition Activity in Durban

It was suggested in Chapter 3 that demolition activity should anticipate redevelopment patterns, and will therefore tend to be concentrated in areas nearer to the city centre, and in other locations which are generally favourable to flat development.

In examining the validity of these postulates with respect to the Durban case, a similar research strategy was adopted to that outlined in the preceeding section. First, a map was compiled to indicate the relative intensity of demolition activity throughout Durban and, second, a stepwise regression analysis was conducted to ascertain the relative effects of DISTPLVI, DISTFRE, DISTB and ZONRES on the dependent variable DEM (the number of dwelling units demolished, 1960-1974).

Figure 5.3 demonstrates that most demolitions were concentrated in the central areas of the city, although the pattern is

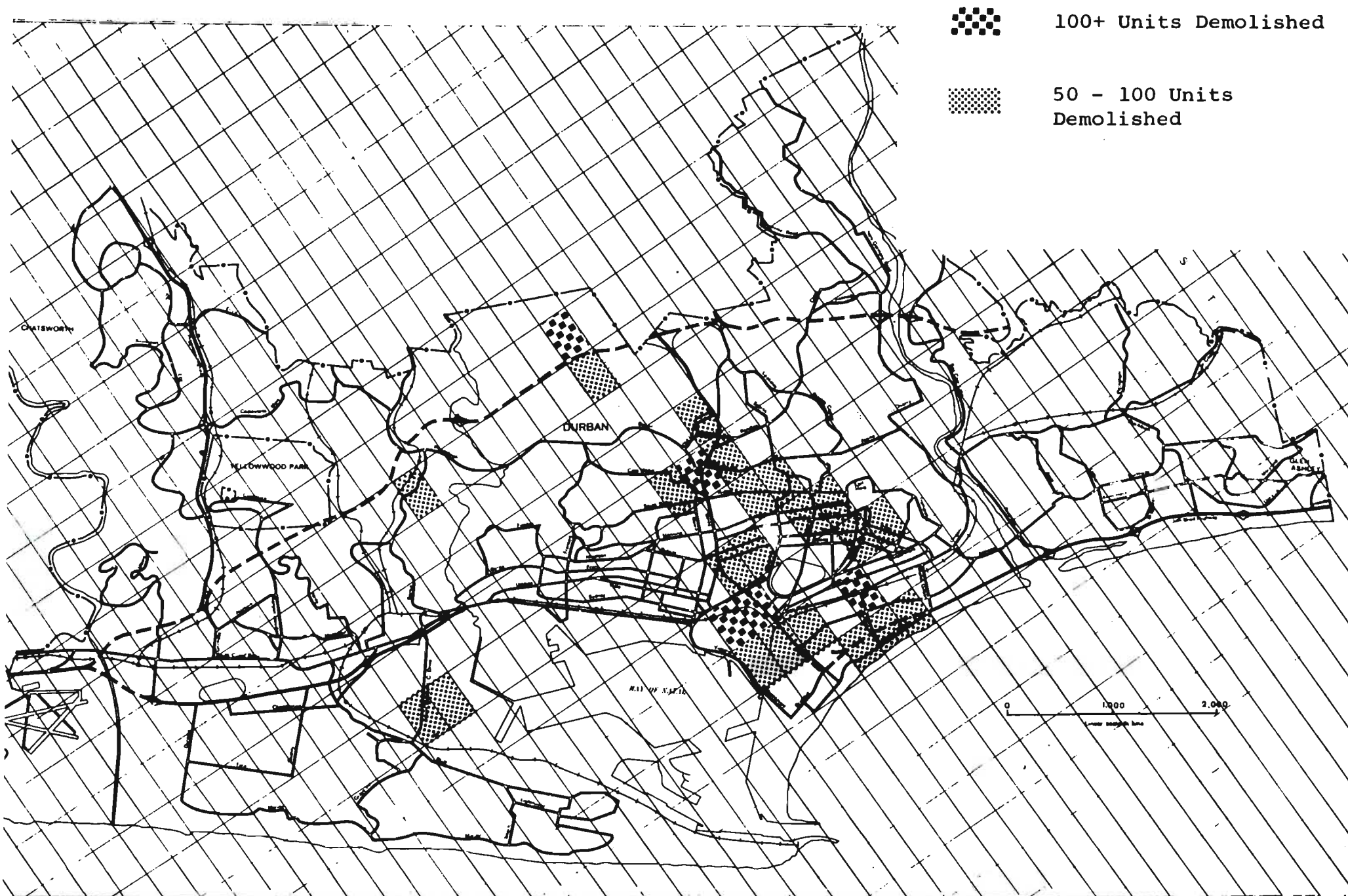


FIGURE 5.3: RESIDENTIAL DEMOLITIONS IN DURBAN, 1960 - 1974

slightly less distance oriented than that which applied for subdivision and consolidation. The best fit regression equation for DEM at step 2 is provided below. (The inclusion of DISTB and ZONRES at further steps may be ignored because of statistically insignificant B_i co-efficients, and small additional contributions to multiple r.)

$$\text{DEM} = 41.8 - 0.16 \text{ DISTPLVI} - 0.28 \text{ DISTFRE} + E$$

Tests of significance (two tailed) for the B_i co-efficient allowed rejection of the null hypothesis that $B_i = 0$ at the 95 percent level of confidence. Statistics relevant to the stepwise procedure at steps 1 and 2 are provided below.

Step	X_i 's included	Multiple r	Δ Multiple r	Partials
1	DISTPLVI	0.47	--	DISTFRE = -0.36
2	DISTPLVI, DISTFRE	0.56	0.09	

The importance of distance to the peak land value intersection and/or to freeway access is shown to be particularly strong in the case of demolitions, and a fairly high level of explanation is achieved with only these two variables in the regression equation.

It would seem, therefore, that competition amongst land developers for accessible locations (near to the city centre or freeway access or both) has led to the replacement of older residential buildings with more intensive land uses in the areas in question.

Analysis of residuals revealed that three areas were significantly under-predicted by the regression equation. In the Cato Manor, Edwin Swales/Bayhead and Berea Ridge areas, higher levels of demolition were recorded than that which would be expected in terms of the predictions of the best fit equation. The first two of these areas are associated with demolition activity accompanying the so-called 'institutional redevelopment' of the South African city. The Berea Ridge area of high demolitions, on the other hand, is probably indicative of pre-redevelopment activity of the private market type.

Conclusion

This chapter has provided an empirical examination of the distribution of those attributes of the residential growth process which are associated with the site preparation stage. In the Durban case, both subdivision/consolidation and demolition are found to be strongly associated with distance to the peak land value intersection, although other accessibility and amenity oriented factors also influence the distribution of site preparation activity. The most marked deviations from theory appear to

be those areas associated with government apartheid policy (e.g., Cato Manor).

With these points in mind, Chapter 6 considers spatial distribution of the second important dimension of residential growth in Durban -- construction activity.

CHAPTER 6

PATTERNS OF RESIDENTIAL CONSTRUCTION IN DURBAN

Introduction

In the final analysis, the residential growth process should result in the construction of dwelling units and, as hypothesized in Chapter 3, these newly constructed dwelling units should be distributed in an orderly fashion throughout the city. It may be anticipated, for example, that flat units will be located in areas of land consolidation, whereas house units will be located in areas of land subdivision. Both flats and houses should also be built in areas of high 'environmental amenity' and 'general accessibility' but, because of the constraints imposed by the structure of urban land values, flat construction should be more centralized within the city than house construction. Finally, it is to be expected that all residential construction will occur in areas zoned predominantly for residential use, since zoning defines the legally possible areas within which the probabilities of growth occur.

The purpose of this chapter is to examine the extent to which patterns of residential construction in Durban correspond with the theoretical expectations referred to above. Thus, four indexes of residential construction in Durban are subject to

analysis here (Table 6.1 refers). A map of the spatial variation of each construction index is provided, and separate stepwise regression analyses are conducted in order to ascertain which linear combination of independent variables best predicts the variation in each index. (Independent variables to be employed in regression analyses are listed in Table 6.2).

TABLE 6.1
DEPENDENT VARIABLES OR INDEXES OF RESIDENTIAL
CONSTRUCTION IN DURBAN

No.	Variable Description	Code Name
1	Number of houses constructed, 1960-74	HOUSE
2	Number of flat units constructed, 1960-74	FLAT
3	Costs of all residential construction, 1960-74	COSTCON
4	Net increment in dwelling units, 1960-74 (i.e. variables 1 + 2 - DEM)	UNITS

TABLE 6.2

INDEPENDENT VARIABLES EMPLOYED IN REGRESSION

ANALYSES OF PATTERNS OF RESIDENTIAL CONSTRUCTION

No.	Variable Description	Code Name
1	Distance of observation from peak land value intersection	DISTPLVI
2	Distance of observation from a freeway access point	DISTFRE
3	Percentage of area zoned residential	ZONRES
4	Net increment or deficit in lots, 1960-74	SUBS
5	Distance of observation from the nearest beach	DISTB

House Construction in Durban

It is evident from Figure 6.1 that house construction is generally confined to the extremities of the city. There have been certain preferred areas, of course, and some parts of the city have not demonstrated any level of housing development, despite apparently favourable locations. Nevertheless, for the city as a whole, the hypothesis that house construction will be a positive function of distance from the city centre does seem valid.

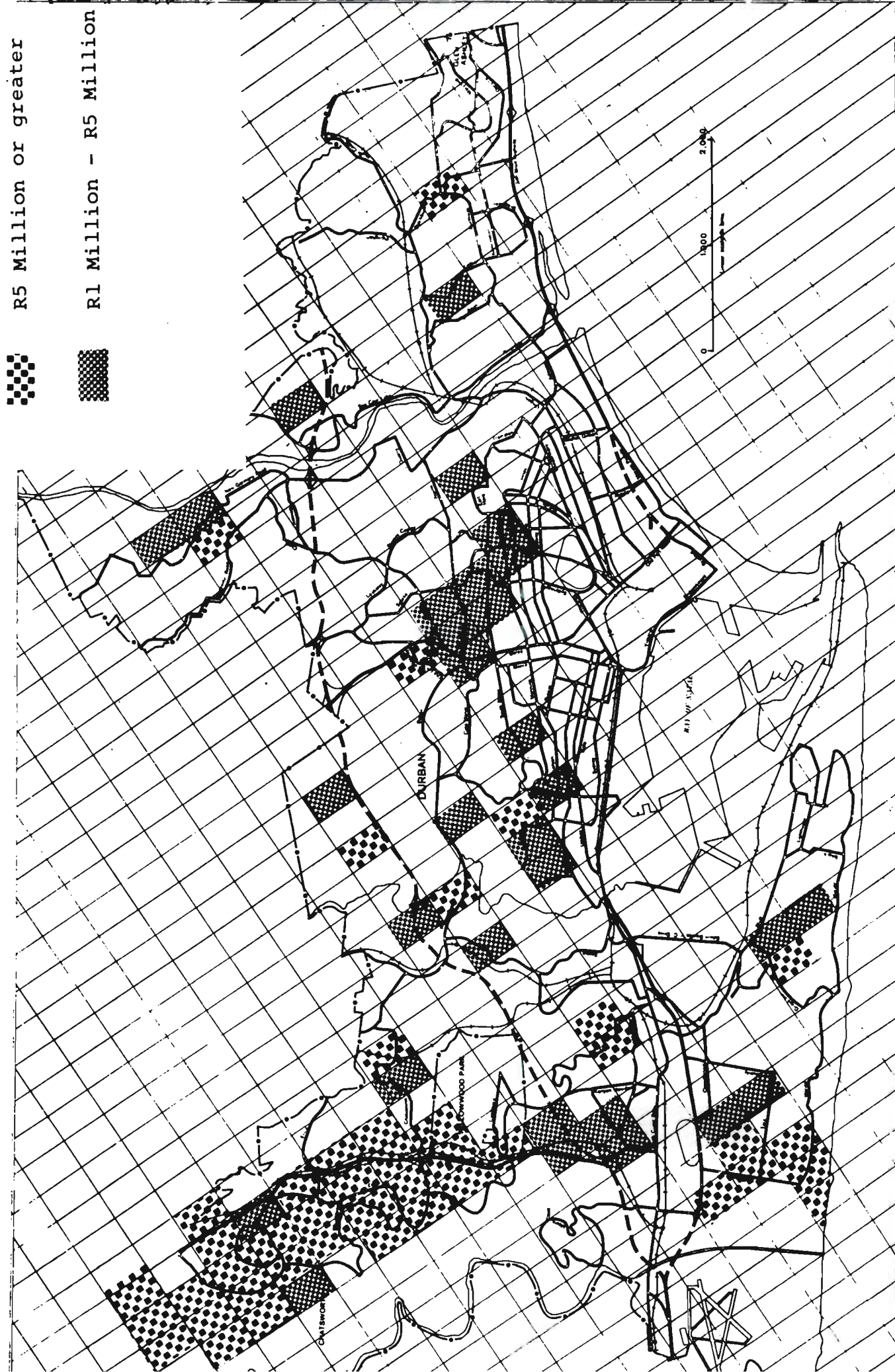


FIGURE 6.1: HOUSE CONSTRUCTION IN DURBAN 1960 - 1974

This distance relationship emerges clearly from the results of the stepwise regression analysis. The best fit regression equation for HOUSE at step two is shown below (1).

$$\text{HOUSE} = -45.72 + 0.69 \text{ DISTPLVI} + 8.16 \text{ ZONRES} + E$$

Two tailed tests of significance for the B_i values allowed a rejection of the null hypothesis that $B_i = 0$ at the 95 percent confidence level. A summary of statistics relevant to the stepwise procedure at steps one and two is provided below:

Step	X_i 's included	Multiple r	Δ Multiple r	Partials
1	DISTPLVI	0.33	--	ZONRES = 0.24
2	DISTPLVI, ZONRES	0.40	0.07	--

It is clear from the regression results that distance from the peak land value intersection remains the independent variable which most adequately accounts for the dependent variable HOUSE. Indeed, the elementary conclusion which is derived from this analysis is that when house development does not occur near to the city limits, it tends to be associated with other areas of the city which are zoned predominantly for residential use. The influence of the other three independent variables (DISTB,

DISTFRE and SUBS) is marginal. It is perhaps surprising that subdivision plays almost no independent role in this regression equation, but this is a matter which is considered further in the conclusion to the chapter.

An inspection of standardized residual plots for the regression revealed that areas near to the Durban City boundary were consistently overpredicted by the best fit equation. This implies that, whereas house construction generally increases with distance away from the city centre, in areas adjacent to the city boundary the 'distance rule' (which is implied by the equation) breaks down. On the other hand, very rapid rates of house construction in the Chatsworth and Merewent areas were substantially underpredicted by the best fit equation. Both of these areas have been associated with housing projects for non-white groups in the City of Durban. Thus, once again, the impact of government policy is evident.

Flat Construction in Durban

Figure 6.2 reveals that flat construction tends to be centralized in an area bounded roughly by the Berea Ridge and the coastline. Apart from this intense pocket of flat development, however, there is a wide distribution of areas which experienced at least moderate levels of flat construction.

500+ Flats

100 - 500 Flats

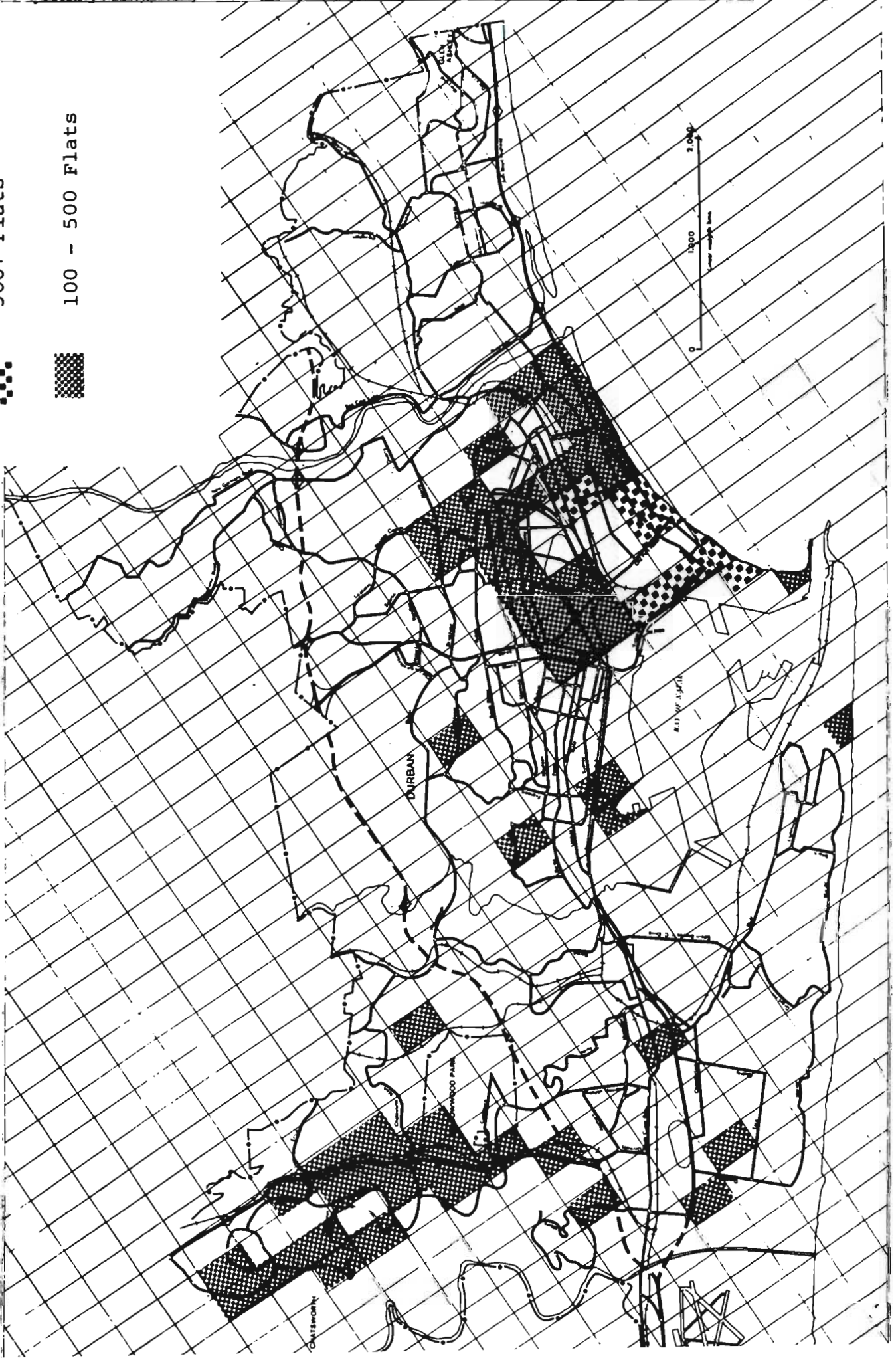


FIGURE 6.2: FLAT CONSTRUCTION IN DURBAN 1960 - 1974

Chatsworth in particular appears as a secondary centre of this activity.

It is noticeable that the only area which did not experience at least some flat development is Durban North. Although this defies most of the logic of conventional location theory (the Durban North area is probably very attractive to flat developers because of a pleasant environment, accessible location, etc.), it would not be incongruent with generally observed patterns of the politics of urban development (cf. Linowes and Allensworth, 1973). A substantial part of Durban North is an influential and prestigious community and, as will be argued in Part II of this study, such areas tend to have low $p(d_{ij})$ values for flat development in particular.

The regression equation for the dependent variable FLAT at step number three is shown below. (Since the additional contribution to multiple r after the inclusion of the ZONRES and DISTB variables was only 0.029, the limited effect of these variables was ignored for purposes of analysis.)

$$\text{FLAT} = 294 - 2.41 \text{ DISTFRE} - 1.39 \text{ DISTPLVI} + 5.45 \text{ SUBS} + E$$

Tests of significance for B_i values allowed a rejection of the null hypotheses that $B_i = 0$ for two tailed tests at the 95 percent level of confidence.

A summary of statistics for steps one to three is provided below:

Step	X _i 's included	Multiple r	ΔMultiple r	Partials
1	DISTFRE	0.22	--	DISTPLVI = 0.23 SUBS = 0.04
2	DISTFRE, DISTPLVI	0.31	0.09	SUBS = 0.29
3	DISTFRE, DISTPLVI SUBS	0.38	0.07	--

The higher the contribution to multiple r of the DISTFRE variable compared to the DISTPLVI variable is particularly interesting. It suggests, for example, the flat development has become sensitive to locations which are not necessarily geometri-
cally central within the city, but which are nevertheless accessible to major transportation routes. This finding would accord with the results of Bourne and Berridge's (1973) analysis of flat development in Toronto, and Nader's (1971) study of apartment location in Central Canada. Both of these studies revealed the flat location has become less sensitive to centrality considerations per se, and more sensitive to the location of major transportation networks (such as railways and freeways). It should be noted, however, that flat development in Durban is still centralized to some extent. Thus, in this analysis, DISTPLVI

was responsible for an increase of 0.09 in multiple r at step two.

The role of the subdivision variable in the best fit equation for FLAT is complex, but informative. The additional contribution of SUBS to multiple r at step three was 0.07, whereas the importance of SUBS in explaining the residual variance at step two was quite high (partial $r = 0.29$). This would be a result of the fact that there is a strong positive correlation between SUBS and DISTPLVI ($r = 0.62$). Thus, much of the independent significance of the subdivision variable is lost when it is included in the third equation, along with DISTPLVI. The overall interpretation, then, is that when the effects of distance to the peak land value intersection and distance to freeway access are taken into account, subdivision tends to be positively associated with the residual variance in flat development (2). Given that the relationships between FLAT and DISTPLVI and DISTFRE are negative, it may be inferred that where flat development is not near to freeway access or the peak land value intersection, it will be accompanied by land subdivision.

The standardized residual plots for the 'best fit' equation for FLATS revealed that substantial underprediction occurred in two areas: (i) the North Beach area, and (ii) along Musgrave Road. These two areas have been conspicuous for rapid rates of

flat development to most casual observers of the development scene in Durban. It would appear that growth in both areas has been stimulated by some special locational advantage, but the precise nature of these advantages could possibly only be determined by behavioral research.

The Overall Costs of Residential Construction

When building inspectors conduct a final site inspection of developed property, they record an estimated cost of construction for the project in question. These data provided the basis for the analysis of spatial variability in overall costs of residential construction in Durban.

