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DEVELOPMENT OF AN OPERATIONAL SYSTEM FOR MONITORING THE CHANGES IN URBAN SUBAREA RESIDENTIAL HOUSING STATUS

A Spatial Analytic Application of the Formulations of Neighborhood Filtering and Neighborhood Dynamics

by

Harold Chike Mba

A dissertation submitted in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

URBAN STUDIES

Portland State University

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TO THE OFFICE OF GRADUATE STUDIES AND RESEARCH:

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AN ABSTRACT OF THE DISSERTATION OF Harold Chike Mba for the Doctor of Philosophy in Urban Studies presented May 27, 1982.

Title: Development of an Operational System for Monitoring Changes in Urban Subarea Residential Housing Status: A Spatial Analytic Application of the Formulations of Neighborhood Filtering and Neighborhood Dynamics.

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This dissertation focuses on the precise and meaningful measurement of change as it pertains to the urban subarea residential housing status. The word "measurement" is qualified as meaningful in the sense that the approach adopted is of relevance to public policy. Specifically, the

dissertation is aimed at providing answers to the following research questions: First, how can the changes in residential housing status in the different parts of an urban area be precisely and meaningfully measured? Second, what variables are most appropriate for the measurement? Third, can these variables be useful for differentiating between various parts of the urban area? Fourth, do the results of an urban subarea housing classification system depend on the specific variables used in the classification?

Using data drawn mainly from the 1960 and 1970 censuses of housing for Portland, Oregon SMSA, a simple but robust methodology is developed for indexing and monitoring changes in the urban subarea residential housing status. The research borrows appreciably from Fisher and Winnick's, and Toulan's formulations of the filtering process in the urban housing market. The variables used in the measurement and classification analyses include the changes in the following variables: median home value or contract rent, median household income relative to the average household size, housing quality, percentage of all occupied housing units, and percentage of owner occupied housing units.

Principal component analysis is used for construction of composite index of change in urban subarea residential housing status. Furthermore, this composite index is used in a multivariate linear discriminant analysis for the classification of the various subareas (census tracts) in Portland, Oregon SMSA.

The findings validate the variables employed in the analyses, and support the hypothesis that the results of an urban subarea classification system depend, to some extent, on the housing market variables used in the classification. The findings from the study show that operationally simple but robust systems can be developed for monitoring the changes in residential housing status in urban neighborhoods, in relation to the general urban area.

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CHAPTER I

INTRODUCTION

There has recently been an increase in interest among civic organizations, urban communities, federal, state, and local government agencies in the preservation and rehabilitation of housing in urban residential areas. This has been due to a number of factors directly and indirectly related to the urban housing market. First, there is an increasing trend in the abandonment of housing in many cities of the country despite continuing rise in the need for housing (Public Affairs Counseling, 1973). Second, considerable evidence has become available concerning deterioration of appreciable percentage of housing in many urban communities. Some of those houses include a few which were publicly built (Goetze, 1979). Third, the recent analysis of federal housing assistance programs have highlighted "the relationship between the need for housing, the potential limits to new construction, and the important role of the existing inventory" (Public Affairs Counseling, 1973).

Fourth, a growing awareness of the scarcity of energy and other resources, dictates a periodic assessment of available resources (Public Affairs Counseling, 1973). It has been suggested that it is only by monitoring resources (including housing), can problem areas be detected early

enough for corrective actions to be taken.

Housing preservation efforts will necessitate periodic assessment of housing conditions in urban areas. This will help to show where each part of the urban area stands in relation to the other parts. Obviously, this will entail ranking the different parts of the urban area according to their housing conditions.

The need for regular and periodic assessment and monitoring of the changes in housing conditions over time was articulated by the Housing and Community Development Act of 1974. Among other things, the act provided for the following:

> The conservation and expansion of the Nation's housing stock in order to provide a decent home and a suitable living environment for all persons, but principally those of low and moderate income..... the promotion of an increase in the diversity and vitality of neighborhoods through the spatial decentralization of housing opportunities for persons of lower income and revitalization of deteriorating or deteriorated neighborhoods to attract persons of higher incomes.....

The Act allowed cities to develop comprehensive strategies and programs for dealing with neighborhood preservation. Moreover, federal funding was no longer limited to specific blighted areas. Preservation of existing housing units also qualified for federal funding under the Community Development Block Grant program of the Act. This was indeed a very significant shift of emphasis from previous physically oriented programs which dealt more

with the houses, and less with the occupants whose characteristics, capabilities, and opportunities were critical to the success of the programs.

Essentially, the Housing Assistance Plan, created by Congress in 1974 as an integral part of the Community Development Block Grant, gave local jurisdictions responsibilities for identifying and defining the housing needs of their communities. Implementation of the Housing Assistance Plan implicitly and explicitly called for the need for development of techniques for monitoring housing situations in urban areas. Some municipalities, and researchers have already developed techniques that would serve their special needs. However, the necessity for standard, generalizable, and adequately sensitive techniques has not yet been met. This investigation stems from this identified necessity.

THE SCOPE OF THE DISSERTATION

This investigation was undertaken with the prime objective of developing a methodology for measuring and monitoring the relative changes in urban subarea residential housing market conditions. It involved development of a measuring index or scale, which was useful for classification of urban residential areas. It also attempted to determine to what extent the results of residential area classification depend on the housing market variables used.

On the basis of the changes in selected variables from 1960 and 1970 census tract housing data for Portland, Oregon

SMSA, principal component statistical analysis was used to develop an index for the changes in status of residential housing market conditions in the SMSA. Subsequently, those changes in housing market conditions were successfully classified into three distinct categories (rise, stable, and decline) using multivariate linear discriminant analysis.

The variables used in the development of the index were the changes in the key variables which were considered necessary for replicating relative changes in urban subarea residential housing market conditions. These variables were as follows: median home value or contract rent, median household income relative to the average size of household, housing quality (percentages of deficient, crowded and much older housing units), percentage of occupied housing units, and percentage of owner occupied housing units.

Altogether, eight different sets of analyses were made, with one or two of the variables excluded from the analysis at each of the stages of the investigation. This approach was adopted in order to observe the relevance of each of the above identified variables in the index building and classification processes. It was considered that this procedure would give a clear indication of the role of each of the variables in effecting housing status changes in subareas. Each of the steps in the various analyses will be described in detail at the appropriate stages in the dissertation. Moreover, the rationale for choosing the proxy variables for the changes in the status

of residential housing market conditions will be made evident.

The investigation also involved some other variables, which were used mainly in multiple linear regression analysis to empirically test the characteristics of the index of change developed. These variables included the following: the percentages of new construction and demolitions relative to the total housing units at the beginning of the period, the percentage change in year-round vacancies, the percentage change in total housing units, and the percentage change in the total population in a subarea. They also included the percentage changes in the number of families in the various income quartiles, the percentage change in the number of employed persons, and the percentage change in the non-white population in a subarea.

The characteristics exhibited by the index developed in this study conformed with the expected results. The expected relationships of the index with selected housing market variables were validated.

The Utility of this Research

The methodology developed in this research is indeed an important improvement on the existing urban area classification systems. Many of those existing systems contain so much subjective input that their final products are far from being objective. Some of those systems have usually been designed to serve the particular needs of

communities applying for Community Development Block Grant money. On the contrary, the methodology which will be fully described in this investigation is both objective and analytical.

Moreover, the methodology can be applied in other urban areas in the country, since the variables used in the various analyses are those for which consistent data can be secured. Another advantage of the methodology used in this research is that the index developed is a scale which can be utilized to accurately determine the extent to which housing market conditions in any part of the urban area change in relation to the entire urban area.

Indeed, many organizations will find the methodology developed in this research useful. For example, urban planning departments will find it an invaluable tool for monitoring changes in housing conditions in various neighborhoods of the urban area under their jurisdiction. Second, federal and state agencies do need a precise and reliable technique for assessing housing situations in localities applying for housing assistance funds. Moreover, urban communities would benefit from a good system for monitoring the relative changes in housing market conditions in various parts of their urban areas.

The advantages of using a reliable composite index for scaling the changes in the status of the housing market in urban subareas are immense. It is pertinent to state that a precise and analytical monitoring system will help overcome

the problems that often arise when different components of the housing market profile variables such as home values or contract rents, incomes of housing occupants, housing quality, percentages of occupied housing units, and percentages of owner occupied housing units happen to change in opposite directions. For example, if the changes in some of those variables are in the positive direction, while the changes in some of the other variables are in the negative direction, it would be difficult to ascertain whether the housing market conditions are actually rising or declining. However, with the use of an index, it will be quite easy to observe the aggregate change in each part of the urban area.

Essentially, monitoring of housing situations in different parts of an urban area will immensely facilitate identifying those places that need rehabilitation and preservation action. This will surely help to obviate the traditional expensive, and dislocative urban renewal projects which will otherwise be called for if the general housing in the locality becomes dilapidated.

Additionally, monitoring of housing conditions can be useful for evaluation of the effectiveness of specific housing program strategies over any desired period of time. This incidentally is an issue which has not been given adequate consideration in urban housing programs. Indeed one would not fully appreciate the point being made here about urban housing programs without some degree of

familiarity with them. It is therefore pertinent to briefly review those programs.

HISTORICAL BACKGROUND AND LITERATURE REVIEW

Urban housing programs in the U.S. could be broadly categorized into three major phases (Yeates and Garner, 1976). These are basically the supply side and urban renewal subsidy phase which existed before 1960; the modified supply side subsidy phase which was in vogue in the 1960's; and the demand side subsidy phase which came into effect in the 1970's.

Although historical evidence shows that Federal Government involvment in public housing dates back to the late 1930's, there is some disagreement about the initial objective of that involvement. Some experts, such as Yeates and Garner, explain that public housing projects were actually aimed at stimulating employment and not necessarily designed to improve urban housing conditions. Nevertheless, the 1937 Housing Act not only provided federal funds for the development, acquisition, construction, and management of low rent public housing projects by local housing authorities, but also encouraged slum clearance measures. Moreover, it established "decent, safe, and sanitary" dwellings as a goal of the U.S. Government. Under this Act, the Federal Government contributed 100 percent of the capital costs for public housing projects, thus enabling local housing authorities to set rents at low levels. Rents

were, as a result, set to cover operating and maintenance costs.

However, Jones (1970) contends that the Housing Act of 1937 failed to achieve significant positive results with regard to elimination of slums in urban areas. Although attempts were made to define what was meant by slum, it was a subjective term and the degree to which that section of the Act could be applied was subject to the preferences of the officials who were to implement it.

It was indeed the Housing Act of 1949 that gave rise to modern urban renewal efforts. The Act provided federal loans and grants to local authorities to plan their redevelopment through private enterprise. The 1949 Act declared as follows:

> The general welfare and security of the nation and the health and living standards of its people require housing production and related community development sufficient to remedy the serious housing shortage, the elimination of substandard and other inadequate housing through the clearance of slums and blighted areas, and the realization as soon as feasible of the goal of a decent home and a suitable living environment for every American family.

One of the objectives of the 1949 Housing Act was promotion of new private construction in the older areas of the central city. Under Title I of the Act, local public redevelopment authorities were allowed to assemble and clear sites and sell at a loss to a private developer. Two-thirds of the difference between the cost of acquiring, clearing, and developing the site and the resale price for the purpose of redevelopment was paid by the Federal Government.

Another important objective of the Act was the improvement of housing conditions. This was to be achieved by "removal of slum housing on the one hand, and the stimulation of the filtering down process" by construction of higher priced housing for new middle- and upper-income housholds (Yeates et al, 1976). Unfortunately, however, urban renewal and slum clearance resulted in reduction in the total supply of housing units. This was because many middle and upper income rental and commercial houses were constructed on sites in which low income houses had existed.

Urban renewal was liberalized by the 1954 Housing Act through the inclusion of provisions for rehabilitation of housing structures, conservation of neighborhoods, as well as comprehensive planning and renewal for commercial and industrial areas. The Federal Government also required communities to develop a "workable program" for community improvement as a broad plan of action for combating urban blight and slums.

In a continuing effort to correct the deficiencies in the urban renewal programs, the Congress, in the 1956 Housing Act, provided for relocation payments to families and businesses displaced from urban renewal sites. Moreover, the community improvement aspect of urban renewal, as introduced in 1954, was reinforced in 1959 through the introduction of the Community Renewal Program.

However, by the 1960's, dissatisfaction with the urban renewal and public housing subsidy programs had become so

obvious that alternative subsidy programs had to be introduced. Although these subsidies were also aimed at stimulating new private construction, the connection between federal subsidies and slum clearance was severed (Yeates et al, 1976). Most of the housing legislations of this decade reflected a separation of housing subsidy issues from urban renewal issues. The only exception was the code enforcement legislation, which was introduced in the 1964 Housing Act for provision of low-interest housing rehabilitation loans, and for protection of sound areas.

Section 221(d)3 of the 1961 Housing Act, which was occasionally referred to as "the below market interest rate" (BMIR) program, was introduced with the objective of reducing rental costs of new, privately constructed units. These units intended for middle- and lower-income families were built at subsidized below-market interest rates of three percent. However, the mortgages for the units were purchased from the financial institutions at the current interest rates by the Government National Mortgage Association (GNMA). This program, which contained subsidies to private developers, favored the construction industry. Its funding was more generous than the funding for the public housing programs.

However, this program did not have much impact on the housing problems of the time. This was because it benefited mainly the lower-middle income households which could afford the money to avail themselves of that opportunity. As some

critics have pointed out, it did not benefit the majority of households which were in the low income category. One other deficiency of Section 221(d)3 was that it did not benefit households whose incomes were too high to qualify them for public housing, but too low to benefit from the program.

In order to correct these deficiencies, a rent supplement program was proposed under which the Federal Government would pay property owners the difference between fair market rent and the share paid by tenants. After appreciable modification, this program was finally enacted as part of the Housing and Urban Development Act of 1965. The Tenant's share of rent was 25 percent of income. Moreover, the Congress, in 1965, took a very significant step on the issue of urban housing by reinforcing accountability for program implementations through the creation of the Department of Housing and Urban Development.

Another significant step taken by Congress was the broadening of the scope of aid to urban areas through the Demonstration Cities and Metropolitan Development Act of 1966. This Act authorized the "Model Cities" program to rebuild or restore blighted and slum areas by means of well coordinated physical and social development programs using funds from federal, state, and local governments as well as the private organizations. The program provided grants and technical assistance to cities which had acceptable comprehensive plans for dealing with the social, economic, and physical problems of selected neighborhoods.

Although the Congress directed attention, in 1966, to the problems of selected neighborhoods, it soon focused attention again on the issue of subsidized housing. The Housing Act of 1968, for example, supplemented the former Section 221(d)3 with sections 235 and 236. Under section 236, the tenant paid at least 25 percent of his income in rent, whereas, the government paid the smaller of the difference between the market rent and the rent that would have been incurred if the mortgage rate were only 1 percent. The design of the government subsidy built into section 236 was very much the same as that applicable to section 235. The two sections of the 1968 Act differ only in two respects: Section 236 was for renters, while section 235 was for homeowners. Homeowners paid 20 percent of income.

By 1969, however, the Congress had become seriously concerned that far fewer new housing units had been constructed compared to the large number of low income housing units that were demolished under the slum clearance and urban renewal programs. This awareness led to the enactment of the 1969 Housing and Urban Development Act which introduced a requirement for one-to-one replacement of housing eliminated by urban renewal, and which had been occupied by low and moderate income families prior to urban renewal projects.

The subsequent years of the 1970 decade witnessed some reappraisal and reorganization of the array of urban housing programs which had been created during the previous decades.

In 1973 for example, the Nixon administration placed a moratorium on all public housing programs, while in the process of evolving alternative approaches for dealing with urban housing problems.

This was because new construction subsidy programs, especially sections 235 and 236 programs were heavily criticized. Moreover, the existing programs did not have appreciable impacts on the housing conditions of lower income households. The new construction under section 235 actually also facilitated the exodus of middle income people to the suburbs, thus reducing the fiscal opportunities of the inner city. This reflected the feeling of the government early in the 1970's. It was no wonder that the later programs that evolved eventually resulted in a significant shift from supply side subsidy programs of the previous decades to the demand side subsidy programs.

In 1974, the Housing and Community Development Act was enacted. Under this Act, the following titles were created:

Title I - which consolidated several existing programs into a Block Grants Program;

Title II - which authorized the leasing of new and rehabilitated private housing (outside the slum areas) to low income families;

Title III - which raised FHA single family home mortgage limits;

Title IV - which provided funds for comprehensive planning by communities for determination of housing needs;

Title V - which liberalized the rural housing law;

Title VI - which established construction safeguards and

enforcement of safety standards for mobile home manufacturers;

Title VII - which raised loan limits for federal savings and loans, and revised the real estate lending authority of national banks;

Title VIII - which among other things, authorized an experimental housing allowance program.

The Housing and Community Development Act of 1974 in many respects liberalized the conditions for aiding urban areas by the introduction of Community Development Block Grants. Federal funding was no longer restricted to blighted or urban renewal areas, but could be available for preservation of existing housing in neighborhoods. This Act has indeed given great impetus to the planning of neighborhood housing to the present day. Apart from its impact on urban development planning, the Community Development Act of 1974 has in many respects broadened the scope of the efforts for improvements of urban housing conditions. As the historical review had shown, several of the past urban housing programs had both implicitly and explicitly indicated concern for improvement of urban housing conditions. In some instances, emphasis was placed on improving the welfare of individual households by reducing their expenditures on housing. In some other instances, the emphasis clearly indicated concern for improvement of urban housing conditions.

However, the concern for urban housing conditions was not only evident in governmental programs. The concern also manifested itself in extensive research efforts directed

toward finding the answer to the question of how best to improve urban housing conditions. Researchers in the area of urban housing have published a wide range of papers on individual housing units and neighborhood housing. Some researchers have referred to changes in neighborhood housing conditions as "neighborhood filtering" (U.S. Department of Housing and Urban Development, 1977). The term "filtering" as was actually first used by Richard Ratcliff in 1949 referred to individual housing units (Ratcliff, 1949). The concept is very much associated with the urban residential housing market, and is of significant importance in this research. This is because it was hoped that the process could be used to achieve one objective of the housing policies initiated in 1949. This objective was improvement of urban housing conditions by construction of new higher priced houses for the middle- and upper-income groups instead of targeting low quality new housing directly to the low income groups. It was considered that the higher priced houses will be of higher quality. Hence higher income groups, who could afford to purchase or rent new higher quality housing units would vacate their current standard housing units for the lower income groups, who would otherwise not have been able to acquire them.

The rationale for the concept was that high quality individual housing units would result in high quality neighborhoods. To this extent, filtering of individual housing units would be closely associated with filtering of

neighborhoods or urban subareas in which those individual housing units are located.

It is, therefore, pertinent to review the different formulations of the filtering phenomenon which have emerged during the past three decades.

The Filtering Process

The term filtering was defined by Ratcliff as:

> changing of occupancy as the housing that is occupied by one income group becomes available to the next lower income group as a result of decline in market price, i.e., in sales price or rent value (Ratcliff, 1949).

Ratcliff's definition invariably incorporated change of occupancy as necessary element of the filtering process. However, there is no strong reason to believe that filtering is always accompanied by change of occupancy. There is also no valid reason for limiting the filtering process to only cases of downward filtering. Upward filtering is also a reality.

Later definitions of the filtering process by other researchers have not only differed from Ratcliff's original definition but have differed from one another. Indeed literature review points up the fact that the differences in the definitions and formulations of the filtering phenomenon were due mainly to attempts by different researchers to adapt their formulations to varying empirical and analytical measurement requirements available to them at the time (Grigsby, 1963).

Fisher and Winnick (1951) for example, defined the process as:

> a change over time in the position of a given dwelling unit or group of dwelling units within the distribution of housing prices and rents in the community as a whole.

Fisher and Winnick argued that any housing unit whose rating with respect to the rest of the housing in the community has improved, has, in fact, filtered up. Their definition, therefore, allowed for the possibility of both downward and upward filtering. Moreover, this definition ignored the change of occupancy aspect of Ratcliff's original definition.

However, total disregard of the income element of the filtering process as stated by Ratcliff seems to divert attention from the meaning and purpose of filtering. According to Fisher and Winnick's definition, a housing unit formerly occupied by a higher income group is not considered as having filtered up if it is taken over by a lower income group at the previous price level. Moreover, if the same housing unit is taken over by a higher income group at a depreciated price or value, Fisher and Winnick's formulation will indicate that downward filtering has taken place, even though this signals a worsening trend in housing conditions. This may have been caused by shortages in the supply of housing and increased demand by housing consumers. But this trend is contrary to what Ratcliff (1949) had referred to as filtering (in a downward sense). For downward filtering to

have taken place under Ratcliff's definition, the subsequent occupant of the housing unit has to be of a lower income group, and the price or rent level of the unit should somehow be less than before. The end product of filtering is supposed to be better housing for all income groups, and at affordable levels.

Nevertheless, Fisher and Winnick's definition of the filtering concept has some positive aspects. First, by measuring the phenomenon as movement of housing prices or rents within the frequency distribution of all housing prices or rents in a community, the whole problem is reduced to a straightforward statistical exercise. The authors claim that this is a major merit of their formulation of filtering. Secondly, this formulation of filtering will be very useful in small sections of urban areas where household income differentials are either minimal or not very significant. For example, it was the only approach that indicated a downward movement of housing units or rents in New York's Lower East Side from the beginning of the century to 1940, when the area was experiencing a visible decline (Grigsby, 1963). The area was obviously experiencing an influx of low income groups.

