Phase One Report

IMPACT OF RAPID TRANSIT ON SUBURBAN RESIDENTIAL PROPERTY VALUES AND LAND DEVELOPMENT

Analysis of the Philadelphia - Lindenwold High-Speed Line

to

Office of the Secretary
U.S. Department of Transportation
Washington, D.C.

by

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Preface

This study and its companion, Impact of Access Distance and Parking Availability on Suburban Rapid Transit Station Choice, constitute the first two volumes in a series, Analysis of the Philadelphia - Lindenwold High-Speed Line. This Phase One Report contains the findings of the first year of research sponsored by the Office of the Secretary, U.S. Department of Transportation under contract DOT-OS-10043. A Phase Two Report covering the second year research effort is planned for mid-1973.

The opportunity to undertake empirical research in a near-experimental mode on significant public policy problems does not arise often in social science. Such an opportunity was manifest in late 1968 as the Philadelphia - Lindenwold High-Speed Line neared operational status. Yet, it was not until mid-1969 that my colleagues and I began to design specific impact studies and investigate sources of data. Even then, had it not been for the interest and encouragement of J. William Vigrass of the Port Authority Transit Corporation, this unusual opportunity might well have been overlooked. The feasibility of the research, however, turned on the cooperation of the Local Property Tax Bureau, New Jersey Division of Taxation. My colleagues and I are deeply indebted to Robert Johnston, Chief, Sales Ratio Section of the Bureau, for his vital support and encouragement of our proposal. Other individuals also contributed advise, encouragement, and support at this stage: Joseph R. Stowers, then of US DOT; John C. Kohl, New Jersey Commissioner of Transportation; and D. W. Gwynn, also of NJ DOT.

Officials of the Delaware River Port Authority supported the effort as well: Willard Cooper, Fred F. Kravath, and Paul T. Osisek have each helped to facilitate this research. Without the full cooperation and support of

the officials of Lindenwold Borough and Voorhees Township, too many to name here, the case studies would not have been possible. Finally, a special debt of gratitude is owed to Eric Beshers, project manager, and Robert Burns, of the Office of Policy and Plans Development, Office of the Assistant Secretary of Transportation for Policy and International Affairs; their interest, practical advise and patience are very much appreciated.

Within the University, my colleagues have contributed to the success of these studies through an unusually effective weekly seminar during the 1971-72 year. Colin Gannon, through his own High-Speed Line research and his penetrating criticism, contributed much to this seminar. Vukan Vuchic was a valuable source of advice and technical expertise on rapid transit systems. Perhaps most important, however, was the contribution of the regional science students who participated in the seminar. At an earlier date, Ben Stevens encouraged me greatly by helping to draft a preliminary version of the research proposal.

The study itself was a team effort, and the list of authors represents only the principal members. In addition, Chin Yang assisted with processing of the property sales data, and solved several difficult computing problems. Mary Ellison retrieved thousands of "non-useable" sales from records of the Local Property Tax Bureau, keypunched these data and assisted in countless other ways. Richard Zuker was a dependable source of advise on computer problems.

Richard Mudge carried the main responsibility of processing and managing the property sales price data file. He demonstrated his outstanding ability to cope with this immense task many times over, to the relief and gratitude of Paul Slater and myself. Moreover, his analyses of the property sales data reported in Chapter 7 constitutes one of the principal findings of this effort. Paul Slater performed the analyses reported in Chapter 6; his innovative

approach to the analysis of large data bases is also a major contribution of this study. A dependable source of valuable advice and criticism in the [illegible] erty sales analyses was found in Jeffrey Platt. His equally significant analyses of an independent data base will be reported in the Phase Two Report.

The case studies of Chapters 8 and 9 were carried out by Andrew Isserman. They represent a major achivement in themselves, and should not be overlooked by the more analytically oriented reader. My colleague Bruce Allen contributed the savings model presented in Chapter 4, and was a much appreciated advisor, critic and troubleshooter for all of the studies reported here.

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David E. Boyce
Principal Investigator

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CHAPTER 1

SUMMARY AND CONCLUSIONS

Introduction

Conventional economic evaluations of proposed rapid transit systems are usually unable to recommend the transportation investment on the basis of user benefits. Indirect, or nonuser benefits, are then cited as additional justification of the proposal. Such benefits include increased property values, more investment in the areas served by the system, more efficient development patterns, a higher property tax base, and reduction of atmospheric pollution.

It is not the purpose of this study to examine the validity of the evaluation procedures by which such conclusions are reached, although they do have many shortcomings. Rather, the overall objective here is to investigate the indirect impact of one rapid transit line in an attempt to determine whether such benefits actually exist, and if so to determine their magnitude. An unusual opportunity for making such a study was created by the construction of the Philadelphia - Lindenwold High-Speed Line. In several respects the impact of this transportation facility on its environs is as close to an experimental situation as is possible in nonexperimental science.

This report presents the findings of the first phase of this impact study. The focus of this phase is the determination of the Line's impact on residential property values and on land development. The choice of research emphases for this phase turned on the coincidence of unusually good data bases with several of the principal research questions. Two areas of research were initiated. The first is to investigate whether an impact of the Line on residential property values can be identified, and if so to measure its magnitude. Research on this question has consumed the majority of the resources of

Phase One.

The second area concerns the impact of the Line on land development at the rapidly developing fringe of the metropolitan area. This research has focused on (a) the development policies and controls of two adjacent municipalities directly served by the Line, and (b) the impact of this development on municipal and educational expenditures. Case studies are the method of analysis used here, contrasting with the array of statistical methods used in the residential property values studies.

In this chapter, the principal findings of the report are summarized. The emphasis here is on the conclusions of the first phase, most of which must be considered tentative at this juncture. Each of the four analysis chapters includes a conclusion section as well. The section headings of this chapter correspond to the chapters in the report itself. Following are the principal conclusions:

1. The High-Speed Line did have a positive impact on residential property values in its South Jersey market area.
2. This impact appears to agree with the theory that travel cost time savings stemming from use of the Line are being reflected in the prices of residential housing.
3. In addition, to spatial variation, the impact varies with socio-economic group, and is more apparent in lower and middle income areas than in higher income areas.
4. There is little evidence that anticipation of the opening of the Line had an impact on residential sales prices before the Line started to operate.
5. Some evidence was found to support the hypothesis that at least a portion of the impact in the Lindenwold corridor is a transfer of property values from nearby unserved corridors.

The High-Speed Line and Its Environment

An understanding of the statistical analyses and case studies presented here may be facilitated by a brief overview of the High-Speed Line and the environment it serves. The Line itself was built on the concepts of automobile access to stations, modern transit system design and automation. Nearly all users of the Line reach their New Jersey suburban station by automobile. Over 8,200 parking spaces were provided for this purpose, and served nearly 40,000 rides per day in late 1972. The technology of the system, especially its rolling stock, is a refinement of conventional rapid transit design with emphasis on speed and comfort. Automation is achieved by automatic train operation with one operator per train and by fully automated fare collection in unattended stations.

Service is frequent with 7 $\frac{1}{2}$ to 10 minute base and 2 to 3 minute peak period headways. The cars are designed mainly for seated riding with 72 to 80 seats per car or about 460 seats per six car train; cars are air conditioned or heated, as are the suburban stations, depending on climatic conditions.

Operation of the Line between New Jersey and Philadelphia began in February 1969 with about 15,000 rides per day increasing to 32,000 rides per day by 1970. 4,400 original parking spaces at six suburban stations were increased to 8,200 spaces by late 1970.

The Line serves the three county New Jersey portion of the Philadelphia metropolitan area; the majority of its riders, however, reside in Camden County which had a 1970 population of 451,000 in an area of 220 square miles. Nearly all of urbanized Camden County lies within four miles of a station; the density of this urbanized area is only about 3,500 persons per square mile or 5.5 persons per acre. Gloucester County to the south of Camden County serves as a control area in the analyses of property value impact.

The New Jersey counties were the fastest growing part of the metropolitan area between 1960 and 1970; 50 of the 101 jurisdictions in the three county area grew more than 20 percent in that period. This growth mainly occurred between three historical rail corridors, the middle one being the location of the Line itself.

Among the top 25 jurisdictions in population increase were Lindenwold Borough and Voorhees Township which are directly served by the two outlying stations, Lindenwold and Ashland. These jurisdictions are the subject of a major case study in this report. Lindenwold was the location of several large apartment construction projects beginning in 1967. Nearly 1500 apartment units were built in the 1960-70 period, as contrasted with about 300 single family dwellings. In contrast, only about 100 apartments were built in Voorhees in the 1960 decade, as compared with 500 new single family homes; however, about 3,700 apartment units have been completed or are planned since 1970 in a large planned unit development that includes a regional shopping center.

A Savings Model of Property Value Impact

The first problem attacked in this study is the impact of the High-Speed Line on residential property values. This section outlines a model useful for specifying testable hypotheses on the Line's impact on property values. The following three sections describe the data and statistical analysis employed in testing these hypotheses.

The rationale of the savings model is straightforward. Users of the High-Speed Line choose it over automobile or bus commuting because it reduces their total travel cost; the amount saved by using the Line varies according to trip origin, as well as the number of trips made. These travel savings, therefore, can be attributed to household location, the usual origin of weekday journey-to-work trips, or of shopping trips. Since these savings accrue to a person or household residing at that site, its capitalized value may be considered to accrue to the property value. In other words any individual selling such a residential property will seek to extract the capitalized value of these savings from the buyer. From the buyer's point of view, the capitalized savings are an investment with a return, at the prevalent rate of interest, equal to the transportation savings he receives by residing at that location. The model sketched below describes the spatial distribution of these savings.

What are the savings, S, received by a trip maker? They are the cost of commuting by auto less the cost of commuting by the High-Speed Line:

$$S = (aD_0 + P_0) - (aD_A + F_A) \qquad (1\text{-}1)$$

where D_0 and D_A are the distance from any origin location to the central business district and Station A on the Line respectively; a is the access cost per mile including travel time and vehicle operating costs; P_0 is parking cost in the center, and F_A is the fare from Station A to the center and return. Solving the equation (1-1) for D_0 and D_A,

$$D_0 - D_A = \frac{S}{a} + \frac{F_A - P_0}{a} \qquad (1\text{-}2)$$

Equation (1-2) is the mathematical formula for a hyperbola. If S equals zero, and $F_A > P_0$, then this equation describes the market boundary of Station A as a hyperbola bending around Station A. For increasingly positive values of S, a family of hyperbolae are generated with each successive hyperbola bending more tightly around Station A. The maximum value of S is reached as $(D_0 - D_A)$ equals the distance from Station A to the center, D_{0A}. At any point along the extension of a straight line from 0 to A, the maximum savings are received:

$$S_{max} = aD_{0A} + P_0 - F_A \qquad (1\text{-}3)$$

This model of travel savings can be easily extended to several stations and to multiple lines. In general, the spatial pattern of the savings depicted by the model is hyperbolic, that is, fan-like bands of equal savings sweeping out from the Line. This pattern contrasts with typical intuitive patterns of impact as either bands paralleling the Line like venetian blinds, or concentric circles of impact around stations.

Using this model with parameter values for access costs based on related studies, the savings for any location can be calculated. If a hypothetical line is assumed for the purpose of a control, then the station choice model underlying the savings model can identify the boundary between the two corridors. This procedure, then, leads to operational definitions, not only for the savings variable, but also for the impact and control corridors.

To see how the daily travel savings calculated from this model results in a capitalized increment to residential property value, consider the flow of savings accruing over t time periods, say years:

$$V = \sum_{i=1}^{t} \frac{NS_i}{(1 + r)^i} \underset{t\to\infty}{=} \frac{N\overline{S}}{r} \qquad (1\text{-}4)$$

where V is the value increment, N is the number if trips per year, S_i is the savings per round trip in year i, and r is the interest rate. If a mean savings, $\overline{S}$, is substituted for S_i, and t is large, then the capitalized value is simply $N\overline{S}/r$. If N = 250 trips/year, $\overline{S}$ = $1.00/trip and r = 0.10/year, then V = $2,500, which corresponds to 10 to 20 percent of residential property values in suburban South Jersey. In the testing of the savings hypothesis, the variable included in the regression analysis is the daily savings. The regression coefficient therefore corresponds to a capitalization factor.

Real Estate Transactions and Property Characteristics Data

Testing of the savings hypothesis set forth in the above section is only feasible if a large sample of property sales is available. An excellent set of data highly suited for this purpose was made available by the New Jersey Division of Taxation. These data were supplemented by property characteristics data from the Camden and Gloucester County Boards of Taxation. For the studies reported in this volume, the following data were available in machine readable form for each bona fide real estate transaction from fiscal 1965-1971:

1. street address, municipality and county
2. deed recording date
3. tax block and lot number
4. property type at date of sale - residential, apartment, commercial, industrial, or farm
5. assessed value
6. sales price
7. lot size
8. building description - number of stories, building material, and number of garages

The calculation of the savings variable and other location variables depended on determining geographical coordinates for each transaction. This was accomplished by identifying each property's Census block group for which geographical coordinates were available. A correspondence table relating tax blocks and municipalities to Census block groups was constructed for this purpose. This table was keypunched, and used to look up the block group of each property by computer. Altogether about 25,000 transactions were processed in this manner. The use of the Census block group zone system also permitted the use of 1970 Census of Population and Housing data in the statistical analyses.

Detection of Transportation Impacts through the Decomposition of Residential Sales Price Data

Two sets of statistical analyses were performed on the above data base.

The first, described in this section, seeks to understand the spatial and temporal trends in sales prices in the impact area of the Line. This analysis is restricted to sales in Camden County during the 1965-1971 period. The basic model estimated by a two-way unbalanced analysis of variance procedure is:

$$p_{ij} = cb_i y_j \tag{1-5}$$

where p_{ij} = mean residential sales price in block group i and year j

c = constant scale factor

b_i = time-stable parameters showing differences in sales prices among block groups

y_j = space-stable parameters showing differences in sales prices over time.

This model is estimated by converting it from a multiplicative form to additive logarithmic form:

$$\ln p_{ij} = \ln c + \ln b_i + \ln y_j \tag{1-6}$$

or, in analysis of variance terms,

$$z_{ij} = \mu + \beta_i + \gamma_j + \varepsilon_{ij} \tag{1-7}$$

where the ε_{ij}'s are assumed to be independent, normal deviates with equal variances.

The analysis of variance rejected the hypotheses that the β's were equal across all block groups and the γ's were constant across years, as expected. The hypothesis of no interaction between block groups and years was also rejected, although the F-ratio was not large. This interaction means property values in some block groups are increasing faster with time than in other block groups; therefore this is a way to test for the existence of an impact of the Line.

The values estimated for the year parameter, y_j, provide an interesting index of inflation in housing prices in the area:

year	estimate of y_j	scaled consumer price index
1965	0.905	0.905
1966	0.913	0.926
1967	0.955	0.947
1968	0.991	0.967
1969	1.067	1.034
1970	1.186	1.155

Here, the government consumer price index for housing in the Philadelphia area is scaled so as to equal the estimate of y_{1965}. The correspondence between the two arrays is quite striking.

Estimates of the b_i's ranged from 0.33 to 2.17. Based on a sample mean price of $15,297, these block group parameters indicate that mean block group prices ranged from 33 percent to 217 percent of the sample mean.

The significant interaction term, which may be related to impact of the Line, was analyzed further by the method of singular decomposition. This procedure modifies equation (1-6) as follows:

$$z_{ij} = \mu + \beta_i + \gamma_j + n_{ij}^{-\frac{1}{2}} (\Theta_1 u_{1i} v_{1j}) \qquad (1\text{-}7)$$

where n_{ij} is the number of sales in the ith block group and jth fiscal year. Θ_1 is a constant term, u_{1i} is a term associated with block groups, and v_{1j} is associated with years.

The first term of the singular decomposition of the matrix of residuals accounted for about 30 percent of the entire interaction term, a statistically significant amount. The u_{1i} terms permit the identification of block groups with rapidly rising or declining values. The block group identified by this analysis as most rapidly rising in value is located just north of Ashland Station. Several additional block groups with relatively large increasing values are located near this station. A large concentration of rising values was also found in Cherry Hill Township, a large suburban area that experienced very rapid development during the 1960's. The area south of the Lindenwold terminus also appears to be gaining in value. A group of block groups with the least increase in value are located in areas adjacent to the City of Camden.

Thus the principal contrast reflected by the decomposition analysis is between older, more established areas in the inner suburbs and newer developing areas on the fringe of urbanization. This more general interpretation of the results does not necessarily conflict with the impact hypothesis since the impact expected from the savings model is largest in the outlying suburban areas.

Several additional analyses were performed on this data set which was augmented to include 1971 sales. Editing procedures were applied in an effort to test for the effect of extreme outliers on the results. The original findings were largely confirmed by these analyses. The variable, number of stories, was added to the model in an effort to explain more of the variation; this variable was statistically significant, but did not contribute substantially to the explanatory power of the model. In general, however, these tests further confirmed the rapid increase in housing value in the area beyond the terminus of the Line, the area in which maximum savings are hypothesized to occur. Further analysis of these data augmented by the Gloucester County control corridor sales should provide additional results from this rather appealing statistical approach.

Statistical Analyses of Transportation Impact on Residential Sales Prices

The second set of analyses of residential sales prices sought to test the savings hypothesis more directly, in part building on the empirically-oriented approach of the above section. Several statistical techniques were applied:

profile analysis, analysis of variance and regression analysis with dummy variables. The most interesting and significant results were obtained using regression analysis, and these will be summarized here. However, it is noted that simple profiles of residential price means by housing type, year and corridor did graphically show the hypothesized divergence in prices for the two corridors beginning in 1968-69. These results, which showed the impact corridor sales prices rising more rapidly than the control corridor for some housing types, were tested statistically by means of regression analysis.

The regression model formulated to test the savings hypothesis included the following types of variables:

1. lot size
2. building description - number of stories, building material and number of garages
3. land use in 1971
4. year of sale
5. neighborhood type
6. distance from the center of Philadelphia
7. travel savings in the impact and control corridors after the opening of the Line.

Lot size, distance from the center, and travel savings were ordinary continuous variables. All other variables were (0,1) dummy variables. These variables provide an estimate of the price differential, plus or minus, caused by the presence of the associated characteristic.

Several analyses were made with different subsamples, variable forms and related variations. For the purposes here, only the main findings are summarized. Lot size was statistically significant, as expected. Generally, a logarithmic form was used, and in some cases it was multiplied by a dummy variable such as neighborhood type.

The principal building description variables were also generally significant. Brick houses were shown to have a premium price compared with frame houses. Two-story houses were also more expensive than other types.

The land use variable refers to the land use at the end of the period of observation, and helps account for higher prices because of changing land use. Since all observations in the sample were residential properties at the date of sale, only a small proportion had changed use by 1971. In some analyses, these observations were simply omitted. Where included, the dummy variables for industrial, commercial and apartment uses in 1971 were all significant with large positive coefficients.

The year variable is a dummy variable accounting for inflation over the entire study area. A pattern similar to that found in the above section was noted, although in this case an additive rather than multiplicative form was assumed. The total amount added to housing values over the six year period was estimated at $5,000 to $8,000.

Neighborhood type is a composite variable defined on Census variables such as number of rooms, educational level, occupation, and type of unit (single person, multiple family, roomers, etc.). The types were defined by means of an AID analysis with 1970 Census housing value as the dependent variable. Neighborhood type attempts to control for variations in housing and neighborhood for which detailed data were not available. The AID analysis classified Census block groups into eleven neighborhood types. Each observation was assigned the neighborhood type of block group in which it was located. In general, the dummy variables for neighborhood type were all significant with coefficients of the expected size and sign.

Distance from the center of Philadelphia is a location variable which represents the decreasing value of land outwards from the center. This variable was also significant with the expected negative sign. The savings variables for the impact and control corridor were included only for sales after the Line began operations. As a general rule, either the impact corridor or the control corridor variable was significant, but not both. This result depicts a differential in property values between the two corridors in proportion to travel savings. The size of the coefficients varied considerably among the several analyses.

In all of the analyses, about one-half of the total variance in sales prices was accounted for by the above variables. This amount of explanation is fairly satisfactory considering that no detailed housing characteristics were available. For example, in a related analysis with FHA mortgage data, about one-half the variance in sales price was accounted for by floor area of the dwelling alone.

This brief summary of statistical findings is only indicative of the results which form the basis for the conclusions. Moreover, the conclusions should be considered tentative and subject to further analysis.

Case Studies of Land Development Policies of Municipalities Adjacent to Outlying Stations

This section and its sequel represent an altogether different approach to studying the impact of the High-Speed Line, in contrast with the above four sections which have considered the question of the Line's impact on property values. These two sections concern the Line's impact on land development and the impact of that development on municipal and educational finance. In other words, did development take place because of the Line, and did this growth produce a net surplus in revenues for the jurisdiction involved?

These questions are examined through case studies of the two municipalities and school districts most susceptible to the impact of the Line, Lindenwold Borough and Voorhees Township. Both have undergone extensive development during the period that the Line was constructed and its initial years of operation. Both are served by stations within their boundaries. Therefore, if a land development impact occurred, other things being equal, it would almost certainly have occurred in one or both of these municipalities.

The case studies summarized here cannot hope to answer the above questions in absolute terms. They can only document what did take place and the reasons for what occurred. The conclusions reached from these exercises therefore must be considered tentative and subject to further investigation.

Lindenwold Borough and Voorhees Township both experienced population increases in excess of 60 percent from 1960 to 1970. Lindenwold's 1970 population was about 12,000 in an area of 4 square miles, whereas Voorhees had a population of about 6,000 in 12 square miles. Lindenwold's housing stock nearly doubled in the 1960's with over 80 percent of the new units in apartments. Voorhees stock increased by 60 percent with over 80 percent of the new units in single family homes. Since the 1970 Census, Lindenwold's stock of apartments has continued to expand rapidly, continuing the trend of the late 1960's. Voorhees' single family stock has also continued to expand, but a major shift from the 1960's trend occurred with the construction by a single developer of a regional shopping center in conjunction with 3,700 apartments and town houses to be completed by the middle of the 1970 decade.

Why have these two municipalities developed so differently? The detailed documentation presented in Chapter 8 takes the position that different local government policies are the cause. Based on interviews with local officials, the case study assumed that apartment developers were just as eager to build in Voorhees as in Lindenwold, or as in other nearby municipalities such as Cherry Hill, Gloucester Township and Maple Shade. Moreover, the case study takes the view that the availability of land and zoning regulations were such important determinants of apartment location, that the presence or absence of the High-Speed Line had little effect. Whether demand for apartments would have been less without the Line, and therefore fewer constructed, is very difficult to determine from a case study. However, the ubiquity of new apartment units throughout the three county South Jersey area suggests that the Line may not have been an important factor.

Briefly, then, what policies did Lindenwold pursue with respect to apartments? Lindenwold's first zoning ordinance enacted in 1964 only provided for apartments through variances to the ordinace. Nevertheless, several apartment projects were approved. In 1965, apartment districts as such were created with fairly severe requirements on developers to provide the public improvements and services associated with these uses. A substantial number of apartment proposals were approved under this ordinance, but each one was a matter of negotiation between the Borough and the developer, with the Borough demanding and receiving more concessions with nearly every plan approved.

Further revisions were enacted in 1969, in part codifying the concessions from apartment developers established on an ad hoc basis prior to that point. These revisions also recognized that higher income single family housing and industrial development were not coming to Lindenwold, and land zoned for these purposes was rezoned for apartment uses. Thus apartment developments came to Lindenwold, but on the Borough's terms. Evidently, developers found these projects profitable, as they continued to come to the Borough with development requests.

The approach followed by Voorhees Township contrasts sharply with that of Lindenwold. The first zoning ordinance enacted in 1958 zoned most undeveloped land as rural residential zone. When a development proposal was accepted by the Township Committee, then the parcel was rezoned accordingly. Only one apartment project comparable to the projects in Lindenwold was accepted to date. Development did come to Voorhees, however, in the form of a very large regional shopping center, Echelon Mall, integrated with an apartment and town house development planned to reach 3,700 units upon completion. This development by the Rouse Company emphasizes a quality housing and living environment. While not nearly as large as other Rouse projects such as Columbia, Maryland, many of the same concepts and approaches may be found in Echelon.

Voorhees Township, which had no central focus prior to Echelon has succeeded in achieving a high quality community center. The choice of the Echelon site by the Rouse Company was almost certainly dependent on the availability of a large plot of land which was formerly a general aviation airport, and the absence of any nearby regional center. The High-Speed Line, while certainly a plus factor in the Echelon planning, was by no means a prime determinant.

This conclusion of the role of the Line in the Echelon development would appear to apply to Lindenwold as well. Although the Line helped draw developers' and renters' attention to Lindenwold, the availability of land in a municipality with growth-oriented elected officials appears to be the primary determinant. The construction of the Line coincided in time with arrival of the fringe of new development to Lindenwold and Voorhees. In this respect it is interesting to consider what might have happended had the Line been built initially eight miles beyond to Berlin as is now proposed. In that case, some of Lindenwold's growth might have been diffused to Berlin if local officials there were also eager to have it. This key question of why local officials seek growth is now considered.

Impact of Growth on Public Finance

Given that development, and apartment projects in particular, did occur in both Lindenwold and Voorhees, what has been the impact on costs and revenues of local governments and school districts? This section summarizes results of two types of studies conducted on this question. First, analysis sought to separate the cost of growth from the cost of quality improvements that occurred during the same time period. Only with education is this possible, and then in a crude fashion. Second, the impact of apartments relative to single family homes is examined.

As discussed in the above section, both Lindenwold and Voorhees have experienced rapid growth in population and housing. Expenditures for local government and schools have also risen rapidly, both in absolute terms and on a per capita basis. Total municipal expenditures on a per capita basis more than doubled in both Lindenwold and Voorhees from 1960 to 1970. Per capita expenditures for local schools increased more than 50 percent during the same period. Increases in expenditures for local government and schools outpaced increases in assessed valuation in Lindenwold despite the large amount of development that occurred. In Voorhees, however, school expenditures have not increased as rapidly as assessed valuation and local government expenditures have increased only slightly faster.

In analyzing local school expenditures, the student-teacher ratio was adopted as a crude quality index. Using this index, it is shown that about one-half of the increase from 1965 to 1971 in the ratio of expenditures to assessed valuation in Lindenwold was because of quality increases, i.e. a reduction of the student-teacher ratio. Also during this period, mean teacher salaries increased by more than 50 percent, some of which may actually reflect increases in the quality of teachers attracted to the system.

Revenue from all apartments in Lindenwold was compared with the average costs imposed by apartment students on the school system. Total average cost of apartment children in 1971 was less than one-third of the school taxes generated by apartments. The marginal costs of these apartment children on the system were probably far less than average costs.

Using the state education aid formulas and the average school costs for Lindenwold, the break-even assessed valuation per student was computed to be $40,000 for 1969. In that year, apartments had an assessed valuation in excess of $66,000 per student. In contrast single family homes had an assessed valuation of less than $24,000 per student.

Similar results were obtained for Voorhees Township. There the 1969 break-even assessed valuation for one student was nearly $59,000. The assessed valuation of single family homes per student was less than $16,000. As the 116 apartment units in Voorhees did not have any school children in 1969, no comparable figure could be calculated. Thus, in both Lindenwold and Voorhees, apartments contribute a surplus on a revenue less average cost basis. These conclusions are largely based on analysis of the 1969-1971 period, before many of the apartment projects were completed. Continuing studies are needed to determine the effects of large scale apartment development on education in both municipalities.

The impact of growth on local government expenditure is much more difficult to analyze because no quality index comparable to the student-teacher ratio is available. Although population-employee ratios might be used for this purpose, reliable population data are only available every ten years from the Census. Therefore, simpler methods for allocating costs on a dwelling unit or assessed valuation basis are often used. However, as is shown in

Chapter 9, these methods often lead to nonsense results. For these reasons, the analysis of increased expenditures for local governments was approached largely on the basis of interviews with local officials concerning the reasons for these increases.

One major area of increased costs in both Lindenwold and Voorhees was police and court costs. The conversion of these areas from rural to suburban did produce large cost increases for these functions. Moreover, the High-Speed Line itself has imposed a substantial police cost on Lindenwold; the Echelon Mall has had a somewhat similar impact on Voorhees Township police costs. In part, these expenses are recovered through court costs and fines. Little evidence was found that apartments result in higher police and court costs than single family homes.

In the case of streets and roads, garbage collection, sewer and water service, the entire capital cost and most of the operating costs are charged directly to apartment developments in both Lindenwold and Voorhees. Single family homes to the contrary are provided with garbage collection and street repair. Thus, as in the case of school expenditures, apartments appear to subsidize single family units.

In conclusion, based on the case studies of Lindenwold and Voorhees, apartments and growth in general appears to have had a positive effect on the fiscal condition of both school districts and government. Quality of education and municipal services has improved despite inflation. These improvements could not have been undertaken without the increased tax revenues generated by development. On the negative side, the surplus generated by apartment development is not so large as to reduce the need for more balanced development. Voorhees Township with its regional shopping center followed by substantial office development appears to be much better able to afford continuing residential expansion than does Lindenwold. Thus, apartments alone do not appear to create an adequate tax base for subsidizing single family development.

Proposed Phase Two Research Program

The Phase One research has explored two related problems:

1. impact of the High-Speed Line on residential property values;
2. impact of the Line on municipal land development policy, and the effect of development on municipal finance.

These studies have identified a significant impact of the Line on residential property value. The amount and extent of the impact appears to be consistent with the capitalized value of actual or potential savings accruing to users.

The case studies of municipal land development policy suggest the Line was one of several factors resulting in large scale apartment development. The decisive factors in this process, however, were vacant land availability and the policies of Lindenwold and Voorhees toward development. The fiscal impact studies demonstrate that apartments are an excellent tax rateable in the sense of producing a net revenue surplus.

The research proposed for Phase Two complements and extends these findings in the following areas:

1. impact of the Line on vacant land value, in particular residential building lots;
2. analysis of trends in municipal finance to provide a larger context for the above case studies;
3. analysis of 1970 Census data on place of work, choice of mode, age of housing, and intraurban migration;
4. extensions of the spatial-temporal analysis to include Gloucester County sales, fiscal 1972 sales, and sales classified as non-useable because of reassessment;
5. documentation of an analysis of Federal Housing Administration Mortgage Appraisal Files for Camden County.

CHAPTER 2

INTRODUCTION

Statement of the Problem

Proposals for the construction of rapid transit systems increasingly cite indirect benefits as justification for the transportation investment for two reasons. First, public transportation systems are unable to produce a positive return on investment, in part because of the pricing of competing modes. This complex question cannot be adequately discussed here; in any case, justification of the investment must be based on more than user benefits.

Second, indirect, or nonuser, benefits of rapid transit systems are claimed and often do appear to be plausible; see, for example, Anderson (1970) on the Bay Area Rapid Transit System, and Shaw (1969). These benefits include (a) increased land values, and therefore a larger real estate tax base, (b) expansion of the central business district at a higher density of development; (c) higher density of residential development, which is often considered to be more efficient in terms of municipal services and transportation, and (d) reduction of atmospheric pollution.

Although these indirect benefits are often used to justify rapid transit investment, few attempts have been made to document and analyze the benefits actually realized by recent transit investments. Some studies of the impact of the Toronto and Montreal systems were conducted; also see Spengler (1930) and Davis (1965) for analyses of earlier transit impacts. There are many reasons for the lack of such studies, but perhaps the main reason is that not many transit lines have been built in the past 20 years. Moreover, in some cases such as Chicago, the lines which were built were extensions or replacements of existing lines making their evaluation difficult.

An unusual opportunity for determining the indirect benefits of a rapid transit line was created by the construction of the Philadelphia - Lindenwold High-Speed Line. In particular, the land value and land development impact of the facility seemed suitable for study since the residential area served is separated from the remainder of the metropolitan area by the Delaware River. In this and other respects, the impact of the Line is as nearly controlled from external circumstances as may be possible in a nonexperimental situation.

The long-range purpose of this study is to investigate the indirect impact of the High-Speed Line, that is, the impact not directly related to the use of the Line. The ultimate reason for making such a study is to improve public transportation in general. The existence of indirect benefits from the Line is not necessarily a foregone conclusion. Therefore, the first research priority is to establish whether significant impacts exist and to measure their magnitude.

Although the problem has been defined in terms of indirect of nonuser impacts, this distinction is partly one of convenience. Ultimately, all impacts must be considered to be a result of the Line. Indeed, the simple impact model proposed seeks to show how users' savings may lead to higher residential property values. In applying findings of this type, one must be careful to distinguish between direct user benefits and capitalization of these benefits as increased property values. However, these issues of application and interpretation remain in the future. The immediate concern is to determine whether indirect impacts exist.

Objectives and Scope of the Phase One Report

This report presents the findings of the first phase of a three phase study on the impact of the Lindenwold High-Speed Line on property value and land development. The results presented here are the product of about 12 months of intensive investigation by the authors. Before outlining the sections of the report, it is useful to review briefly the objectives and scope of the first phase, and the orientation of the researchers toward this phase of the study.

As stated above, the overall purpose of the study is to investigate the indirect or nonuser impact of the High-Speed Line. To conduct such a study in a comprehensive manner would clearly be an enormous undertaking, even for a relatively simple transit system which is the case here. Moreover, it is not clear than an attempt to account for all the Line's impacts is as productive as concentrating on fewer, but hopefully more significant research problems. In any event, this has been the approach taken to date, and no effort has been expended on developing a system for an overall accounting of the Line's indirect impacts.

In designing the research for the first phase, certain problems were selected for intensive study. Generally, these may be characterized as areas where the availability of unusually good data coincided with the principal research questions. These studies may be regarded as an exploratory probe into a rich set of data on property sales prices, together with case studies of municipal development policies and their impact on municipal and educational finances. The objective of this first phase, then, is to determine whether a significant impact on residential property value and land development has resulted from the High-Speed Line, as the first step in determining the magnitude, distribution and extent of the impact.

Organization of the Report

The report is organized in ten chapters. The tentative conclusions of phase one and a summary of the findings make up Chapter 1. Chapter 3 provides a brief orientation to the High-Speed Line and the area it serves. Chapter 4 presents a simple model of station choice and market area impact, providing the basis for the empirical studies that follow. Chapter 5 briefly describes the data available for the statistical studies on land value reported in Chapters 6 and 7.

Chapter 6 reports on an empirically-oriented analysis of the spatial-temporal trends in residential property sales prices in Camden County. Chapter 7 describes the results of statistical tests concerning the existence of increases in residential property values in the market area of the Line as compared with other control market areas.

Chapters 8 and 9 adopt a case study mode of analysis in contrast to the statistical approach of Chapters 6 and 7. In Chapter 8, the course of development in two outlying municipalities served by the Line is examined from the viewpoint of the policies and controls exercised by these jurisdictions in the face of heavy pressure for development. Chapter 9 considers the impact of the development that occurred on municipal and educational finance.

Chapter 10 outlines the research proposed for Phase Two of the study.

CHAPTER 3

THE HIGH-SPEED LINE AND ITS ENVIRONMENT

Introduction

In order to understand the models, statistical analysis and case studies presented in this report, a limited appreciation of the urban environment served by the High-Speed Line is useful. This chapter is intended to orient the reader to the geographical pattern of growth in the New Jersey portion of the Philadelphia metropolitan area, i.e., in Burlington, Camden and Gloucester Counties. In as much as the time period of interest in this research mainly concerns 1964 to date, the 1960 Census is used as a bench mark for most purposes, and the 1960-1970 growth is compared and contrasted. The chapter begins with a brief description of the High-Speed Line itself.

Physical and Operating Characteristics of the High-Speed Line

The Philadelphia-Lindenwold High-Speed Line basically consists of a high performance rail transit vehicle operating on a high-speed two rail roadbed on grade-separated right-of-way. The transit vehicle itself is a direct descendent of the Broad Street Subway vehicle (Philadelphia), the BMT Line in New York and the Cambridge-Dorchester Line in Boston. The vehicle has a normal running speed of 75 mph; acceleration is 3 mph per second.

Within the car, seating is arranged in a four-seat-across transverse position with 72 or 80 seats per car depending on whether the car has an operating console at one end or both ends. The cars, as well as the stations, are fully air conditioned, or heated, depending on climatic conditions. Train operation is essentially fully automated with one attendant per train for the purpose of operating the doors and initiating the automated cycle for departing from each station; manual operation is also available as needed.

Collection of fares is an automated operation with no attendant in any station. Single-ride tickets incorporating a graduated fare structure are sold from vending machines, as are transfers to the Philadelphia transit system. Ten-ride tickets are sold by the newsstand concessionaire in each station. Tickets are collected by automated turnstiles.

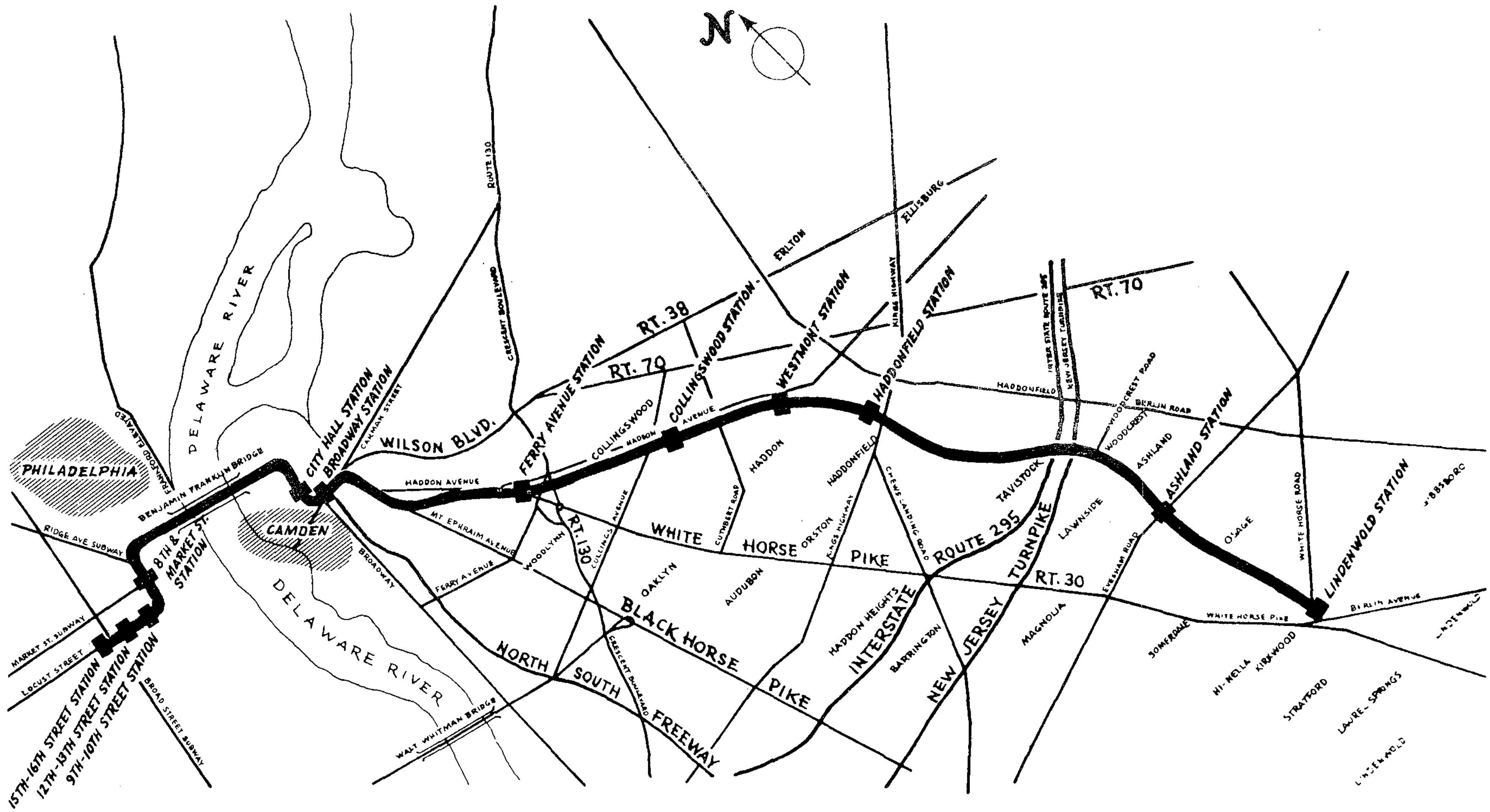
The High-Speed Line serves a suburban corridor in South Jersey, with six stations spanning 8.5 miles; in addition, the central area of Camden is served by two stations and the central business district of Philadelphia by four stations. The Camden and Philadelphia portions of the High-Speed Line use the modernized facilities of the old Camden-Philadelphia Bridge Line and Locust Street Subway, including the rail facility over the Benjamin Franklin Bridge spanning the Delaware River. Operation speeds on these portions of the Line are limited to 40 mph and in some sections do not exceed 15-20 mph. The location of the stations and the Line with respect to Philadelphia, Camden and suburban New Jersey are shown on Map 3-1.

Initially, over 4400 parking spaces were provided at the six suburban stations in New Jersey, station access being predominately by auto. The parking facilities were expanded to nearly 5900 spaces during 1969, the first year of operation, in order to meet demand at selected stations. A second stage expansion to over 8200 spaces was undertaken in the summer of 1970. Of the 8200 spaces available in March 1971, about 4400 were in free parking lots, and about 3800 were pay parking lots or meter parking, both at 25¢ per day.

The Line operates a peak period service of 10 to 12 six car trains per hour (5 to 6 minute headway) according to a published schedule; some distortions from this headway interval occur because of express trains. In 1970, a two car base service with a regular ten minute headway was operated at other

Map 3-1

Philadelphia - Lindenwold High-Speed Line



times of the day between 6 a.m. and midnight. Hourly one car service was operated from midnight to 5 a.m. with some additional trains in the 12-2 a.m. and 5-6 a.m. intervals.

Weekend service was very similar to weekday service except during peak periods. Ten minute headways were operated from 6 a.m. to midnight on Saturday and 15 minute headways were operated from 6 a.m. to midnight on Sundays. Hourly service was operated from midnight to 6 a.m. on both days. During 1971 and 1972, the base service frequency was improved to 7½ minute headways during most of the weekday.

Patronage of the Line has increased from an initial level of about 15,000 rides per day in February 1969 to 32,000 rides per day in April 1970. By November 1970 following the parking lot expansion, patronage has increased to nearly 34,000 rides per day; patronage continued at the 34,000 rides per day level in early 1971, and increased to 37,000 rides per day by the end of 1971. During the Transport of New Jersey bus strike in March and April 1972, daily ridership exceeded 50,000. Following the strike settlement, ridership has been maintained at the 40,000 level.

Urban Environment of the High-Speed Line

Broadly defined, the area served by the Line includes the three New Jersey counties in the Philadelphia metropolitan area. During the 1960 decade, these New Jersey counties increased in population by 26.4 percent. As shown in Table 3-1, the three county area accounted for 42 percent of the areawide growth in population from 1960 to 1970. The proportion of the SMSA growth in New Jersey continued to expand during the 1960's, whereas the Pennsylvania suburbs encountered a relative decline and the absolute decline of the Philadelphia continued. Nearly all of the New Jersey growth is suburban, as the

Table 3-1

Historical Growth Trends of New Jersey Counties of Philadelphia Metropolitan Area

Area	Census Population (1,000's) 1940	1950	1960	1970	Proportion of Areawide Growth 1940-50	1950-60	1960-70
Pennsylvania Counties	2775	3143	3592	3866	0.78	0.67	0.58
Philadelphia	1931	2072	2003	1949	0.30	-0.10	-0.11
Suburban*	844	1071	1589	1917	0.48	0.77	0.69
New Jersey Counties	425	528	751	952	0.22	0.33	0.42
Burlington	97	136	224	323	0.08	0.13	0.21
Camden	256	301	392	456	0.10	0.14	0.13
Gloucester	72	92	135	173	0.04	0.06	0.08
Metropolitan Area	3200	3671	4343	4818			

* Pennsylvania Counties excluding Philadelphia: Delaware, Chester, Montgomery, and Bucks.

City of Camden also had an absolute decline in population during the decade.

As can be seen in Table 3-1, the population growth was widely distributed among the three counties. In order to gain some perspective on the location of this development, it is useful to examine the 101 cities, boroughs and townships in the area, ranked in order of total population increase and relative increase, 1960 to 1970. This information is given in Table 3-2 for the first 25 jurisdictions. Of all 101 jurisdictions, 50 increased more than 20 percent, 32 increased between 0 and 20 percent, and 19 lost population. The jurisdictions losing population included the City of Camden, several small municipalities adjacent to it, and several rural townships. Also, it should be noted that two rural townships with large population increases, North Hanover and Pemberton, are adjacent to a military base.

The pattern of growth generally borders the elongated cluster of municipalities directly served by the High-Speed Line from Camden to Lindenwold. The corridor was largely developed prior to 1960 out to Haddonfield and Haddon Heights. Growth during the 1960 decade extended this development to Stratford, Lindenwold, Laurel Springs and Berlin, and added growth in Cherry Hill and Gloucester Townships on either side of the historical growth corridor. Thus, Stratford and Lindenwold at the terminus of the Line were on the edge of suburban development during the 1960 decade. Of particular interest, then, is a comparison of the type of housing built in this area, to be served by the High-Speed Line, with other parts of the three county area.

Perhaps the most significant change in suburban housing construction throughout the U.S. in the 1960 decade was the increase in multiple family type construction. In Camden County, over two-thirds of all new units were multiple family; see Table 3-3 summarizing the main growth trends in housing stock.

Table 3-2

Rank of First 25 New Jersey Municipalities on Absolute and Relative Population Increase, 1960-70

Municipal Name (Co.) (in order of 1960-70 increase)	area, square miles	1970 population	1960-70 increase	percent increase 1960-70	rank order of relative increase
1. Cherry Hill Twp-C	24.51	64395	32873	104	12
2. Willingboro Twp-B	7.86	43414	31553	266	1
3. Washington Twp-G	22.29	15741	10818	220	3
4. Evesham Twp-B	29.65	13477	8928	196	4
5. Gloucester Twp-C	23.48	26511	8920	51	24
6. Cinnaminson Twp-B	7.39	16992	8660	104	13
7. N. Hanover Twp-B	17.31	9858	7062	253	2
8. Deptford Twp-G	17.36	24232	6354	36	31
9. Pemberton Twp-B	64.51	19754	6028	44	26
10. Mt. Laural Twp-B	22.05	11221	5972	114	9
11. Stratford Boro-C	1.47	9801	5493	128	8
12. Lindenwold Boro-C	3.89	12199	4864	66	20
13. Delran Twp-B	6.85	10040	4713	89	14
14. Monroe Twp-G	46.50	14071	4675	50	25
15. Edgewater Park Twp-B	2.86	7412	4546	159	5
16. Burlington Twp-B	14.02	10612	4321	69	18
17. Bellmawr Boro-C	3.02	15618	3765	32	33
18. Maple Shade Twp-B	3.72	16464	3517	27	37
19. Franklin Twp-G	54.13	8990	3461	21	48
20. Medford Twp-B	40.32	8292	3448	71	15
21. Moorestown Twp-B	15.18	15577	3080	25	41
22. W. Deptford Twp-G	15.92	13928	2776	25	45
23. Glassboro Boro-G	9.23	12938	2685	26	40
24. Pennsauken Twp-C	10.21	36394	2623	8	50
25. Voorhees Twp-C	11.91	6214	2430	64	21

Code: B - Burlington
C - Camden
G - Gloucester

Table 3-3

Increases in Housing Stock, 1960-1970, in N.J. Counties

Housing type	Burlington	Camden	Gloucester	New Jersey Counties
Single family				
units in 1970	68,841	109,494	42,052	220,387
increase, 1960-70	15,413	6,638	5,169	26,220
percent increase, 1960-70	28	6	11	14
Multiple family				
units in 1970	17,517	32,842	7,892	58,251
increase, 1960-70	10,831	16,511	3,812	31,154
percent increase, 1960-70	161	100	91	115
All housing				
units in 1970	86,358	142,236	49,944	278,638
increase, 1960-70	26,244	23,149	7,981	57,374
percent increase, 1960-70	44	19	19	26

In order to gain a perspective on the location of this growth, rank order lists comparable to Table 3-2 for population are presented. Tables 3-4 and 3-5 give the rank order of the top 25 jurisdictions in single family and multiple family units in absolute and relative terms.