Figure 6.3 displays this variation in map form. The most obvious generalization which can be made on the basis of this map is that residential construction in Durban, as measured in cost terms, is still centralized within the city. The best fit regression equation for COSTCON tends to confirm this initial impression (3):

$$\text{COSTCON} = 2736220.45 - 11004.16 \text{ DISTPLVI} - 16929.90 \text{ DISTFRE} + E$$

The B_i co-efficients in the above equation were found to be statistically significant at the 95 percent level of confidence for two tailed tests. A summary of statistics for steps one and two in the stepwise procedure is provided below:

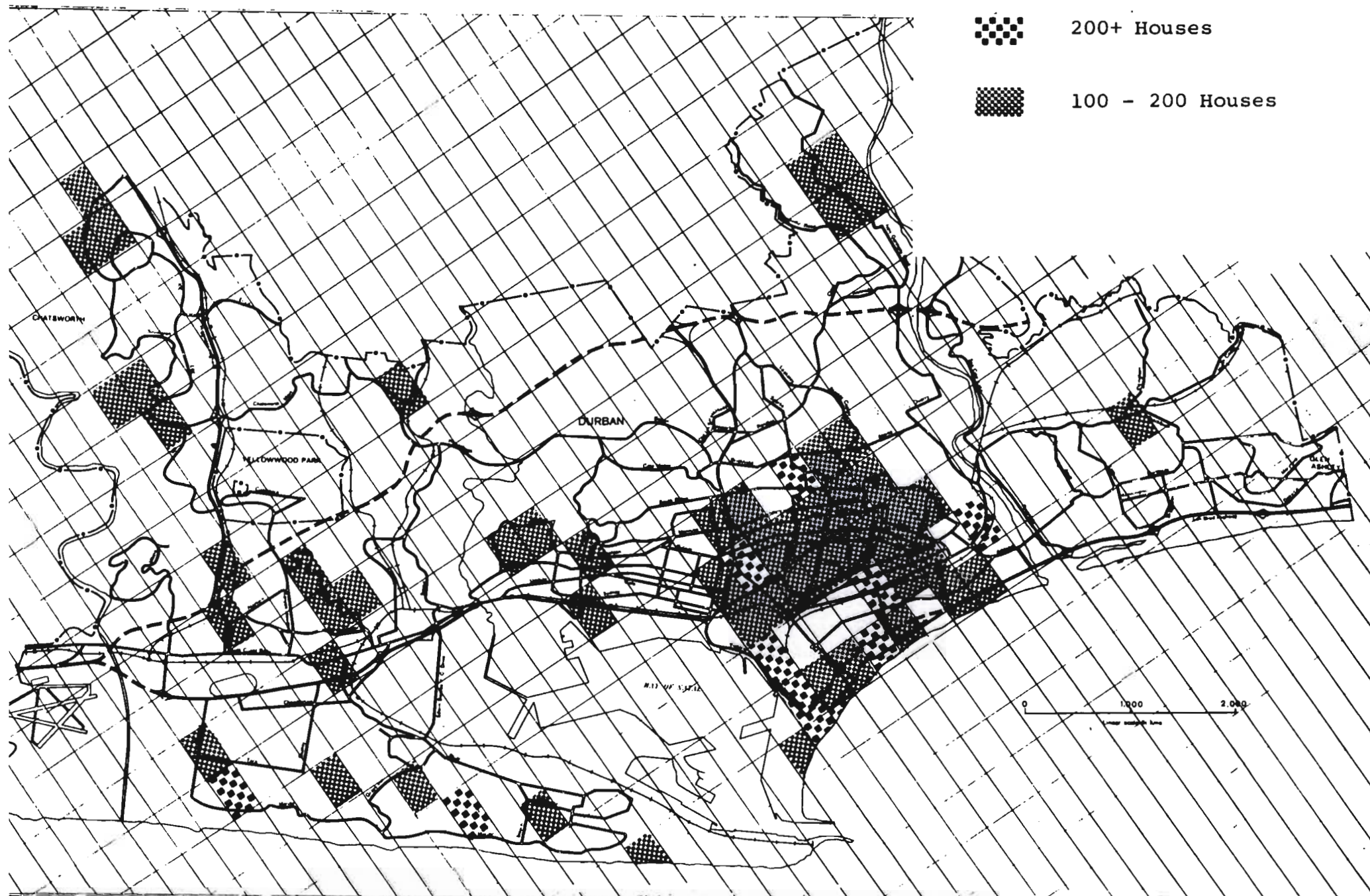


FIGURE 6.3: OVERALL COSTS OF RESIDENTIAL CONSTRUCTION IN DURBAN, 1960 - 1974

Step	X _i 's included	Multiple r	Δ Multiple r	Partials
1	DISTPLVI	0.30	--	DISTFRE = -0.20
2	DISTPLVI, DISTFRE	0.36	0.06	

The predominant and negative influence of DISTPLVI is once again evident from this analysis. DISTPLVI was entered first in the stepwise process ($r = 0.30$) and carried a negative regression co-efficient value. The entry of DISTFRE at Step 2 also indicates the negative relationship of residential construction activity to this 'general accessibility' variable. (DISTFRE raised multiple r by 0.06 and carried a negative regression co-efficient value.)

Thus, it would appear that the overall pattern of residential construction activity is similar to that manifested by flat construction: growth has gravitated towards the city centre and near to freeway access points.

Analysis of residuals did not shed much further light on patterns of residential construction in Durban. No single area was markedly overpredicted by the regression equation, although three areas were substantially underpredicted: an area along Sparks Road (coloured group area), a region at the northern end of Umbilo Road, and a section of the North Beach area near to Argyle Road.

The Net Increment in Dwelling Units

Perhaps the singly most important index of residential growth, from the city planner's point of view, is the net increment in dwelling units which occurs during a given period (i.e., flats constructed plus houses constructed minus dwelling units demolished). It is, after all, part of the planner's task to anticipate patterns of housing provision for a growing urban population.

Figure 6.4 reveals that whilst a very large part of the city experienced some net growth in the housing stock, two regions of the city were outstanding in this regard: (i) the Central/Berea area, and (ii) the Chatsworth area. The former area, of course, is associated with private redevelopment to flat use, and the latter area is associated with what might be termed as the 'institutional suburbanization process' (4).

The best fit regression equation for UNITS at step number two is shown below (5):

$$\text{UNITS} = 199.19 - 2.83 \text{ DISTFRE} + 4.63 \text{ SUBS} + E$$

Again, statistical tests of significance for the B_i co-efficient allowed a rejection of the null hypothesis at the 95 percent level of confidence for two tailed tests. Statistics pertinent to the stepwise procedure at steps one and two are provided below:

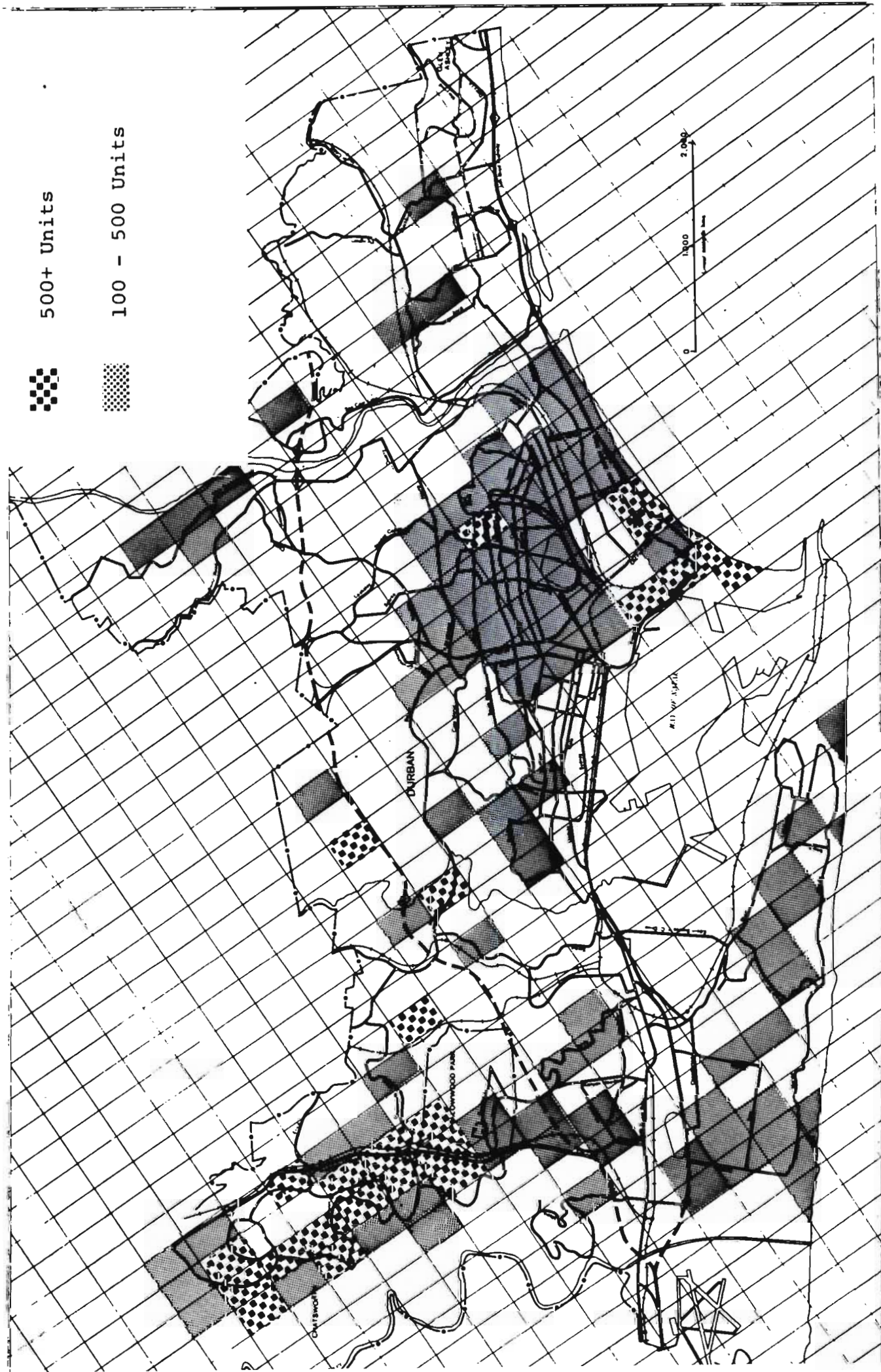


FIGURE 6.4: NET INCREMENT IN RESIDENTIAL UNITS IN DURBAN. 1960 - 1974.

Step	X _i 's included	Multiple r	ΔMultiple r	Partial
1	DISTFRE	0.22	--	SUBS = 0.18
2	DISTFRE, SUBS	0.28	0.06	--

The most that can be claimed on the basis of these results is that the net provision of units tends to be associated with areas close to freeway access and, when this is not the case, provision is associated to some extent with areas of land subdivision consolidation (SUBS).

Although the low level of explanation is in some respects disappointing, the results have some important implications. The lack of significance of distance from the peak land value intersection (DISTPLVI) to the net provision of units (UNITS), for example, is interesting when it is recalled that the overall cost of residential construction (COSTCON) showed a distinct tendency toward centralization. (It will be remembered that the most important independent variable affecting the behavior of the dependent variable COSTCON was DISTPLVI.) It would seem that the reasons for this are twofold:

- (i) The variable measuring the net increment in units (UNITS) is essentially the sum of the number of flats and houses constructed minus the number of demolitions (i.e., UNITS = (FLAT + HOUSE) - DEM). This means that in the areas with

high levels of demolition, the net number of units provided will be low compared with the level of cost associated with the construction of the new units. Given that it has been established that demolitions are centralized within the city, this would imply that, ceteris paribus, central areas should have high levels of construction costs. Moreover, it should be noted that the dependent variable COSTCON measures the overall cost of all residential construction (i.e., including 'other residential' construction and alterations which do not lead to an increment in units). Given that regression analyses (not reported here) revealed that these kinds of construction are centralized, this too would explain why COSTCON is negatively associated with distance from the peak land value intersection, whilst the dependent variable UNITS is not (6).

- (ii) Since housing growth in the central areas of the city has been for the more affluent white group, and since a substantial portion of suburban development has been for the lower income asiatic group, the overall costs of construction per unit are not surprisingly higher in central areas where effective demand for housing is at a premium (7).

Summary and Conclusions for Part I

It will be useful, at this stage, to provide a summary of research conclusions which are applicable not only in the case of construction, but also in the case of site preparation. This summary will serve as the capstone to Part I of the study.

1. It has been established that, in the 1960-1974 period, patterns of site preparation are distinct from patterns of construction. The factor analysis in Chapter 4, for example, revealed that site preparation and construction are identifiable as discrete dimensions of common variance within a matrix containing indexes of residential growth for the 1960-1974 period in Durban.

In one respect this result is surprising: the study period is long enough to expect that patterns of site preparation will accord, at least broadly, with patterns of construction. After all, site preparation activity between 1960 and 1974 should have been catering, in part at least, to the construction process occurring within the same period.

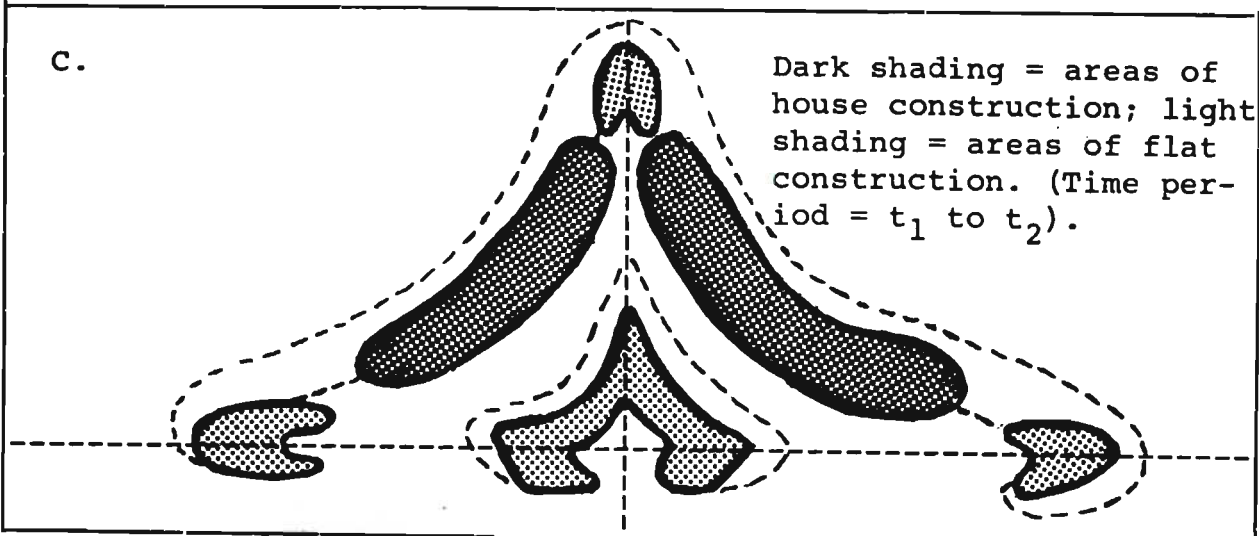
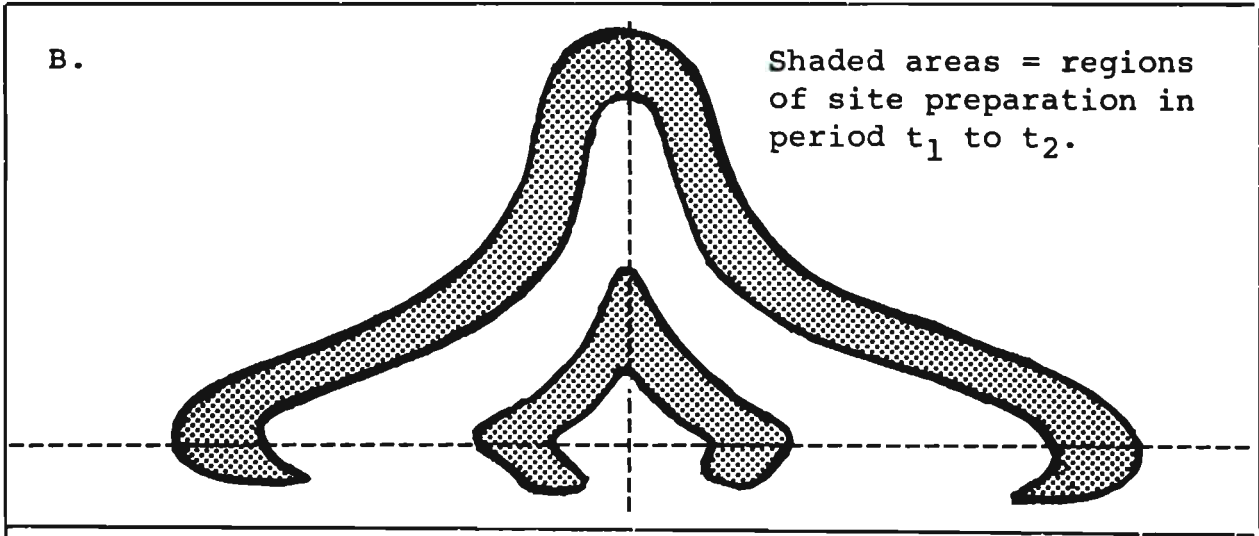
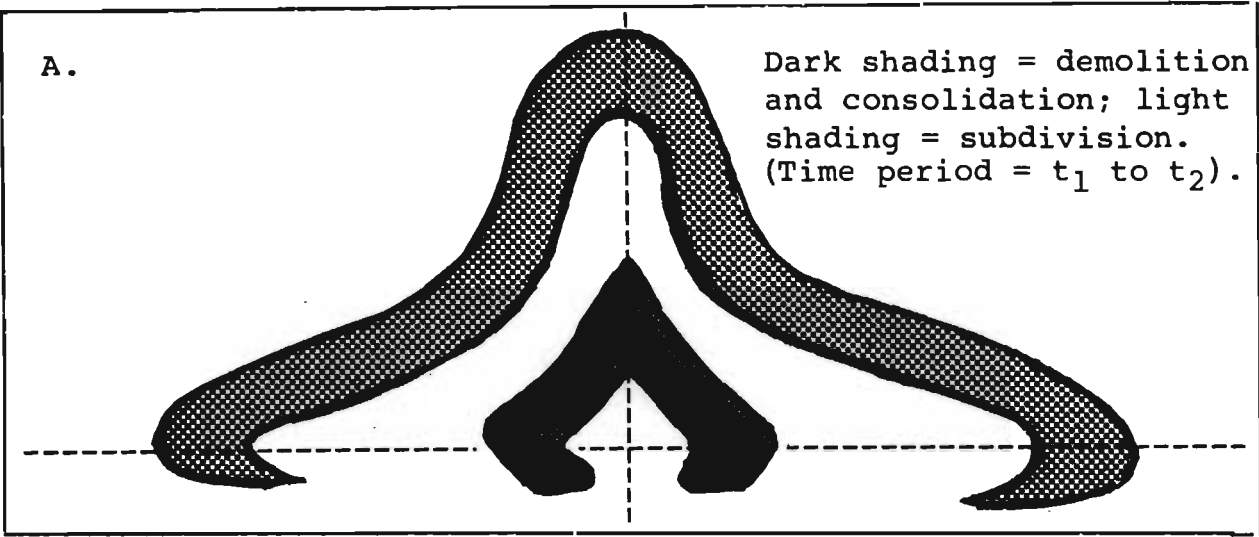
On the other hand, two considerations would detract from a perfect fit between patterns of site preparation and patterns of construction. Firstly, some site preparation activity during the 1960-1974 period would have been in anticipation of residential construction in years

subsequent to 1974; and some residential construction during the 1960-1974 period would have occurred on sites which were prepared prior to 1960. In the second place, residential site preparation activity is not always intended to act as a direct supply (of sites) for residential development or redevelopment. As indicated in Chapter 2, to the dismay of city planners, property speculators will often find it economically rational to withhold 'prepared' sites from development for considerable periods of time. If this tendency is pronounced, patterns of construction will tend to be dislocated from patterns of site preparation -- even over a fourteen year period.

Discussion of the planning implications of this and other aspects of the study is left to Chapter 9. From a purely analytical point of view, however, it should be clear that patterns of site preparation merit separate treatment from patterns of construction for some common period t_1 to t_2 .

2. The form of residential site preparation in Durban has been described in Chapter 5. Subdivision/consolidation and demolition were found to be correlated with distance to the peak land value intersection and, to a lesser extent, with certain accessibility and amenity variables.

FIGURE 6.5: GENERALIZED MODEL OF PATTERNS OF RESIDENTIAL GROWTH



A generalized model of this pattern of site preparation is provided in Section A of Figure 6.5. The diagram illustrates how land consolidation and demolition is concentrated in areas adjacent to the non-residential urban core (at the intersection of the two transportation arterials shown with broken lines). It also indicates that land subdivision is most intense in a region at the extremities of the city.

3. The shaded areas in Section B of Figure 6.5 isolate regions of site preparation for the 1960-1974 period from the remainder of the idealized city. The outline of these areas is superimposed upon a diagram of patterns of residential construction in Section C of Figure 6.5. This allows comparison of patterns of site preparation with patterns of construction.

Patterns of residential construction have, of course, been considered in previous sections of this chapter. The most important aspects of these patterns are shown in Section C of Figure 6.5. House construction is concentrated in areas remote from the peak land value intersection. Flat construction is sensitive to freeway access, and tends to increase towards the peak land value intersection. On

the other hand, when flat construction is not associated with central locations, it tends to occur in areas of subdivision.

4. The models in Figure 6.5 are extremely generalized, of course. They deal only with the 'explained variance' resulting from analyses conducted in previous chapters, and do not take account of systematic variations in residuals. In many instances, residuals revealed the influence of the political process in the determination of patterns of residential growth. Part II of the study is concerned, in large part, with the theoretical implications of these politically induced 'deviations'.

PART II

THE POLITICAL ECONOMY OF RESIDENTIAL GROWTH IN DURBAN AN EXPLORATORY ANALYSIS

For an increasing minority of economists, geographers and city planners there is a growing unease with that neoclassical paradigm which has been so influential hitherto in economics and location theory ... Probing towards a new paradigm for the study of urban problems are expressed in all social science disciplines and, at a very general level, are shown by a shift in paradigmatic emphasis: a shift away from paradigms based on the idea of a fundamental harmony of interests linking one individual to another in society and towards paradigms based on the idea of fundamental conflicts between them.

Kevin R. Cox, Urbanization and Conflict in Market Societies. (Chicago: Maaroufa Press, 1977).

CHAPTER 7

TOWARDS AN ALTERNATIVE CONCEPTUALIZATION OF THE URBAN LAND USE PROCESS

Introduction

In Part I of this study it was assumed, in common with the predominant traditions in urban geography, that private market forces were responsible for patterns of urban residential growth. A modicum of success was achieved in empirical tests of hypotheses predicated upon such assumptions. Nevertheless, it remains true that events in certain sections of the City of Durban did not conform to the hypothesized patterns. For instance, the Chatsworth area grew more rapidly than it should have (in terms of theory); Cato Manor did not register as much growth as expected; and the Durban North area manifested surprisingly low levels of flat development.

To those familiar with the planning history of Durban, such deviations from theory may not be difficult to understand. It might be pointed out, for example, that high levels of residential growth in Chatsworth were artificially stimulated by government housing programs; that low levels of development in Cato Manor may be attributed to that area's role in government plans for urban apartheid; or that the lack of flat development in Durban

North may be attributed to the peculiarities of local land use policy in Durban. In short, it might be argued that patterns of residential growth have been influenced not only by an underlying market order, but also by the specific characteristics of the political process in South Africa as a whole, and in Durban in particular.

It is interesting to note in this regard, however, that the problem of 'politically induced deviations from theory' may not be unique to the South African case. Indeed, urban geographers in Europe and North America have recently been expressing serious reservations about the apolitical nature of traditional, market-based land use theory. Scott (1975) for example, concluded his review of the French literature on land rent and land use as follows:

(It would seem) that behind every merely structural interpretation of problems of land use and land rent, there is a social and political reality that we tend persistently to overlook.

As a consequence of such reservations, urban theorists have been working towards some overtly political theories of the urban land use process in capitalist societies (cf. Cox, 1977; Scott, 1976; Wolpert, 1970).

These theoretical developments may have important implications for South African urban geography in general, and the present

study in particular. For this reason the first half of this chapter provides a critical review of the neoclassical paradigm which has dominated geographic thought on the urban land use process in the past. Consequent upon such a critique, the second half of the chapter provides an outline of some alternative conceptualizations of the urban land use process in capitalist societies, with specific reference to housing. It is these conceptualizations which will be applied to the problem of the political economy of residential growth in Durban, in chapters to follow.