Besides Fisher and Winnick, a few other subsequent researchers have formulated the filtering process using only rents or values of housing. Lowry (1960), for example, defined filtering as: "change in price or rent of a house

in constant dollar units with respect to prices generally."

This definition relates the process to costs of all goods and services - a standard outside the housing market. It might be realistic to relate the filtering process to the general prices since the expenditure that can be allocated to housing depends on technology, landuse controls, union scales, taxes, and personal expenditure patterns that are components of general prices.

Although this definition of filtering is much closer to Ratcliff's definition, it is inconsistent with the original purpose of using filtering to improve housing conditions. Disregard for the important issue of matching housing units to their occupants (using such household characteristics like income) limits it to mere price depreciation to constant dollar units (Grigsby, 1963). It would, therefore, not matter whether a house which was occupied by a higher income group depreciated slightly in price, but is still unaffordable to a lower income group. Filtering will be said to have taken place as long as prices or values keep swinging up and down.

A definition which broadened the scope of variables used by Fisher and Winnick, as well as by Lowry, to define the filtering process was postulated by Toulan (1960). He not only incorporated income as an important element of the filtering process, but also included the physical structure

of the housing units under consideration. Toulan defined filtering as:

> a process of homogeneous and relatively proportional change, through time in the position of rent or price, income of occupants, and physical condition of the structure on the frequency distribution of rents or prices, incomes of occupants, and the physical condition of the structures (Toulan, 1960).

This definition of filtering is particularly relevant for relating the process to urban housing policies. However, because of the number of variables directly or indirectly involved in the measurement of filtering as defined above, it does appear that this formulation will involve some index problems if the variables happen to change in opposite directions. With the increased availability of standard statistical procedures, this index problem is no longer insurmountable. Nevertheless, the above definition of filtering has considerable merit in the sense that it does identify an adequate range of variables for replicating the process. In particular, it reintroduces the income element as originally stated by Ratcliff (1949).

Changes in housing values and contract rents alone are inadequate for explaining or formulating the filtering phenomenon. Although it might be argued that a housing unit, which has been renovated, can appreciate in value, and could thus lead to the conclusion that value (or rent) can serve as perfect surrogate for the quality of the housing, it is doubtful whether this assumption is always valid. There is no doubt that the basic function of the housing

market is to match households with the existing stock of housing. Therefore, since income is one of the major determinants of housing demand, and is about the most important household characteristic related to housing, matching of households with existing stock is equivalent to matching up a distribution of households differentiated by income with a distribution of housing units differentiated by cost (Yeates et al, 1976). Moreover, empirical evidence has shown that there is a strong relationship between income on the one hand, and housing quality on the other hand (Muth, 1969).

Grigsby (1963) seemed to agree with the broader and social notion of the filtering process. He stated as follows:

> filtering (changes in house prices and rents) must be measured while holding income, quality and space per room constant, or in more relaxed form, that filtering occurs only when value declines more rapidly than quality so that families can obtain higher quality and more space at the same price, or the same quality and space at a lower price than formerly.

However, he empirically studied the process only in relation to residential housing prices and rents as well as consumer incomes. His theoretical discussions were focused on the relationship of these variables with consumer prices.

In a later attempt at modeling the filtering process, Smith (1964), devised an assignment model based on simple matrix of prices bid by different families for houses of

different qualities. He used a demand matrix to show the changes in housing assignment to households (represented by income) resulting from new construction. The fundamental assumptions of this assignment model are that rent offers increase with housing quality, and that rent offers also rise with income; since higher income households are more likely able to offer greater premium for housing quality than lower income households are willing to offer. There is thus a basic assumption of strong relationship between housing rent or value, housing quality and income of a housing occupant. Smith's model (Smith 1964) is difficult to test empirically and cannot be adapted to practical use. However, the logic of the formulation appears to be quite sound.

Edel (1972) commenting on Smith's model called attention to the role of decentralization and fragmentation of housing ownership in the filtering process, and stressed the need to incorporate those characteristics in a model of the process. He also noted that the construction of housing, and the maintenance of rental housing are, with a few exceptions, undertaken by many small businesses and not by giant private corporations nor the public housing authorities.

Nourse and Guy (1970) in their time series study of the filtering process in selected neighborhoods in Kankakee, Illinois, and Webster Groves, Missouri, based their formulation on comparison of assumed (proxy) income levels of a

succession of occupants in the same housing units. They stated as follows:

> filtering down is said to occur if the income of the person moving out is higher than the income of the person moving into the same house. Filtering up, of course, would occur if the income of the person moving out is less than the income of the person moving into the same house (Nourse et al, 1970).

Because income values of housing occupants were not available to Nourse and Guy, they used occupational rankings of those housing occupants as proxy for income ranking. This they did by converting occupational information to estimates of income ranks, using values of decile rankings for all occupations as contained in the Bureau of the Census data for the periods studied. The basic assumption in this procedure is that occupation is a highly reliable function of income. However, household income does not necessarily come from wages or salaries alone. There are indeed some households whose major incomes come from sources other than wages. Although Nourse et al (1970) included values of possible non-wage income in the annual income for each occupation, there is still a wide latitude for error in this approach.

The second problem with this approach is the assumption that change of occupancy is a necessary condition for filtering to occur. But it is obvious that a household whose income has declined relative to the incomes of all households in the area will be spending a higher percentage of its income on housing than those other households. In

effect, the household's housing has become comparatively more expensive.

The third problem with the above approach is the assumption that each worker would have to necessarily be located near the median earnings for his or her occupation. This is implied from the sets of data used in converting occupational rankings to income rankings. However, it is known that as the differential between occupations narrows down, the possibility of error in the rankings increases. Also the degree of error will increase with increase in the dispersion of earnings within occupational categories. Fourth, despite the considerable emphasis placed on housing rent or value in most of the earlier formulations of filtering, the above definition rarely made mention of any of these two variables.

Nevertheless, this study marked another significant step in the operationalization of filtering. The model was empirically tested, and found by the investigators to be somewhat satisfactory, although only estimated income rankings were used in the analysis.

While Nourse and Guy (1970) used income ranking proxies to replicate the filtering process, some other researchers (Ohls, 1975; Partridge, 1971; Rothenberg, 1972; Sweeney, 1974) defined the process on the basis of housing prices (or rents), and housing quality. It was pertinent to note that those two major groups when considered together have used the three variables (income, rent, or value and

quality of housing) which were used by Toulan (1960) to define filtering.

Another broad group of researchers, such as: Firestone (1951) in Canada, Kristof (1965, 1966) in the United States, Lansing et al (1969), Watson (1974) in Scotland, and Murie et al (1976) in Northern Ireland based their formulations on the impact of new construction and changes of occupancy resulting from subsequent chain reactions. There is an inherent assumption in these formulations of filtering that higher income groups change occupancy because they feel their current housing is 'obsolescent', due perhaps to changing technology, and tastes.

In much more recent years, another trend in the investigation of the filtering theory has been the use of vacancy chains instead of the four variables (rent or value of housing, quality of housing, income of housing occupants, and change of occupancy) which had been commonly used in the past. Among this more recent group of investigators, is Harrison White (1971), who used a Markov probably model to evaluate the filtering process. White examined the 'careers' of housing vacancies as they moved through the housing system. The vacancies resulting from construction of new dwelling units were carefully traced so as to see whether vacancies remained local and thus moved to less expensive units or to other units of the same costs, or whether they entirely moved out of the local market.

Following the example of White (1971), Gary Sands (1979), defined the filtering process using the first order Markov probability model. Sands used data from a vacancy chain study conducted by Southeast Michigan Council of Governments for his investigation. These included a clustered random sample of new residential construction. Sands observed as follows:

> new units at all cost levels have a substantial impact on the availability of moderate- and low-cost housing opportunities. This result generally supports reliance on indirect strategies. However, the greatest number of moderate-cost turnover vacancies result from construction of new moderate-cost units. A similar situation exists with respect to low-cost units. It would appear, if the aim of public policy is to ensure an adequate supply of low- or moderate-cost housing opportunities, this end would be best served by direct rather than indirect strategies (Sands, 1979).

The controversy over the correct definition of filtering is far from resolution. With the passage of time, researchers have tended to add more ideas and variables to the original concept of filtering as defined by Ratcliff (1949), while dropping some others.

The controversy over the formulation of filtering not-withstanding, the concept has, indeed, had far reaching implications in urban neighborhood (or other small area) residential housing planning. The term 'neighborhood filtering', which is now a common word in housing and urban planning literature is an obvious extension of the broader definition of filtering, and is surely of immense significance for urban development planning. Its formulation will

be useful for detecting urban subareas that need special attention.

Moreover, the problems of individual housing units can neither be adequately understood nor solved in isolation from the larger context of the locality in which the units are located. It will surely be more profitable to take a broader approach in dealing with the problems of the urban residential housing market. Little (1976) and Leven et al (1976) had validly stated that the housing market should not be viewed as a market for a single commodity, but one for housing bundles. These bundles include not only the attributes of the housing units but also the physical and socioeconomic environment as well as the public sector aspect of the neighborhood in which the units are located.

Indeed a macro-analytic approach is both valid and appropriate for dealing with the filtering process since the neighborhood context is an important part of the issue. It is for this reason that the next chapter of this dissertation has been devoted to the discussion of neighborhood filtering and neighborhood dynamics. These concepts form the basis for the methodology developed in this dissertation for monitoring the changes in the status of the residential housing market in different parts of the urban area.

CHAPTER II

NEIGHBORHOOD FILTERING AND NEIGHBORHOOD DYNAMICS

One of the very sparse published works on neighborhood filtering was done by Little (1976). Little defined it as "a change in the ordering of neighborhoods as reflected in a change in relative housing prices among neighborhoods."

This definition was an obvious extension of Fisher and Winnick's definition of the filtering concept (Fisher and Winnick, 1951). Just as Fisher and Winnick related prices and rents of individual housing units to the prices and rents of all the housing units in an urban area, Little related the prices of houses in individual neighborhoods to the prices of houses in all the neighborhoods in an urban area.

The basic subject or unit of the study was the census tract which he defined as a neighborhood. His rationale for the definition was that the socioeconomic characteristics of census tracts are a close approximation of the socioeconomic characters of neighborhoods in which housing units are located. He explained that neighborhood filtering derived from the fact that all units in a neighborhood would change in the same direction as a result of changes in the socio-economic character of the neighborhood. Neighborhood filtering was, therefore, measured as the changes in

rankings of neighborhoods based on sales prices of houses in those neighborhoods. He explained that the sales prices were standardized for differences in their structural characteristics using multiple linear regression techniques.

Altogether 32 neighborhoods in the inner ring of suburbs surrounding the city of St. Louis, and adjacent city tracts were used in the analysis. These were census tracts which had shown considerable racial change during the study period (1961 to 1971). Little used the mean of all the standardized prices for each neighborhood (census tract) and for any particular year to create an index for that neighborhood. There was considerable variation in both the size and other characteristics of the census tracts. However, in spite of the large variation among the areas in terms of socioeconomic and racial change, the rankings developed were relatively stable over time. Only a few of the neighborhoods showed any significant changes in rank. As this was not quite expected, he went on to carry out an alternative set of analysis.

Little assumed that the differential in standardized price for any two neighborhoods would be linearly related to the racial composition, income level, and characteristics of the housing stock in both neighborhoods. He therefore, tested the relationship between socioeconomic change and neighborhood filtering. Strangely enough, his results showed insignificant relationship between the initial income rank measures and neighborhood filtering. Nevertheless, the

results showed some relationship between neighborhood filtering and both the initial relative proportions of nonwhites and relative change in the proportions of nonwhites.

He concluded that the finding might be correct in the short run, and then argued that in the long run, neighborhood income would be more important than racial composition in affecting neighborhood filtering. He stated that it appeared that racial change would provide the initial impetus for neighborhood filtering. However, this conclusion seemed to have stemmed from his previous research on the subject.

The problem with this empirical study was very much evident from the results obtained. The conclusion arrived at did not derive completely from the analysis. It also derived from the author's previous studies. It should be expected that neighborhood filtering, if properly measured, would be strongly related to the initial income rank measures also. A reasonable explanation for the insensitivity of the index developed by Little (1976), is that changes in the average sales prices of houses in a neighborhood are inadequate for measuring the neighborhood filtering phenomenon. Although he had clearly identified the multidimensional nature of the neighborhood housing bundles, his empirical investigation did not reflect this. However, his broad perspective of housing as a bundle of attributes sheds considerable light on the understanding of

neighborhood filtering and neighborhood change.

Little's perspective of housing is quite consistent with the views expressed by Leven et al (1976). Leven et al. stated that the housing market should be viewed in the neighborhood context rather than just in terms of the physical characteristics of housing units.

They defined neighborhood filtering as follows:

> Neighborhood A filters down relative to neighborhood B, if, over time, the differential price of A over B, standardized for differences in the physical characteristics of the units involved, changes from a premium to a discount. Intuitively then, A filters relative to B if the same house that once sold for more in neighborhood A now sells for more in neighborhood B (Leven et al, 1976).

Leven et al argued that neighborhood filtering is a two way process. In other words, if neighborhood A has filtered down relative to neighborhood B, then neighborhood B has filtered up relative to A. At the same time, households that lived in neighborhood A both before and after the changes in housing prices would experience downward filtering. On the other hand, households in neighborhood B would experience upward filtering.

The above definition of neighborhood filtering by Leven et al was an extension of their conceptualization of filtering in terms of household preferences. They differentiated between active filtering (involving change of occupancy) and passive filtering (which does not involve change of occupancy). However, it is not quite clear why the authors associated neighborhood filtering much more with

passive filtering. One would have expected that neighborhood filtering, as an extension of the filtering of individual housing units, should be equally associated with both active and passive filtering. Moreover, neighborhood filtering as defined by Leven et al (1976) was actually based on the prices of housing units in the neighborhoods. This again seemed to be a reduction in the number of housing attributes they had identified. The logical conclusion would be that they held all other attributes of the housing market constant.

However, the U.S. Department of Housing and Urban Development (1977) defined neighborhood filtering rather much more comprehensively as "the process of change in the use of housing resources in a neighborhood". In all, five variables were identified for representing housing resources. These include: The average rent or value per housing unit in a neighborhood, median family income, housing conditions, percentage of owner occupied housing units, and percentage of occupied housing units. HUD's definition reflects the multidimensional nature of the housing market. An adequate representation of the housing market as a bundle of attributes should include the physical and socioeconomic environment as well as the public sector aspect of the neighborhood in which the housing units are located. The basic assumption in this case, however, is that there are no major differentials in the levels of public services provided.

Another group of researchers that stressed the importance of the neighborhood context in determining the housing decisions of households were Nourse, and Phares (1974). In their study of the filtering process in the inner city suburbs, they related the phenomenon to neighborhood transition process. In effect, the role of the neighborhood was explicitly stated. Among the various factors which were identified as major contributors to neighborhood effects were race and socioeconomic status. The racial transition in the inner suburbs was strongly related to the whole process of change in those neighborhoods.

Perhaps the most extensive and indeed intensive discussions on the neighborhood context of the housing market behavior to date were those made by Goetze (1976, 1977, and 1979). Although he did not focus his studies directly on neighborhood filtering, Goetze emphasized that housing decisions of households should be considered in the light of neighborhood housing dynamics. He noted that abandoned homes have sometimes been restored when neighborhoods in which they were located became attractive again. This might be due to location of such desirable facilities like entertainment centers and parks. Goetze argued that the neighborhood context strongly influences participants in the housing market, and consequently affects home prices and rents. Therefore, a proper understanding of neighborhood filtering in the housing market calls for adequate knowledge

of urban neighborhood change and succession. Most researchers would agree with the views expressed by Goetze. It is indeed pertinent and useful to understand how neighborhood filtering relates to neighborhood dynamics, which is defined as "the process of periodic and successive changes in urban neighborhoods."

THE DYNAMIC CHARACTERISTICS OF NEIGHBORHOOD CHANGE

In spite of the differences among various investigators about the definition of the neighborhood filtering process, literature review shows that the housing market conditions in neighborhoods are in continuous flux and change. It is therefore, evident that no neighborhoods are ever in a static position. Nevertheless, neighborhoods in which changes in housing market conditions are negligible (on the basis of some specified criteria) are considered to be stable.

Although change is a general term, a specific usage of it can have a definite meaning. Specifically, it can be used to describe movements in the housing market. It can also be used to describe shifts in social, economic, and racial composition of residents in a neighborhood. The later usage of change is what is referred to as neighborhood succession. For example, Little (1977) defined neighborhood succession as "change in a neighborhood's socioeconomic composition". He, however, explained that the phenomenon could be correctly perceived as a manifestation of the

changes in the housing market. In effect, the two types of changes are very closely interwoven.

Little, et al (1975) have described an intuitive process which they referred to as arbitrage model of neighborhood succession. This model was based on two basic postulates. First, it was postulated that household utility is positively related to incomes of residents in a neighborhood, and negatively related to the proportion of nonwhites in the neighborhood. Second, it was postulated that rapid changes in prices and occupancy in any neighborhood are as a result of the market response to significant changes in the rankings of housing units located in that particular neighborhood. These assertions have been empirically tested by Little who did confirm that household decisions with respect to the housing market are not only related to age and physical characteristics of housing units, but also to the neighborhood, the available public services and the socioeconomic compositions of the neighborhoods. The logical questions to ask at this juncture are as follows: How do neighborhoods undergo changes, and what are the causes of these changes?

Causes of Neighborhood Change and Succession

A neighborhood which was once a high income area, may over a long time witness a significant downward change in status. Some of the high income households may have moved out and are replaced by households of lower socioeconomic

status. High income households remaining behind would usually dislike the idea that households of lower socio-economic status are moving into their high prestige neighborhood. They would take this as a symptom that their neighborhood is about to decline. They, therefore, are likely to sell their homes and move out of the neighborhood. The long term effect of these movements may lead to a complete succession of the neighborhood to households of a lower socioeconomic status.

The process thus described may or may not continue in the same direction. The neighborhood may not even experience any further significant changes for a considerable length of time. When this is the case, the neighborhood is said to be stable. In this situation, the neighborhood tends to retain the same characteristics for a long time. Residents tend to organize themselves toward maintenance of the characteristics of their neighborhood. They also tend to be concerned about the quality of the homes in their neighborhood.

However, a once stable neighborhood may begin to experience significant changes. Such changes may be either significant rise or decline in the housing submarket. Housing market conditions in the neighborhood can be on the rise for a number of reasons: For example, higher income households can become attracted to a lower income neighborhood either because of location of such attractive facilities as parks and entertainment centers in the

neighborhood, or renovation of lower income housing units through grants. Whatever may have resulted in the attraction of higher income households to the neighborhood, the consequence of their influx is rapid rise in prices of housing in the locality as housing seekers compete for available units. A neighborhood housing submarket which experiences such rapid rise in home values and socioeconomic status is said to have risen. A few central city neighborhoods have shown increases in housing prices and rents due to the influx of middle income households (Goetze, 1979). Fichter (1977) reported an appreciable evidence of young professionals returning to the inner city neighborhoods in Boston.

Although a rising housing market is usually very profitable to real estate brokers and builders, it has often led to displacement of lower income households who are usually unable to compete with higher income households. This type of neighborhood succession, which is referred to in housing literature as gentrification, is generally considered undesirable. Goetze (1979) has argued that the gentrification aspect of rising housing market makes it a less desirable situation than a stable housing market. This is because it encourages inflation in the housing market.

However, neighborhood change is not a one-way process. The housing market conditions in a neighborhood can actually decline. Some households in the neighborhood may be unable

to maintain their homes. Moreover, many low income households may have moved into the neighborhood. Since some of the low income households cannot afford the costs of home maintenance, the general housing conditions in the neighborhood may decline. Homes which were owner occupied may now become renter occupied, thus increasing the percentage of absentee landlords, who are usually less committed to rental housing maintenance.

There are indeed other reasons why neighborhoods decline. HUD (1977) has identified five other causes of neighborhood decline: One of these is incompatible land use. Residential units located near industries in the inner city neighborhoods are usually undesirable since they can be overtly exposed to pollutions of all types. Moreover, most of these inner city neighborhoods have become considerably congested. With the improved transportation system in most urban areas of the country, there has been considerable exodus of the middle income households from the inner city areas to the suburbs. This has had deleterious effects on the inner city neighborhoods to which the loss of the middle class meant erosion of their essential tax base.

Another cause of neighborhood decline is discrimination in housing. Discriminatory practices in housing are caused by overt consciousness among households about class and racial differences between them and some other households. It has been argued that since a greater percentage

of the nonwhite population belongs to the low income groups, it is quite difficult to separate class discrimination from racial discrimination (HUD, 1977). Moreover, there are as yet very low proportions of middle income nonwhites in most urban areas to be used in empirical te_ ; of the assumption that nonwhites are being discriminated against mainly because they belong to lower socioeconomic status (Leven et al, 1976).

Another cause of neighborhood decline is availability of new construction at the urban fringes. Newly constructed housing units at the urban fringes have usually attracted the middle income households. These households desire to relocate partly because of lack of satisfaction with their neighborhood environment, and partly because their current housing units have become prone to obsolescence. The fact, however, is that the mass exodus of the middle class to the suburbs has enhanced the decline of the inner city areas from where they moved.

Apart from the above causes of neighborhood decline, the aging of a large number of housing units in a neighborhood adds to the decline of such a neighborhood. Although aging may not necessarily affect the quality of a house, it is often the older units that are more expensive to maintain. Moreover, older housing units are most susceptible to functional obsolescence -- a major factor why higher income households decide to buy new and modern homes.