The two groups of 25 municipalities in Tables 3-4 and 3-5 present an interesting contrast. Thirteen jurisdictions appear on both lists, with Cherry Hill Township leading this common group in absolute increases in both single and multiple family units. The twelve additional municipalities on single family units list are nearly all on the urbanizing fringe; six are in Burlington County, which led the three county area in single family unit increases during the decade.

The twelve additional municipalities on the multiple family units list may be characterized as older, more densely developed areas. These include the City of Camden which led all jurisdictions in this category. In general, the High-Speed Line corridor tends to be closely aligned with the distribution of multiple family units, whereas it is nearly totally excluded from the distribution of single family units, except for the outlying suburbs.

This pattern of the location of single vs. multiple family units is quite logical. Single family units require less land, and are able to support a higher unit land price. Thus, multiple family units are found in previously developed areas, either as redevelopment, or as initial development of land held off the market in earlier time periods. The general trend toward apartment living also has resulted in multiple family unit construction on the urban fringe at a scale never experienced before.

It is extremely difficult to conclude that a cause and effect relationship existed between the High-Speed Line and apartment construction in the area served by the Line. Nevertheless, apartment construction trends during

Table 3-4

Rank of Top 25 New Jersey Municipalities on Absolute and Relative Single Family Housing Units Increase, 1960-70

Municipal Name (Co.) (in order of 1960-70 increase)	no. of units 1970	increase 1960-70	percent increase 1960-70	rank order of relative increase among top 25
1. Willingboro Twp-B	10375	7133	220	1
2. Cherry Hill Twp-C	14955	6734	82	6
3. Washington Twp-G	3712	2131	135	2
4. Cinnaminson Twp-B	4133	1817	79	7
5. Gloucester Twp-C	6211	1711	38	16
6. Evesham Twp-B	2916	1589	120	3
7. Mt. Laurel Twp-B	2817	1330	89	5
8. Bellmawr Boro-C	3493	987	39	15
9. Stratford Boro-C	2044	865	73	8
10. Medford Twp-B	2267	812	56	10
11. Deptford Twp-G	5728	798	16	22
12. Moorestown Twp-B	3957	639	19	20
13. Delran Twp-B	2062	607	42	14
14. Edgewater Park Twp-B	1455	600	70	9
15. Monroe Twp-G	3632	587	19	21
16. Burlington Twp-B	2303	517	29	18
17. Winslow Twp-C	2552	511	25	19
18. Voorhees Twp-C	1564	500	47	12
19. Woodbury Hgts. Boro-G	931	451	94	4
20. Berlin Twp-C	1275	445	54	11
21. Pemberton Twp-B	4431	409	10	25
22. Medford Lakes Boro-B	1287	408	46	13
23. Maple Shade Twp-B	3948	382	11	24
24. Greenwich Twp-G	1410	343	32	17
25. Lindenwold Boro-C	2383	319	15	23

Code: B - Burlington
C - Camden
G - Gloucester

Table 3-5

Rank of Top 25 New Jersey Municipalities on
Absolute and Relative Multiple Family Housing Units Increase, 1960-70

Municipal Name (Co.) (in order of 1960-70 increase)	no. of units 1970	increase 1960-70	percent increase 1960-70	rank order of relative increase among top 25
1. Camden City-C	8021	3207	67	24
2. Cherry Hill Twp-C	3015	1959	186	17
3. Lindenwold Boro-C	1517	1486	4794	2
4. Maple Shade Twp-B	1527	1395	1058	11
5. Pennsauken Twp-C	2315	1209	109	21
6. No. Hanover Twp-B	1233	1160	1590	6
7. Delran Twp-B	1087	1053	3097	4
8. Collingswood Boro-C	3220	960	42	25
9. Evesham Twp-B	976	952	3967	3
10. Gloucester Twp-C	1098	876	395	14
11. Haddon Twp-C	1869	838	114	19
12. Runnemede Boro-C	867	814	1536	7
13. Burlington Twp-B	877	809	1190	8
14. Edgewater Park Twp-B	877	736	1081	10
15. Glassboro Boro-G	934	734	367	15
16. Stratford Boro-C	732	703	2424	5
17. Pemberton Twp-B	1312	690	111	20
18. Bordentown Twp-B	713	653	1089	9
19. New Hanover Twp-B	786	605	334	16
20. Deptford Twp-G	699	573	455	12
21. Washington Twp-G	533	524	5822	1
22. Audubon Boro-C	892	504	130	18
23. Monroe Twp-G	589	473	408	13
24. Burlington Boro-B	967	469	94	22
25. Barrington Boro-C	863	416	93	23

Code: B - Burlington
C - Camden
G - Gloucester

the 1960's clearly increased the Line's potential market, and in some cases such as Lindenwold Borough were closely related to the Line, as documented in more detail in Chapter 8.

CHAPTER 4

A SAVINGS MODEL OF PROPERTY VALUE IMPACT

Introduction

Ideally, in analyzing the impact of an urban transportation improvement on land values and land use, one would like to formulate specific questions for quantitative estimation and statistical hypothesis testing on the basis of theory. Moreover, it would be desirable to use the findings of the empirical analysis to reject existing theory as necessary, and then to formulate new theoretical structures and hypotheses for testing. This interplay among deductive theoretical analysis, statistical estimation and hypothesis testing on empirical data, and inductive reasoning from empirical results back to the theory invokes the classical research methodology known as the scientific method.

Upon examining the existing land value and land use theory applicable to studying the impact of an urban transportation improvement, one immediately realizes that the above ideal situation does not hold. Urban land use theory, for example as found in Alonso (1964) and Muth (1969), does not lend itself to the formulation of statistically testable hypotheses; the reason is the rather restrictive assumptions made in order to obtain any theoretical results whatsoever. Nevertheless, much can be gained from examining this theory in developing a general framework for analysis and *a priori* reasoning concerning the expected results. Furthermore, it is possible to develop some simple analytical results that are particularly well suited to the study of the impact of an urban rapid transit line. These results are essentially an extention of the model proposed by Mohring and Harwitz (1962).

Mohring and Harwitz's model provides a simple definition of the market area for a transportation improvement with continuous access, and can be extended to the case of a rapid transit line with discrete access points. The resulting station market areas are defined on the savings that accrue to persons who have a preference for the rapid transit line over competing commuter modes. These savings, which accrue on a daily basis, can be capitalized and thereby considered to increase the value of any household location permitting the user to receive these benefits. Although the assumptions of this model are rather simplified, the results are very useful in interpreting these empirical studies. Moreover, these interpretations do not agree with the usual intuitive impact areas for rapid transit stations, namely concentric circles of impact around stations or a band of impacted area paralleling the transit line. Therefore, the theoretical results are helpful in gaining a new perspective on the nature of transit impact.

In this chapter, the Mohring-Harwitz model is extended to the rapid transit line case, first for transit station market areas, and then for transit impact on land value. A more detailed treatment of the market area model is given in Boyce et al. (1972). Following the development of the impact model itself, the implications of the model for the empirical analyses and hypotheses testing that follow in Chapters 6 and 7 are considered. Finally, related urban land use theory is briefly summarized to provide a more general framework for these empirical studies.

A Model of Rapid Transit Station Choice

The model of station choice depicts the market area for each station of a rapid transit line; this area is, in turn, the area of each station's impact on land values. Assume that an urban transportation innovation, referred to here as the High-Speed Line, has been constructed from the central business district (CBD) in a straight line out into the suburban areas of the metropolitan area. Initially, consider that only one station, A, serves the suburban area; also, assume that commuters do not need their automobiles in their work. The central business district, the chief but not necessarily the only employment center, is considered to be a point, and is designated by the subscript, 0. A homogeneous transportation plane is considered to exist for the purpose of automobile transportation. In other words, the cost and speed of automobile transportation is uniform throughout the metropolitan area.

Now consider a short run analysis in which the location of residence and place of work are given, and two trips per day are made by each individual between his residence and work place. The problem is to determine by what mode these work trips are made; that is, are they made by automobile or by the tran-sit line?

Each user maximizes his utility in this short run situation by minimizing his total transportation cost to work. An individual located at point X, then, decides whether to drive to work or to use the High-Speed Line by comparing the cost of his two alternatives:

1. Cost by car
    a) automobile cost per mile, a, times the distance from location X to the CBD, D_{XO}, or aD_{XO}
    b) parking cost in the CBD, P_0
    c) bridge or road tolls, T
2. Cost by High-Speed Line
    a) access cost to the Speed Line station, or the distance from location X to Station A times the automobile cost per mile, aD_{XA}
    b) High-Speed Line fare from Station A, F_A

Each individual minimizes his total cost by selecting the mode with the lower total cost as given above. If, upon comparing these costs, he finds they are equal, then an individual at that location is indifferent between the two modes; all such locations define a locus of indifference between using auto and the High-Speed Line, and therefore form the market boundary for the High-Speed Line station. Using the notation defined above, the two total costs can be equated, and the locus of indifference obtained as follows:

$$aD_{XO} + P_O + T = aD_{XA} + F_A$$

$$a(D_{XO} - D_{XA}) = F_A - (P_O + T); \quad \text{letting } M = P_O + T,$$

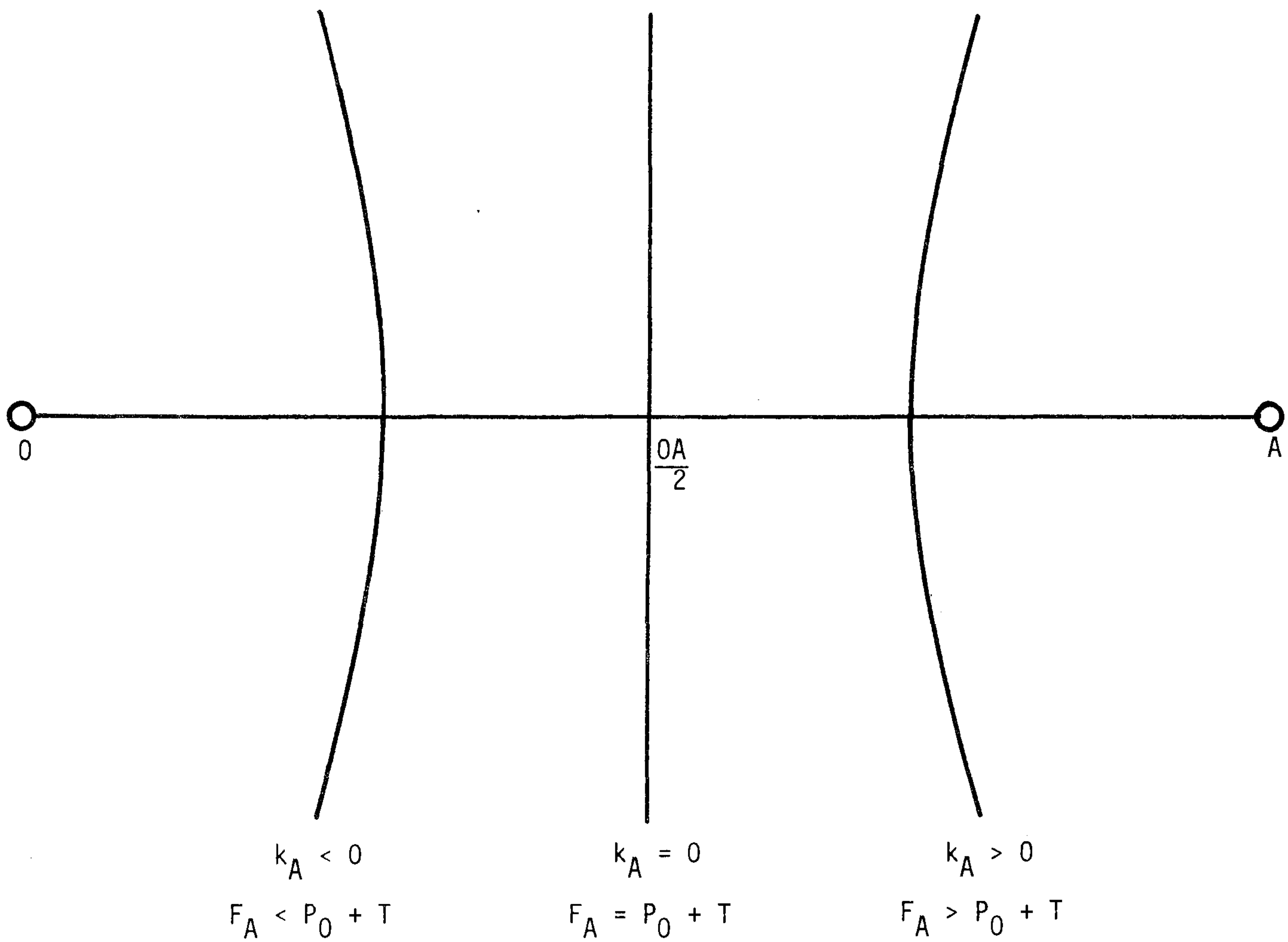
$$D_{XO} - D_{XA} = \frac{F_A - M}{a} = k_A \qquad (4\text{-}1)$$

The right-hand side of equation (4-1) is a constant, k_A, that depends upon the auto cost per mile, other auto charges and tolls, and the High-Speed Line fare. The left-hand side of (4-1) is the difference in the distances from location X to the CBD and to the station. Thus, (4-1) is the equation form of a hyperbola.

Several interesting cases result depending on the value of the right-hand constant, k. First, when k_A is equal to zero, the hyperbola becomes the perpendicular bisector of the distance between the station and the CBD, OA. See Figure 4-1. Such a situation implies that individuals living to the left of the market boundary drive to work. Second, if the High-Speed Line fare exceeds auto tolls and parking charges, then the market advantage lies with driving to the CBD. In this case, the hyperbola bends around Station A intersecting the line OA to the right of its midpoint, as also shown in Figure 4-1. Third, if the constant is less than zero, that is if tolls and parking charges exceed the High-Speed Line fare, then the hyperbola bends

Figure 4 - 1

Modal Boundaries for a Single Station



around the CBD to the left, and crosses the Line to the left of its midpoint; again see Figure 4-1.

The analysis may now be extended by considering the addition of several stations to the High-Speed Line, with a differential fare structure roughly in proportion with distance to CBD. For example, suppose that Station B is added farther out on the Line beyond Station A. Now, the market boundary between Station B and driving is given by equation (4-2):

$$D_{XO} - D_{XB} = \frac{F_B - M}{a} = k_B \tag{4-2}$$

Here, D_{XO} is the distance from the CBD to a location of indifference, X, between driving and using Station B, and D_{XB} is the distance to Station B from X. Similar conditions on the constant k_B can be defined yielding market area boundaries analogous to those for Station A.

A market area boundary between Stations A and B may also be easily determined by equating the cost for using each station for the trip to the CBD:

$$aD_{XA} + F_A = aD_{XB} + F_B$$

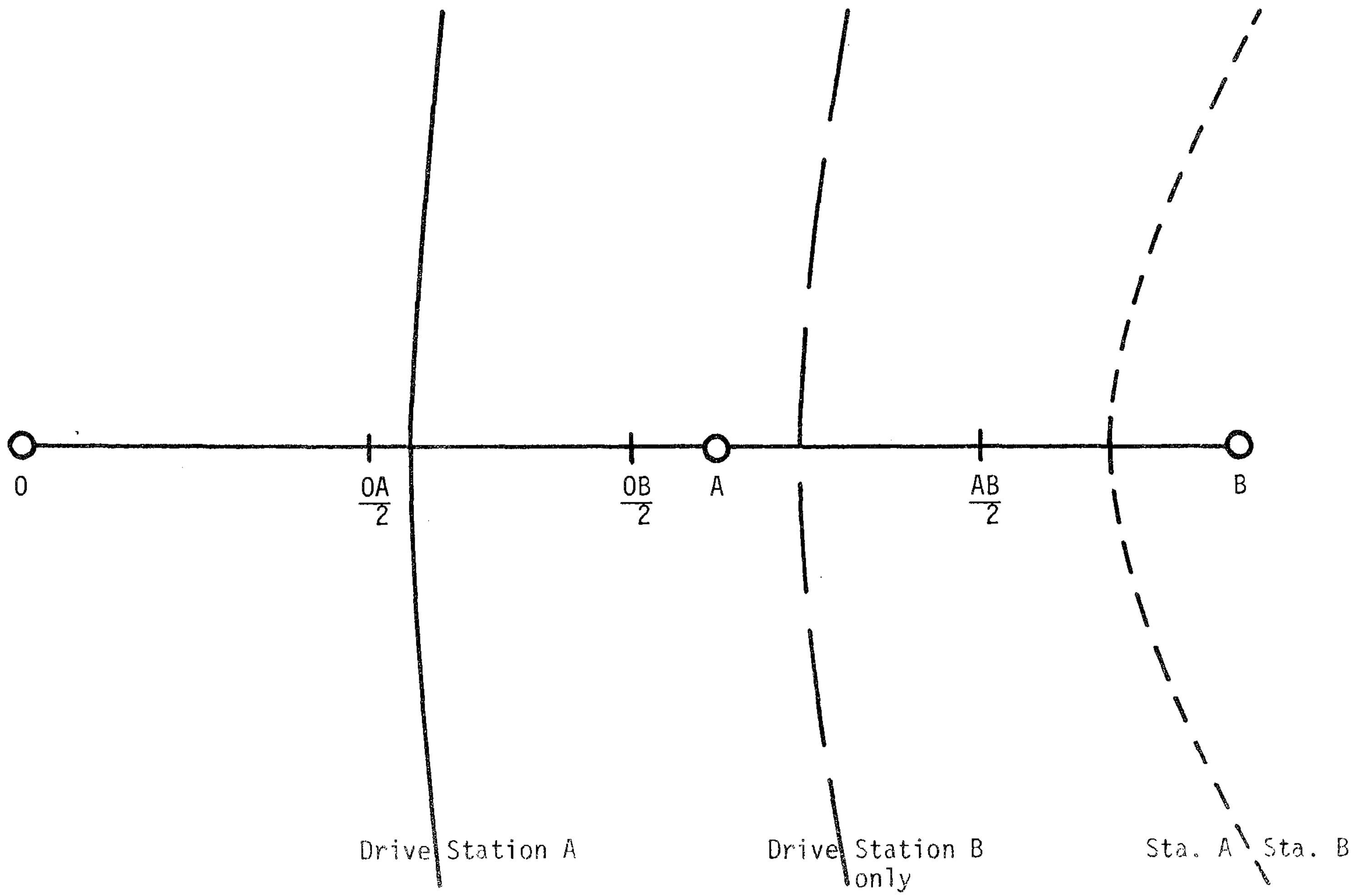
$$D_{XA} - D_{XB} = \frac{F_B - F_A}{a} \tag{4-3}$$

This equation is also hyperbolic; several cases exist with respect to the division of the market area between Station A, and Station B, and driving. In the first case, Station A's market boundary determines the market area for all High-Speed Line stations. That is, the market boundary between the Station B and driving is totally contained within Station A's market boundary, as shown in Figure 4-2. One form of the market boundary between Stations A and B is also shown in Figure 4-2.

A second case arises if the addition of Station B permits the High-Speed

Figure 4 - 2

Market Boundaries for Two Stations - Case I



Line to gain some new market territory away from the automobile mode, as shown in Figure 4-3. As before, the boundary between Stations A and B shows how the overall market area of the Line is divided between the two stations.

As was the case with the boundary between driving and Station A, the boundary between Stations A and B is the perpendicular bisector of the line D_{AB} if the fares for the two stations are equal. If outlying Station B has a higher fare, then the hyperbola will bend around Station B as shown in both Figures 4-2 and 4-3.

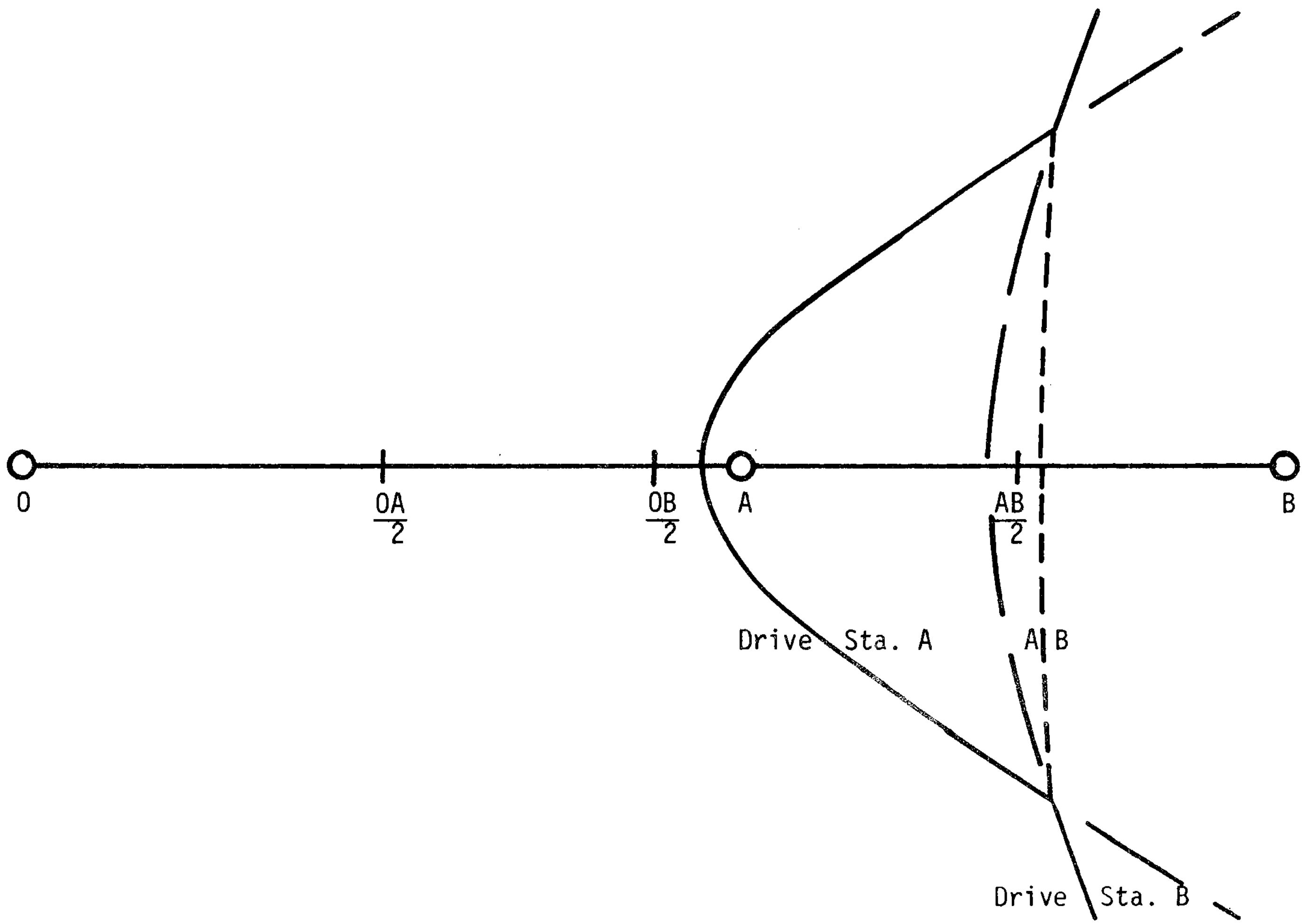
It is interesting to note that the fares, bridge tolls and parking charges represent control variables which have considerable influence over the size of the market areas. By adjusting such prices, market areas of each mode and each station on the High-Speed Line, as given by the model, can be substantially altered. For example, an increase in parking costs will substantially enlarge the market area of the Line, as will a decrease in fares.

If such a model is to be used for modal choice analysis, extreme care must be taken. Given the population density of the area under consideration and a knowledge of the proportion of persons working in the CBD, the modal choice can be easily calculated. However, some individuals who live in the High-Speed Line market areas undoubtedly drive to work because they need their cars in their work. In this respect, the model overestimates the number of High;Speed Line users. What the model does show is the location of individuals who should continue to drive, despite the existence of the High-Speed Line. As one moves out from the CBD, the proportion of suburban area in the Line's market area increases very substantially depending on the shape of the hyperbolas involved.

The High-Speed Line's market area also defines the impact area of the transportation improvement. In this way, an operational definition of the

Figure 4 - 3

Market Boundaries for Two Stations - Case II



impact "corridor" is immediately obtained; interesting enough, the market areas obtained from this analysis do not correspond to the intuitive notion of a transportation corridor, or band, but rather are expanding areas of impact as one proceeds outward from the CBD. It should be noted, however, that these areas do not extend indefinitely. Although the market boundaries are indifference loci, expenditure on transportation increases as one moves outward. At some point these transportation expenditures will exhaust the income which the individual can obtain from the CBD, or equal the net income he can receive from working by commuting to another location. Thus, there is a finite, but here undefined, outer boundary for the market area of the Line.

The above analysis can be extended in several ways. First, additional costs can be introduced into the analysis. Perhaps the most important of these is travel time, which can enter the analysis as follows:

1. access time to the station;
2. waiting time at the station;
3. travel time on the train;
4. auto travel time driving to the CBD.

The introduction to these travel time variables again results in hypberbolic market boundaries, and, if shown to be valid, their introduction makes new control variables available to the decision makers. In addition to transit fares, parking charges and highway tolls, the decision makers can manipulate highway speeds, transit speeds, and transit frequency of service in order to influence the area of impact of the transportation improvement. Thus, higher speeds and more frequent service, as well as lower fares, increase the market area of the High-Speed Line.

Variables like comfort, convenience, and safety can also be introduced if their economic values can be estimated. In general, studies conducted to date have not succeeded in estimating the values associated with such variables in modal choice decisions; however, it may be expected that these variables can be added in the future.

A second extension of the above analysis concerns the relaxation of the homogeneous transportation plane assumption, replacing uniform travel speeds with station specific access speeds or over-the-road travel times. Another case, which has been worked out, is the grid highway network; see Boyce, et al. (1972). In this case, if the transit line is aligned with one direction of an x-y grid, then the market boundaries between driving and stations, and between pairs of adjacent stations, will be perpendicular to the transit line.

A third extension of this analysis considers the case of market boundaries between two High-Speed Lines. The same procedures may be used to derive boundaries in this situation, and for cases in which the High-Speed Line is not a straight line but rather has bends and curves in it.

In summary, then, the simple market area models described above can be extended to respond to numerous conditions and alternative assumptions. The model has been only outlined in this chapter in order to provide a basis for investigating the impact of the High-Speed Line on residential property values.

Impact of the High-Speed Line on Residential Property Values

The introduction of the High-Speed Line should result in transportation savings to its users; otherwise, they would not use the Line, or would be indifferent between the Line and driving. The capitalized value of such transportation savings may be expected to accrue to the value of the property at which each user resides. Clearly, the amount of these transportation savings depends upon (a) the number of trips made between the residence and the CBD, and (b) the number of individuals per household making such trips. In this section, the station choice model outlined above is extended into a market area impact model. Inasmuch as the principal focus of this report is on the impact of the Line on land value and land use, this analysis is developed in somewhat more detail than the station choice model.

The transportation savings which each user enjoys differ depending on his residential location relative to stations of the Line. These savings, S, may be defined by subtracting the cost of using the Line from the cost of driving. For example, consider the one station case with only monetary costs included. Using the notation defined in the above section, the user's savings, S, are defined as follows:

$$S = (M + aD_{XO}) - (aD_{XA} + F_A) \tag{4-5}$$

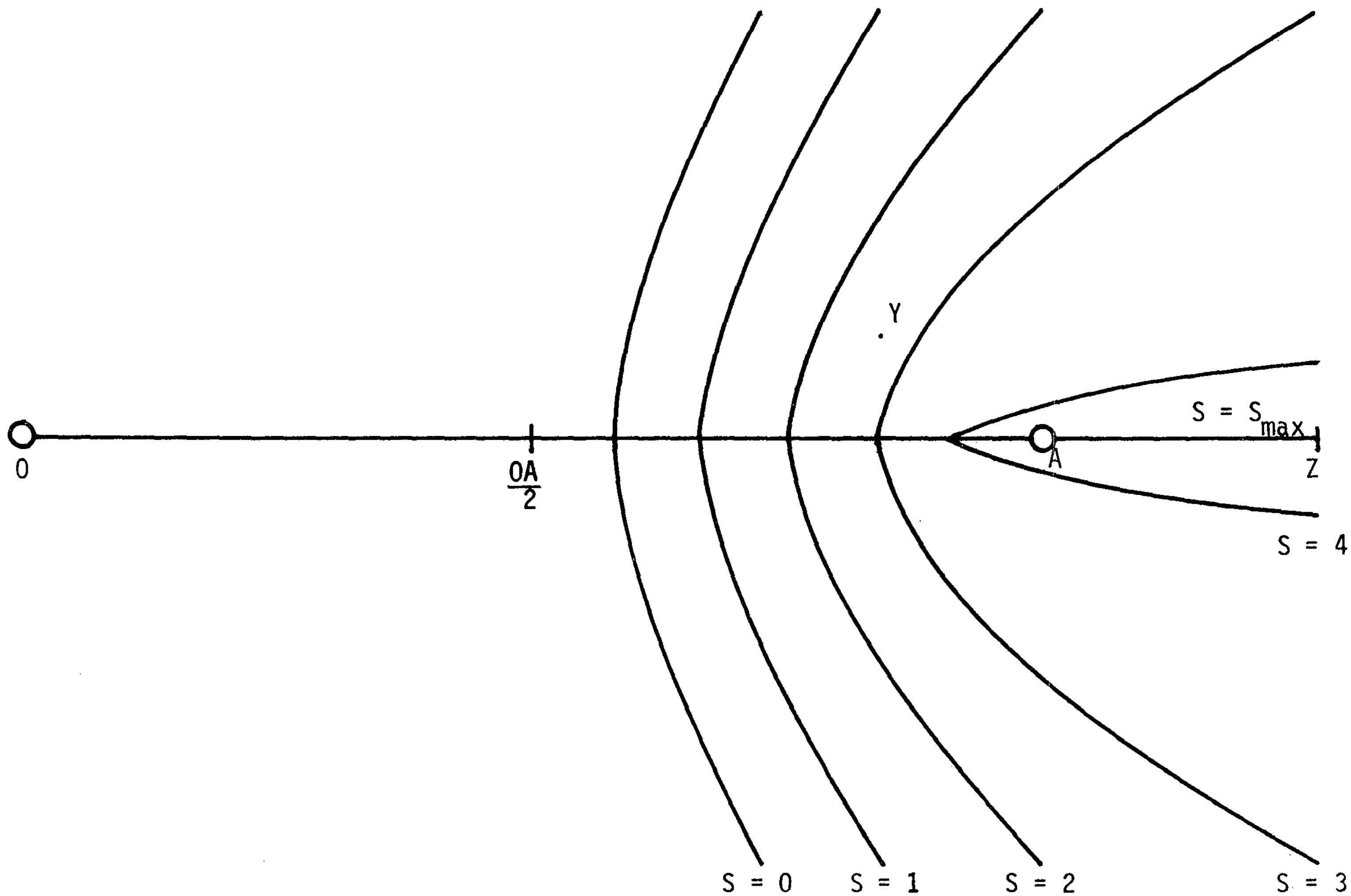
where M is the sum of parking costs and highway and bridge tolls. Here, the two terms on the right hand side correspond to the total cost by driving minus the total cost of using the Line. This equation can then be solved for the difference in driving distances, $D_{XO} - D_{XB}$:

$$D_{XO} - D_{XA} = \frac{S}{a} + \frac{F_A - M}{a} = \frac{S}{a} + k_A \tag{4-6}$$

This equation is the same as the market boundary equation except for the inclusion of the S/a term. Whenever the savings, S, equal zero, the above equation describes the market boundary. When $S/a > 0$, the right hand side remains a constant; therefore, the locus of points for a given level of savings for Station A is specified by a hyperbola bending around Station A. These equal-savings hyperbolas are contained within the market area boundary which corresponds to the zero savings locus, as shown in Figure 4-4. The equal-savings loci extend outward from the immediate area of the station and

Figure 4 - 4

Equal Savings Loci for One Station



away from the CBD. Contrast the shape of these areas with the conventionally assumed impact areas, that is concentric circles around the station, or parallel band along the Line. This finding is of major importance for the empirical studies, both for defining distance measures from the Line, and for interpreting the results.

In the one-station case being considered, there is clearly a limit to the savings that may be obtained by using the Line. For hyperbolas bending around Station A to exist,

$$D_{XO} - D_{XA} \leq D_{AO}$$

Therefore,

$$\frac{S}{a} + \frac{F_A - M}{a} \leq aD_{AO}, \text{ or}$$

$$S + (F_A - M) \leq aD_{AO}$$

In other words,

$$S \leq M + (aD_{AO} - F_A), \text{ and}$$

$$S_{max} = M + (aD_{AO} - F_A) \qquad (4\text{-}7)$$

This result is quite logical: savings from using the Line cannot exceed the tolls and parking fees avoided plus the net savings of traveling by the High-Speed Line rather than driving.

The users who receive the maximum saving are those who live to the right of the station, as shown also in Figure 4-4; their savings are equal to the right-hand side of the above equation. Since the driving costs for such an individual are the same up to the point of Station A, whether he uses the Line or not, all individuals living along the line A-Z save exactly the same amount.

Moreover, an individual at point Y using the Line saves less than an individual at Z, even though he is closer to Station A than Z is. The reason is that the driving costs from Y to A are incurred in the direction away from the CBD destination. The savings to an individual at Y are as follows:

$$S_Y = (aD_{YO} + M) - (aD_{YA} + F_A)$$

$$= M + a(D_{YO} - D_{YA}) - F_A$$

Since $(D_{YO} - D_{YA})$ is clearly less than D_{AO},

$S_Y < S_{max}$, or substituting from above:

$$M + a(D_{YO} - D_{YA}) - F_A < M + aD_{AO} - F_A:$$

Eliminating M and F_A gives

$$a(D_{YO} - D_{YA}) < aD_{AO}. \qquad (4\text{-}8)$$

As shown above, the form of equation for the savings loci is a hyperbola. Now consider the shape of these loci in more detail. Suppose that k = 0. The market boundary and the zero savings locus are then the perpendicular bisector of the Line connecting the CBD and Station A. For positive savings, and

$$\frac{S}{a} + \frac{F_A - M}{a} < D_{AO},$$

then hyperbolas occur. The closer the savings are to zero, the closer the equal savings locus is to the midpoint between the CBD and A, and the wider the spread of the hyperbola is from this point. As the savings increase, the hyperbola moves closer to A and bends more sharply around A. Finally, when

$$\frac{S}{a} + \frac{F_A - M}{a} = D_{AO}$$

the hyperbola becomes coincident with the extension of the abscissa to the right of A, as shown in Figure 4-4, above.

Now consider an extension of the above case with two stations, A and B. As in the derivation of the market areas in the above section, it is possible to derive a zero savings locus between Station B and the CBD.

$$S^B = (aD_{RO} + M) - (aD_{RB} + F_B) \qquad (4\text{-}9)$$

The zero savings line for station B generally falls in the market area for Station A, and thus is not relevant. However as a limiting case, suppose that F_B, the fare to the CBD from Station B, is equal to F_A. Then, the market area boundary between Stations A and B is the perpendicular bisector of the line AB. The above savings equation may be then transformed as follows:

$$D_{RO} - D_{RB} = \frac{S^B}{a} + \frac{F_A - M}{a} = k_A + \frac{S^B}{a} \qquad (4\text{-}10)$$

Thus, the right-hand side of equation (4-10) is the same as the comparable equation for Station A. However, since Station B is farther out on the Line, its hyperbola for a given level of savings is flatter than the comparable hyperbola for Station A. As a result, Station B's hyperbola intersects those of Station A as shown in Figure 4-5. If, on the other hand, $F_B > F_A$ then the above equation must be revised as follows:

$$D_{RO} - D_{RB} = \frac{S^B}{a} + \frac{F_B - M}{a} = k_B + \frac{S^B}{a}, \qquad (4\text{-}11)$$

where $k_B > k_A$. In this case, depending on the relationship of k_A and k_B, the equal-savings loci for Stations A and B intersect as shown in Figure 4-6 and have a kink at the market boundary between Stations A and B. If $F_B > F_A$, then the market boundary between the two stations is a hyperbola instead of a perpendicular bisector. The equal savings loci again have a kink at the market boundary, depending on the amount of the fare differential and its relation to distance. As in the case of the single station, the maximum

Figure 4 - 5

Equal Savings Loci for Two Stations with Equal Fares

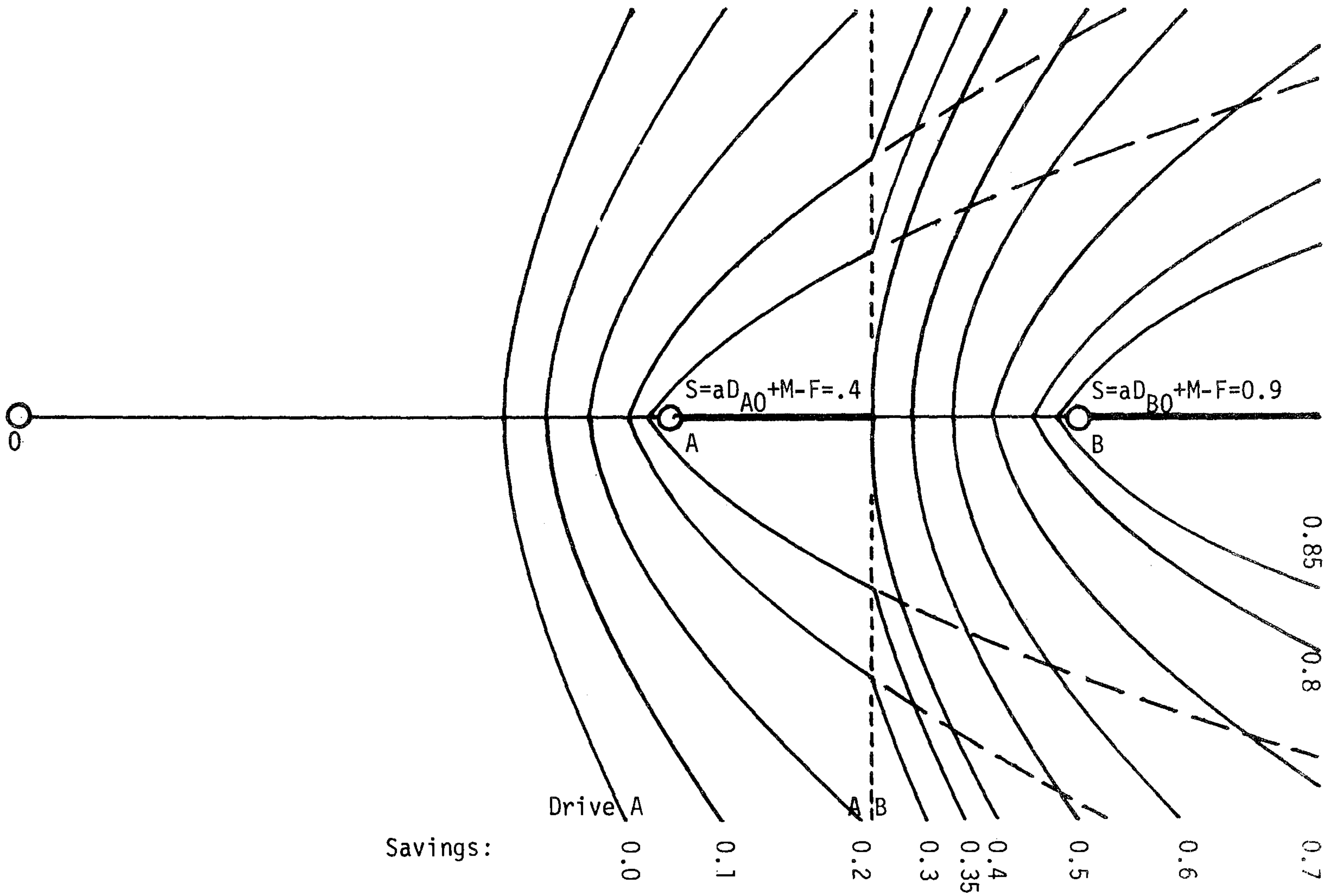
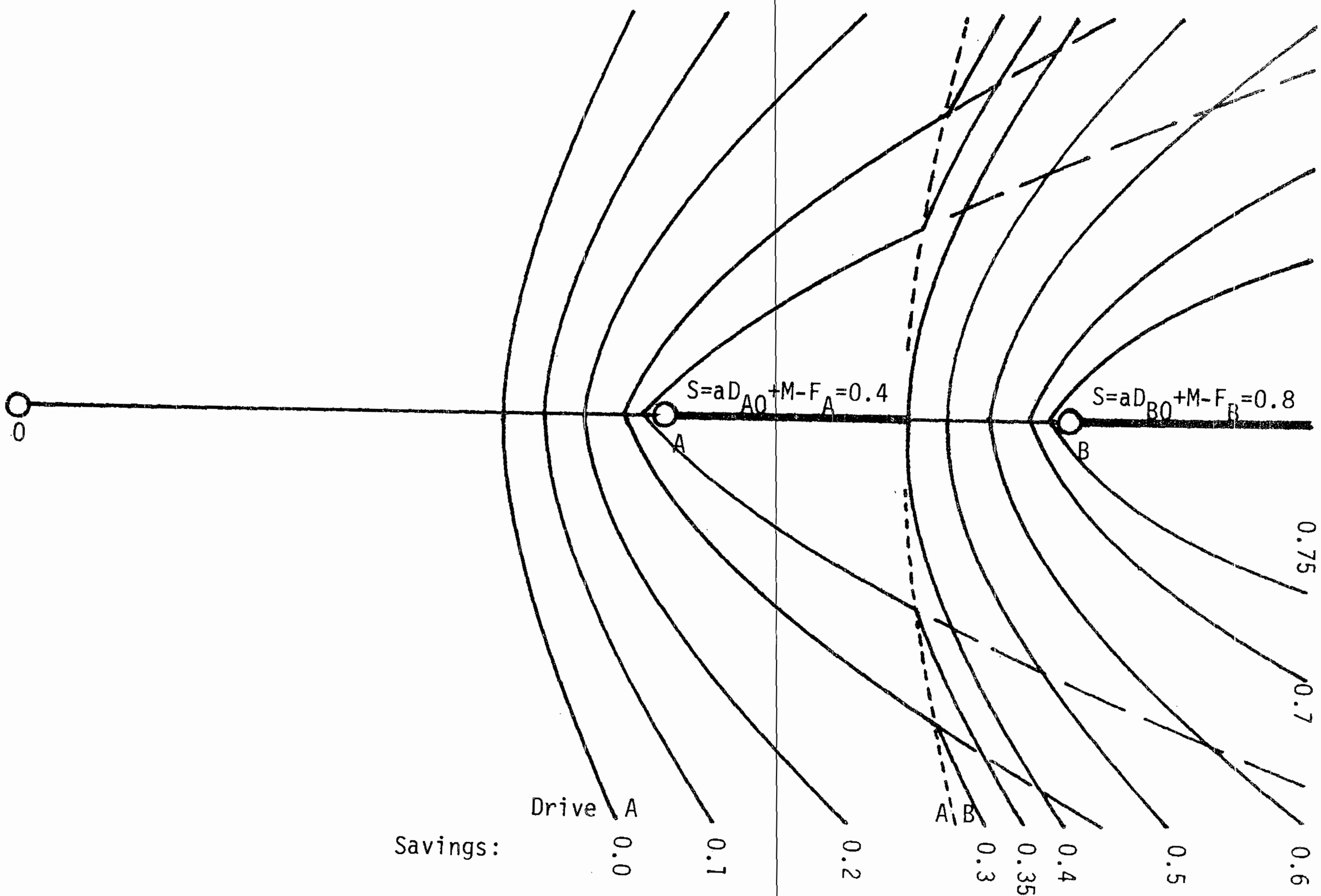


Figure 4 - 6

Equal Saving Loci for Two Stations with Different Fares



savings locus occurs along the line extended from B, and has a value of $(aD_{BO} - F_B + M)$. These results can be extended to grid transportation networks and multiple High-Speed Line as in the case of the station choice model above.

In summary, then, the savings accruing to users of the High-Speed Line do not conform to the usual notion of concentric circles around stations or parallel bands along the Line itself. Rather, impacts in the form of transportation savings are distributed throughout the market area of the Line. As the distance from the CBD increases, the areas in which savings accrue also increase in a fan-like pattern around the Line. Of course, the maximum savings do accrue at the stations and in the area of the extension of the Line beyond the last station. In the next section, the implications of these findings for empirical research are considered.

Implications of the Model for Statistical Analysis

The simple station choice and impact models developed in the above sections are useful for the statistical analysis of property sales data in two ways. First, they provide an *a priori* basis for specifying hypotheses for statistical testing. Second, they provide operational definitions for such variables as corridors, distance from the CBD, and distance from stations. These variables are difficult to define operationally in the absence of such a model.

In the statistical analyses in Chapters 6 and 7, based on the data described in Chapter 5, several approaches to statistical estimation and hypothesis testing are explored, ranging from a rather empirically oriented statistical model to tests of specific hypotheses on sales price variation. In this section, the theoretical hypotheses underlying these tests are developed.

Present Worth of Savings

The impact model developed above provides the basis for defining loci or areas whose residents enjoy real or potential savings from using the High-Speed Line. The amount of these savings depends upon the location of the residence with respect to stations, as depicted above in Figures 4-4 to 4-6. The amount also depends upon the number of trips made per time period (day, week or year), and the number of persons per household making such trips. In addition, the savings per unit of land area depends on the housing density, but this aspect does not affect the analysis, which is conducted on a dwelling unit basis.