The Neoclassical Paradigm and its Critics

As Wheaton (1977) has noted, the modern economic/geographic approach to urban land use has its origins in the work of Heinrich von Thunen who, over a century ago, developed a rationale for the distribution of agricultural land use around a single market. Von Thunen's initiative in formulating a general theory of land use was not provided with much support, however, until the 1950s. At this time, several economists -- notably L"sch (1954), Beckman (1957) and Alonso (1964) -- resurrected the subject, modified the von Thunen (classical) theory to a neoclassical form, and applied it in an urban context.

More recently urban economic land use theory has been dominated by the works of Muth (1969), Mills (1972) and their protégés. Muth (1969) and Mills (1972) have tended to concentrate their research energies on the housing sector within the city but, more importantly, they have now become the two most influential figures within the school known as the "New Urban Economics" (Richardson, 1976). It is this school which has become virtually synonymous with the term 'urban economics', and which has had an overwhelming impact upon geographic thought on the urban land use process in recent years (cf. Papageorgiou, 1976). It is this school, therefore, which is to receive critical consideration in the paragraphs to follow.

The New Urban Economics Framework

The central problematic for the New Urban Economics (N.U.E.) School has been the question of the relationship of patterns of land use to land rent (Wheaton, 1977). Briefly, the argument has been that both land use and land rents within the city are equilibrium solutions to the problem of locating n land users practicing m activities on j possible sites when it is assumed that:

- (i) All land users prefer, ceteris paribus, to be located at the city centre in order to avoid

transportation costs to work (in the case of residents), in order to locate at the centre of demand (in the case of retailing), etc.

- (ii) Sites are differentiated only with respect to distance from the city centre and transportation cost is a simple, linear function of distance to the centre.
- (iii) There is a household utility function in which the most important factor is a trade-off between commuting costs and housing (land and capital) consumption.
- (iv) The market is a competitive one in that the highest bidder for a parcel of land is entitled to its use, market information is ubiquitously perfect, etc.
- (v) There is a system of housing and non-residential capital supply in which it is assumed that structures on the land are neither rigid nor immobile.

Despite these apparently unrealistic assumptions, the predictions of the basic N.U.E. models are both intuitively and empirically reasonable, and have by now become familiar to most students of urban affairs as 'the economic theory of land use,' analogous to (and largely congruent with) the more 'descriptive' contributions to urban structure and growth postulated by such figures as Burgess (1925) and Clark (1951).

In recent times, however, numerous economists, planners and geographers have taken issue with the assumptions of the N.U.E. school (cf. Harvey, 1973; Roweis and Scott, 1977; Walker, 1977; Wheaton, 1977). Although the specifics of these criticisms differ from case to case, and range from relatively trivial issues such as the monocentricity assumption to all encompassing matters such as "the epistemological inadequacy of the neoclassical problematic" (Roweis and Scott, 1977), it is possible to isolate three broad themes about which debate has tended to cluster.

The Equilibrium Assumption

The N.U.E. tradition assumes that a state of equilibrium exists between the forces of supply and demand in the urban land market. However, a consideration which either neglected or assumed away in the N.U.E. models is that neither households nor housing capital (structure) are as mobile as is required for equilibrium. Thus Harvey (1973), Whitbread and Bird (1973), and others, have challenged the validity of equilibrium modelling with respect to a housing market in which there may be differential mobility constraints.

There are, for example, transactions costs attached to the act of relocating within the housing market, and such factors may give rise to what Harvey (1973) has termed as a condition

of "differential disequilibrium." Moreover, Wheaton (1977) and Bourne (1976) pointed out that housing capital (i) is fixed and immobile, and (ii) takes considerable time to respond to demand (the so-called 'construction lag' problem). This leads to the conclusion that the N.U.E. models "fail to capture the essence of housing capital that distinguishes it from other goods" (Wheaton, 1977).

The assumption of an equilibrium state also presupposes (i) that the highest bidder for a unit of property should be entitled to its use, and (ii) that all bidders are reasonably aware of what is available in the market. Yet, as several critics have indicated, neither of these conditions are likely to hold in reality. The evidence on racial discrimination in housing markets is ambiguous, but there are several factors, even apart from racial discrimination, which might mitigate against the highest bidder securing the use of a site (1). Consider, for example, the case of zoning -- not only exclusionary zoning between jurisdictions -- but 'externality zoning' within jurisdictions (Ohls et al., 1974; Bish and Nourse, 1975). Here, as Williams (1971) observes, the political planning process acts "as an explicit means of abridging market allocation." Moreover, Fenton (1976) has suggested that even when non-monopolistic conditions prevail in housing markets, variations in house prices

(and rents) may arise through income-related variations in levels of information about opportunities available within the housing market.

Absence of a Political Process

In a recent commentary upon the neoclassical tradition in urban economics, Roweis and Scott (1977) have noted that N.U.E. analyses of urban land use patterns are "profoundly quiestic." In the N.U.E. models, the most turbulent events in the urban land use process are those which are manifest in competitive attempts amongst landowners to serve competitive consumers of land use services. And even this dual competition within the city has a relatively harmonious resolution in the state of equilibrium. Thus, in the neoclassical models, "the market perfectly harmonizes and co-ordinates its allocation amongst competing users ... Bidding for land secures an agreement between buyers and sellers ... and this equilibrium must be socially optimal ... in the sense that the realized land use will also be pareto efficient" (Roweis and Scott, 1976).

The objection is that such a view of the urban land use process is manifestly unrealistic and, moreover, ideological (2). After all, the external costs and benefits of urban growth and change give rise to local political reactions which have profound

implications for the determination of urban land use patterns (cf. Cox, 1973; Cox and Dear, 1975; Harvey, 1973; Molotch, 1967; 1977; Wolpert, 1970). For example, if a developer attempts to locate some 'noxious' land use adjacent to a high income residential area, it is likely that he will invoke the wrath of local resident groups, who will then seek to ensure that permission for the project is denied (cf. Linowes and Allensworth, 1973). Indeed, a strong case can be made out for the fact that zoning itself is the product of the endeavours of politically influential groups to secure 'protection' from undesirable land uses -- including low income housing (Toll, 1969).

However, even outside of the zoning framework, political behaviors have an impact upon patterns of urban land use. For example, if 'natural' market forces determine that Blacks begin to move into a white neighborhood where some asymmetry of racial preference exists, it is likely that white residents will use a variety of informal political devices to bring this process to a halt (cf. Molotch, 1972; Wolf and Lebeaux, 1969). The essential point, as Cox (1977) and Wolpert (1970) have repeatedly stressed, is that models of urban spatial structure cannot afford to ignore that the local political process is brought about by market induced patterns of urban change, and that this political process,

in turn, acts to shape the nature of future constraints upon market behavior within the city.

A second reason why the urban land use process is neces-
sarily political is that urban land is, as Roweis and Scott (1977) have put it, a "non-commodity". Despite the historical trend towards commodity production in capitalist societies, urban land remains a peculiarly social or 'public' product. The value of residential land, for example, is a value which cannot be produced by a private corporation. To a very large extent it is a value which derives from an 'externality field'-- that is a set of spillover effects determined by the characteristics of surrounding properties. Moreover, all sites in urban areas require publicly provided services in order to function effectively. Thus, for example, a tract of land at the suburban fringe requires sewer facilities, water facilities, electric facilities and roads before it can be legitimately regarded as 'urban land.' The implications of this for the politicization of the urban development process should be self-evident: local politicians and planners become focal points in the competition to reap profits from investment in urban real estate. Quite literally, as Clawson and Hall (1973) report, "a stroke of the pen on a planner's desk can make a difference of thousands of pounds (to the developer)."

Class Conflict

Scott (1975) argues that one of the most important deficiencies of the neoclassical models is that they exclude the potential for what is, after all, one of the most powerful forces shaping capitalist society and its cities: that is, the force which marxists term as class conflict.

Neoclassical urban economists see no essential contradiction, for example, between the interests of landowners, labourers and capitalists. Yet, as Harvey (1977); Scott (1975) and Walker (1977) suggest, in an historical sense, the dynamics of social class relations may have a quite decisive impact upon the form of the capitalist city.

This emerges for example, in the debate between Mills (1972) and Muth (1969) on the one hand, and Harvey (1973) and Edel (1976) on the other, on the nature of rent within the American city. Harvey (1973) contends that absolute and monopoly rents (particularly the latter) may have become concentrated in the central city in North America. Consequently, part of the land price gradient which Mills (1972) and Muth (1969) explain exclusively in terms of differential rents may, in reality, be determined by power relationships which exist between social classes, and not competitive equilibrium.

Harvey (1977) also contends that it is impossible to understand the emergence of rent control policies, and the trend

towards public housing, without regard to the historical demise of the landed interests at the hands of both capital and labour. These policies, which have had a substantial impact upon the emerging form of the capitalist city, have had the effect of lowering the costs of the reproduction of labour power for industrial capital, and are symptomatic of the emergence of a specific stage in the historical development of the social class relations of capitalism (Harvey, 1977).

It is noteworthy, moreover, that Scott's (1976) so called 'classical' model of the urban land use process yields similar results to those postulated by Harvey (1977). In Scott's (1976) model, the benefits of agglomerated production are essentially fixed, and must be shared amongst three groups -- workers, capitalists and landowners. Distribution is determined by conflicts amongst these three. The mathematical model (which is based upon Sraffa's Neo-Richardian economics) reveals that the central land use conflict is between capitalists and landowners. Since competition forces capitalists to increase the capital/labour ratio indefinitely, a zero rate of profit is approached, and this necessitates an attack upon land monopolies (Scott, 1976).

Implications for a Revised Theory of the Urban Land Use Process

So far, three broad areas of weakness have been identified in the N.U.E. approach to the theory of the urban land use process. It should be noted, however, that these three types of theoretical weakness are not unrelated. It is reasonably evident, for example, that the assumption of an equilibrium state within the housing market, and the assumed absence of a local political process, are in fact mutually supportive abstractions. Likewise, the absence of any class conflict in basic economic theory is a condition which is conducive to a consensual view of the urban land use process.

This would suggest that any attempt to 'modify' the N.U.E. paradigm through minor adjustments to assumptions would be ill conceived. It is the basic structure of the N.U.E. paradigm which is at question, and not the detail of theory. For, clearly, the overriding shortcoming of the N.U.E. approach is its consensual, a-political view of the social processes responsible for patterns of urban land use. Any attempt at a reconstituted theory of the urban land use process must, therefore, take a more comprehensive account of the nature of social relationships in capitalist societies than that which is implied in the N.U.E. School's exclusive emphasis upon market exchange.

This is not to say that competitive market relationships, or economic relationships in general, are an insignificant aspect of the urban land use process in capitalist society. On the contrary, the behaviour of the urban land market is very largely responsible for the emergence of a local political process. Moreover, social class relations are economic relations in the general sense of the term (3).

What it does imply, however, is that 'politics' and 'economics' are inseparable dimensions of the social relations of capitalist societies; and it is these social relations, in toto, which are responsible for patterns of urban land use and land use change.

Towards an Alternative Conceptualization of the Urban Land Use Process in Capitalist Societies

Partly as a consequence of the critique of the N.U.E. paradigm, two alternative frameworks have emerged for conceptualizing the urban land use process in contemporary capitalist societies. The first of these has been termed as the 'manipulated city' framework, and the second might be labelled as the 'class conflict' framework. Each of these are considered below.

The Manipulated City Framework

The manipulated city framework, which is basically liberal

in outlook, is evident in works such as Cox's (1973) Conflict, Power and Politics in the City, Danielson's (1976) The Politics of Exclusion, Harvey's (1973) essay on the "redistribution of real income within the city" (Chapter 2 of Social Justice and the City), Pahl's (1975) Whose City?, and several of the readings in The Manipulated City (edited by Gale and Moore (1975)).

This framework emphasizes the primary role of what Cox (1978) terms as the "politics of competitive consumption" in the determination of patterns of urban land use. Urban residents are envisaged as striving to maintain or enhance the use values and exchange values of their properties -- these values being contingent upon general social and physical conditions within the neighborhood (Cox, 1973; Cox and Dear, 1975).

The relative success which resident groups experience in their negotiations with civic authorities to ensure favourable neighborhood conditions will, as Molotch (1967) suggests, be proportional to the 'political clout' of the residents concerned. The nature of 'political clout' is explained by Cox (1973): voters attempt to elect politicians who will serve their interests, and politicians will attempt to serve the interests which get them re-elected. Thus, information exchange between resident groups and local politicians becomes a factor of great significance to 'political clout'. Some groups (particularly those in upper and

middle income neighborhoods) keep local politicians more informed of their interests, and are therefore more likely to have their interests served (Cox, 1973).

There is, however, more to 'political clout' than simple information. As Cox (1973) continues, some groups will not only keep local politicians informed of their interests; they will also be availed of certain bargaining resources with which to persuade local politicians to 'co-operate'. One such resource is, of course, the vote. But there are other factors, including (i) the organizational abilities of the group, (ii) the ability to harness non-controversial, 'public interest' ideologies to local effect, and (iii) general levels of influence within decision making elites. Once again, it would appear that upper and middle income groups are more effective in these dimensions of 'political clout' (Cox, 1973; Orbell and Uno, 1972).

In view of such a framework, it is not surprising that studies within the manipulated city tradition present an image of urban society in which it appears that there has been a consistent redistribution of real income (or welfare) away from the poor and the politically inarticulate towards the upper and middle income groups: highways are built over ghettos to facilitate the affluent suburbanite's trip to the shopping centre; low income housing projects are located in areas where they cannot

harm the 'environmental quality' of upper income neighborhoods, etc. (cf. Cox, 1973; Harvey, 1973).

It should be noted, however, that upper and middle income resident groups are not the only interests which are thought to 'manipulate the city' to their private advantage. For instance, Pahl (1975) argues that property developers and landowners exert an influence upon decision making elites which is quite out of proportion to their numbers:

Planners have tidied up the physical urban scene so that one might see them as the estate handymen of the major property owners. (Pahl, 1975)

Again, developers and landowners make use of the superior information resources to impress their desires upon decision makers. By hiring professional planners and lawyers to present their cases, they inevitably 'speak the language' of urban planners and politicians more effectively than the average citizen.

To reiterate, therefore, the manipulated city framework interprets the urban land use process in capitalist society as reflecting the interests of the 'urban elites' in those societies. The sociology upon which the framework is predicated should be familiar to those acquainted with the liberal reform literature in capitalist societies: low income groups have inferior information of market conditions and opportunities, they are less able to express their wants through political channels, etc. Consequently,

they will tend to be well behind in the competition for some fund of the 'utility enhancing' within the city. At the forefront of the competition are upper and middle class resident groups, landowners, developers and the 'professional classes' in general.

The Class Conflict Framework

The class conflict approach to the urban land use process in capitalist societies has been presented in several recent works on urban political economy. Examples include Cox's (1977) Urbanization and Conflict in Market Societies, Tabb and Sawer's (1978) Marxism and the Metropolis and the second half of Harvey's (1973) Social Justice and the City.

The class conflict framework differs from the manipulated city framework in that the former places only secondary emphasis upon 'consumptive groupings' within the city. Much more important to the class conflict framework are the dynamics of class conflict, where class is defined in terms of relations to the means of production. Very broadly, therefore, the class conflict and manipulated city frameworks derive from the marxist and liberal intellectual traditions respectively.

The point of departure for the class conflict framework is the economic raison d'etre for the city. This is seen as having

changed historically, but it is argued that the most important consideration during the period of industrial capitalism is that advantages of scale and proximity multiplied the magnitude of the social surplus product (Tsuru, 1962). Thus, under industrial capitalism, the city became "a force in production... a set of technical relations which increased the efficiency of the production process" (Harvey, 1973).

The marxist school has generally argued, however, that whilst increasingly agglomerated production facilitated the efficiency requirements of industrial capitalism, the urbanization process has not been without its internal contradictions. For example, "the agglomeration of workers into large enterprises and urban areas... increased the potential for working class action against capital" (Bowles and Gintis, 1976). This tension (or contradiction) between the efficiency requirements of industrial capitalism on the one hand, and social relations of production on the other, is seen as having been alleviated, to some extent, by certain parallel developments within the mode of production.

Firstly, the marxists argue, class conflict is not limited to a struggle between capital and labour alone. There are at least three groups of claimants to the social surplus product (or that portion of wealth which exists over and above the amount socially necessary for the reproduction of labour power). These

groups are (i) the landed interests (landowners), (ii) labour (workers), and (iii) industrial capitalists (owners of the means of production). The form in which the landed interests appropriate their share of the social surplus product is rent. Labour, on the other hand, appropriates its share in wages, and industrial capital, in turn, appropriates its share in the form of profits. In view of this situation, it may well be that labour will join forces with capital against the landed interests. If rents can be reduced by the political actions of labour and capital, then profits and/or wages may rise accordingly (Harvey, 1977).

Such conflicts have important implications for the urban land use process in capitalist societies. For example, to the extent that the interests of labour and capital tend to prevail (in the longer term) under capitalism, a secular decline in the role of the 'slumlord' in the supply of residential space is to be expected. Labour and capital may encourage 'public housing' policies designed, on the one hand, to exclude the landed interests claims to 'monopoly rents' and, on the other, to increase labour and capital's share of the social surplus (Harvey, 1977).

A second development within the capitalist mode of production which tends to detract from open conflict between industrial capital and labour is that which is associated with the

division of labour. Economies of specialization in production become reflected in concomitant shifts in the social relations of capitalist societies. In particular, labour is bifurcated into 'consumptive classes', 'authority groupings' and 'status groups'. Competition between these groups (a theme, of course, of the manipulated city framework) detracts from the homogenization of labour, and functions to suspend any direct conflict between capital and labour (Giddens, 1973).

A final point of interest is that marxists have recently identified a structural conflict in capitalist society which has special significance for the problem of urban residential growth. This is the conflict which has emerged between finance capital and labour (cf. Harvey, 1974; Cox, 1978).

Finance capital is the catalytic agent behind the urban land use process in capitalist societies. It is this group which searches for the speculative profits of land use conversion, or the $E(Pu_1 \rightarrow u_2)$ values described in Part I of this study. According to the 'hidden hand' postulate of neoclassical theory, these 'entrepreneurs' are the servants of labour. For a small fee, they cater to labour's 'demand' for housing. Yet, the marxists argue, what this view neglects is that there may be important conflicts between the two groups which originate in the different interests which each have in the residential growth process.

Finance capital cannot have any affective ties to the city; competition dictates that the city will be seen simply as a matrix for the realization of $E(P_{u1} \rightarrow u2)$ values. Labour, on the other hand, views the city, and the urban land use process, in use value terms; what matters to labour in urban land use change is the impact upon labour's welfare. This contradiction emerges, for example, when finance capital's search for profits leads to an alteration in the use value characteristics of sites adjacent to those which are being developed. Whenever this occurs, the preconditions exist for conflict between finance capital and labour.

There are, of course, relatively few instances in which the two groups engage in outright political confrontation over the relative costs and benefits of urban growth and change as a whole. For, firstly, these conflicts have tended to be institutionalized and depoliticized by the urban planning process (Cockburn, 1977). And, secondly, labour tends to focus merely upon the phenomenal forms of the conflict, and thus limits its attentions to blow by blow skirmishes at the most local of levels (Cox, 1978).

Nevertheless, these skirmishes still exert a substantial influence upon the urban land use process. In Cox's (1978) view, for example, patterns of urban form are fundamentally determined

by finance capital's attempt to seek out the 'path of least resistance' to urban land use change. In practice, this often means that politically articulate fractions of labour (in South Africa, for example, higher status Whites) will be least troubled by finance capital's search for profits, whereas politically inarticulate groups (in South Africa, low status Whites and non-white groups) will be more subject to the negative 'external effects' of finance capital's endeavours.

Conclusion

If one point should be clear, at this stage, it is that patterns of residential growth and change in a capitalist city will reflect not only a market-based social consensus, but also economically-based social conflict. There is a logical fallacy in the neoclassical view that the urban land process mirrors (via the 'hidden hand') a consensual solution to the locational preferences of residents in cities; the land use process will also be characterized by politically imposed constraints (4). In addition, some social conflicts will give rise to patterns of residential growth which are not the product of private market activities. All in all, therefore, the field of urban residential growth seems ripe for what Kuhn (1962) would term as a "paradigm shift." In this case, the obsolete paradigm would be the neo-classical approach, whilst the new paradigm would be either the

manipulated city framework or the class conflict framework or,
perhaps, some combination of both.

CHAPTER 8

THE URBAN LAND USE PROCESS IN DURBAN REVISITED

-- APPLYING THE REVISED FRAMEWORKS

Introduction

Although it would be premature to attempt anything definitive, it seems important to make a start towards applying the manipulated city framework, and the class conflict, to the problem of residential growth and change within the South African city. It is not only that the neoclassical approach yields results which are inconclusive in an empirical sense. There is also the issue of the conceptual inadequacy of the neoclassical framework. Thus, this chapter represents an initial attempt at reorienting both theoretical and empirical research on residential growth and change in the South African city towards the revised (manipulated city and class conflict) frameworks.

The structure of the chapter is as follows: first, it is argued that much of the literature on the emergence of the apartheid city (implicitly) suggests that the manipulated city framework is applicable to certain aspects of the land use process within the South African city. Second, an empirical analysis is presented which suggests that patterns of urban residential growth have been sensitive to variations in the social geography of the

city. It is argued that this relationship may be indicative of the role of local political opposition (either real or anticipated) with respect to the external effects of urban residential growth. Again, this would support the postulates of the manipulated city school and, to a certain degree, the class conflict school. Finally, it is suggested that certain aspects of the urban land use process in South Africa -- especially those associated with public housing for non-white groups -- correspond with the class conflict view of the urban land use process in capitalist societies.

The Emergence of the 'Apartheid' Urban Form
and the Manipulated City Framework

Social scientists are generally agreed that one of the more outstanding features of the urban land use process in South Africa in the past few decades has been the emergence of an apartheid urban form (1). As has already been noted, traditional, neo-classical land use theory does not make allowance for such developments. The question at this stage, however, is whether either manipulated city theory, or class conflict theory, is able to provide a reasonable and non-particularistic explanation for this allegedly 'peculiar' policy.

It is the purpose of this section to argue that manipulated city theory, in particular, is very clearly applicable to the

problem of the emergence of an apartheid urban form. In presenting this argument, it will be useful to begin with a review of the literature on the emergence of the apartheid city.

Discussion of Pre-1948 Urban Racial Segregation

Apartheid, as a policy of racial segregation, has usually been associated with the post 1948 period and the ideology of Afrikaner Nationalism. Observers of the South African city, however, have generally acknowledged that the particular problem of urban racial segregation has not been the unique creation of Nationalist policy. Kuper, Watts and Davies (1958), for example, have indicated that in 1951 (prior to implementation of Nationalist urban apartheid plans), de facto racial segregation was quite pronounced in Durban. De jure segregation is also recognized as having a history which predates Nationalist legislation. For instance, Welsh (1971) has noted how the Natives (Urban Areas) Act of 1923 precluded the ownership of urban lands by Africans, and thereby laid the foundation of racial segregation throughout South Africa. Kuper, Watts and Davies (1958) have also indicated that, at the local level, a plethora of municipally imposed legislation effectively separated the races since the nineteenth century (2).