Finally, it is often stated that lenders and real estate brokers have been instrumental to the incidence of neighborhood decline. Lenders and real estate brokers have often facilitated housing investments in certain preferred neighborhoods, while at the same time discouraging investment in many low income and low yield neighborhoods. Lenders, for example, are prone to denying loans meant for investments in some neighborhoods simply because of the perceived risks in such investments. This practice, which is referred to as redlining, contributes immensely to the decline of several residential low income neighborhoods especially in the older cities of the country.

SOME CONCLUDING REMARKS ON NEIGHBORHOOD FILTERING AND NEIGHBORHOOD DYNAMICS

Some experts have argued that neighborhood filtering and dynamics are inevitable processes for adjusting both the changing needs of the population and fluctuating economic conditions (HUD, 1977). However, in the absence of public intervention, downward neighborhood filtering and changes could lead to continued abandonment of residential housing units in urban neighborhoods. Furthermore, as Goetze (1979) has indicated, large scale housing abandonment in neighborhoods often leads to increased cases of arson and associated crimes. These are indicators of urban decay. It is for this reason that many urban communities and individuals around the nation have shown some interest in developing

mechanisms for early detection of changes in neighborhoods. An attempt is made in the next chapter of this dissertation to discuss some efforts which have been made to date at monitoring changes in urban neighborhoods and housing.

CHAPTER III

MONITORING URBAN RESIDENTIAL HOUSING MARKET STATUS

Given the array of factors which are related to housing decline in urban areas, it is obvious that local governmental agencies or researchers interested in good quality housing will need reliable measures for assessment and monitoring of neighborhood housing situations. Of primary importance is the capability of identifying where "given neighborhoods stand" in relation to the rest of the community, and where such neighborhoods might be expected to be in subsequent years (HUD, 1977). The approaches adopted in the monitoring process have been numerous and diverse. However, the most significant approaches have involved development of urban neighborhood classification techniques. It is, therefore, pertinent to discuss the major neighborhood classification efforts.

URBAN NEIGHBORHOOD HOUSING CLASSIFICATION EFFORTS

A number of neighborhood classification systems have been developed within the last decade for some urban areas around the country. Most of these systems were basically targeted at the Community Development Block Grant, and were consequently developed with the prime objective of attracting as much federal assistance as possible. In most cases,

some degree of objectivity have been sacrificed. Moreover, some private research organizations have been involved in neighborhood monitoring efforts. Some of the more sophisticated systems have been developed by researchers in this group. Generally, neighborhood classification systems have been quite substantial in number. However, the system that appeared to have sparked off subsequent classification efforts was the five-stage classification system developed by the Real Estate Corporation.

The Five-Stage Classification Systems by Real Estate Research Corporation

The Real Estate Research Corporation has developed a five-stage neighborhood classification system which was tested in 66 cities throughout the country (Real Estate Research Corporation, 1975). The system was mainly descriptive and reflected the conditions of individual residential areas which were in the process of neighborhood change. This classification system was based on observations made during field visits to the neighborhoods by the research analysts from the Real Estate Research Corporation. It reflected neither the perceptions of neighborhood residents nor those of the local government officials. The Real Estate Corporation's analysts aimed at ensuring that they obtained a classification system that was consistent for all the studied neighborhoods throughout the country. Moreover, selected data from 1970 census of housing and population were used. Some of the variables utilized

reflected both housing and population characteristics of the neighborhoods. These were as follows: Age of dwellings, type of dwellings, vacancy rates, 1969 housing values, racial characteristics of neighborhoods, 1969 family income, residential tenure, household type, age composition, education, and employment.

The five general stages in neighborhood change presented in this classification system can be summarized as follows: the first was described as the healthy and viable stage. Neighborhoods in this category are relatively new and thriving, or relatively old and stable. Property values in these neighborhoods are generally on the rise, and there are no symptoms of decline. The second was described as the incipient decline stage. Neighborhoods in this category are experiencing a small degree of functional obsolescence. Houses in neighborhoods experiencing incipient decline have minor deficiencies and characterized by increasing densities. Property values are either stable or increasing gradually. The level of public services is also on the decline. The third was described as the clear decline stage. Neighborhoods in this category have more serious kinds of housing problems referred to in the second stage above. The percentage of renters would have increased tremendously with increase in conversions to higher density use. Traces of housing abandonment have begun to appear. The fourth stage was described as the heavy decline stage. Neighborhoods in this category have become highly

dilapidated. Most of the houses would require major repairs. The neighborhood is now occupied by the lowest income groups. The last was described as the unhealthy and nonviable stage. Neighborhoods in this category certainly have reached terminal points at which massive abandonment occurs.

The major problem with the above classification developed by the Real Estate Research Corporation is that it suggests that once a neighborhood is no longer stable and viable, it can only be in a declining stage. However, many neighborhood rehabilitation and preservation programs have resulted in significant improvements of those neighborhoods. In fact, the process of neighborhood succession is not usually a continuous one, rather it is a harmonic process that occurs in waves. The phenomenon can be considered as essential for adjustment of housing conditions to the ever changing needs of the population as well as the fluctuating economic conditions (HUD, 1977). Moreover, some of the stages are not easily distinguishable. For example, stages 2 (incipient decline), and 3 (clear decline) are very similar.

Rolf Goetze's Two-Dimensional Conceptual Neighborhood Classification Matrix

A two-dimensional conceptual neighborhood classification matrix was developed by Rolf Goetze (1976). Goetze referred to this system as "universal neighborhood classification matrix". On one dimension four types of housing

conditions were considered. Housing conditions were measured by the amount of resources needed to bring housing units up to the minimum code standards required by the city. Basically, the four categories of housing conditions were subjectively assigned. Housing units in good condition were classified as group A housing. Units that required minor repairs were classified into group B. Units which required moderate repairs were classified as group C housing. Group D represented poor housing units. These were units that required major repairs.

On the second dimension, market perception was represented. Four types of market perception were identified. These were as follows: rising, stable, declining, and rapidly declining categories. Goetze admitted that measurement of market perception was difficult and sometimes intuitive. He noted that the ranking of neighborhood market perception as rising, stable or declining or rapidly declining depended on the subjective judgment of the Research and Planning staffs of the Boston Redevelopment Authority who took part in the study. Some of the data on the market perception were collected by interviewing long term residents of neighborhoods, real estate brokers, and bank officials. They were asked to provide information about the situations in the neighborhoods both in the past and at the time of the survey.

Data were collected from various sources including, the police records, voter listings, sales records, tax data,

fire department, and Boston Redevelopment Authority. The information collected and used in the classification included changes in turnover rates, sales prices of houses, percent of down payments, owner occupants, renters, ages and occupations of household heads, property taxes, frequency of fire alarms, fire incident locations, types of home insurance, and physical appearance of houses.

Although the author argued that this classification system was very revealing, it contained considerable subjective input. For example, there was no objective measure for physical appearance of housing units. Moreover, there was too much reliance on the ability of long term residents to recall what happended in their neighborhood some years back.

R.L. Polk's Neighborhood Situation Ratings System (NSR's)

A Neighborhood Situation Ratings (NSR's) System was developed by the urban statistical division of R.L. Polk Company. This classification system, which was designed for census tracts, was based on a combination of more than twelve factors. Relative to the rest of the census tracts in the city, each census tract was grouped into one of four classes (A to D) on the basis of a composite of eight variables considered to be proxy variables for neighborhood change. The eight variables included the following: residential units recently vacated or newly completed, residential units found vacant at each of two surveys,

vacant commercial units, occupied housing units with a change of household, jobless heads of household, female heads of household with children, low income households, household money income. The grouping of census tracts as indicated above actually constituted a condition rating step. To obtain neighborhood change ratings, twelve factors from two consecutive periods were combined to show changes within the periods. The changes in the twelve factors were combined into a single weighted index of change. Depending on its index value, each neighborhood was assigned to one of the following four categories: strongly positive, moderately positive, negative (or mixed), and strongly negative.

In spite of the sophisticated nature of this system, it was surprising that neither the values of homes nor rents paid by households were included in the analysis. Yet these have always appeared as key variables in the neighborhood filtering phenomenon. Moreover, although the authors explained that the variables used in the classification were combined by using a complex weighting function, it would have been much better to have used a technique that would allow the matrix of the equations to endogeneously weight the variables.

The Pittsburgh Neighborhood Atlas Project

In Pittsburgh, a group of social scientists and neighborhood leaders succeeded in delineating the Pittsburgh

urban area into seventy-eight distinct neighborhoods using economic, demographic, and other social indicators. Also included was input from residents of the different areas of Pittsburgh concerning their perceptions of their neighborhoods. The product of this effort included an atlas for each neighborhood of the city. This atlas contained the following: neighborhood description; neighborhood map depicting actual street boundaries; neighborhood satisfaction indicator; neighborhood problems; level of satisfaction with public services; crime rate; characteristics of neighborhood population; neighborhood income; public assistance data; housing characteristics; real estate and mortgage loan data; and voter registration data.

This classification system as actually designed, only differentiated between neighborhoods at the same point in time. It has not yet been developed to measure changes between different periods.

The Community Analysis Model

Birch et al (1977) of the MIT and Harvard Joint Center for Urban Studies have developed a community analysis model which monitors changes on a number of socioeconomic variables on an annual basis. Basically, the behaviors of households, homeowners, landlords, builders, insurers, lenders, employers, and individuals whose decisions affect urban neighborhoods are monitored.

Among the major determinants of the model are

potential housing demand by homeowners in relation to available units, housing preferences of homeowners, ages of housing units, neighborhood housing conditions, potential demand by landlords relative to available units, characteristics of tenants including age, education, and ethnicity, ethnic composition of neighborhoods, vacancy rates, availability of land, availability of credit, absorption rates in submarkets, zoning restrictions and others.

Although the system has been tested in six cities, its complicated nature greatly inhibits its general acceptance and application. Moreover, some experts regard it as an over ambitious project (Goetze, 1979).

Milwaukee Neighborhood Classification System

Cannon et al (1977) classified neighborhoods in Milwaukee, Wisconsin into six categories using aggregated values of those variables. According to the authors, all the data items, except values for percent of units considered to be deteriorating units, derived from the 1970 census of housing. Values for deteriorating units derived from a 1969 city of Milwaukee survey of structural conditions. Cannon et al identified 10 varieties which they felt could be used to measure relative residential status. These variables were as follows: median home value, median contract rent, percent of homes valued at $20,000 or more, percent of homes valued at less than $10,000, percent of rental units renting at least $150 per month, percent of

rental units renting for less than $60 per month, percent of units occupied by owners, percent of persons living in the same unit in 1965, percent of overcrowding (more than one person per room), and percent of units considered to be deteriorating.

The above stated variables were subjectively grouped into three major characteristics, as follows: housing quality was represented by median home value, median contract rent, percent of homes valued at $20,000 or more, and percent of units renting for more than $150 per month. Neighborhood stability was represented by percent of units occupied by owners, and percent of units occupied by renters. Deterioration potential was represented by overcrowding, percent of homes valued at under $10,000, percent of rental units renting at less than $60 per month, and percent of units considered to be deteriorating.

Because the various variables used in the study were in different measurement units, Cannon et al normalized them by their respective means and standard deviations. The mean of each variable was reduced to zero, while the corresponding standard deviation was reduced to unity. The authors them computed an average value for the standard scores of the variables in each of the assumed dimensions. These averages were again standardized by their respective means and standard deviations. The net effect was that each of the census tracts was described by the three standardized variables, one for each dimension or characteristics as

explained above.

Canon et al then averaged the three standardized composite scores for each census tract. A single score was consequently obtained for each of the census tracts. Furthermore, each of the scores was standardized. In effect, a single measure which included the contribution of each of the original 10 variables was obtained. Finally, the authors classified the census tracts in the city of Milwaukee into six categories. This was done by plotting the single composite score and observing the location of the score for each tract in the resulting clusters.

The above methodology used by Cannon et al has some major problems. The first problem concerns the identification of both the basis dimensions or characteristics and groupings of the initial 10 variables used in the study. The initial groupings of the variables were subjective. For example, there was actually no valid reason for including variables that have very identical characteristics in two different dimensions. The variables used to describe housing quality and deterioration potential are very similar, when viewed in the context of the broader urban area. A variable such as overcrowding, which was one of the variables used to describe deterioration potential, could also be included among the variables that describe housing quality.

Moreover, as Mark (1980) pointed out, the dimensions which were assumed by Cannon et al (1977) might not actually

be those that could be deciphered from the data. It is possible that there were other dimensions which the analysis ignored. In addition, the authors should have not weighted the variables equally. THey ought to have allowed the weighting to be endogenously derived from the matrix of the data set which essentially contained the coefficients of the variables. Also, it is statistically wrong to repetitively aggregate and standardize the variables at different stages in the analysis.

Prince George's County Neighborhood Classification System

A classification system has been developed for Prince George's County. This county is a partially built-up area east of the District of Columbia. Like many neighborhood classification systems developed by municipalities, this model was designed for Community Development Block Grant money. Changes in socioeconomic and housing market variables available to the authors were utilized in the classification. The system was basically the product of a combination of objective and subjective factors.

The authors explained that both current and anticipated future changes in neighborhoods were explicitly stated. Moreover, the ratings of the neighborhoods in the county were carefully designed to avoid objections from neighborhood residents.

Neighborhood Classification System for Memphis

A monitoring system has been developed in Memphis,

Tennessee. Changes in several socioeconomic and housing market variables were included in the development of this system. The sole objective was to target Community Development Grant money. The model acted as an information system which indicated when housing rehabilitation action was needed in pertinent neighborhoods. The nature of the system necessitated that neighborhoods had active associations. Residents of declining and unorganized neighborhoods were informed to organize and apply for aid.

Neighborhood Classification System for Indianapolis, Indiana

A five-stage classification system has also been developed in Indianapolis, Indiana. This classification was essentially targeted toward Community Development Block Grand assistance. For example, each of the five identified types of neighborhoods was correlated to a particular housing assistance program. Consequently, several socio-economic variables were factored into the neighborhood housing analysis. As in many other municipal classification systems, all available information was included in the classification. This system seemed to possess some of the features of the five-stage classification system originated by the Real Estate Research Corporation.

Annual Neighborhood Information Profiles for Portland, Oregon

Annual neighborhood information profiles have been in use in Portland, Oregon since 1979. The profiles which

cover the 72 neighborhoods within the city limits of Portland include data on the following variables: demographic characteristics, housing, land, neighborhood needs, crime, fire services, parks, sewers, street conditions, street lighting, traffic, parking, arts activities, and nuisance control. The data set is compiled from information obtained from city bureaus. However, data types which are usually unavailable in city bureau offices are obtained by conducting telephone surveys and visual inspections.

A limited set of data on housing is available from city bureaus, and from visual inspections. Housing data collected from city bureaus include total housing units for single and multi-families, total residential care facilities, vacant houses in relation to total complaints, number of single family permits, values of new residential units, commercial units, and conversions. Data on housing quality are obtained mainly from visual inspection. The profiles do not contain information on incomes, and owner occupied housing units.

Indeed, Portland's annual neighborhood information profiles do mark a major step toward obtaining a more comprehensive set of data for all the neighborhoods in the SMSA. It will be useful to expand the coverage of the profiles to include the rest of Portland SMSA. This is because the behaviors of some of the variables on which information is currently collected are better understood and interpreted in the context of the entire metropolitan area.

Portland's housing market, for example, should include data on all housing submarkets in the SMSA. Moreover, it will be useful to incorporate data on incomes in the neighborhood information profiles. As Little (1976), and Leven et al (1976) have stressed, neighborhood income constitutes the most significant determinant of neighborhood change and conditions.

It is pertinent to mention that prior to the introduction of the current neighborhood information profiles, there had been a proposal for a computer-based neighborhood management information system for Portland SMSA. The system was to serve many agencies and users in Portland metropolitan area. It was aimed at facilitating access to census and labor data to be used in periodic updating and provision of employment and other types of data. However, that multi-purpose system did not materialize partly because of the exorbitant costs involved, and partly because of the issue of administrative responsibility for its implementation.

GENERAL REMARKS ON EXISTING URBAN NEIGHBORHOOD CLASSIFICATION SYSTEMS

There are some problems with most of the existing urban neighborhood classification systems. First, the designers have incorporated so many variables that their products are too complex to accurately interpret without considerable subjective input. For example, school district

and crime data have often been included in the analysis while some key housing market variables have been left out. In fact it becomes quite unclear what is actually being monitored or classified when any available variable is included in the systems. It is not surprising, therefore, that the interpretation of such results leaves room for errors. It surely would have been much more beneficial to use only sets of variables that are related to definite, and clearly defined phenomena. Second, some of the systems discussed have either ignored the quality aspect of changes in housing market conditions, or have for the sake of convenience, used economic variables as proxy for housing quality. They thus imply that quality of housing units in neighborhoods is always depicted by the prices or rents paid for those units.

Third, many of the neighborhood monitoring system have ranged from ad hoc techniques to very complicated models of the type developed by Birch et al (1977). On the one end of the spectrum, therefore one finds systems that are not much better than visual subjective observations, while on the other end of the spectrum one finds systems that are not only very complicated, but are too difficult to be easily usable in many local planning agencies. There are as yet no systems that are both simple and statistically robust. Yet many housing agencies require a simple but reliable system that can be used by most planning staff with minimum effort.

This dissertation stems from the need to develop a

system that will meet the dual objective of practicality and robustness. The methodology used in the development of this system is explained in the next chapter, to which attention should now be directed.

CHAPTER IV

METHODOLOGY

In the light of the problems identified in the literature review on neighborhood filtering and dynamics as well as neighborhood monitoring, it is obvious that many issues concerning changes in residential housing status have remained unresolved. In particular, definitive answers to the following research questions are useful: first, how can the changes in residential housing status in parts of the urban area be reliably measured, and what variables are appropriate for the measurement? Second, can these variables be useful for differentiating between the types of changes taking place in various parts of the urban residential housing market? Third, do the results yielded by a classification system depend on the specific variables used in the classification?

The answers to the above questions provided the basic framework for this dissertation. The dissertation among other things centered on precise and meaningful measurement and monitoring of change as it relates to the residential housing market. The study borrowed appreciably from the definitions of the filtering process by Fisher and Winnick (1951), and Toulan (1960). The following hypotheses were postulated and investigated:

Hypothesis 1

The changes in the residential housing status of parts of urban areas can be precisely and meaningfully measured and indexed using the changes in their ordering (ranking) as reflected by the changes in a few of their pertinent housing market variables. These include: home value or contract rent; household income relative to household size; housing quality; and proportions of all occupied and owner occupied housing units.

Hypothesis 2

Urban residential subareas can be adequately classified using the changes in their ordering as reflected by the changes in home values or contract rents; household incomes relative to household sizes; housing quality; and proportions of all occupied and owner occupied housing units.

Hypothesis 3

The products of an urban area residential housing classification system will depend on the housing market variables used in the classification.

Hypothesis 4

The change in an urban subarea residential housing status is positively related to the other housing market variables not considered pertinent for replicating the change.

Hypothesis 5

The change in an urban subarea residential housing status is positively related to the change in the proportion of families in different income groups, and to the change in the proportion of employed persons; but is negatively related to the changes in the proportion of nonwhite population in the subarea.

OPERATIONALIZING AND VALIDATING THE VARIABLES

For the purpose of testing the first and second hypotheses of this dissertation, the five identified housing market variables were explicitly operationalized as indicated below. Home values and contract rents in the urban subarea were operationalized with median home value and median contract rent in the subarea. Household incomes relative to sizes of households in the subarea were represented with median household income relative to the average household size in the subarea. Housing quality was operationalized as percentages of deficient, crowded, and much older housing units. Proportion of all occupied housing units was defined as percentage of all occupied housing units in relation to all housing units. Proportion of owner occupied housing units was defined as the percentage of owner occupied housing units in relation to all housing units in the subarea. The reasons for the identification of the above variables are elaborated upon in the succeeding paragraphs.

Median Home Value and Contract Rent

It is quite appropriate to assume that home values and contract rents in parts of urban areas are indicative of the desirability of housing in such subareas. For example, highly desirable neighborhoods are usually associated with higher home values and contract rents, while deteriorating neighborhoods are characterized by low home values and rents. In this investigation, median home values and contract rents were used because they represented better measures of central tendencies for home values and contract rents than average home values and contract rents. Moreover, the use of contract rents as opposed to gross rents ensured that utility costs were excluded from the analysis.

Median Household Income Relative to Average Household Size

Higher income neighborhoods benefit considerably from high concentrations of households that are not only willing but are capable of maintaining their homes. On the other hand, neighborhoods in which the majority of the residents are low income households are immensely constrained on the amount of money available to them for home maintenance. In effect, the conditions of housing in urban neighborhoods are related to the incomes of the households resident. in the neighborhoods. In this investigation, median household income has been related to average household size. This was because it was recognized that sizes of households affect

the effective incomes of households. For example, neighborhoods in which household incomes have increased only slightly in comparison to disproportionately high increases in household sizes, have actually become worse off. On the contrary, neighborhoods with rising incomes accompanied by decreasing sizes of households will really indicate higher increases in effective incomes.

Percentages of Deficient, Crowded, and Much Older Housing Units

Deficient, crowded, and much older housing units are used as proxy for housing quality. They are symptomatic of poor housing conditions in a neighborhood. Therefore, neighborhoods with increasing percentages of these problems are considered to be on the decline, while neighborhoods with little or no traces of these problems are considered to be either stable or on the rise. In effect, information about the percentage of deficient, crowded, and much older housing units is useful for detecting the status of a neighborhood.