The present worth of the savings or potential savings, if the resident does not now use the Line, may be hypothesized to form an increment to the property value. For example, if savings amounted to $1 daily, or $250 annually assuming 250 working days per year, then the present worth would be as follows:

$$V = \sum_{i=1}^{t} S_i/(1+r)^i = \left.\frac{S}{r}\right|_{t\to\infty} = \frac{250}{0.10} = 2500 \qquad (4\text{-}12)$$

where S_i = savings in the ith year; S = mean savings over all years

V = present worth of the savings

r = interest rate, taken to be 10 percent, or 0.1

However, the Line did not have to be in operation for these potential savings to affect property sales prices. Instead, the present worth of the savings might have been implicitly discounted and added to sales prices before the Line was opened. For example, if a property sold in 1967 while the Line was under construction, but two years before it opened, the discounted value of the savings would be:

$$V_D = \frac{V}{(1+d)^t} = \frac{2500}{(1+d)^2} \qquad (4\text{-}13)$$

V_D = discounted value of capitalized savings, V

d = discount rate

t = number of years until the line opens

The discount rate, d, might well be greater than the interest rate, since the savings are much less tangible at this stage, and therefore involve some risk. Suppose a discount rate of 0.30 is assumed. Then,

$$V_D = \frac{2500}{(1+d)^2} = \frac{2500}{1.69} = 1480 \qquad (4\text{-}14)$$

The final decision to build the High-Speed Line was made in 1964, about five years before it opened. Therefore, at that time, the discounted present worth of savings would have been:

$$V_D = \frac{2500}{(1.3)^5} = \frac{2500}{3.71} = 675 \qquad (4\text{-}15)$$

Prior to the final decision to build the Line, studies were made over a period of several years. One such study was completed in 1958, ten years before the Line was opened. If at that time an individual believed there was a 50/50 chance that the Line would be built and opened in 1969, his expected discounted capitalized saving would be:

$$E(V_D) = (0.5)\frac{2500}{1.3^{10}} = (0.5)\frac{2500}{13.8} = 90 \qquad (4\text{-}16)$$

or a relatively negligible amount.

This example serves to suggest the order of magnitude of impacts that may be expected on residential sales prices. The amount could easily be 2 or 3 times the amount in the example, or it could be much less. These amounts represent about 10 to 20 percent of the average sales price of used houses in the area, and perhaps 5 to 10 percent of a typical new house price. Thus, the size of the impact is relatively modest, but also reasonable. It should also be noted that the magnitude of the present worth of savings is comparable with the effect of inflation, suggesting that the statistical studies need to be carefully controlled for inflationary effects.

The manner in which the savings accrue with time is shown in Figure 4-7. During the period before the decision was made to build the Line, increments of value based on speculation may accrue to property values. During construction, an increasing increment accrues, corresponding to future savings. Once operation is initiated, a constant increment is added to prices, assuming the savings remains constant. Since bridge tolls and parking costs could rise faster than Line fares, unit savings could well increase over time resulting in an increase in the present worth of savings as well.

Definition of Levels of Savings

Conventionally, variables such as distance from transit stations, or freeway interchanges, and distance from the CBD have been used to analyze the impact of transportation improvements. The impact model developed above suggests an altogether different formulation based on the measurement of savings at each location. In analysis of variance terminology, a series of levels of savings form a factor incorporating a savings effect. These levels may be visualized in terms of equal savings areas or bands as illustrated in Figure 4-8. For analysis of variance, or equivalently for regression analysis on dummy variables, these geographic bands need only be defined in terms of relative costs; the bridge tolls and parking costs included in the station choice model may be omitted, as they are constant for all users. Therefore, the savings for a user at X for Station I is simply:

$$S = aD_{XO} - (aD_{XI} + F_I) \qquad (4\text{-}17)$$

Figure 4 - 7

Effect of Savings on Sales Price over Time

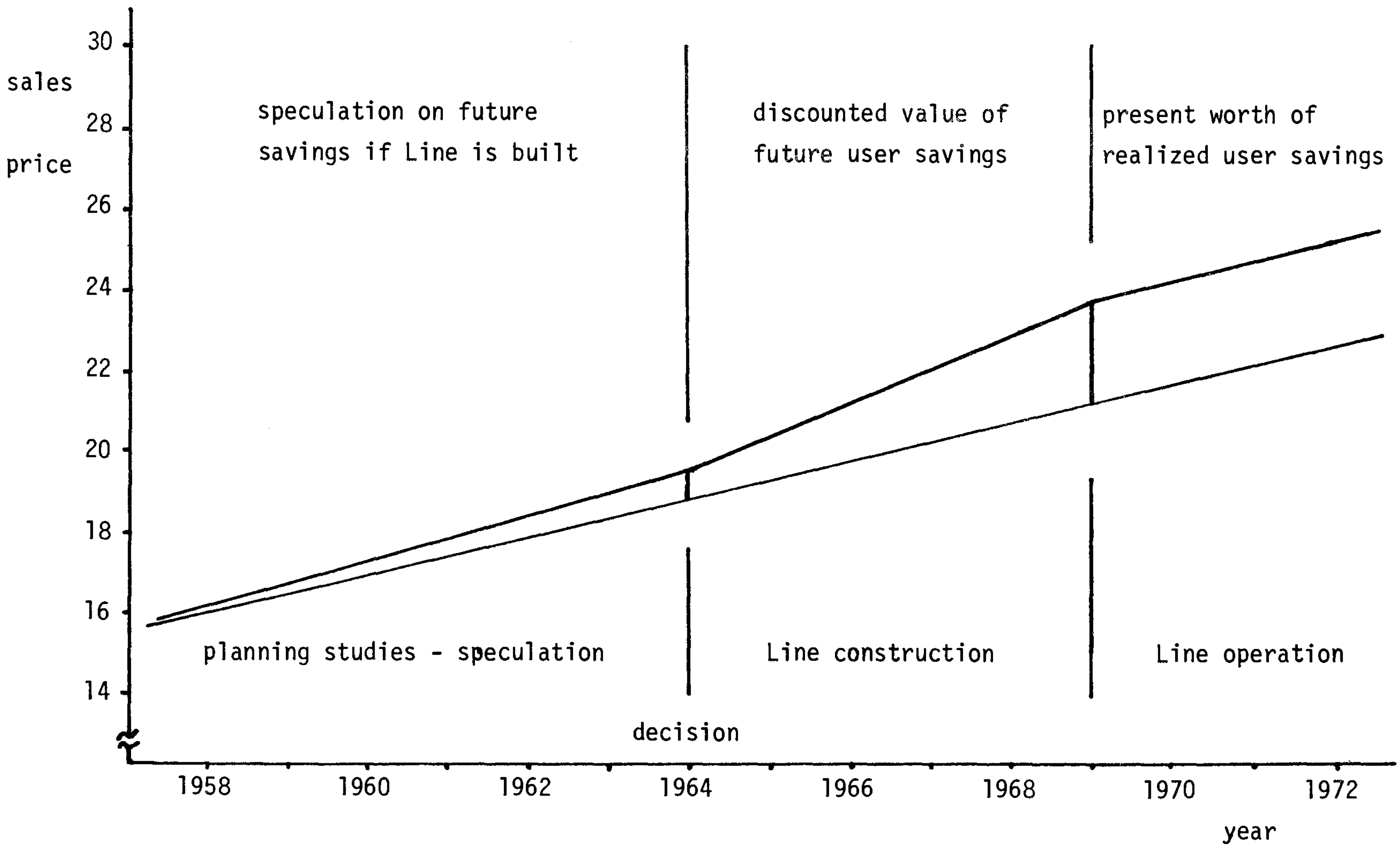
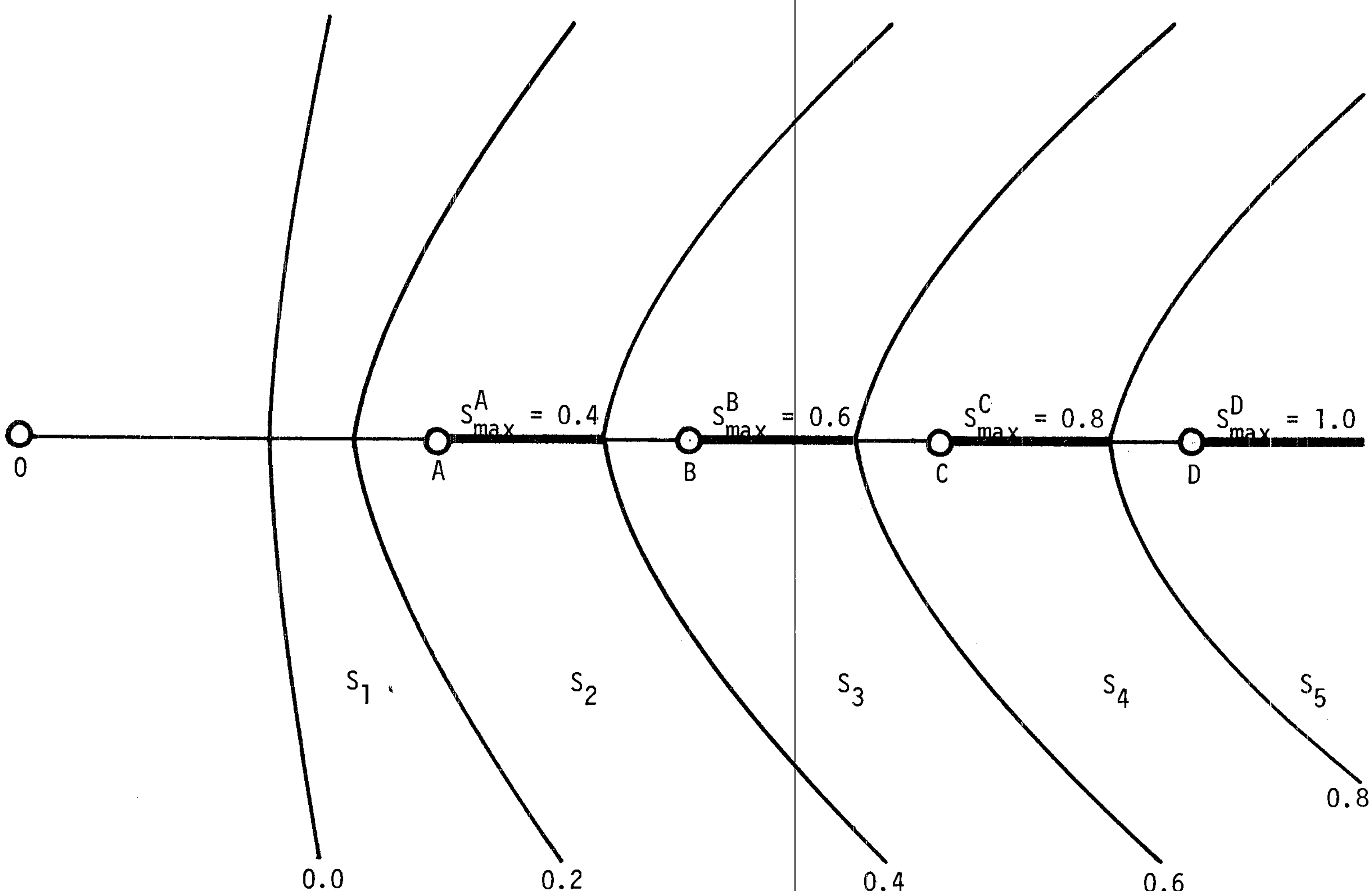


Figure 4 - 8

Levels of Savings for a Multiple Station Line



where as before D_{XO} = distance from location X to the CBD in miles

a = driving cost per mile

F_I = fare at Station I to the CBD

The user chooses his station so as to minimize $(aD_{XI} + F_I)$, or equivalently to maximize S. Thus, each location is assigned to a station and a savings level. By choosing intervals $S_1, S_2, \ldots S_j$ over the range of savings hypothesized to be present, the desired number of levels can be defined. These levels can also be interpreted in terms of S/a, the savings per cost of driving per mile.

$$\frac{S}{a} = D_{XO} - D_{XI} - \frac{F_I}{a} \qquad (4\text{-}18)$$

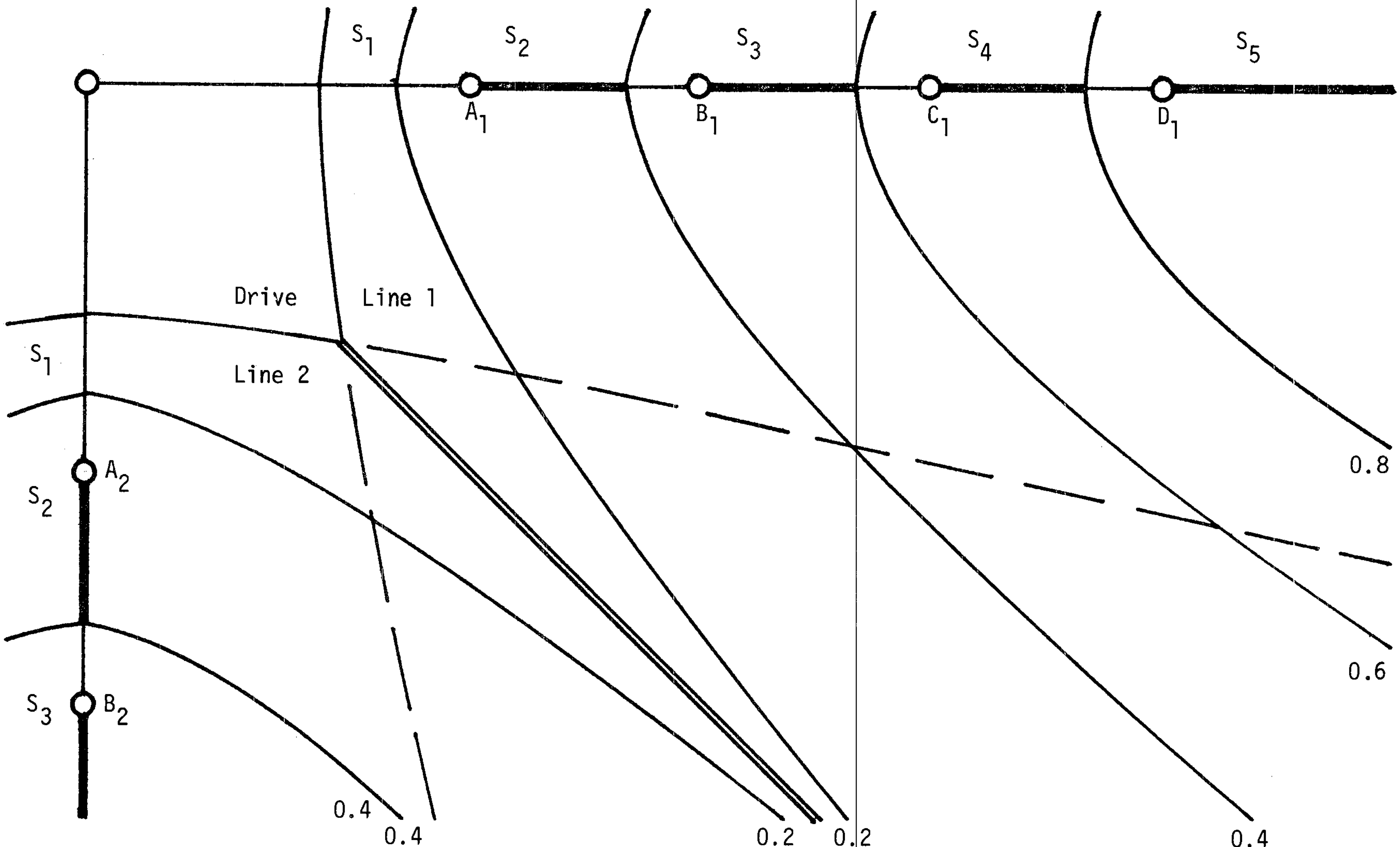
F_I/a, then, is the transit fare relative to driving cost per mile. The set of savings levels define the market area for the entire High-Speed Line, and the stations chosen in maximizing S define the market areas of each station.

The same approach can be used in defining levels of savings and market areas for a control line. Suppose a hypothetical (or proposed) Line is defined as shown in Figure 4-9. Then, as before, S can be maximized for each location, with stations on both lines being considered. Each location is assigned to the station on the Line that maximizes S; the value of S determines the level of savings that location would gain from High-Speed Line service. This assignment not only determines the market area for each station, but also the market area for each line; these may then be regarded as the corridors served by each line. Thus, from the savings model, a delineation of impact areas for both the actual and control lines are obtained which is strictly a function of the actual or hypothetical savings.

The observed savings for the control line are, of course, by definition

Figure 4 - 9

Levels of Savings for Two Lines



zero. Therefore, sales prices in the control saving areas may be compared with corresponding areas of hypothesized savings for the High-Speed Line. One problem here is that each location in the control market area also lies in a level of savings area for the High-Speed Line. Therefore, the difference in the two levels of savings must be incorporated into the analysis. The details of this formulation are left to he chapters employing this concept, principally Chapter 7.

Formulation of Hypotheses

The detailed statistical estimates and tests of hypotheses are presented in the chapters describing the findings of the empiricals analysis; however, it may be useful to summarize here the underlying hypotheses and statistical approaches to these analyses.

The first model, presented in Chapter 6, represents an empirically oriented approach to estimating the total variation of residential property prices over time and space. In this case, hypotheses related to the savings effect are not tested directly. Rather, this hypothesis and others are considered in interpreting the results. An unbalanced analysis of variance model is applied to partition the total sums of squares of logarithms of sales prices, observed over years and geographic units (census block groups), into a grand mean, years effect, neighborhood effect, an interaction effect and an error term. The model seeks to attribute as much of the observed variation in sales prices to inflation (years effect) and differences in housing quality (neighborhood effect) as possible.

If sales prices in a block group increase faster, or slower, than the years effect indicates, then this variation is captured by the interaction effect. This effect may be decomposed into a series of terms related to block groups and years, as described in detail in Chapter 6. Several competing hypotheses, including the savings hypothesis, must be considered in interpreting these interaction terms.

In terms of the savings model, block groups on a high savings locus would receive a larger increase in value than block groups on a low savings locus. If the present worth of this savings increment was present during all years of the anlysis (1965-1971), then it would be impossible to distinguish this savings effect from the main neighborhood effect. In other words, block groups along a high savings locus might have higher mean sales over all years, but these could simply be related to higher neighborhood quality.

As shown in the above section, however, the full worth of the savings should not accrue in years before the operation of the Line; rather, it should be discounted by the time remaining until opening of the Line. Therefore, the savings effect should increase with time during the construction phase, leading to an interaction effect in this model.

However, several other hypotheses may be suggested to account for such an interaction effect. For example, the age of housing may have a differential effect on the rate of price increase, with newer housing increasing faster than older housing. Moreover, outlying suburban areas may be preferred over inner areas in a way affecting price increases differentially. To some extent, these effects can be distinguished through analysis of the geographic pattern of the terms of the interaction effects presented in Chapter 6.

The second model, presented in Chapter 7, attempts to test the savings hypothesis more directly. For this analysis, a relative level of savings is calculated for each block group in the High-Speed Line market area and for each block group in market areas of control hypothetical lines. Since the block groups in the control market areas do receive some savings from the High-Speed Line, the differential savings must be computed.

Relative levels of savings form one factor in a regression analysis on dummy variables. Other variables are as follows:

1. neighborhood quality as indicated by number of rooms, family type and size and related census variables;
2. lot size of parcel;
3. type of building construction;
4. number of stories;
5. time period;
   a) during construction
   b) after initiation of service
6. corridor;
   a) High-Speed Line
   b) control line
7. distance from the CBD.

Using this setup, it is possible to contrast the change in mean sales price before and after initiation of service for similar neighborhoods in different corridors and with different levels of savings.

Each of th analyses outlined above can also be interpreted in terms of the theory of location rent. In order to make this interpretation, difficult questions related to the supply of land must be resolved. Although no attempt is made here to make a location rent interpretation, this theory does underlie the analysis. For this reason a brief review of rent theory is included in the final section of Chapter 4.

Rent Theory and Impact Theory

The impact of transportation improvements on land rents, values and uses is discussed extensively in the location theory literature; see Alonso (1964), Wingo (1961), Mohring and Harwitz (1962), Mills (1967), Muth (1969), Lave (1970), and Hochman and Pines (1971), for examples. Since access to the CBD has played a centrol role in most economic models of urban form, the impact of radial transportation improvements are easily derived in theory. This review follows the works of Wingo, and Mohring and Harwitz, most closely. They, in turn, have followed the classic study by von Thunen. These models, while very restrictive in their assumptions, are more suited to empirical testing than the other models cited above; the latter have more realistic assumptions from the point of view of theory, but are more difficult to test empirically.

Wingo, Mohring and Harwitz, and Lave all assume all employment is located in the center of a city of circular form, which extends outward a sufficient distance to house all individuals (on uniform sized lots). Rent paid by the family on the periphery is assumed to equal the opportunity cost of land, agricultural rent. An individual located on the urban periphery has to pay transportation expenses from his home to the CBD. As a result of these high transportation expenses, the individual is willing to bid more for land located closer to the CBD, but not more than his rent plus transportation costs at the periphery less transportation costs from the site under consideration. Urban land rent thus begins at the agriculture level at the periphery and rises to a maximum at the CBD, where no transportation costs are incurred. This maximum rent is equal to the agricultural rent plus transportation costs from the periphery to the CBD.

A uniform transportation improvement which decreases transportation cost yields rent savings throughout the city. A selective transportation improvement will rearrange the configuration of the city with regard to the improvement, lowering rents at some places in the city and increasing them elsewhere.

In toto the rent which the entire area is able to generate is decreased. This location rent decrease is a benefit of the transportation improvement, as a result of transport savings.

Alonso provides a theory of residential rent which is based on consumers preferences of land quantity, commuting, and all other goods and services. A traditional consumer constrained maximization problem is postulated: maximize utility subject to a budget constraint. Alonso's model allows for the demand for land to be responsive to price. The first order conditions for a maximum require that rent per unit of land be decreasing, as distance from the center of the city increases. A similar model is proposed by Muth for describing consumer behavior in the land market.

The effect of a uniform improvement in transportation in Alonso's model is to lower rents per unit of land at the center and raise rents at the periphery, as well as to extend the periphery. Whether aggregate rents rise or fall in this case of less than infinitely inelastic demands for land depends on the price elasticities of demand of all the consumers. Nonetheless, the impact of the transportation savings is to increase the well being of the consumers, giving them more utility even if their rent has increased.

Alonso's model has very little to offer for empirical testing, as it is formulated in terms of basically unobservable utility variables. The Herbert-Stevens programming model is an attempt to operationalize Alonso's model. This approach has a great many heroic assumptions from a theoretical viewpoint, and has not been successfully implemented to date. While differing somewhat from the earlier approaches, Alonso is still closely related to the classic formulation of von Thunen: savings in transport costs result in an economic location rent which is added onto the existing rent structure for some residences.

A different method of approaching rent theory is found in Lefeber (1966), Mills (1967), Muth (1969), and Hochman and Pines (1971). The Mills and Muth models emphasize the supply side more than other models, although they are general equilibrium models in nature. Lefeber uses production function information directly, and shows that the marginal product of land falls as one leaves the city. The factor payment to land, or rent, also falls off with distance from the center.

Muth assumes that the price of housing and the supply of residential land are given exogenously. Muth thus explains only how much housing is produced at each location. Mills (1967) assumes that the demand for housing and for land used in transportation are perfectly inelastic with respect to prices. More recently, Mills (1969) allows for the quantity of land used in transportation to be endogenous to his model. Transportation demand in general, however, is left as exogenous. Both authors derive an exponential rent function which declines with distance. Using a Pareto income distribution, a general utility function, and a crude land supply relationship, Beckmann (1969) derives a power rent function.

All these models conclude that $dR/dT < 0$, where R is rent/unit area and T is distance from the center. The sign of the second derivative is zero in Mohring (1961), undetermined in Alonso (1964), and positive in Muth (1969) and Mills (1967). Hochman and Pines (1971) follow Muth and Mills in spirit, but incorporate the exogenous variables of Mills and Muth into their model. Equilibrium conditions for households, producers and the land market are developed, and the rent function is shown to be negative exponential in form.

A remaining approach is that of Schall (1971) which is based on the best use of land. Schall argues that land and structure values may shift in opposite directions as the result of an externality entering an area, such as a transportation improvement, and that the change in the total value of the land should be utilized to measure the benefits of an external investment. Changes in land values alone will probably overestimate such benefits. The research designs outlined above follow Schall's advice in attempting to view total residential value as (a) a function of characteristics of the structure,(b) its location, and (c) changes in access to the land.

While the marginal productivity theories shown above are empirically testable, the theory needed for the negative exponential result is very involved and entails assumptions concerning production functions of housing and transportation and their returns to scale which are empirically very difficult to make. Such models are very complex, and general equilibrium in nature.

The residual models of Alonso and Mohring are simpler in nature than marginal productivity models. The Alonso model, however, is based on some non-empirically testable variables. The residual savings model suggested here, then is like the Mohring model in spirit; it is simple in nature and amenable to easy testing.

CHAPTER 5

REAL ESTATE TRANSACTIONS AND PROPERTY CHARACTERISTICS DATA

Introduction

Typically, it is not practicable to test hypotheses relating to the theory presented in Chapter 4 because the necessary data are usually unavailable in a form suitable for analysis. This is not to say that the necessary data are confidential; information on real estate transactions and the physical characteristics of real estate parcels is generally part of the public record. However, the cost of assembling a sample of real estate transactions data with property characteristics is usually prohibitive. For this reason, the number of studies that have statistically tested hypotheses on land values is very small; see, for example, Pendleton (1963) and Grether and Mieszkowski (1971).

Preliminary exploration in 1970 of the availability of real estate transactions data in the State of New Jersey revealed that a very large amount of data was available, and in machine readable form suitable for computer processing. As a result of the availability and nature of the real estate transactions data, and tax assessment data on property characteristics also in machine readable form, the preliminary research designs were strongly oriented towards the exploitation of these unusual data files. In addition, the availability of the 1970 Census of Population and Housing, and related geographic base files, further strengthened the desirability and feasibility of this approach.

The purpose of this short chapter is to describe in some detail the data files available for analysis. An understanding of the nature and structure of these files is essential to comprehend the research results that follow. Some readers may only wish to scan this material, however, and then refer back to it for details as needed when reading the analyses that follows.

State of New Jersey Real Estate Transaction File

The State of New Jersey Division of Taxation collects information on all real property sales occurring within the stat in order to adjust the aggregate assessed value of each of the 567 taxing districts in the state to current market prices. These adjusted assessed values are the basis for allocation of county and school district tax burdens to municipalities, and for the distribution of state school aid.

The State Table of Equalized Valuations is promulgated by the Director, Division of Taxation, on October 1 of each year. This table consists of a ratio of sales prices to assessed values for each municipality and taxing district in the state. In order to compute the sales price/assessed value ratio, the Local Property Tax Bureau of the Division of Taxation collects and processes data on each real estate transaction in the entire state. The sales price and assessed valuation of each parcel of real property transacted are obtained by the Local Property Tax Bureau with the cooperation of a) the County Clerk, b) the County Board of T xation, c) the municipal tax assessor, and d) field staff of the Local Property Tax Bureau.

In addition to the sales price and the assessed valuation, one of the principal types of information obtained concerns the usefulness of the data for calculating a valid sales price/assessed value ratio. Each sale is classified as "useable" or "non"useable" in accordance with criteria established by the Local Property Tax Bureau. For example, sales between members of an immediate family, sales in which "love and affection" are stated to be part of the consideration, and 25 other categories of sales and assessed values are used to determine whether the transaction is useable or non-useable. This determination is essential for the purposes of these statistical studies; moreover, the lack of availability of information of this type is usually a major contributing factor to the difficulty of conducting research on real estate transactions.

Typically, about 40 percent of all sales are classified as useable. Unfortunately, some of the reasons for which transactions are considered non-useable pertain only to the assessed valuation portion of the data. For example, if a municipality undergoes a reassessment in a given year, the transactions recorded before the reassessment cannot be used in computing the sales price/assessed value ratio for that year. Therefore, these transactions are declared non-useable, although their sales prices are perfectly valid. In addition, new houses, which are only assessed after their initial sale, are also declared non-useable. Several other related criteria are also used to declare sales non-useable because of missing or incorrect assessed values.

Inasmuch as these non-useable sales are both "useable" and valuable for these research studies, it was necessary to recover these sales from the no - useable files. Because of the time and expense incurred in obtaining the sales price for these transactions from the files of the Local Property Tax Bureau, it was only possible to recover such sales for Camden County and only in fiscal 1969 and 1971. These years were selected because reassessment practices in these two years has resulted in a very large number of sales being declared non-useable, thereby substantially restricting the sample size for these periods. In future phases of this research, a more complete recovery of these non-useable sales will be undertaken.

Beginning with fiscal year 1965 (that is, from July 1, 1964) the useable and non-useable transactions have been stored on magnetic tape. Initially, six fiscal years, 1965-1970 were provided by the Division of Taxation for the research. Later, the data files for fiscal 1971 were also received. Similar data files exist in hard copy form for the period fiscal 1954-1964 in the offices of the Local Property Tax Bureau in Trenton, New Jersey. Because of the difficulty of transcribing these files into machine readable form, no serious effort has been made to date to recover this information. However, future studies of these data may be desirable. In addition, the original data collection forms from July 1, 1953 to date are available, either as microfilm or hard copy, in the Trenton offices.

The data available on magnetic tape for fiscal 1965-1970 are as follows:

1. useable transactions

   a) municipality and county

   b) deed recording date (month and year)

   c) tax block and lot number

   d) property classification - residential, apartment, commercial, industrial, or farm

   e) assessed value of land and total assessed value of property

   f) sales price

2. non-useable sales

   a) - d) same as above

   e) total assessed value of property

   f) reason why the property is classified as non-useable

These real estate transaction data, then, form one of the principal data files to be analyzed. Although these files are unusual in their accuracy and completeness, a considerable effort was required in order to process them into a form convenient for spatial analysis with regard to transportation improvements. The steps required to complete the data processing are described below, following the description of the other data files available for analysis.

Camden and Gloucester County Tax Assessment Files

Although the State Real Estate Transactions File described above provides the essential variable for analysis, additional information is needed in order to test specific hypotheses. Some information on the characteristics of the property transacted is desirable in order to account for variation in sales prices associated with features of the property. Typically, such information is available from tax assessment records, but the cost of obtaining such information is usually formidable. In this case, however, two of the counties in the study area had computerized their tax assessment records, in connection with a state-wide program of tax records computerization recommended by the State Division of Taxation. Therefore, tax assessment records for Camden and Gloucester Counties were obtained from the respective County Boards of Taxation. Unfortunately, similar machine readable files have not yet been completed for Burlington County, but are under preparation and should be available for future research.

Unlike the Real Estate Transactions File, the Tax Assessment File is only available for the current year. Therefore, properties which have changed use or other characteristics since the transaction, cause some difficulty in the data processing. However, for the most part these property characteristics are stable with time, once development has occurred.

The information available on each property from the County Tax Assessment File is as follows:

1. municipality
2. tax block and lot number
3. property location - street location
4. property type - vacant, residential, farm, commercial, industrial, apartment, etc.

5. lot size in dimensions or acres
6. building description
   a) number of stories
   b) building material
   c) number of garages
7. assessed value of land, assessed value of improvements, and total assessed value
8. other assessment information pertaining to tax deductions and exemptions

The detail of the property characteristics given in the Tax Assessment File is perhaps not as great as desirable. However, the basic information required for the subsequent analysis is present, in particular, lot size, number of stories and building material. Inasmuch as the property type is given on both the State Transactions File and the Tax Assessment File, it is also possible to determine whether the use of the property has changed since the transaction has taken place.

Geographical Base Files and Zonal System

In order to analyze the above data files on spatially, it is necessary to organize the transactions by geographical location. Various levels of geographical aggregation were considered for this purpose, ranging from individual blocks to municipalities or other large units. A principal consideration in the decision was the capability (a) to relate the sales date to Census and other characteristics of the areas being studied, and (b) to manipulate the data in a spatial manner. Principal candidates from a Census viewpoint are Census block groups and Census tracts. Census block groups have the advantage of being compact and relatively homogeneous. In addition, the geographical coordinate of each Census block group was available, facilitating the computation of distances to High-Speed Line stations and other points of interest. However, only the information from the 100 percent Census questions are available at the block group level of detail, whereas much more information from the sample questions is available at the Census tract level of detail. Census tracts, however, appeared too large to be useful for analysis and in some cases are not geographically contiguous. Therefore, the block group was chosen as the basic geographic zone system, recognizing that block groups can be easily aggregated to tracts, if necessary or desirable.

In order to process the State Transaction File into block group form, it was necessary to develop a correspondence table between tax assessment block and lot numbers, or property addresses, and Census block groups. Essentially, this correspondence table can be constructed in one of two ways: (a) manually compile the tax assessment block number and the Census tract and block number for each block by municipality (b) use the Census Address Coding Guide to match property addresses to Census tracts and blocks.

Examination of the Tax Assessment File, which contains the property address for each parcel, revealed that difficulties would be encountered in attempting to match these addresses to the Census Address Coding Guide. Therefore, a correspondence table was manually constructed using Census maps and tax assessment maps. For example, for Camden County over seven thousand blocks were manually located on these two maps, and the relevant information coded and keypunched.

1970 Census of Population and Housing

In addition to the use of Census tract and block group geographic system, the 1970 Census of Population and Housing provides an important reference data file for these studies. At this level of geographic detail, the Census findings may be divided into two parts: (a) the 100 percent questionnaire reported in the First County Summary Tapes, and (b) the sample questions reported in the Fourth Count Summary Tapes. The research studies reported here have relied entirely on the First Count Tapes, nasmuch as the Fourth Count Tapes are not yet available.

The 100 percent questions on the Census questionnaire pertain almost exclusively to population characteristics and housing characteristics. The number of variables reported on the First Count Summary Tapes is too extensive to reproduce here; however, the following brief list is indicative of the information provided:

1. population by age, race and sex
2. number of households by type of head of household
3. number of housing units by number of rooms and building type
4. total value of owner occupied housing
5. total gross rent of rent or occupied housing

One of the most important variables omitted from the 100 percent questionnaire is household income; other data, including information on employment, journey to work, migration, and detailed population characteristics will be available on the Fourth Count Tapes. The First Count Tape variables listed above are available for Census block groups. The Fourth Count Tape variables will only be available by Census tract, thereby somewhat limiting their usefulness for these studies.

One important additional data file obtained through the Census is the Master Enumeration District List (MEDList). This file contains the longitude and latitude of the population centroid for each Census block group and enumeration district. In addition, this file provides a master list of all Census block groups and enumeration districts in the study area. The geographic coordinates of Census block groups and enumeration districts were converted to the New Jersey plane coordinate system using the Metropolitan Map Series (1" = 2000') maps prepared by the Census. From the same maps the geographical coordinates of each High-Speed Line Station and other key geographic reference points were obtained, and the straight line distance between each block group and station computed.

CHAPTER 6

DETECTION OF TRANSPORTATION IMPACTS THROUGH THE DECOMPOSITION OF RESIDENTIAL SALES PRICE DATA

Introduction

Objectives of This Study

The decision to exchange a certain amount of money for the acquisition of a residence is subject to diverse and multitudinous influences.

> "In buying housing, families jointly purchase a wide variety of services at a particular location. These include a certain number of square feet of living space, different kinds of rooms, a particular structure type, an address, accessibility to employment, a neighborhood environment, a set of neighbors, and a diverse collection of public and quasi-public services including schools, garbage collection, and police protection" Kain and Quigley (1970, p.532).

This study is primarily concerned with factors related to housing location and their effect on the cost of housing. Its methodological objective is the analysis of spatial-temporal data, and the evaluation of the usefulness for such data, by means of a recently developed statistical decomposition design that combines features of analysis of variance and principal components analysis [Gollob (1968) and Mandel (1969b, 1971)]. This procedure entails the estimation of a matrix of observed means by an analysis of variance model. Residuals from such an additive model can then be examined with the use of decomposition techniques to find possibly significant multiplicative patterns within the residuals. Such a sequence of steps has several conceptual advantages for exploratory research, over principal components analysis, as usually implemented.

The substantive goal of this work is the construction and estimation of models of spatial-temporal trends in residential real estate markets. An unbalanced, two-way, fixed-effects analysis of variance model is considered for explaining all chronological and geographic variation in the logarithms of residential sales prices, on the basis of inflation and stable neighborhood differences. The capability of this model is evaluated with property sales data for suburban Camden County, New Jersey. It is hypothesized that through the application of decomposition techniques to that portion of the data left unexplained by the model, impacts of the High-Speed Line upon the price of residences, can be discerned.

Relevant Prior Studies

Davis (1965), employing a variety of data sources, studied the impact of the elevated transit system, built in the early 1900's, upon the growth of Northern Chicago. He concluded that the greatest increase in land values stemming from the network were in the areas, previously inadequately served by transit facilities, most distant from the Central Business District of Chicago.

Spengler (1930), in his study of the relation between land values in New York City and its subway system, found a similar phenomenon to be present.

> "As in the Bronx, the greatest increases in value took place in the outlying sections of the borough [Brooklyn]. Where the borough was already well-developed, the only places where large gains were made in the value of the land were at certain centers of concentration" Spengler (1930, p.107).

His major conclusion was that a new transit facility often raises land values in areas with increased accessibility to central locations, if land values in those areas had been rising previously.

> "It appears that a subway reflects the conditions of the section through which it passes, in any influences which it might exert upon land values. If the district is growing rapidly, the subway usually accelerates such growth; where it is stagnant, the values along the subway route change little; where influences are such as to cause land values to drop, the subway fails to pull the area in question from the slump which it is experiencing" Spengler (1930, p.65).

It is plausible that transit facilities are constructed, at least in part, to serve new, growing areas. More well-developed areas should already have some degree of accessibility, to have reached their state of growth. Thus, any attempt statistically to isolate the effect upon land values of a transportation innovation per se, may find such an effect to be substantially confounded with other causes of rising land values.

> "In studying the influences of subways on land values it must be remembered that many other factors must enter into the story. To compare land values with the extension of subway routes without recognizing these other factors, is to attempt to establish a false correlation" Spengler (1930, p.50).

A question of this nature arises in the analysis below. Cherry Hill Township has been undergoing intense, suburban development. Many new homes have been introduced into the real estate market there. For reasons which may be obvious, but which in any case will be enumerated, the sales of such homes can be expected to raise average prices in the various neighborhoods of Cherry Hill. Some of these areas appear to be highly benefited by the High-Speed Line, while the accessibility of other areas to downtown Philadelphia has not greatly increased. Since most of these neighborhoods are found to have rising average sales prices, relative to the norm for suburban Camden County, it is difficult to disentangle the impact of new housing from that of new transit facilities. It would be highly desirable if the age of homes could be made an explicit variable in this study. However, neither of the two extensive data sources employed yields this information, or a proxy variable for it.

Difficulties Associated with the Use of Sales Price Data

Spengler employed assessed valuations for all classes of property, not residential sales prices, as his data base. His reasons for not using market values in efforts to determine impacts were several: (a) they were not readily available; (b) many properties were not sold for long periods of time, resulting in small numbers of observations; (c) many conveyances were not <u>bona fide</u> transactions that reflected market conditions; (d) market values were subject to temporary inflation due to speculative selling; and (e) sales prices for non-vacant land did not separate the value of the land from that of the buildings Spengler (1930, ch.3). Difficulties (a) and (c) are obviated in this study, due to the availability of New Jersey sales data, classified into useable and non-useable transactions.

Czamanski (1966) discussed several measures that can be employed to evaluate urban real property. One of these he referred to as "Comparative Sales". This measure "depends upon the existence of recent sales of comparable real property in the vicinity. In view of the heterogeneity of urban real property, its relatively high value, and the difficulty of obtaining reliable information about conditions of sales, the method appears to be of limited usefulness and is rarely applied" Czamanski (1966, pp.205-206). To alleviate problems stemming from heterogeneity, sales should be classified by various relevant criteria. However, as more descriptive variables are employed, any statistical effort designed to isolate their individual effects becomes more complex.

Clawson has contended that residential sales prices are often poor indicators of economic conditions:

> "The market for housing exhibits several peculiarities which make prices more unreliable for studies of demand than prices usually are for commercially traded products. There is little turnover; the stock of housing is large, annual additions are small, and even annual turnover in the older housing is not large. A small rate of turnover would not, alone, invalidate the market price as a reliable measure. In the grain exchanges or on the stock exchange, for instance, the volume of turnover daily is small relative to the total volume of grain or of stocks; but every holder of grain or of stocks is also a buyer, to the extent that his reservation price is at least as high as the market price. He may not sell, but he knows

> he could do so and what price he would receive. But many owners or occupiers of housing occupy their space for reasons of sentiment or inertia, or because they do not know the cost they might incur elsewhere for equal or better housing, or the price they could receive for their house if they decided to sell. The imperfection in the housing market or the lack of standardization in housing is a major factor here. One cannot seriously argue that the present dwelling space for most occupiers represents closely reasoned choice based on cost or price and of quantity purchased or consumed. Many racial groups have been denied the opportunity to buy housing they were willing and able to pay for" Clawson (1971, p.114).

It would appear unlikely, due to these specific reasons and to the imperfection of economic data in general, that detailed models of the housing market, such as the one based on transportation savings described in Chapter 4, could be empirically verified and estimated with residential sales price data. The most that seems achievable is the perception of broad trends.

Design of the Study

A general procedure for analyzing a collection of residential sales price data obtained from different time periods and different geographic areas, will be presented. It is based upon an analysis of variance model that appears to explain the most prominent spatial and temporal features that collections of residential sales price data commonly possess. The parameters of the model will be estimated with a sample of the New Jersey residential sales price data drawn from suburban Camden County, for the seven-year period from fiscal 1965 through fiscal 1971. A statistical test will be conducted to determine the extent to which the model fits the data. If the model fails to provide a sufficiently complete explanation, then decomposition techniques designed to distinguish additional significant features in the data will be applied. If such structural patterns are found, they may, upon examination, suggest that certain changes in land-use characteristics in the particular geographic areas and time periods sampled, have influenced residential sales prices. Such modifications might be the introduction of the High-Speed Line, construction of certain Interstate highways, suburbanization, etc.

If the analyses to be conducted, fail to develop a sufficiently convincing case for the existence of such effects upon residential sales prices, the results should not be taken as conclusive evidence that they are not present.

> "Economic observations rarely constitute a fair experiment, and the unavoidable interference of other factors will often obscure the working of a particular relation. When this happens it is regrettable, but it is certainly not an argument for rejecting the existence of that relation; by itself, the available evidence does not permit us to conclude either way. The trouble with economic data is not so much that we have no means of experimental control over the variables, but that we are unable to achieve greater discriminating power by improving the experimental design.
>
> In these conditions we must decide on other grounds whether to retain a particular hypothesis or not, and much will depend on its intuitive appeal or plausibility. At any rate the poor experimental quality of the processes which generate economic observations does not justify the highly skeptical attitude which underlies the traditional statistical tests of significance. We must be far less exacting of economic data than of the outcome of a fair trial by experiments that are subject to control or at least to conscious design. As a rule economic evidence is equally compatible with a wide range of alternative hypotheses.
>
> Since this is a common situation, econometrics is primarily concerned with the estimation of parameters rather than with the testing of hypotheses" Cramer (1969, pp.2-3).

This study will present estimates of the parameters of certain models. While significance testing is conducted, it is usually not very revealing, since even small deviations from null hypotheses will be found to be significant with the large samples analyzed. The question of how robust the model is against suspected violations of the parametric assumptions made for its estimation will also be investigated. Robust estimation procedures and editing of outliers will be employed to resolve this question.

The analytical procedures necessary to investigate models which incorporate individual housing characteristics, in addition to spatial and temporal measures, will be detailed. To illustrate these methods, a three-way analysis of variance model which includes a structural housing variable, number of stories, will be estimated. The residuals from this model will be decomposed in the manner recently advanced by Carroll and Chang (1970).

A Model of Spatial-Temporal Trends in the Residential Real Estate Market

Relations between Model Construction and Data Analysis

Mandel has discussed several questions of methodology that arise in the use of models in data analysis. His discourse is pertinent to the study of the New Jersey residential sales price data, and reflects the concerns and approaches of this study.

> "The central problem of data analysis is the achievement of just the right balance between prior assumptions on the one hand and the findings based on observation of the data on the other hand.
>
> To analyze a set of data without any prior assumptions about an underlying model is impossible. To adopt too rigid a set of assumptions, on the other hand, results in forcing the data into a mold in which they may not fit at all well.
>
> There exist cases in which this problem is of secondary importance: those are the relatively rare instances in which a completely specified mathematical model is available prior to analysis. In contrast, the problem is most pertinent when all the information available to the data analyst is that contained in the data themselves.
>
> Between those extremes, which we may refer to respectively as the purely theoretical case and the purely empirical case, lie a multitude of situations in which prior information is available to some extent, subject however to confirmation by the experiment, which also serves to supply the missing parts of the assumed model.
>
> Curve fitting and surface fitting are often treated in the purely empirical way. When this is done, it is essential to let, as it were, 'the data speak for themselves' by making the priorly assumed model as general and flexible as possible " Mandel (1969a, p.411).

In accordance with Mandel's position, the model presented below makes no assumptions as to the existence of impacts of the High-Speed Line. Rather, the dominant patterns in the residuals from the analysis of variance model are examined to determine whether or not they are identifiable with distance to the Line. Likewise, no assumptions are made as to the presence of chronologically monotonic patterns within the data, although two such trends are discerned. Econometricians, on the other hand, introduce specific trend functions into their models to estimate such effects. Of course, although trends of some form may be present, specific functions may not fit them well. Thus, the analysis of the time variable in this study, appears to have advantages over the more conventional approach.

Use of Prior Information in the Construction of the Model

Two items of prior information in the sense of Mandel, then, are available to assist in constructing a general and flexible model for residential sales price data. One is of a temporal nature, the other of a spatial one. The temporal item is cognizance of the fact that residential sales prices are affected by alterations in the purchasing power of money (see Spengler 1930, p. 129, for a discussion of why variations in real estate prices lag behind changes in commodity prices). This power, generally, decreases with the passage of time. Such inflationary phenomena are generally regarded as having a multiplicative effect on prices; i.e., it is anticipated that the prices of homes change by the same percentage for a given degree of inflation, *ceteris paribus*. In contrast, an additive effect would result in the prices of homes changing by the same amount of money, independent of the individual magnitudes of the prices. It appears implausible that inflation could be well represented as such an additive effect.

The spatial item of prior information that should be incorporated into a model of the residential sales price data, is the knowledge that prices are strongly related to geographic location. Houses in low income areas, in general, cost much less than houses in neighborhoods inhabited by high income households. Such neighborhood differences often persist for considerable periods of time. Whether this phenomenon is better represented as multiplicative or additive is not as easily resolvable as the case of temporal variations. However, there exists a general presumption that economic variables are more meaningful when treated as multiplicative; see Cramer (1969, pp.71-72).

A multiplicative model of residential sales price data, cross-classified by (a) time period, e.g. fiscal year, and (b) geographic location, e.g. Census block group, incorporates these two items of prior information. The model can be expressed as

$$p_{ij} = cb_iy_j \qquad i = 1,\ldots,m;\ j = 1,\ldots,n \qquad (6\text{-}1)$$

p_{ij} is the mean of the recorded sales prices in the i^{th} block group and the j^{th} fiscal year; c is a constant, scale factor. The b's are quantifications of time-stable neighborhood differences in sales prices in a sample of m block groups. The y's are parameters that reflect the transitory value of money over n fiscal years.