Much of the pre-1948 segregation has been attributed to the concerns of white residents with respect to negative external

effects of non-white neighbors. In the Durban case, for example, it is suggested that the urbanization of Indians provided cause for 'concern' amongst white urban residents, and that these concerns led to early attempts to legally separate the races. Thus, the Durban Housing Survey (1952) and Kuper, Watts and Davies (1958) both describe how white residents reacted to declining property values in racially changing neighborhoods, and how this led to the appointment of several commissions of inquiry into the problem of 'neighborhood change' (3). It is noted that these inquiries, in turn, culminated in legislation such as the Trading and Occupation of Land (Transvaal and Natal) Restriction Act of 1943 and the Indian Representation Act No. 26 of 1946 -- both of which effectively froze the existing racial distribution of lands in Durban (4).

The events which led to the demolition of African slums are often cited as a second example of how the external effects of urban growth and change gave rise to political attempts by white residents to ensure racial segregation in the cities. For instance, the Durban Housing Survey (1952) suggests that white residents in Durban were concerned with the potentially contagious effects of social deviance and disease in the notorious Cato Manor slum, and that these concerns led the City Council to enact legislation which, together with several acts of Parliament, allowed for the

implementation of comprehensive slum removal plans, and the displacement of the nonwhite population to peripheral townships (5).

The processes responsible for segregation have generally been identified in the literature as having distributionally perverse effects. For example, it is argued that the highest quality lands -- those with sea views, cooler climates and more central locations -- have consistently been retained for white use, whilst the unwanted remainder has been assigned to Non-whites (6). Indeed, the central proposition of the literature would appear to be that, in the pre-1948 era, residential segregation along racial lines was secondary to, and often instrumental in, the "redistribution of real income" in favour of the "dominant social group" (i.e. the Whites) (7).

The Problem of the Apartheid City

The emergence of the post-1948 apartheid city, however, presented observers with a new set of considerations. For example, in 1950 parliament passed the controversial Group Areas Act. Whilst this Act did not prescribe specific plans for particular cities, it did provide the uniform legal machinery necessary to attain permanent urban racial segregation throughout South Africa. And, perhaps more importantly, it contained a 'planning philosophy' to which individual cities were expected to conform.

Briefly, the planning philosophy behind the Group Areas Act recognized the functional interdependence of the races in production and exchange, but it laid down certain principles according to which they should be separated in residence. The Durban Housing survey (1952) has summarized these principles as follows:

- (i) There should be consolidated residential areas for each race group.
- (ii) Each consolidated area should be so placed as to have access to a growth hinterland for future development.
- (iii) The consolidated areas should, wherever possible, be separated from each other by strong physical barriers (e.g., a river valley). As a second option strong man-made barriers should be used (e.g., railway, highway, etc.). In the event of neither of these options being available, 'buffer zones' of open space should be employed as a divide.
- (iv) Each group should have access to and from the work zone where interaction is permissible (and indeed, obligatory). In the process of movement to and from the work zone, however, no ethnic group should cross another's residential area. Consequently 'ethnic islands' should also be avoided.
- (v) The black areas should be located as closely as possible to work centres, since it is they who have to bear transport costs on low wages.
- (vi) Each area should become self-governed and should become as functionally independent as is possible of all other areas. Areas should proceed towards equality in all respects.

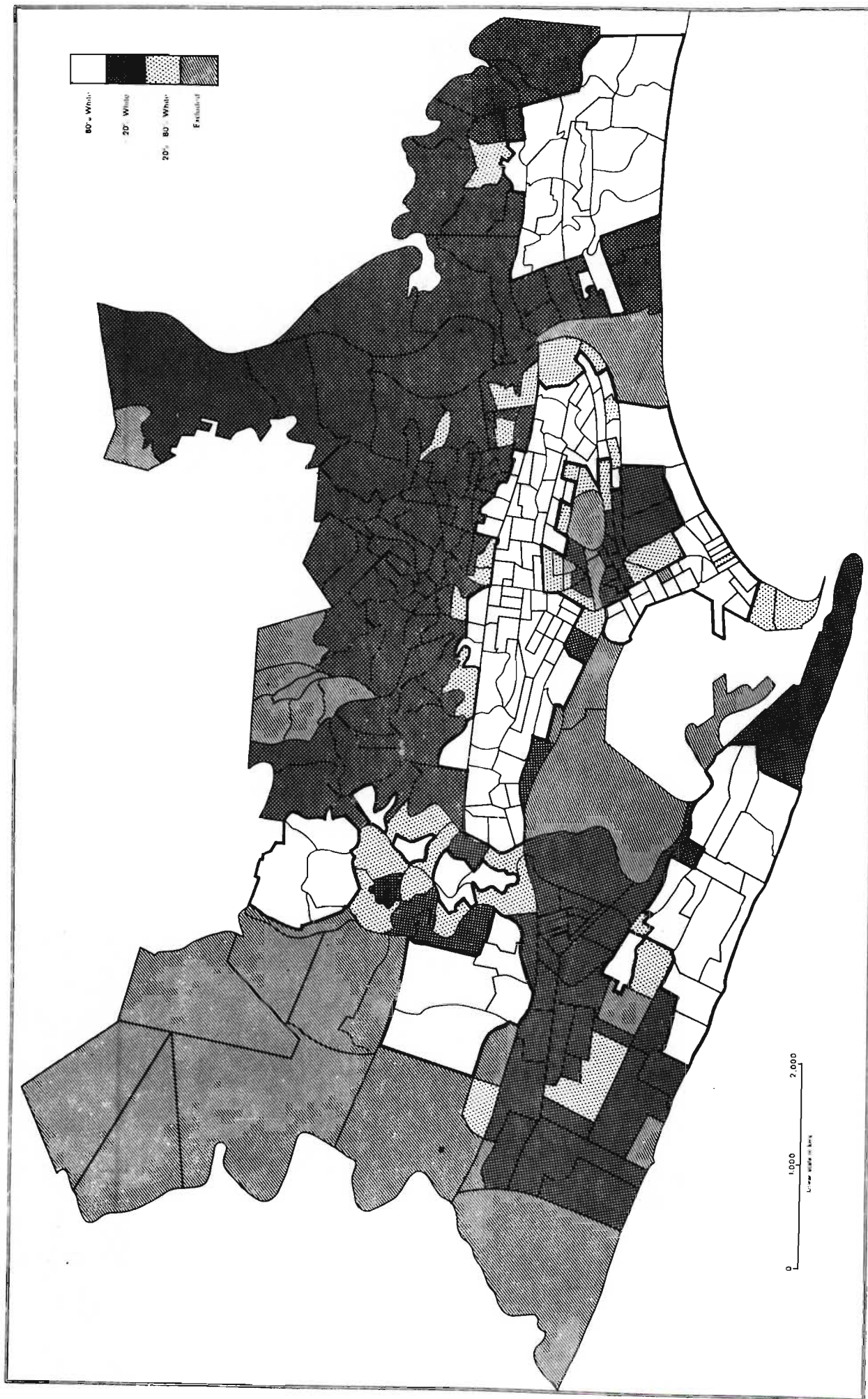


FIGURE 8.1: RACIAL DISTRIBUTION IN DURBAN IN 1960



FIGURE 8.2: GROUP AREAS FOR DURBAN IN 1975

Davies (1974) has noted that only one spatial model can satisfy all of these conditions simultaneously -- a sectoral model in which members of each race group are located (in residence) in different sectors, and where each commutes to production and exchange facilities at the centre of the city. Figure 8.2 demonstrates that, in the Durban case, the sectoral model has been quite closely approximated.

The questions which these plans posed for observers of the South African city were as follows: first, to what extent did apartheid plans represent a departure from the previous form of the South African city; and, secondly, what were the essential social processes underlying such a departure?

The first question proved quite simple to answer: despite criticism that the plans could never be implemented, in practice Group Areas legislation did facilitate a substantial alteration in the residential structure of the city (8). In Durban, for example, almost one half of the city's population was forced to relocate in accordance with Group Areas proposals (9).

The second question, however, required more careful consideration. Nationalist planners have tended to argue that their policy was motivated simply by a need for a more consistent policy of 'separate development' -- that is, a policy designed to provide completely separate opportunities and residential areas for

members of each race group. Liberal observers, however, have remained skeptical on this point. Davies (1976), for example, has noted that the existence of high levels of pre-apartheid legislation "suggest that if segregation alone were at issue, no great stress need have been placed upon existing residential structures (as in the implementation of Group Areas legislation)."

In the light of such conclusions, liberal observers found it necessary to probe more deeply into the relationship between apartheid theory and apartheid practice in order to uncover the covert social processes responsible for the policy. The conclusions have been almost unanimous: the theory of separate development, or apartheid, should be interpreted simply as a new form of legitimation for a relatively old social process -- viz. the organization of the city to the advantage of Whites, and the displacement of the social and economic costs of urban growth and change to Non-whites (10).

Data supporting this view have been presented in several studies. Kuper, Watts and Davies (1958), for example, indicated that whereas sixty percent of the non-white population were to be displaced under the Group Areas plan for Durban, the equivalent figure for Whites was only ten percent. Similarly, the Durban Housing Survey (1952) noted the unequal exchange of property between Whites and Indians in Durban: Group Areas plans required

fourty percent of Indian-owned lands (by value) to be set aside for White use, but only five percent of White-owned lands (by value) were provided for Indian use (11). Such unequal exchanges, of course, would be reflected in elasticities of supply, and would raise the price of Indian lands disproportionately. Several observers have also argued that, in the implementation of Group Areas plans, non-white workers have been displaced to the urban periphery and this has raised their journey to work costs (Dewar, 1978; Maasdorp and Humphries, 1975; Western, 1978).

Theoretical Implications

In sum, therefore, the liberal thesis on the emergence of the apartheid city would seem to support Harvey's (1973) postulate that, in the process of bargaining over the external costs and benefits of residential locations in cities "we can expect considerable imbalance in the outcome... because (i) different groups have different resources with which to bargain, (ii) large groups in the population are generally weak and more incoherent than small groups and (iii) some groups are kept away from negotiation altogether." This is, of course, essentially the manipulated city thesis on the urban land use process in capitalist societies: In the politics of urban land use, there will tend to be a 'redistribution of real income' towards politically resourceful, articulate and powerful groups (in this case, white residents).

Residential Differentiation and Residential Growth

in Durban: An Empirical Analysis

The preceding review of the literature on the emergence of the apartheid city has demonstrated that the manipulated city framework is applicable to some policy related aspects of the urban land use process in South Africa. It should be noted, however, that manipulated city theory does not confine itself to questions of racial competition within the city. More importantly, it emphasizes conflict between 'status groups' and/or 'housing classes' within urban housing market (12). Thus, in the case of residential mobility within the housing market, neighborhood 'gentrification' issues and/or political activity associated with 'downwardly transitional' neighborhoods have become important to debate within the manipulated city school (cf. Cox, 1973).

In the case of residential development, on the other hand, flat construction is especially salient to the manipulated city approach. There is little doubt that flat dwellers, and the general physical environment associated with flats, have negative connotations for many urban residents (Cox, McCarthy, and Nartowitz, 1978). Thus, despite the fact that flat use is 'high bidding', flat developers may be constrained in their choice of sites by the potential threat of resident groups anxious to exclude flats from their particular neighborhoods (Linownes and

Allensworth, 1973). This is reflected in the United States, for example, by the fact that the majority of land use conflict issues are associated with resident group opposition to rezonings for apartment (flat) use and/or high density housing (McCarthy, 1978).

If the manipulated city framework is to be applied to the problem of residential growth within the South African city, it would be advantageous to know whether the threat of resident group opposition is significant to patterns of residential growth. Clearly, however, a definitive analysis of the relationship between local political resistance and urban residential growth would require a set of survey data -- data which, unfortunately, are not readily available.

On the other hand, ecological analysis is not entirely devoid of value. It might be possible, for example, to establish certain relationships between patterns of residential growth during some period t_1 to t_2 , and patterns of residential differentiation existing at t_1 . The advantage of such an analysis is that it would permit some generalization about the likelihood for residential growth in different social areas. These generalizations could then be compared with the postulates of the manipulated city school. For example, if it is assumed, with manipulated

city theorists, (a) that flat construction will constitute an undesirable externality for residents in the immediate neighborhood, and (b) that higher status areas are more effective in using 'political clout' to exclude undesirable developments, it may be anticipated that patterns of flat development will be negatively associated with areas in which there are high status populations.

Although there are several such hypotheses which could be considered in the Durban case, at this stage, an exploratory analysis of the relationship between patterns of residential growth and patterns of residential differentiation seems more appropriate than a formal, hypothesis testing methodology. For this reason, the results of a canonical correlation analysis of the relationship between patterns of residential growth (1960-1974) are presented here.

Canonical correlation analysis is discussed in an appendix to this study, but it may be noted here that the principal objective of the technique is that of 'pattern matching'. The variance within some matrix X is compared to the variance within some other matrix Y, and an attempt is made to isolate patterns of common variance within X which are maximally correlated with patterns of common variance within Y (Cooley and Lohnes, 1971). In this case, the matrix X is a set of factor scores which summarize

patterns of residential differentiation within the city in 1960. The matrix Y, on the other hand, is a set of indexes of residential growth for the 1960-1974 period in Durban.

The Derivation of Factor Scores for the Matrix X

There is a need to derive some summary indexes of the state of residential differentiation existing in Durban in 1960. The technique known as 'urban factorial ecology' is adequately suited to such a task (cf. Murdie, 1971; Rees, 1970; Timms, 1971). In brief, the objective of urban factorial ecology is to isolate patterns of common variance (or factors) within some matrix of variables (typically, social characteristics of the population) and observations (typically, subareas of the city). The factors are then interpreted, in conceptual terms, as parsimonious 'dimensions of social differentiation.' The spatial variability of the dimensions can subsequently be established by plotting the factor scores for each observation on a map.

In this particular case, the input matrix is a set of social indexes derived from the 1960 census. These indexes are weighted averages of measures provided by the Bureau of Statistics for the White, Asian and Coloured population groups in 1960. A complete listing of the twenty nine variables employed in the analysis is provided in Table 8.1. It may be noted that the

FIGURE 8.1

VARIABLES INCLUDED IN FACTOR ANALYSIS OF SOCIAL DIFFERENTIATION

No.	Variable	Means	Comunalities
1	% White population	53.6%	0.96
2	% Population in houses	65.5	0.79
3	% Persons/(1,000 ft) ² (population density)	50.1	0.64
4	% Aged 0-4 yrs.	13.0	0.79
5	% Aged 5-20 yrs.	35.1	0.75
6	% Aged 21-34 yrs.	22.1	0.52
7	% Aged 35-49 yrs.	16.8	0.72
8	% Aged 50-64 yrs.	10.2	0.87
9	% Aged 65+ yrs.	8.9	0.89
10	% Male	49.8	0.79
11	% Married Women	20.3	0.71
12	% Widowed Women	5.8	0.88
13	Per Capita Income	40.8	0.87
14	% Not gainfully employed	66.5	0.81
15	% Professional, Technical or Admin. employed	14.8	0.85
16	% Clerical and/or Sales employed	30.1	0.80
17	% Primary (not mining) employed	19.0	0.62
18	% Transport employed	7.5	0.69
19	% Services employed	10.1	0.54
20	% Craftsmen employed	32.9	0.72
21	% English home language	54.9	0.90
22	% Afrikaans home language	8.7	0.77
23	% Hindu Religion	28.7	0.90
24	% Islam Religion	9.4	0.65
25	% With no education	25.4	0.88
26	% With Primary education	28.2	0.91
27	% With Std. 6 - Std. 8 education	32.3	0.88
28	% With Std. 9 - Std. 10 education	11.3	0.91
29	% With post high school education	6.2	0.88

Table 8.2

Factor 1: Table of Significant (<-0.6 , or $>+0.6$) Rotated Factor Loadings.

Positive Loadings			Negative Loadings		
No.	Variable	Loading	No.	Variable	Loading
23	% Hindu Religion	0.87	1	% White	-0.85
26	% Primary Education	0.75	21	% English	-0.79
25	% No Education	0.73	7	% 35-49 Age	-0.78
19	% Services Employed	0.67	13	% Per Capita Inc.	-0.76
			27	% STD. 6-8 Educ.	-0.74
			11	% Married Females	-0.72
			16	% Clerical/Sales W.	-0.70
Variance Explained by Factor 1 = 32.5% Total					

Tables 8.3 and 8.4

Factor 2: Table of Significant (<-0.6 , or $>+0.6$) Rotated Factor Loadings.

Positive Loadings			Negative Loadings		
No.	Variable	Loading	No.	Variable	Loading
18	% Transport Employed	0.77	15	% Prof./Tech./Admin. Employed	-0.74
22	% Afrikaans	0.65	29	% Post School Educ.	-0.66
Variance Explained by Factor 2 = 11.2% Total					

Factor 3: Table of Significant (<-0.6 , or $>+0.6$) Rotated Factor Loadings.

Positive Loadings			Negative Loadings		
No.	Variable	Loading	No.	Variable	Loading
3	Raw Pop. Density	0.75		(None)	
24	% Islam	0.66			
Variance Explained by Factor 3 = 6.6% Total					

Table 8.5

Factor 4: Table of Significant (0-.6, or +0.6) Rotated Factor Loadings.

Positive Loadings			Negative Loadings		
No.	Variable	Loading	No.	Variable	Loading
2	% Single Fam. Dwell.	0.84	12	% Widowed	-0.81
14	% Not Gain. Employed	0.74	9	% 65+ Age	-0.77
5	% 5-20 Age	0.70	8	% 50-64 Age	-0.74
4	% -04 Age	0.69			
Variance Explained by Factor 4 = 21.8% Total					

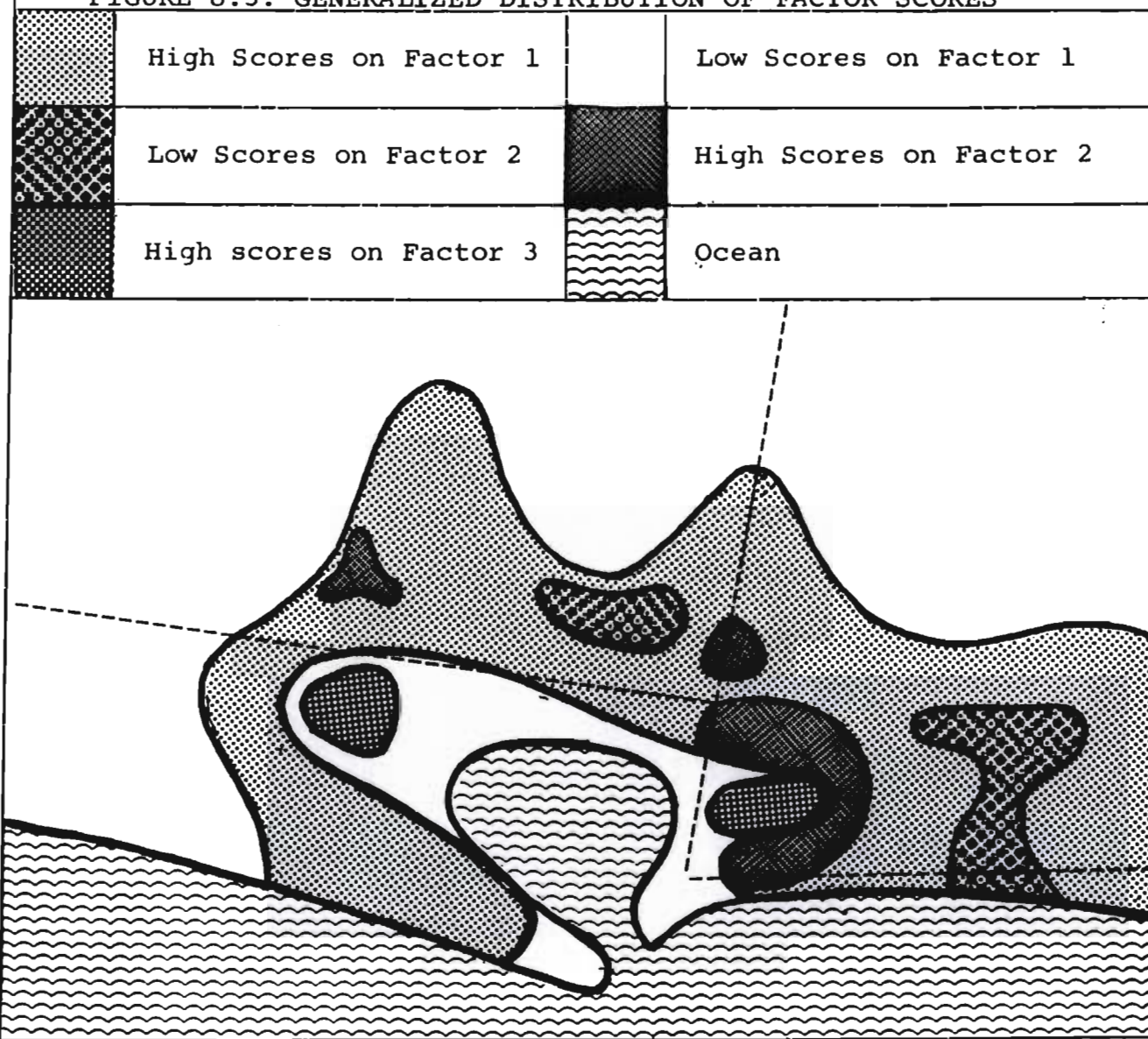
observations for the analysis are the 321 enumerator subdistricts applicable to the City of Durban in 1960.

The results of the S.P.S.S. version PA2 varimax rotated factor analysis were as follows: four varimax rotated factors were isolated and, together, these accounted for over 73 percent of the total variance existing within the input matrix. Tables 8.2, 8.3, 8.4 and 8.5 list the most important factor loadings for each of these factors. As can be seen from these tables, factor 1 makes a broad distinction between the two major population groups in the City of Durban: on the one hand, Hindus with lower educational qualifications and incomes and, on the other hand, Whites with higher educational qualifications and incomes. This dimension, which summarizes a great deal of the variance within the input matrix (33 percent), is clearly a racial differentiation factor (13). Factor 2, on the other hand, contrasts very high status populations with lower status, Afrikaans speaking and transportation employed groups. In short, this factor identifies the major dimension of status differentiation within the white group (14). Factor 3 isolates the Islamic population living in high density areas of the city. This factor, then, is indicative of religious/ethnic differentiation within the black group (15). Factor 4 isolates what urban ecologists terms as the 'family status' dimension of social differentiation. Thus, in this

analysis, areas in which there are families living in single family dwellings with children and non-working mothers are contrasted with areas in which there are families with older and widowed persons (16).

Detailed maps of the distribution of factor scores are provided in an appendix to the study. Figure 8.3, however, provides a diagrammatic summary of the pattern of residential differentiation according to factors 1, 2 and 3. These are the factors which are most likely to be related to patterns of residential growth, since each is in some way associated with income variations, educational variations and/or variations in political power and influence. It may be noted that high scoring areas on factor 1 (i.e., essentially the white areas) are concentrated in a broad band surrounding the Durban bay. Within this band of white occupance it is possible to isolate certain areas of high social status (i.e., high education, income, etc.) and low social status (i.e., low education, low income, Afrikaans speaking, etc.). The former areas (low scores on factor 2) are located in certain sections of Durban North and the Berea Ridge, whilst the latter areas (high scores on factor 2) are located in a band surrounding the non residential urban 'core', an area straddling Berea Road and the Rossburgh area. High scoring areas on factor 3 are those sections of the city characterized by high population

FIGURE 8.3: GENERALIZED DISTRIBUTION OF FACTOR SCORES



populations densities and higher social status within the non white group (17). These predominantly Islamic areas are located (a) in the vicinity of Grey Street, and (b) the Bayhead region (an Indian "shantytown", since demolished).