For the purpose of this investigation, the term "deficient" was used to describe percentages of housing units lacking plumbing facilities or such conventional heating facilities as, built-in electric or gas equipment, furnace, hot water or steam equipment. However the term is general enough that it could also be used to describe many of the housing quality indicator variables usually included in the Annual Housing Survey data. These include data on

broken windows, ceilings, and floors, as well as frequency of breakdowns in housing equipment. Since these variables that describe deficient housing units are actually highly correlated, it was not considered essential that they all be included in the analysis.[1] It was quite appropriate to use one or two dominant variables as proxy for the rest. In this respect, plumbing information (which also implies provision for water facilities), and heating information are most basic and essential for describing deficient housing units. They are indeed much more important than data on broken windows and frequency of breakdowns of housing facilities. In fact, a housing unit could hardly be occupied without ensuring that it contains these most basic facilities.

The term "crowded" was used to describe percentage of housing units with more than 1.0 person per room. Housing units built before 1940 were regarded as much older units. Although not all older housing units are of low quality, a great majority of these units are susceptible to obsolescence and aging (HUD,1977). Moreover, older housing units not only require frequent repairs, but also cost a lot more to maintain.

[1]A principal component analysis done by this investigator with data on deficient housing units resulted in a single factor. The results confirmed that the variables were highly correlated.

Percentage of All Occupied Housing Units

The percentage of occupied housing units in a neighborhood reflects the extent to which the housing stock in the neighborhood is utilized. This in effect, indicates the extent to which a neighborhood's housing submarket is competitive and attractive. Neighborhoods with higher percentages of occupied housing units are generally more desirable and stable. On the other hand, neighborhoods with low percentages of occupied housing units are usually rapidly declining areas with not only decreasing home values and rents, but also deteriorating housing conditions (HUD, 1977). Therefore, the percentage of all occupied housing units is a good indicator of housing situations in neighborhoods.

Percentage of Owner Occupied Housing Units

The percentage of owner occupied housing units is also considered a good indicator of housing situations in neighborhoods. This is because owner occupants are not only less mobile than renters, but have their equity at stake in their neighborhoods. On the contrary, most renters do not live for a long time in the same neighborhoods. Moreover, like absentee landlords, renters do not have long run interests in their neighborhoods. Essentially, a high percentage of owner occupied housing units is indicative of stability of neighborhoods. This is true of both condominium and single family housing ownership.

The Other Research Variables

For the purpose of testing the fourth hypothesis of this investigation, the composite index of changes in residential housing status which was developed during the test of the first hypothesis was used as the dependent variable. Some housing market variables which were not included in the indexing of the changes in residential housing status were used as independent variables. These were as follows: the percentages of new construction and demolitions relative to the total housing stock at the beginning of the study period; the percentage change in year-round vacancies relative to the total housing stock at the beginning of the period; and the percentage change in the total housing units relative to the number at the beginning of the period, and the percentage change in the total population in a subarea. These were used mainly for validation purposes.

In order to test the fifth hypothesis, the composite index of change in residential housing status was used as the dependent variable. The following socioeconomic variables were used as the independent variables: the percentage of change in the number of families in the first, second and fourth income quartiles; the percentage change in the number of employed persons; and the percentage change in the number of nonwhite population in a sub-area. As in the fourth hypothesis, these variables were used for further

validation of the composite index of change in residential housing status.

DATE TYPES AND DATA SOURCES

All the data items used in this investigation were metric (interval scale) data. This meant that they were data that had measurable values which meaningfully conform to mathematical operation laws. They were, therefore, amenable to most types of mathematical computations.

Sources of Data

The major source of data for this investigation was the 1960 and 1970 U.S. Census of Population and Housing. In order to ensure that the same subarea units were studied within the two decennial census years, the 1960 census tracts which were split before the 1970 census were re-aggregated to the original 1960 units. Moreover, groups of census tracts whose parts had been moved into other census tracts, or which had been affected by boundary changes were all aggregated to their original units. Altogether 188 distinct census tracts and groups of census tracts were obtained.

Supplemental data were obtained from the Building Permit Statistics for construction activity in Portland SMSA during the period from April, 1960 to March, 1970. These were published by the Metropolitan Service District (1960-1970), Portland. The source provided supplemental

information on permits for demolitions and new construction for the study period. It was assumed that the houses for which permits were issued were actually built. In view of the fact that prospective house owners are usually given fixed times during which they have to complete their buildings, that assumption was considered a good approximation.

It is recognized that R. L. Polk's Profile of Change was a probable source of data for this investigation. This source contains information on housing and businesses in census tracts. The Polk's Company also has information on tapes for some housing units within the city limits. However, these data sets were not considered suitable for this research because they do not contain information on housing units outside the city limits. Moreover, the data do not contain suitable measures of housing quality.

A complete set of valuable data could have been obtained from the 1975 and 1979 Annual Housing Surveys for Portland SMSA. However, the spatial locations of housing units in the data set are not usually available. These were therefore considered unsuitable for this research, which required explicit identification of the various residential areas in the SMSA.

TESTING THE RESEARCH HYPOTHESES

Hypothesis No. 1

The statement of the first hypothesis was such that

there was no distinction between the variables in terms of being dependent (predicted) or independent (predictor) variables. What was implied by the hypothesis was the capability for development of a meaningful measure (in terms of public policy) or composite index for changes in the urban residential housing status, using the five identified housing market variables. An increasingly important statistical technique which was used to test the validity of the hypothesis is principal component analysis. This technique is briefly discussed in the succeeding section.

The Nature of Principal Component Analysis

Principal component analysis is a technique used to determine the minimum number of independent characteristics (dimensions) which account for most of the variance in a set of variables (Rummel, 1970). In more general terms, it is a technique which can be used to reduce several variables to a lesser number of characteristics which represent the original variables as much as possible (Davies, 1979). Principal component analysis is based on the assumption that variables (such as rent, income, and housing quality) are appreciably correlated. When the constituent variables are correlated, they tend to portray the same characteristics. The variables can be reduced to just one composite variable which reflects those characteristics. Reducing several variables to fewer sets of variables with principal component analysis is similar to combining separate maps of

those variables into a fewer set of maps which are easier to compare visually. In the fewer set of maps, characteristics which are similar in all the maps (and variables) are combined into one, whereas characteristics which are dissimilar are represented separately (Yeates, 1974). Principal component analysis identifies those characteristics, and shows how the variables are associated with them. On the basis of the characteristics (components), and the strength of the association of the factors with the variables, the data units are given scores. The scores are usually in interval scale units, and can be positive or negative depending on whether they positively or negatively reflect a characteristic or phenomenon.

If both correlated and uncorrelated sets of variables are included in a principal component analysis, all the variables which are highly correlated will load heavily on the same component. Consequently, all the data units (subareas) which have high values of these variables will have high scores on that component. On the contrary, all the data units with low values of those variables will have low scores on that component. In effect, the variables included in a principal component analysis may reflect different characteristics. The variables involved in the first hypothesis do, in fact, belong to the general category of correlated and uncorrelated variables. This will be evident from the discussion of the research results in the next chapter.

Analytically, each of the variables can be expressed in terms of the principal components (factors) as follows:

$$Z_1 = a_{11}F_1 + a_{12}F_2 + ... + a_{1n}F_n$$
$$Z_2 = a_{21}F_1 + a_{22}F_2 + ... + a_{2n}F_n \quad \text{_____} \quad (1)$$
$$Z_m = a_{m1}F_1 + a_{m2}F_2 + ... + a_{mn}F_n$$

where $Z_1, Z_2, ..., Z_n$ are the original variables in standardized form

$F_1, F_2 ....., F_n$ are the principal components

$a_{11}, a_{12}, ..., a_{mn}$ are the correlation coefficients of the factor loadings on the variables

(See Rozeboom, 1966).

Using the original variables, and factor score coefficients, factor scores can be computed for each data unit (residential area). The pertinent mathematical relationship is as follows:

$$S_1 = b_{11}Z_1 + b_{12}Z_2 + ... + b_{1n}Z_n$$
$$S_2 = b_2Z_1 + b_{22}Z_2 + ... + n_{2n}Z_n$$
$$S_m = b_{m1}Z_1 + b_{m2}Z_2 + ... + b_{mn}Z_n$$

where $S_1, S_2, ..., S_n$ are the factor scores on a data unit

$Z_1, Z_2, ..., Z_n$ are the original variables in standardized form

$b_{11}, b_{12}, ..., b_{1m}$ are factor score coefficients in standardized form

The products of the principal component analysis also include the communality and eigenvalues among others. A

communality value is a measure of the variability in a variable held among the significant principal components. It is the percentage variance in a variable explained by the significant principal components, and is evaluated as the sum of the squares of the loadings across each component. Kerlinger (1964) described the communality value as the validity component of a measure.

The eigenvalue is the measure of the variability of a principal component between the variables. It is computed by squaring and summing the principal component loadings across the variables. Harris (1975) showed that the variance of a principal component is equal to the eigenvalue associated with that component. He also showed that the variances of principal components are additive.

Although principal component analysis has not had significant application in housing research, Little (1976) has used the technique to reduce 20 housing market variables (rents, values, lot sizes, et cetera) and socioeconomic variables into 5 components. These components were assumed to be representative of the original twenty variables. Brian Berry has convincingly used the principal component analysis technique to reduce socioeconomic variables into much fewer dimensions. These include a study of the basic dimensions of economic development (Berry, 1960), and multivariate regional classification (Berry, 1961). Berry (1963) determined the various roles played by unplanned

nucleations in the commercial structure of Chicago. Moser and Scott (1961) used the principal component technique to extract the factors that enabled them to group populations with similar combinations of characteristics for towns in Great Britain. Davies (1979) computed trends in households, population, and other characteristics for towns of 50,000 and over in England and Wales between 1951 and 1971, using the principal component analysis technique. Cloke (1977) used the technique to develop an index of rurality for England and Wales. All the above mentioned references do validate the appropriateness of the use of principal component analysis in this research.

Hypothesis No. 2

The test of the second hypothesis of this research basically required a classification technique. This hypothesis was tested with a rarely used by powerful classification technique called multivariate discriminant analysis. Three groups of data units (residential areas) were identified apriori. The discriminant analysis statistical technique was then used to determine the most probable limits of the groups.

The Nature of Discriminant Analysis

Discriminant analysis is essentially a technique used to classify objects, by a set of independent variables, into one of two or more categories, which are mutually exclusive and exhaustive (Morrison, 1969). For example, on the basis

of home value, income, housing quality, tenure and occupied units,[2] it is possible to determine whether a residential area is stable, improving or declining. Another possible application of discriminant analysis is in classification of industries as losing or gaining employment or as stable, on the basis of unionization data, capital investment, and other relevant variables. Discriminant analysis is essentially both a classification and prediction technique. With two or fewer number of independent variables, it is very similar to multiple linear regression (Kerlinger, 1964).

Discriminant analysis combines a set of variables (for example, the five housing market variables identified in this hypothesis) in a linear manner so that the variance between differing data units (residential areas) is made as large as possible. This is achieved by the use of discriminant functions. These discriminant functions are linear combinations of the original variables and can be symbolically expressed as follows:

$$D_1 = d_{11}Z_1 + d_{12}Z_2 + \ldots\ldots + d_{1n}Z_n$$

$$D_2 = d_{21}Z_1 + d_{22}Z_2 + \ldots\ldots + d_{2n}Z_n$$

$$D_m = d_{m1}Z_1 + d_{m2}Z_2 + \ldots\ldots + d_{mn}Z_n$$

where $D_1, D_2, \ldots\ldots\ldots, D_m$ are the scores on the discriminant functions

$d_{11}, d_{12}, \ldots\ldots, d_{mn}$ are the weighting coefficients

[2]See pages 62 to 66 for the discussions on the justification for the use of these variables.

$Z_1, Z_2, \ldots\ldots, Z_n$ are standardized values of n discriminating variables

Classification of cases (residential areas) is achieved through the use of a series of classification functions, one for each group. The equation for any particular group can be symbolically expressed as shown by the following set of equations:

$$C_1 = c_{11}X_1 + c_{12}X_2 + \ldots\ldots + c_{1n}X_n + c_{10}$$
$$C_2 = c_{21}X_1 + c_{22}X_2 + \ldots\ldots + c_{2n}X_n + c_{20} \quad \text{_____(4)}$$
$$C_m = c_{m1}X_1 + c_{m2}X_2 + \ldots\ldots + c_{mn}X_n + c_{mo}$$

where $C_1, C_2, \ldots\ldots, C_m$ are the classification scores for the groups

$c_{11}, c_{12}, \ldots\ldots, c_n$ are the classification coefficients for the groups

$X_1, X_2, \ldots\ldots, X_n$ are the raw scores on the discriminating variables

The products of the multivariate linear discriminant analysis include the discriminant function, the relative percentage variance, the chi-square with the associated degrees of freedom, the significance ratio and the percentage of "grouped" cases correctly classified. Although discriminant analysis has not been used in social science research for operational (practical) classification purposes, the technique has been utilized for hypothesis testing (Morrison, 1969).

Hypothesis No. 3

The test of the third hypothesis required no different

techniques from those used in testing the first two hypotheses. The implication of this hypothesis is that the variables used in the classification of urban residential areas determine the results of such a classification. In order to test the hypothesis, the procedures adopted in testing the first two hypotheses were repeated for different combinations of the original variables, and by excluding one or more of the variables in each analysis. Each combination was used in principal component analysis to develop an index of change in the residential housing status. The index resulting from each principal component analysis was used as the dependent variable while the constituent variables were used as the independent variables. Among other things, the various sets of analysis yielded the most probable classifications of the residential areas. Altogether, eight different sets of analysis were made, each set comprising of a sequential run of principal component analysis and discriminant analysis. The variables involved in the various sets of analyses are indicated below.

Analysis Set 1. The first set of analyses included three independent variables which were appreciably correlated. These were the median home value or contract rent; median household income relative to the average household size; and housing quality. The percentages of all occupied housing units, and owner occupied housing units were excluded from this set of analyses.

Analysis Set 2. All the five variables were included in the second set of analyses. These were: the median home value or contract rent; median household income relative to the average household size; housing quality; percentage of all occupied housing units and percentage of owner occupied housing units. Since this set was exactly the same as the analyses of the first and second hypotheses, it was not actually repeated.

Analysis Set 3. For the third set of analyses, the median home value or contract rent was excluded. Only the following variables were included: median household income relative to the average household size; housing quality; the percentage of all occupied housing units, and the percentage of owner occupied housing units.

Analysis Set 4. For the fourth set of tests, median household income relative to the average household size was excluded from the analyses. The independent variables included in the analyses were median home value or contract rent; housing quality; the percentage of all occupied housing units; and the percentage of owner occupied housing units.

Analysis Set 5. For the fifth set of tests, housing quality was excluded from the analyses. The independent variables included in the analyses were median home value or contract rent; median household income relative to the

average household size; the percentage of all occupied housing units; and the percentage of owner occupied housing units.

Analysis Set 6. The sixth set of analyses included the following: median home value or contract rent; median household income relative to the average household size; housing quality; and the percentage of owner occupied housing units. The percentage of all occupied housing units was excluded from the analyses.

Analysis Set 7. The seventh set of analyses included the median home value or contract rent; median household income relative to the average household size; housing quality; and the percentage of all occupied housing units. The percentage of owner occupied housing units was excluded from the analyses.

Analysis Set 8. The eighth set of analyses included only two independent variables. These were: the median home value or contract rent, and the percentage of owner occupied housing units. These two variables were selected on the basis of a pre-test principal component analysis which showed them to have the highest factor loadings in the two main groups of correlated variables which were observed. The first group of correlated variables were as follows: median home value or contract rent, median household income relative to average household size, and housing quality.

Among this group, median home value or contract rent (housing cost) had the highest factor loading. The second group of correlated variables included the percentage of all occupied housing units, and the percentage of owner occupied housing units. The percentage of owner occupied housing units had the highest factor loading among this group.

On the whole, the procedure adopted in testing the third hypothesis of this research was basically a parsimony approach. This approach was taken because it was considered useful to observe what differences might show up in the classification results when each of the five variables was excluded from the analyses.

The products of these analyses are the same or similar to those obtained for hypotheses numbers 1 and 2.

Hypothesis No. 4

The fourth hypothesis of this investigation postulated a positive relationship between the index of change in the relative residential housing status and some other housing market variables not used in the development of the index. Multiple linear regression (MLR) analysis was used in testing this hypothesis. The factor scores which were produced from the principal component analyses were used as the dependent variable, while the variables identified in the hypothesis were used as the independent set.

The hypothesized relationship could be symbolically expressed as follows:

$$y = a + b_1x_1 + b_2X_2 + ... + b_5X_5 \quad \text{_____(5)}$$

where y is the index of change in urban subarea residential housing status

a is the constant of the regression equation

X_1 is the percentage of new construction relative to the total housing stock in a residential area at the beginning of the period

b_1 is the coefficient of X_1

X_2 is the percentage of demolitions relative to the total housing stock in a residential area at the beginning of the period

b_2 is the coefficient of X_2

X_3 is the percentage change in the year round vacancies relative to the total housing stock in a residential area at the beginning of the period.

b_3 is the coefficient of X_3

X_4 is the percentage change in the total housing stock relative to the number in residential area at the beginning of the period.

b_4 is the coefficient of X_4

X_5 is the percentage change in the total population relative to the total population in the residential area at the beginning of the period.

b_5 is the coefficient of X_5

The products of this analysis included R^2, regression coefficients, F ratios and the degrees of freedom.

Hypothesis No. 5

Multiple linear regression analysis was used for the test of the fifth hypothesis which postulated varying

relationships of the change in relative residential housing status to selected socioeconomic variables. These were the percentage changes in proportions of families in different income groups; the percentage change in the number of employed persons; and the percentage change in the nonwhite population in a residential area.

The symbolic representation of this hypothesis could be expressed as follows:

$$y = a + a_1X_1 + a_2X_2 + ... + a_5X_5 \quad \text{_____(6)}$$

where y is the index of change in residential housing status

a is the constant of the regression equation

X_1 is the percentage change in the number of families in the highest income quartile

a_1 is the coefficient of X_1

X_2 is the percentage change in the number of families in the next highest income quartile

a_2 is the coefficient of X_2

X_3 is the percentage change in the number of families in the lowest income quartile

a_3 is the coefficient of X_3

X_4 is the percentage change in the number of employed persons in a residential area

a_4 is the coefficient of X_4

X_5 is the percentage of change in the nonwhite population in a residential area

a_5 is the coefficient of X_5

The relationship of the index to the percentage change in the number of families in the third income quartile was not tested. This was because of collinearity problems which would arise if the percentage of changes in the number of families in each of the four income quartiles were included as independent variables in the multiple regression analysis.

The products of this analysis included R^2, the regression coefficients, F ratios and the degrees of freedom.

CHAPTER V

DATA ANALYSIS AND RESULTS

Hypothesis No. 1

The results of the analyses lent support to the first hypothesis of this investigation. It was hypothesized that the changes in the residential housing status of parts of an urban area can be precisely and meaningfully measured and indexed using the changes in their ordering as reflected by the changes in a few pertinent housing market variables. These included home value or contract rent, household income relative to household size, housing quality, and proportions of all occupied, and owner occupied housing units.

The principal component analysis technique which was used to test this hypothesis yielded two sets of components as shown in Table I. The results reported in this table, in addition to those reported in Table III, do validate the first hypothesis. It is easily observed from Table I that the relative changes in home value or contract rent; household income per capita; and housing quality loaded heavily on the first component (with values of .85215, .83659, and .79133 respectively), but very low on the second component (with values of .16241, .15804, and .04802 respectively). On the other hand, the relative changes in the percentages of all occupied housing units and owner occupied housing

units loaded high on the second component (with values of .88882 and .91105 respectively), but low on the first factor (with values of .19322 and .07053 respectively).

TABLE I

VARIMAX ROTATED FACTOR MATRIX FOR THE RELATIVE CHANGES IN THE RESIDENTIAL AREAS AS REFLECTED BY THE RELATIVE CHANGES IN ALL THE FIVE KEY STUDY VARIABLES

VARIABLE	PRINCIPAL COMPONENT I	PRINCIPAL COMPONENT II	COMMUNALITY
Change in home value or contract rent	.85215	.16241	.75254
Change in household income per capita[1]	.83659	.15804	.72486
Change in housing quality	.79133	.04802	.62852
Change in percent all occupied housing units	.19322	.88882	.82734
Change in percent owner occupied units	.07053	.91105	.83499
EIGENVALUE	2.09455	1.67367	

The patterns and magnitudes of the loadings of the variables on the two components strongly suggest that they depict definite characteristics. For example, the first component in which home value, household incomes, and housing quality were heavily loaded seemed to depict a demand-side component of change in the residential housing status. Moreover, it reflected the neighborhood filtering

[1]Household income per capita is used in this context for household income relative to the average household size.

phenomenon in the housing market. On the other hand, the second component in which the percentages of all occupied and owner occupied housing units were heavily loaded seemed to depict a supply-side component of change in the residential housing status. This second factor also reflected the stability component of the residential areas.

Table I shows the communality values for all the five variables. For example, the relative change in housing cost had a communality value of .75254 which implied that over 75 percent of the variance in this variable was held among the significant principal components. Moreover, the communality value of .83499 computed for the percentage change in owner occupied housing units implied that over 83 percent of the variance in this variable was held among the two significant principal components. The high communality values obtained for all the five variables were a confirmation of the validity of those variables as appropriate measures of changes in residential housing status.

The eigenvalues for the first and second principal components were 2.09455 and 1.67367 respectively. Table III shows the composite indexes (factor scores) for a representative sample of census tracts. These scores were a measure of the changes in the status of urban residential areas on the basis of the changes in the identified housing market variables. The composite scores were the aggregate values of the two sets of factor scores which resulted from

the principal component analysis. The factor scores were aggregated using, as weights, the variances of their respective principal components relative to the total variance explained by the two principal components.