<u>Logarithmic Transformation of the Multiplicative Model</u>

Several distinct advantages can be gained by studying the multiplicative model (6-1) in its logarithmic form

$$\ln p_{ij} = \ln c + \ln b_i + \ln y_j \qquad (6\text{-}2)$$

A rationale for studying the logarithms of prices has been discussed by Cramer (1969, p.30):

> "For physical stimuli the hypothesis that their intensity as perceived by the individual should be measured on a logarithmic scale has been formulated long ago in the celebrated <u>Weber-Fechner law</u>; there is no reason why it should not equally apply to economic stimuli. In the case of economic variables the idea has indeed a strong intuitive appeal: whenever we wish to compare incomes or prices we use <u>relative</u> differences (usually on percentage base) as a matter of course. The transformation of economic variables to a logarithmic scale is at any rate an ancient tradition; Bernoulli expressed the utility of a sum of money by its logarithm in order to solve the Petersburg paradox as early as in 1738."

The powerful statistical technique of analysis of variance can be applied to yield estimates of the parameters of the log-linear model, (6-2). This can be seen by reparametizing the variables of (6-2) and introducing a term, ε_{ij}, for error, to obtain a standard two-way analysis of variance model.

$$z_{ij} = \mu + \beta_i + \gamma_j + \varepsilon_{ij} \tag{6-3}$$

The ε_{ij}'s are usually assumed to be independent, homoscedastistic (equal variance), normal deviates; the least-squares estimates of the parameters are then identical with the maximum-likelihood estimates. Homoscedasticity is more likely to hold on the logarithmic scale, than on the untransformed scale in economic applications because the coefficient of variation (the ratio of the standard deviation to the mean) of untransformed variables tends to be constant, rather than the variance; see Cramer (1969, p.86). (Grether and Mieszkowski, 1971, p. 13, in their study of determinants of real estate values in New Haven, did, in fact, note more variation associated with larger residential sales transactions.) Such heteroscedasticity can be approximately removed by the logarithmic transformation.

Normality of the error distribution may also be promoted by the logarithmic transformation.

> "[e]conomic variables like income and prices .... are by their very nature restricted to the positive range, barring some pathological exceptions. Unless the mean is quite large relatively to the standard deviation this rules out the normal distribution; and if we impose the restriction to positive values on a process which would lead to a normal distribution if it were to proceed unhampered, it may well result in a skew distribution of the lognormal type. The Central Limit Theorem leads to a normal distribution whenever the value of a variable is determined by a large number of <u>additive</u> independent random shocks; the simplest analogous model which excludes negative and zero values consists of a large number of nonnegative independent random shocks that have <u>multiplicative</u> effects. Since the latters' logarithms again satisfy the additive model this will lead to the lognormal distribution" Cramer (1969, pp.30-31).

The statistical nature of price changes has been extensively studied with stock market data by Granger and Morgenstern (1970, ch.7). It appears with such data that the logarithmic transformation does diminish heteroscedasticity. However, substantial deviations from normality are, generally, found both with untransformed and logarithmic prices. Their distributions are leptokurtic, i.e., there are too many observations near the means and also in the tails, for normality to hold.

Unbalanced Analysis of Variance Necessary to Estimate the Model

Equation (6-3) can be used to predict the mean logarithmic sales price for a block group x fiscal year category on the basis of a constant (μ), inflationary effects (γ's) and time stable neighborhood effects (β's). The least-squares estimates, and maximum likelihood estimates if ε_{ij} is $N(0,\sigma)$, can be relatively easily determined if the sample of residential sales examined contains the same number of sales in each block group in each fiscal year.

In such a design, μ could be estimated by the arithmetic mean of the logarithms of all the sampled residential sales prices, or equivalently, the logarithm of the geometric mean of these prices. Each β_i could be calculated as the difference between the mean logarithmic sales price in the i^{th} block group and μ. Each γ_j would be equal to the difference between the mean logarithmic sales price in the j^{th} fiscal year and μ. The sum of squares for the three sets of effects, μ, β's, and γ's, could be calculated independently of each other; i.e. the sets would be orthogonal.

These desirable properties are a consequence of balance, or equal cell sample sizes; see Sprent (1969, pp.112-117) for an illustration of how the normal equations simplify in these circumstances. For the unbalanced case, which inevitably arises with non-experimentally obtained data, such as the New Jersey residential sales price data, more elaborate estimation procedures must be undertaken.

The method of fitting constants is usually employed to estimate an unbalanced fixed-effects analysis of variance model; see Bancroft (1968, pp. 16-24) or Searle (1971, pp.443-451). This procedure is equivalent to regression on dummy (0,1) variables, one such variable being necessary for each parameter estimated. The term "constants" is used because the parameters, or effects, of fixed-effects models are sometimes referred to as constants. In a fixed-effects model, the effects are regarded as non-stochastic. It seems appropriate to regard inflationary and time stable neighborhood effects in such a manner in this study, since interest is focused on time periods themselves, and specific neighborhoods, with respect to their location. If, however, it were desired to make inferences concerning types of time periods or geographic areas, the effects should be treated as stochastic, i.e. not fixed.

Estimation of the Model

The model presented above was developed with the expectation that it would assist in revealing predicted impacts of the High-Speed Line upon residential land values. If the objective of identifying such ramifications is to be attained, it is necessary to estimate the model with a set of residential sales prices that should show the hypothesized influence of the Line. Such a set of data should clearly be drawn, at least in part, from areas proximate to the Line. It should also contain observations from periods both before and after the anticipated impacts, so that the data themselves may reflect any changes that occurred.

Data Sampled for Initial Analyses

The collection of data chosen for the first series of studies consists of the useable and acceptable non-useable residential sales prices in suburban

Camden County, i.e. exclusive of Camden City, for the six fiscal years 1965 to 1970. This time period extends over the construction of the Line beginning in mid-1964 and the commencement of operation in early 1969. The New Jersey segment of the Line lies entirely within Camden County. Subsequent analyses may be conducted with expanded samples to include later fiscal years as they become available, as well as the neighboring counties of Burlington and Gloucester, as discussed in Chapter 11. Considerable effort is involved in classifying the sales price data obtained from the State of New Jersey into the geographic units of this study, Census block groups. Therefore, initial studies have been limited to Camden County. Camden City itself has been excluded due to a combination of factors: (a) limitations in manpower needed to process the data; and (b) depressed housing conditions which seemed unlikely to respond to transit improvements.

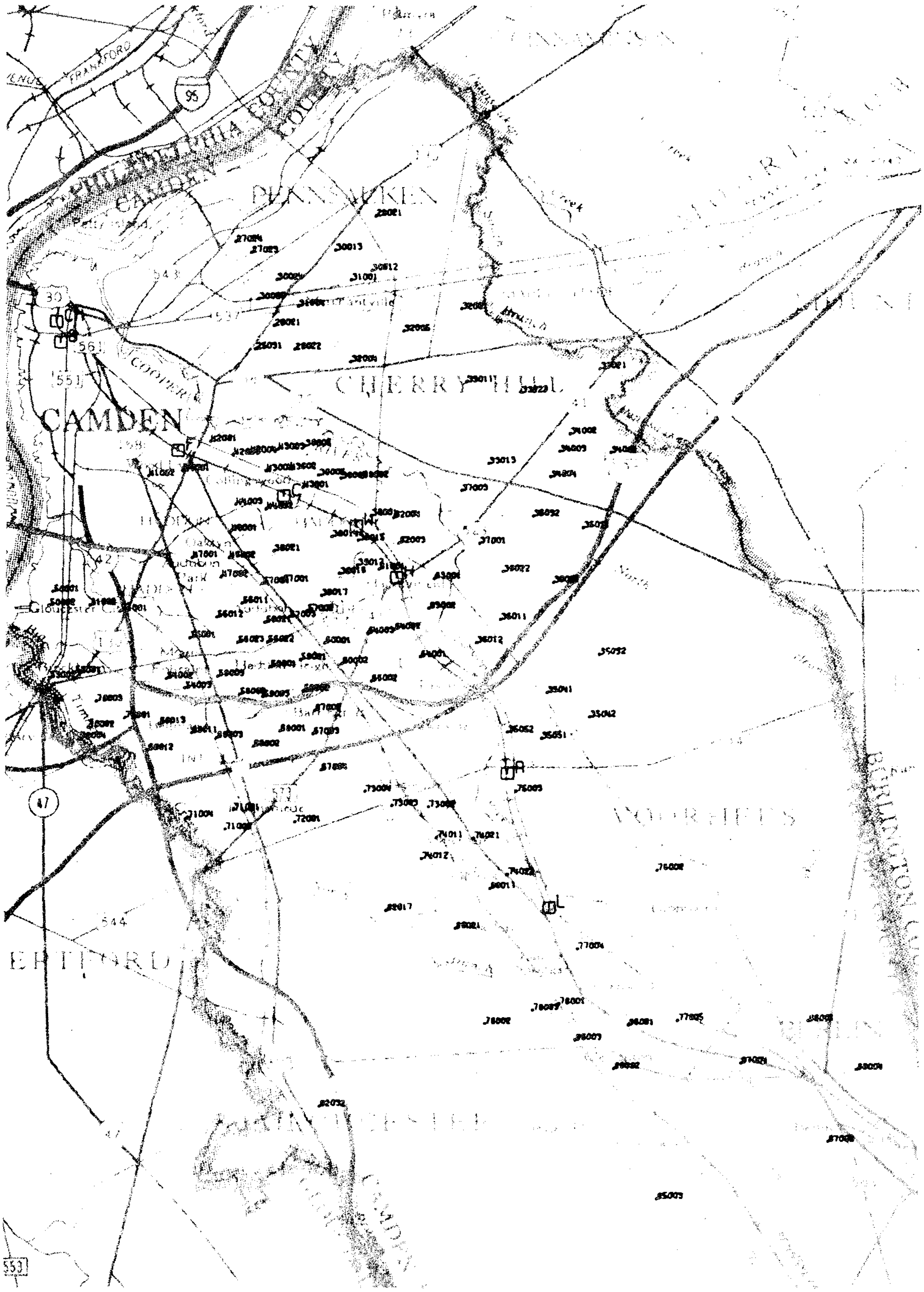
Not all the block groups in suburban Camden County were incorporated into the first series of analyses. Only those block groups that had at least five useable and/or acceptable non-useable residential sales in each of the six fiscal years were considered. 140 block groups satisfied this criterion. This cut-off rule was adopted after preliminary examination and analysis of the data revealed the presence of what appeared to be a significantly large number of uncharacteristic observations, or outliers, in the block group by year categories. Most of these suspect observations were conveyances with small sales prices, relatively to the others in the same category. It was desired to compare results obtained from an initial analysis that did not question the legitimacy of any of the recorded observations, or the parametric assumptions made to estimate the model, with more critical approaches that utilized robust estimation procedures and editing of outliers. To highlight the differences between these procedures, in general, several observations were required in each block group x year category. If, in fact, the initial analyses were found to be robust against the presence of these outliers, and other possible violations of model assumptions, the analyses could then be repeated for an expanded sample of block groups, containing many of those that were eliminated by the requirement of the cut-off rule.

12,464 sales were recorded in the sampled 140 block groups for the six fiscal years. Due to inaccuracies in the original data sources, approximately 75 sales were counted twice. The error has been corrected, so that subsequent samples analyzed do not contain duplicate sales. The numbers of sales recorded in each year did not fluctuate greatly. 1,833 were listed in 1965, 2,131 in 1966, 2,144 in 1967, 2,183 in 1968, 2,053 in 1969 and 2,120 in 1970. Numbers of sales recorded in the block groups varied more widely. Some averaged more than fifty sales a year, while others averaged less than ten.

Map 6-1 shows the population centroids, obtained from the U.S. Census MEDList for the State of New Jersey, of these 140 block groups, together with their corresponding Census tract and block numbers. The first four digits, when preceded by the prefix 60, denote the Census tract in which the block group lies. The final digit is the block group number within the Census tract. The eight Camden County stations of the High-Speed Line are denoted by squares on the map. The scale is 1 inch = 2 miles. The background map is also used for presentation of analytical results.

Analysis of the Data

The method of fitting constants, briefly described above, was applied to this collection of data; 147 parameters (1μ, 140 β's and 6 γ's) were estimated by solving a set of 147 linear simultaneous least-squares equations; see Bancroft (1969, p.18).



Map 6-1 Census Identification Numbers of 140 Block Groups

These equations express the conditions that the weighted row, column and grand sums of the estimates of the cell means in the logarithmic model (6-3), must equal the corresponding weighted sums of the observed means of the logarithms of the sales prices. The weights used, as elsewhere in the analysis, are the associated numbers of observations upon which the means are calculated.

Two constraints must be imposed so that this collection of simultaneous equations yields a unique solution. These are usually taken to be of the form

$$\sum_{i=1}^{m} w_i \beta_i = \sum_{j=1}^{n} v_j \gamma_j = 0, \qquad (6\text{-}4)$$

where the v's and w's are sets of weights. Typically, the weights are all chosen to be equal. This, as Kendall and Stuart (1968, p.25) argue, stems from the fact that in most analyses the cell sample sizes are not proportional to population sizes. However, the numbers of observations in cells may bear relation to the population sizes, i.e. the numbers of possible observations. It is then more appropriate to employ the total numbers of observations in rows and columns as weights, in expressing linear dependence. Such "restrictions assume that our sample has approximately the same stratification as the parent population and that the unequal frequencies in the subclasses will affect the values of marginal means and the grand mean" Fei (1946, p.110). Sets of weights based upon observed frequencies have, on the applicability of these arguments to the sample of sales price data, been employed in this study. The choice of weights does affect the estimated values of the parameters of the model, since these parameters themselves are not estimable. However, the sum of squares for interaction, an important element in the study, is not affected by the particular selection of weights; see Scheffe (1969, p.114).

The solution of the full set of equations is greatly facilitated by substituting the smaller set of unknown parameters (six γ's), for the larger set of unknown parameters (140 β's). Bancroft (1968, pp.22-24) has described, in detail, computational procedures to determine the effects in an unbalanced analysis of variance. These calculations, as most in this study, were programmed, utilizing double precision arithmetic when appropriate, in MATLAN (Matrix Language; IBM, 1968). MATLAN is a programming system designed to simplify handling and computation involving matrices. Storage management for matrices is done automatically. Thus, core size is not a primary limitation for matrices. Segmenting algorithms are used if the storage requirements of the matrices exceed available core size. A large set of statements are available to conduct operations such as matrix generation, matrix manipulation and matrix arithmetic; FORTRAN subprograms can be called from a MATLAN main program. The use of this programming language greatly facilitated manipulation of the large collection of residential sales price data.

<u>Main Effects</u>

Table 6-1, following the format of Bancroft (1968, p.24) presents the summary statistics of the unbalanced analysis of variance.

The phrases "eliminating fiscal years" and "eliminating block groups" are necessary in the tabular presentation, due to the unequal sample sizes in the block group x fiscal year categories. The two classificatory factors are not orthogonal, as in the balanced case, so that the sum of squares for one cannot be totally separated from the sum of squares for the other. Thus, a form of multicollinearity exists in which it is impossible to completely isolate the effect of one classification from that of the other. However, since the subclass sum of squares, 1518.78, almost equals the sum of the three sums of squares, 1332.98 + 109.17 + 75.89 = 1518.04 , such multicollinearity

Table 6-1

Unbalanced Analysis of Variance
of Suburban Camden County 1965-70 Residential Sales Price Data

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-ratio
Subclass	839	1518.78		
Block groups eliminating fiscal years	139	1332.98	9.590	121.39*
Fiscal years eliminating block groups	5	109.17	21.834	276.38*
Interaction of block groups and fiscal years	695	75.89	.109	1.37*
Within cell	11624	923.40	.079	
Total	12463	2442.18		

*significant at $\alpha = 0.01$ level

is by no means severe. The subclass sum of squares is the additional amount of explanation obtained by fitting the observed means to the data, over that obtained by fitting only the grand mean. In the orthogonal case, it equals the sum of the three sums of squares below it.

The designations, "block groups eliminating fiscal years" and "fiscal years eliminating block groups," indicate the additional amount of explanation obtained by fitting one of the classifications after the other one has already been fitted. The sum of squares for "block groups eliminating years" is the difference between the sum of weighted squares of the estimated cell means under the full model (6-3) and the sum of weighted squares obtained by fitting the model ignoring the block group classification. The sum of squares for "years eliminating block groups" is obtained in an analogous fashion. The two F-ratios for these terms are highly significant, thus, confirming the items of prior information upon which the model was constructed.

The estimated value of the constant term (μ) obtained was 9.635. This is the logarithm of the geometric mean, $15,297, of the 12,464 residential sales prices in the sample. (The geometric mean of r positive numbers is the r^{th} root of the product of the r numbers. It can never be larger than the arithmetic mean, for a sample consisting of only positive numbers. The arithmetic mean was independently computed; its value is $16,729.)

The estimates of the γ's obtained are as follows:

$$\begin{aligned} \gamma_{1965} &= -.0996 \\ \gamma_{1966} &= -.0910 \\ \gamma_{1967} &= -.0464 \\ \gamma_{1968} &= -.0092 \\ \gamma_{1969} &= .0652 \\ \gamma_{1970} &= .1709 \end{aligned} \qquad (6\text{-}5)$$

The values of the γ's are monotonically increasing with time, as was anticipated from prior knowledge of the existence of inflationary trends.

The antilogarithms of the γ's are estimates of the year parameters (y's) in the multiplicative model (6-1). As shown below, these estimates are increasing at a generally increasing rate with time.

		per cent change in exp (γ_j)	
exp (γ_{1965}) =	.905		
exp (γ_{1966}) =	.913	0.88%	
exp (γ_{1967}) =	.955	4.60%	
exp (γ_{1968}) =	.991	3.77%	
exp (γ_{1969}) =	1.067	7.67%	
exp (γ_{1970}) =	1.187	11.15%	(6-6)

These estimates, however, are not unbiased. If samples of the residential sales price data were repeatedly analyzed by the method of fitting constants, the average values of the y's obtained by the exponential transformation of the γ's, would not converge to their population values; see Kruskal (1968, p.188) for a discussion of the properties of inverse transformation of estimates.

It is of interest to compare these values with the consumer price index for homeownership issued monthly by the U.S. Bureau of Labor. The costs of home purchase, mortgage interest, taxes, insurance, and maintenance and repairs are included in this index, for which the base period of 1957-1959 is assigned the value 100. The second column in Table 6-2 presents the average value of the index for metropolitan Philadelphia for the twelve months of each of the six fiscal years. The third column shows these figures proportionally reduced so that the value for fiscal 1965 is equal to its estimate (.905), shown above, in the multiplicative model (6-1). The last column repeats the estimates of the year parameters, y_j.

Table 6-2

Comparison of Mean Consumer Price Index with Year Effects

year	mean consumer price index	reduced consumer price index*	estimate of y_j
1965	111.8	.905	.905
1966	114.3	.926	.913
1967	116.9	.947	.955
1968	119.4	.967	.991
1969	127.7	1.034	1.067
1970	142.7	1.155	1.186

*column 2 divided by 123.7, so that 111.8/123.7 = .905.

The consumer price index and the estimates obtained in this analysis both indicate that there has been considerable acceleration in the costs of houses in fiscal 1969 and 1970.

The antilogarithms of the β's are indicators of time stable relative costs of homes in the 140 block groups. Map 6-2 associates these values, rounded to two decimal places and multiplied by 100 for ease and clarity of presentation, with the population centroids of the corresponding block groups. Map 6-3 ranks these values from a high of 217 (rank 1) to a low of 33 (rank 140). Most of the highest priced neighborhoods are in Cherry Hill and Haddonfield. Gloucester City, directly across the Delaware River from Philadelphia and south of Camden, has several of the low values. The area south of the Lindenwold terminus also has a relatively inexpensive stock of homes.

Interaction

The F-ratio for interaction, 1.37, while not large, is significant at the α=.01 level for the associated degrees of freedom (695 and 11624); in such large samples, small deviations from the null hypothesis can be significant. The sum of squares for interaction is equal to the sum of weighted squares of the residuals of the means of the logarithmic sales prices from the estimates of these means under the log-linear model (6-3). Significant interaction implies that the model has not provided a complete explanation of the data, and that further elaboration may be meaningful. The residuals, in such a case, cannot be explained solely on the basis of random variation.

Since the hypothesis that the suburban Camden County 1965-1970 residential sales price data can be explained solely on the basis of inflation (the γ parameters) and on time stable neighborhood differences (the β parameters) is rejected by the F-test for interaction, the interaction residuals may legitimately be examined to determine if explanatory variables can assist in their interpretation. Proximity to the High-Speed Line may be one such factor.

Decomposition of the Interaction Matrix

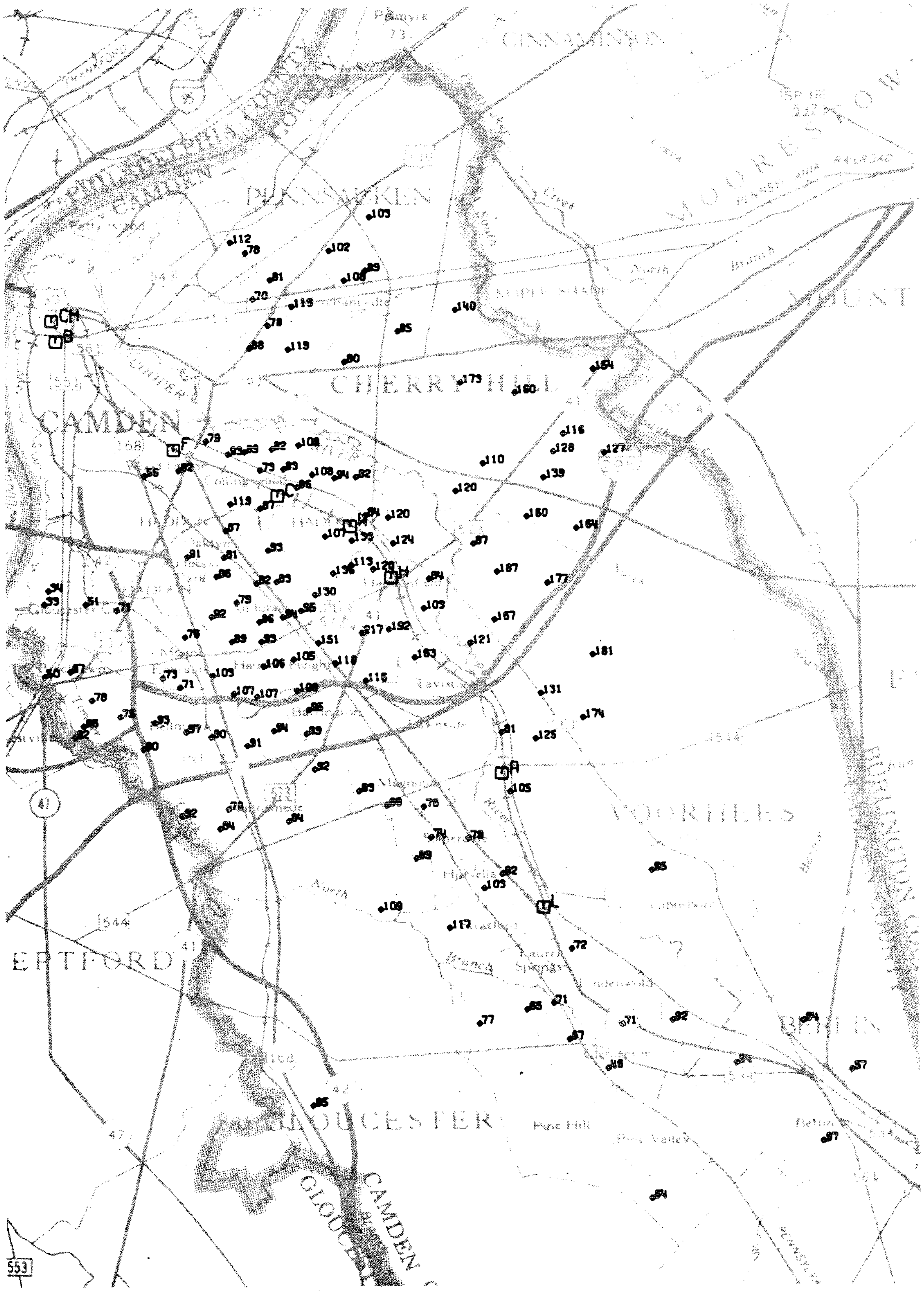
Singular Decomposition

Strategies for isolating structure in interaction matrices have been described recently by Mandel (1969b, 1970, 1971), Gabriel (1971), Gollob (1968) and Good (1965, 1969). All these approaches utilize a common analytical procedure, the singular, or canonical, decomposition of a matrix.

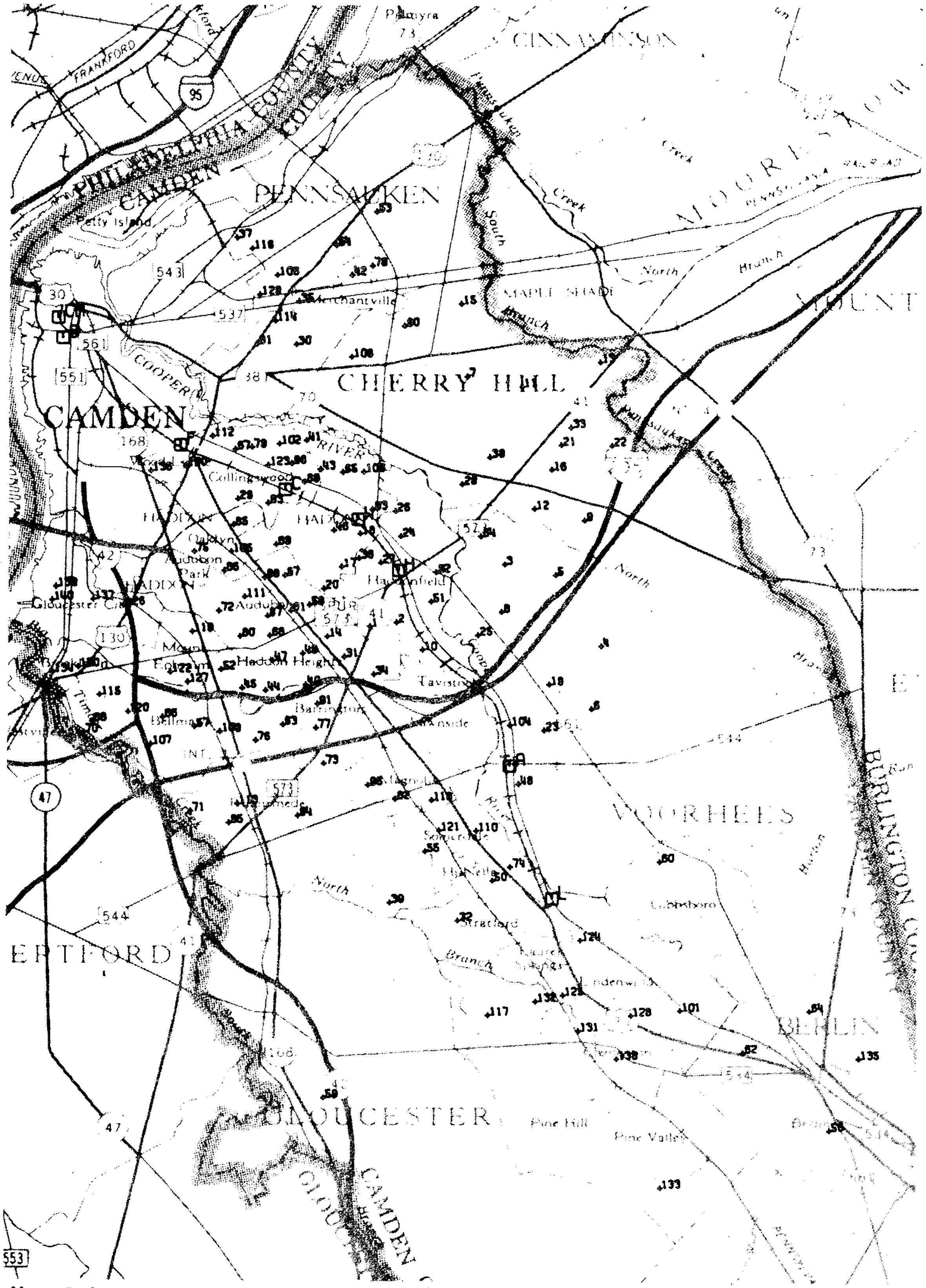
> "If M is an arbitrary real m x n matrix, of rank r, it can be expressed as the sum of r matrices of rank one in a variety of ways. Of these, perhaps the most useful is the 'singular decomposition'
>
> $$M = \theta_1 \underline{u}_1 v_1' + \theta_2 \underline{u}_2 v_2' + \ldots + \theta_r \underline{u}_r \underline{v}_r'$$
>
> where the column vectors $\underline{u}_1, \underline{u}_2, \ldots, \underline{u}_r$ are orthonormal (orthogonal and each of length one) and each has m components, and the row vectors $\underline{v}_1', \ldots, \underline{v}_r'$ are real and positive, and are the square roots of the positive eigenvalues of the m x m matrix MM' or the n x n matrix M'M, each of which is a symmetric square semipositive definite matrix. The vectors $\underline{u}_t$ and $\underline{v}_t$ are eigenvectors of MM' and M'M respectively. The numbers $\theta_1, \theta_2, \ldots,$ are the <u>singular values</u> of M and the vectors $\underline{u}_1, \underline{u}_2, \ldots, \underline{v}_1, \underline{v}_2, \ldots,$ are the right and left <u>singular vectors</u>. When M is square and symmetric the singular decomposition reduces to the better known spectral decomposition, where the left and right singular vectors are identical and reduce to eigenvectors " Good (1969, p. 823).

The singular decomposition of M can be employed to understand the effect of M regarded as a linear transformation; Good (1969, p.829).

The importance of the singular decomposition is that the sum of the first s terms is among all matrices of rank s, the closest one to M in a least squares



Map 6-2 Time Stable Relative Costs of Houses in 140 Block Groups
[values are $100 \cdot \exp(\beta_i)$]



Map 6-3 140 Block Groups Ranked by Time Stable Relative Costs
[1 = highest cost; 140 = lowest cost]

sense. Gabriel (1971) has proposed the following proportion as a measure of the closeness of the approximation of rank s;

$$(\theta_1^2 + \theta_2^2 + \ldots + \theta_s^2)/\sum_{k=1}^{r}\theta_k^2$$

Application of the Singular Decomposition to Analysis of Variance

Mandel (1969b, 1970, 1971) and Gollob (1968) have specifically studied the application of the singular decomposition to the search for structure in interaction matrices obtained from analyses of variance. In his article, "A New Analysis of Variance Model for Non-additive Data," Mandel motivates and describes his approach in the following manner:

> "Using the common analysis of variance notation, the additive model is usually represented by
>
> $$z_{ij} = \mu + \beta_i + \gamma_j + \varepsilon_{ij}$$
>
> Few sets of data obey a strictly additive model. To obtain an algebraic representation for the more general, non-additive situation, it is customary to write
>
> $$z_{ij} = \mu + \beta_i + \gamma_j + \eta_{ij},$$
>
> where η_{ij} is referred to as the interaction between rows and columns, and where η_{ij}, unlike ε_{ij}, is no longer considered as just random error. However, a part of η_{ij} may be just random error. Because of the presence of η_{ij}, which, apart from its random error component, is a function of two variables, all advantage of the additive model will be lost, unless one can again partition the non-random portion of η_{ij} into functions of only one variable each. Obviously, an additive partitioning of η_{ij} is impossible since all additive parts have already been extracted from the model. We propose a partitioning of η_{ij} into the sum of multiplicative functions of i and j, according to the model
>
> $$z_{ij} = (\mu + \beta_i + \gamma_j) + (\theta_1 u_{1i} v_{1j} + \theta_2 u_{2i} v_{2j} + \ldots).$$
>
> Thus, the interaction term is represented by
>
> $$\eta_{ij} = \sum_{t=1}^{h} \theta_t u_{ti} v_{tj}$$

> As mentioned above, part of the interaction may well be random error. Consequently, in practice, the partitioning of the interaction into multiplicative terms is carried out only partially; i.e., only a few multiplicative terms of the $\theta u_i v_j$ type (generally one or two such terms) are retained; the remaining terms are pooled together and considered as experimental error" Mandel (1971, pp.1-2).

Theil (1967, ch. 11), studying economic variables, has also found a multiplicative decomposition of error variances to be an appropriate form of analysis.

Least-squares estimates of the last equation above are obtained by calculation of the singular decomposition of the residual matrix. The log-linear model (6-3) can, thus, be extended to include multiplicative terms. If two such terms were incorporated, the model could be written as:

$$z_{ij} = \mu + \beta_i + \gamma_j + n_{ij}^{-\frac{1}{2}}(\theta_1 u_{1i} v_{1j} + \theta_2 u_{2i} v_{2j}) \tag{6-7}$$

Transforming this relation (6-7) into the extension of the multiplicative model (6-1), we obtain:

$$p_{ij} = cb_i y_j \exp [n_{ij}^{-\frac{1}{2}}(\theta_1 u_{1i} v_{1j} + \theta_2 u_{2i} v_{2j})] \tag{6-8}$$

The u's and v's are, thus, exponential parameters in this relation.

Mandel (1969b, p.322) has indicated that traditional principal components analysis is deficient in its failure to treat rows and columns symmetrically. Decomposing interaction residuals, rather than deviations from the column means, allows one to proceed in a symmetrical manner. Clusters of rows and clusters of columns can then be interrelated. Good (1969, p.828) refers to such procedures as "conjugate clumping," and places them in the science of "botryology." In addition, the interaction residuals are measures, standardized by sample sizes. Thus, the difficult question encountered in principal components analysis of assigning weights, is solved by the formal procedures suggested by Mandel and Gollob.

<u>Statistical Tables for Evaluation of Decomposition</u>

Mandel's special contribution is the tabulation of a new table of statistics. These allow one to compare the percentage of the total sum of squares of a matrix accounted for by a term of that matrix's singular decomposition, with the expected percentage that would be obtained if the entries of the matrix were only random, normal deviates.

These statistics were computed for matrices of certain preselected dimensions by a series of Monte Carlo experiments. The first three terms of the singular decomposition were calculated for each of 625 matrices for each pair of chosen dimensions. The entries of these matrices were random normal deviates. The expected percentages of variation explained by the terms are given by Mandel's table; an extract is reproduced here as Table 6-3.

For an interaction matrix of dimensions 100 x 6, the table should be entered with $r = 99$ and $s = 5$ degrees of freedom. The first term of the singular decomposition of a 100 x 6 interaction matrix, thus, can be expected to explain 26.96% of the interaction sum of squares, if the interaction is only composed of random gaussian error. The second and third terms have expectation of 22.72% and 19.66%, respectively, in similar circumstances.

Since the percentage explained by the first term decreases with increasing dimensions, 26.96% is an upper bound for the analogous, untabulated statistic in interaction matrices of dimensions 140 x 6. The statistics for the second and third terms do not behave in such a monotonically decreasing fashion. It is clear that 20% serves as a lower bound for this statistic, since the first term of the decomposition must account for, as least, as much variation as any of the other four non-null terms.

Table 6-3

Expected Percentages of Variation Explained by Terms of Singular Decomposition

t	r	s: 2	3	4	5	6	7	9	15	19
1	2	88.73	83.78	79.24	75.32	74.70	72.51	70.92	65.26	63.43
	3	83.78	74.54	69.42	65.66	62.91	60.68	57.64	51.63	49.72
	4	79.24	69.42	63.83	59.06	55.83	53.67	50.46	44.18	41.89
	5	75.32	65.66	59.06	54.05	51.57	48.48	44.96	38.85	36.74
	9	70.92	57.64	50.46	44.96	41.47	38.66	34.55	28.73	26.54
	49	59.03	43.39	35.36	29.98	26.36	23.73	20.14	14.53	12.66
	99	56.17	40.44	32.14	26.96	23.40	20.82	17.15	11.90	10.21
2	2	11.27	16.22	20.76	24.68	25.30	27.49	29.08	34.74	36.57
	3	16.22	22.39	25.06	26.69	27.67	28.61	29.56	31.21	31.51
	4	20.76	25.06	26.34	27.25	27.75	28.13	28.13	28.17	27.96
	5	24.68	26.69	27.25	28.09	27.41	27.72	26.85	26.17	25.55
	9	29.08	29.56	28.13	26.85	26.04	25.05	23.83	21.18	19.88
	19	36.57	31.51	27.96	25.55	23.77	22.24	19.88	16.28	14.83
	49	40.97	32.72	27.44	23.76	21.28	19.36	16.61	12.38	10.93
	99	43.83	32.93	26.80	22.72	20.01	17.87	14.98	10.59	9.10
3	3		3.07	5.52	7.65	9.42	10.71	12.80	17.16	18.77
	4		5.52	8.56	11.08	12.75	13.41	15.09	17.83	18.86
	5		7.65	11.08	12.76	13.86	14.96	16.10	17.66	18.08
	9		12.80	15.09	16.10	16.38	16.57	16.58	15.79	15.42
	49		23.89	21.31	19.37	17.57	16.21	14.18	10.88	9.71
	99		26.63	22.65	19.66	17.38	15.81	13.40	9.66	8.31

Calculation of Decomposition

To pursue the approach suggested by Mandel, the complete singular decomposition of the interaction matrix was determined. A sophisticated packaged MATLAN subprogram which employs the power method, sometimes referred to as von Mises' Method, was utilized:

> "This subprogram computes eigenvalues and eigenvectors to a symmetric matrix. An arbitrary starting vector is successively multiplied by the matrix. It will finally converge towards the eigenvector, which belongs to the eigenvalue of maximum modulus. To speed up the computation, a shift of origin is applied, as well as another process for speeding of convergence described by V.W. Worodjow. If an eigenvector has been found it is removed by a process, known as Hotelling deflation. The corrections added to the iterates during the speeding process are used as initial guesses for the next eigenvector" IBM (1968, p.171).

The subprogram was accurate to fourteen significant digits in its application to the data. Thus, the sum of squares of the individual terms of the decomposition, virtually, equalled the sum of squares of the interaction matrix decomposed. Results were much more accurately and speedily achieved through use of the subprogram than by a simple, iterative procedure initially employed. Since the last terms of the singular decomposition could be of interest (Gnadesikan and Wilk 1969, p.599), the entire decomposition was computed. Partial results from this decomposition are presented in Table 6-4.

Results of Decomposition

First Term The first term of the decomposition accounts for 29.85% of the interaction sum of squares. This is greater than would be expected if the interaction were just gaussian error, since 26.96% is a known upper bound on the untabulated value of the statistic corresponding to a 140 x 6 interaction matrix. Though larger than expected under the null hypothesis, the figure of 29.85% does not appear to be highly substantial. The same impression is

Table 6-4

Right Singular Vectors (Fiscal Years) of 140 x 6 Interaction Matrix

t	1	2	3	4	5	6
$v_{t(1965)}$	.465	-.240	.257	.681	-.115	.382
$v_{t(1966)}$	.226	-.637	-.260	-.424	.318	.443
$v_{t(1967)}$	.367	.636	-.515	-.104	-.122	.413
$v_{t(1968)}$	.006	.356	.689	-.208	.452	.389
$v_{t(1969)}$	-.368	-.083	.202	-.326	-.739	.406
$v_{t(1970)}$	-.680	.015	-.219	.444	.290	.414
% of Interaction Sum of Squares Explained	29.852	20.891	19.870	15.200	13.848	.003

obtained from the F-ratio for interaction, 1.37. These two statistics appear to reinforce one another.

The components (v_{1j}'s) of the first right singular vectors(fiscal years) are monotonic with time, with the exception of 1967, as shown in Table 6-4, column 1. Thus, a plausible interpretation of the first term is that it represents a time trend in the interaction matrix. To understand further the structure of the first term of the decomposition, it is necessary to examine the first left singular vector (block groups). Map 6-4 shows three significant digits of the components (u_{1i}'s) of this vector, multiplied by 1000, at the population centroids of the block groups. Map 6-5 ranks these values from a high of 247 (rank 1) to a low of -284 (rank 140).

Block groups with high positive components can be contrasted with block groups with strongly negative components. If the component associated with a block group in this first left singular vector is positive, the cell entries corresponding to that block group and the years 1965-68 in the first term of the singular decomposition are positive. (The first term is equal to the product of a positive scalar and the outer product of the first pair of singular vectors.) Similarly, the cell entries in the first term for 1969 and 1970 for such a block group are negative. Reverse cell signs hold for block groups associated with negative components. Since the first term of the singular decomposition is the matrix of rank one that best approximates, in least squares, the interaction matrix, these cell entries are approximations to the actual values of the interaction matrix.

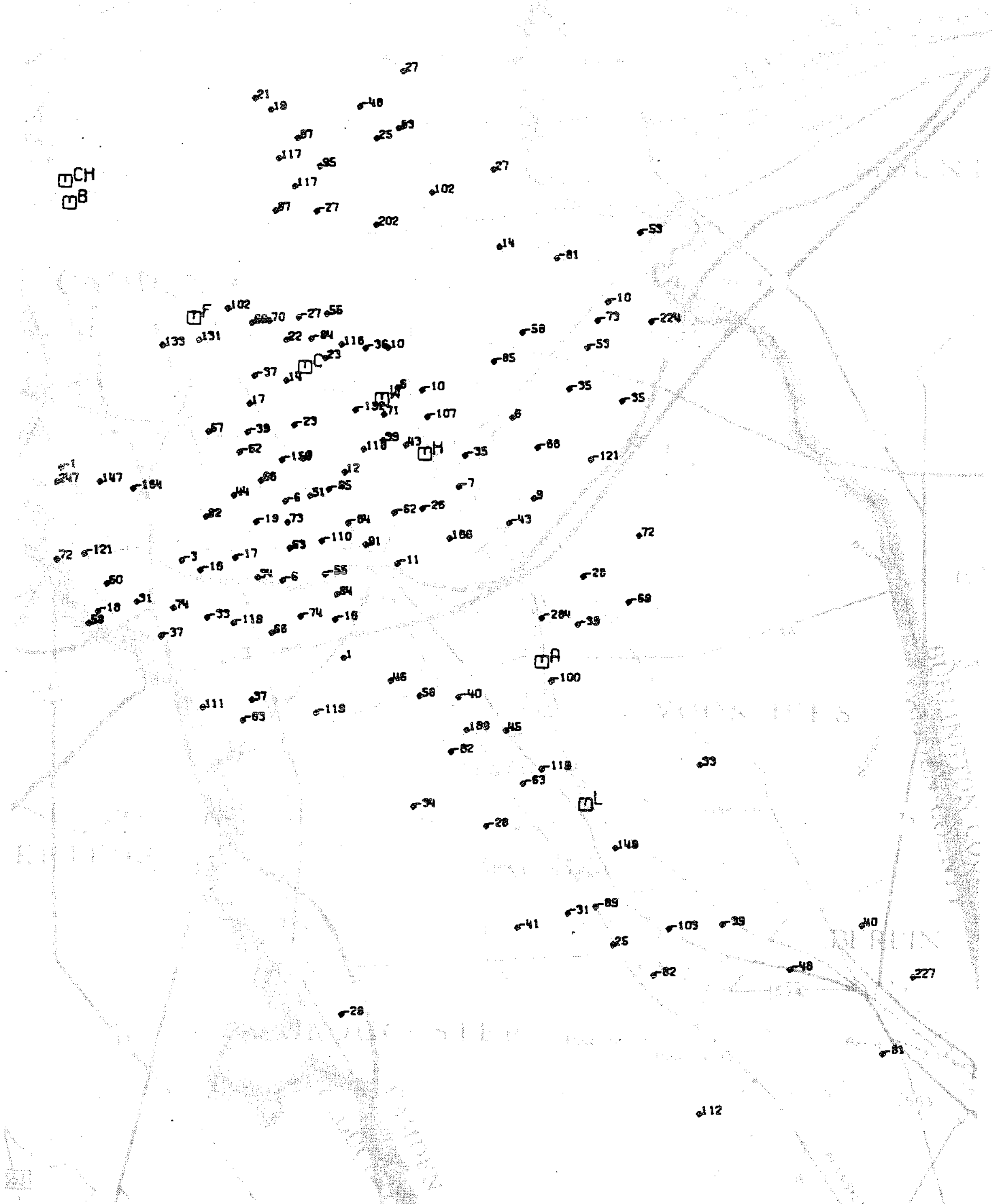
The first left singular vector for block groups, then, provides a contrast among these geographic units. Block groups with positive components in this vector, appear to decline relatively in value over the six-year period (except for 1967), after having taken into account inflationary effects and time-stable neighborhood differences. Block groups with negative components seem to have risen relatively in value over the six years (except for 1967), more than would be expected on the basis of the two main effects.

The block group selected by this analysis as the most rapidly rising in value, is located in Cherry Hill, just north of the Ashland Station. The recorded sales prices, their means and the model estimates for this block group for the six fiscal years are shown in Table 6-5. Several additional block groups with relatively large increasing values are found near this station. A large concentration of rising values can also be found in Cherry Hill, one of the developing suburban areas. The area south of the Lindenwold terminus also appears to be relatively gaining in value.

An easily distinguishable collection of block groups, at the other extreme with the least rapidly rising values, are located in the areas adjacent to Camden City. A block group in Gloucester City adjacent to the Walt Whitman Bridge is a prototypical example. The recorded sales prices, means and model estimates for this geographic unit are shown in Table 6-6.