Comparison of the Matrix X with the Matrix Y

As indicated earlier, the canonical correlation analysis compares a matrix of indexes of residential differentiation in 1960 (i.e., the factor scores derived above) with a matrix of indexes of residential growth for the 1960-1974 period (i.e., the indexes of residential growth discussed in Part I of the study). A complete listing of the variables contained in both of these matrixes is provided in Table 8.6 below. The observations in each of the matrixes are the same: that is, the set of 88 grid cells chosen for analysis in Part I of the study.

From a statistical point of view the results of the S.P.S.S. canonical correlation analysis are satisfactory and well defined. As is evident from Tables 8.7 and 8.8, two pairs of canonical variates were derived, with high canonical correlations between each pair.

TABLE 8.6

VARIABLES INCLUDED IN THE CANONICAL CORRELATION ANALYSIS

Matrix	Var. No.	Code	Description
X	1	FACS1	Scores for factor 1
X	2	FACS2	Scores for factor 2
X	3	FACS3	Scores for factor 3
X	4	FACS4	Scores for factor 4
Y	1	HOUSE	No. of houses constructed
Y	2	FLAT	No. of flats constructed
Y	3	COSTCON	Net cost res. construction
Y	4	DEM	No. of units demolished
Y	5	OTHER	Net increment in units

TABLE 8.7

CANONICAL WEIGHTS FOR CANONICAL VARIATES 1 AND 2

X Variables	Weights for Can.Var.1	Weights for Can.Var.2
FACS 1	-0.02	-0.87
FACS 2	-0.03	0.79
FACS 3	-1.07	0.14
FACS 4	0.39	-0.50
Y Variables	Weights for Can.Var.1	Weights for Can.Var.2
HOUSE	0.15	0.29
FLAT	1.25	1.10
COSTCON	-1.81	0.05
DEM	-0.41	-0.36
UNITS	-0.19	-0.26

TABLE 8.8
CANONICAL CORRELATIONS BETWEEN PAIRS OF VARIATES
AND RELATED STATISTICS

Statistics	Can. Var. 1	Can. Var. 2
Eigenvalue	0.50	0.24
Canonical Correlation	0.70	0.49
Chi-Square	88.64	32.49
Degrees of Freedom	28.00	18.00
Level of Significance	0.001	0.02

The interpretation of the conceptual status of canonical variates is similar to the interpretation of factors from a table of factor loadings in factor analysis. (In canonical correlation analysis the canonical weights are equivalent to factor loadings). Thus, it may be noted that the first canonical variate relates a pattern of low cost flat construction to areas which were typified by lower population densities and lower status within the black group in 1960. (As is evident from Table 8.7, the higher canonical weights for variables within the Y matrix were 1.25 for FLAT and -1.81 for COSTCON; similarly, the single high canonical weight for variables within the matrix X was -1.07 for FACS3). The

second canonical variate also relates a pattern of flat construction to certain social areas within the city. In this case, however, the pattern of flat construction is not low cost, and the social areas are those occupied by blacks and/or lower status whites in 1960. (Note that the high canonical weight for variables within the Y matrix was 1.10 for FLAT; in matrix X, the weights -0.87 for FACS 1 and 0.79 for FACS 2 stand out).

Social Processes Underlying the Relationships Identified by the Canonical Variates

The relationship which is identified by canonical variate 1 points to the significance of public housing policies for patterns of residential growth in Durban. In accordance with such policies, low cost housing schemes (mostly semi-detached flats for Indians) have been in progress in areas remote from the city centre and in areas which, in 1960, were associated with low density, semi-rural Hindu occupation (e.g., Chatsworth). To some extent, these housing schemes have been a logical consequence of Group Areas policy in Durban: Indians displaced from Cato Manor, the Bayhead and elsewhere needed to be relocated within the city. Thus, to a certain degree, the relationship identified by variate 1 is symptomatic of the effects of race conflict upon patterns of residential growth in Durban. (It will be recalled that Group

Areas policy has been interpreted as a policy associated with the redistribution of welfare from Non-whites to Whites). On the other hand, variate 1 may also be identifying a relationship which is symptomatic of the operation of the forces of class conflict in South Africa: that is, conflict between capital, the landed interests and labour. This point may not seem self evident at this stage, but it will hopefully be clarified in a section to follow.

The relationship identified by canonical variate 2 would appear to be symptomatic of the effects of status group competition upon patterns of residential growth. Higher cost flat construction (probably for lower status whites) has proceeded apace in areas of the city which were of lower social status in 1960; at the same time, flats have been virtually excluded from areas of the city which were of higher social status in 1960. It is noteworthy, moreover, that variate 2 identifies flat development as being negatively associated with white areas in general. Thus, it is not simply high status areas which have been impervious to flat development but, more specifically, high status areas within white regions of the city.

Before concluding discussion of the effects of the political process upon patterns of residential growth, it will be necessary

to consider public housing programs in South Africa in the light of the class conflict framework.

Public Housing Projects and the Class

Conflict Framework

The manipulated city framework tends to assume that 'social elites' (in South Africa, for example, higher status groups and/or the white group in general) will consistently rearrange the structure of the city so as to 'redistribute real income' to their own advantage. It might be argued, however, that one aspect of the land use process in South Africa which defies the postulates of the manipulated city theorist is government provision of public housing for non-white groups. Here, at least, it may be argued, is evidence of the philanthropic behavior of the government of an allegedly self-interested and exploitive "white oligarchy" (18).

No doubt , manipulated city theorists would object that the advantages to the white oligarchy of such policies outweigh the disadvantages (19). It may be noted, however, that class conflict theorists would argue that both such views are indicative of a misunderstanding of the nature of the state in capitalist society. The policies of the capitalist state, it is argued, will express the historical development of social class relations, where class is defined in terms of relationships to the means of production (20).

Thus, for example, apartheid policy in general, or public housing policies for Non-whites in particular, should not be interpreted in terms of conflicts between status groups, race groups and the like. More properly, such policies are to be interpreted in terms of the historical development of social class relations.

Some social scientists have already recognized the utility of this view for the analysis of 'macro-apartheid' policy. The Homelands, for example, are seen as the modernization of an earlier Native Reserve policy. Initially, the reserves, in conjunction with 'pass law' and 'poll tax' legislation, served to create a labour supply for the emerging mining and industrial centres in South Africa (21). In more recent times, they have served to minimize the costs of reproducing labour power by maintaining economically inactive Africans (women, children and the elderly) in a subsistence economy (22).

But how might such a framework be applied to the problem of urban public housing? Some clues are offered in the debate on the emergence of public housing policies in other capitalist societies (discussed in Chapter 7). The emergence of public housing programs for low income workers, it is held, is indicative of the demise of the 'landed interests' at the hands of both capital and labour (Harvey, 1977). Slum landlords and other groups who extract surplus value by levying 'monopoly rents'

on labour, are the victims of a state policy which is directed to the interests of industrial capital and labour.

That this may be true of the South African case is almost beyond doubt. Before 1950, the majority of Non-white workers in the South African city were housed in shack dwellings where rents were very high, given the primitive level of shelter afforded. In Durban, for example, Indian slumlords were able to levy monopoly rents which, for one small room, were equivalent to approximately one quarter of the average earnings of a non-white labourer (23). In view of the fact that more than one half of Durban's non-white labouring population lived under such conditions, it was clear that the costs of reproducing labour power were significantly higher than that which would be possible under a state supervised system of public housing. Consequently, several studies were conducted into the feasibility of such low cost housing schemes (24).

It is noteworthy that two policy considerations arose out of these studies:

- (i) It was argued that the cost factor in construction should always be related to the so-called 'poverty datum line' level of income of black families. This 'poverty datum line' was a specific proxy for the minimum costs required for the reproduction of labour power in the cities (25).

- (ii) There was some difficulty in raising capital for housing projects for Non-whites. Private industry, for one, was most reluctant to contribute (26). In the long run, therefore, the 'solution' was to pass construction costs on to labour (27). This would raise industry's wage bill somewhat, but it did exclude monopoly rents previously levied by Indian landlords.

In practice, public housing has probably been as much a victory for capital and labour as it would seem in theory; unfortunately, the data to support this view, or to contradict it, are unavailable. The point to be emphasized here, however, is that the forces of class conflict may have been reflected in patterns of residential growth in Durban. It is very difficult to understand why there should have been publicly assisted housing development in Chatsworth, for example, without recourse to the class conflict framework.

Conclusion

This chapter has considered a variety of materials which suggest that conflicts between classes, status groups, and race groups have had an effect upon patterns of residential growth in Durban. The analysis represents little more than a start in a certain direction of research. There are, for example, complex interdependencies between class, status and race group conflicts in South Africa, and the full implications of these interdependencies have not been examined here. Nevertheless, it will

be useful to provide a summary and synthesis of what has been accomplished thus far:

1. Competition between race groups for some fund of the 'utility enhancing' has given rise to an apartheid urban form. In the course of the evolution of this form, non-white groups (mainly Indians) have been removed from certain areas of the city (notably Cato Manor and the Bayhead area). These areas of displacement (shaded portions of Figure 8.4) subsequently became zones of institutional redevelopment. These zones have been characterized by high levels of demolition and land consolidation, anticipating redevelopment to either white residential use (as in the case of Cato Manor) or industrial use (as in the case of the Bayhead area).
2. Partly as a consequence of race group competition, and urban apartheid policy, the population displaced from zones of institutional redevelopment has been relocated to areas which are remote from the city centre (the checkered section of Figure 8.4). In these zones of institutional suburbanization land subdivision and residential construction (both flats and houses) have been marked.

FIGURE 8.4: DISPLACEMENT AND GROWTH ASSOCIATED WITH APARTHEID

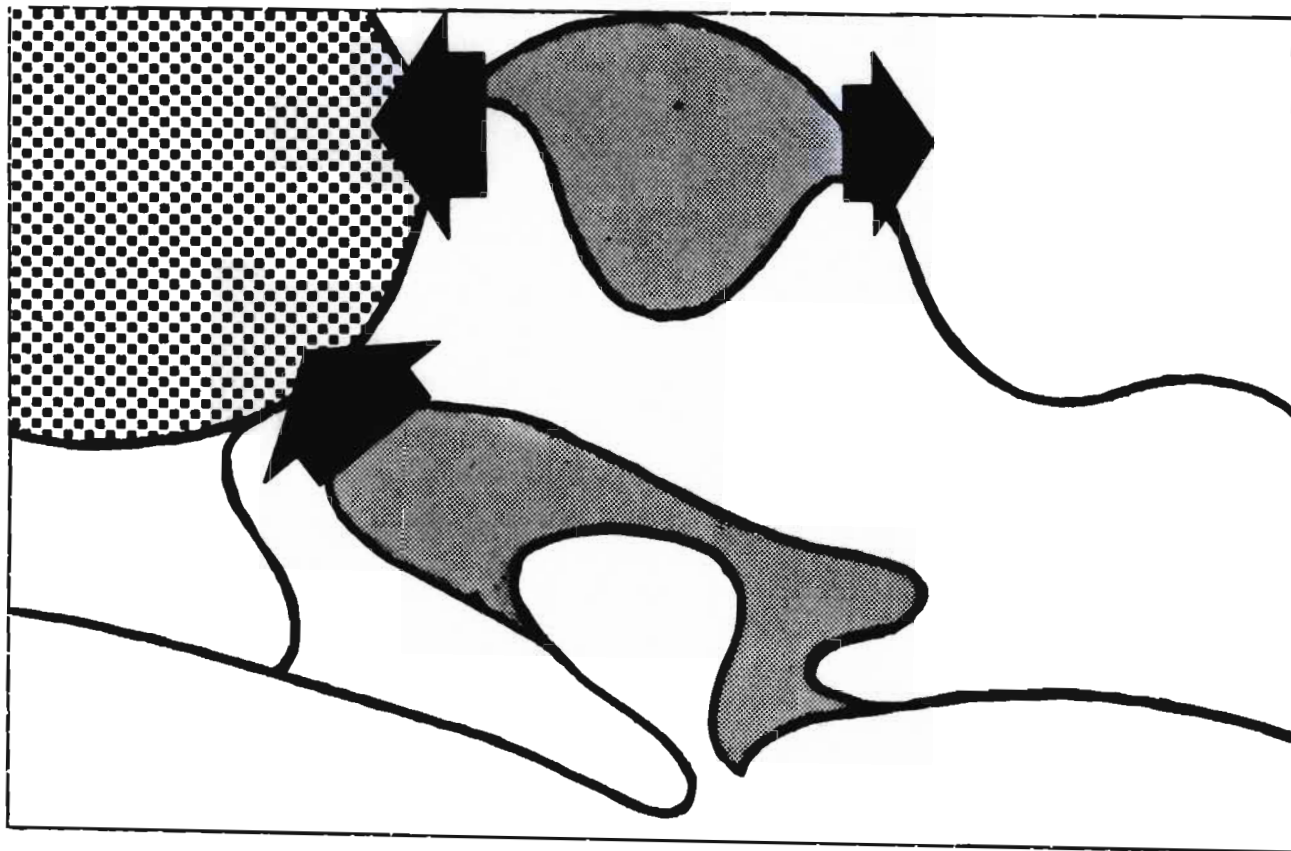
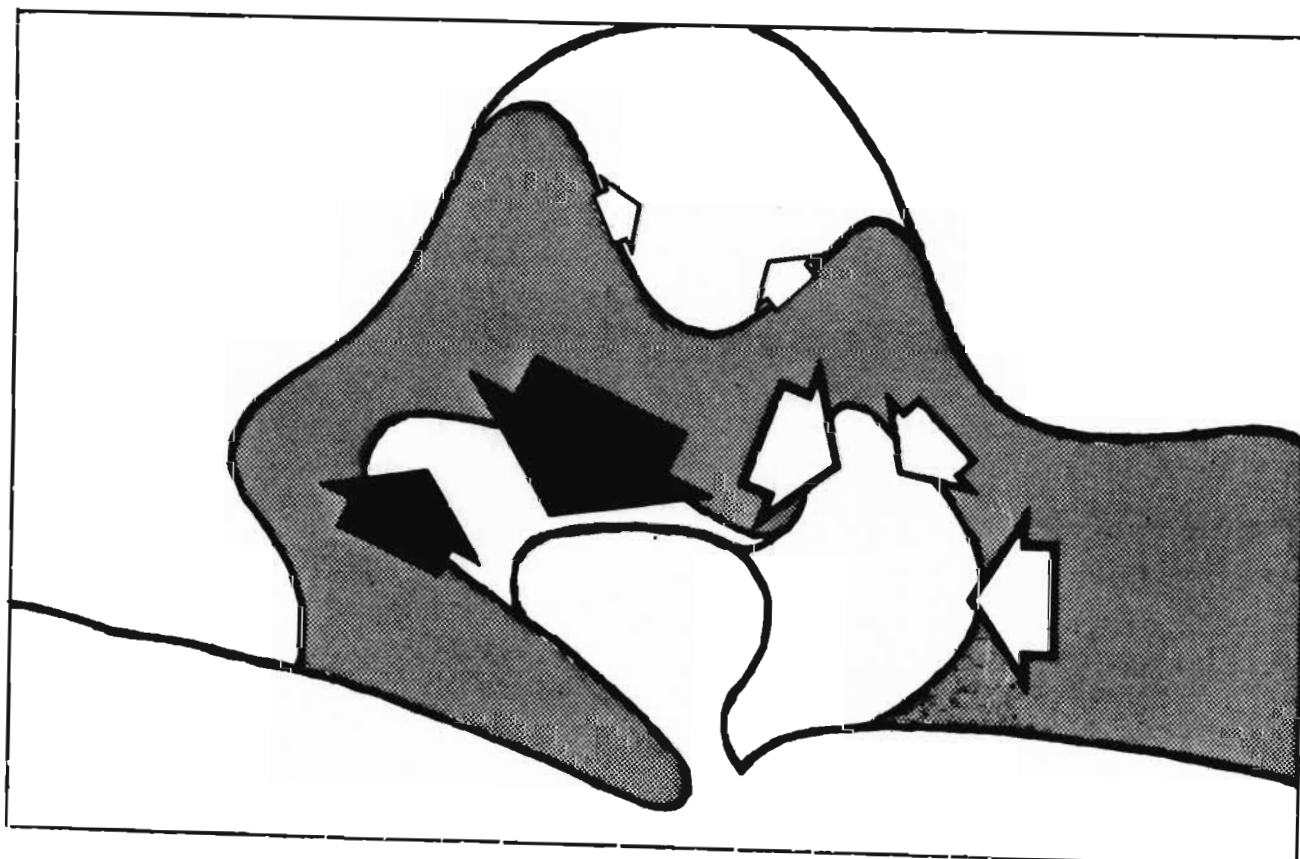


FIGURE 8.5: REPULSION OF GROWTH FROM HIGHER STATUS WHITE AREAS



3. The process of institutional suburbanization may have been supported by an underlying class conflict between capital and labour on the one hand, and a 'landed interest' on the other. Thus patterns of growth diagrammed in Figure 8.4 reflect, in part, the demise of a class of slum landlords in Durban, at the hands of capital and labour.
4. The effects of status group competition have been reflected in the uneven distribution of 'noxious' residential development in Durban. Thus, higher status areas within white residential districts have remained impervious to patterns of residential redevelopment (especially flat construction). The larger white arrows in Figure 8.5 illustrate that flat development, which might ordinarily have occurred in higher status white areas (such as Durban North), has been constrained to central locations within the city (previously occupied by politically inarticulate and/or powerless groups -- e.g., low status Whites and/or Blacks).
5. A final observation is that Group Areas removals, and subsequent institutional redevelopment, has relieved the 'White core' (shaded in Figure 8.5) of some of the pressures of industrial encroachment and the demand for new residential growth. Thus, new residential development for Whites is

now able to expand into the Cato Manor area (smaller white arrows in Figure 8.5 indicate this expansion) whilst industrial expansion is accommodated in the Bayhead region (black arrows in Figure 8.5 note the deflection from white areas to the Bayhead/Mobeni/Jacobs industrial wedge).

CHAPTER 9

RETROSPECT AND PROSPECT

A Review of the Findings

As noted in Chapter 1, the principal objective of this study has been to provide an analysis of patterns of residential growth within the City of Durban for the 1960-1974 period. The study has been divided into two parts. In Part I, a conceptual framework for the analysis of patterns of residential growth was derived from what Cox (1976) terms as "mainstream location theory" in urban geography. Typically, as Cox (1976) has observed, the assumptions underlying this theory are micro-economic and neoclassical in nature.

In terms of the conceptual framework presented in Part I it is important to recognize (i) that suburban development and central city redevelopment for residential use are merely different manifestations of the same social process, and (ii) that patterns of residential site preparation will anticipate (and not necessarily mirror) patterns of residential construction. The specific characteristics of the distribution of residential site preparation and residential construction in Durban have been considered in Chapters 5 and 6. A summary model of patterns of residential site preparation and patterns of residential construction has been provided in the conclusion to Chapter 6.

Part II opened with the observation that most of the 'unexplained variance' from Part I appeared to be a consequence of the operation of political factors in the process of residential growth. These factors did not enter into the conceptual framework presented in Part I, since this framework was predicated upon an essentially consensual view of the social process which is implicit within the neoclassical approach. Thus, Chapter 7 provided a critical review of the apolitical nature of traditional, neoclassical approaches to urban land use and land use change, and presented a summary of two overtly political frameworks which could be applicable to the problem of residential growth within cities in capitalist societies.

These two frameworks were employed in an initial interpretation of the political economy of residential growth and change in Durban, in Chapter 8. On the basis of analyses reported in this chapter, it was concluded that class conflict, status group competition and race group conflict have each, in their own way, contributed towards the determination of patterns of residential growth and change in Durban. A summary model of the effects of this variety of social conflicts upon patterns of residential growth and change in Durban has been provided in the conclusion to Chapter 8.

Towards and Integrated Model of Residential Growth and Change

In studies of this kind (i.e., studies in 'spatial analysis') it is customary to conclude by presenting an 'integrated model' of the phenomena under consideration.. However, this raises a question as to the kind of model which is required.

The Nature of Models in Geography

Chorley and Haggett (1967) write that "models can be viewed as selective approximations which, by the elimination of detail, allow some fundamental, relevant or interesting aspect of the real world to appear in some generalized form." Although this definition captures some of the essentials of the purpose of models in geography, it remains incomplete, in a certain sense. For example, on the basis of the Chorley and Haggett (1967) definition, it would appear that the geographer is simply interested in providing a descriptive summary of the spatial properties of the phenomena under examination (1). Yet, in many respects, this is a retreat into description; there is no reference to the problem of explanation, and how spatial forms may be related to the social processes which produce them (2). In this regard, Amedeo and Golledge's (1975) view of process-form reasoning in geography merits consideration:

It seems natural -- or perhaps we should say plausible -- that we should be interested in the processes that generate the spatial conditions we study, for this allows us to point to them as possible reasons for these conditions. To study spatial conditions independently of the processes that generate them leaves us with no indication of "cause" and, hence, rather small possibilities for connecting things, which is an essential phase of scientific analysis. One thing appears to be clear about this kind of reasoning: the processes thought of as being responsible for or influential in the generation of certain spatial configurations of events are not so-called "pure" spatial ones. Rather, for those of us interested in some phase of human geography, the processes of concern are generally those thought about and discussed by other social scientists; the difference being that our concern is predominantly with the implications of them in space, while their concern is elsewhere. It might be argued that geographers should shy away from this kind of reasoning, for it is not purely spatial when it deals with processes studied by other social sciences. Such an argument might go on to say that we should find geometric or pure spatial laws to explain and/or account for the form of the spatial conditions with which we are commonly concerned. The point is, however, that if we are dealing with the manifestations of human events (which we are in all phases of human geography), then there is no way we can divorce these events from the processes that generate them and still hope to account for or explain them.

An explanatory model of patterns of residential growth and change would, therefore, take account of the way in which a given social process (or set of social processes) determines a given spatial ordering of the indexes of residential growth. Thus, in the elementary model of patterns of residential growth to be presented here, an attempt is made to relate patterns of residential growth to the processes responsible for them.