It will be observed that some census tracts showed appreciably large negative scores, while some other tracts showed large positive scores. The other census tracts showed smaller negative and positive scores (magnitudes approximately between -.33 and +.30). The census tracts that scored large negative values were those mostly located in the inner city areas of Portland, Oregon and Vancouver, Washington (See Figures 1 and 2). Prominent among the tracts that had large negative scores were numbers: 15, 16.01, 16.02, 17.02, 24.01, 30, 31, 32, 33.02, 34.01, 35.01, 38.02, 38.03, 39.02, 49, 83, and 84, mainly in the Portland City/Multnomah County areas; tract numbers 219 in Clackamas County, 307 in Washington County, and tract numbers 421 and 425 in Vancouver City/Clark County areas. These results were quite consistent with the actual trends in the region during the study period as these were the older built-up areas in the respective areas of the region.

On the other hand, those census tracts which had large positive scores were mainly located in the suburbs of Portland and Vancouver. Conspicuous among these census tracts were numbers 95 and 99 in the Portland City/Multnomah County areas; and tract numbers 204, 215, 218, 222, and most of the other census tracts in Clackamas County; tract

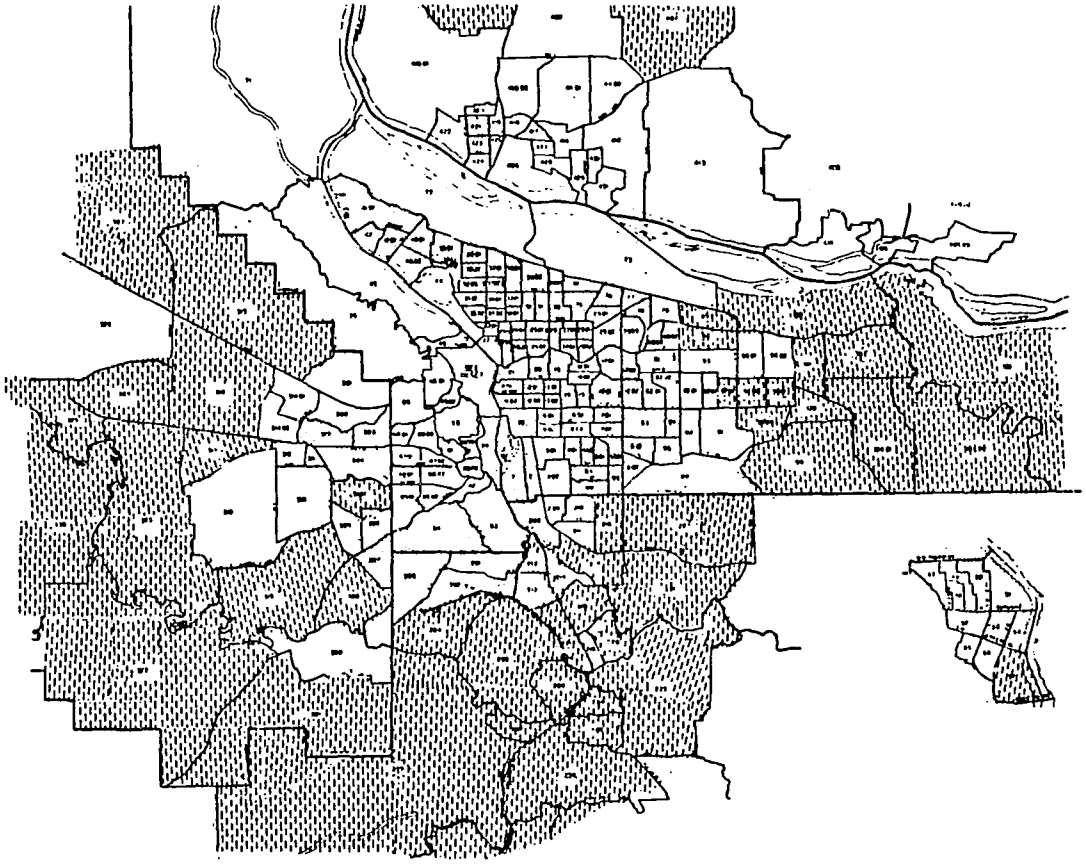

Figure 1. 1970 census tract map of Portland SMSA (urban portion) showing the classification of the tracts on the basis of the changes in their relative residential housing status during the 1960-70 period.

LEGEND:

decline in relative residential housing status

stable residential housing status

rise in relative residential housing status

Source of the census tract outline map: Metropolitan Service District, Portland, Oregon

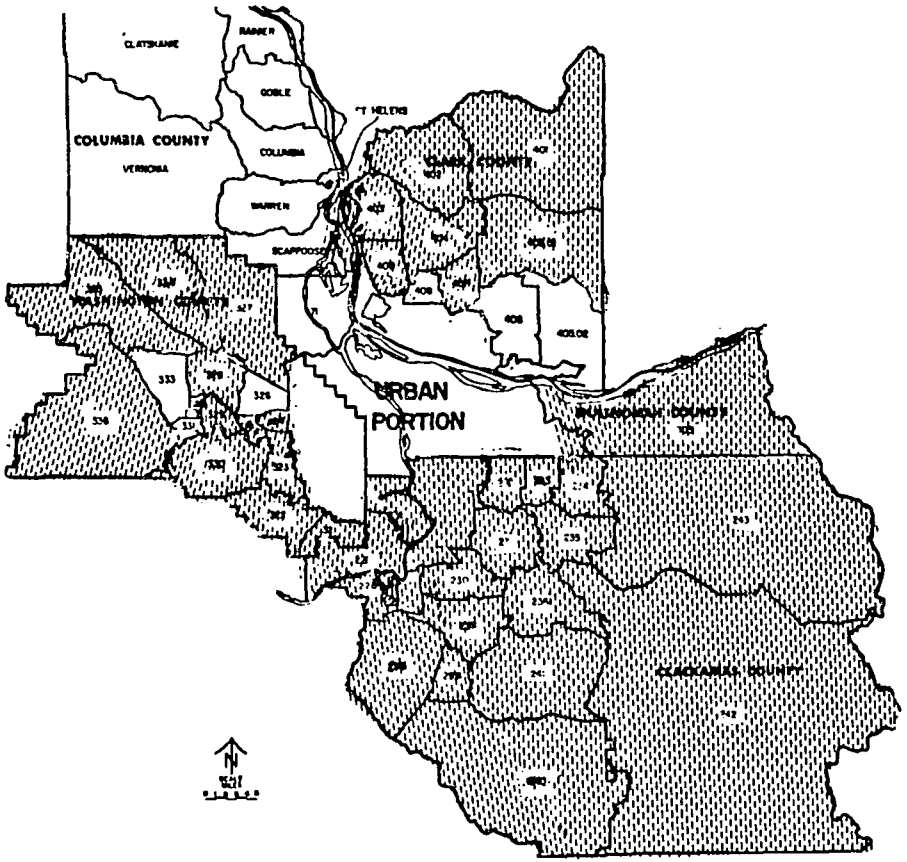

Figure 2. 1970 census tract map of Portland SMSA (non-urban portion) showing the classification of the tracts on the basis of the changes in their relative residential housing status during the 1960-70 period.

LEGEND:

decline in relative residential housing status

stable residential housing status

rise in relative residential housing status

Source of the census tract outline map: Metropolitan Service District, Portland, Oregon

numbers 308, 315, 317, 319, 321, 323, 324, 327, 328, 329, 334, and 335 in Washington County areas; tract numbers 401, 402, 404, 405.01, 407, and 409 in Vancouver City/Clark County areas of Washington State. Again, the results were quite as expected since these census tracts were the areas that experienced major new housing construction and metropolitan expansion during the decade of the sixties. In fact, housing development has continued to expand to this day.

The census tracts that did not show large scores (positive or negative) were fairly distributed around the SMSA, but mostly located in the older suburban areas. Conspicuous among these tracts were numbers 3.01, 7.02, 9.02, 25.02, 29.01, 52, 59, 61, and 62 in Portland City/Multnomah County areas; numbers 202, 213, and 214 in Clackamas County; tract numbers 302, 303, 320, 326, 331, and 332 in Washington County areas; and tract number 424 in Vancouver City/Clark County areas.

Hypothesis No. 2

The results of the analyses also lent support to the second hypothesis of this investigation. It was postulated that urban residential areas can be adequately classified using the changes in their ordering as reflected by the changes in home values or contract rents; household incomes relative to household size; housing quality; and the proportions of all occupied and owner occupied housing units

in the subareas. The multivariate discriminant analysis which was used to test this analysis yielded two discriminant functions, the products of which are reported in Table II. These products do validate the second hypothesis of this research. For example, the table shows that 80.21 percent of the cases were correctly grouped (classified) initially before being input to the multivariate discriminant analysis. The table also shows that the first discriminant function accounted for 98.55 percent of the variance in the variables.

TABLE II

THE DISCRIMINANT FUNCTIONS AND THEIR RELATIVE PERCENTAGE VARIANCES, CHI-SQUARE VALUES, SIGNIFICANCE RATIOS AND THE PERCENTAGE OF "GROUPED" CASES CORRECTLY CLASSIFIED

Discriminant Function	Relative Percentage Variance	Chi-Square	Significance Ratio	Percentage Cases Correctly Classified
1	98.55	238.97	0.0000	80.21
2	1.45	6.77	0.1483	

Moreover, Table II shows that a chi-square value of 238.97 was obtained for the first discriminant function, and that the test was validated at 0.0000 significance level.

Besides the results in Table II, the output shown in Table III confirms that the classification was satisfactorily made, judging from the situation in the census

tracts studied. Table III shows a representative sample of the census tracts and the scores they recorded on the basis of the relative changes in their residential housing situations. The table also shows the types of relative changes that took place in housing situations in the respective census tracts during the study period.

TABLE III

A REPRESENTATIVE SAMPLE OF THE CENSUS TRACTS IN PORTLAND SMSA[2] SHOWING THEIR CLASSIFICATION RESULTS ON THE BASIS OF THE CHANGES IN THEIR RELATIVE RESIDENTIAL HOUSING STATUS DURING THE 1960-1970 PERIOD

CENSUS TRACT	COMPOSITE[3] INDEX	CLASSIFICATION CATEGORY
1	-.45	decline
3.01	.06	stable
5.02	-.38	decline
7.01	-1.04	decline
7.02	-.33	stable
9.02	-.20	stable
10	-.35	decline
14	-.74	decline
15	-.86	decline
16.01	-.56	decline
16.02	-.77	decline

[2]Continued on the following 3 pages.

[3]Composite indexes less than -0.33 indicate a decline in status. Composite indexes greater than or equal to -0.33 but less than or equal to 0.30 indicate a stable status. Composite indexes greater than 0.30 indicate a rise in status.

TABLE III (CONTINUED)

CENSUS TRACT	COMPOSITE INDEX	CLASSIFICATION CATEGORY
17.02	-.69	decline
19	-.35	decline
24.01	-1.08	decline
25.02	-.07	stable
29.01	-.30	stable
30	-.63	decline
31	-1.05	decline
32	-1.43	decline
33.02	-.73	decline
34.01	-1.01	decline
35.01	-.80	decline
38.02	-.99	decline
38.03	-1.00	decline
39.02	-.79	decline
49	-1.03	decline
52	-.16	stable
59	-.26	stable
61	.03	stable
62	-.24	stable
83	-.87	decline
84	-.89	decline
84	-.89	decline
85	-.39	decline
95	1.20	rise

TABLE III (CONTINUED)

CENSUS TRACT	COMPOSITE INDEX	CLASSIFICATION CATEGORY
99	1.16	rise
202	-.25	stable
204	.70	rise
212	-.34	decline
213	.00	stable
214	.24	stable
215	1.56	rise
218	.93	rise
219	-.76	decline
222	.58	rise
227	1.16	rise
243	.92	rise
301	-.20	stable
302	.15	stable
303	.12	stable
307	-.75	decline
308	.52	rise
315	1.01	rise
317	.76	rise
319	1.36	rise
320	.11	stable
321	.81	rise
323	.92	rise

TABLE III (CONTINUED)

CENSUS TRACT	COMPOSITE INDEX	CLASSIFICATION CATEGORY
324	.42	rise
326	.19	stable
327	1.20	rise
328	.86	rise
329	.87	rise
331	-.21	stable
332	.24	stable
334	1.27	rise
335	.65	rise
401	.60	rise
402	.92	rise
404	.82	rise
405.01	1.13	rise
407	.55	rise
409	1.61	rise
421	-.75	decline
424	-.24	stable
425	-.70	decline

It will be observed that the census tracts which had high negative scores were those that showed a decline in residential housing status. Similarly, the census tracts which had high positive scores were those that showed a rise in residential housing status. Moreover, the census tracts

which had small and insignificant scores were those that indicated stable residential housing status. It is pertinent to mention that the classification results obtained in this analysis were based on the housing market variables used.

The census tracts in which residential housing status showed a decline were those located in the inner city areas of Portland, and Vancouver (See Figures 1 and 2). Some of the tracts were numbers 15, 16.01, 16.02, 17.02, 24.01, 30, 31, 32, 33.02, 34.01, 35.01, 38.02, 38.03, 39.02, 49, 83, and 84. These were mainly in the city of Portland, and Multnomah County. They also included census tract number 219 in Clackamas County, number 307 in Washington County, and tract numbers 421 and 425 in Vancouver City and Clark County. As already indicated, these were the older built up areas in Portland SMSA and were in fact part of the areas that showed considerable decline between 1960 and 1970. For example, census tracts 33.02, 34.01, and 35.01 situated in the Albina district of Portland, Oregon have been part of a conspicuously declined area of Portland, and have continued to be the same to this day. The Albina area is located at the northern part of Portland. This area was actually a separate city until 1893 when it became annexed into the city of Portland. It was already built up before World War I, and by the 1950's had started to show appreciable signs of deterioration (Portland City Club, 1971). This general

area had experienced both socioeconomic and racial transitions which culminated in downward neighborhood filtering and succession. This area still contains a high percentage of the low income households and nonwhite population in Portland SMSA.

On the other hand, the census tracts in which the residential housing status had risen during the study period were mostly those located in the suburbs of metropolitan Portland. These were census tract numbers 95 and 99 in the city of Portland, and Multnomah County. They also included census tract numbers 204, 215, 218, 222, and the majority of the census tracts in Clackamas County; tract numbers 308, 315, 317, 319, 321, 323, 324, 327, 328, 329, 334, and 335 in Washington County; tract numbers 401, 402, 404, 405.01, 407, and 409 in Vancouver City and Clark County areas. These were essentially the parts of Metropolitan Portland in which considerable new construction took place during the study period. Moreover, as had been stated earlier, that area has continued to have the largest share of new construction. Most of the eastern part of Washington County and a significant part of Clackamas County belong to this category. These areas of Portland SMSA are where the higher and middle income households reside. Although the neighborhoods in these areas had not experienced significant succession, it was obvious that considerable upward filtering had taken place.

In contrast to the two different situations considered above, it will be observed that the census tracts, which were indicated as being stable, were those mainly located at the older suburban and some inner city areas of Portland SMSA. Among these census tracts were the following: numbers 3.01, 7.02, 9.02, 25.02, 29.01, 52, 59, 61, and 6 2. These were located in the city of Portland and Multnomah County. Also included among these were census tract numbers 202, 213, and 214 in Clackamas County; numbers 302, 303, 320, 326, 331, and 332 in Washington County; and number 424 in the city of Vancouver and Clark County. The census tracts in this category were basically those in the areas with a good mix of older and newer housing units. These areas experienced neither appreciable neighborhood filtering nor neighborhood succession. They were mainly populated by some lower middle income and blue collar workers.

The classification results described above strongly confirm that the second hypothesis of this dissertation was validated. In addition to the analysis aspect of this second hypothesis, which was validated by the products of the discriminant function, the results of the classification satisfactorily depicted the change in the status of the residential areas during the study period.

Hypothesis No. 3

The results of the analyses did lend some support to the hypothesis that the products of an urban area

residential housing classification system will depend on the housing market variable used in the classification. They shed light on the issue of why researchers do not always agree on the choice of variables for residential housing market analysis. The principal component analysis technique, which was used to index the change in the urban residential housing status yielded a varying number of components (factors) for the eight different sets of analyses (See Table IV). Each of the analysis sets 2, 3, 4, and 5 yielded two components or characteristics, implying that the variables used in those analyses were indicative of two different types of phenomena.

On the other hand, each of the analysis sets 1, 6, 7, and 8 yielded a single component or characteristic, implying that the variables used in those analyses were indicative of one phenomenon. If in fact, analyses sets 1, 6, and 7 are indicative of only one characteristic or phenomenon, they obviously ignore the other characteristic which was clearly indicated by analysis sets 2, 3, 4, and 5.

This statement is substantiated by the fact that analysis sets 6 and 7 had very low communality values for the change due to percentage of owner occupied housing units, and for the change due to percentage of all occupied housing units respectively. The communality value for the change due to percentage of owner occupied housing units in analysis set 6 was .14188. This was the analysis that did not include the change due to percentage of all occupied

housing units (See Table IV). Since the other three of the four variables included in this analysis were correlated, they loaded heavily on one component. However, the change due to percentage of owner occupied housing units also loaded, but rather low, on this component since it had no other variable to pair up with. It did not really belong to this lone component, but was surely a part of another component that was not represented by the four variables included in analysis set 6.

For a similar reason, the change due to percentage of all occupied housing units loaded low on the lone component that resulted from analysis set 7. Table IV shows that the communality value for the variable in this particular analysis was .26048. This variable actually did not belong to that component, but was associated with another component that was not represented by the four variables included in analysis set 7.

With the exception of the low communality values obtained for the changes due to the percentage of owner occupied housing units, and the percentage of all occupied housing units in analysis sets 6 and 7 respectively, Table IV shows that all the variables showed high communality values in the other analyses. For example, in analysis set 1, communality values of .75374, .72974, and .61676 were obtained for changes due to home value or contract rent, household income per capita, and housing quality respectively. In analysis set 2, communality values of .75254,

TABLE IV

PRINCIPAL COMPONENT MATRICES FROM THE EIGHT SETS OF PRINCIPAL COMPONENT ANALYSIS

ANALYSIS SET NUMBER	VARIABLES	PRINCIPAL COMPONENT I	PRINCIPAL COMPONENT II	COMMUNALITY
1	Home Value or Contract Rent	-.86818		.75374
	Household Income Per Capita	-.85425		.72974
	Housing Quality	-.78534		.61676
	EIGENVALUE	2.10024		
2	Home Value or Contract Rent	.85215	.16241	.75254
	Household Income Per Capita	.83659	.15804	.72486
	Housing Quality	.79133	.04802	.62852
	Percent Occupied Units	.19322	.88882	.82734
	Percent Owner Occupied Units	.07053	.91105	.83499
	EIGENVALUE	2.09455	1.67367	
3	Household Income Per Capita	.17785	.83819	.73420
	Housing Quality	.05357	.86975	.75933
	Percent Occupied Units	.89696	.15927	.82990
	Percent Owner Occupied Units	.90882	.08101	.83252
	EIGENVALUE	1.66499	1.49096	

TABLE IV (CONTINUED)

ANALYSIS SET NUMBER	VARIABLES	PRINCIPAL COMPONENT I	PRINCIPAL COMPONENT II	COMMUNALITY
4	Home Value or Contract Rent	.18303	.84891	.75415
	Housing Quality	.05020	.87626	.77036
	Percent Occupied Units	.89321	.17794	.82949
	Percent Owner Occupied Units	.90966	.06341	.83151
	EIGENVALUE	1.66133	1.52416	
5	Home Value or Contract Rent	.89628	.13768	.82227
	Household Income Per Capita	.89485	.12873	.81733
	Percent Occupied Units	.22623	.87901	.82384
	Percent Owner Occupied Units	.05606	.91918	.84803
	EIGENVALUE	1.65840	1.65308	
6	Home Value or Contract Rent	.85445		.73008
	Household Income Per Capita	.84487		.71380
	Housing Quality	.77246		.59669
	Percent Owner Occupied Units	.37667		.14188
	EIGENVALUE	2.18246		

TABLE IV (CONTINUED)

ANALYSIS SET NUMBER	VARIABLES	PRINCIPAL COMPONENT I	PRINCIPAL COMPONENT II	COMMUNALITY
7	Home Value or Contract Rent	.86097		.74127
	Household Income Per Capita	.84038		.70623
	Housing Quality	.74571		.55608
	Percent Occupied Units	.51037		.26048
	EIGENVALUE	2.26406		
8	Home Value or Contract Rent	.76813		.59003
	Percent Owner Occupied Units	.76813		.59003
	EIGENVALUE	1.18005		

.72486, .62852, .82734, and .83499 were obtained for changes due to home value or contract rent, household income per capita, housing quality, the percentage of occupied housing units, and the percentage of owner occupied housing units respectively. In analysis set 4, communality values of .74515, .77036, .82949, and .83151 were obtained for changes due to home value or contract rent, housing quality, the percentage of occupied housing units, and the percentage of owner occupied housing units respectively.

Moreover, the analyses showed that the variance accounted for by each of the eight different sets of analyses varied quite appreciably. For analysis set 1, the total variance accounted for by the single principal component (that is the eigenvalue) was 2.1004. Analysis set 2 yielded eigenvalues of 2.09455 and 1.67367 for the first and second principal components respectively, giving the total variance of 3.76822. Analysis set 4 yielded eigenvalues of 1.66133 and 1.52416 for the first and second principal components respectively, giving a total variance of 3.18549.