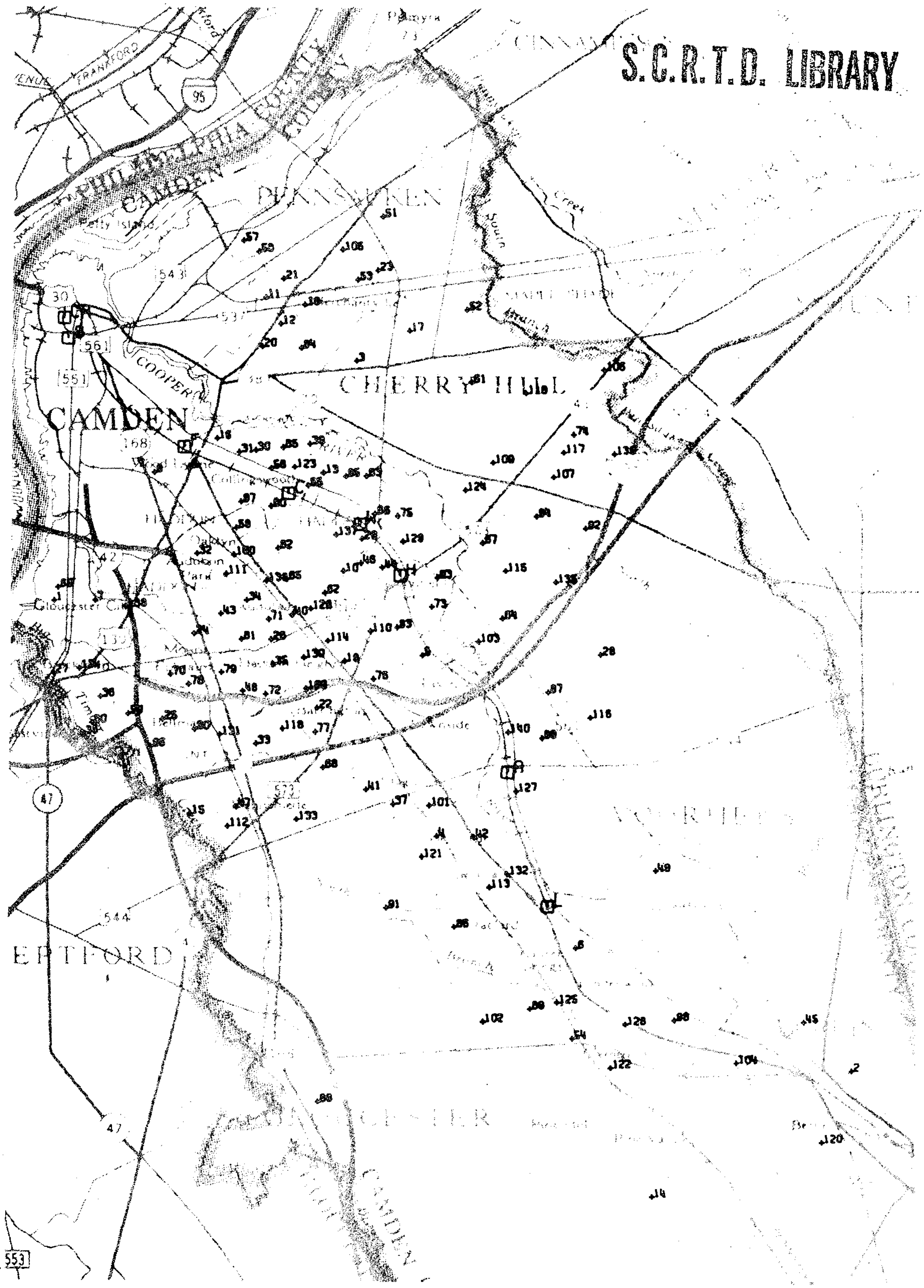
A large cluster of positive values are also found in Pennsauken. Block groups in the vicinity of the Ferry Avenue station in Camden, also manifest relatively depressed housing prices. This last item appears consistent with Spengler's conclusion that the introduction of transit facilities does not stimulate growth in otherwise stagnant areas.

<u>Interpretation of First Term</u> Maps 6-4 and 6-5 provide a contrast between the older, more established areas of Camden City, e.g., Pennsauken, and the developing suburban sections, such as Cherry Hill. Any impacts of the High-Speed Line that are reflected in the first term, appear to be of secondary importance. Repercussions of the Line that are present in the first term, may occur in the manner described by Spengler, i.e., neighborhoods already



Map 6-4

Principal Contrast among 140 Block Groups
[values are 1000 · u_{1i}]



Map 6-5

140 Block Groups Ranked by Principal Contrast
[1 = greatest positive value of u_{1i}]

Table 6-5

Recorded Sales Prices, Cell Means, and Model Estimates for Block Group with Most Rapidly Increasing Value

(Census Tract 603505, Block Group 2)

	1965	1966	1967	1968	1969	1970
	1500	5000	6850	6700	11900	16000
	6258	6950	9300	8900	13500	18500
	8500	7250	10400	11000	13900	19250
	10750	8500	10900	12500	16600	20000
	11750	9000	11700	12500	17000	20000
	12500	10500		12500	18500	21000
	13500	12250		14000	20400	24900
	15500	13500		14000		34000
	20000	13500		15000		
		14000				
		14500				
		14750				
		15550				
Cell means	11140	11169	9830	11900	15971	21706
$cb_i y_j$	11231	11328	11844	12294	13243	14719
$cb_i y_j \exp(n_{ij}^{-\frac{1}{2}} \theta_1 u_{1i} v_{1j})$	9109	10409	9491	12263	15985	20372

[$c = 15{,}297$; $b_i = 0.81$; y_j given in equation (5-3); $u_{1i} = -0.284$; v_{1j}'s given in Table 6-1; $\theta_1 = 4.76$]

Table 6-6

Recorded Sales Prices, Cell Means and Model Estimates for Block Group with Least Rapidly Increasing Value

(Census Tract 605000, Block Group 2)

	1965	1966	1967	1968	1969	1970
	650	2500	3500	2300	960	2000
	2150	3000	4000	2500	999	3200
	4000	3250	4800	2800	1000	6500
	4500	3500	5500	3700	1250	6500
	4500	3500	5800	4000	2100	7500
	6000	4000	6700	4250	2400	8500
	7000	4500	7300	5900	3600	
	7100	5000	8750	6250	3800	
	8100	5000	9000	6500	4500	
	9250	5000	15000	6500	5800	
	9350	5000		6825	6000	
	9800	6000		8000	6000	
		6500		8700	6050	
		7000		10000	6500	
		9200			7200	
		10500			8000	
					8000	
					8000	
					8000	
					9300	
					10100	
					15000	
Cell Means	6033	5321	7035	5588	5662	5700
$cb_i y_j$	4555	4595	4804	4896	5372	5970
$cb_i y_j \exp(n_{ij}^{-\frac{1}{2}} \theta_1 u_{1i} v_{1j})$	5333	4890	5504	4995	4899	4310

[c = 15,297; b_i = 0.33; y_j's given in equation (5-3); u_{1i} = 0.247; v_{1j}'s given in Table 6-1; θ_1=4.76] undergoing expansion for other reasons, may receive an additional impetus from the construction of the Line. The especially rapid increase in sales prices in the block group in Cherry Hill, just north of the Ashland station, may be attributable to such a mechanism.

That the principal contrast of changing land values, should be a chronological one between well developed areas and growing suburbs, does not appear unreasonable in light of what is known concerning the changing structure of American urban areas. The concept of "filtering" in housing markets may also be of value in interpreting the first term of the decomposition. Briefly, it states that new dwellings are built primarily for well-to-do households. Older structures left unoccupied by higher-income households, moving into new housing, then "filter down" to lower-income groups; see Smith (1970).

American cities have undergone extensive suburbanization since World War II; Clawson (1971, pp.45-46) documents this phenomenon, in depth. Stimuli which have encouraged this trend are: (a) attractiveness of new houses available in the suburbs; (b) the desire to escape from problems of older residential areas; (c) convenient financing of new suburban homes; (d) favorable income tax provisions, allowing deduction of interest and local real estate tax payments; and (e) the value of the purchase of a house as a hedge against inflation; see Clawson (1971, pp.45-46). The role of the automobile in this regard should also be emphasized; see Rae (1971, ch.11).

Accompanying suburbanization have been rapidly accelerating land prices, more than can be accounted for on the basis of overall inflation; Clawson (1971, pp.133-134) states:

> "It should be clearer now why suburban land prices tend to ratchet upward. Landowners have reservation prices, below which they will not sell, but they are prepared to take advantages of higher

prices. Developers will pay higher prices, perhaps reluctantly, rather than cease to operate, especially during periods of high demand for housing. The pressures are all upward, with no effective pressure leading to a reduction in land price. The uncertainty lies in how rapidly the upward pressures will be effective. The upward spiral of suburban land prices in the past was inevitable given the structure of the market" Clawson (1971, p.126).

"The market tends to push up the price of raw land dollar by dollar as more and more speculation occurs, to levels beyond those explainable in terms of alternative land use values of the land plus costs of development. The home buyer, of course, must buy the whole package, including the lot on which his house is built. If the lot price inches up, the kind of house that can profitably be built on it rises even faster, since the cost of the site is only a fifth or a fourth of the total sales price of the finished house" Clawson (1971, p.140).

The introduction of new structures into the housing market should thus lead to steeply rising mean sales prices, in areas where this process is of substantial magnitude, such as Cherry Hill. The first term of the decomposition of the interaction residuals, appears to verify the occurrence of this effect.

The apparent importance of the effect suggests that age-of-dwelling should be an explicit variable in the analysis. However, no such variable is available in either the New Jersey land sales price data file, or the data source to which it has been matched in this study, the Camden County Tax Assessor's File.

Sixth Term of Decomposition No strong interpretations seem possible for the significance of the second through fifth terms of the decomposition. The sixth term should theoretically explain no part of the interaction sum of squares, since removal of the main effects from the data matrix reduces its rank by one. Mandel (1970) has established this proposition by proving that the frequency distribution of the singular values of an r x s interaction matrix is the same as the distribution of the singular values of an (r - 1) x (s - 1) matrix of independent random normal deviates.

Gnadesikan and Wilk argue that the last term of a decomposition can often be meaningfully interpreted:

> "One hope in the case of principal components analysis is that the bulk of the observations will be near a linear subspace, and thence that one can employ a new coordinate system of reduced dimension. Generally, interest would be in those coordinates along which the data show their greatest variability. However, while the eigenvector corresponding to the largest eigenvalue, for example, provides the projection of each point onto the first principal component, the equation of the first principal component coordinate is given by the conjunction of the equations of planes defined by the remaining eigenvectors. More generally, if most of the variability of a p-dimensional sample is confined to a q-dimensional linear subspace, that subspace is described by the (p-q) eigenvectors which correspond to the (p-q) 'small' eigenvalues. For purposes of interpretation--detection or specification of constraints on, or redundancy of, the observed variables--it may often be the relations which define near constancy (i.e., those specified by the smallest eigenvalues) which are of greatest interest" Gnadesikan and Wilk (1969, p.599).

Table 6-4 gives the values of the components (v_{6j}'s) of the sixth right (fiscal years) singular vectors, while Map 6-6 shows the values of three significant figures of the components (u_{6i}'s), multiplied by 1000, of the sixth left (block groups) singular vector. Map 6-7 shows the rankings of these values from a high of 472 (rank 1) to a low of -268 (rank 140).

In comparison with the first term of the decomposition, which constitutes the strongest contrast among block groups and years, the sixth term provides the weakest contrast. An appropriate interpretation of the term is, however, difficult.

Effect of Outliers upon the Analysis

Parametric Assumptions of the Unbalanced Analysis of Variance Model

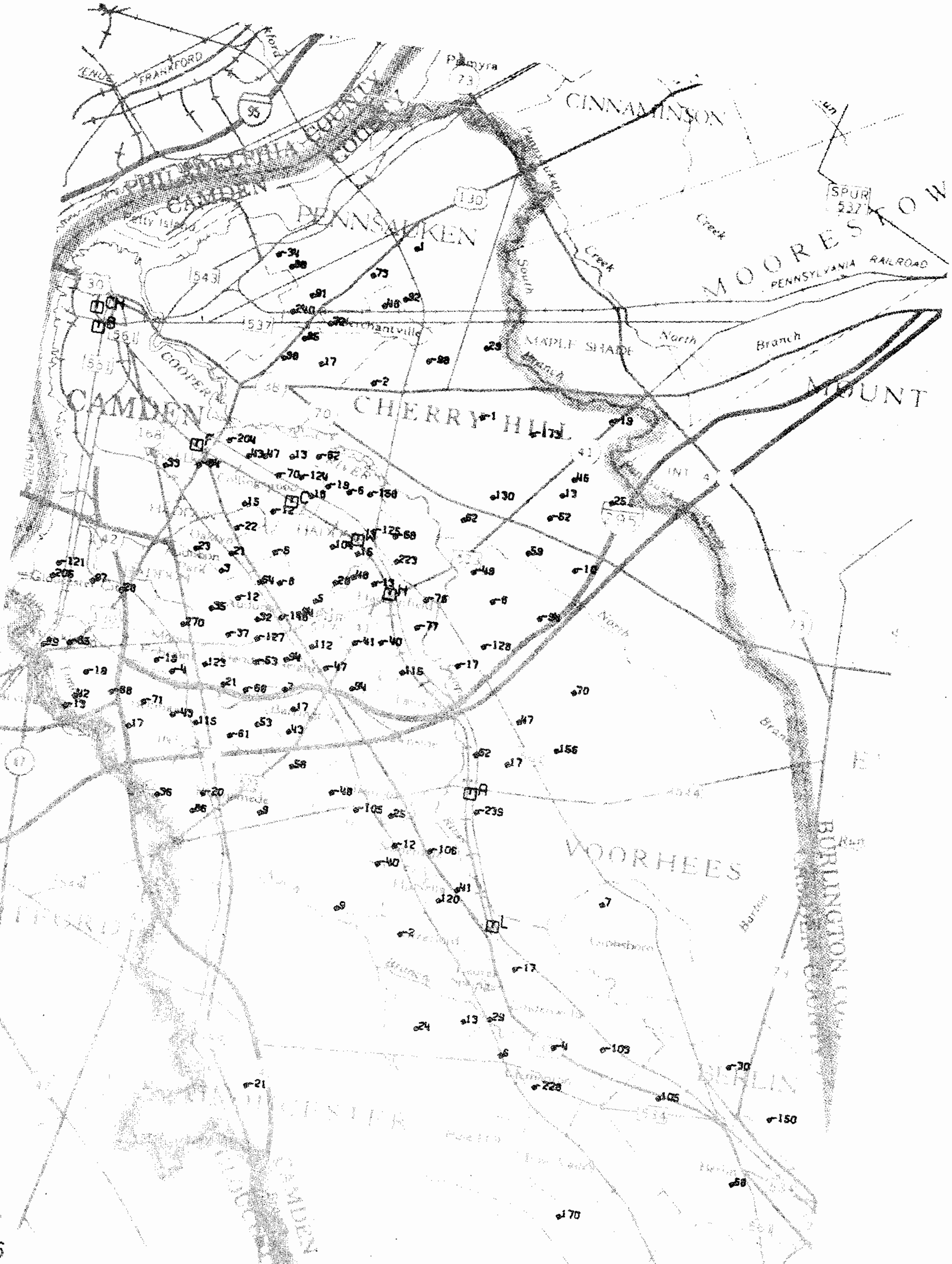
The power of the unbalanced analysis of variance conducted above to describe the data meaningfully is dependent to a large, although not precisely quantifiable, extent upon certain traditional parametric assumptions being satisfied. Two of these are, in this case, that the logarithms of the residential sales prices are (a) normally and (b) homoscedastically distributed over the block group x year categories.

If normality does not hold, the mean logarithmic sales price can be an inefficient estimator of central location; see David (1970, p.125). If heteroscedasticity prevails, the analysis may conclude that real differences in means exist when the phenomena could be adequately explained on the basis of different within-cell variances in the block group x year categories; see Elashoff (1968). In addition, Gnadesikan and Wilk (1969, pp.633-635) demonstrate that outliers may substantially perturb eigenanalyses, such as the singular decomposition.

Suspected Violations of Parametric Assumptions of the Model

As stated earlier, preliminary examination and analysis of the data indicated that substantial departures from these assumptions might exist. The particular feature of the data that appeared most suspect, was the occurrence in a seemingly not insignificant number of cells, of extreme, uncharacteristic values, particularly exceptionally low ones. Concern that this phenomenon might be interfering with the identification of impacts of the High-Speed Line prompted exploration of this matter. The presence of outliers increases the within-cell variance, and thus, diminishes the significance of the interaction term, within which these transportation impacts are hypothesized to be found.

It was known from other data sources that many of the uncommonly large sales prices were for residences that were zoned for industrial or commercial uses, and converted to such uses after the conveyances. Some of the atypically small observations were sales of houses subsequently cleared from the property. If these items of information concerning the post-sale use of the property, has been available in a systematic and unbiased manner, it would have been



Map 6-6

Weakest Contrast among 140 Block Groups
[values are 1000 · u_{6i}]

Map 6-7

140 Block Groups Ranked by Weakest Contrast [1 = greatest positive value of u_{6i}]

desirable, and have constituted an acceptable practice, initially to screen such sales from the data; see David (1970, p.172). Since the primary focus of this study is meant to be upon the value of residences, qua residences, such a procedure would not have appeared to bias the analysis. However, since this information was available for some block groups and not for others, and in some years more than others, it was felt inadvisable to conduct such preliminary screening.

Procedures for Diminishing the Effects of Outliers

If one wishes to minimize the influence of extreme, uncharacteristic values (outliers) upon an analysis, there are, in a broad sense, two possible approaches. One is, on the basis of assumptions and/or extrinsic information, to edit, i.e., exclude, such maverick observations. The other approach does not involve editing, but rather the use of estimators that are robust against the potential presence of such outliers. (David 1970, pp.124-130 and Gnadesikan and Kettenring 1972, have made extensive reviews of the literature on robust estimation.)

Robust Estimation Two techniques of robust estimation were applied to the data. Both these procedures, as do most in this field, seek to estimate the midpoint of a symmetrical population. The assumption of symmetry is, of course, weaker than the assumption of normality. However, as mentioned above, the logarithms of the residential sales prices do not appear to be symmetrically distributed within block group x year categories, but rather to be skewed to the left, i.e. to have more extreme low values than high ones.

The first procedure pursued, employed the sample kurtosis,

$$n \sum_{i=1}^{n} (X_i - \bar{X})^4 / [\sum_{i=1}^{n} (X_i - \bar{X})^2]^2, \qquad (6\text{-}9)$$

of each block group x year category to select one of four possible estimators of the assumed point of symmetry. If the sample kurtosis was less than 2, the mean of the [n/4] smallest and [n/4] largest observations was utilized. If it was between 2. and 4., the mean was used. If between 4. and 5.5 the midmean, i.e. the mean of the interior observations, omitting the [n/4] smallest and [n/4] largest values, was taken. For cells for which the sample kurtosis was greater than 5.5, the median was employed as the estimate of the assumed point of symmetry. This procedure is suggested by Hogg (1967), and discussed in David (1970, p.129); it is recommended because these estimators have desirable properties over the associated ranges of the sample kurtosis. Of the 840 block group x year categories in the 140 x 6 two-way classification of the data, the sample kurtosis was less than 2 for 145 cells, between 2 and 4 for 480 cells, between 4.0 and 5.5 for 113 cells, and greater than 5.5 for 102 cells.

The sample skewness,

$$n^{\frac{1}{2}} \sum_{i=1}^{n} (x_i - \bar{x})^3 / \left[\sum_{i=1}^{n} (x_i - \bar{x})^2 \right]^{3/2} \qquad (6\text{-}10)$$

for each cell was computed in the same procedure. 487 of the values were negative and 353 positive. This confirmed the tendency for the logarithms of the sales prices, within each block group x year category, to be negatively skewed. The low values of these logarithms, thus tended to be further from the sample means than the high values.

The other set of robust estimators obtained were the 1/5-trimmed means for each block group x year category.

The 1/5-trimmed mean is defined as follows:

let $r = [n/5]$ = the integral part of n/5

$$m(\tfrac{1}{5}) = \frac{1}{(n-2)r} \sum_{i=r+1}^{i=n-r} X_i \qquad (6\text{-}11)$$

The X_i's are the order statistics of a random sample of size n; see Jaeckel (1971). The 1/5-trimmed mean is, thus, obtained by discarding as closely as can be done, in light of non-divisibility, at most the upper and lower twenty percent of the observations.

These two sets of estimates were analyzed by the unbalanced analysis of variance and singular decomposition previously applied to the means of the logarithms of the residential sales prices. For the estimates obtained on the basis of the sample kurtosis, the original weights (numbers of sales per block group x year categories) were employed. No estimate of the within cell variance was possible in this case. For the trimmed means, the weights were the original number of observations minus 2r.

These analyses were disappointing in that they did not lead to substantially different or more significant results than obtained in the original analysis. The F-ratio for interaction was greater (2.96) in the trimmed-means analysis than in the initial analysis (1.37). An effect of this nature would be expected since the within-cell variance is clearly reduced by the trimming process.

Two-Sided Outlier Rejection Test In retrospect, it was felt that the lack of power of these procedures for the problem at hand stemmed from the fact that they were conducted independently on each block group x year cateogry. These robust estimation techniques did not take into account the analysis of variance framework in which the data had been embedded. Accordingly, the next course of action adopted was the application of an outlier-editing procedure to the data; this approach considered the block group x year categories in light of the assumptions of the analysis of variance. Two of these assumptions, in the analysis of variance of the log-linear model (6-3), are that the logarithms of the residential sales prices are (a) normally and

(b) homoscedastically distributed over the 840 cells of the two-way classification. The outlier-rejection procedure explained below, screened those observations which appeared most inconsistent with these two assumptions.

The estimate of the within-cell variance (.079) obtained in the initial unbalanced analysis of variance presented in Table 6-1, was taken to be an estimate of the homoscedastic value, based upon an infinite number of degrees of freedom. The variance was, thus, regarded as known. It was considered to be independent of any individual block group x year cell. Given such an independent estimate of the variance and the table of 5% points for the studentized maximum absolute deviate in normal samples (Halperin, et al., 1955), two-sided outlier-rejection tests can be performed. These tests involve computing (a) the difference between the greatest observation in each cell and the mean of the cell, and (b) the difference between the mean of each cell and the smallest observation in the cell. Since the cut-off rule applied in obtaining the sample of 140 block groups, required the presence of at least five sales in each cell, these procedures did not degenerate due to small cell sample sizes. These differences were standardized by the estimate of the within-cell standard deviation (.282), and tested against the appropriate critical values, as given by Halperin, et al., (1955). Since these critical values are listed only for sample sizes of 3-10, 15, 20, 30, 40 and 60, non-tabulated values were obtained by interpolation. Errors resulting from this procedure do not appear to be substantial. If neither of the two standardized differences exceeded the critical value, no observation in the cell was rejected. If one of the standardized differences exceeded the critical value, the corresponding sale was rejected. If both exceeded the critical value, the one giving rise to the greatest value of the test statistic was rejected.

This test was conducted iteratively, so that more than one outlier per cell could be rejected. A suggestion of David's concerning an appealing method for editing multiple outliers was adopted.

> "Apply a certain test statistic to the sample of n. If significance is obtained, eliminate the most extreme observation and apply the same test statistic to the reduced sample of n-1, adjusting the significance point to the new sample size. If significance holds again, repeat the procedure until the test statistic ceases to be significantly large. Such a procedure has obvious appeal, since the same set of tables may be referred to repeatedly" David (1970, p.191).

If an observation was rejected by the studentized maximum absolute deviate test, the mean of the cell in which the observation was found, was recomputed for the reduced cell sample size. Differences between the extreme values in the cell and this mean were standardized by the original sample standard deviation of .282. The value of the sample standard deviation might be recalculated after each series of eliminations of observations; it necessarily decreases with the rejection of extreme observations. However, even if the distributions of logarithms of sales prices in all the cells were normal and homoscedastic, sales would be rejected by the test, due to their high improbability of occurrence, and the significance level of subsequent outlier rejection tests would be greater than 5%. Thus, the conservative position of maintaining the original value of .282 was pursued.

In all 252 of the 12,464 sales in the data collection were rejected. 192 of these were extreme values below the sample mean and 60 were extreme values above the sample mean. Thus, most of the 840 cells in the block group x year classification had no values edited. 143 cells had only one value eliminated. Two cells in each of two block groups, however, had five or more extreme low values edited.

Results of the Decomposition of the Edited Data

The application of the unbalanced analysis of variance and singular decomposition to the revised sample of 12,212 sales yielded somewhat different, and apparently more significant results, than when applied to the original 12,464 sales. The analysis of variance table and estimates of main effects for the revised sample are quite similar to those for the original sample as given in Table 6-1 and Map 6-2. The F-ratios are somewhat higher as the within cell variance is reduced by the editing procedure. These results for the revised sample are not repeated here. Table 6-7 gives the singular decomposition results for the revised sample, which are comparable with the results of Table 6-4 for the unedited data.

First Term The components (v_{1j}'s) of the first right singular vector (fiscal years) are now monotonic with time. Fiscal 1967 does not behave anomalously, as in the prior analysis. The first term of this decomposition explains approximately three per cent more of the variation than in the original decomposition. The percentage of variation accounted for by the second term has increased somewhat negligibly, but is now substantially greater than that explained by the third term. This suggests that the second term may, in addition to the first, have a meaningful interpretation.

Maps 6-8 and 6-9 may be compared with Maps 6-4 and 6-5. Map 6-8 shows three significant digits of the components (u_{1i}'s), multiplied by 1000, of the first left singular vector (block groups). Map 6-9 ranks these values from a high of 185 (rank 1) to a low of -446 (rank 140).

The block group in Cherry Hill just north of the Ashland station, considered by the earlier analysis to be the most steeply rising in value, is selected, after editing, to be the third most rapidly rising (rank 138, value = -203). A sale for $1,500 in fiscal 1965 was the only observation rejected;

Table 6-7

Right Singular Vectors (Fiscal Years) of
140 x 6 Interaction Matrix, After Removal of Outliers

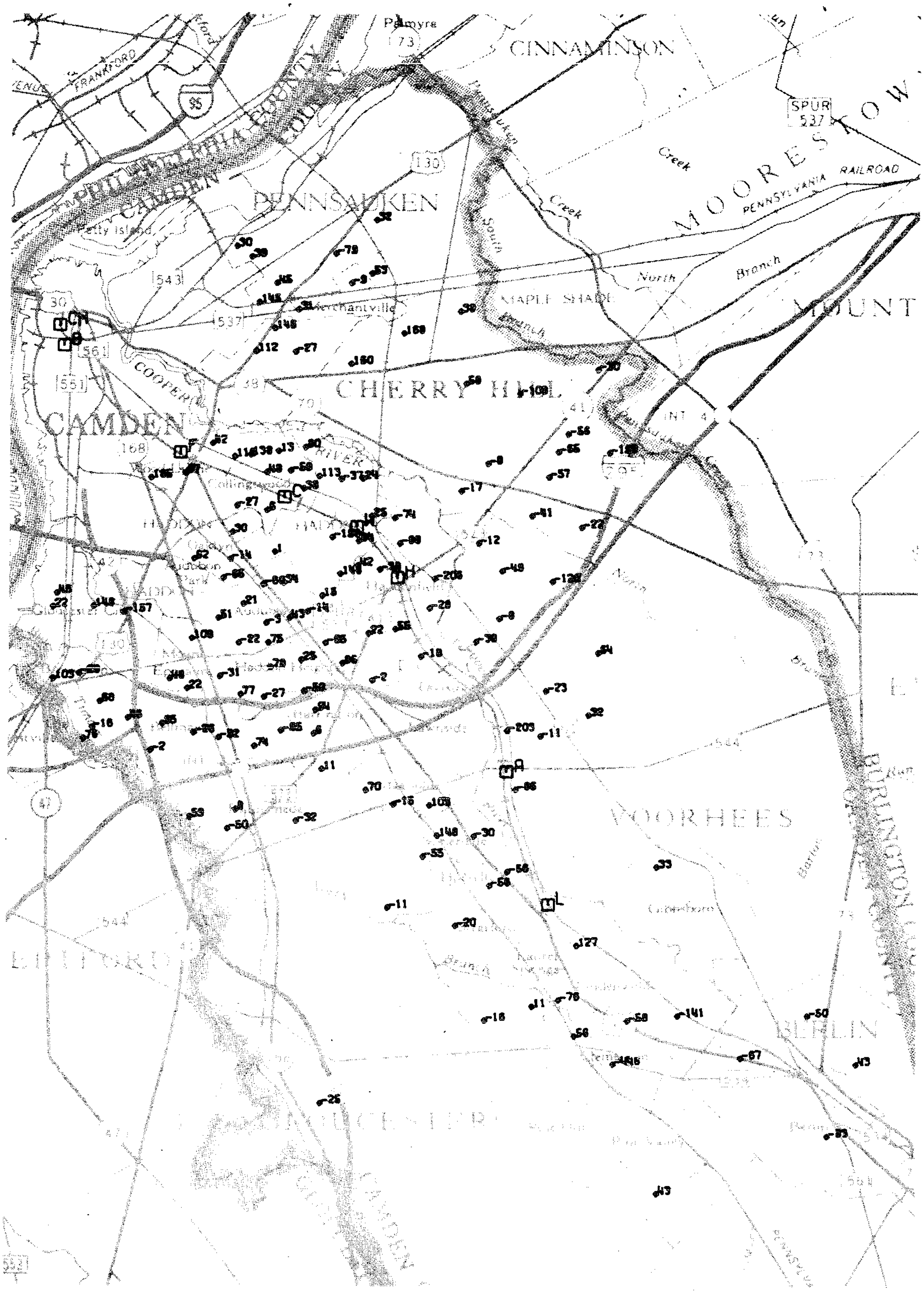
t	1	2	3	4	5	6
$v_{t(1965)}$	.537	-.002	-.335	.182	.660	.361
$v_{t(1966)}$	.439	.461	-.120	-.171	-.604	.431
$v_{t(1967)}$	.124	-.398	.600	-.526	.117	.420
$v_{t(1968)}$	-.068	-.240	.309	.790	-.229	.405
$v_{t(1969)}$	-.390	-.466	-.636	-.183	-.175	.401
$v_{t(1970)}$	-.589	.595	.119	-.042	.319	.427
% of Interaction Sum of Squares Explained	32.742	21.375	16.102	15.613	13.722	.004

see the sales prices for this block group given in Table 6-5. The block group ranked 139 (value = -206) is in Haddonfield, to the east of the Haddonfield station. The total cost of travel to the Philadelphia CBD of the block group ranked 137 (value = -190) would, as for the other block groups just discussed, appear to have been substantially reduced by the introduction of the High-Speed Line. It is located in Haddon Township, on the west side of the Westmont Station. A block group (rank 136, value = -190) in Cherry Hill, adjacent to the recently completed Interstate 295 Highway, also shows relatively steep increases in residential sales prices.

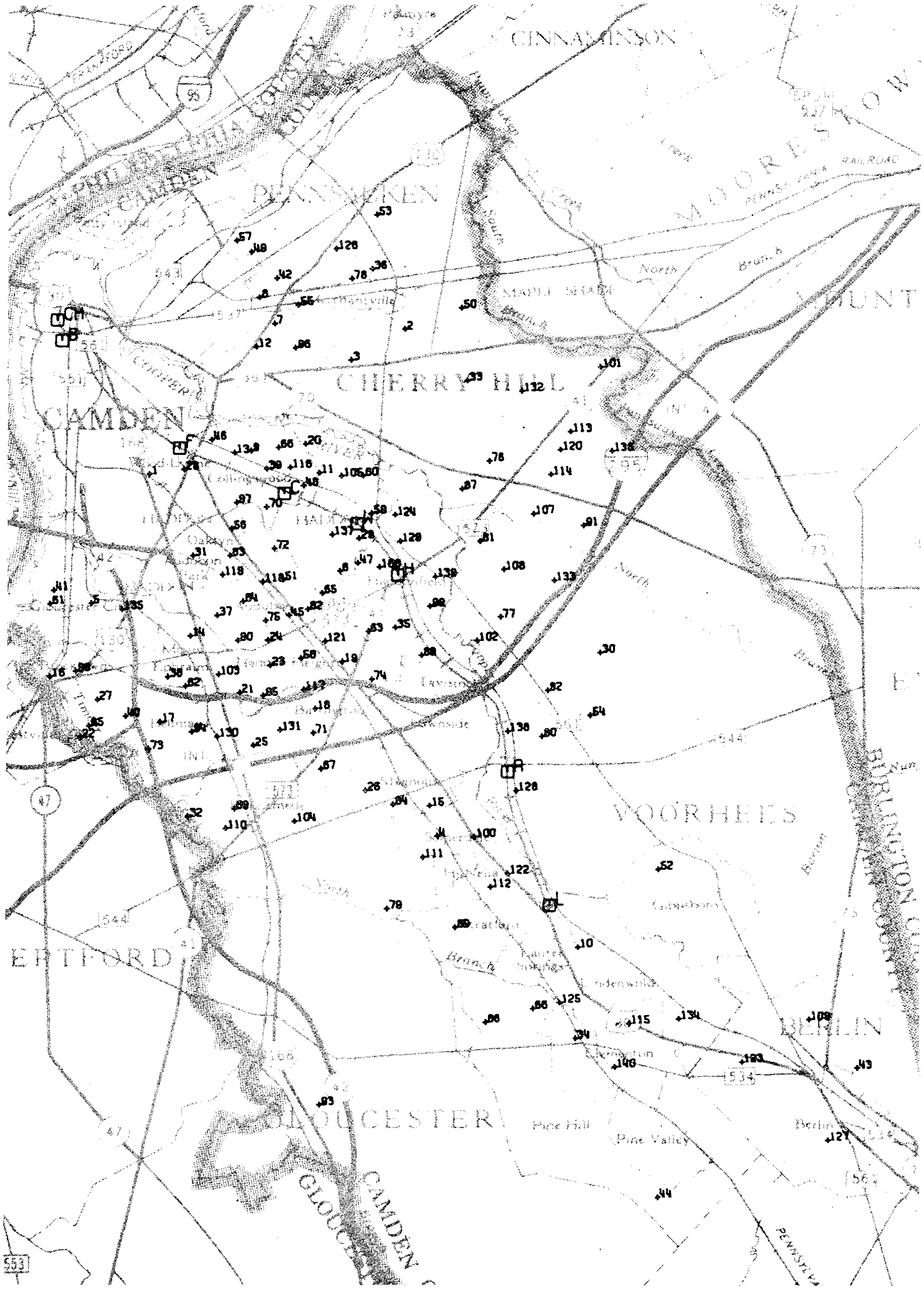
The locations of the block groups ranked 137, 138, and 139 would seem to support a finding of a positive impact of the High-Speed Line on land values. The block group with the rank of 140 (value = -446) is located south of the Lindenwold station in Clementon. Several other neighborhoods with relatively rising land values are in this vicinity. The cost of travel to the Philadelphia CBD from the block groups in this area would also appear to have substantially reduced with the construction of the Lindenwold Line.

The Clementon block group designated the fastest rising in value is one for which many sales were rejected by the studentized maximum absolute deviate test. The values of all the recorded useable and acceptable nonuseable sales are given in Table 6-8; the rejected observations are starred. The outlier test is, of course, performed on the logarithms. The exceptionally large negative value, -446, associated with this block group can, at least, partially be explained by the pattern of rejection. High values were rejected in the earlier years and low values in the later years, thus accentuating the time trend of increasing value.

In conclusion, the first term of the decomposition, after data editing, is not radically different from the term obtained before editing. Developing



Map 6-8 Principal Contrast after Editing of Outliers [values are $1000 \cdot u_{1i}$]



Map 6-9 140 Block Groups Ranked by Principal Contrast, after Editing [1 = greatest positive value of u_{1i}]

Table 6-8

Recorded Sales Prices, Cell Means, and Model Estimates for Block Group with Most Rapidly Increasing Value, After Removal of Outliers

	1965	1966	1967	1968	1969	1970
	2500	2500	2500*	3200*	1000*	2000*
	2500	2500	3500	3500*	1500*	3200*
	3000	3000	3500	3800	2500*	3500*
	3000	3500	3500	4000	3000*	3500*
	3200	4500	5750	4500	3000*	3800*
	3500	5000	6400	4800	3500*	4250
	4000	5500	7300	4900	4000*	4500
	4500	5700	7500	5000	6800	5000
	5500	6100	7800	5000	7500	5500
	6100	7000	7900	5800	7500	5900
	7250	7500	8200	7000	8000	6000
	7300	8500	9300	7400	8000	6500
	7700	10700	9500	7500	8500	6500
	8000	11990*	9800	8300	8750	7000
	8200	13250*	12000	8750	9000	7200
	8500		12900	9800	10000	7500
	10250			10000	10000	7500
	11000			10400	11300	8550
	13000*			10500	11500	8800
	15500*			10500	13500	9750
				11500	13630	10650
				12000	13900	10800
				13300	13900	12000
				13500	14250	12500
				13500	15000	12900
				14550	17500	13000
				14800		16000
				16900		18000
				17500		18900
						19000
						20000
						21000
						22000
						31800*
before editing						
cell means	6571	6482	7334	9041	8372	10514
after editing						
cell means	5763	5538	7657	9463	11027	11506
$cb_i y_j$	6926	6985	7274	7570	8228	9132
$cb_i y_j \exp(n_{ij}^{-\frac{1}{2}} \theta_1 u_{1i} v_{1j})$	5466	5527	6839	7736	9869	11262

*rejected by sequential application of 5% studentized maximum absolute deviate test.

suburban areas are still contrasted with older, more established sections. However, the term is somewhat more significant and indicates more strongly than before that some block groups, with reduced travel costs and times to the Philadelphia CBD as a result of the High-Speed Line, have experienced relatively rapid increases in residential sales prices.

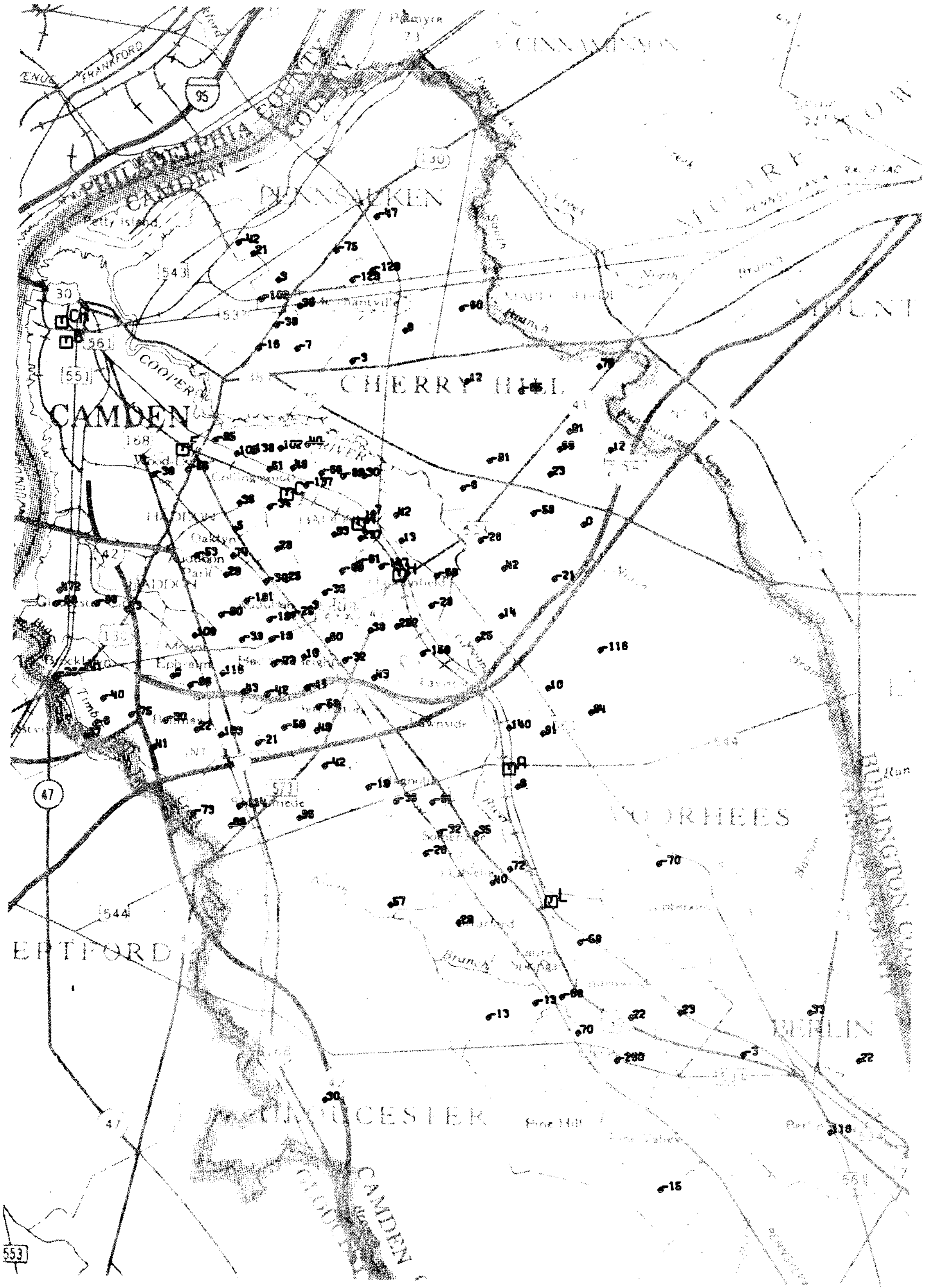
Second Term The components (v_{2j}'s) of the second right singular vector (fiscal years) are negative in the period fiscal 1967 to fiscal 1969. During this period, the High-Speed Line was under construction, and then commenced operations in early 1969. Block groups associated with negative components in the second left singular vector have positive entries for this period in the second term.

Map 6-10 shows three significant digits of the components (u_{2i}'s) of this vector, multiplied by 1000. Map 6-11 ranks these values from a high of 472 (rank 1) to a low of -268 (rank 140). There appear to be noticeable clusters of block groups associated with negative values by the Ferry Avenue and Haddonfield Stations. Such values may indicate that numbers of real estate transactions, in these areas, were conducted in anticipation of the opening of the Line.

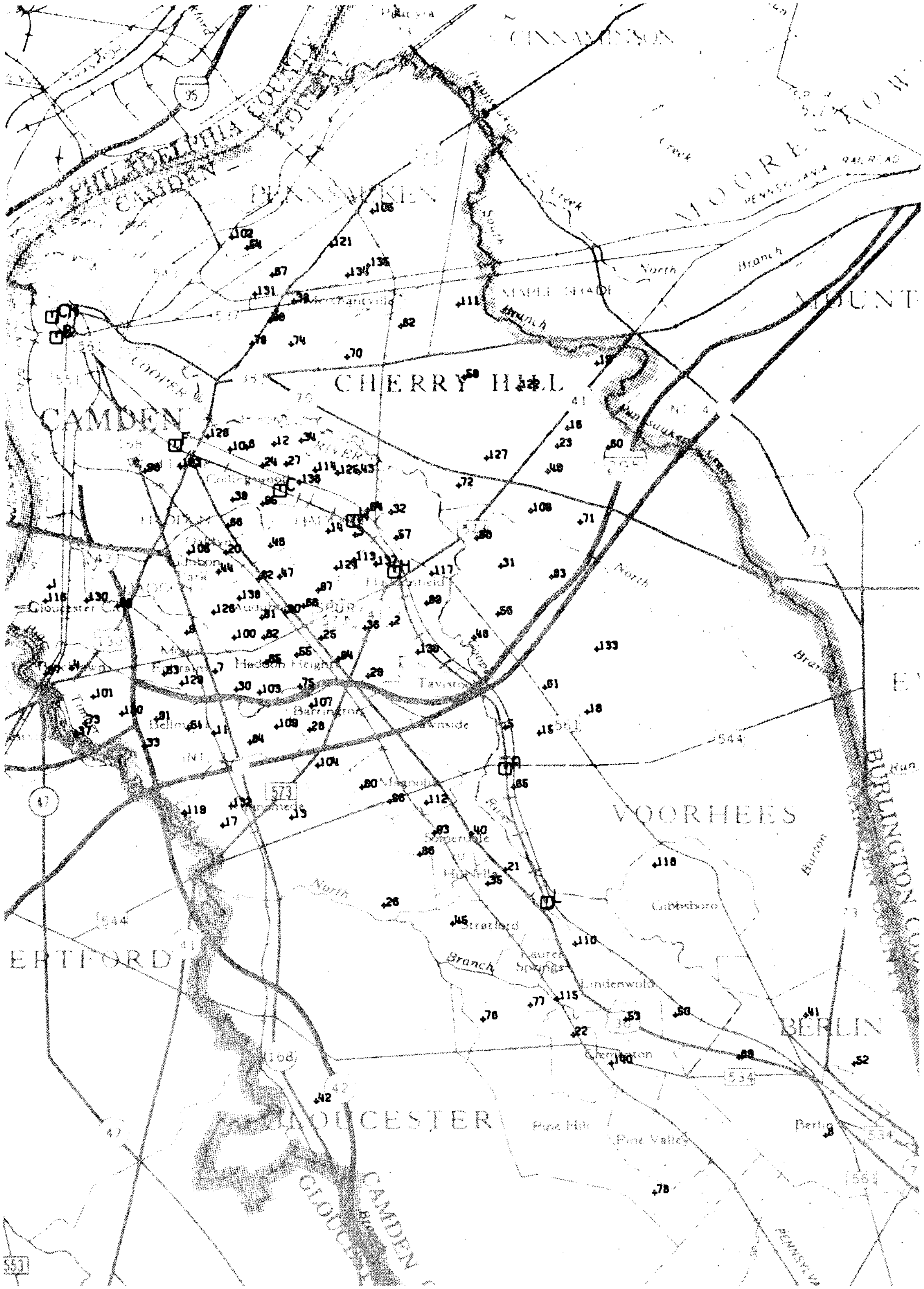
Sixth Term Maps 6-12 and 6-13 are the analogues of Maps 6-6 and 6-7. No meaningful interpretation of these results has yet been developed.

One-Sided Outlier Rejection Test

Since the outliers in the logarithmic residential sales price distributions are found predominantly in the left tails, it was felt that the one-tailed analogue of the above test might be more powerful than the two-tailed test in rejecting uncharacteristic observations. Accordingly, the one-sided equivalent of the studentized maximum absolute deviate test was conducted on the left tails of the distributions. Grubbs (1969) gives tables



Map 6-10 Secondary Contrast after Editing of Outliers [values are 1000 · u_{2i}]



Map 6-11 140 Block Groups Ranked by Secondary Contrast, after Editing [1 = greatest positive value of u_{2i}]

of the 5% points for these statistics for sample sizes between 2 and 25. For larger sample sizes, the tables were extended in the manner suggested by David (1970, pp.73-75).

239 sales were rejected, after sequential application of the statistics. The unbalanced analysis of variance and singular decomposition of this set of edited data did not, however, give indications of more significant results than those obtained with the data edited by the two-tailed test.

Analyses with Expanded Samples

The investigations presented above were conducted with a sample of 140 block groups and six fiscal years. The number of block groups was restricted so that the methods for dealing with outliers could be appraised. The most appropriate technique was found to be an outlier rejection procedure based on the studentized maximum absolute deviate test. This procedure showed that the presence of outliers appears to interfere with the principal objective of this study, i.e., the determination of significant patterns in interaction matrices.

This conclusion can usefully be applied in the analysis of an enlarged sample of block groups and fiscal years. No limitations on cell sample sizes need be imposed for the unbalanced analysis of variance to yield least-squares estimates. Degrees of freedom, however, have to be adjusted if empty cells are present. There must be at least three sales in a block group x fiscal year category for the outlier-rejection procedure to be applicable to that cell. Insufficient information exists to discard observations in cells with two or fewer sales. However, such cells can still be permitted to be present.