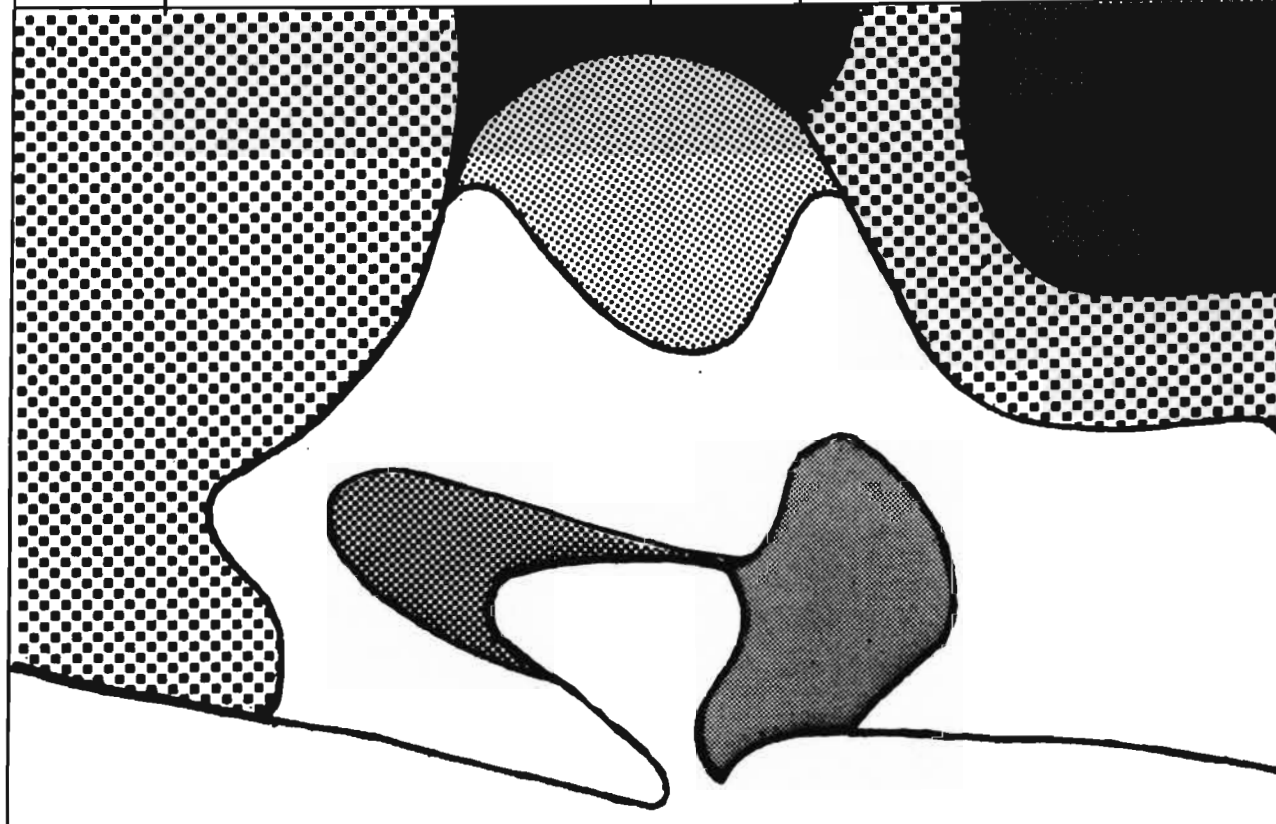
A Model of Residential Growth in Durban

Figure 9.1 identifies six broad zones within the city, four of which are directly concerned with the problem of residential growth and change for the white, coloured and asian groups:

1. The zone of private redevelopment is located in an area surrounding the non-residential core of the city. The zone is characterized by high levels of land consolidation, residential demolition and flat construction. The social processes responsible for the zone are, firstly, competitive efforts by developers to supply a demand for housing to a 'distance minimizing' public; and, secondly, the political resistance (either real or imputed) of higher status residents to the location of flats in their vicinity.
2. The zone of stability is an area of the city characterized by relatively low levels of residential site preparation and construction. This zone, which is located in a broad band surrounding Durban bay and the area of private redevelopment, has been bypassed because of the relatively long economic lives of structures in the area (as discussed in Part I) and because of the relatively high political resistance of residents in these areas (as discussed in Part II).

FIGURE 9.1: AN INTEGRATED MODEL OF RESIDENTIAL GROWTH

	Zone of Private Redevelopment (Consolidation demolition and flats).		Zone of Institutional Suburbanization (Sub-division, houses, flats)
	Zone of Institutional Redevelopment (Consolidation, demolition).		Institutional Redevelopment for Industrial use (Cosol./Dem.)
	Zone of Stability (Little site prep. or construction activity)		Beyond City Limits



3. The zone of institutional redevelopment, in the Durban case, is located principally in the Cato Manor area. This zone is characterized by high levels of demolition and consolidation, and relatively low levels of construction. As argued in Part II of the study, the social processes responsible for this zone are, firstly, race group competition and, secondly, class conflict.
4. In the Durban case, the zones of institutional suburbanization are located in the southwestern and northwestern sectors of the city (corresponding to Indian group areas). The zones are identifiable by very high levels of land subdivision and residential construction. Although there has been some residential growth of the private market type in these zones (especially for higher status Indians), the principal social processes responsible for their emergence are race group competition and class conflict (as discussed in Part II).

It should be noted that a fifth possible zone -- that of private suburbanization -- has been located beyond the bounds of the study area in municipalities such as Westville and Amanzimtoti (3).

Looking Forward: The Questions Remaining

The model depicted in Figure 9.1 is basically a synthesis of the conclusions derived from Part I and Part II of the study. If it is compared with actual patterns of residential growth in the City of Durban it will be found that, in fact, the model captures a substantial proportion of the reality which it purports to explain. Yet, an important question must be posed at this stage: no doubt, the consensual and integrative market relations of capitalist societies (the conceptual foundation of Part I of this study) constitute a part of the social reality which is responsible for patterns of residential growth. The same would seem true of the more antagonistic relations of class, status and ethnicity (the conceptual foundation of Part II). However, to what extent are the two conceptual frameworks (presented in Part I and Part II) compatible?

The level of integration achieved in Figure 9.1 (and the accompanying text) is a relatively loose one. It remains to be demonstrated whether or not a tight integration can be achieved at the level of the theory of the processes responsible for patterns of growth. At the present time, the prospects for such an integration appear to be poor. Indeed, it might even be argued that the theoretical frameworks presented in Part I and

Part II are predicated upon mutually exclusive views of the relationship of social process to spatial form in capitalist societies. The two parts, it might be argued, reflect a conceptual transition in urban geography which Kuhn (1962) would characterize as a "paradigm shift"; and, as Kuhn (1962) has noted, when there is a paradigm shift within a discipline or area of study, the researcher is generally required to reject either the old or the new paradigm in toto. Thus, it may be asked, is a conceptual integration even desirable; should the the geographer not dispose of 'mainstream location theory', and pursue the task of applying the newly emerging conceptual frameworks to the South African case?

Planning Considerations: Theory and Practice

As Harvey (1973) has observed, there are few geographical studies which originate out of 'thought alone.' The nature of the problems selected for study, and the priorities which are brought to bear in analysis, are generally materially determined. Certainly, the present study has been no exception.

The original impetus for the research was provided by the Natal Town and Regional Planning Commission. Officials within the commission had expressed disquiet at certain indications that residential site preparation activity was taking place in

some areas of the Durban-Pietermaritzburg Planning Region without accompanying construction. In short, the spectre of private 'land holding' or 'speculation' had arisen in the minds of planning officials (4). In consequence, a study was conducted to ascertain the degree to which patterns of site preparation were "correlated with" patterns of residential construction within the planning region (5).

In the case of Durban, of course, the findings are quite unequivocal: patterns of residential site preparation have been found to be distinct from patterns of residential construction for the period under consideration. The question is, however, does this finding confirm the suspicion that private 'land holding' is strongly at work within the City of Durban?

In seeking the answer to this question, it becomes clear that the framework which the researcher brings to bear upon his problem will influence his conclusions. For example, if the framework chosen for analysis is exclusively that which has been presented in Part I, the answer will probably be in the affirmative: patterns of site preparation, it would be argued, have been distinct from patterns of construction because of the economic advantages to developers of 'land holding.'

On the other hand, a quite different conclusion might be reached from the standpoint of the manipulated city framework.

It might be argued, for example, that patterns of site preparation and construction have been distinct because of the effects of race conflict processes, and policies such as the Group Areas Act. For instance, in areas such as Cato Manor, site preparation activity (demolition and consolidation) has occurred without accompanying redevelopment (construction), and such occurrences are sure to dislocate site preparation patterns from patterns of construction for the city as a whole.

The essential point, therefore, is that the theoretical apparatus which the geographer brings to bear upon a 'planning problem' may influence his conclusions about the social processes underlying that problem. And to the extent that his conclusions affect planning decisions, the geographer's theoretical framework enters into the concrete realm of social practice.

Conclusion

Before this study was conducted, very little was known of patterns of residential growth within the South African city. Hopefully, however, the preceeding chapters will have contributed towards at least a level of understanding of the patterns in question. Perhaps even more importantly, the study may have provoked some thought on the relative merits of alternative

paradigms in urban geography, and the ways in which they might be applied to future research on the problem of urban residential growth. For, it is only by keeping in touch with new developments within the alternative paradigms (and perhaps also the literature on the specific nature of South African capitalism) that the geographer's understanding of the dynamics of the South African city will progress.

APPENDIX 1

DISCUSSION OF STATISTICAL TECHNIQUES

The Regression Model

When pairs of (x,y) values fall exactly into a function that can be plotted as a straight line, the function is said to be linear and may be defined by $Y = B_0 + B_1X$

The basic objective in regression is to obtain a 'best fit' (or predictor) linear function with respect to a data set (i.e. n pairs of x and y values) in such a manner as to minimize the sum of the squared deviations from the predicted linear relationship.

Given that, in most cases, the data set is a sample of the total population of x and y values, and given also that there is some 'error in prediction', we may define our computed relation as follows:

$$\hat{Y}_i = \hat{B}_0 + \hat{B}_1X_i + \hat{E}_i$$

where \hat{Y}_i is the estimated value of the dependant variable Y, \hat{B}_1 is a constant by which all values of x are multiplied and \hat{B}_0 is a constant which is added to each case. The error term (\hat{E}_i) is a measure of how inexact the stochastic relationship is, or may be regarded as the 'unsystematic' part of the relationship which we are attempting to establish between variables x and y. It is a measure of the 'residual

variation' in the data after the 'best fit' function has been achieved. Thus

$$\hat{E}_i = \frac{\sum e_i^2}{n} = \text{Minimum}$$

for any regression equation. (e_i^2 represents the squared distance between the i th co-ordinate of x and y values and the slope of the regression line $\hat{y}_i = \hat{B}_0 + \hat{B}_1 x_i$).

Although, as mentioned earlier, the error term (\hat{E}_i) is sometimes regarded as the 'unsystematic' part of the relation, such a definition may be somewhat misleading. The magnitude of the error term (\hat{E}_i) derives from a large number of possible factors, some of which may exert a random impact on the distribution of y values, but many of which may exert a systematic influence. Data specification and measurement problems, for example, could under many (but not all) circumstances be expected to contribute randomly to 'unsystematic' variation in y values. On the other hand the effect of certain omitted variables may not be of this 'random noise' type at all, and may exert a systematic influence on y values.

This is not a trivial problem, of course. Since the 'best-fit' equation is determined according to the values of the sample data, there is no way of knowing exactly what proportion is due to 'random noise' of experimental error and what proportion is due to systematic variation (some of which may be 'counterbalancing') owing to the non-inclusion other

independent variables affecting the distribution of y.

Although the researcher is not entirely defenseless against this problem - (a visual inspection of scattergrams may often aid in detecting certain kinds of 'systematic error') - it remains true that he can almost never be certain as to the precise origin of the errors.

Part of the output of the regression routine is, of course, the r^2 value for the relation. This r^2 value, or co-efficient of determination, is a measure of the proportion of variation in data which is accounted for by the relation $\hat{Y}_i = \hat{B}_0 + \hat{B}_1 X_i$. That is

$$r^2 = \frac{\sum (Y_c - \bar{Y})^2}{\sum (Y - \bar{Y})^2} = \frac{\text{explained variation}}{\text{total variation}}$$

$\sqrt{r^2} =$ is referred to as the correlation coefficient with values between -1.0 and 1.0, and this statistic allows the interpretation of both the direction and the magnitude of the relation.

$$\text{Note that since } r^2 = \frac{\sum (Y_c - \bar{Y})^2}{\sum (Y - \bar{Y})^2}$$

$$\text{then when } Y_c = Y, r^2 = \frac{\sum (Y - \bar{Y})^2}{\sum (Y - \bar{Y})^2} = 1$$

$$\text{and when } Y_c = \bar{Y}, r^2 = \frac{\sum (\bar{Y} - \bar{Y})^2}{\sum (Y - \bar{Y})^2} = 0$$

Thus the maximum and minimum values of r^2 are 1 and 0 respectively and the maximum and minimum values of $r = \sqrt{1} = \pm 1$.

It should be evident, therefore, that the frequent definition of r in terms of the 'degree of scatter' around the regression line (Hays, 1973) is an appropriate conceptualization of this term.

The Assumptions of the Regression Model

In summary the assumptions of the regression model are:

- (i) $E(\epsilon_i) = 0$
- (ii) $\text{Var}(\epsilon_i) = \sigma^2$ (constant)
- (iii) $E(\epsilon_i, \epsilon_j) = 0$ for $i \neq j$
- (iv) X_i is a non-stochastic variable having fixed values
- (v) $n > m$ (where n = number of cases or observations and m = number of independent variables including B_0)

Special mention should be made of assumption (iii) here which, it appears, often goes unmet in regression analyses. Essentially this assumption concerns the stochastic independence of the error terms and has been the subject of some recent debate in geography under the auspices of 'spatial autocorrelation' (Curry, 1966). It is agreed that in general an attempt should be made to avoid serial correlation in the data for if this assumption is violated, the estimators will be unbiased but inefficient.

Statistical Significance of Co-efficients

Yeates (1974) writes "The question ... that arises is whether (\hat{B}_1) is an adequate estimate of the regression

co-efficient that would have been obtained had the population data been used." If we term the population regression co-efficient B_1 , then it becomes evident that in order to test for statistical significance of the regression co-efficients, we should perform a test of the null hypothesis $H_0 : \hat{B}_1 = B_1$. However, since B_1 is not usually known, we substitute the hypothesis $H_0 : \hat{B}_1 = 0$ with the aim of rejecting in favor of the research hypothesis $H : \hat{B}_1 \neq 0$ for some chosen level of confidence (Yeates, 1974).

Some Operational Considerations

It is extremely unusual for one independent variable to be the only significant factor to influence the distribution of y values, and for this reason very high r values might be regarded as the exception rather than the rule. Despite the human mind's quest for simplicity in explanation (Harvey, 1969), real world problems are usually comprised of more than simple bivariate relationships. It would be wrong, therefore, to see the objective of regression analysis as 'the search for the 0.99 correlation' and to regard relatively low correlations for bivariate analyses with a sense of disappointment. In any statistical analysis the results are, in a pure sense, 'inconclusive' and the confirmation or disconfirmation of an hypothesis is really only a matter of degree. On the other hand researchers will often feel discontent with only having explained a small proportion of the

total variation in the behavior of a dependent variable in which they are interested. Under these circumstances the inclusion of several relevant independent variables may be desired, and for this reason we consider the multiple regression technique next.

The Multiple Regression Model

The multiple regression model is an extension of the simple (bivariate) regression model where the principles of the bivariate case are carried over to situations involving two or more independent variables. Here the general form of the regression becomes

$$\hat{Y}_C = \hat{B}_0 + \hat{B}_1 X_1 + \hat{B}_2 X_2 + \dots \hat{B}_k X_k + \hat{E}$$

where \hat{Y}_C represents the estimated value for Y, \hat{B}_0 is the Y intercept and $\hat{B}_1, \hat{B}_2, \dots, \hat{B}_k$ are regression co-efficients. The \hat{B}_0 and \hat{B}_i co-efficients are once again selected in such a way as to maximize the sum of the squared deviations from the predicted relationship. Thus, once again

$$\hat{E}_i = \frac{\sum e_i}{n} = \text{Minimum}$$

The calculation of \hat{B}_0 and $\hat{B}_1, \hat{B}_2, \dots, \hat{B}_k$ values may begin with the specification of the normal equations for the model in deviational form which, for two independent variables, X_1 and X_2 are

$$n \hat{B}_0 + \hat{B}_1 \cdot \Sigma X_1 + \hat{B}_2 \Sigma X_2 = \Sigma Y'$$

$$\hat{B}_0 \Sigma X_1 + \hat{B}_1 \Sigma X_1^2 + \hat{B}_2 \Sigma X_1 X_2 = \Sigma X_1 Y'$$

$$\hat{B}_0 \Sigma X_2 + \hat{B}_1 \Sigma X_1 X_2 + \hat{B}_2 \Sigma X_2^2 = \Sigma X_2 Y' \quad \text{where } X_i = X - \bar{X}$$

$$Y' = Y - \bar{Y}$$

We can rewrite these normal equations in matrix notation as follows:

$$\begin{bmatrix} \Sigma X_1^2 & \Sigma X_1 X_2 \\ \Sigma X_2 X_1 & \Sigma X_2^2 \end{bmatrix} \begin{bmatrix} B_1 \\ B_2 \end{bmatrix} = \begin{bmatrix} \Sigma X_1 Y' \\ \Sigma X_2 Y' \end{bmatrix} \quad (I)$$

If we let

$$X = \begin{bmatrix} X_{11} & X_{12} \\ X_{21} & X_{22} \\ X_{31} & X_{32} \\ X_{41} & X_{42} \end{bmatrix}$$

$$\begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ Y_4 \end{bmatrix}$$

equation (I) then becomes

$$(X'X) B = X'Y \quad \text{or}$$

$$B = (X'X)^{-1} X'Y$$

Note that the forms of the above equations are identical to those if we did not use the deviational form. To recover the \hat{B}_0 term we can simply write

$$\hat{B}_0 = \bar{Y} - \hat{B}_1 \bar{X}_1 - \hat{B}_2 \bar{X}_2$$

We may express $(X'X)^{-1}$ as

$$\begin{bmatrix} \Sigma X_1^2 & \Sigma X_1 X_2 \\ \Sigma X_2 X_1 & \Sigma X_2^2 \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix}$$

The regression co-efficients may be expressed as

$$\begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix}^{-1} \begin{bmatrix} \Sigma X_1 Y \\ \Sigma X_2 Y \end{bmatrix} = \begin{bmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{bmatrix} \begin{bmatrix} \Sigma X_1 Y \\ \Sigma X_2 Y \end{bmatrix}$$

$$= \begin{bmatrix} C_{11} \Sigma X_1 Y & C_{12} \Sigma X_2 Y \\ C_{21} \Sigma X_1 Y & C_{22} \Sigma X_2 Y \end{bmatrix}$$

or
$$\hat{B}_1 = C_{11} \Sigma X_1 Y + C_{12} \Sigma X_2 Y$$

$$\hat{B}_2 = C_{21} \Sigma X_1 Y + C_{22} \Sigma X_2 Y$$

Note that the C_{ij} 's in this case are elements of the inverse matrix and are termed 'Gauss Multipliers.' Having derived these multipliers we can find (i) the co-efficients of the regression and (ii) the variances of the \hat{B}_i co-efficients.

(1) We can calculate the r_{y12}^2 value in deviational form:

$$r_{Y12}^2 = \frac{\sum (Y_c - \bar{Y})}{\sum (Y - \bar{Y})}$$

$$\begin{aligned}\sum (Y_c - \bar{Y}) &= \sum Y^2 \\ &= \sum (\hat{B}_1 X_1 + \hat{B}_2 X_2)^2 \\ &= \hat{B}_1 (\hat{B}_1 \sum X_1^2 + \hat{B}_2 \sum X_1 X_2) + \hat{B}_2 (\hat{B}_1 \sum X_1 X_2 + \hat{B}_2 \sum X_2^2)\end{aligned}$$

$$\begin{aligned}\text{Since } \hat{B}_1 \sum X_1^2 + \hat{B}_2 \sum X_1 X_2 &= \sum X_1 Y \\ \text{and } \hat{B}_1 \sum X_1 X_2 + \hat{B}_2 \sum X_2^2 &= \sum X_2 Y\end{aligned}$$

$$\begin{aligned}\text{we can write } \sum Y^2 &= \hat{B} \sum X_1 Y + \hat{B} \sum X_2 Y \\ &= [\hat{B}_1 \hat{B}_2] \begin{bmatrix} \sum X_1 Y \\ \sum X_2 Y \end{bmatrix} \\ &= [\hat{B}_1 \hat{B}_2] \begin{bmatrix} X_{11} & X_{21} & X_{31} & X_{41} \\ X_{12} & X_{22} & X_{32} & X_{42} \end{bmatrix} \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ Y_4 \end{bmatrix}\end{aligned}$$

$$\text{Now since } \sum (Y - \bar{Y})^2 = \sum Y^2 = Y'Y$$

$$\text{we can write } r_{Y12}^2 = \frac{\hat{B}' X' Y}{Y' Y}$$

(ii) The Variance-Covariance Matrix

Since we may wish to establish the sampling variances of the \hat{B}_1 co-efficients, we may wish to establish the variance-covariance matrix for these values.

Since we know that $\hat{B} = (X'X)^{-1} X'Y$

and $Y = X\hat{B} + e$

$$\begin{aligned} \text{we may write that } \hat{B} &= (X'X)^{-1} X'(XB + e) \\ &= (X'X)^{-1} X'XB + (X'X)^{-1} X'e \\ &= IB + (X'X)^{-1} X'e \\ &= B + (X'X)^{-1} X'e \end{aligned}$$

$$\text{Thus } E(\hat{B}) = E(B) + E[(X'X)^{-1} X'e]$$

Given that we know that B is a population parameter and that $X'X$ consists of observations, it follows that

$$E(\hat{B}) = B + (X'X)^{-1} X'E(e)$$

We also know by assumption (iii) that $E(e) = 0$; thus $E(\hat{B}) = B$.

This implies that

$$E \begin{bmatrix} \hat{B}_0 \\ \hat{B}_1 \\ \hat{B}_2 \end{bmatrix} = \begin{bmatrix} E(\hat{B}_0) \\ E(\hat{B}_1) \\ E(\hat{B}_2) \end{bmatrix} = \begin{bmatrix} B_0 \\ B_1 \\ B_2 \end{bmatrix}$$

It will be remembered that we derived

$$\hat{B} = B + (X'X)^{-1} X'e$$

Therefore

$$\begin{aligned} \text{Var } (\hat{B}) &= E(\hat{B} - B)(\hat{B} - B)' \\ &= E\{[(X'X)^{-1} X'e][(X'X)^{-1} X'e]'\} \\ &= E(X'X)^{-1} X'e e'X (X'X)^{-1} \end{aligned}$$

(We attain this by using the theorem $(ABC)' = (C'B'A')$).