However, the products of the discriminant functions showed that the different sets of analyses yielded only slight differences in both the precision and pattern of the classification of the census tracts. The products of the discriminant functions showed that all the eight sets of analyses were satisfactory. The chi-square tests of the first discriminant functions showed that they were significant at 0.0000 percent level (See Table V). In fact, the

least percentage of apriori "grouped" cases correctly classified was 79.68, which was obtained for analysis set 4 (chi-square, 235.40; degrees of freedom, 8). This was the analysis which excluded the change in the ordering of the census tracts due to household income per capita. In effect, the slightly lower percentage of "grouped" cases correctly classified could be attributed to the exclusion of the income variable from the analysis. This is substantiated by the fact that when none of the five independent variables was excluded from the analysis, the percentage of apriori "grouped" cases correctly classified was 80.21 (See the results of analysis set 2 in Table V).

Obviously the products of the discriminant functions showed that the precision of the results of the analysis was only slightly affected by the exclusion of any of the five key variables. However, the grouping (classification) of the census tracts clearly pointed at the ultimate effects. Table VI shows that there were several instances in which a particular census tract was classified into different categories by various groups of variables. For example, census tract number 1 was classified into a stable category by the variable groupings used in analysis sets 1, 6, 7, and 8. However, analysis sets 2, 3, 4, and 5 classified it into the group that declined during the study period.

Moreover, census tract number 5.02 was classified in

TABLE V

THE DISCRIMINANT FUNCTIONS, AND THE ASSOCIATED PRODUCTS FROM DISCRIMINANT ANALYSIS OF THE RELATIVE CHANGES IN RESIDENTIAL HOUSING STATUS AS REFLECTED BY THE CHANGES IN DIFFERENT GROUPINGS OF THE FIVE KEY RESEARCH VARIABLES

ANALYSIS SET NO.	VARIABLES	DISCRIMINANT FUNCTION	RELATIVE PERCENT VARIANCE	CHI-SQUARE VALUE	DEG. OF FREEDOM	SIG. RATIO	PERCENT "GROUPED" CASES CORRECTLY CLASSIFIED
1	Home Value or Cont. Rent)	I	97.93	249.57	6	0.0000	88.71
	Household Income Per Cap.)	II	2.07	10.17	2	0.0062	
	Housing Quality)						
2	Home Value or Cont. Rent)	I	98.55	238.97	10	0.0000	80.21
	Household Income Per Cap.)	II	1.45	6.77	4	0.1483	
	Housing Quality)						
	Percent all Occup. Units)						
	Percent Owner Occup. Units)						
3	Household Income Per Cap.)	I	99.69	239.43	8	0.0000	82.98
	Housing Quality)	II	0.31	1.52	3	0.6776	
	Percent all Occup. Units)						
	Percent Owner Occup. Units)						
4	Home Value or Cont. Rent)	I	99.35	235.40	8	0.0000	79.68
	Housing Quality)	II	0.65	3.06	3	0.3818	
	Percent all Occup. Units)						
	Percent Owner Occup. Units)						

TABLE V (CONTINUED)

ANALYSIS SET NO.	VARIABLES	DISCRIMINANT FUNCTION	RELATIVE PERCENT VARIANCE	CHI-SQUARE VALUE	DEG. OF FREEDOM	SIG. RATIO	PERCENT "GROUPED" CASES CORRECTLY CLASSIFIED
5	Home Value or Cont. Rent)	I	99.05	240.64	8	0.0000	82.26
	Household Income Per Cap.)	II	0.95	4.60	3	0.2032	
	Percent All Occup. Units)						
	Percent Owner Occup. Units)						
6	Home Value or Cont. Rent)	I	97.96	265.14	8	0.0000	85.56
	Household Income Per Cap.)	II	2.04	11.12	3	0.0111	
	Housing Quality)						
	Percent Owner Occup. Units)						
7	Home Value or Cont. Rent)	I	98.69	274.72	8	0.0000	91.98
	Household Income Per Cap.)	II	1.31	7.86	3	0.0490	
	Housing Quality)						
	Percent all Occup. Units)						
8	Home Value or Cont. Rent)	I	98.57	302.03	4	0.0000	87.17
	Percent Owner Occup. Units)	II	1.43	10.14	1	0.0015	

analysis sets 1, 3, 5, 6, and 7 as having been stable during the same period. This same census tract was classified in analysis sets 2, 4, and 8 as having declined during the same period. It is useful to recall that analysis set 8 was carried out with the group of variables that included only the median home value or contract rent, and the percentage of owner occupied housing units. Furthermore, census tract number 301 was classified as having improved (risen) in analysis set 1. On the contrary, analysis sets 3, 4, and 8 classified it as having declined, whereas analysis set 2, 5, 6, and 7 did classify this same census tract as having been stable during that period. Obviously, these results are very contradictory.

The above examples are not the only contradictory cases. They have only been highlighted in order to demonstrate the effect of using different combinations of variables in urban area housing classification. Some of the other census tracts with conflicting classifications included numbers 19, 85, 219, and 308. The differences in the classifications occurred in over 55 percent of the census tracts (or groups of census tracts) in the study area. A close inspection of appendix A will make this evident. Although, most of the differences were slight in that a census tract was classified into an adjacent category (decline instead of stable, or stable instead of rise),

TABLE VI

A REPRESENTATIVE SAMPLE OF THE CLASSIFICATION RESULTS FOR THE SUBAREAS (CENSUS TRACTS) OF PORTLAND, OREGON SMSA ON THE BASIS OF RELATIVE CHANGES IN THE RESIDENTIAL HOUSING MARKET STATUS

CENSUS TRACT NO.	NO. OF DWELLING UNITS BY YEAR		CLASSIFICATION CATEGORIES BY ANALYSIS NUMBERS[4]							
	1960	1970	1	2	3	4	5	6	7	8
1	2184	2358	S	D	D	D	D	S	S	S
5.02	1345	1400	S	D	S	D	S	S	S	D
7.02	1509	1612	S	S	S	S	S	D	S	D
10	2342	2360	S	D	S	S	S	S	S	S
15	1347	1328	D	D	D	D	D	D	D	D
16.02	1645	1623	D	D	D	D	D	D	D	D
19	1959	2028	S	D	S	D	S	S	S	D
25.02	1583	1927	S	S	S	S	S	S	S	S
30	1869	1878	D	D	S	D	D	D	D	D
32	1674	1656	D	D	D	D	D	D	D	D

[4]Refers to the different analyses made with various groups of variables. Explanations of code numbers follow:
1 - Analysis using the changes in median housing cost, median household income, and housing quality.
2 - Analysis including all five variables.
3 - Analysis excluding change in median home value or con. rent.
4 - Analysis excluding change in median household income/cap.
5 - Analysis excluding change in housing quality.
6 - Analysis excluding change in percent occupied units.
7 - Analysis excluding change in percent owner occ. units
8 - Analysis made with changes in median home value or contract rent, and percent owner occupied units.

D indicates a decline in status; S indicates a stable condition; and R indicates a rise in status.

TABLE VI (CONTINUED)

CENSUS TRACT NO.	NO. OF DWELLING UNITS BY YEAR		CLASSIFICATION CATEGORIES BY ANALYSIS NUMBERS							
	1960	1970	1	2	3	4	5	6	7	8
34.01	1489	1436	D	D	D	D	D	D	D	D
38.02	1405	1249	D	D	D	D	D	D	D	D
39.02	1254	1234	D	D	D	D	D	D	D	D
48	2297	2242	D	D	D	D	D	D	D	D
52	3085	3046	S	S	S	S	S	S	S	D
61	567	663	S	S	S	S	S	S	S	S
83	1951	2255	S	D	D	D	D	D	D	D
85	849	1150	S	D	D	D	S	S	S	S
99	749	1076	R	R	R	R	R	R	R	R
204	1156	2264	R	R	R	R	R	R	R	R
213	1115	1549	S	S	S	S	S	S	S	S
215	388	753	R	R	R	R	R	R	R	R
219	701	919	S	D	D	D	D	S	D	D
227	811	1296	R	R	R	R	R	R	R	R
301	682	1537	R	S	D	D	S	S	S	D
303	1236	1660	S	S	S	S	R	S	S	S
306	796	1072	S	S	S	S	R	S	S	S
308	563	1737	R	R	R	R	S	R	R	S
317	805	1451	R	R	R	R	R	R	R	R
320	492	668	S	S	S	S	R	S	S	R
323	495	591	R	R	R	R	R	R	R	R
326	1944	2757	S	S	S	S	S	S	S	S
328	313	373	S	R	R	R	R	S	R	R

TABLE VI (CONTINUED)

CENSUS TRACT NO.	NO. OF DWELLING UNITS BY YEAR		CLASSIFICATION CATEGORIES BY ANALYSIS NUMBERS							
	1960	1970	1	2	3	4	5	6	7	8
331	1271	1444	S	S	S	S	S	S	S	S
334	503	432	S	R	R	R	R	R	R	R
401	874	836	S	R	R	R	R	R	S	R
404	1670	2269	R	R	R	R	R	R	R	R
407	886	1468	R	R	R	R	R	R	R	R
421	875	943	D	D	D	D	D	D	D	D
424	964	634	S	S	S	S	S	S	S	D
427	517	738	R	R	S	R	S	R	R	S

there were some instances in which a particular census tract was classified into all three categories (decline, stable, and rise) by different sets of variables. About 2 percent of the census tracts or groups of census tracts fell into this category (See Appendix A).

On the basis of the above findings, it is obvious that the housing market variables included in the classification of the census tracts affected the results of the classification. Although the differences were not very large, they were indeed significant. This is because it does make a great difference to neighborhood residents when they hear that their residential housing status has declined when it is, in fact, stable. Indeed, further empirical study is required, especially using data from some older

eastern seaboard and midwestern cities. Such studies will shed further light on this issue of proper choice of variables for indexing and classifying urban residential housing status.

Hypothesis No. 4

The results of the investigation lent support to the hypothesis that the change in urban residential housing status is positively related to the percentage of new construction, and to the percent change in year round vacancies in a locality (R^2=.52). The hypothesized relationships of the change in urban residential housing status to the percentage of housing demolitions, and to the percentage change in the total housing stock were not validated. The stated relationship of the change in the residential housing status to the percentage change in population in a locality was not investigated further when it was observed that the percentage change in population was correlated with the percentage change in housing stock (r-.97) in the locality. Inclusion of the former variable would have caused collinearity problems. The detailed descriptions of the analyses are given in the following sections.

Relationship of the Change in Residential Housing Status to the Percentage of New Construction

The change in the residential housing status was found to be positively related to the logarithmic value of

the percentage of volume of new construction (significance level, .01) added to the housing stock in a subarea during the study period (See Table VII). The values for the percentage of new construction had to be transformed into the logarithmic form. This was because the much higher correlation coefficients obtained for the logarithmic values showed that the relationship was curvilinear.

TABLE VII

RELATIONSHIPS OF THE CHANGE IN RESIDENTIAL HOUSING STATUS TO SELECTED HOUSING MARKET PROFILE VARIABLES

VARIABLE	COEFFICIENTS
Log Percent of New Construction	1.03141 (53.880)
Percent Demolitions	-1.37205 (0.903)
Percent Change in Year-Round Vacancies	5.03236 (13.432)
Percent Change in Total Housing Units	0.19874 (2.138)
Regression Constant	0.57798
Degrees of Freedom	5.166
R^2	0.522

Note: F values are shown in brackets
F, 3.13 significant at 0.01
F, 2.27 significant at 0.05

This finding was not unexpected, given the fact that new construction increases the housing opportunities of households that can afford to buy or rent new homes. The logarithmic functional relationship obtained for new construction suggests that for every tenfold increase in new

construction, the residential housing status increased by about 1.03 percent. Although this relationship might appear considerably strong, the results were quite consistent with findings in a number of studies in the United States (Grigsby, 1963; Kristof, 1965; 1966). They were also consistent with the findings in Great Britain (Watson, 1971; Murie, 1976), and in Canada (Firestone, 1951). However, like Grigsby (1963) has observed, most of the new construction was in the suburbs where most of the middle income households did migrate to during the study period. In effect, new construction has facilitated rather than prevent the decline of inner city areas. These were the areas that showed the most decline.

Relationship to the Percentage of Demolitions

The multiple linear regression tests also showed that the change in the relative residential housing status was not related to the percentage of home demolitions during the study period (based on .05 level of significance). This was probably because demolitions were not necessarily confined to the low quality houses. Some of the homes were those that had to be demolished so as to create space for alternative land uses. For example, some standard homes were demolished during the construction of the Stadium Freeway. Moreover, a good number of standard houses were demolished in downtown Portland during the study period in order to give way to urban renewal projects. During this

period, some residential houses were converted to non-residential use. The change in the relative residential status was not related to the percentage of demolitions partly because many of the homes that were demolished had characteristics which were close to the SMSA average. Their removal from the housing stock did not therefore affect the general housing situation significantly. Moreover, the level of demolitions in many of the census tracts was low. However, a separate study may be needed to specifically address this issue.

Relationship to the Percentage Change in the Year Round Vacancies

The change in the relative residential housing status was observed to be positively related to the percentage change in the year round vacancies in an urban subarea during the study period (significance level, .01). This result was quite consistent with the normal trend in urban subareas. Goetze (1979) and Grigsby (1975) did explain that vacancy figures reflect the extent to which there is balance between supply and demand for housing in a locality. In fact, many real estate investors usually regard vacancy information as indicative of the housing market status.

Relationship to the Percentage Change in the Total Housing Stock in a Subarea

The multiple linear regression analysis did not validate the hypothesized relationship between the change in

relative residential housing status and the percentage change in the total housing stock in an urban subarea (based on F test at .05 significance level). This finding was probably due to the fact that the net changes in the total housing units through new construction were appreciably counterbalanced by losses through demolitions and conversions from residential to commercial use.

Hypothesis No. 5

The results of the investigation supported the hypothesis that the change in urban residential housing status is positively related to the percentage change in the number of families in the highest income quartile. The hypothesized relationship to the percentage change in the number of families in the lowest income quartile was not supported. The relationship to the percentage change in the nonwhite population was not validated. The percentage change in the number of families in the next highest income quartile, and the percentage change in the number of employed persons in a subarea were highly correlated (r=.9) with the percentage change in the number of families in the highest income quartile. The former two variables were, therefore not included in the multiple linear regression, since their inclusion would have resulted in collinearity problems. However, simple linear regressions run with the change in the residential housing status as dependent

variable, and each of those two variables as independent variable showed that they were positively related. The detailed information about the multiple linear regression analysis is given in the succeeding sections.

Relationship to the Percentage Change in the Number of Families in the Highest Income Quartile

The observed relationship of the change in the relative residential housing status to the percentage change in the number of families in the highest income quartile was validated (significant at .01 level). It fairly reflected the situation in Portland SMSA during the study period. Many higher income families had migrated to the suburbs at the time - a trend which had continued from the end of the World War II. This outward intra-urban migration trend might have been instrumental to the strong relationship between the change in the residential housing status, and the percentage change in the number of families in the highest income quartile. However, this would need to be separately hypothesized and tested before any causality assumption could be confirmed.

Relationship to the Percentage Change in the Number of Families in Lowest Income Quartile

The change in the residential housing status was found to be unrelated to the percentage change in the number of families in the lowest income quartile during the study period (based on F-test at .05 significance level). This

group of families mainly comprised those which were below the poverty level. Even if they had wished to migrate from the inner city areas to the suburbs, they would not have been able to afford the expenses involved. Moreover, they were unlikely to have had the funds needed for effecting any major repairs on their homes.

Relationship to the Percentage Change in the Nonwhite Population

The change in the residential housing status was observed to be unrelated to the percentage change in the number of nonwhite population in a subarea (based on F-test at .05 significance level). That was probably due to the very small proportion of nonwhites in the SMSA at that period. For example, by 1970, the percentage of the nonwhite population in the SMSA had barely risen to 3.79 (U.S. Bureau of the Census, 1960 and 1970). That was quite a different trend from what would have been expected in the northeastern seaboard and midwestern cities of the country at the time.

GENERAL REMARKS ON THE RESULTS OF THE TESTS

In general, the foregoing empirical tests have yielded results which were consistent with what was the situation in Portland, Oregon SMSA during the study period. In effect, they have validated both the measures and the techniques used in developing the index of change in urban residential

housing status. In particular, the system described in these tests, which includes a sequence of procedures and techniques, has been shown to be both satisfactory and operationally feasible.

CHAPTER VI

CONCLUSIONS AND THE IMPLICATIONS OF THE STUDY

An operational and meaningful system (in terms of public policy) for monitoring and analyzing change in urban subarea residential housing status provides a great potential for better understanding of housing situations in urban areas. Moreover, it enhances the predictability of the consequences of intervention and remedial actions in the urban residential housing market. The major cause of the continuation of unsuccessful intervention strategies is the absence of effective, operational, and sensitive mechanisms for monitoring the effects of such strategies.

Indexing the Changes in Urban Residential Housing Status

In addition to shedding some light on the above important issue, this dissertation has provided a statistically sound system for indexing the changes in residential housing status in urban subareas. The system is operational and can be used by any agency concerned with the monitoring of housing situations in urban areas. The products have shown that the following variables were adequate for replicating the changes in urban subarea residential housing market status: median home value or contract rent; median

household income per capita; housing quality (operationalized as the percentages of deficient, crowded and much older housing units); percentage of occupied housing units; and percentage of owner occupied housing units.

Other housing market variables appear superfluous for replication of changes in urban subarea residential housing status. For example, inclusion of the number of units that are vacant does not add anything to what has already been extracted from knowledge of the number of occupied housing units. Moreover, inclusion of non-residential housing market variables among the proxy variables that replicate residential housing market conditions confuses the situation considerably. It also leads to complicated outcomes. For example, inclusion of information on commercial units which are not usually occupied by households is likely to result in misleading interpretations. Even worse than this is inclusion of data on crimes, schools, and other facilities.

There is no doubt that changes in urban subarea housing market conditions must be assessed with variables that are broader in context than just housing prices and rents. Changes in supply and demand for housing, and some key variables indicating the socioeconomic characteristics of households who occupy the housing units, as well as the quality of the units must be part of the assessment. However, while it may appear rational to include all known housing market and several socioeconomic variables in an assessment of changes in the residential housing market,

such an analysis may yield complex sets of results in which the desired result is only a part.

A research of this nature usually must be explicit on definitions. The variables used in the research must in turn reflect the given definitions. While analytically powerful, and statistically sound techniques can yield accurately determined dimensions or characteristics of some phenomena, accuracy in the interpretation of the results could be inhibited by human subjective inputs. This is very much pronounced when the results of the analysis are complex. Examples of this type of situation are very common in principal component analysis (or factor analysis) in which many factors may be identifiable within the data set (this statistical technique has the capability of identifying all the phenomena portrayed by the data set). It is most reassuring, however, when as was the case in this investigation, one or two principal components (factors) are identified.

The results of the first hypothesis of this research showed that a composite index can be developed for monitoring the changes in urban residential housing status. The technique utilized has a great potential for practical application in the area of housing market analysis.

Classification of Urban Subareas on the Basis of Changes in Housing Market Conditions

This investigation showed that a satisfactory and objective classification system for changes in urban subarea

residential housing market conditions can be obtained by carefully identifying the number, as well as the boundaries of differentiated groups in the local data set. Factor scores which were input to multivariate linear discriminant analyses yielded classification patterns based on the scores on the discriminant functions. In effect, the classification patterns were analytically derived instead of being intuitively obtained. Classification patterns, which are analytically derived, are not only objective, but also do immensely reduce the chances of erroneous and subjective classifications. In this research, changes in residential housing in the individual census tracts (subareas) were related to the changes in residential housing in the rest of the SMSA. It was therefore possible to observe how any individual subarea's housing situation changed in relation to other subareas.

The Importance of Choice of Variables used in the Classification of Residential Housing Status.

This investigation did show that the results of an urban subarea classification system will, to some extent, depend on the housing market variables used in the classification. This does indeed imply that both researchers and government agencies involved in housing policy decisions need ensure that housing information systems do contain as many as possible, or preferably all of the five key variables identified for assessing changes in

residential housing situations. This has not always been the case. Real estate entrepreneurs have often subjectively formed opinions on neighborhoods by simply observing the trend on such a single variable as home value. Some also have only used vacancy rates in assessing the need for housing.

The Relationship of the Changes in Urban Subarea Residential Housing Status to Selected Housing Market Variables

The study showed that the changes in the residential housing status were positively related to the percentage of new construction in Portland SMSA during the study period. The observed relationship was appreciable. However, the negative classification ratings obtained for the inner-city areas as opposed to the positive results recorded for the suburbs were indicative of the fact that the nature of the relationships of the changes in residential housing status to the percentage of new construction was very much varied. While new construction enhanced the development of the suburbs, it also facilitated the decline of the inner-city areas.

The changes in the residential housing status were also found to be related to the percentage change in the year-round vacancies in residential homes in the Portland SMSA during the study period. This finding was not unexpected. Although vacancy figures do not actually give a complete picture of the residential housing market behavior, they often reflect the nature of the interplay of housing

supply and demand in an urban area.

The changes in the urban subarea residential housing status were found to be unrelated to either the percentage of residential housing demolitions or the percentage change in the total housing stock in the SMSA during the study period. The residential housing demolitions and the total housing stock did not change appreciably in percentage terms during the study period. However, a study specifically addressed to these variables may shed further light on the findings.

The Relationship to Selected Socioeconomic Variables

The investigation also showed that the changes in the residential housing status were positively related to the percentage change in the number of families in the highest income quartile, but were not related to the percentage change in the number of families in the lowest income quartile. This finding did fairly reflect the true situation in Portland SMSA not only during the decade of the sixties, but also during the earlier decade or two. The outward migration of the higher income families from the inner-city areas to the suburbs had considerable effect on the status of housing both in the inner-city areas and the suburbs.