Description of Expanded Sample

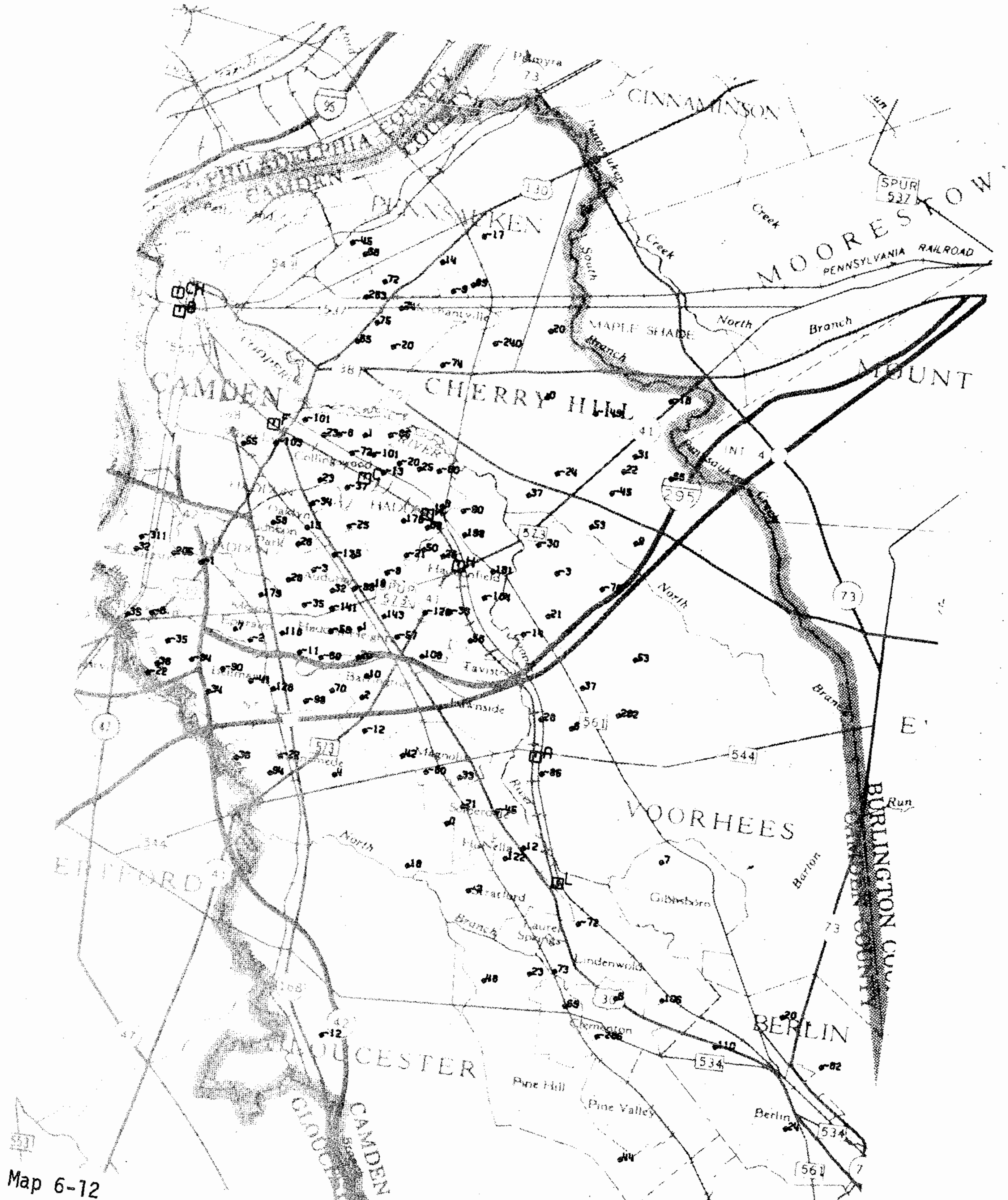
Data for fiscal 1971 became available after the completion of the previous analyses. Seven fiscal year classifications (1965-1971) were accordingly employed in the expanded sample. For 267 block groups in suburban Camden County, at least one sale was recorded in one of these seven fiscal years. 17,791 sales were tabulated in this 267x7 classification. Some sales were excluded, however, because they lacked information concerning housing characteristics. This knowledge was desired for subsequent analyses. The sales were rather evenly distributed over the seven fiscal years.

An estimate of the within cell standard deviation was obtained by: (a) subtracting the sum of weighted squares of the observed logarithmic means from the total sum of squares of logarithmic sales prices; (b) dividing this quantity by the associated degrees of freedom, i.e., 17791 - (267·7) or 15922; and (c) taking the square root of this quantity. This value (.316) was used to standardize differences between largest cell values and cell means, and smallest cell values and cell means. These results were tested in a sequential manner against the 5% critical points of the studentized maximum absolute deviate, for the appropriate sample size; 641 observations were rejected. Of these 590 were less than the cell mean and 51 were greater than the cell mean.

Analysis of Variance and Singular Decomposition of Expanded Sample

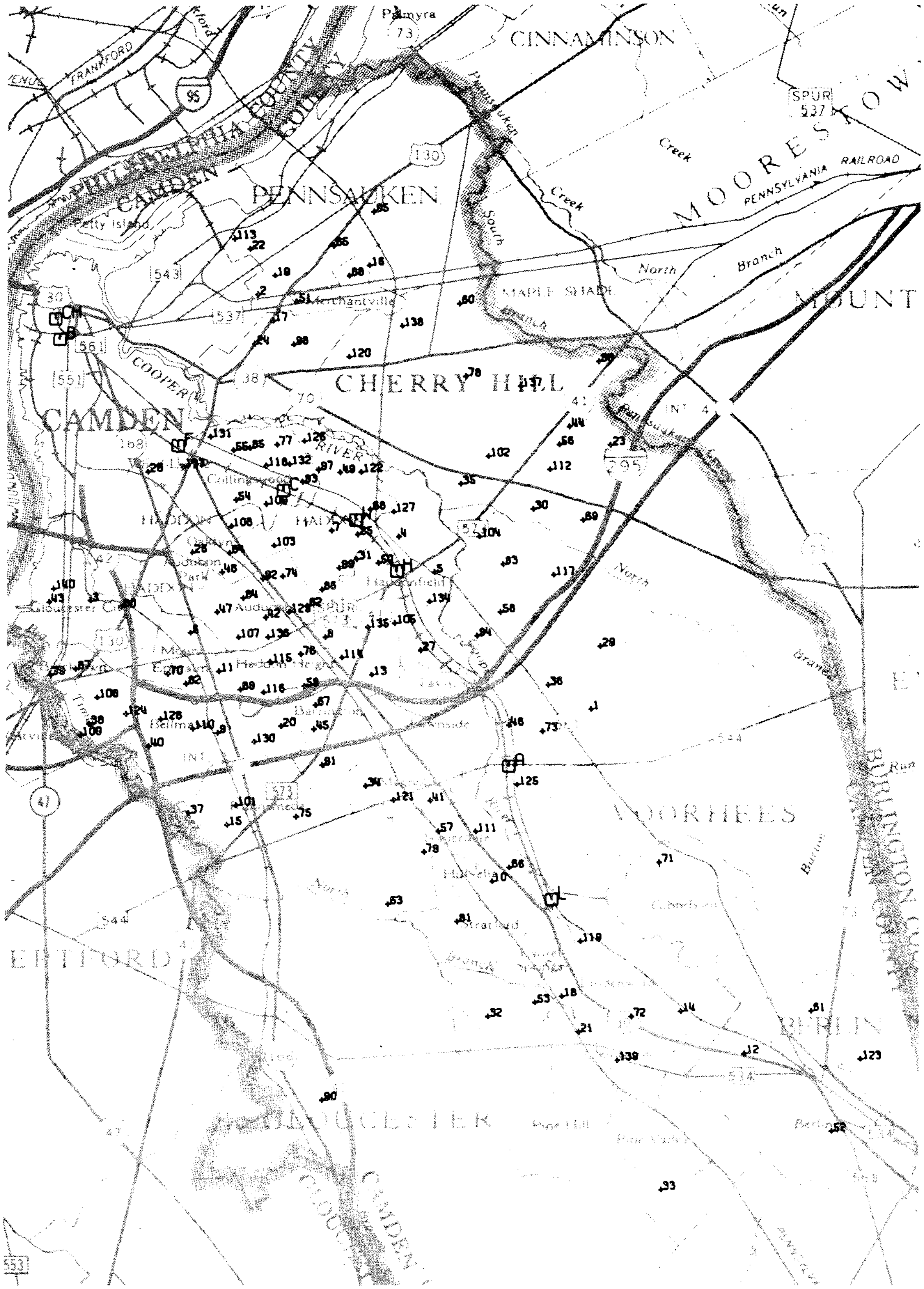
Main Effects The unbalanced analysis of variance was applied to the edited, expanded sample of sales, to yield estimates of the parameters of the log-linear model (6-3). The estimate of μ obtained is 9.693. This value is the natural logarithm of the geometric mean, 16196, of the 17,150 sales analyzed.

The antilogarithms of the seven fiscal year parameters (γ's) are biased



Map 6-12

Weakest Contrast after Editing of Outliers
[values are $1000 \cdot u_{6i}$]



Map 6-13 140 Block Groups Ranked by Weakest Contrast, after Editing [1 = greatest positive value of u_{6i}]

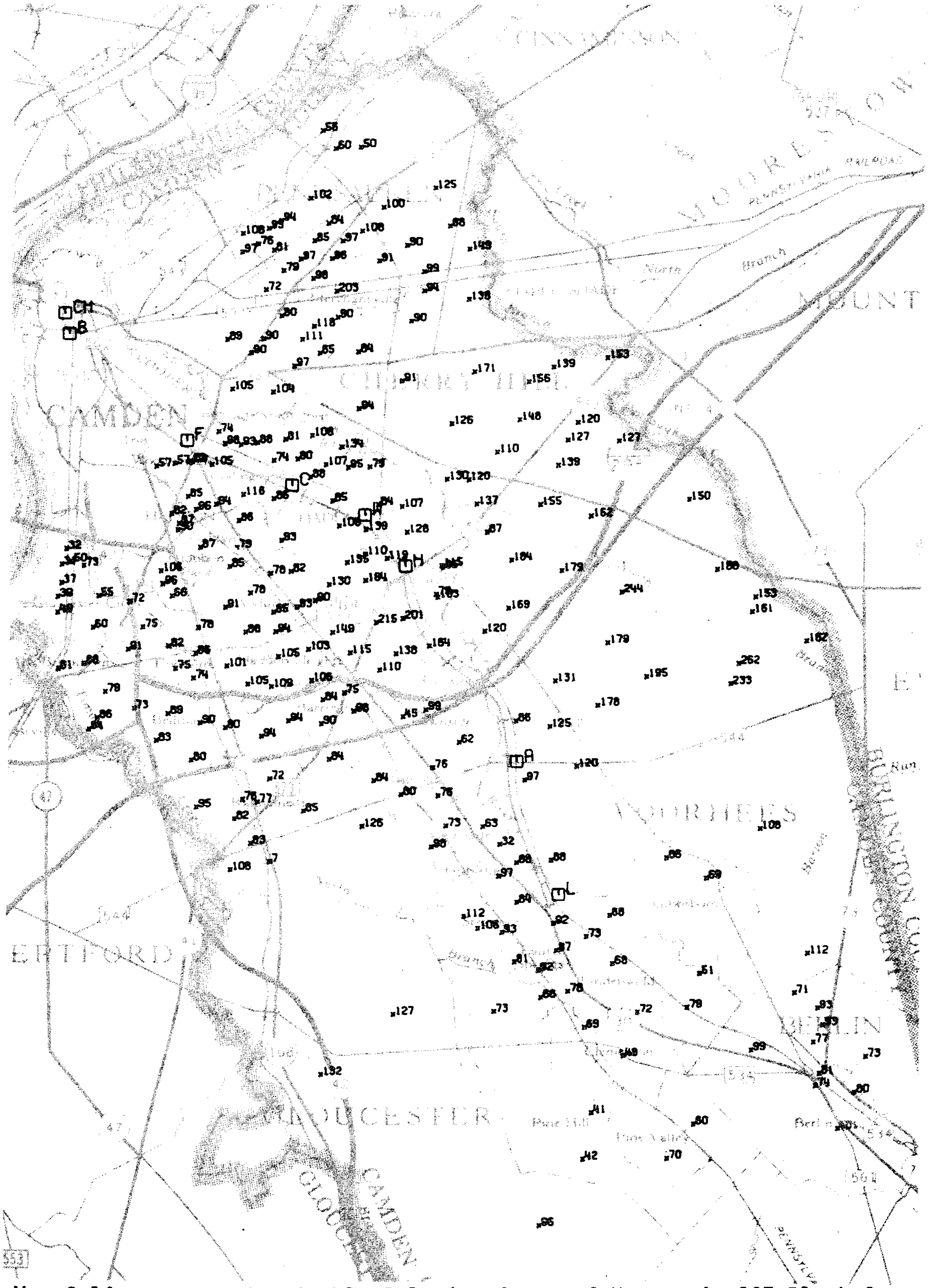
estimators of the parameters, β's, in the multiplicative model (6-1). These values are:

		per cent changes in exp (γ_j)	
$\exp(\gamma_{1965}) =$	.864		
$\exp(\gamma_{1966}) =$	.869	0.58%	
$\exp(\gamma_{1967}) =$	.903	3.92%	
$\exp(\gamma_{1968}) =$	.938	3.88%	
$\exp(\gamma_{1969}) =$	1.026	9.38%	
$\exp(\gamma_{1970}) =$	1.130	10.15%	
$\exp(\gamma_{1971}) =$	1.276	12.92%	(6-12)

The generally accelerating inflationary trend in suburban Camden County thus extended into fiscal 1971.

Map 6-14 shows the antilogarithms of the β's, multiplied by 100, to three significant digits; this map extends Map 6-2 to additional block groups and fiscal years. Only 251 values are plotted as the population centroids of sixteen block groups are not within the area shown. As previously, the largest concentration of expensive homes are found in Cherry Hill. A cluster of low-income neighborhoods is located in Gloucester City.

Singular Decomposition Though the existence of empty cells in the 267x7 matrix of mean logarithmic residential sales prices raises no questions in the unbalanced analysis of variance, its effect on the singular decomposition of the residuals is more uncertain. If no empty cells are present, the residuals should constitute a random sample from a normal population, under a null hypothesis. Assigning a value of zero in the interaction matrix to empty cells undermines this property. However, such a course of action has been taken in this study. It was felt that since the decomposition reveals patterns in the residuals, values of zero essentially randomly inserted in the matrix should



Map 6-14 Time Stable Relative Costs of Houses in 267 Block Groups [values are $100 \cdot \exp(\beta_i)$]

not lead to the existence of different principal patterns.

This position was to some extent confirmed by the decomposition of the interaction residuals. The right singular vectors (fiscal years) are presented in Table 6-9.

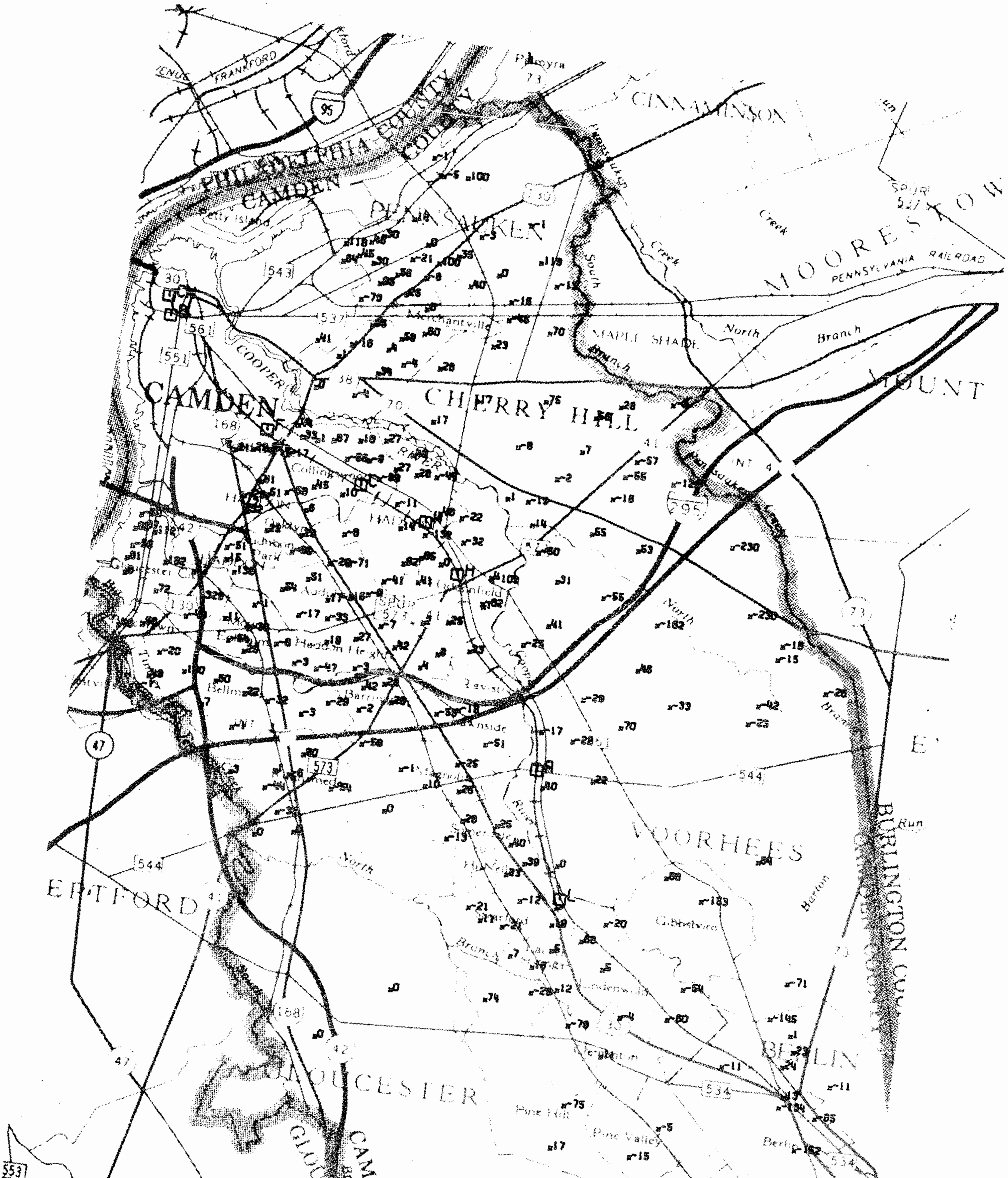
The principal contrast among the fiscal years is monotonic, with a slight aberration in fiscal 1969. This finding suggests that the presence of empty cells has not greatly perturbed the results. The additional seventh year, fiscal 1971, stands out strongly in the first term. Map 6-15, which gives the values, multiplied by 1000, of the components of the first left singular vector, thus, approximately provides a contrast between those block groups with relatively rising sales prices (especially those with relatively high prices in fiscal 1971) and those with relatively decreasing sales prices (especially those with relatively low prices in 1971). Several block groups with strong negative components are found in Cherry Hill and areas south. These block groups have apparently risen in value. No particular pattern appears discernible in the vicinity of the High-Speed Line stations.

It is difficult to judge the significance of the terms of the decomposition for two reasons: (a) Mandel's table of statistics (Table 6-3) does not have entries for matrices of more than 100 rows, and (b) the 267x7 interaction matrix is not a true interaction matrix for the purposes of Mandel's statistics, due to the assignment of the value zero to the empty cells. A reflection of the latter property is shown by the fact that the last term of the decomposition explains a substantially larger percentage of the variation than in the previous analyses. Theoretically, for an interaction matrix in the sense of Mandel, the last term of its decomposition should explain no part of the variation.

Table 6-9

Right Singular Vectors (Fiscal Years) of
267 x 7 Interaction Matrix After Removal of Outliers

t	1	2	3	4	5	6	7
$v_{t(1965)}$	.336	-.401	-.319	-.271	.093	-.652	.344
$v_{t(1966)}$	.266	-.092	-.402	-.379	-.093	.707	.327
$v_{t(1967)}$	.204	.331	-.373	.738	-.140	-.043	.379
$v_{t(1968)}$	.109	-.107	.532	-.042	-.750	-.039	.358
$v_{t(1969)}$	.231	-.247	.524	.238	.601	.206	.388
$v_{t(1970)}$	-.197	.717	.118	-.409	.198	-.165	.447
$v_{t(1971)}$	-.819	-.368	-.164	.110	-.005	.044	.391
% of Interaction Sum of Squares Explained	22.404	20.048	16.697	15.227	13.884	10.558	1.182



Map 6-15 Principal Contrast among 267 Block Groups in Two-Way Analysis [values are $1000 \cdot u_{1i}$]

Extension of the Model and Decomposition Procedure

Incorporation of Additional Variables into Residential Real Estate Model

Two variables, fiscal year and block group, have thus far been employed to classify and study residential sales prices. Certainly, there are many additional factors that influence these prices. The analyses above have suggested that inclusion of an age-of-residence variable might assist in distinguishing effects of the High Speed Line from those of generally increasing suburban land costs. No such variable, or reasonable facsimile thereto, is available in this study.

Model-building consists of abstracting certain prominent factors from reality, and ignoring others.

> "Since empirical research is hard work we have an obvious interest in keeping the model as simple as is compatible with the process by which the observations are supposed to be generated. This involves a correct specification of the economic phenomena we wish to study as well as of the stochastic element that is supposed to have entered into the actual observations. The trouble is that economics abounds with interdependent relations which together simultaneously determine the course of events. This interdependence may affect the properties of the stochastic terms, and hence the probability distribution of the sample which the observations represent. In the interest of a correct specification we must take all relevant relations into account. Thus even if we wish to study only a single relation we may be forced to consider others as well because they have contributed to the determination of the observations at hand. We cannot ignore such relations at will; although opinions may differ, it is ultimately a question of fact and not of arbitrary personal choice what is the minimum number of relations that is necessary to describe properly in what manner the observations have been generated" Cramer (1969, p.5).

The estimation of elaborate models, however, encounters difficulties stemming from the interdependence of the variables employed.

> "Thus by the very existence of a large number of intercorrelations among all economic variables we can estimate but a few partial coefficients with tolerable precision. This accounts for the contrast between economic theory and empirical research. The theory is comprehensive: if we list the determinants of, say, consumption or investment that have been discussed by economists we may easily find

some ten or twenty distinct effects. But in econometric research we rarely try to estimate more than four or five coefficients for the simple reason that the data do not permit it" Cramer (1969, p.102).

A related problem arises when observations are classified by several criteria. It is often difficult to obtain data for all possible combination of classifications; see Good (1965) for a discussion of the implications of this phenomenon for the estimation of probabilities.

For instance, lot size might be a suitable variable to incorporate into a model of residential sales prices. However, as Clawson (1971, pp.116-117) indicates, one cannot usually choose a house on the basis of lot size, ceteris paribus. More expensive structures tend to be found on larger lots and in certain neighborhoods.

If the model developed above is to be extended to include factors other than fiscal year and block group, such as age of structure, number of stories, building material, or lot size, appropriate analytic procedures should be available to estimate the model and analyze the residuals therefrom.

Analytical Procedures for Extended Models

The extension of the unbalanced analysis of variance model to include more than two categorical variables requires computationally more complex procedures than the two-variable case. However, the formulation of the least-squares equations remains straightforward. Bancroft (1968, Chap. 3 and 5) displays these equations.

The generalization of the singular decomposition, so that interaction matrices of three or more dimensions can be partitioned into multiplicative terms has, however, only recently been derived by Carroll and Chang (1970); see also Theil (1967, Chap. 11). It has not been implemented in much empirical research. A proof of convergence of the computational algorithm has not yet been given, although convergence has always been found to occur. Carroll and Chang (1970

p. 312) point out "that the three-way or higher-way case is inherently more complicated than the two-way case in at least one important aspect." In the two-way case, the second term of the decomposition of a matrix (A) can be obtained by computing the first term of the matrix which is equal to the original matrix (A) minus the first term of A's decomposition. Thus, in the two-way case, the full decomposition can be obtained by proceeding sequentially. Such a sequential process is not possible in the three-way case.

Carroll and Chang give the specific formulae for the three-way case and the general formulae for the n-way case. The model for the three-way case, adjusting their notation to conform to that of Mandel, except for omission of the constants of normalization (θ's), is

$$\eta_{ijl} = \sum_{t=1}^{h} u_{ti} v_{tj} w_{tl} \qquad \begin{array}{l} (i = 1,\ldots\ldots,m) \\ (j = 1,\ldots\ldots,n) \\ (l = 1,\ldots\ldots,p) \end{array} \tag{6-13}$$

Starting with initial estimates of the v's and w's, the least-squares estimates of the u's can be obtained, using standard multiple regression procedures. These estimates are given by

$$U = Q^{-1}P \tag{6-14}$$

where U is the h x m matrix whose general entry is u_{ti}, and P is an h x m matrix whose entries, p_{ti}, are given by

$$p_{ti} = \sum_{j=1}^{n} \sum_{l=1}^{p} \eta_{ijl} v_{tj} w_{tl} \tag{6-15}$$

and Q is an h x h matrix whose general entry q_{ts} is given by

$$q_{ts} = \sum_{j=1}^{n} \sum_{l=1}^{p} (v_{sj} w_{sl})(v_{tj} w_{tl}) \tag{6-16}$$

$$= \left(\sum_{j=1}^{n} v_{sj} v_{tj}\right)\left(\sum_{l=1}^{p} w_{sl} w_{tl}\right)$$

A proof that these equations yield the least squares estimates of the u's, is given by Carroll and Chang (1970, p.311). A program that performs this procedure iteratively (first holding the v's and w's constant, and computing the u's; then determining the v's, holding the u's and w's constant, etc.) has been written for seven-way, or lesser-way, tables by Carroll and Chang (1970, p.313). The iterative procedure "can be regarded as a generalization of standard relaxation procedures for optimizing a function of many variables, in which the optimum is sought out with respect to one variable, holding all the other fixed, then with a second variable, holding the first and the remaining variables fixed, and so on, iteratively, until convergence is achieved. The difference in the present procedure is that whole subsets of variables are treated in this way" Carroll and Chang (1970, p.287). Though a two-dimensional matrix can be regarded as a linear transformation the effect of which is revealed by the singular decomposition, analogous interpretations of n-way matrices do not appear to have been given.

Number of Stories as a Third Categorical Variable

Due to interest in this multi-dimensional generalization of the singular decomposition, and also desire to gain additional insight into the residential sales price data, an additional variable was incorporated into the basic model. The variable chosen was number of stories. Other descriptors that were available were lot size and building materials. Number of stories was selected because there seemed to be more heterogeneity of this characteristic within block groups than of the other two attributes. This discrete variable was dichotomized to represent houses of less than two stories, or two stories or more. It was hypothesized that houses in the first classification would tend to sell for less than those in the second. This extension of the log-linear model (6-3) can be represented as:

$$z_{ijk} = \mu + \beta_i + \gamma_j + \sigma_k \qquad \begin{pmatrix} i = 1,\ldots\ldots,m \\ j \quad 1,\ldots\ldots,n \\ k = 1,2 \end{pmatrix} \qquad (6\text{-}17)$$

The same expanded sample used in the two-way analysis was employed in this three-way case. However, the initial data were re-edited so that sales highly inconsistent with the assumptions of normality or homoscedascity in the three-way framework could be rejected. The within cell standard deviation was calculated by: (a) subtracting the sum of weighted squares of observed logaritmic means from the total sum of squares of logaritmic sales prices; (b) dividing this quantity by the associated degrees freedom, i.e., 17791-(267·7·2) = 14053; and (c) extracting the square root of that value. The within cell standard deviation, .312, was only slightly less than that obtained in the two-way case, .316. This indicates that the stories variable is not a powerful explanatory one.

As previously described, the value of .312 was used to standardize differences between cell means and extreme values in cells. Approximately thirty per cent of the 3738 cells were empty. The studentized maximum absolute deviate test was then applied sequentially. In all, 333 of 17,791 sales were rejected. 208 of these were from the collection of 8,252 sales of residences with less than two stories, and 125 were from the set of 9,539 sales of residences with at least two stories. As previously, a large majority of the rejected observations were less than their respective cell means.

Three-Way Unbalanced Analysis of Variance

For the sample at hand, estimation of the log-linear model (6-17) requires the solution of a set of 277 linear simultaneous least-squares equations. While, in the two-way case, a substitution scheme was employed by which the number of equations was greatly reduced, a more direct approach was utilized in this instance.

An inverse matrix of dimensions 277 x 277 was computed. This involved partitioning the coefficients matrix of the equations. A 266 x 266 diagonal submatrix was extracted. Its inverse was readily calculated. Matrix identities were then used to determine the full inverse by the method of partitioning.

The year parameters (γ's) obtained very strongly resembled those obtained in the two-way analysis of the expanded sample. The two additional story effects were $\sigma_1 = -.013$ and $\sigma_2 = .011$. The antilogarithms of these values are .987 and 1.011. Although the difference between these two effects is not substantial, they do confirm the hypothesis that houses with more stories tend to cost more than houses with fewer levels. The F-ratio for stories was highly significant, as would be expected from the large sample at hand.

Three-Way Decomposition

A MATLAN program was written to perform the computational procedure given by Carroll and Chang. It was applied twice to the interaction residuals obtained in the three-way analysis of variance. One term and two term expansions were calculated. As noted earlier, Carroll and Chang indicated that, unlike the two-dimensional case, the first term of the expansion is not independent of the number of terms computed.

For the one term expansion, the first pair of singular vectors obtained in the decomposition of the 267 x 7 interaction matrix, were taken as initial values. For the two term expansion, the first and second pair of singular vectors were employed as starting vectors. Twenty iterations, each consisting of three solutions of least squares equations, were performed to obtain the one term expansion; twenty-five iterations were employed to obtain the two-term expansion. In both cases, convergence appeared to be occurring, although the strict requirement of convergence to fourteen digits, applied in the two-way decompositions, was not utilized.

The results of the one term expansion are presented in Table 6-10 and Map 6-16. Those of the two term expansion can be found in Table 6-11 and Maps 6-17 and 6-18.

The inner products of the vectors in the two term expansion indicate that they are not orthogonal, as in the two-way decomposition. The similarity between the story vectors in the two term expansion may be a result of the fact that this variable has only two levels.

The fiscal year vector in the one term expansion suggests greater variation in residential sales prices within block groups, in the later years. The same conclusion may be inferred from the fiscal year vectors in the two term expansion. The principal vector in the two-term expansion emphasizes variation in fiscal 1970, while the secondary one accentuates variation in fiscal 1971.

Though somewhat obscured due to the density of block groups, there is a strong cluster of negative values about the Ferry Avenue Station, shown in Map 6-16. This may indicate an upsurge, in fiscal 1971, in the value of houses in this area with less than two stories. Map 6-17 and 6-18 also indicate clusterings of negative values near the Ferry Avenue Station.

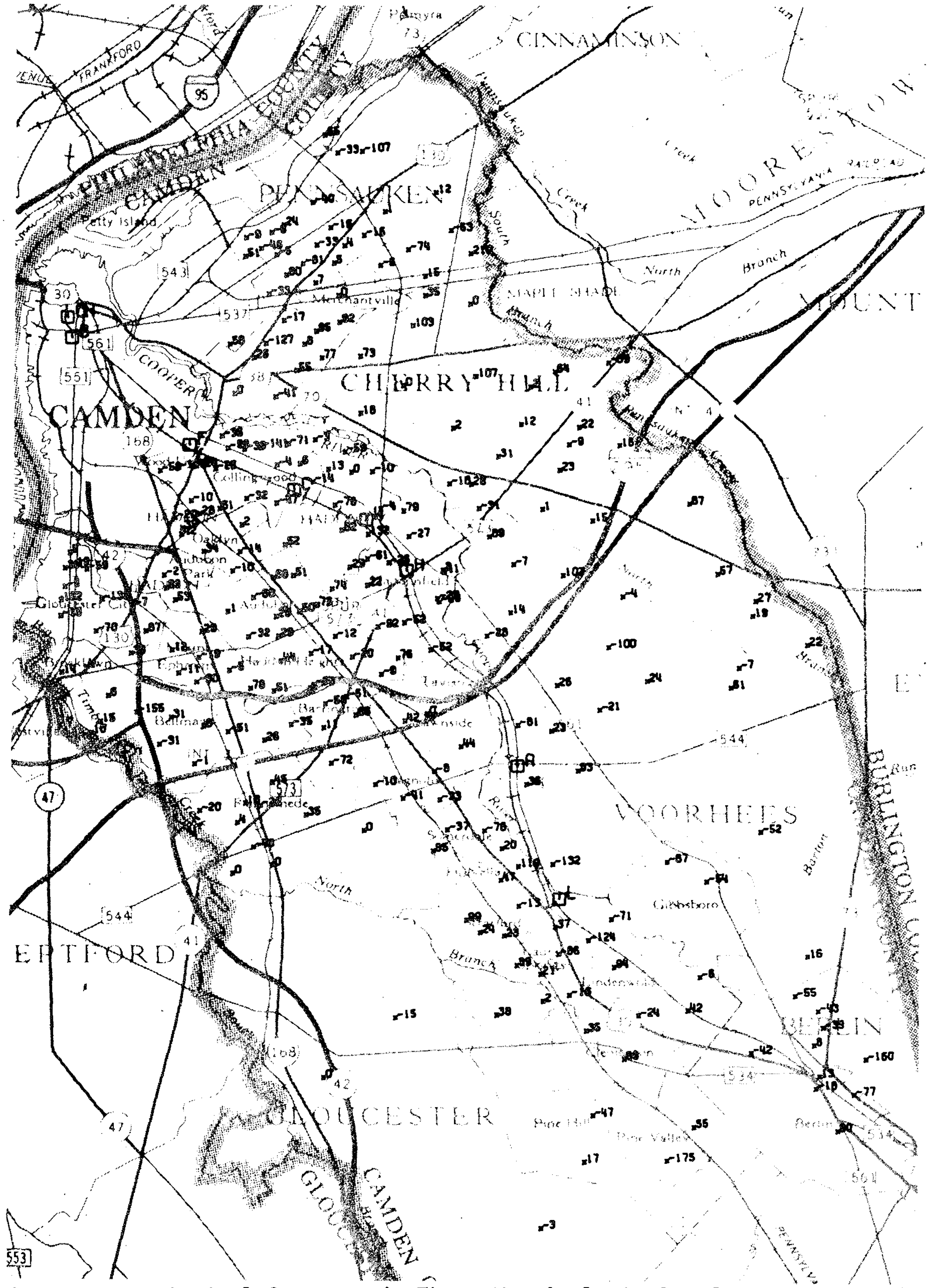
Conclusions

The substantive objective of this study has been the comprehension of spatial and temporal trends in a particular body of residential sales price data. To this end, the logarithms of the data were examined with the use of an unbalanced analysis of variance model. This model fit the data quite well, although some room was left for additional explanation. The presence of a substantial time trend in the prices was shown. Through comparison with consumer price indices, it was demonstrated that this trend was strongly identifiable with inflation, thus, supporting the postulate of the model that

Table 6-10

Fiscal Year and Story Vectors in One Term Decomposition

$v_{1(1965)}$	-.162
$v_{1(1966)}$	-.138
$v_{1(1967)}$	-.252
$v_{1(1968)}$	-.133
$v_{1(1969)}$	-.456
$v_{1(1970)}$	-.446
$v_{1(1971)}$	-.683
$w_{1(<2)}$	.74
$w_{1(\geq 2)}$	-.67
% of Interaction Sum of Squares Explained	16.650



Map 6-16 Principal Contrast in Three-Way Analysis-One Term Decomposition
[values are 1000 · u_{1i}]

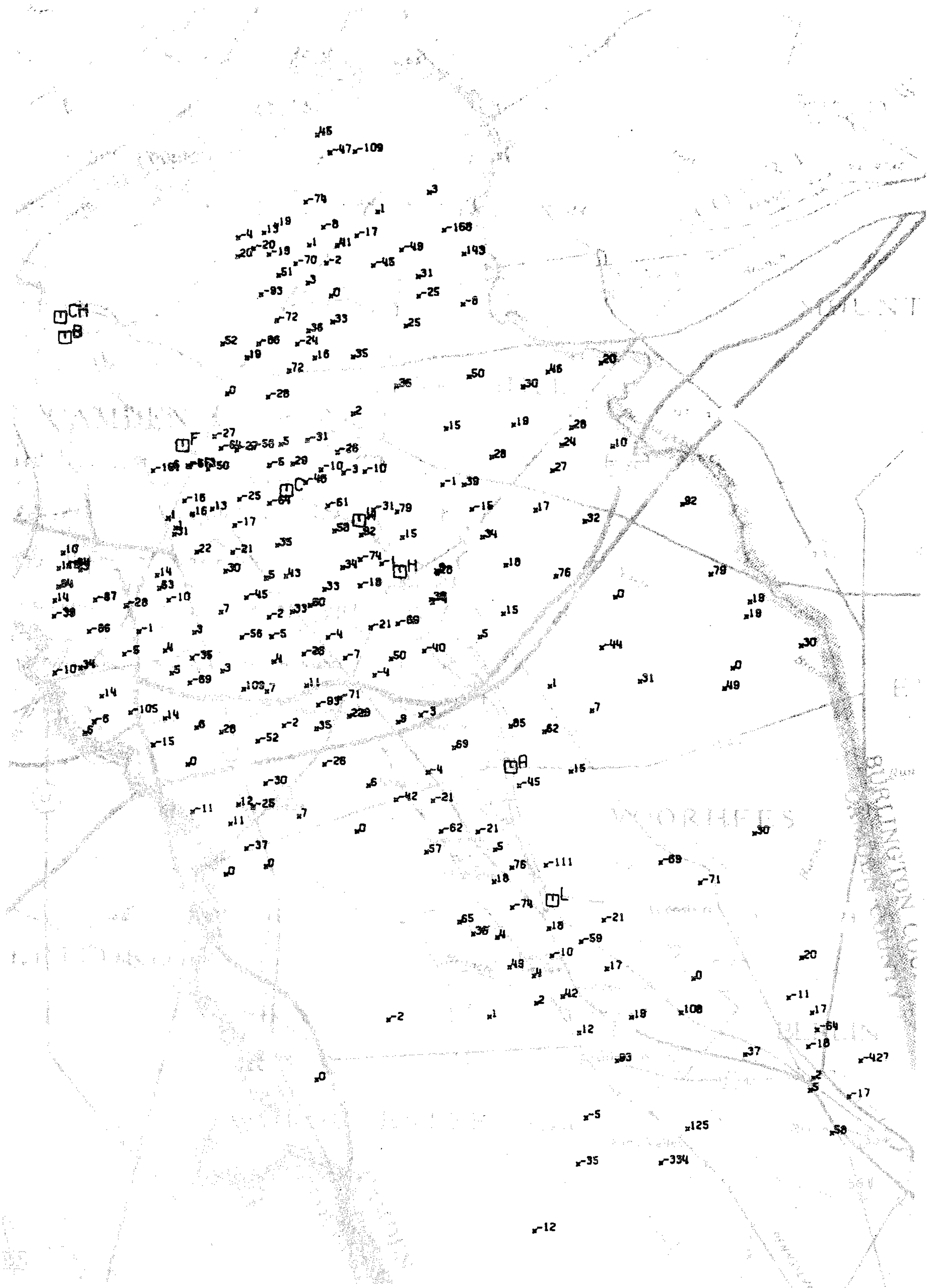
Table 6-11

Fiscal Year and Story Vectors in Two Term Decomposition

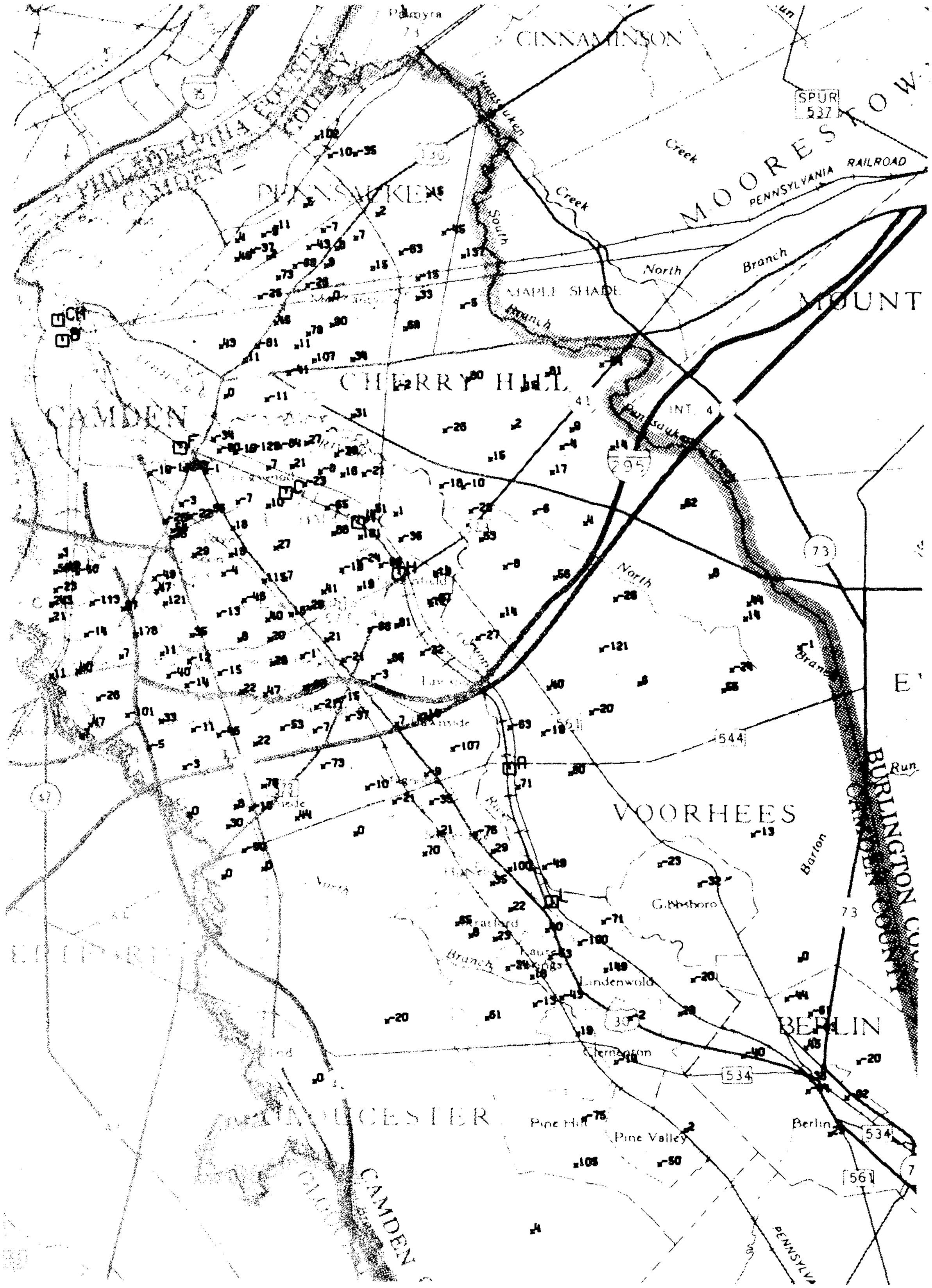
t	1		2		
$v_{t(1965)}$	-.061		.097		
$v_{t(1966)}$	-.072		.043		
$v_{t(1967)}$	-.123		.121		
$v_{t(1968)}$	-.023		.029		
$v_{t(1969)}$	-.463		.143		
$v_{t(1970)}$	.213		.974		
$v_{t(1971)}$	-.846		.064		
(inner product of $\underline{v}_1$ and $\underline{v}_2$ = .063)					
$w_{1(<2)}$	.944		-.332		
$w_{2(\geq 2)}$	-.330		.943		
(inner product of $\underline{w}_1$ and $\underline{w}_2$ = -.625)					
(inner product of $\underline{u}_1$ and $\underline{u}_2$ = .306)					
% of Interaction Sum of Squares Explained by Individual Terms	14.692	+	14.958	=	29.650
% Explained by Two-Term Decomposition		29.293			

inflation can be regarded as a multiplicative effect. The rate of these rises in prices appears to be increasing rapidly through fiscal 1971. Quantitative expressions were also obtained for time stable values of houses in different neighborhoods. These conformed in large measure to the common understanding of the value of houses in suburban Camden County. Cherry Hill Township, for example, showed a large number of areas with expensive housing.

The application of decomposition procedures to the residuals from the model, revealed the presence of a secondary time trend in the data. This trend was more firmly established when an outlier editing procedure, based on the maximum studentized absolute deviate, was employed. The use of this statistic seems particularly appropriate in unbalanced analyses of variance. Its use in balanced analyses of variance, however, would destroy the property of balance. By interrelating components of the first pair of singular vectors, it was seen that the secondary time trend provided a contrast between developing suburban areas and older, more well-established ones. Prices in the former locations have been increasing more rapidly than those in the latter ones. This finding, supported by independent studies of residential phenomena, helps to confirm the suspicion of Good (1969, p.828) that decomposition procedures possess heuristic value. To some extent, block groups near stations of the High-Speed Line manifested relatively large increases in residential sales prices. However, this effect did not appear strongly. The incorporation of a variable concerning the number of stories in residences, did not add substantial power to the model.



Map 6-17 Principal Contrast in Three-Way Analysis-Two Term Decomposition
[values are 1000 · u_{1i}]



Map 6-18 Secondary Contrast in Three-Way Analysis-Two Term Decomposition
[values are 1000 · u_{2i}]

CHAPTER 7

STATISTICAL ANALYSES OF TRANSPORTATION IMPACT ON RESIDENTIAL SALES PRICES

Introduction

Residential property values are determined by many factors. Thus, even if we are interested in only a single element, such as changes in access to the CBD, a general model must be formulated. One classification of the types of variables which might be included in such a model is as follows:

1. Site elements, describing the individual property; e.g., lot size, characteristics of the structure, topography;
2. Neighborhood variables, describing the areas immediately adjacent to the property. Possible variables might include measures of neighborhood homogeneity, the occupational status of the residents, the age distribution of the residents, the predominant type of families (e.g., retired, extended), the general physical condition of local housing, the degree of crowding and the degree to which other land uses intrude on the area;
3. Regional variables, measuring such items as access to shopping, jobs and schools, local tax rates, and the quality of local services;
4. Historical or externally imposed factors, such as zoning limitations, the financial markets or special prestige areas such as Haddonfield;
5. Impact variables, measuring the expected impact of the Lindenwold High-Speed Line.

The basic hypothesis explored in this chapter is that property values are a function of the five types of variables listed above. The specific variables that are chosen to represent the effect of each of these factors are limited in two general ways:

1. whether or not they are good measures of the phenomena they are intended to represent;
2. their availability, cost of procurement, accuracy and detail.

As in most social science research, the second limitation is more restrictive in this study.

The next section of this chapter describes how the available data were used to define measures of the above variable types. These data are then employed in statistical analyses, mainly analysis of variance and regression analysis, to test specific hypotheses concerning the contribution of each type of variable to residential property value. The findings of these analyses are presented in several subsequent sections.

Definition of Variables

Site and Neighborhood Characteristics

Of the five variable types defined above, site variables related to individual properties are the most detailed. Except in studies with a very small sample, or a very large budget, one is usually limited to whatever data has been collected by others and can be obtained from them.

In the case of these studies, computer tapes of the tax assessors' records for Camden and Gloucester Counties were made available, thereby providing a limited number of site variables for each property in these counties. The assessors' files were matched with the real estate transactions files resulting in the following site data for each matched sale:

1. date and price of sale
2. lot size
3. outside building material
4. number of stories
5. number of garages
6. land use at time the tapes were prepared in 1970 and 1971

Approximately 25,000 residential sales have been matched in the two counties for the period from July 1964 through June 1971.