Additionally we know $(X'X)^{-1}$ is a symmetric matrix

$$(X'X)^{-1} = \begin{bmatrix} c_{00} & c_{01} & c_{02} \\ c_{10} & c_{11} & c_{12} \\ c_{20} & c_{21} & c_{22} \end{bmatrix}$$

where $c_{ij} = c_{ji}$

$$\text{also } \begin{bmatrix} c_{00} & c_{01} & c_{02} \\ c_{10} & c_{11} & c_{12} \\ c_{20} & c_{21} & c_{22} \end{bmatrix}' = \begin{bmatrix} c_{00} & c_{10} & c_{20} \\ c_{01} & c_{11} & c_{21} \\ c_{02} & c_{12} & c_{22} \end{bmatrix}$$

The implication of this is the

$$[(X'X)^{-1}]' = (X'X)^{-1}$$

Since X is the observation matrix and consists of fixed values we get

$$\begin{aligned} \text{Var}(\hat{B}) &= (X'X)^{-1} X'E(ee') X(X'X)^{-1} \\ &= (X'X)^{-1} X'\sigma^2 X(X'X)^{-1} \\ &= \sigma^2 I (X'X)^{-1} X'X (X'X)^{-1} \\ &= \sigma^2 (X'X)^{-1} \end{aligned}$$

$$\text{Thus Var}(\hat{B}) = \sigma^2 \begin{bmatrix} c_{00} & c_{01} & c_{02} \\ c_{10} & c_{11} & c_{12} \\ c_{20} & c_{21} & c_{22} \end{bmatrix} \quad (I)$$

Then, assuming three regressors X_0 , X_1 and X_2 (where X_0 is a column vector of values of one) we obtain

$$\text{Var } (\hat{B}) = \begin{bmatrix} \text{Var } (\hat{B}_0) & \text{Cov } (\hat{B}_0 \hat{B}_1) & \text{Cov } (\hat{B}_0 \hat{B}_2) \\ \text{Cov } (\hat{B}_1 \hat{B}_0) & \text{Var } (\hat{B}_1) & \text{Cov } (\hat{B}_1 \hat{B}_2) \\ \text{Cov } (\hat{B}_2 \hat{B}_0) & \text{Cov } (\hat{B}_2 \hat{B}_1) & \text{Var } (\hat{B}_2) \end{bmatrix} \quad (2)$$

The elements in matrix (2) correspond to the elements in matrix (1) above. Thus, for example:

$$\text{Var } (\hat{B}_0) = \sigma^2 C_{00}$$

$$\text{Var } (\hat{B}_1) = \sigma^2 C_{11}$$

$$\text{Var } (\hat{B}_2) = \sigma^2 C_{22}$$

Tests of Significance for $\hat{B}_1, \hat{B}_2, \dots, \hat{B}_k$ Coefficients

Tests of the statistical significance of $\hat{B}_1, \hat{B}_2, \dots, \hat{B}_k$ are similar to the simple regression case. This time, however, since the population parameter σ^2 is generally not known, we use $\sqrt{C_{ii} \sigma^2}$ in our denominator, and the test of significance becomes

$$\text{test} = \frac{\hat{B}_i - 0}{\sqrt{C_{ii} \sigma^2}}$$

(This has a "t" distribution with $(n-k-1)$ degrees of freedom, where k is the number of independent variables in the relation). To accept the Null hypothesis $\hat{B}_i = 0$ implies that the relation between \hat{Y}_i and \hat{X}_i is not statistically significant. It may be, however, that we wish to test for the hypothesis that $\hat{B}_1 = \hat{B}_2 = 0$. For this we use the "F test" where

$$F_{\text{est}} = \frac{\sum (Y - \bar{Y})^2 / k}{\frac{\sum (Y - Y_c)^2}{(n - k - 1)}}$$

The Stepwise Variation

Under certain circumstances the researcher may be concerned with establishing the relative importance of each independent variable insofar as the explanation of Y is concerned. According to Yeates (1974) "a stepwise regression is really a search procedure, for the technique enters each (independent) variable, one at a time, into the regression equation in the order of contribution to the total variance, the greatest contributor being entered first." Since this is the case, the researcher has the opportunity of establishing the independent and additive effects of each independent variable as it is entered into the equation. For example, the value $(r_{y123}^2 - r_{y12}^2)$ will allow the researcher to establish the additive contribution of variable X_3 to the explanation of variation in y_i values in a relation with three independent (X) variables. (i.e, that part of the explanation which X_3 contributes which is additive to, and independent of, the pre-existing cumulative explanation contributed by X_1 and X_2 .)

The stepwise method also has the advantage that it allows for the a posteriori (Harvey, 1969) search for the "best" regression equation, although this procedure may be

methodologically unsound if it is not theory linked. A second method of determining the relative importance of the different independent variables relates to the use of partial correlations. According to Yeates (1974) "partial correlations indicate the intercorrelation of any one independent variable with the dependent variable, with all other independent variables held constant."

Another statistic of interest which is produced by most regression routines is the adjusted coefficient of multiple determination (\bar{R}_{y12}^2). This statistic, which is derived from the formula

$$\bar{R}_{y12}^2 = \frac{n - I}{n - k - I} \cdot \frac{S_E}{S_{yy}}$$

and allows us to determine in comparison, how much of the increase in R_{y12}^2 in the stepwise regression procedure comes about from a change in the number of degrees of freedom with the inclusion of a new independent variable. It should be noted that as n becomes large, this matter becomes less significant.

Although not used here, some mention may be made of the occasional use of "dummy variables" in regression analysis. The basic objective of the utilization of the dummy variable is to improve the efficiency of the regression by increasing the sample size with the addition of two sample subpopulations. One is still able to distinguish between subpopulation behaviors in the analysis, although occasionally the "dummy variable trap" leads to variation between subpopulations

being confused in the analysis for variations within regions.

Assumptions and Problems

The assumptions for multiple regression are the same as for the simple regression model although in the multiple regression case assumption (v) becomes of particular importance. This assumption specifies that the number of observations (n) should be greater than the number of regression coefficients to be estimated (k).

The problem of multicollinearity in the data set is one which is familiar in the use of multiple regression analysis, and also deserves mention here. Although it is obviously practically impossible to have any two independent variables which are not correlated in some way, if the correlation between them exceeds a certain (arbitrarily high) limit, the regression may become inefficient. Related to this problem is the matter of the number of independent variables included in a single regression analysis. It should be noted that not only does the probability of multicollinearity in the data increase with the size of k , but it is also true that the conceptual manageability of the results become increasingly cumbersome.

The Factor Analysis Model

Assuming an $n \times m$ matrix x of n observed values on m variables, one may explain the objective of factor analysis in terms of vector spaces. Before proceeding to such an explanation, we must first consider some basic definitions:

(i) The Rank of a Matrix.

A square matrix is said to be singular if its determinant exists. The rank of an $n \times m$ matrix is the largest integer r for which a non-singular $r \times r$ matrix submatrix exists. (The rank of any matrix of zeros is zero).

If $n > m$ we have no linear dependence in the matrix. The rank of this matrix is n .

(ii) Eigenvectors and Eigenvalues.

Let A be a square matrix of order $n \times n$. For some scalar λ there is a matrix equation

$$A_x = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \lambda x \quad (1)$$

More generally we may write

$$[A - \lambda I]X = 0 \quad (2)$$

Such vectors x in (1) are called eigenvectors and the corresponding values λ are the eigenvalues of Matrix A .

Equation (2) gives n homogeneous equations with the elements of x as n unknowns; in addition there is the unknown value of λ . We know that there is a non trivial solution to the equation if and only if the matrix of coefficients has a rank smaller than n ; so the determinant of the $n \times n$ matrix of coefficients $(A - \lambda I)$ must be equal to zero.

$$\text{i.e. } |A - \lambda I| = 0$$

$$\begin{aligned} \text{Thus we have} \\ |A - \lambda I| = \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} - \lambda \begin{vmatrix} 1 & 0 \\ 0 & 1 \end{vmatrix} = \begin{vmatrix} a_{11} - \lambda & a_{12} \\ a_{21} & a_{22} - \lambda \end{vmatrix} = 0 \end{aligned}$$

$$\begin{aligned} \text{or } (a_{11} - \lambda)(a_{22} - \lambda) - a_{21} \cdot a_{12} &= 0 \\ \lambda^2 - (a_{11}\lambda + a_{22}\lambda) - a_{21} \cdot a_{12} &= 0 \end{aligned}$$

In general the determinant $(A - \lambda I)$ is obtained by subtracting λ from the diagonal elements of A . Expanded, the determinant becomes an equation of the n th degree in λ , which will in general have n different roots. The equation is called the characteristic equation of A . It follows that a matrix A of $n \times n$ order will in general have n different eigenvalues and therefore n different eigenvectors.

The eigenvectors may be collected into a matrix of

eigenvectors x with x_1, x_2, \dots, x_n as columns. Then we can rewrite our original equation $A_x = \lambda X$ in matrix form

$AX = X\Lambda$ with Λ a diagonal matrix of eigenvalues.

(iii) Direction Cosines

Let X be a vector in an n dimensional space with certain angles to the n axes. The cosines of these angles are called direction cosines. They specify the direction of the vector irrespective of length. The sum of direction cosines will always be equal to unity.

(iv) Projections of Points on Vectors

Let x_i (a vector of order $n \times 1$) specify a point p_i in n -dimensional space. Suppose we introduce into this space a new vector whose direction cosines are given in a vector k , also of order $n \times 1$ that satisfies $k'k = 1$. The projection y_i of point p_i onto the new vector is given by $y_i = x_i'k$ (Van de Geer, 1971).

Generalizing, if we have a collection of points p_1, p_2, \dots, p_n , the coordinates of which are given in a matrix X of order $m \times n$, then all projections cut a vector with direction cosines k are obtained from $y = xk$.

THE OBJECTIVE

The $n \times m$ correlation matrix R is such that $s's/n = \$.$ x/n results in a bundle of m vectors in Λ space. Each of these vectors have unit length and have direction cosines

equal to their correlations.

The bundle of m vectors are then embedded within a subspace V_m of δn . (This is because it never requires more than m dimensions to picture relations between m vectors.)

Now, clearly, if we could find a set of $m-p$ vectors in the space V_m on which x vectors had zero projections, we would be able to fit the $n \times x$ vectors into a subspace V_p . This would allow us to describe the positions of x vectors in terms of p coordinates instead of m coordinates. In practice, of course, it will be unlikely that we will find such a V_p with p much smaller than m (unless we are using duplicative variables!). It may be, however, that p can be made small if we trade off some distortion of the vector bundle whilst forcing it into a V_p . In other words we might find vectors in V_m on which the projection's are not actually zero but small enough to be neglected. Van de Geer (1971) uses the analogy of an umbrella:

...imagine three vectors in a V_m located like three ribs of an opened umbrella. The projections of the ribs on the stick of the umbrella are small; therefore, the angles between the ribs are not changed very much if we force the ribs into a flat plane.... Factor analysis generalizes the idea to higher dimensional spaces. The x vectors in a V_m are ribs of a hyperumbrella that has $m-p$ orthogonal sticks on which the ribs have sufficiently small projections. It is then possible to force the ribs into a V_p without too much distortion of the angles between the ribs.

The Factoring Procedure

Given that the x vectors are of unit length and that the squared projections of each one on an orthogonal coordinate system is equal to unit y , we know that the total sum of squared projections for all m vectors together equals m . It follows, therefore, that if there are y vectors in a V_m on which the sum of squared projections is relatively small, then there must be other vectors on which the sum of squared projections is relatively large. According to Van de Geer (1971) the strategy is to first find a y vector in the V_m such that the sum of squared projections of the x vectors on it is a maximum. Next a second direction in the V_m , orthogonal to the first, is sought such that once again there is a maximum sum of squared projections on it. We continue in the same manner searching for y vectors until after the p th direction the total sum of squared projections equals m .

Rummel (1967) has likened the derivation of y vectors to the finding of an equilibrium within a gravity field.

...it is analogous to giving each vector point in a duster a mass of one and letting the factor axes (y vectors) fall through their center of gravity.

In other words the directions of the y vectors in V_m (which we called reference directions) form an optimal orthogonal co-ordinate system for the description of R , the correlation matrix. The X vectors themselves we called the factors.

The x vectors have projections on the y vectors, these projections being given by a matrix F_p , the factor loading matrix. Since the factors are essentially defined by these projections, it is this matrix which is the basis for the interpretation of the factor constructs. It should be noted that each y vector is orthogonal to other y vectors and it therefore follows that the factors will be uncorrelated with each other.

Consequently although all factors are defined with respect to all variables, those variables which are most interrelated will correlate (or load) highly on a particular factor together. The square of a factor loading times 100 indicates the percentage variation that a variable has in common with a particular factor.

The communality of each variable is the proportion of each variables total variance that is accounted for by all the factors. Of course, if the analysis is allowed to run to its terminal solution where the total sum of squared projections equals m , then all communalities will equal 1. In practice, however, most analyses only report factors where the eigenvalues are greater than 1 and thus exclude some less significant dimensions of variation. The sum of the communalities divided by the number of communalities and multiplied by 100 equals the percentage of total variation

in the data which is accounted for by the factor analysis results.

The eigenvalues equal the sum of the column of squared loadings for each factor. The eigenvalues, therefore, measure the amount of variation accounted for by each factor. Dividing an eigenvalue by the number of variables and multiplying by 100 determines the percentage of total variance explained by that factor.

Rotation of Factor Axes

There are various methods of rotating the factor axes (y vectors) around the origin from the initial solution, each method with its own specific objective in mind. In general, however, the purpose of rotation is to simplify the factor structure (Kim, 1970) so that the "most meaningful set of factors" (Van de Geer, 1971) may be derived.

We limit our consideration here to varimax rotation where the factor axes remain orthogonal and where the rotation criterion centers on the columns of a factor loading matrix. Varimax defines a simple (and therefore meaningful) factor as one with only 1s and 0s in the column. In the attempt to reach the 'most simplified' solution, therefore, the varimax objective is to maximize the variance of the squared loadings in each column.

Factor Scores

The factor scores matrix (produced for both rotated

and unrotated factor solutions) provides a score for each observation and indicates the extent to which each factor describes each observation.

Each variable is weighted proportionately to its involvement in the particular factor. To determine the score for an observation on that factor, the observations' data on each variable is multiplied by the factor weight for each variable. The sum of the weight times data product for all variables yield the factor score. Factor scores are interpreted as any other data is, and show the variation of amalgams of variation across observations.

The Methodological Role of Factor Analysis

According to Rummel (1967) factor analysis "can be applied in order to explore a content area, structure a domain, map unknown concepts, classify or reduce data, illuminate casual nexuses, screen or transform data, define relationships, test hypotheses, formulate theories, control variables or make inferences." Such a list of methodological applications of the technique implies a more liberal view of the utility of the tool than is accepted here, however.

Factor Analysis is, after all, no more than a method of summarizing data. There is nothing in the mathematics of factor analysis which gives it a 'special' place amongst statistical techniques with respect to the meaning of the

results. Indeed, if anything, the results of factor analysis should be treated with more caution . then is necessary with many other techniques. Unlike regression analysis, for example, factor analysis does not allow a rigorous test of the statistical significance of the results. Also, given that some meaning must be assigned to factors on the basis of a whole list of factor loadings, there is obviously much scope for subjectivity in the interpretation of the results. The use of factor analysis under certain circumstances has also drawn criticism on philosophical grounds. Babbie (1973), for example, has suggested that the tool can become instrument of gross induction since "no matter what data are input, factor-analysis produces a solution in the form of factors...(yet) the generation of factors by no means insures meaning."

On the other hand, it may be that factor analysis has an important role to play in social analysis when it is wisely administered within the context of a well articulated conceptual framework. The factorial ecological tradition (Berry, 1971) is a case in point here. It may be that Berry (1971) is unduly optimistic in claiming some special phenomenological basis for the subfield; also Rees (1971) is probably incorrect in assuming that factors produced represent dimensions of variation underlying the variables studied. It does remain, however, that some useful empirical generalizations have emerged from factorial ecology

which have been linked to theory. It is true that this link had not been a formal one, but to adopt a strictly formal posture towards either the validation or invalidation of theory in some branches of social science may be premature.

The Canonical Correlation Model

According to Van de Geer (1971), canonical correlation analysis can be viewed as a generalization of multiple correlation. It will be remembered that in a multiple correlation problem there is a set of m variables X_i and one Y variable; the objective is to find a linear compound of X_i variables that has maximum correlation with the dependent (Y) variable. In canonical correlation analysis, on the other hand, there is more than one dependent (Y) variable, and the objective is to find a linear compound of the X_i variables that has a maximum correlation with a linear compound of the Y_i variables.

More formally, it is assumed that X is an $n \times M_1$ matrix of n observations on M_1 variables, and Y is an $n \times M_2$ matrix of n observations on M_2 variables. Now let X be an $n \times 1$ vector defined by $X = XC$, with C an $M_1 \times 1$ vector of weights. Similarly we may define a linear compound of the Y variables where $n = Yd$ and where d is an $M_2 \times 1$ vector of weights.

The objective of canonical correlation analysis is to find c and d such that the correlation between X and n is at a maximum. This correlation is called a canonical correlation coefficient.

The objective of canonical correlation may also be explained in terms of vector spaces, as in the case with factor analysis. Whereas in factor analysis there is only one $n \times M$ matrix X , with canonical correlation analysis there are two such matrices, X and Y .

The problem thus becomes to find out whether and how these two matrices are related.

If the M_1 and M_2 variables are standardized so that $X'X/n = R_{XX}$ (of order $M_1 \times M_1$), and so that $Y'Y/n = R_{YY}$ (of order $M_2 \times M_2$), it is possible to picture two spaces, S_{M_1} with M_1 vectors within it, and S_{M_2} with M_2 vectors within. The objective is then to relate the two spaces so that a vector is found in S_{M_1} where the projections of the X vectors on it are maximally correlated with the projections of the Y vectors on some vector in S_{M_2} . Once the first two such vectors are found, the next stage is to find a second direction in S_{M_1} , orthogonal to the first, such that, once again the projections on it are maximally correlated with the projections on a vector in S_{M_2} , which is

also othogonal to the first chosen direction in that space, etc. These pairs of vectors are linear combinations called (pairs of) canonical variates. Note that since each successive pair of canonical variates accounts for the residual variance only, they are clearly pairs of linear combinations of variables which are independent and uncorrelated with each other.

Comparisons are sometimes drawn between simultaneously performing two factor analyses and canonical correlation analysis (cf. Warwick, 1970). It should be noted, however, that whereas factor analysis and canonical correlation analysis both produce linear combinations of original variables, canonical correlation does so not with the object of accounting for as much variance as is possible within one set of variables, but with the aim of accounting for a maximum amount of relationship between two subsets of variables (Warwick, 1970).

Interpretation of Results

From the point of view of interpretation, the two most important types of information are the canonical variates, and the canonical correlations between them.

In output form the canonical variates come in two sets: one for each of the subsets of variables entered into the analysis. The variates are composed of coefficients 'importancing' the

original variables in the subset forming the variates. As with a matrix of factor loadings, these canonical weights must be used to deduce the conceptual meaning of the canonical variates.

The canonical correlations between pairs of variates represent the degree to which the variates in a pair are related, and the direction of that relationship. The square of the canonical correlation is equivalent to the eigenvalue.

The canonical variate scores are an additional feature of the output of the canonical correlation routine. These scores (which are analagous to factor scores) are provided for each canonical variate and are interpreted as showing the extent to which a given observation is characterized by a given canonical variate.

It is possible to derive estimates of the statistical significance of the canonical correlations from the output of most computer programmes for canonical correlation analysis. These estimates are listed in the tables of research results, reported in the study.

Assumptions of the Model

According to Warwick (1970) the technique assumes that (i) the variables are interval in level of measurement, (ii) the relationships among the variables are linear, and (iii) that

the basic aim is to account for as much variance in certain variables as is possible.

In short, the assumptions are the same as for the factor analysis case discussed earlier.

Some Operational Considerations

As with any other statistical technique, the main advantage of canonical correlation analysis can only be judged with reference to the specific kind of research problem under consideration. For example, if the researcher is confronted with the problem of accounting for the behavior of one variable assumed to be dependent upon the behavior of a few others, then the most applicable statistical technique would probably be multiple regression. On the other hand, if the researcher is searching for some common order in a large array of variables, and is relatively unconcerned with the distinction between dependent and independent variables, factor analysis is probably the most appropriate tool. Under certain circumstances, however, the researcher may be confronted by a large array of variables which he may feel can be divided into two subsets -- a dependent subset and independent subset. If he wishes to investigate the way in which the variation within the dependent subset can be related to variation within the independent subset, canonical correlation analysis may provide an appropriate tool.

Perhaps the most important disadvantage of canonical correlation analysis is that results can be very difficult to interpret. Just as factor analysis will produce factors which the researcher may or may not be able to identify in substantive terms, so canonical correlation can produce canonical variates (even clearly defined ones) which may or may not make sense to the researcher. For this reason it is clearly advantageous to preselect variables in terms of some well articulated conceptual framework.