On the other hand, the families in the lowest income quartile were less mobile than those in other income quartiles in terms of change of residential location between

the inner-city areas and the suburbs. The families in the lowest income quartile were basically people below the poverty level during the period. Moreover, the percentage of families in the lowest income quartile did not change appreciably in the SMSA during the decade of the sixties. It is, therefore, not surprising that it did not show any significant relationship to the change in the residential housing situation during the period.

Similarly, the percentage change in the number of nonwhite population in the SMSA was not significantly related to the change in the residential housing status during the study period. This result was not unexpected. The great majority of the nonwhite population belonged to families in the lowest income quartile. It was this same group whose population and spatial distribution did not change appreciably during the decade studied.

Limitations of the Study

The major limitation of this study is the time interval within the study period. This was due to the dependence on the decennial census tract housing data sets for 1960 and 1970.[1] Data sets currently published on an annual basis do not contain the complete set of information

[1]The 1980 census tract housing data were not yet available at the time of this investigation. However, their availability would not have made any difference in terms of the methodology used. They would, however, have given a picture of the general housing situation in a different decade.

usually available in the censuses of housing. In particular, reliable data on incomes could hardly be obtained from local sources on an annual basis. In effect, the reason for the use of the census tract level housing data was that they provided the most complete sets of information needed for the analysis.

In spite of the issue of time interval between the decennial censuses, the methodology can be applied to any suitable annual data set. Even then, decennial monitoring of changes in housing market conditions can be more useful than annual monitoring under certain circumstances. There are some urban subareas which do not show significant or measurable changes in some housing market profile variables within a year or two. For example, changes in many housing quality component variables do not show up on an annual basis. One might argue that the census data do not contain detailed information on external and visual physical features of dwellings which contribute to housing quality. However, the fact is that these external features of dwellings are secondary to the most basic issues of availability of very essential facilities such as plumbing and heating. The occupancy of a dwelling is dependent on the availability of these basic facilities. Room crowding is also very basic to housing quality.

Advocates of annual change monitoring systems need remember that decennial monitoring systems are as useful as annual monitoring systems. Moreover, critics of census data

do not seem to realize that the censuses provide very valuable, national, and uniformly collected data sets obtained from respondents at the same period of time. These census data sets have provided reliable data benchmarks for all governmental agencies and organizations around the country.

Apart from the issue of data set, it was realized that it would have been useful to investigate the relationships of the changes in urban subarea residential housing status to other characteristics of household heads such as sex, occupation, education, and age. However, this study was not intended to be an exhaustive investigation of relationships between changes in urban subarea residential housing conditions and socioeconomic characteristics of households. What was intended was adequate evidence to establish a double validation of the composite measure developed in the study. This measure had initially been validated by observing the compatibility of the results obtained with what actually existed in the subareas during the study period. Moreover, cost and time limitations did not permit investigation of many detailed relationships. This investigator hopes, however, to explore those "terrains" in the future.

The Merits of the Study

The methodology developed in this study for measuring and monitoring relative changes in urban subarea housing market conditions is standard and robust, and yet easy to

apply. It can be easily used by the planning staffs of urban development commissions as well as other planning agencies. The methodology can also be adapted to meet the local needs of communities.

Second, the variables used in developing the composite index for changes in urban subarea residential housing situations do depict the concepts of neighborhood filtering and neighborhood stability. They are, therefore, useful for identifying subareas that need attention and those that do not. In particular, the composite index can serve as very useful input for classification of urban residential subareas. This was amply demonstrated in the investigation. Third, the composite index included housing quality as an important determinant of the changes in residential housing market status. This component has not been adequately represented in previous research. Yet housing quality has usually been one of the most important concerns in urban renewal and community development programs.

Apart from its potential use for identification of problem subareas, the system developed in this research can be used for evaluation of specific program outcomes. This investigation did show that with data available in the censuses of housing, urban communities can develop operational and valuable systems for monitoring the changes in the status of housing in urban residential subareas for any desired time interval.

Data collected on an annual basis can also be used for monitoring housing situations without modifications of the methodology. Moreover, data on individual housing units can be processed using the appropriate variables. Finally, the methodology developed in this research can be used to test the existing definitions of the filtering process. In fact, it might well give a clue to the resolution of the controversy over the definition and formulation of the phenomenon.

Applications in Other Areas

The methodology developed in this research is general, and therefore, can also be used for monitoring changes in other socioeconomic activities. For example, it can be utilized in the study of changes in the spatial distribution of populations and demographic groups. Although a few classification schemes had in the past incorporated school district data and crime data in neighborhood housing monitoring systems, this methodology can be easily adapted to specifically address those issues as separate and distinct issues. Moreover, it could be useful for monitoring changes in consumer preferences for specific goods and services among different socioeconomic groups.

BIBLIOGRAPHY

Adams, John S. New Homes, Vacancy Chains and Housing Submarkets in the Twin Cities Area, Minneapolis: University of Minnesota, Center for Urban and Regional Affairs, 1973.

Ahlbrandt, Roger S. Jr. and Brophy, Paul C. Neighborhood Revitalization: Theory and Practice, Lexington Books, Lexington, Massachusetts, 1975.

Altshuler, Allan. "The Potential of Trickle Down", Public Interest, Vol. 15 (Spring 1964), pp. 46-56.

American Institution of Planners. Housing Planning, an AIP Background Paper, 1971.

American Public Health Association. An Appraisal Method for Measuring the Quality of Housing: A Yardstick for Health Officers, Housing Officials and Planners, Part I, Nature and Uses of the Method. Committee on the Hygiene of Housing New York, 1945, 71 pp.

Anderberg, M.R. Cluster Analysis for Applications, New York: Academic Press, 1973, 359 pp.

Andrews, H.F. "A Cluster Analysis of British Towns," Urban Studies, Vol. 8, pp. 271-281, 1971.

Ash, Joan. "Residential Rehabilitation in the U.S.A.," in Urban Studies, Vol. 4, No. 1, pp. 22-40, 1967.

Ball, M. "Recent Empirical Work on the Determinants of Relative House Prices," Urban Studies, Vol. 10, pp. 213-233, 1973.

Ball, M., and Kirwan R. "The Economics of An Urban Housing Market, Bristol Area Study, Center for Environmental Studies," Research Paper, No. 15, London, 1975.

Barnes, McKin N. "A Strategy for Residential Rehabilitation," in Real Estate Review, Vol. 6, No. 3, Fall 1976.

Berry, B.J.L. "An Inductive Approach to the Regionalization of Economic Development," in Ginsberg (ed.): Essays in Geography and Economic Development, Chicago: The University of Chicago Press, 1960.

Berry, B.J.L. "A Method for Deriving Multi-Factor Uniform Regions," Przegl. Geog., 56: pp. 551-569, 1961.

Berry, B.J.L. "Commercial Structure and Commercial Blight," Dep. Geogr., Research Paper 105, Chicago, The University of Chicago, 1963.

Berry, B.J.L. "Approaches to Regional Analysis: A Synthesis," Annals of Association of Geographers, Vol 5, pp. 2-11, 1964.

Birch, David L. et al. The Community Analysis Model: An Overview, Cambridge, Massachusetts, Joint Center for Urban Studies of the MIT and Harvard University, 1977.

Bird, Heather. "Residential Mobility and Preference Patterns in the Public Sector of the Housing Market," Institute of British Geographers, Transactions, Vol I, No. 1, pp. 20-33, 1976.

Black, J. Thomas. "Private Market Housing Renovation in Central Cities: a U.L.I. Survey," Urban Land, November, 309, 1975.

Bloom, Nathan. Government Role in Housing, First National City Bank of New York, 1971.

Brueggeman, William., Racster, Ronald., and Smith Halbert. "Multiple Housing Program and Urban Housing Policy," Journal of the American Institute of Planners, Vol. 38, No. 3, May 1972, pp. 160-167.

Brueggeman, William, B. An Analysis of the Filtering Process with Special Reference to Housing Subsidies, National Housing Policy Study Papers, U.S. Department of Housing and Urban Department, 1973.

Brueggeman, William, B. "Federal Housing Policies: Subsidized Housing, Filtration and Objectives: A Reply," Land Economics, Vol. 1, No. 3, August 1974, pp. 317-320.

Caliner, Geoffrey. "Determinants of Home Ownership," Land Economics, Vol. 6, 1974, pp. 109-118.

Cannon, Donald S., Lachman, M. Leonne., and Bernhard, Arlyne S. "Identifying Neighborhoods for Preservation and Renewal," Growth and Change, Vol. 8, No. 1, January 1977, pp. 35-38.

City of Portland. Housing Market Analysis and Data Summary, Portland, September, 1978, 126 pp.

City of Portland. 1981 Neighborhood Information Profiles, Office of Fiscal Administration, Services Research Division, Portland, 1981, 349 pp.

Clay, Philip L. "Neighborhood Revitalization and Community Development: The Experience and the Promise." Center for Community Economic Development Newsletter, August-October, pp. 1-9, 1978b.

Cloke, Paul J. An Index of Rurality for England and Wales, Regional Studies, Pergamon Press Ltd., 1977.

Cooper, James R. Can the 1968-78 National Housing Goal be Achieved?, University of Illinois, Champaign, 1971.

Daniels, Charles. "The Filtering Process and Its Implications for Housing Policy," Human Ecology, Vol. 4, No. 3, pp. 18-20, Winter 1974.

Davies, E.M. "A Longitudinal Study of Urban Populations in England and Wales," Urban Studies, Vol. 16, No. 2, June 1979, pp. 165-177.

Downs, Anthony and Lachman, J. Leanne. "The Role of Neighborhoods in the Mature Metropolis," paper prepared for Symposium on Challenges and Opportunities in the Mature Metropolis, St. Louis, Missouri, June 6-8, 1977.

Eaves, Elsie. "How the Many Costs of Housing Fit Together," Research Report No. 16, The National Commission on Urban Problems, 1969.

Edel, M. "Filtering in a Private Housing Market," (Eds.) Edel, M., and Rothenberg J. Readings in Urban Economics, Macmillan, New York, 1972.

Embry, Robert. "Urban Reinvestment and the Effects of Displacement of Low and Moderate Income Persons," Testimony before the Senate Committee on Banking, Housing, and Urban Affairs, July 7, 1977.

Fichter, Robert. Young Professionals and City Neighborhoods, Boston, Massachusetts, Parkman Center for Urban Affairs, August, 1977.

Firestone, O. J. Residential Real Estate in Canada, University of Toronto Press, 1951.

Fisher, Ernest, and Winnick, Louis. "A Reformulation of the Filtering Concept, "The Journal of Social Issues, Vol. VII, 1951, pp. 47-85.

Frank, Ronald E., Massy, William F., and Morrison, Donald G. "Bias in Multiple Discriminant Analysis." Journal of Marketing Research, Vol., August 1965, pp. 250-258.

Frei, William, and Specht H. "The Housing and Community Development Act of 1974: Implications for Policy Planning," Social Service Review, Vol. 50, June 1976, No. 2, pp. 275-79.

Goetze, Rolf. Building Neighborhood Confidence, Ballinger, Cambridge, Massachusetts, 1976.

Goetze, Rolf. Colton, Kent W., and O'Donnell. Stabilizing Neighborhoods: A Fresh Approach to Housing Dynamics and Perceptions, prepared for HUD, Office of Policy Development and Research, Boston Redelopment Authority and Public Systems Evaluation, Inc., November, 1977.

Goetze, Rolf. "Avoiding Both Disinvestment and Speculation in Private Multifamily Housing," Journal of the American Real Estate and Urban Economics Association, Vol. 6, No. 2, Summer, 1978, pp. 175-85.

Goetze, Rolf. Understanding Neighborhood Change, Ballinger Publishing Company, Cambridge, Massachusetts, 1979, 162 pp.

Grebler, Leo. Housing Market Behavior in a Declining Area, Longterm Changes in Inventory and Utilization of Housing on New York's Lower East Side, Columbia University Press, New York, 1952.

Grigsby, William G. Housing Markets and Public Policy, University of Pennsylvania Press, 1963, 346 pp.

Grigsby, William G., and Rothenberg, L. Urban Housing Policy, APS Publications, New York, 1975.

Groove, D. M., and Roberts, Carole A. Principal Component and Cluster Analysis of 185 Large Towns in England and Wales, Urban Studies, Vol. 17, pp. 77-82, 1980.

Guy, Donald Copeland, "An Analysis of Filtering Hypothesis in Urban Housing Market," unpublished Ph.D. dissertation , University of Illinois at Urbana, 1970.

Harris, Richard J. A Primer of Multivariate Statistics, Academic Press, New York 1975, 332 pp.

Hartman, Chester W. Housing and Social Policy, Prentice Hall 1975.

Hoad, William. "Real Estate Prices: A study of Residential Real Estate in Lucas County, Ohio," unpublished Ph.D. dissertation, University of Michigan, 1942.

Hoyt, Homer. The Structure and Growth of Residential Neighborhoods in American Cities, U.S. Government Printing Office, Washington, D.C. 1939.

Jones, Charles O. An Introduction to the Study of Public Policy, Duxburg, 1970.

Jones, Colin. "Household Movement, Filtering and Trading up Within the Owner Occupied Sector," Regional Studies, Vol. 12, pp. 551-561, 1978.

Keeler, E., and Rogers, W. A Classification of Large American Urban Areas, document R-1246-NSF, Santa Monica, California Rand Corporation, 1973.

Kerlinger, Fred N. Foundations of Behavioral Research. Holt, Rinehart and Winston, New York, 1964, 741 pp.

Kristof, Frank S. "Housing Policy Goals and the Turnover of Housing," Journal of the American Institute of Planners, Vol. 31, No. 3, August 1965, pp. 232-242.

Kristof, Frank S. "Housing Policy Goals and Housing Market Behavior: Experience in the United States," Urban Studies, Vol. 3, 89-110, 1966.

Kristof, Frank S. "Federal Housing Policies: Subsidization, Filtration, and Objectives: Part I," Land Economics, Vol. 48, No. 4, November 1972, pp. 309-320.

Lansing, John B., Clifton, Charles, W., and Morgan, James N. New Homes and Poor People: A Study of Chains of Moves, University of Michigan, Institute for Social Research, 1969.

Leven, Charles L., Little James T., Nourse, Hugh O., and Read, R.B. Neighborhood Change: Lessons in the Dynamics of Urban Decay, New York Praeger 1976, 205 pp.

Lipton, Gregory. "Evidence of Central City Revival," Journal of the American Institute of Planners, Vol. 43, April 1977, pp. 136-147.

Listokin, David. The Dynamics of Housing Rehabilitation: Macro and Micro Analyses, Center for Policy and Research, Rutgers University, New Brunswick, 1973.

Little, James T. "Household Preferences, Relocation and Welfare: An Evaluation of the Filtering Concept," working paper HMS 2, Institute for Urban and Regional Studies, Washington University, St. Louis 1974.

Little, James T., Nourse, H. O., Read, R. B., Leven, C. L. The Contemporary Neighborhood Succession Process, Institute for Urban and Regional Studies, Washington University, St. Louis, 1975.

Little, James T. "Residential Preferences, Neighborhood Filtering and Neighborhood Change," Journal of Urban Economics, Vol. 3, pp. 68-81, January, 1976.

Little, James T. "The Dynamics of Neighborhood Change," in Donald Phares (eds), A Decent Home and Environment: Housing Urban Americs, Ballinger, Cambridge, Massachusetts, 1977, pp. 63-78.

Lowry, Ira S. "Filtering and Housing Standards: A Conceptual Analysis," Land Economics, Vol. 36, 1960, pp. 362-370.

Maher, C. A. "Residential Change and the Filtering Process: Toronto 1953-1971," unpublished Ph.D. dissertation, Department of Geography, University of Toronto, 1971.

Maher, C. A. "Spatial Patterns in Urban Housing Markets: Filtering in Toronto, 1953-1971," Canadian Geographer, 1974, Vol. 18, No. 2, pp. 108-124.

Mark, Jonathan H. "Identifying Neighborhoods for Preservation and Renewal: Comment," Growth and Change, Vol.II, No. 4, October 1980, pp. 47-48.

Mba, Harold C. An Analysis of the Depleting Rental Housing Stock in Portland, Oregon SMSA, unpublished research paper on Urban Housing Policies, Graduate Program in Urban Studies and Planning, Portland State University, Portland, Oregon, Spring 1980.

Metropolitan Service District. Building Permit Statistics by Census Tracts, 1960 to 1970 series.

Morrison, Donald G. "Measurement Problems in Cluster Analysis," Management Science, Vol. 13, August 1967, B775-780.

Morrison, Donald G. "On the Interpretation of Discriminant Analysis," Journal of Marketing Research, Vol. VI, May 1969, pp. 156-163.

Moser, C. A., and Scott, W. British Towns, A Statistical Study of their Scoial and Economic Differences, Edinburgh and London, Olver and Boyd, 1961.

Murie, A., Hillyard P., Birrell, D., and Roche, D. "New Building and Housing Need: A Study of Moves in Housing in Northern Ireland, Progress Plann., Vol. 6, 1976, pp. 81-186.

Murie, A., Niner, P., and Watson C. "Housing Policy and the Housing System," Allen and Unwin, London, Nationwide Building Society, Occasional Bulletin, No. 134, London, 1976.

Muth, Richard. "The Demand for Non-Farm Housing," in Arnold Harberger, (ed.) The Demand for Durable Goods, Chicago, University of Chicago Press, 1960.

Muth, Richard. Cities and Housing, Chicago, University of Chicago Press, 1969.

Muth, Richard. "A Vintage Model of the Housing Stock," Regional Science Association Papers, Vol. 30, 1973.

Myers, Dowell. "Housing Allowances, Submarket Relationships and the Filtering Process," Urban Affairs Quarterly, Vol. 2, No. 2, pp. 215-240, December 1975.

Myers, Phyllis and Binder, Gordon. Neighborhood Conservation: Lessons from three Cities, An Issue Report, Washington D.C. The Conservation Foundation, 1977.

National Commission on Urban Problems. "Building the American City," Part III, Chapter 1, Housing Needs 66-87, 1969.

Nourse, Hugh O., and Guy, Donald C. "The Filtering Process: The Webster Groves and Kankakee Cases," papers and proceedings of the American Real Estate and Urban Economics Association, Vol. V, December 1970, pp. 33-49.

Nourse, Hugh O., and Phares, D. "The Filtering Process in the Inner Suburbs," in R. Sutker and N. Sutker (eds.) Racial Transition in the Inner Suburbs, 1974, pp. 80-104.

Ohls, James C. "Public Policy Toward Low Income Housing and Filtering in Housing Markets," Journal of Urban Economics, No. 2, 1975, pp. 144-171.

Partridge, T. J. "The Filtering Process and Public Housing Policy," paper read at the Urban Economics Conference, University of Keele, July 1971.

Pattison, Tiomothy. "The Process of Neighborhood Upgrading and Genttrification: An Examination of Two Neighborhoods in the Boston Area," unpublished Master's Thesis, Massachusetts Institute of Technology, 1977.

Portland City Club. "Report on Urban Renewal in Portland," Portland City Club Bulletin, Vol. 52, No. 12, Aug. 13, 1971.

Public Affairs Counseling, A Division of Real Estate Research Corporation. The Dynamics of Neighborhood Change, 1973, 63 pp.

R. L. Polk and Company. "The T.E.A.M. Approach," Update, Profiles of Change No. 8, undated.

Racster, Ronald., Smith, Halbert and Brueggeman, William, "Federal Housing Programs in the Local Housing Market," Appraisal Journal, Vol. 39, No. 3, July 1971, pp. 396-414.

Rapkin, Chaster. "Rent-Income Ratio," in Wheaton et al. (ed.) Urban Housing, 1966, pp. 168-175.

Ratcliff, Richard U. "Filtering Concept," in Urban Land Economics, pp. 321-333, McGraw-Hill, New York, 1949.

Real Estate Research Corporation. Neighborhood Preservation, A Catalog of Local Programs, Washington D.C.; Government Printing Office, 1975.

Reid, Margaret, G. Housing and Income, University of Chicago Press, 1962.

Rothenberg, J. "Urban Housing Markets: An Analytical Model and its Applications to the Impact of Rent Control." 1972, in Brown, A. A., Licardi J. A., and Neuberger, E, (eds.) Urban and Social Economics in Market and Planned Economics, 2, Praeger, 1974.

Rozeboom, William W. Foundations of the Theory of Prediction, Homewood, III, Dorsey Press, 1966.

Rummel, R. Applied Factor Analysis, Evanston III, Northwestern University Press, 1970.

Sands, Gary. "Housing Turnover: Assessing its Relevance to Public Policy," Journal of the American Institute of Planners, Vol. 42, No. 4, October, 1976.

Sands, Gary. "A Model for Evaluation of Filtering," Growth and Change, Vol. 10, No. 4, October 1979, pp. 20-24.

Smith, Halbert C., Tschappat, C. J., and Racster, Ronald. Real Estate and Urban Development, Irwin Inc., Homewood, Illinois, 1977, 561 pp.

Smith, Wallace. "Filtering and Neighborhood Change," Research Report No. 24, Institute for Urban and Regional Development, University of California, Berkeley, 1964.

Smith, Wallace. "Filtering," in Housing - The Social and Economic Elements, University of California Press, Berkeley and Los Angeles, 1970.

Sweeney, J. "A Community Hierarchy Model of the Rental Housing Market," Journal of Urban Economics, Vol. 1, 1974, pp. 288-323.

Toulan, Nohad A. "The Filtering Process: A conceptual Appraisal," research paper, Institute for Urban Studies, University of Pennsylvania, 1960.