Short of a large and expensive survey, the only way to supplement the limited site data listed above is to use more readily available area data from a source such as the U.S. Census. Of course, this approach assumes that, except for the site variables already available, any given property is typical of its surrounding census block group or tract. Census information was also considered to be useful in defining many of the neighborhood characteristics. A statistical technique called AID analysis (Automatic Interaction Detection) was selected as an efficient method for data reduction and selection of characteristics related to property value.

AID is a multivariate technique that performs two important functions:

1. From a large group of possible explanatory variables, it selects those most useful for statistically explaining the variation in a given dependent variable.
2. AID also splits the total number of observations (say census block groups) into K mutually exclusive types that, for a given K, explain more of the total sum of squares than any other K types.

For the neighborhood analysis, each of these types may be viewed as defining a relatively homogeneous class of neighborhood.

<u>An Example of an AID Analysis</u>

An understanding of what AID does can best be seen from an example, given by Sonquist and Morgan (1964, pp. 48-65). Their original sample consisted of data on 1959 hourly income and a large number of possible income related variables for over 2500 individuals. The AID algorithm found that the best way, in terms of reducing the total sum of squares, to split the sample was on the variable, education. College graduates averaged $3.45 per hour, while non-collect graduates averaged $2.16, as compared with the overall mean of $2.31.

There are now two groups to be analyzed, college graduates and non-college graduates. For each group, AID found the most useful variable for explaining the variation in income within each group, and used this variable to split each group. The four resulting groups are then split, and the process continues until one of the following criteria is met for each candidate group;

1. The group contains less than a given portion of the original total sum of squares;

2. The best split available for the group does not decrease the total sum of squares of the group by a given amount;

3. There are too few observations in the group;

4. The total number of sub-groups has reached a specified upper limit.

The tolerance of each of these criteria can be easily varied by the user.

The results of an AID analysis can be displayed as a tree branching from the original total sample. Figure 7-1 is an example of a tree used in the High-Speed Line study. If a given node on the tree has no further branches from it, it becomes a final group. In the income example described above, thirteen final groups were formed. For example, one of these groups was reached after four splits and was defined as follows: non-college graduates who grew up on a farm or in the South, who completed nine grades of school or more and who were female.

For each independent variable, AID examines every possible way of splitting the group under consideration. Of course, to ensure that there are only a finite number of split possibilities, continuous variables must be divided into mutually exclusive *a priori* categories. For example, the variable "individual's age" may be grouped as follows: 20-29, 30-39, 40-49, 50-59, over 60.

Statistically, AID can be seen as a "step-wise application of one-way analysis of variance." See Sonquist (1970, p. vii.) In an analysis of variance model with K sub-groups, each containing n_k observations and N total observations, the total variation in the data can be described as follows:

$$\sum_{i=1}^{N}(X_i - \bar{X})^2 = \sum_{k=1}^{K}(\bar{X}_k - \bar{X})^2 + \sum_{k=1}^{K}\sum_{i=1}^{n_k}(X_{ki} - \bar{X}_k)^2 \qquad (7\text{-}1)$$

or, TSS = BSS + WSS

The total sum of squares (TSS) equals the sum of squares between the groups (BSS) plus the sum of squares within the groups (WSS). The between sum of squares can be seen as the portion of the total variation explained by dividing the sample into sub-groups.

AID calculates the total sum of squares of the dependent variable for each group that can be split. Then for each potential split, AID calculates the between sum of squares that would result if that split were chosen. That split which results in the largest BSS, and therefore the largest reduction in the total sum of squares, is chosen. For example, if there are 40 independent variables, each divided into seven categories or ranges, there would be 40(7 - 1) = 240 potential splits to be considered. By looking at each potential split's BSS score, it is possible to identify variables that explain almost as much of the TSS as the split actually performed.

<u>Application of AID to Defining Neighborhood Types</u>

AID analysis can be used to identify similar geographic areas and their characteristics, thereby extending the variable set available for each parcel. This analysis has been applied to census block groups, which consist of 10-25 city blocks. There have been two major results from this work:

1. Because of its tree-forming nature, AID defines mutually exclusive, relatively homogeneous sets of block groups, which are called "neighborhoods" or "neighborhood types;"

2. AID indicates which census variables are potentially most useful in explaining property values.

To date over a dozen AID runs have been made; 331 block groups in the urbanized part of Gloucester County and all of Camden County, except Camden

City, have been included. In all cases, the dependent variable was the mean owner occupied home value, as reported in the 1970 census. These values were found to correspond approximately to mean 1970 sales prices in the real estate transactions files.

Most of the AID runs have attempted to choose the best neighborhood descriptors from the vast amount of census data. For example, percent of housing units in mobile houses, percent of the population who are inmates of institutions and percent of the families with eight or more members were all tried and dropped. These variables not only resulted in no splits, but were not even second or third choices for any splits. In all over 100 different variables were tried. The variables selected most often were then used in several final runs. The earlier runs were also used to explore the sensitivity of the program to different numbers of variables and to different numbers of a priori categories for each variable. In general, it was found that increasing the number of categories above seven or eight made little difference in reducing the total sum of squares or in the number and types of splits. In the final runs, the program's capacity of forty explanatory variables was fully used.

The results of the AID run (AID 16), which is extensively used in regressions, is now described in some detail. Table 7-1 lists the forty explanatory variables included. The last eleven variables come from the 1960 census, and as a result were available only at the 1960 tract level. Unfortunately, the comparable 1970 data is not yet available, and these variables were considered too important to be ignored.

One omission from the list deserves some comment. There is no racial or ethnic variable such as "percent population Negro." This variable was tried many times, but consistently failed to be significant. There are important

Table 7 - 1

Variables Used as Input into AID Analysis

Dependent Variable - mean owner occupied housing value

1970 Census Variables

1. percent of households that are husband-wife households
2. percent of households with male heads of households, other than the husband in a husband-wife household
3. percent of households with female heads of households
4. percent of husband-wife households with all members aged 18-65
5. percent of husband-wife households with all members aged 0-65
6. percent of housing units owner occupied
7. mean contract rent of renter occupied units
8. percent of housing units in single-family houses
9. percent of housing units in multi-family structures
10. percent of housing units with 8 or more rooms
11. mean number of rooms per owned unit
12. mean number of rooms per rented unit
13 percent of housing units with 1 person
14. percent of housing units with 2 persons
15. mean number of persons per unit
16. percent of housing units with < 1 person per room
17. percent of housing units with 1-1.5 persons per room
18. percent of housing units with > 1.5 persons per room
19. percent of owned units with > 1.5 persons per room
20. percent of rented units with > 1.5 persons per room
21. percent of housing units in 2-4 unit structures
22. percent of housing units in 5-9 unit structures
23. percent of housing units in 10+ unit structures
24. percent of housing units with a basement
25. percent of housing units with direct access and kitchen facilities
26. percent of housing units without direct access and kitchen facilities
27. percent of housing units with telephone
28. percent of housing units with roomers
29. percent of housing units lacking one or more plumbing facilities

1960 Census Variables

30. median school years
31. percent of adult working males who were professionals
32. percent of adult working males who were in sales
33. percent of adult working males who were craftsmen
34. percent of population who moved into their home in 1958-60
35. percent of population who moved into their home in 1954-57
36. percent of population who moved into their home in 1940-53
37. percent of population who moved into their home before 1940
38. percent of population in same housing units as five years ago (1955)
39. percent of population who moved from center city of same SMSA within the last five years (1955-60)
40. percent of population who moved from suburbs of same SMSA within the last five years (1955-60)

areas of black population in the study area (e.g. Lawnside); but, evidently the racial variables were dominated by variables that cut across racial lines such as variables describing different family structures.

Figure 7-1 shows the structure of the tree formed by the AID analysis. The numbers at each junction or node are the identifying numbers used by AID algorithm. The order in which the types are formed does not affect the outcome, since each split is performed independently of all other splits. Because the splits are achieved within the analysis of variance framework, significance tests for each split are easy to calculate. In this run, all of the splits were highly significant with "t" values of over four.

Table 7-2 defines how the eleven final neighborhood types shown on the tree are defined. Mean price is the mean of the mean owner occupied house value for each block group over all of the block groups assigned to a given neighborhood type. n_k gives the number of block groups assigned to that particular neighborhood. For the entire sample, the mean value is $18,589; The number of block groups is 331.

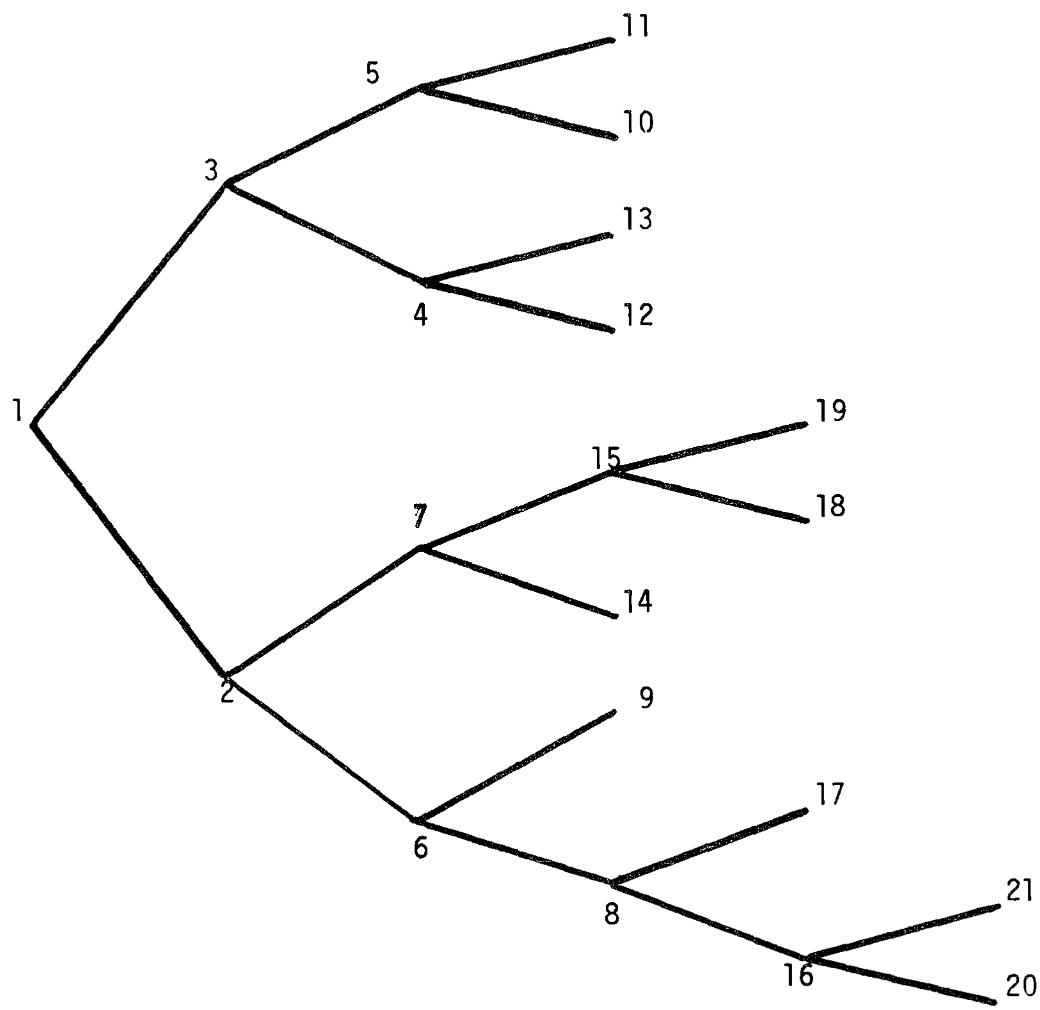
In this run, a type became a final type in one of three ways:

1. the total sum of squares for that type is less that 1.0 percent of the original total sum of squares;
2. the BSS for the best possible split was less than 0.6 percent of the original total sum of squares, i.e., if the split could not reduce the unexplained sum of squares by at least this amount;
3. the type contained fewer than 20 block groups.

Most of the variables that resulted in splits seem to make common sense. The variable, percent of the 1960 population moving to tract in 1954-57 would seem to be best interpreted as a housing age factor. Less expensive areas (types 12 and 13), were probably much more fully developed in the late 1950's, although they might also score low on this variable if they were very much

Figure 7 - 1

Tree Diagram of Neighborhood Types from AID Analysis



Numbers indicate neighborhood types formed
from Census block groups.

Table 7 - 2

Definition of Neighborhood Types in AID Run 16

Type Number	Mean Value	Block Groups	Explanatory Variables
11	$42139	11	> 24% of 1970 units with 8 or more rooms > 40% of 1960 tract pop. moved to tract in 1954-57 < .2% of 1970 housing units had roomers
10	$31573	14	> 24% of 1970 units with 8 or more rooms > 40% of 1960 tract pop. moved to tract in 1954-57 > .2% of 1970 housing units had roomers
13	$30633	10	> 24% of 1970 units with 8 or more rooms < 40% of 1960 tract pop. moved to tract in 1954-57 < 15% of 1960 tract adult male workers were craftsmen
12	$21463	33	> 24% of 1970 units with 8 or more rooms < 40% of 1960 tract pop. moved to tract in 1954-57 > 15% of 1960 tract adult male workers were craftsmen
19	$25146	10	< 24% of 1970 units with 8 or more rooms 1960 tract adult pop. averaged > 12 yrs. school < 1% of 1970 units were in multi-family structures > 90% of households are husband-wife households
18	$20316	10	< 24% of 1970 units with 8 or more rooms 1960 tract adult pop. averaged > 12 yrs. school < 1% of 1970 units in multi-family structures < 90% of households are husband-wife households
14	$17859	37	< 24% of 1970 units with 8 or more rooms 1960 tract adult pop. averaged > 12 yrs. school > 1% of 1970 units in multi-unit structures
9	$15968	139	< 24% of 1970 units with 8 or more rooms 1960 tract adult pop. averaged > 12 yrs. school average 1970 rent was $90 or more or was suppressed
17	$15692	22	< 24% of 1970 units with 8 or more rooms 1960 tract adult pop. averaged > 12 yrs. school average 1970 rent of $10 - $90 < 13% of 1970 housing units with only one person
21	$13963	22	< 24% of 1970 units with 8 or more persons 1960 tract adult pop. averaged < 12 yrs. school average 1970 rent of $10 - $90 > 13% of 1970 units with only one person > 92% of 1970 units with telephone
20	$10674	23	< 24% of 1970 units with 8 or more persons 1960 tract adult pop. averaged < 12 yrs. school average 1970 rent of $10 - $90 > 13% of 1970 units with only one person < 92% of 1970 units with telephone

undeveloped in 1960. Large parts of types 10 and 11 are in the outer portions of Cherry Hill, an area of recent rapid growth with generally large lots. It is also of interest that the variable which was almost chosen to split types 10 and 11 from 12 and 13 was "one percent of 1960 population moving from suburbs of SMSA." Therefore, this split may also be a measure of areas with large numbers of people owning their second or third suburban home.

Craftsmen is an occupation that characterizes middle income areas. As an explanatory variable, craftsmen were consistently more important than a lower income occupation such as laborers. On the lower branch of the tree measures of the proximity and type of apartments such as percent of units in multi-family structures and average rent are employed. In most of the expensive upper branch groupings apartments are less common, so this variable had little chance to be used.

The output of this AID analysis is one basis for multiple regression models of the South Jersey housing market. Results reported below show that the AID neighborhood groupings are very valuable in explaining sales prices. Three primary reasons for including a neighborhood variable in the statistical analyses that follow are:

1. The characteristics of the neighborhood are important factors in determining property values;
2. Because of the limited number of site variables in the data base, the census neighborhood characteristics are important proxy variables;
3. Neighborhoods help define submarkets within the overall housing market. There is no reason to assume that these submarkets should react identically to external changes such as the High-Speed Line.

Impact Variables - Definition of Corridors

There are many approaches to measuring the impact of transportation on property values; one of the most common is the before-and-after study. However, as such studies are typically made only for areas adjacent to the transportation improvement, it is very difficult to distinguish transportation impacts from other temporal and regional changes affecting property values. Better statistical control of these changes can be achieved by comparing two or more separate transportation corridors over time. In this approach the area or corridor adjacent to the improvement can be contrasted with a control corridor.

In the control corridor approach, any region-wide changes in property values that might coincide in time with initiation of the High-Speed Line service should be netted out. By simultaneously controlling for site and neighborhood characteristics, it should be possible to isolate any actual effect on property values resulting from the High-Speed Line. The multi-corridor approach also increases the number of observations in the sample, thereby also helping to improve the reliability of the results.

The transportation corridors defined in this study are centered on the following actual, proposed and hypothetical transit alignments:

1. High-Speed Line itself, designated the Lindenwold Corridor;
2. the proposed extension of the High-Speed Line from Camden south through Woodbury in Gloucester County, known as the Woodbury Corridor;
3. the proposed extension from Camden north to Moorestown in Burlington County, known as the Moorestown Corridor;
4. an abandoned commuter rail line from Camden to Grenloch in Camden County, designated here as the Grenloch Corridor.

In this analysis, the Woodbury Corridor is the most realistic as well as most useable control corridor because of its geographic separation from the Lindenwold Corridor and because the data base permits complete coverage of the corridor. The Moorestown Corridor being only partially in Camden County, cannot be properly studied with the available data base. When the tax assessors' files for Burlington County become available, the Moorestown Corridor should provide a most interesting control. Complete data coverage does exist for the Grenloch Corridor. However, because it is parallel to the North-South Freeway, the only radial expressway in South Jersey, and because of its relative proximity to the Lindenwold Corridor, the Grenloch Corridor's use as a control is somewhat suspect.

Stations for the control corridors are taken to be the proposed stations, or for the Grenloch case, locations were chosen that approximated the station densities of the other lines. A fare structure similar to that of the High-Speed Line before the April 1972 fare increase was assigned to the three control transit corridors.

Given these alignments and station locations, the market area boundaries for each line are easily defined. Using parameters from the station choice and market area analysis described in Chapter 4 and Boyce et al. (1972) crude cost functions for travel to the CBD were calculated for each census block group and each corridor. Each block group was then assigned to its lowest cost corridor. The cost function used is of the following form:

$$C_i = \min_j (aD_{ij} + F_{ij}) \qquad (7\text{-}2)$$

where D_{ij} is the straight-line distance from the block group under consideration to station j of corridor i. F_{ij} is the corresponding fare to the Philadelphia CBD. C_i is minimized over all corridors and stations to find the minimum cost corridor and station; the block group is then assigned to that corridor's market area.

The parameter a is the cost per mile for auto operating expenses and personal travel time. Auto driving time is valued at $2.00 per hour. Car operating expenses are assumed to be 5.5 cents per mile. At an average access speed of twenty miles an hour, this translates into an overall cost of 15.5 cents per mile. The cash fare F_{ij} is added to this station access cost; no provision is made for travel time on the rapid transit line, as fares are roughly proportional to riding time. Also, it appears that the actual station market areas are relatively insensitive to differences in travel time on the line.

Accordingly, the two county region may be divided into four mutually exclusive transportation corridors. Each census block group and each residential sale can be assigned to one corridor. Similar calculations are made for the two corridor case, consisting of the Lindenwold and Woodbury Corridors. The boundaries of these corridors are shown on Map 7-1.

Calculation of Savings Function

In conjunction with the cost calculations, travel cost savings resulting from the introduction of the High-Speed Line may also be calculated. The theoretical importance of these savings for property value changes has already been discussed in Chapter 4.

Before the High-Speed Line, commuters reached the Philadelphia CBD by car. A good proxy for the cost of this trip is the straight line distance to Camden City Hall, D_{CH}, multiplied by the cost per mile (a), plus a fixed charge for bridge tolls, parking costs and other access costs in Pennsylvania (M):

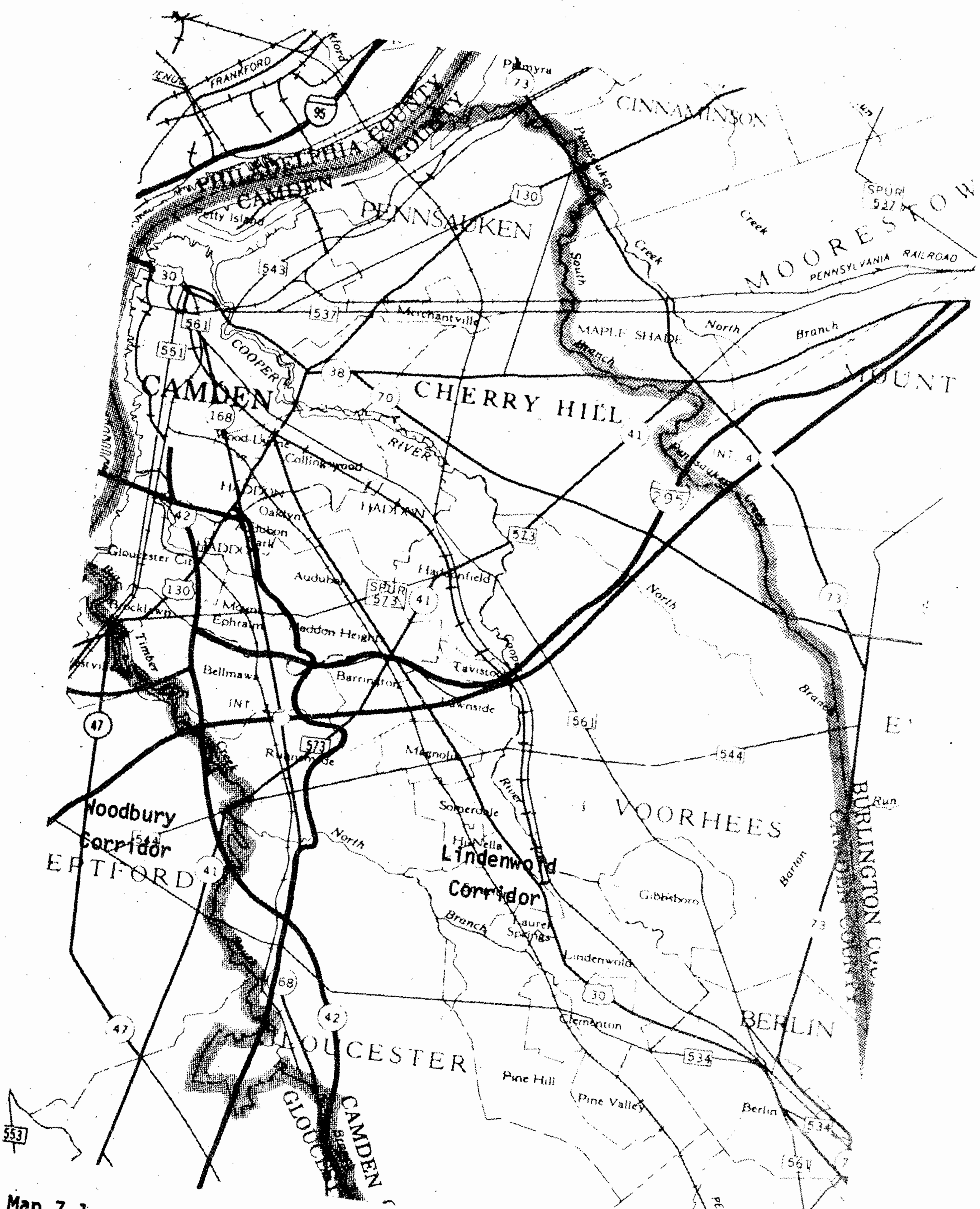
$$C_0 = aD_{CH} + M$$

The difference between this cost and the cost of using the Lindenwold Line, C_L, represents the travel savings due to the Line.

$$TS_L = aD_{CH} + M - C_L$$

$$TS_i = aD_{CH} + M - \min_j(aD_{ij} + F_{ij}) \qquad (7\text{-}3)$$

where TS_i is the savings for corridor i over all stations j in corridor i. The above equation is not an exact measure of realized savings, but it should be roughly proportional to these savings, and hence is a good measure



Map 7-1

Boundary of Lindenwold and Woodbury Corridors of the relative impact of the High-Speed Line on different block groups.

For sales within the Lindenwold Corridor, TS_L is the proper variable for measuring the impact of the Line on property values. For a single corridor model, this formulation of savings would be the appropriate measure of impact for the entire area. In a multi-corridor design, however, a hypothetical travel savings for each control corridor can also be calculated, as *if* that corridor also contained a rapid transit line. But, anyone located in a control corridor *actually* can experience travel savings due to the High-Speed Line. For the control corridor savings to be comparable to the Lindenwold Corridor savings, the actual High-Speed Line savings should be subtracted from the savings due to the hypothetical transit line in a control corridor. Thus, for each control corridor, the net savings are:

$$NS_i = aD_{CH} + M - \min_j(aD_{ij} + F_{ij}) - TS_L \qquad (7\text{-}4)$$

In much of the statistical analysis that follows, the pattern of property transactions with a given savings level in the Lindenwold Corridor is being compared with similar property transactions with the same level of net savings in a control corridor area. In a multiple regression model, the signs and magnitude of the regression coefficients for savings in the Lindenwold Corridor may be compared with the coefficients for savings in the control corridor. Based on the savings formulation, one would expect to find a positive, significant coefficient for the Lindenwold Corridor savings and a negative, or insignificant, coefficient for the control corridor savings. The importance and interpretation of the net savings concept will be discussed in more detail below.

Time Profile Analysis of Housing Type, Neighborhoods and Corridors

The principal statistical approaches used to analyze the real estate transactions data are analysis of variance and multivariate linear regression analysis. Before presenting the results of these methods, some simpler, graphical analysis are considered. These profile analyses are helpful in gaining an understanding of the variation in sales prices before considering the analytical results.

For each housing type, and neighborhood category mean sales prices vs. six month time intervals may be plotted for the Lindenwold Corridor and the control corridors. If the profiles for two or more corridors are roughly parallel over the 1965-71 period, then price changes would appear to be largely a function of national or overall regional factors. That is, no special advantage, such as improved transportation, would be apparent for one corridor over the other.

In Figures 7-2 and 7-3, the mean sales price for a particular housing and neighborhood subpopulation is the y axis; the x axis designates time periods from July 1, 1964 to June 30, 1971, divided into fourteen six month intervals. The High-Speed Line began operations in time period ten, the first six months of 1969.

Figure 7-2 shows the time profile of mean sales prices of non-brick houses for Neighborhood Type 14 in the Lindenwold and Woodbury Corridors; Figure 7-3 shows the same results for brick houses. Neighborhood 14 is a middle class neighborhood defined by the AID analysis described above. It is the second largest neighborhood type, accounting for about fourteen percent of all sales. Neighborhood 14 was chosen because of its relatively large size, its fairly even geographic distribution, and its "average" nature. Brick homes were selected as a special sub-case because they have a consistently higher value than

Figure 7 - 2

Mean Sales Prices of Non-brick Houses in Neighborhood 14

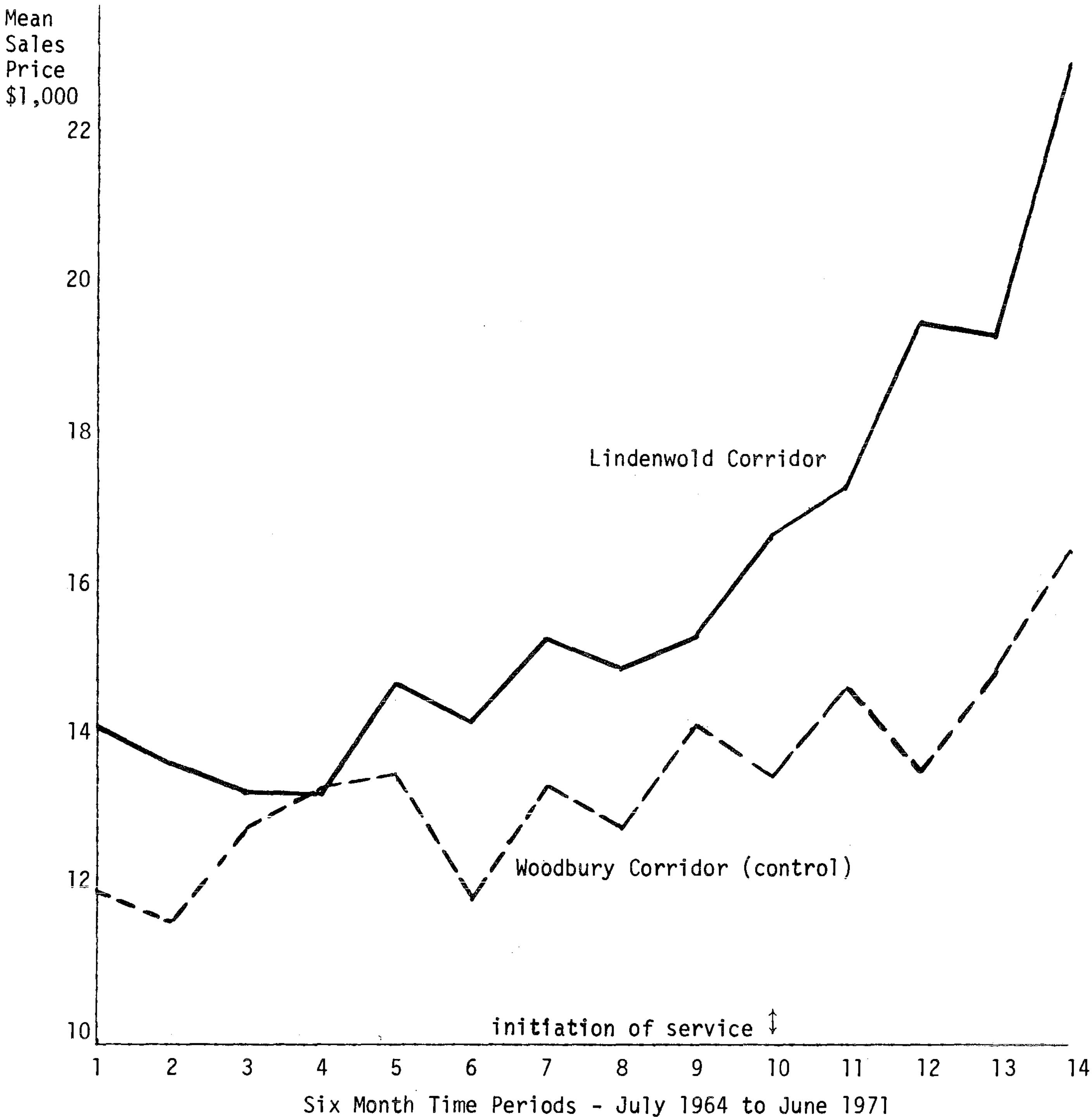
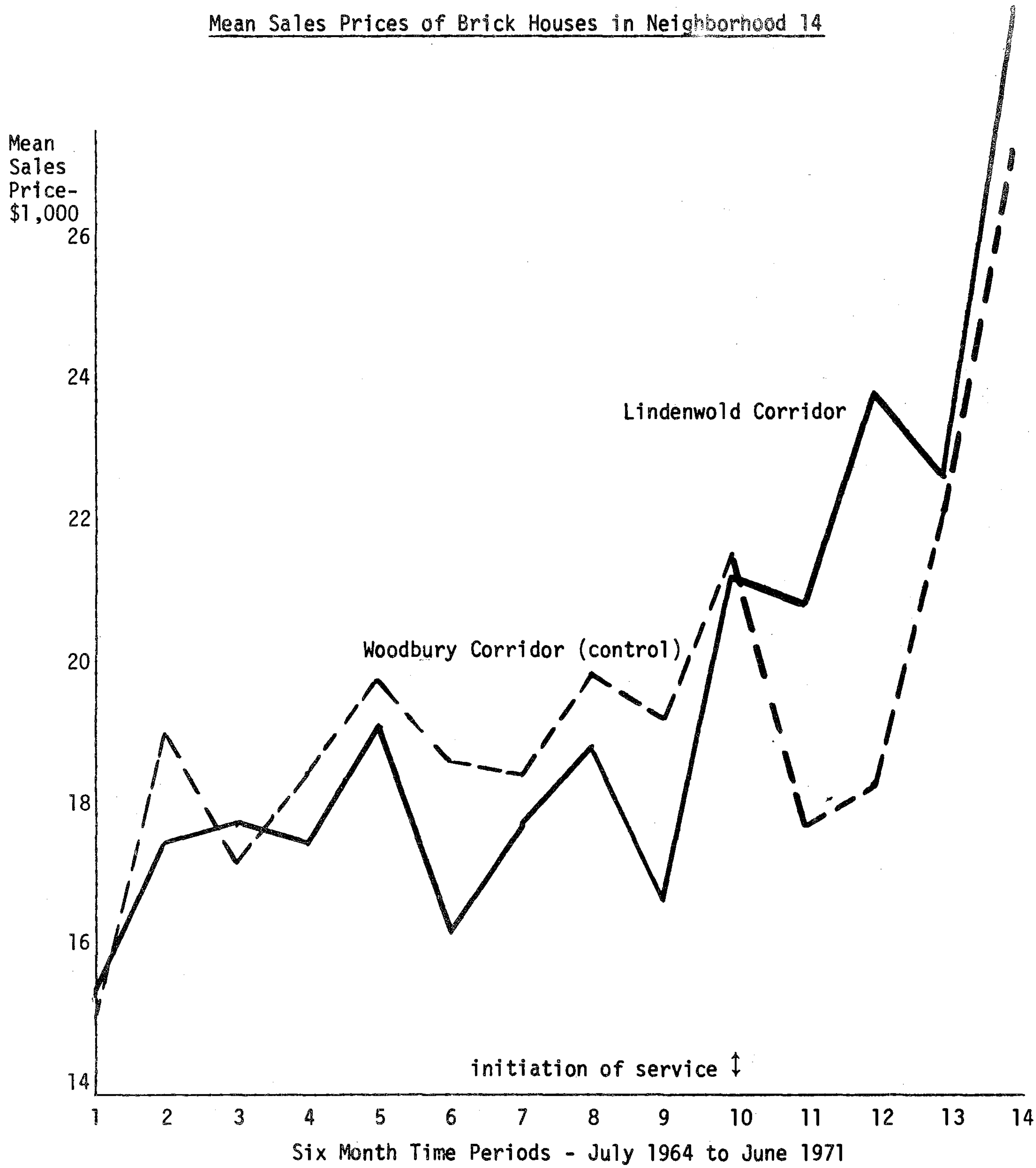


Figure 7 - 3

Mean Sales Prices of Brick Houses in Neighborhood 14



other building types.

Figure 7-2 dramatically shows that something special happened in the Lindenwold Corridor (or failed to happen in the Woodbury Corridor) after time period ten; this coincides with initiation of service on the High-Speed Line. Of course, the null hypothesis of no impact of the High-Speed Line cannot be rejected on the basis of such a simple analysis; however, it is encouraging. Figure 7-3 shows a similar pair of profiles for brick houses in Neighborhood 14. The results are less clear than for non-brick houses, but the Lindenwold Corridor definitely shows a greater increase in value after time period nine.

Analysis of Variance

A second method that has been used to test hypotheses of High-Speed Line impact is the analysis of variance. In this approach, several factors hypothesized to affect the dependent variable are specified. For example, if sales price is the dependent variable, factors might include corridors and neighborhoods. The basic model is defined as follows:

$$X_{ijk} = A_i + B_j + C_{ij} + e_{ijk} \qquad (7\text{-}5)$$

where X_{ijk} is an observed sales price in corridor i and neighborhood j, A_i is the main effect of corridor i, B_j is the main effect of neighborhood j. C_{ij} is the interaction between neighborhood j and corridor i on the assumption that neighborhoods behave differently in different corridors; e_{ijk} is the error term for observation k.

The observations are grouped into i times j subdivisions called cells. For analysis of variance to be feasible, there must be at least one observation in each cell. In the above example, each neighborhood must be found in each corridor at least once. The analysis of variance can also be regarded as a model in which the total sum of squares of the dependent variable is partitioned into main effects associated with the factors, interaction effects among factors and the unexplained within cell sum of squares. One of the principal results of analysis of variance is a test of significance for each of the hypothesized effects.

The profile analysis presented above can be interpreted as an analysis of variance, and the null hypothesis that the profiles are parallel can be tested statistically. In this case time periods and corridors are the factors. The existence of parallel profiles corresponds to the hypothesis of no interaction effect between time periods and corridors. In principle, this test compares the divergence of the profiles with the variation around each of the mean sales prices plotted in Figures 7-2 and 7-3.

The analysis of variance considered here was based on nearly 13,000 observations in Camden County. Two corridors were used; the Lindenwold Corridor and the Grenloch Corridor paralleling the Black Horse Pike along the western edge of the county. Two geographic areas within Camden County were excluded from this analysis. Pennsauken and Merchantville in the northeastern corner of the county were omitted as they actually pertain to the Moorestown Corridor, only part of which is in Camden County. Parts of Cherry Hill and Haddonfield were also dropped because they formed a high income neighborhood that is geographically self-contained in the Lindenwold Corridor. Thus, no comparisons with Grenloch Corridor sales were possible for this neighborhood.

In this case, five factors and their interactions were considered. Their definitions are as follows:

1. C: the two corridors defined above, Lindenwold and Grenloch.
2. T: before (July 1964-June 1968) and after (July 1968-June 1971) time periods.

3. N: three neighborhoods; to ensure non-empty cells in the analysis of variance model, neighborhoods adjacent to one another in the AID tree were grouped into what might be called upper middle class, middle class, and lower class areas. A slightly different AID run than the one presented above was the basis for defining these neighborhoods.

4. R: radial distance from Camden divided into two categories with Interstate 295 as the boundary.

5. L: distance from the center of the corridors divided into two categories — less than one-half mile, and more than one-half mile.

The total number of cells in this five-way analysis of variance is 2x2x3x2x2 = 48.

Table 7-3 summarizes the analysis of variance results. Main effects are shown by the appropriate single letter. Interaction effects are indicated by combinations of letters. Thus CNT represents the interaction between corridor, neighborhood and time. The sum of squares column gives the variation explained by the given factor or interaction term. The total sum of squares in this sample is 612,445. Thus, less than one-third of the variation is explained by the main effects and their interactions. The F-ratio shown in the last column is the basis of the test of statistical significance of each effect.

The most obvious result of this analysis is the concentration of explanatory power in the main effects for neighborhoods, time and radial distance. This is not too surprising since the characteristics of the neighborhood, inflation and distance from the CBD should all have an important impact on property values. However, with a few exceptions, the importance of the interaction terms fall off rapidly. Indeed, most of the third and all the fourth and fifth order terms are not significant. This result is desirable for testing the significance of the pairwise interactions and main effects, and suggests that the structure of sales price variation is somewhat simpler than could be the case.

Table 7 - 3

Summary of Analysis of Variance of Sales Price

Source of Variation	Sum of Squares	d.f.	Mean Square	F-ratio
C	8304	1	8304	244.3
R	22083	1	22083	649.6
L	9275	1	9275	272.8
N	65026	2	32513	956.4
T	38141	1	38141	1122.0
CR	5678	1	5678	167.0
CL	1081	1	1081	31.9
CN	2802	2	1401	41.2
CT	8	1	8	0.2**
RL	6320	1	6320	185.9
RN	2725	2	1362	40.1
RT	131	1	131	3.9*
LN	2509	2	1254	36.9
LT	693	1	693	20.4
NT	2462	2	1231	36.2
CRL	1699	1	1699	50.0
CRN	983	2	492	14.5
CRT	274	1	274	8.1
CLN	12	2	6	0.2**
CLT	57	1	57	1.7**
CNT	134	2	67	2.0**
RLN	773	2	387	11.4
RLT	441	1	441	13.0
RNT	247	2	124	3.6*
LNT	80	2	40	1.2**
CRLN	81	2	41	1.2**
CRLT	74	1	74	2.2**
CRNT	11	2	5	0.2**
CLNT	157	2	79	2.3**
RLNT	159	2	80	2.3**
CRLNT	17	2	8	0.3**
Within cells	440,003	12944	34	
Total	612,446			

* F-ratio is not significant at the .01 level
**F-ratio is not significant at the .05 level

From the point of view of analyzing the impact of the High-Speed Line, there is an interesting result. CT, the interaction term for corridors and time, is definitely not significantly different from zero. If the High-Speed Line did have a strong impact on property values, this interaction effect should be significant. There are at least two possible explanations for this:

1. There is no High-Speed Line effect; that is, changes in property values over time have occurred independently of the corridor. However, this conclusion is contradicted by the profile results and by the multiple regression results to be presented below.

2. The Grenloch Corridor is a poor control since it is too close to the Lindenwold Corridor. Indeed, when the Grenloch Corridor is split up between the Woodbury and Lindenwold Corridors, most of Camden County is assigned to the Lindenwold Corridor.

The largest interaction effect is between radial distance and distance from the Line (RL); this result, in fact, suggested the use of the savings loci described above to measure impact. This interaction term roughly describes the savings hypothesis. That both R and L are consistently involved in the most important second and third order interactions indicates that using straight line distance from the High Speed Line and from the CBD alone does not properly explain all the influence of distance.

There are also several important limitations to using analysis of variance with this data set. Much detail is lost by forcing continuous variables such as distance into a discrete format. Also, because of the necessity of having no empty cells, a large number of observations can not be used. Although most of the eleven neighborhood types are located throughout the area, each neighborhood type does not occur in each combination of corridor, radial distance and distance from the Line. Thus, to fit the analysis of variance framework, neighborhoods must be aggregated with a substantial loss of detail. Also, it is not possible to fit what structural characteristics are available into a manageable analysis of variance framework. The ability of analysis of variance to include interaction terms and several levels on each factor does not make up for these deficiencies. In order to overcome these shortcomings, further analyses have employed multiple regression analysis with dummy variables.

Multiple Regression Analyses

The technique that has been used most extensively in these studies is multiple linear regression analysis. In this approach the dependent variable, say sales price, is hypothesized to be a linear function of several independent variables. The most important independent variables in this study are building and site descriptors, neighborhood variables, locational variables and impact variables. Of the theoretically important types of variables mentioned at the beginning of the chapter, only the category of historical or externally imposed factors is missing. The data collection problems here extended beyond the scope of the project.

The building and site descriptors are from the county tax assessors' records and include (a) lot size, (b) number of garages, (c) number of stories, (d) outside building material and (e) latest (early 1971) land use. Lot size is a continous variable that increases monotonically with sales price; however, the relationship is probably not a linear one. For this reason, the natural logarithm of lot size has been used in most of the analyses. The relationship of sales price to number of garages is assumed to be linear.

The number of stories cannot be viewed as a monotonic relation with sales price inasmuch as a one story house is normally considered to be a different type of house than a two story house or a split level. Therefore, this important variable is treated as a series of (0,1) dummy variables; for example, the variable for one story house equals one if the observation is on a one story house, and equals zero for all other types of houses. Similarly, there are dummy variables for one-and-one half, two, two-and-one-half, three, and over three story houses.

The outside building material is also treated as several distinct (0,1) dummy variables, as is the latest land use variable. The neighborhood variables, taken from the AID analysis presented above, consist of eleven separate types of census block groups called neighborhoods. These are also treated as dummy variables. However, since the effect of neighborhood type may be proportional to the size of the property and is not necessarily a lump sum addition to the property's value, in some analyses the neighborhood dummy variables are multiplied by the logarithm of the lot size. In this case we have (0, log of lot size) dummy variables.

The locational variable most often used is a simple function of the straight line distance to Camden's City Hall. This variable is hypothesized to account for the contribution of the urban land rent gradient to property value. The transit impact variables include several forms of the cost and savings functions derived earlier.

In summary, the basic model has the following form:

$$P_h = a + \sum_{i=1}^{I} b_i S_i + \sum_{j=1}^{J} b_j N_j + \sum_{k=1}^{K} b_k L_k + \sum_{\ell=1}^{L} b_\ell I_\ell + e_h \qquad (7\text{-}6)$$

where the b's are the estimated regression coefficients. P_h and e_h are the sales price and residual for observation h; a is the constant term. The S_i, N_j, L_k and I_ℓ are the site variables, neighborhood variables, locational variables and impact variables, respectively.

Since dummy variables play an important role in this model, a brief discussion of their use is appropriate. Dummy variables are normally used to describe qualitative phenomena or dichotomous situations. For example, a brick house is qualitatively different from a frame house. A property is either in neighborhood fourteen or it is not.

Mathematically, a (0,1) dummy variable adds the amount of the variable coefficient to the constant term whenever the variable equals one. Thus, by modifying the constant, two parallel equations, say one for one story houses and one for all other houses can be estimated as a single equation. Dummy variables also permit observations on certain variables (e.g., lot size), to be pooled thereby gaining more degrees of freedom, and yet retaining some of the characteristics of working with two subsamples. The interpretation of the regression coefficients and significance tests is the same as with ordinary continuous variables.

An important statistical problem arises if a set of dummy variables is used that completely exhausts the alternatives, as would be the case if all eleven neighborhood variables were included in one regression. The covariance matrix would be singular, and therefore impossible to invert, because the eleventh variable is an exact linear function of the other ten variables. The problem is solved by omitting one of the neighborhoods from the regression. This must be done in every case in which a set of dummy variables exhausts the alternatives. In the regression analysis reported in Table 7-4, this is done for the neighborhood, number of stories, building description and year dummies. Neighborhood nine, two story houses, frame houses, and the year 1968 are the dummy variables deleted.

The multiple regression reported in Table 7-4 is based on all residential sales with lot size less than 80,000 square feet (about two acres). Preliminary results were distorted by approximately 200 observations with very large lots. There are 24,082 observations in this reduced sample. The lot size variable is strictly the logarithm of lot size in thousands of square feet.

Table 7 - 4

Multiple Regression on Residential Sales Price

Independent Variable	Regression Coefficient	t-statistic
log lot size	3.967	50.94
Number of Stories (two-stories omitted)		
1 story	-0.908	10.14
1½ stories	-0.504	3.43
2½ stories	-0.894	3.36
3 stories	0.829	1.59**
over 3 stories	-0.840	0.32**
Building Description (frame omitted)		
brick	3.190	24.06
concrete block	0.209	0.81**
metal	1.929	2.91
reinforced concrete	-0.839	0.25**
stucco	0.929	4.21
stone	-2.380	2.09*
number of garages	1.339	20.02
Land Use in 1971 (residential omitted)		
public property	-2.861	2.27*
commercial	16.346	14.06
industrial	15.516	4.57
apartment	3.835	7.84
vacant	0.378	1.11**
Inflation (1968 omitted)		
1965	-1.374	9.21
1966	-1.039	7.34
1967	-0.593	4.19
1969	1.317	6.50
1970	2.974	14.66
1971	5.295	25.88

Independent Variable	Regression Coefficient	t-statistic
Neighborhoods (9 omitted)		
11	17.129	66.63
10	10.375	69.58
13	8.248	47.56
19	5.994	27.41
12	2.512	16.87
18	1.545	5.90
14	1.746	14.51
17	-0.579	3.07
21	-1.811	9.09
20	-3.896	21.86
Location and Impact		
distance to City Hall	-0.280	19.60
impact corridor savings	0.149	1.96*
control corridor savings	-0.246	1.72**
Constant	6.737	

standard error - 5.894
R square - 0.526
F-ratio for regression - 722.15

* Not significant at .01 level
**Not significant at .05 level

The dependent variable is sales price in thousands of dollars. Therefore, the regression coefficients must also be interpreted in units of thousands of dollars. For example, the coefficient (-0.908) for one story houses means that $908 should be subtracted from the constant term of $6737.