APPENDIX 2

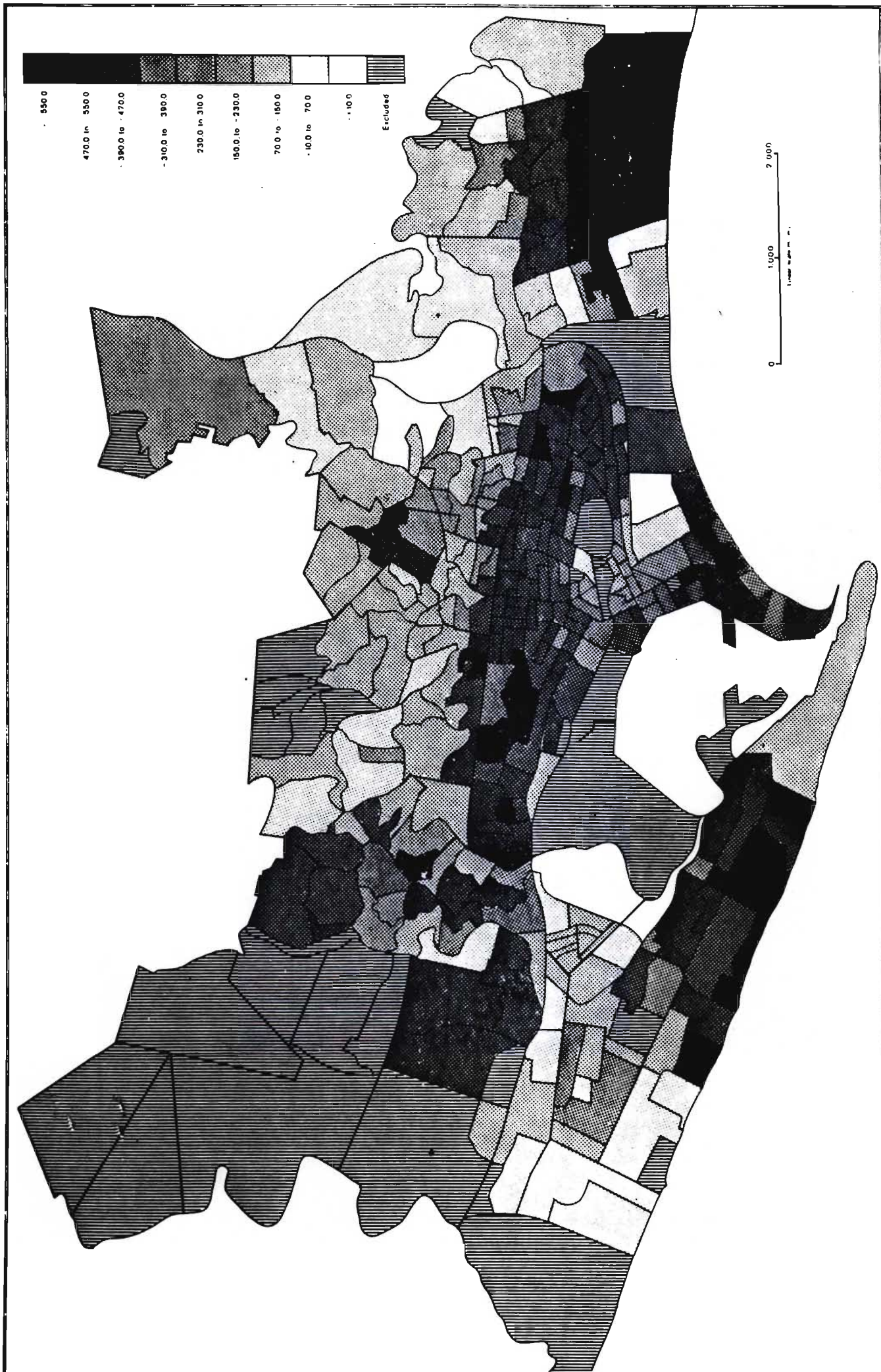
MAPS



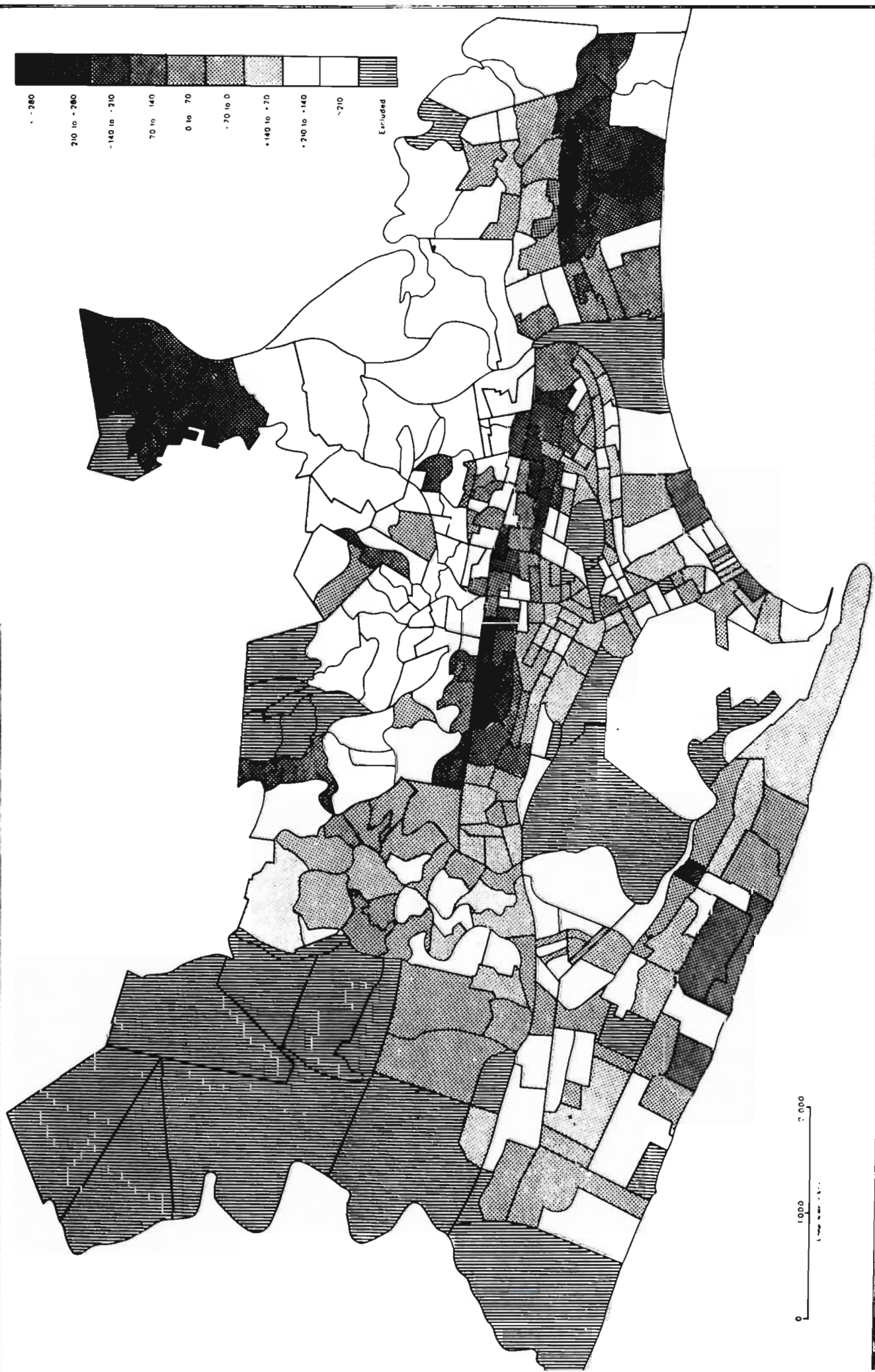
MAP 1: GENERALIZED LAND USE IN DURBAN



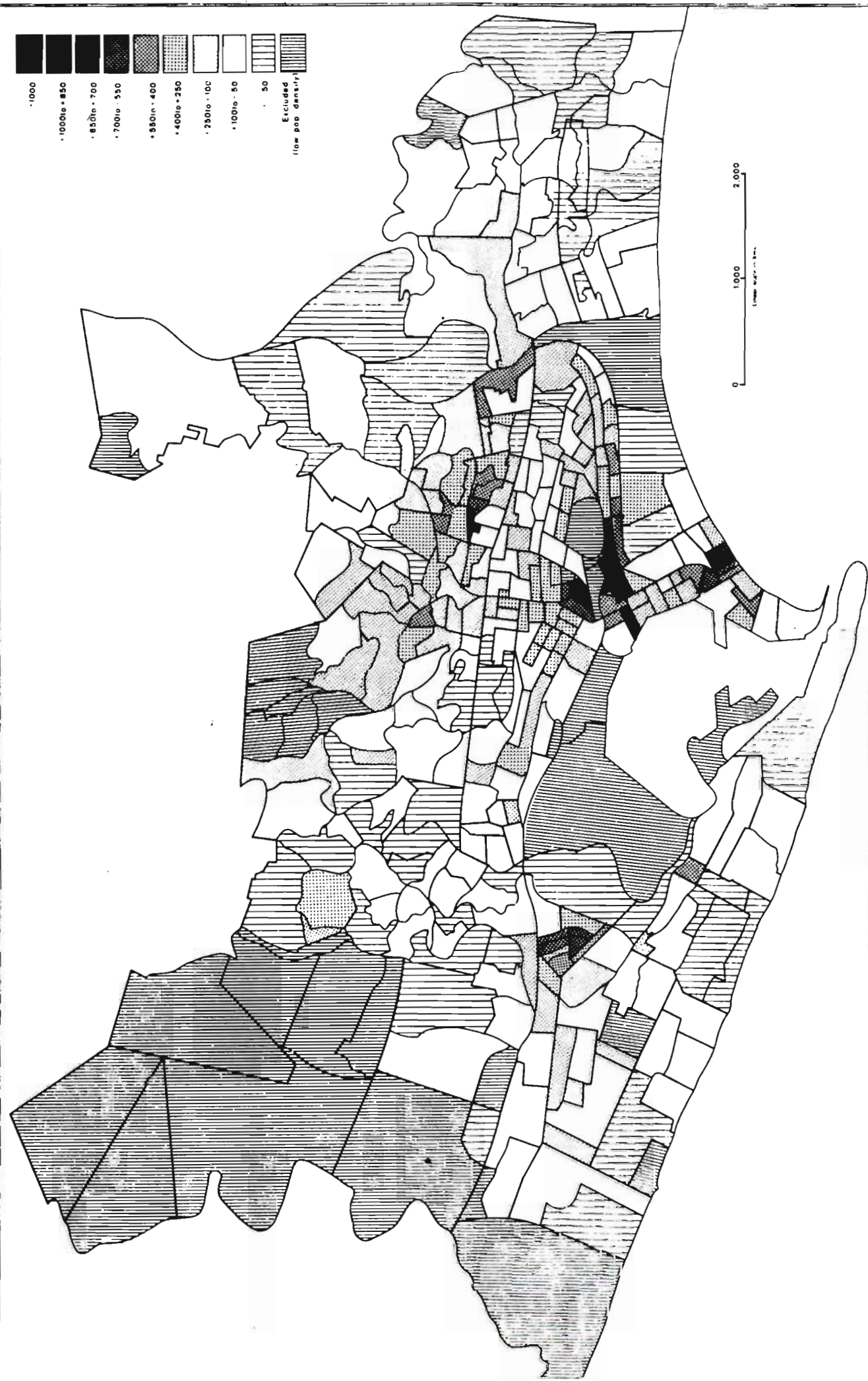
MAP 2: ISOPLETH MAP OF FACTOR SCORES FOR FACTOR 1.

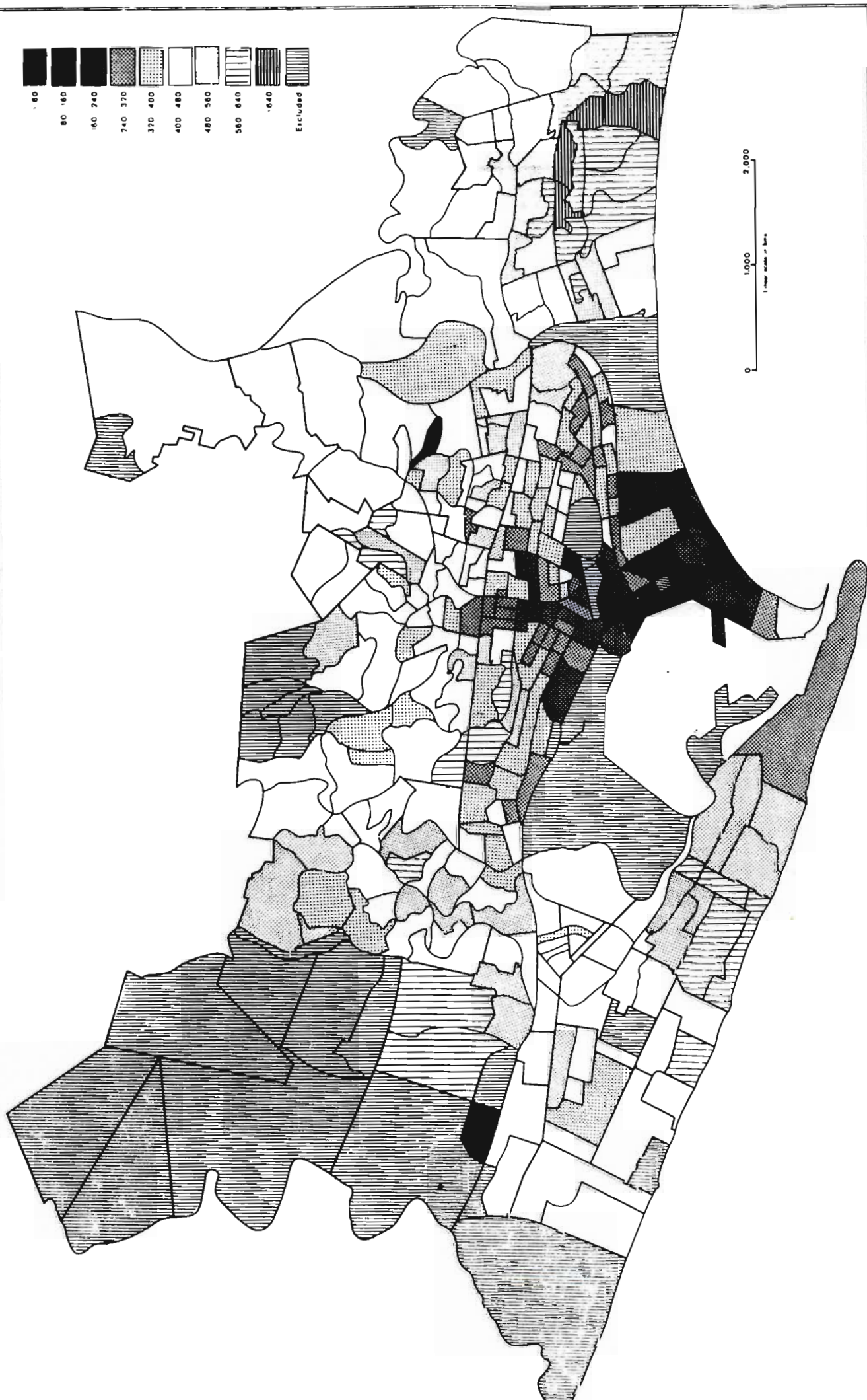


MAP 3: FACTOR 1 SCORES



MAP 4: FACTOR 2 SCORES





MAP 6: FACTOR 4 SCORES

NOTES

Chapter 1

1. For a discussion of the influence of the assumptions of neoclassical economics upon location theory see, for example, Cox (1976).

Chapter 2

1. Mills' (1970) analysis was more sophisticated, in a methodological sense, than Clark's (1951). Mills used multiple regression analysis in an attempt to establish which variables could most accurately account for changes in density functions over time. Clark's (1951) conclusions on the role of transportation, however, were based largely upon intuitive speculation .

2. It should be noted, however, that the increase in effective demand for housing was supported by rising per capita incomes, and an increase in the availability of mortgage finance in the post war years in particular (Clawson, 1975).

3. Clawson (1975) discusses the problem of the 'suburban fashion' in housing. It is not entirely clear how or why the fashion came about, but it appears to have been accelerated by the deterioration of the central city: a problem which, paradoxically, is related to the suburbanization process itself (cf. Little et al., 1975).

4. The term 'economic productivity' is borrowed from Richardson (1971). The precise definition of the concept in this study, however, is original.
5. In the author's junior thesis (University of Natal, 1973) it was established that the value of one particular tract of land, under rural use, was only $\frac{1}{60}$ th of the value of an adjacent tract, under residential use. Sinclair (1967) has noted that such differentials will often create an "air of anticipation" in a zone just beyond the built-up city. Although neoclassical, 'bid rent' models of land use postulate smoothly declining intensity of use away from a city centre, Sinclair (1967) has indicated that, at the edge of the built-up area, there is a zone of surprisingly low intensity of use (disused farms, etc.). Sinclair (1967) argues that this is a consequence of the fact that farmers will decline to invest in agricultural improvements when the 'air of anticipation' of urban development arrives.

Chapter 3

1. Examples of the work of the 'North Carolina School' include Kaiser's (1968) 'producer model' of residential growth, Weiss et al.'s (1966) study of residential developer decisions and Massie's (1969) system of linked models for forecasting urban residential growth.

2. The concept of 'general accessibility' refers to the degree to which a location is connected, via transportation networks, to all other locations within the city. In practice, general accessibility is usually measured by proximity to a freeway access point (as in this study).
3. The 'environmental amenity' of a place is very difficult to measure. Obviously, the quality of a residential environment is a multivariate problem. Troy (1973), in particular, considers some of the methodological issues associated with measuring 'environmental amenity.'
4. See, in particular, Baerwald's (1978) study, but also the work of the North Carolina School, cited above.
5. Carey (1976) provides a discussion of this problem, and its implications for the 'health' of the metropolis as a whole.
6. McCann (1975) reaches this conclusion from a study of cities in central Canada.
7. Again, McCann (1975, p. 66) demonstrates that the age of the housing stock increases with distance from the nonresidential core of the city.
8. Bourne (1967) established that, in Toronto, the number of lots within central areas of the city decreases with time as the scale of land required for redevelopment increases. This is partly a consequence of large scale office developments in

the 'downtown' area, but it is also a consequence of flat development just beyond the C.B.D./office zone.

Chapter 4

1. This figure was calculated by comparing the number of lots on a cadastral map produced for 1960 with the number of lots on a similar map produced for 1974.
2. Flat construction normally necessitates a net reduction in the number of lots within the city (because of consolidation). On the other hand, flat construction increases the number of dwelling units within the city.
3. For a discussion of a similar 'flat boom' in Christ Church, New Zealand, see Nahakies (1974).
4. The data on residential construction and demolition were derived from a study of approximately one hundred thousand records of building inspection for the City of Durban in the 1960-1974 period. For each instance of residential construction, demolition or major alteration, the following information was recorded: the location of the instance, the estimated cost of construction, the number of dwelling units, the type of construction or demolition (flats, houses, etc.) and the date.
5. During the 1960-1962 period, demolitions associated with the Group Areas Act (to be discussed in Part II) were particularly

marked. In addition, the national economy was at a low point, and there were relatively few building starts.

6. Factor analysis is discussed in Appendix 1.

7. The data set is the same as that described in note 4 above.

8. The sample was stratified with reference to distance to the city centre, according to procedures described by Yeates (1974, p. 54). This strategy allowed a set of observations to be selected which was not concentrated in any particular zone or sector of the city.

9. A basic reference on the problem of spatial auto-correlation is Curry (1966).

10. It will be recalled from Chapter 3 that net subdivision/consolidation (SUBS) should increase with distance from the city centre; demolitions, on the other hand, should decrease with distance from the centre.

11. It may be noted that the next two highest loadings on factor 3 were DISTFRE (-0.47) and DISTB (0.45).

Chapter 5

1. The transects are spaced at 18° intervals. In the case of transects which crossed the Cato Manor area (a 'special case' of politically induced consolidation) the curves in Figure 5.2 have been generalized to fit the overall trend.

2. Multiple regression, and the stepwise variation, are discussed in Appendix 1.

3. It is recognized that DISTB is only a limited index of 'environmental amenity'. Nevertheless, in this case, the variable at least serves as an indicator of the extent to which a location is close to the sea, sea views and the sea breeze.

Chapter 6

1. Steps three, four and five are excluded since the cumulative additional contribution to multiple r amounted to only 0.007.

2. As a rule, flat construction is negatively associated with subdivision, because land consolidation is measured as 'negative SUBS'. It is clear from the analysis reported here, however, that this generalization only applies in central areas, or areas near to freeway access points.

3. Steps three, four and five are excluded because of statistically insignificant B_i coefficients for SUBS, DISTB and ZONRES. Also, there was a relatively small additional contribution to multiple r .

4. The process of institutional suburbanization is considered in Part II of the study.

5. Once again, steps three, four and five are excluded because of low additional contributions to multiple r , and statistically insignificant B_i coefficients.

6. An analysis of the distribution of major alterations in Durban resulted in the following equation:

$$\text{ALTS} = 13.67 - 0.04 \text{ DISTPLVI} - 0.09 \text{ DISTFRE} - 0.03 \text{ DISTB} + E$$

(multiple $r = 0.43$)

7. Effective demand refers not only to the desire for housing, but the capacity to pay. Since Whites have generally higher incomes, it follows that they will spend more, per capita, on the housing good.

Chapter 7

1. The literature on racial descrimination in housing markets is somewhat inconclusive. On the one hand there are empirical studies which seem to indicate that Blacks pay more than Whites for housing (cf. Kain and Quigley, 1970; King and Miskowski, 1973). On the other hand, Lapham (1971) concludes from her studies that no price differential is evident. Still others suggest that Whites pay more for housing than Blacks (cf. Daniels, 1975; Muth, 1969).

2. Roweis and Scott (1977) put the ideological critique well: "(Neoclassical) models are profoundly quiestic. For if current urban patterns are nothing more than the expression of consumer's preferences, then on what grounds (in a democratic society) can public intervention ever be justified?"

3. Clearly, the reference here is to the classical (marxist) conception of class (cf. Giddens, 1971; 1973).
4. Roweis and Scott (1977) deliver a damning critique of the neoclassical assumption that preferences are revealed in behavior: "Neoclassical models can never in practice refute the alleged relationship between land prices on the one hand and tastes and preferences on the other; for in such modles tastes and preferences are always taken to be realized in the pattern of land prices and land uses. This is a case of explaining the thing by itself with a vengeance."

Chapter 8

1. See, for example, the discussion provided by Western (1978).
2. A review of the Durban case is provided by the Durban Housing Survey (1952), Appendix J.
3. See especially, the Durban Housing Survey (1952), Appendix I, for details of these commissions.
4. The Durban Housing Survey (1952) notes of the Indian Representation Act that "it specified specific areas for control. Within these areas (considered predominantly White) no Asiatic may occupy any property not already so occupied on 21st January, 1946, even if he owns the property, and no sale of property can take place between Asiatics and Europeans except by permission of the Minister of the Interior."

5. Legislation here included: (i) The Public Health Act No. 36 of 1919; (ii) The Slums Act No. 53 of 1934; (iii) The Local Government Ordinance No. 21 of 1942 (Durban); (iv) The Regulations for the Control and Inspection of Premises in Defined Zones of 1939 (Durban); (v) Durban Extended Powers Ordinance No.21 of 1949, Section 8.
6. An argument, to this effect, is provided in Kuper, Watts and Davies (1958). However, the theme is also repeated in a number of other sources (cf. Brookfield and Tatham, 1957).
7. The phrase 'redistribution of real income' is borrowed from Harvey (1973). It refers to the problem of welfare distribution (in the broadest sense) within the city.
8. Opposition politicians in South Africa held, in 1950, that the Group Areas Act would prove impossible to implement. For a similar view in the geographical literature, see Brookfield and Tatham, 1957.
9. Data on the exact numbers involved are provided in Kuper, Watts and Davies (1958) and the Durban Housing Survey (1952).
10. This view is expressed, for example, by Kuper Watts and Davies (1958) and Western (1978).
11. These figures were derived from the Durban Housing Survey (1952, p. 436).

12. By 'status groups' we mean groups which are differentiated according to occupational characteristics and incomes, in particular (cf. Giddens, 1973). The term 'housing class' refers to, most generally, the distinction between renters and owners.

Very often, however, the term is used to distinguish apartment (flat) dwellers from those who live in houses (cf. Rex, 1971).

13. It should be stressed that the discussion of the results is necessarily abbreviated here because of space limitations. A 'factorial ecology' is generally a study in its own right (cf. Hart, 1975). In this particular case, however, the factorial ecology is simply one step in a larger research design. Thus, whilst the definition of factor 1 as a 'racial differentiation' may appear to the specialist as overly simplified, in the context of this study such simplification is necessary.

14. In 1960 the Afrikaans speaking population of Durban was largely occupied in semi-skilled employment categories within the public sector (especially railways and harbours). Few Afrikaners held high status positions; hence the association of variable 22 with lower status positions within the white group. Hart (1975) identified a similar relationship in his analysis of Johannesburg.

15. In point of fact, the Islamic population is differentiated from Hindus by more than religion. In general, the former

group enjoys considerably higher incomes and occupational status.

16. Family status is a dimension of social differentiation which emerges from almost all factorial ecologies (cf. Rees, 1970). In this particular case, it is clear that factor 4 makes the usual contract between opposite poles of the life cycle.

17. It is interesting to note that the higher status Non-whites (mainly Islams) are concentrated in the centre of the city. This stands in contrast to the spatial organization of socio-economic status which is characteristic of the western city (cf. Rees, 1970). On the other hand, it would be congruent with the pattern which applies, for example, in India (Berry and Horton, 1970).

18. The term "white oligarchy" is borrowed from Adam (1971). Davies (1976) and Welsh (1971) have each remarked on the 'paradox' that an ostensibly racist government was first responsible for providing Non-whites with public housing.

19. Certainly, this would be the implication of Western's (1978) argument.

20. The concept of the state, here, is derived from Poulantzas (1975).

21. De Kiewiet (1966) points out that the so-called 'land wars' (which drove Africans into the areas now known as 'Homelands') "were also labour wars." Given that very limited reserve areas had been established for African use, increasing numbers of Africans were compelled to sell their labour power to employers in the emerging industrial and mining centres.
22. Several authors have proposed this view of the Homelands of late. Perhaps the most interesting treatment is provided by Buroway (1976).
23. Maasdorp and Humphries (1975) provide some data on the relative costs of slum housing in Durban. The Durban Housing Survey (1952), however, is the source for the statistics cited here.
24. The Durban Housing Survey (1952) reports of several such studies.
25. Maasdorp and Humphries (1975) provide a review of the concept of the "poverty datum line" (or PDL).
26. This is according to Welsh (1971).
27. A popular strategy here was to use the profits from the sale of 'native beer' as capital for housing. Since local government held a legally enforced cartel over the production and sale of this beer, local government could sponsor African housing projects without cost to the white electorate.

Chapter 9

1. As King (1970) has noted, unfortunately the geographic community tended to concentrate upon such 'descriptive' models in the 1960's.
2. On the question of process, form and explanation, a basic reference is Harvey (1969).
3. As yet unpublished research by J. F. Butler-Adam has established this point.
4. Private 'land holding' and 'speculation' has been an almost traditional concern of the planning community in the United States and Britain (cf. Clawson and Hall, 1973). The same would seem true of South Africa.
5. The study was supervised by Professor R. J. Davies, and was concerned with "the growth and alienation of land for township development in the Durban-Pietermaritzburg Planning Region."

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