U. S. Congress. "Housing Act of 1937," ch. 896, §1, 50 Stat. 888, 42 U.S.C. §1401 (1964).

U. S. Congress. "Housing Act of 1949," ch. 338, §2, 63 Stat. 413, 42 U.S.C. §1441 (1964).

U. S. Congress. "Housing Act of 1954," §101, 68 Stat. 590, 623, 42 U.S.C. §1451(c) (Supp. IV, 1965-68).

U. S. Congress. "Housing Act of 1956," §305, 70 Stat. 1091, 1100-01.

U. S. Congress. "Housing Act of 1959," §405, 418, 73 Stat. 654, 672-677, U.S.C. §1463(a), 1463, (1964).

U. S. Congress. "Housing Act of 1964," §§301, 312, 78 Stat. 769, 785, 790, 42 U.S.C. §1460(c)(5) (Supp. IV, 1965-68).

U. S. Congress. "Housing and Urban Development Act of 1965," §5, 79 Stat. 667, 669, 42 U.S.C. §3534(a) (Supp. IV, 1965-68).

U. S. Congress. "Demonstration Cities and Metropolitan Development Act of 1966," §701, 80 Stat. 1255, 42 U.S.C. §5301-74 (Supp. IV, 1965-68).

U. S. Congress. "Housing and Urban Development Act of 1968," §501, 82 Stat. 476, 518-20, 42 U.S.C. S1469-1469(c) (Supp. IV, 1965-68).

U. S. Congress. "Housing and Urban Development Act of 1969," §210, P.L. 91-152, 83 Stat. 379, 388.

U. S. Congressional Research Service. Inflation in Housing Costs, October 5, 1976, updated November 20, 1979.

U. S. Congressional Research Service. The Rationale for Assisted Housing, A Review and Discussion, August, 1979, 31 pp.

U. S. Congressional Research Service. Housing Assistance to Low- and Moderate- Income Households, May 1979, updated February 1980, 12 pp.

U. S. Department of Commerce, U.S. Censuses of Population and Housing: 1960, Census Tracts: Portland, Oregon-Wash. SMSA.

U. S. Department of Commerce. 1970 Census of Population and Housing, Census Tracts, Portland, Oregon-Washington SMSA.

U. S. Department of Commerce. "Annual Housing Survey; Portland, Oregon 1975, "U.S. Bureau of the Census.

U. S. Department of Housing and Urban Development. Developing a Local Housing Strategy, A Guidebook for Local Government, 1977.

U. S. Department of Housing and Urban Development. Local Housing Assistance Tools and Techniques: A Guidebook for Local Government, Prepared for the Office of Community Planning and Development, and Office of Policy Development and Research, HUD, by the U.S. Conference of Mayors, National Community Devleopment Association, and Urban Land Institute, 1977.

U. S. Department of Housing and Urban Development. Displacement Report, 1979.

U. S. Department of Housing and Urban Development. Housing in America, The Characteristics and Uses of the Annual Housing Survey, February, 1980, 35 pp.

U. S. Department of Housing and Urban Development. Data Resources in Housing and Urban Development, March 1980, 7 pp.

Watson, C. J. "Household Movement in West Central Scotland: A Study of Housing Chains and Filtering," Center for Urban and Regional Studies, University of Birmingham, Occasional Paper, No. 26, 1973.

Watson, C. J. "Vacancy Chains, Filtering and the Public Sector," Journal of the American Institute of Planners, Vol. 40, No. 5, September 1974, pp. 346-352.

Welfeld, Irving H. "America's Housing Problem, An Approach to its Solutions," Evaluation Study No. 10, American Enterprise Institute for Public Policy Research, Washington, D.C., 1973.

White, Harrison. "Multipliers, Vacancy Chains, and Filtering in Housing," Journal of the American Institute of Planners, Vol. 37, No. 2, March 1971, pp. 88-94.

Yeates, Maurice. An Introduction to Quantitative Analysis in Human Geography, McGraw-Hill, 1974, 300 pp.

Yeates, Maurice and Garner, Bary. The North American City, Harper and Row, New York, 1976.

APPENDIX A

CLASSIFICATION OF SUBAREAS (CENSUS TRACTS) OF PORTLAND, OREGON SMSA ON THE BASIS OF RELATIVE CHANGES IN THE RESIDENTIAL HOUSING MARKET CONDITIONS

CENSUS TRACT NO.	NO. OF DWELLING UNITS BY YEAR		CLASSIFICATION CATEGORIES BY ANALYSIS NUMBERS[1]							
	1960	1970	1	2	3	4	5	6	7	8
1	2184	2358	S	D	D	D	D	S	S	S
2	1898	2502	S	D	D	D	D	S	S	D
3.01	810	1004	S	S	S	S	S	S	S	S
4.02	1144	1286	S	D	D	D	S	S	S	S
5.01	1252	1342	D	D	D	D	D	D	D	D
5.02	1345	1400	S	D	S	D	S	S	S	D
6.01	1479	1633	S	D	D	D	S	D	S	D
7.01	1366	1646	D	D	D	D	D	D	D	D
7.02	1509	1612	S	S	S	S	S	D	S	D
8.01	1763	1876	D	D	D	D	D	D	D	D
8.02	1440	1820	S	S	D	S	D	S	S	S

[1]The numbers refer to the sets of analysis used in testing hypothesis no. 3
1 - Analysis set 1
2 - Analysis set 2
3 - Analysis set 3
4 - Analysis set 4
5 - Analysis set 5
6 - Analysis set 6
7 - Analysis set 7
8 - Analysis set 8

D - indicates a decline in residential housing status
S - indicates a stable residential housing status
R - indicates a rise in residential housing status

APPENDIX A (CONTINUED)

CENSUS TRACT NO.	NO. OF DWELLING UNITS BY YEAR		CLASSIFICATION CATEGORIES BY ANALYSIS NUMBERS							
	1960	1970	1	2	3	4	5	6	7	8
9.01	1650	1782	D	D	D	D	D	D	D	S
9.02	1176	1456	S	S	S	S	S	S	S	S
10	2342	2360	S	D	S	S	S	S	S	S
11.01	1479	1508	D	D	D	D	D	D	D	D
11.02	1024	890	D	D	S	S	D	D	D	D
12.01	2143	2397	D	D	D	S	D	D	D	S
12.02	1394	1383	D	D	D	D	D	D	D	D
14	2083	2147	D	D	D	D	D	D	D	S
15	1347	1328	D	D	D	D	D	D	D	D
16.01	1845	2071	D	D	D	D	S	D	D	D
16.02	1645	1623	D	D	D	D	D	D	D	D
17.02	1009	1257	S	D	D	D	D	D	D	D
19	1959	2028	S	D	S	D	S	S	S	D
20	2871	3046	D	D	D	D	D	D	D	D
23.01	1268	982	D	D	S	D	D	D	D	D
24.01	1176	1137	D	D	D	D	D	D	D	D
24.02	1151	1611	S	S	R	S	S	S	S	D
25.01	1726	1760	D	D	S	D	D	D	D	D
25.02	1583	1927	S	S	S	S	S	S	S	S
26	1132	1112	D	D	D	D	D	D	D	D
27.01	1228	1209	D	D	S	D	D	D	D	D
27.02	930	1323	S	D	S	S	D	S	S	D
28.01	1270	1278	D	D	D	D	D	D	D	D

APPENDIX A (CONTINUED)

CENSUS TRACT NO.	NO. OF DWELLING UNITS BY YEAR		CLASSIFICATION CATEGORIES BY ANALYSIS NUMBERS							
	1960	1970	1	2	3	4	5	6	7	8
28.02	1206	1332	D	D	S	D	D	D	D	D
29.01	1838	1883	S	S	S	D	S	S	S	D
30	1869	1878	D	D	S	D	D	D	D	D
31	1842	1754	D	D	D	D	D	D	D	D
32	1674	1656	D	D	D	D	D	D	D	D
33.01	1111	1110	D	D	D	D	D	D	D	D
33.02	1177	1063	D	D	D	D	D	D	D	D
34.01	1489	1436	D	D	D	D	D	D	D	D
34.02	1317	1141	D	D	S	D	D	D	D	D
35.01	1576	1535	D	D	D	D	D	D	D	D
35.02	1145	937	D	D	S	D	S	D	D	D
38.02	1405	1249	D	D	D	D	D	D	D	D
38.03	1691	1590	D	D	D	D	D	D	D	D
39.02	1254	1234	D	D	D	D	D	D	D	D
40.02	1610	1659	D	D	D	D	D	D	D	D
41.02	1537	1762	S	D	D	D	D	D	D	D
42	933	1180	D	D	D	D	D	D	D	S
48	2297	2242	D	D	D	D	D	D	D	D
49	2249	2309	D	D	D	S	D	D	D	D
50	665	549	D	D	S	D	D	D	D	D
51	1613	744	D	D	D	D	D	D	D	D
52	3085	3046	S	S	S	S	S	S	S	D
53	1847	1838	D	D	D	D	D	D	D	D

APPENDIX A (CONTINUED)

CENSUS TRACT NO.	NO. OF DWELLING UNITS BY YEAR		CLASSIFICATION CATEGORIES BY ANALYSIS NUMBERS							
	1960	1970	1	2	3	4	5	6	7	8
54	1194	527	D	D	S	D	S	D	D	D
55	1321	767	D	D	D	S	D	D	D	S
57	1757	681	R	R	R	R	R	R	R	R
59	1245	1321	S	S	S	S	S	S	S	S
61	567	663	S	S	S	S	S	S	S	S
62	912	990	S	S	S	S	S	S	S	S
63	954	1168	S	S	S	S	S	S	S	S
64	1202	1564	S	D	D	D	S	S	S	S
74	681	916	S	S	S	S	S	S	S	S
75	1469	1551	D	D	D	D	D	D	D	S
76	1149	1320	D	D	D	D	D	D	D	D
77	793	696	S	S	D	S	R	S	S	R
79	1162	1574	S	S	S	D	S	S	S	D
81	1804	2473	S	D	D	D	D	S	S	D
83	1951	2255	S	D	D	D	D	D	D	D
84	735	890	S	D	D	D	D	D	D	D
85	849	1150	S	D	D	D	S	S	S	S
86	1032	1165	D	D	D	D	S	D	D	D
90	1127	1449	S	S	S	D	D	S	S	D
91	1051	1557	S	S	S	S	S	S	S	S
93	1396	2100	R	S	S	S	S	S	R	D
94	1133	1687	S	R	R	R	R	S	R	S
95	153	1198	R	R	R	R	R	R	R	R

APPENDIX A (CONTINUED)

CENSUS TRACT NO.	NO. OF DWELLING UNITS BY YEAR		CLASSIFICATION CATEGORIES BY ANALYSIS NUMBERS							
	1960	1970	1	2	3	4	5	6	7	8
99	749	1076	R	R	R	R	R	R	R	R
105	823	878	R	R	R	S	R	R	R	R
*199.01	3547	3788	S	S	S	S	S	S	S	S
*199.02	2815	2911	D	D	D	D	D	D	D	D
*199.03	2493	2665	S	S	S	S	S	S	S	S
*199.04	2937	2858	D	D	D	D	D	D	D	D
*199.05	4940	5568	S	S	S	S	S	S	S	D
*199.06	4309	3224	S	D	S	D	S	S	S	D
*199.07	4557	4716	D	D	S	D	S	D	D	D
*199.08	13422	14633	D	D	D	D	D	D	D	D
*199.09	1589	1434	S	S	R	S	R	S	S	S
*199.10	7387	7635	S	S	S	S	R	S	S	S
*199.11	4943	3910	S	S	S	R	S	S	S	S
*199.12	963	1151	S	S	S	S	R	S	S	S
*199.13	1874	2260	S	S	S	S	S	S	S	S
*199.14	1506	2180	D	D	D	D	D	D	S	D
*199.15	1274	2377	S	S	D	D	S	S	S	D
*199.16	849	1543	S	S	D	S	S	S	S	D
*199.17	1771	2200	S	S	S	S	S	S	S	D
*199.18	2232	2618	S	S	S	S	S	S	S	D
*199.19	2049	2950	R	S	S	S	S	S	R	D

* Grouped census tracts; see Appendix B

APPENDIX A (CONTINUED)

CENSUS TRACT NO.	NO. OF DWELLING UNITS BY YEAR		CLASSIFICATION CATEGORIES BY ANALYSIS NUMBERS							
	1960	1970	1	2	3	4	5	6	7	8
*199.20	1547	3253	R	S	S	S	S	R	R	S
*199.21	1973	3285	S	R	R	S	S	S	R	D
*199.22	5259	8881	R	R	R	R	R	R	R	R
201	986	1328	S	S	D	D	S	S	S	S
202	1373	1680	S	S	D	S	S	S	S	S
203	681	1189	S	S	S	S	S	S	S	S
204	1156	2264	R	R	R	R	R	R	R	R
208	1012	1380	R	S	S	S	S	R	R	S
209	1102	1418	S	S	S	S	S	S	S	D
210	932	1412	S	S	R	S	S	S	R	S
211	1055	1542	S	S	R	S	R	S	R	S
212	1060	1511	S	D	D	S	D	S	S	S
213	1115	1549	S	S	S	S	S	S	S	S
214	814	1071	S	S	S	S	S	S	S	S
215	388	753	R	R	R	R	R	R	R	R
216	1469	2302	R	R	S	R	R	R	R	S
217	1040	1537	S	R	R	R	R	R	R	R
218	752	1613	R	R	R	R	R	R	R	R
219	701	919	S	D	D	D	D	S	D	D
222	1102	1724	S	R	R	R	R	R	R	R
227	811	1296	R	R	R	R	R	R	R	R

* Grouped census tracts; see Appendix B

APPENDIX A (CONTINUED)

CENSUS TRACT NO.	NO. OF DWELLING UNITS BY YEAR		CLASSIFICATION CATEGORIES BY ANALYSIS NUMBERS							
	1960	1970	1	2	3	4	5	6	7	8
230	418	734	R	R	R	R	R	R	R	R
231	543	771	R	R	R	R	R	R	R	R
232	610	948	R	R	R	R	R	R	R	R
233	708	941	R	R	R	R	R	R	R	R
234	1536	1582	R	R	R	R	R	R	R	R
235	609	835	S	R	R	R	R	R	R	R
236	462	515	S	R	R	R	R	R	R	R
237	605	753	S	R	R	R	R	S	R	R
238	1139	1259	S	R	R	R	R	R	R	R
239	982	1166	S	R	R	R	R	S	S	R
243	2655	1469	R	R	R	R	R	R	R	R
*299.23	2403	3356	R	R	R	R	R	R	R	R
*299.24	2212	3322	R	R	R	R	R	R	R	R
*299.25	4209	5182	S	R	R	R	R	S	S	S
*299.26	1528	2101	R	R	R	R	R	R	R	R
*299.27	1864	2182	S	R	R	R	R	S	S	R
301	682	1537	R	S	D	D	S	S	S	D
302	1054	2061	S	S	S	S	S	S	S	S
303	1236	1660	S	S	S	S	R	S	S	S
304	879	2318	S	S	D	S	S	S	S	S
305	1022	1766	R	R	R	R	R	R	R	S

* Grouped census tracts; see Appendix B

APPENDIX A (CONTINUED)

CENSUS TRACT NO.	NO. OF DWELLING UNITS BY YEAR		CLASSIFICATION CATEGORIES BY ANALYSIS NUMBERS							
	1960	1970	1	2	3	4	5	6	7	8
306	796	1072	S	S	S	S	R	S	S	S
307	327	626	S	D	D	D	D	S	S	D
308	563	1737	R	R	R	R	S	R	R	S
309	559	1385	R	S	D	S	D	R	S	D
310	594	2442	R	S	S	S	S	R	R	S
311	776	886	S	S	S	S	S	S	S	S
312	756	1962	R	S	S	S	S	R	R	S
313	935	1559	S	D	D	D	D	S	S	S
315	795	2703	R	R	R	R	R	R	R	R
316	1121	1635	R	R	S	R	R	R	R	R
317	805	1451	R	R	R	R	R	R	R	R
318	620	965	R	S	S	S	S	R	R	S
319	858	2580	R	R	R	R	R	R	R	R
320	492	668	S	S	S	S	R	S	S	R
321	799	1143	R	R	R	R	R	R	R	R
323	495	591	R	R	R	R	R	R	R	R
324	1198	2322	R	R	S	S	R	R	R	R
325	1107	1298	S	R	R	R	R	S	S	S
326	1944	2757	S	S	S	S	S	S	S	S
327	965	771	S	R	R	R	R	R	R	R
328	313	373	S	R	R	R	R	S	R	R
329	669	1265	R	R	R	R	R	R	R	R

APPENDIX A (CONTINUED)

CENSUS TRACT NO.	NO. OF DWELLING UNITS BY YEAR		CLASSIFICATION CATEGORIES BY ANALYSIS NUMBERS							
	1960	1970	1	2	3	4	5	6	7	8
331	1271	1444	S	S	S	S	S	S	S	S
332	624	767	S	S	S	R	S	S	S	S
333	926	1261	S	S	S	R	S	S	S	S
334	503	432	S	R	R	R	R	R	R	R
335	505	532	S	R	R	R	R	R	R	R
336	524	521	S	R	R	R	R	R	S	R
*399.28	1820	3733	S	S	S	S	S	S	S	S
*399.29	1463	1784	-	-	R	-	-	-	-	-
401	874	836	S	R	R	R	R	R	S	R
402	869	1065	R	R	R	R	R	R	R	R
403	768	841	S	R	R	R	R	S	S	R
404	1670	2269	R	R	R	R	R	R	R	R
405.01	490	546	S	R	R	R	R	R	R	R
407	886	1468	R	R	R	R	R	R	R	R
408	1100	1817	S	S	S	R	S	S	S	S
409	1001	1959	R	R	R	R	R	R	R	R
421	875	943	D	D	D	D	D	D	D	D
423	1312	1223	D	D	D	D	D	D	D	D
424	964	634	S	S	S	S	S	S	S	D
425	904	818	D	D	D	D	D	D	D	D
427	517	738	R	R	S	R	S	R	R	S

* Grouped census tracts; see Appendix B

APPENDIX A (CONTINUED)

CENSUS TRACT NO.	NO. OF DWELLING UNITS BY YEAR		CLASSIFICATION CATEGORIES BY ANALYSIS NUMBERS							
	1960	1970	1	2	3	4	5	6	7	8
*499.30	4938	5451	S	S	R	S	S	S	S	S
*499.31	14047	22223	S	S	S	S	S	S	S	S

* Grouped census tracts; see Appendix B

APPENDIX B

GROUPED CENSUS TRACTS

CENSUS TRACT IDENTIFICATION BY YEAR		ASSIGNED GROUP NO.
1960	1970	
3-B	3.02)	
88	88)	199.01
4-A	4.01)	
87	87)	199.02
6-B	6.02)	
89	89)	199.03
13	13.01)	
	13.02)	199.04
17-A	17.01)	
18	18.01)	199.05
	18.02)	
21	21)	
22-A	22.01)	
22-B	22.02)	199.06
23-B	23.02)	
44	44)	
29-B	29.02)	
29-C	29.03)	199.07
78	78)	
36-A	36.01)	
36-B	36.02)	
37	37.01)	
	37.02)	
38-A	38.01)	199.08
39-A	39.01)	
40-A	40.01)	
41-A	41.01)	
72	72)	
36-C	36.03)	
73	73)	199.09
43	43)	
45	45)	199.10

APPENDIX B (CONTINUED)

CENSUS TRACT IDENTIFICATION BY YEAR		ASSIGNED GROUP NO.
1960	1970	
46	46.01)	
	46.02)	
47	47)	
69	69)	199.10
70	70)	
71	71)	
56	56)	
58	58)	199.11
60	60.01)	
	60.02)	199.12
65	65.01)	
	65.02)	199.13
66	66.01)	
	66.02)	199.14
67	67.01)	
	67.02)	199.15
68	68.01)	
	68.02)	199.16
80	80.01)	
	80.02)	199.17
82	82.01)	
	82.02)	199.18
92	92.01)	
	92.02)	199.19
96	96.01)	
	96.02)	199.20
97	97.01)	
	97.02)	199.21
98	98.01)	
	98.02)	
100	100)	199.22
101	101)	
102	102)	

APPENDIX B (CONTINUED)

CENSUS TRACT IDENTIFICATION BY YEAR		ASSIGNED GROUP NO.
1960	1970	
103	103)	
104	104.01)	199.22
	104.02)	
C-0005	205)	
C-0006	206)	299.23
C-0007	207)	
C-0020	220)	
C-0021	221)	299.24
C-0023	223)	
C-0024	224)	
C-0025	225)	299.25
C-0026	226)	
C-0028	228)	
C-0029	229)	299.26
C-0040	240)	
C-0041	241)	299.27
C-0042	242)	
W-0014	314.01)	
	314.02)	399.28
W-0022	322)	
W-0030	330)	399.29
N-0005B	405.02)	
	405.03)	
N-0006	406)	499.30
N-0014	414)	
N-0015	415)	
N-0010	410.01)	
	410.02)	
N-0011	411.01)	
	411.02)	
N-0012	412)	
N-0013	413)	499.31
N-0016	416)	
N-0017	417)	
N-0018	418)	
N-0019	419)	

APPENDIX B (CONTINUED)

CENSUS TRACT IDENTIFICATION BY YEAR			ASSIGNED GROUP NO.
1960	1970		
N-0020	420	)	
N-0022	422	)	
N-0026	426	)	499.31
N-0028	428	)	
N-0029	429	)	
N-0030	430	)	
N-0031	431	)	