In interpreting the coefficients, recall that number of stories is defined with reference to two story houses, for which the dummy variable was omitted. Similarly, frame houses were omitted from building descriptions; neighborhood nine which ranked between neighborhoods fourteen and seventeen on reported value is omitted, and year 1968 is omitted from the inflation variable. The dummy variable that is deleted is arbitrary and should not bias the results. For example, when fiscal 1965 is deleted instead of fiscal 1968, the total inflation from 1965 to 1970 remains unchanged at about $7,000.

The coefficient for straight line distance to Camden City Hall has the expected negative sign and is highly significant. This is interpreted as a decrease in sales price of $280 per mile. Several other distance forms were tried. With very few exceptions they have had the proper sign and were significant. In general, the other coefficients are stable as the form of the distance variable is changed.

The impact variables have consistently shown a significant, positive impact of the High-Speed Line on property values. The savings variables are defined as follows for this analysis. The impact corridor savings is the total savings in the Lindenwold Corridor multiplied by a (0,1) dummy variable for the "after" time period (fiscal 1969, fiscal 1970 and fiscal 1971). The control corridor savings is the net savings for the Woodbury Corridor multiplied by the same "after" time period dummy. Thus, any sale before July 1968 has a savings of zero because the High-Speed Line was not in operation. After July 1968, the savings depends on which corridor the sale is in and its location within the corridor.

The coefficient for the Lindenwold Corridor savings can be interpreted as meaning an addition to the sales price of $149 for each dollar of savings. This is the increased value of the property as a result of the High-Speed Line. The savings values range from less than fifty cents to over three dollars. Of course, the savings function is a relative amount and does not attempt to estimate the actual travel savings due to the High-Speed Line.

The coefficient for the control corridor is not significant, although it does have a negative sign. In almost all the runs that have been made, the coefficients bear the relationship shown here. That is, if the Lindenwold Corridor coefficient has a positive sign, the control corridor coefficient is negative or not significant. If the Lindenwold savings are insignificant, the control corridor savings are negative and significant. This pattern also seems to agree with theories of transportation impact which hold that the impact is really a transfer from one part of the region to another. Such a transfer seems to be indicated in the results so far, though whether there is a complete balance is hard to say. Because the savings function used for the control corridor is net of Lindenwold Corridor savings, the mean level of savings in the control corridor is significantly less than the corresponding mean for the Lindenwold Corridor.

The regression equation reported in Table 7-5 is an attempt to test a three period impact model. The three time periods correspond to (a) early construction, (July 1964 to December 1966), (b) late construction (January 1967 to December 1968), and (c) after operation (January 1969 to June 1971). Of course, the extent of construction underway in the early construction period was less than in the late construction period. In addition, since the early construction period is over two years before the actual start of operation,

Table 7 - 5

Multiple Regression on Residential Sales Price with Three Time Periods

Independent Variable	Regression Coefficient	t-statistic
Number of Stories (nonframe-two-stories omitted)		
1 story	-1.036	8.15
1½ stories	0.643	3.74
2½ stories	-2.671	9.47
3 stories	-3.130	5.93
over 3 stories	-1.217	0.45**
2 story frame	-0.908	6.68
Building Description (nontwo-story-frame omitted)		
brick	1.710	11.68
concrete block	-0.703	2.66
metal	1.955	2.89
reinforced concrete	0.089	0.03**
stucco	0.190	0.83**
stone	-1.476	1.28**
number of garages	1.584	23.54
Land Use in 1971 (residential omitted)		
public property	-3.605	2.81
commercial x log lot size	5.418	13.35
industrial	13.992	4.06
apartment	3.686	7.43
vacant	-1.049	2.94
Inflation (1968 omitted)		
1965	-0.815	4.13
1966	-0.572	2.98
1967	-0.556	3.87
1969	1.226	8.04
1970	2.716	13.65
1971	4.977	24.72

Independent Variable	Regression Coefficient	t-statistic
Neighborhoods x log lot size (9 omitted)		
11	7.747	73.20
10	4.997	78.74
13	4.423	58.72
19	3.262	33.31
12	1.452	22.10
18	1.200	9.17
14	1.308	22.04
17	-0.107	1.26**
21	-0.850	7.80
20	-1.910	19.75
Location and Impact		
inverse of distance to Camden City Hall x lot size	1.392	31.71
after operations savings for impact corridor	0.586	8.74
after operations savings for control corridor	0.196	1.44**
late construction savings for impact corridor	0.268	3.99
late construction savings for control corridor	0.643	5.02
Constant	10.285	

standard error - 5.971
R square - .513
F ratio for regression - 649.46

**Not significant at .05 level

anticipation of the High-Speed Line impact should have been much less than in the late construction period. Therefore, the early construction period is used as a base for comparing the two later periods.

Table 7-5 contains several other important differences from the first regression reported in Table 7-4. The effect of the neighborhoods is hypothesized as being proportional to the logarithm of lot size, rather than as a lump sum. These variables are still dummy variables, but now take the form (0, log of lot size). The effect of commercial properties is also formulated as a function of the size of the property. Also a (0,1) dummy variable for two story frame houses is added. Two story nonframe houses are still omitted from the set of dummy variables to ensure nonsingularity of the covariance matrix.

Straight line distance to Camden City Hall is not used but rather the inverse of this distance multiplied by the lot size. Many investigators have found that the urban rent gradient fits a negative exponential form of distance, so the inverse of distance to the CBD may be an appropriate measure of location on the regional rent gradient. This is multiplied by lot size so as to simultaneously correct for the increase in lot size with distance from the CBD. The coefficient of this variable has the proper sign and significance.

The after operation period savings function behaves as in the first equation. In this case, the Lindenwold Corridor savings coefficient is strongly positive while Woodbury Corridor savings are not significant. Both of the late construction period savings have positive and significant coefficients. Their interpretation is somewhat more difficult than the after operation savings. A problem in this regard is that as the number of impact time periods increases, these variables begin to measure some of the inflationary effect.

One possible interpretation of the late construction and after operation periods savings is based on an examination of the changes in coefficients from one period to the next for each corridor. The coefficient for the Lindenwold Corridor increases by about $220 per dollar of estimated savings, while the Woodbury Corridor change is a decrease by $450 per dollar of estimated savings.

There are no very surprising changes in the other coefficients. The combined neighborhoods and log (lot size) variable is as powerful as in the previous additive form.

Table 7-6 presents a third regression equation that attempts to examine both a submarket of the housing market and to examine more closely the timing of the impact. In this run, only the transactions from Neighborhoods 19, 18, and 14 are included, reducing the sample to 4,797 observations. Again, there are a few changes in variable definition from the previous regression. Brick houses are subdivided according to the neighborhood in which they are located because the value of a particular housing type might vary significantly from neighborhood to neighborhood. Several variables that consistently showed non-significance were omitted from this run in an attempt to improve the estimates of the significant variables. The dummy variables for over three story houses, stone and reinforced concrete houses have been omitted.

Six variables represent the impact of savings in this equation. The regular impact and control corridor savings have been multiplied by dummy variables for the years 1969, 1970 and 1971, resulting in two savings variables for each of these years. All but the control corridor savings for 1970 and 1971 are insignificant. However, these control variables have strongly negative coefficients, indicating again there has been a positive impact in the Lindenwold Corridor relative to the control corridor. The fact that both of the savings functions for fiscal 1969 are insignificant indicates that, at least for

Table 7 - 6

Multiple Regression on Residential Sales Price for Neighborhoods 19, 18, 14

Independent Variable	Regression Coefficient	F-ratio
Number of Stories (over three-stories and nonframe-two-stories omitted)		
1 story	-2.316	67.17
1½ stories	-2.103	43.29
2½ stories	-1.454	5.35*
3 stories	0.672	0.35**
2 story frame	-1.662	31.33
Building Description (stone, reinforced concrete and two-story nonframe omitted)		
concrete block	1.317	3.60**
metal	3.012	13.94
stucco	1.209	11.97
brick in neighborhood 19	1.458	6.85
brick in neighborhood 18	3.005	32.61
brick in neighborhood 14	3.335	118.12
number of garages	0.755	34.37
Land Use in 1971 (residential omitted)		
public property	-0.467	0.05**
commercial	5.742	11.95
industrial	46.878	77.15
apartment	8.187	87.32
vacant	-0.618	0.53**
Inflation (1965 omitted)		
1966	-0.028	0.01**
1967	0.699	5.84*
1968	1.328	21.33
1969	2.663	9.96
1970	5.186	38.65
1971	8.252	109.12

Independent Variable	Regression Coefficient	F-ratio
Neighborhoods x log lot size		
19	6.937	1985.25
18	5.180	826.08
14	5.302	1251.42
Location and Impact		
distance to Camden City Hall	0.172	38.76
impact corridor savings for 1971	0.422	1.13**
control corridor savings for 1971	-1.744	7.28
impact corridor savings for 1970	-0.246	0.35**
control corridor savings for 1970	-1.684	7.98
impact corridor savings for 1969	-0.050	0.01**
control corridor savings for 1969	-0.53	0.79**
Constant	5.406	

standard error - 5.299
R square - .449
F ratio for regression - 117.41

* Not significant at .01 level
**Not significant at .05 level

this submarket, there was no easily discernible impact until fiscal 1970 (July, 1969). Since the saving coefficients for fiscal 1970 and fiscal 1971 are at approximately the same levels, the impact of the High-Speed Line appears to have stabilized. Since the results for 1971 are almost exactly the same as for 1970 for both corridors, an equilibrium may have been achieved again. A longer time series and more detailed analysis are needed to confirm this tentative conclusion.

In this regression (Table 7-6), the coefficient for change to industrial land use has increased dramatically. This is no doubt because very large lots were not eliminated from this run and most of these lots are industrial properties. The coefficients show no inflationary effect from 1965 to 1966, probably because 1966 was a particularly difficult year for obtaining mortgages.

Conclusions

The regressions developed by this study describe the South Jersey housing market fairly well. The amount of variation explained is generally around 50 percent, which is good considering the lack of detailed housing characteristics. For example, in studies with more detailed FHA mortgage data, floor area of the house alone was found to explain over 60 percent of the variation. The neighborhoods perform well in explaining overall neighborhood differences, but of course cannot explain the still important difference within neighborhood variations.

It should be noted that several of the dummy variables are based on very few observations, and their overall influence is therefore small. This is especially true of the 1971 land uses, three-and-one-half story houses, and metal, reinforced concrete, and stucco houses. The consistently high coefficient for metal houses may result because the more valuable industrial and commercial properties are more apt to have metal buildings.

The savings functions have consistently performed well, and consistently shown a positive impact of the High-Speed Line on property values. As mentioned above in almost all cases where the two time period savings functions are used, the coefficient for the Lindenwold Corridor is greater than that for the control corridor and at least one of the coefficients is significantly different from zero. In most cases, the coefficients also have opposite signs. In fact, the degree of consistency shown by this variable has been somewhat surprising, considering the impact that was expected a priori.

When multiple time period savings variables are used, the results are less clear, although the results for the two time period savings model are confirmed. It is not too surprising that it is more difficult to discern whether there has been any impact during the period that people are only just becoming aware of the rapid transit line. During the construction period there are no travel savings, and even if properties are sold with the expectation of receiving these savings, they must be discounted both by the number of years until operation actually commences and by the probability that the transit line may never be completed. Thus, in the three time period models, while the operation time period shows a positive impact in the Lindenwold Corridor, the late construction period savings variable is inconclusive.

While the preliminary results reported here are encouraging in the sense that the basic model performs well, more detailed analysis are being undertaken. By employing more detail in the time aspect of the savings function it should be possible to describe better the time path of impact.

Submarket analysis is another major area of work. Specific neighborhoods and building types are being analyzed in isolation in a manner similar to neighborhoods 19, 18 and 14 in Table 7-6. Thus it should also be possible to determine to what degree the impact of the High-Speed Line has varied for different neighborhood types.

Work is underway on interpreting the savings coefficients in terms of the total value of the impact, as well as how much of the increased value in the Lindenwold Corridor is really just a transfer from other parts of the region. Thus, in the near future it should not only be possible to describe the impact of the High-Speed Line on property values in terms of overall corridor changes and multiple year periods, but in terms of differential impact on specific neighborhoods and in terms of much shorter time periods.

CHAPTER 8

CASE STUDIES OF LAND DEVELOPMENT POLICIES OF MUNICIPALITIES ADJACENT TO OUTLYING STATIONS

Introduction

Chapters 3 to 7 of this report have tested statistically a set of hypotheses relating to the impact of the High-Speed Line on residential sales prices. These tests were possible because of the availability of a large, high quality data base. Nevertheless, they represent a fairly narrow approach to the study of land use impact of the High-Speed Line. This chapter, together with Chapter 9, seeks to balance the foregoing statistical studies with a more general research strategy: case studies of the development process and its impact on public finance in two outlying municipalities served by the Line.

The High-Speed Line is reputed to have had a substantial impact on land development. Interviews of real estate agents, developers and local officials tend to support the view that the High-Speed Line has resulted in a type and extent of development that might not have otherwise occurred. However, such opinions tend to be based on personal knowledge of a few cases. It is very difficult to develop more general support for the subjective opinion that the Line has made a significant impact on development. When pressed for details or evidence most persons suggest that the Line is one of several factors affecting a development decision, and that more research is required to determine the Line's importance.

In pursuing this research objective, a somewhat indirect research strategy was adopted. In-depth case studies were designed for the two municipalities most often cited as examples of the Line's land development impact, Lindenwold Borough and Voorhees Township. As will be shown in detail below, Lindenwold Borough is the location of a large amount of apartment construction. Voorhees Township is the location of Echelon Mall, a regional shopping center with a large adjoining tract of apartments and town houses.

These case studies are indirect in that they do not seek to document specifically the role of the Line in these land development projects. Instead, the case studies seek to understand the entire development process as seen from the communities' point of view. If the High-Speed Line was a prominent factor, then this should be clearly evident in the development process. As will be shown below, the two municipalities chosen for the study have had a much different development experience, although each has a similar location with respect to stations on the High-Speed Line. In a sense, then, each case study is a control for the other. A third case altogether removed from the Line would have also been desirable; however, resources available did not permit the study to be extended in this manner.

Each case study consists of two parts:

1. the land development process as viewed from the municipality that controls the type and extent of land development through zoning and related police powers;

2. the effect of development on public finance; that is, the changes in services demanded as a result of development and the altered capability of the municipality to pay for these services through its augmented tax base.

Chapter 8 deals with the first part of each study. Following a brief review of the powers of local government to control development, and a scenario describing the two municipalities, the zoning and development experience of Lindenwold, and then Voorhees, are documented in detail. Then the experience of these two governmental units is contrasted and compared. Throughout this exercise, the High-Speed Line is in the background as one of several development factors. The reasons that it does not emerge more strongly in the development process should be evident by the end of this chapter.

Chapter 9 examines the effect of land development in Lindenwold and Voorhees on municipal and educational services and costs. One objective of this analysis is to try to establish how the extensive apartment development that did take place in Lindenwold affected the demand for educational and municipal services, and how the cost of these services compared with real estate tax revenues they produced. As shown in Chapter 9, these are difficult questions to answer because of the paucity and type of data available. The chapter begins with a thorough review of trends during the 1960 decade on municipal expenditures and school expenditures, both current and long term. Taxation trends are then examined in relation to total assessed valuation. Then, the analysis of expenditures during the period of growth seeks to allocate increases in expendure to: a) larger quantity of services required; b) higher quality of services; c) inflation. In some cases it is concluded that an allocation cannot be made among these three causes of increased expenditures.

The findings of these analyses are significant for any local government or planning unit undergoing development, whether it is because of a transportation improvement such as the High-Speed Line or an area on the fringe of urban development whose time has come. If, indeed the High-Speed Line was a significant factor in the apartment construction in Lindenwold and Echelon Mall in Voorhees, then these fiscal studies document the effects of this transportation impact.

Effect of Local Governmental Policies on Development

Local governments can and often do exercise considerable control over the rate of population growth, the composition of the new population, the type of land development, and the budgetary impact of new population and development.

One key instrument of this power is the zoning ordinance. Generally, it designates permitted land uses in each section of the locality as well as such characteristics as lot size, height of structures, ground area covered, floor area, yard dimensions, and even number of bedrooms.

The relationship between this control over the type and characteristics of development and the nature of the new population, in terms of numbers, age, and income, can be quite direct. For example, areas zoned in categories for which developers perceive no market demand or cannot obtain financing will remain vacant unless rezoned. Thus, a municipality may not develop, although it could with different zoning. The physical zoning requirements also affect construction costs, which may in turn affect the probability of development as well as the income class of the new population. Also, unit size requirements and restrictions can affect the composition of the new households.

Some examples will illustrate these processes. If developers perceive little demand for highly priced single family homes, there may be less development in an area with large lot sizes and other more costly requirements. However, the development which does occur will attract wealthier residents. Similarly, luxury apartments with high rents will generally attract wealthier residents than more moderately priced units. Efficiency, one bedroom, or high-rise luxury apartments will attract households with fewer children than multi-bedroom or single family homes.

The resulting size, age, and income of the new population will affect service needs and demands, as will the properties themselves. Most significantly, the number of school children affect expenditures for education. New voters, with different tastes from the original residents may prefer and obtain a different range of public services. Likewise, an industrial property may require more water and sewerage capacity than a commercial property or a different industrial use; farms may require fewer roads than shopping malls; apartment complexes may require wider access roads than single family developments, and so on.

Not only do different land uses and population groups have varying service needs, but they also contribute varying amounts of revenue. A factory built on what was once farmland should have a higher assessed value than did the farm. Assessed value of a potential land use can be expected to be more important in writing zoning ordinances in areas where the property tax is the major source of local revenue, as in New Jersey. If local sales or income taxes are the revenue source, the number and kind of commercial establishments and the wealth and consumption habits of residents can also affect revenue. In addition, their number, age, and income may affect revenue from the federal and state governments.

These factors are now examined in detail for Lindenwold Borough and Voorhees Township. These case studies document how two adjacent municipalities served by the High-Speed Line responded in quite different ways to development pressure and opportunities associated in time with a) the completion of the High-Speed Line, and b) the expanding suburban development in South Jersey in the late 1960's.

The Scenario of the Case Studies

Lindenwold Borough and Voorhees Township are contiguous municipalities in which are located the terminal station (Lindenwold) and the next to last station (Ashland) of the High-Speed Line. Both communities experienced over 60 percent increases in population from 1960 to 1970. Lindenwold's 1970 population was 12,199, and Voorhees' was 6,214; see also Table 3-2. Although Lindenwold is small in area (3.89 square miles), it is the ninth largest of

37 municipalities in Camden County. Voorhees is considerably larger (11.91 square miles), and is the fifth largest jurisdiction in the county. Lindenwold is oriented around White Horse Pike (U.S. 30), with Lindenwold Station in one corner. Ashland Station, as well as Lindenwold Station, serves Voorhees, but it is not centrally located in the township which is more oriented toward Haddonfield - Berlin Road (551) and Evesham Road (554), as shown on Map 8-1.

A comparison of land use surveys by the Camden County Planning Board for 1958 and 1968 shows extensive land development in Lindenwold and Voorhees between those years. Defining developed land as all surface area except vacant land, farm land and water, developed acreage in Lindenwold increased by 577 acres from 852 in 1958 to 1,429 in 1968, and in Voorhees by 1,659 acres from 676 to 2,335. These increases are, however, slightly overestimated because of changes in definition and procedure by the Planning Board.

The housing stock in single and multiple family units in Lindenwold nearly doubled from 2,095 units in 1960 to 3,900 units in 1970. As shown in Table 8-1, most of this development occurred in multiple family dwellings with five or more units. The housing stock in Voorhees increased from 1,064 units in 1960 to 1,680 units in 1970. In contrast, much of the growth in Voorhees was in single family development, although a long term multiple family housing development plan was approved in 1968, and is reflected in the large number of multiple family unit building permits issued by Voorhees Township in 1970 (see Table 8-1).

The Lindenwold Zoning and Development Experience

Initiation of Zoning and Related Controls

On June 8, 1964, Lindenwold passed its first zoning ordinance. The objectives of the ordinance seem to have been to attract more expensive single

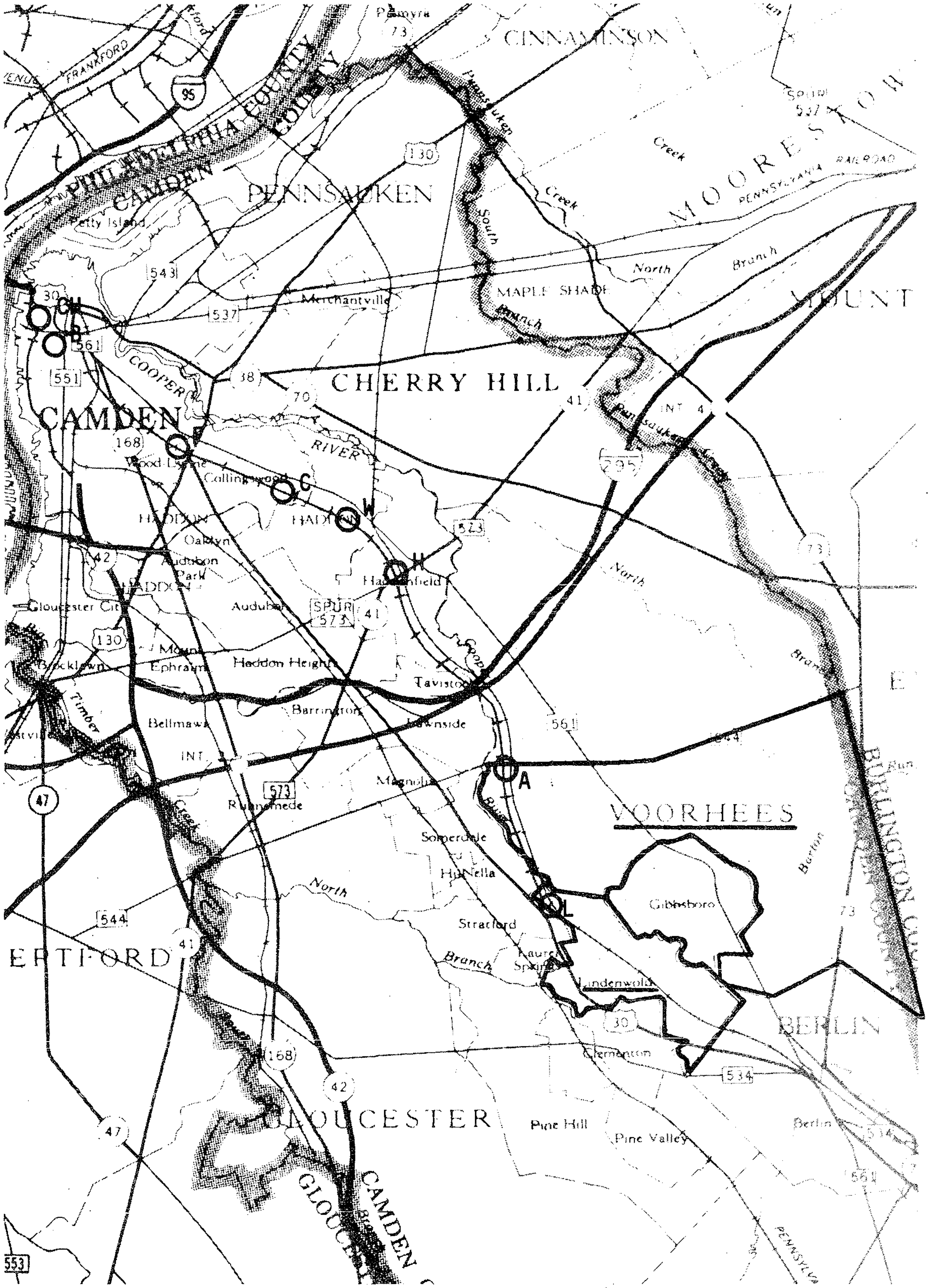
Table 8 - 1

Housing Stocks and Additions in Lindenwold Borough and Voorhees Township, 1960-1970

structure type:	Lindenwold Borough: single family	Lindenwold Borough: 2 units	Lindenwold Borough: 3, 4 units	Lindenwold Borough: 5 or more	Lindenwold Borough: total units	Voorhees Township: single family	Voorhees Township: 2 units	Voorhees Township: 3, 4 units	Voorhees Township: 5 or more	Voorhees Township: total units
1960 Stock[1]	2095	31	0	0	2095	1064	0	0	0	1064
Additions[2]										
1960	na	na	na	na	102	na	na	na	na	127
1961	33	0	0	0	33	109	0	0	0	109
1962	na	na	na	na	33	56	0	8	0	64
1963	20	0	0	0	20	10	0	8	64	82
1964	19	0	0	26	45	13	0	0	16	29
1965	18	0	0	0	18	49	0	0	0	49
1966	10	0	0	80	90	44	0	0	0	44
1967	23	0	0	506	529	58	0	0	0	58
1968	21	0	0	752	773	85	0	0	0	85
1969	20	0	0	340	360	10	0	0	0	10
1970	30	0	0	502	532	10	0	0	669	679
1970 Stock[1]	2383		1517		3900	1564		116		1680

1. Housing stocks are from 1960 and 1970 Census of Housing.

2. Housing additions are from State of New Jersey records based on building permit reports submitted by municipalities. Since permits may be used in years after the year of issue, and some permits are issued but never used, 1960 stocks plus 1960 to 1970 additions do not equal 1970 stocks. Also, the 1960 and 1970 stocks are recorded as of April 1, whereas flows are for the entire year.



Map 8-1 Location of Lindenwold Borough and Voorhees Township

family housing than currently existed, as well as to encourage light industry, a good tax rateable. The ordinance established nine types of districts: four residential, four commercial and one industrial. These districts are briefly described to provide a setting for the development decisions and rezoning that followed. Then the reasons for these decisions are documented in a detailed manner.

In the 1964 ordinance much vacant land was zoned R-1, the most stringent residential district which required 36,000 square foot lots with a minimum width of 120 feet at the building line; see Table 8-2. The maximum building area was set at 20 percent with minimum ground floor living areas of 1500 square feet for single story, 1700 square feet for split-level, 1000 square feet for one-and-one-half stories, and 900 square feet for two or two-and-one-half stories. Other uses permitted in R-1 zones were schools, public buildings, libraries, museums, noncommercial clubs, and professional offices attached to the professional's residence.

The R-2 districts covered a fairly small area and were already largely developed. Acceptable uses were identical to R-1, but the lot requirements were less stringent. The R-3 districts appear also to have been developed at least partially by 1964. As well as the uses permitted in R-1 and R-2, other uses such as dressmaking, subscription sales, and insurance agencies were allowed, if the person with the occupation lived in the dwelling unit. District R-4 may also have included an older part of the Borough. The same uses as in district R-3 were permitted, but here the lot requirements were least stringent.

The I-1 industrial districts were predominantly vacant land. Industries whose processes were odorous, noisy, or polluting were excluded from the Borough; 41 uses were explicitly prohibited. Also excluded from this

Table 8 - 2

1964 Lindenwold Zoning Ordinance Requirements

District	minimum lot area (sq.ft.)	minimum lot width (feet)	maximum building area (percent)	minimum yard size[1] (feet)	minimum floor area[2] (100's sq.ft.)	maximum height (feet)
R-1	36,000	120	20	50/30/45	15/10/17/ 9	35
R-2	18,000	100	25	35/30/35	12/ 9/13/ 7	35
R-3	10,000	70	30	30/30/20	11/ 8/12/ 6	30
R-4	7,000	45	35	30/30/20	10/ 7/11/ 5	30
C-1	7,000	70	50	30/30/20	6	35
C-2	5,000	50	60	20/30/20	6	45
C-3	5,000	50	70	20/30/20	5	50
C-4	120,000	250	30	100/50/100	5	65
I-1	none	none	35	100/50/80		65

1. dimensions of front/back/total side yards;

2. R-1 to R-4: ground floor area of 1 story/1½ story/split level/2-2½ story single family structures;
   C-1 to C-4: interior area of multi-family unit.

district were all residential uses including trailer parks. Permitted uses may be characterized as clean, light or necessary industry such as electric substations, heating plants, bottling plants, movies, television studios, manufacture of textiles, paper products, electronic devices, office buildings, warehouses, laboratories, restaurants, parking garages, and similar uses.

The commercial districts covered a very small part of the Borough. Six strips, generally one block deep, were zoned along the White Horse Pike (U.S. 30), Chews Landing Road and Berlin Avenue, the latter two being county roads. The largest of these districts was zoned C-1, which permitted all uses permitted in R-3 districts, as well as office buildings for which off-street parking must be provided. Apartment houses, defined as a multi-family dwelling for two or more families living independently of each other and doing their cooking upon the premises, were permitted only

> "when such buildings are authorized by the Zoning Board of Adjustment as a special exception in accordance with the power conferred by law or when authorized by the Borough Council upon recommendation by the Zoning Board of Adjustment in accordance with the law...such uses and buildings must be appropriately located and designed and meet a community need without adversely affecting the neighborhood."

The same qualifications are stipulated for clubs, community centers, lodges, schools, parking lots and parking garages.

The only C-2 district was three blocks long and one block wide. Permitted uses included apartment houses for not more than two families in combination with a permitted business use, stores for commercial-retail purposes with no exterior displays, personal services such as barber shops or dry cleaning agencies, business offices, restaurants, private schools, automobile showrooms, day camps, clubs, printing establishments, funeral homes, and parking lots. Public garages or automotive service stations require the procedures stated for apartments in the C-1 districts.

C-3 districts also consisted of narrow strips; permitted uses were public garages and service stations, auto showrooms, wholesale businesses, manufacturer display rooms, theaters, hotels and motels, public utility buildings, and rail or bus stations. Buildings for residential or residential-commercial use were prohibited, although minimum sizes of apartments were given in the ordinance for a reason which is not apparent.

The only C-4 district was an undeveloped strip two blocks long and two blocks wide. Here office buildings, multiple family units, hotels and motels, research laboratories, shopping centers or similar uses were permitted. A lot area of 120,000 feet was required per building with a minimum of 500 square feet per dwelling unit in apartment houses with a maximum of 30 percent of the lot to be occupied. The ordinance also specified off-street parking requirements, limited sign types and sizes, and regulated smoke, soot, cinder, dust, fly-ash, noxious acid vapor, fumes, and gas emission.

Finally, the ordinance detailed some specific tools of the local government to control development and enforce the zoning ordinance. The ordinance stated no public, commercial, industrial, or other non-residential use shall be permitted, nor shall any building permit or occupancy permit be issued for such uses, until the Building Design and Site Plan Review shall have been considered and approved by the Planning Board of the Borough of Lindenwold. The purpose of this review is:

> "to protect and preserve the road network of the Borough of Lindenwold, insure the movement of traffic, promote the development of a beautiful and well-ordered community, further the comprehensive planning, and best serve the interest of public health, safety, and general welfare."

Four specific criteria were made explicit:

> "a) every effort shall be made either to preserve the landscape in its natural state, or to improve existing site conditions in keeping with adjacent areas; b) consideration shall be given in site

positioning that either provides a desirable focal point, does not block a natural vista, provides a desirable space enclosure, or otherwise respects the established lots siting or surrounding buildings or structure; c) in the use of building material, use of color, and/or texture, fencing, forestation, and advertising feature, every effort shall be made in the proposed building or structure to relate these elements harmoniously to similar elements in surrounding buildings or structures; and d) special consideration shall be given to the use of green planting or similar screening methods where special features are incongruous with the existing or contemplated environment."

These criteria can be at best subjective. The Planning Board is asked to consider the application in light of its effect upon the planning for the Borough of Lindenwold, giving due consideration to land use, traffic, health, safety, and general welfare. Within this broad framework, the Planning Board is not required to give any reasons for turning down the building design and site plan. If it is rejected, a building permit cannot be issued.

The building inspector is charged with ascertaining if proposed or existing buildings comply with the specifications of the zoning ordinance. If they do not, he can refuse the building permit or the occupancy permit. The first is "required prior to the erection, conversion or structural alteration of any building or land," the second is required before actual use of the structure can begin. Any decision of the building inspector can be appealed to the Zoning Board of Adjustment.

The Zoning Board has five members appointed by the mayor with consent of the Council. It has four powers:

"a) hear and decide appeals where the appelant alleges that there is an error in any order, requirement, decision, or refusal made by an administrative official or agency based on or made in the enforcement of the zoning ordinance; b) hear and decide requests for special exceptions or for interpretations of the zoning map; c) grant variances from the zoning regulations because of exceptionally narrow, shallow, or odd shaped lots, topographic conditions, or other exceptional conditions of the property where strict application of a regulation would result in exceptional practical difficulties or undue hardship upon the owner; and d) recommend in particular cases and for specific reasons the governing body the granting of a variance to allow a structure or use in a district restricted against such structure or use."

All of the above actions can only be granted if there is no substantial detriment to the public good, and no impairment of the intent and purpose of the zoning ordinance.

The Borough Council can amend, modify, or repeal, any parts of the zoning ordinance by a majority passing an ordinance. The new ordinance is not effective until the Planning Board approves it, or in the case of an unfavorable report, until two-thirds of the members of Council approve it. When a petition is presented by owners of 50 percent or more of the area of the lots included in a proposed change, the Council shall vote within 60 days of the filing of the petition. If a protest against a change is submitted by owners of 20 percent of the affected area and the surrounding land within 100 feet, the change will not become effective without a two-thirds majority.

Finally, the zoning ordinance stipulates penalties for violations not to exceed 90 days in the County Jail or a fine not exceeding $200, or both. Violations are defined as the failure to secure variances, building permits, or occupancy permits previous to erection, construction, extension, addition, or occupancy.

Thus, as of June 1964, the Borough of Lindenwold had considerable power to control local growth. Any new development, which complied with the zoning districts, had to pass specific lot size and construction requirements, while non-residential development had to satisfy more vague requirements for site and design. The area available for apartment and commercial development was quite small with most vacant land zoned for single family homes on larger lots than most of the existing residential development. Any developer of apartments and commercial facilities outside the small commercial districts would need the approval of the Zoning Board, and either two-thirds of Council, or a majority of Council and the Planning Board. Hence, the development of apartments did not just happen by market forces. It required the concurrence of the local government, as is now shown.

Apartment Development under the 1964 Zoning Ordinance

On July 24, 1964, Lindenwold Council approved a plan by Joyce Construction Company to build 26 one-bedroom units to be known as Lindenwold Manor on land zoned R-4. On October 16, 1964, Joyce Construction requested permission to change its plans to 18 one-bedroom and 8 two-bedroom apartment units. No decision was made at this time. On November 9, 1964, a petition from nearby residents was submitted stating that they did not want apartments on the site, and moreover, that they had not been notified as required by the Zoning Ordinance. A special meeting of the Zoning Board was called. At its December 30 meeting, Council unanimously approved the 18/8 plans over the objection of the Planning Board. The following conditions were stipulated:

1. The building would be set in 25 feet from the rear property line;
2. A six-foot weave fence would be erected along the rear line;
3. The owner would be responsible for garbage and trash collection, snow removal, and janitorial service;
4. The owner must follow the approved plan.

The third condition is an example of the local government's power to limit the budgetary impact of development by requiring the owner to provide services.

In this case, citizen complaints did not sway the councilmen. The neighbors' opposition voiced at the public meetings was based on the new construction cutting off light and air and interfering with the privacy of adjacent property. In addition, it was pointed out that there was no play area for the apartment children, suggesting that they would spill over onto neighboring properties. The most vocal opponent stated that the developer had harassed him and twice threatened to sue him. The allegations were substantiated by Police Chief Wilkie.

On January 11, 1965, a variance for 48 garden-type studio apartments, to be known as Radient Apartments, was unanimously approved with four conditions:

1. Conformance to all requirements of C-3, except a minimum floor area of 464 square feet was permitted;

2. Construction and maintenance of a fence along the railroad right-of-way;

3. Provision of streets, gutters, curbs, drainage, and sidewalks to the Borough engineer's specification;

4. Provision of janitorial, trash, and snow removal service;

The Radient Apartments were in fact never built. At the same meeting an ordinance was passed requiring all new buildings and structures of any kind to provide for sidewalks, curbs, driveways and streets.

Four more variances for apartments were granted in 1965 as follows:

1. 224 apartments and 100 senior citizen apartments, with medical center, stores, and swimming pool, to be called Pine Chapel Village; this development was also never built.

2. 112 one-bedroom and 32 two-bedroom units (Bralow Construction Co.); only 80 units were constructed, and are known as Parc One.

3. 300 units on 17.5 acres with at least 75 percent in one-bedroom and the remainder in two-bedroom units to be built by Lihn Construction Co.; 412 units were eventually built and are known as Trent Court.

The variances had more conditions and were more demanding than those for Joyce Construction and Radient Apartments. New requirements imposed at least once included installation of lighting in all public areas, initiation of construction within six months of sewerage availability; landscaping according to plan, provision of masonry stairs and corridors, posting a $5000 performance bond, provision of roads, including posting of 125 percent performance bonds, and use of cinder block with masonry firewalls.

On April 14, 1965, a Council passed an ordinance stating:

"the Borough will not be responsible for collection, removal, disposal, etc., of garbage for industrial enterprise, commercial

> business, stores, shops, or apartments with more than three units. Any of the above wanting collection should contact the mayor who will determine if service is to be provided and what the charge will be."

Thus by enacting an ordinance, the costs of servicing apartments were avoided.

Opposition to apartments was voiced by councilmen and citizens alike, but no requests were ultimately refused. On March 16, 1965 Councilman Bowman stated he had "no interest in (having) the Lindenwold Apartments." On April 14, 1965, Councilman Lamb proposed concentrating all apartments in one area at White Horse Pike and Gibbsboro Road. At the July 12th meeting, citizens were very active, although they may have been attracted by a vote on criminal registration whose constitutionality was questioned from the audience. One stated that the Borough had more than its share of apartments and should reject permission to build more on the Clementon-Blackwood Road. Another said it was time to stop all apartment buildings in particular, as it was "people that own homes that have to pay for the schools." Councilman Madon then stated that the Planning Board and Zoning Board "know they have allowed too many apartments." Two citizens, one, allegedly harassed by Joyce Construction in the year before, stated that favoritism was being shown certain builders, and another asked if the solicitor "represented the thieves around here." The developer of the site in question then asked why everyone objected since it would enable all in the area to have sewerage.

Establishment of Apartment Districts

On November 8, 1965 an amendment to the Zoning Ordinance was passed which established the category C-5, Commercial Apartment District. Permitted uses were garden apartments, multiple family apartments, office buildings with no retail or wholesale trade, and state licensed nursing homes. The minimum lot would be seven acres, 30 percent of which might be occupied, with minimum front, side, and rear yards of 20 feet. In addition, 25 feet planted buffer zones were required along all adjacent or opposite property. Also required were one-and-one-half parking spaces per unit; the maximum building height was 65 feet.

In addition, the zoning ordinance was amended to permit apartment houses and apartment buildings in C-2 commercial districts. These amendments were passed despite opposition voiced at this meeting by citizens, but not the same ones who spoke in July. A citizen and Councilman Lange felt the apartments would add to already existing traffic problems. Another questioned the effect on schools and was answered by Mayor Ernst that it shouldn't affect them too much. Others were more aesthetic. "Lindenwold is a beautiful community...people moved here for suburban living, not apartments" and apartments "made a jungle of my area." Also at the November meeting, the Planning Board recommended a moratorium on apartments.

It appears the citizenry and Council monitored apartment developers after plans were approved. In February, 1965, a citizen reported Joyce Construction was not meeting the requirement on number of feet from curb line to building front, and was told by Council that the building permit would be withdrawn if this was not resolved satisfactorily. In June 1965, another stated that the Green Terrace Garden Apartments was "causing considerable damage to surrounding properties." In August, 1965, a formal complaint was filed against Joyce for moving in tenants without occupancy permits and he was told to remove trash from behind the apartments. Finally in December 1966, Parc-One was reported as not meeting masonry standards, but it was able to secure a revision of those standards.

In 1966, Borough Council acted to halt apartment construction. In February 1966 a moratorium on apartment construction until May 31, 1966 was unanimously approved. In November 1966, four developments that had been granted variances in 1965, but had made no applications for construction permits, were served notice that the variances would be vacated. In December, an extension was granted until April 1967, after two developers reported they had financing difficulties and two reported they were awaiting Borough engineer or Council approval. Only one major variance was requested in 1966, and it was approved. In October, the only development of the five 1965 variances actually under construction (Parc One) was granted a revision to construct concrete stairwells instead of masonry ones.

On January 9, 1967, an amendment to the zoning ordinance was passed re-zoning an area from R-4 to C-3; on February 3, an amendment forbid apartment houses or buildings in districts zoned C-2. An amendment to the zoning ordinance to approve more apartments near Pine Lake was sent to the Planning Board on June 12, 1967. At the same meeting it was reported that the Zoning Board had unanimously turned down these apartments. It appears that the Zoning Board turned down the variance, so an application was submitted to the Planning Board for a change of classification, making a variance unnecessary. When asked if he was "pushing apartments," Mayor Ernst replied, "I am certainly not in favor of more apartments."

Some complaints about construction were also voiced in 1967. One citizen expressed concern that streets being constructed by the Lindenwold Apartments did not conform to plans. A second citizen complained another development was extending fifteen feet beyond the building line, while another said they were using terra-cotta pipe and were making deep construction holes.

At the end of the year the Borough went to court over land now known as the Coachman East Tract. It appears a death had delayed construction beyond the date specified in the sale. On December 27, it was reported that the Coachman plans conformed to Borough specifications, and on March 27, 1968 the

Lindenwold solicitor withdrew from the suit.

The occupancy permit gives the Borough its final leverage over the developer. On June 17, 1968, a resolution was passed unanimously by Council that no occupancy permits be issued to the Lindenwold Apartments, Coachman East, and Coachman Manor until they have made sewer arrangements.

On December 16, 1968 Mayor LaPorte introduced an ordinance to form a Housing Authority to seek funds for low income housing. Its basis was that there was a shortage of low income housing, there existed unsanitary, unsafe dwellings, and these conditions lead to an increase in the spread of disease and crime. Although no location for the housing was announced, eight of nine citizens appearing spoke against the Housing Authority and it was rejected. A February 17, 1969 proposal for a public playground also encountered opposition, but primarily from residents near the site. One citizen declared "suburbanites do not require public play areas as each individual creates his own." Nevertheless, it was passed unanimously.

At the same meeting, former Mayor Ernst commented the "town would be consumed by apartments." However, as we mentioned, the 1966 ordinance zoning the area along Gibbsboro Road as C-5 meant there was now "no legal way for the present public body to refuse approval." This incident illustrates how a town by zoning for a use such as apartments can forfeit to a degree its control over land use. When little land was zoned for apartments, each proposed development required a variance, and, thus, had to be approved separately. Once the land was zoned for apartments, a development had only to comply with the conditions set forth by the ordinance.

At the April 21 meeting, a new argument against apartments appeared. A citizen stated that there was no fire fighting equipment for high-rise apartments, and proceeded to question proposed high-rise development in the Pine

Lake area.

Overcrowding and School Costs

The image of crowded, deteriorating central city apartments filled with low income families with large numbers of children is a cause for concern for suburban councilmen. Probably with that image in mind, the Lindenwold Council unanimously passed an ordinance on June 16, 1969, "to regulate the number of persons occupying apartment buildings." In order "to maintain public health, safety, and the financial integrity of the Borough," apartments owners are required "to place a reasonable limitation upon the number and nature of the persons resident within the apartment buildings in this Borough and to obtain a Certificate of Reasonable Occupancy for each apartment complex."

The number of residents is limited to one adult per 250 feet of interior floor space. The maximum number of school children in the complex "shall be determined yearly, having due regard to the cost of education per child and the tax income produced from the real estate involved." In essence the mean cost per school child would be divided into the school revenues paid by the apartment to determine the maximum allowable number. If the number is exceeded, the Certificate of Reasonable Occupancy would be issued upon receipt of an additional fee not exceeding the amount of loss involved, which would be the mean cost times the number of excess children. The certificate would be issued upon payment of a $50 application fee and approval of the Planning Board. The penalty for failure to obtain a certificate is large: $500 for each excess child, for each day after the beginning of the school year.

In reply to questions, Councilman McManus stated that "this would control the amount of people in the apartments and would compensate us for the number of children in the apartments and the cost of educating these children." Also, he advised that "the greatest concern of the persons in our Borough is the amount of school children in the apartments and the cost of educating same." In conclusion, the solicitor advised that "there could be a question of constitutionality which would have to be tested in the courts, but his legal advice after research is that it is constitutional."

As of early 1972, only one apartment complex, the oldest and the one with the highest proportion of two bedroom apartments, had been officially cited for exceeding its maximum number of students. Moreover, this building was in financial difficulties and behind in other taxes. Lindenwold had not yet collected any fees for excess school children.

A variance for five apartments with 40 units was approved on July 21, 1969. Councilman McManus stated he "agrees with some type of apartments, but not garden type." At the November 17 meeting, Ernst, now a County Freeholder, asked that no more apartments be allowed. Mayor LaPorte replied that apartments are the "greatest asset, tax-wise, that we have had for a number of years and any additional rateables of this type would certainly be desirable... (They have) minimal school kids."

Major Zoning Revisions in 1969

On December 15, 1969, a revised zoning ordinance and map were approved. There were changes in uses as well as minimum standards and the categories were consolidated from ten to seven. The four residential categories were reduced to two (R-1 and R-2) which had lower requirements; see Table 8-3. The five commercial categories were changed to two for commercial and two for apartments. The standards of the new C-1 were similar to those of the old C-1 and C-2, while those of new C-2 were almost identical to the old C-4. The permitted uses in the new C-1 included those of the old C-1 and C-2, while those in the new C-2 included those of the old C-3 and C-4. The one exception to the above is that apartments, formerly only allowed in the commercial districts, were

Table 8 - 3

1969 Lindenwold Zoning Ordinance Requirements

District	minimum lot area (sq.ft.)	minimum lot width (feet)	maximum building area (percent)	minimum yard size (feet)	minimum floor area[2] (100's sq.ft.)	maximum height (feet)
R-1	15,000	100	27	30/30/30	11/ 8.5/12.5/ 7.5	45
R-2	5,000	50	40	30/30/15	8/ 6.5/10.0/ 4.5	35
C-1	7,000	70	60	20/30/25	same as R-2	45
C-2	120,000	250	30	100/50/100	residences not permitted	none
A-1[4]	2,000	none	60	20/30/20	6	none
A-2	120,000	250	30	50/30/50	6	(3)
I-1	none	none	35	100/50/80	residences not permitted	none

1. dimensions of front/back/total side yards;
2. R-1,2: ground floor area of 1 story/1½ story/split level/2-2½ story single family structures;
   C-1,2: interior area of multi-family units;
3. minimum height of six stories;
4. minimum lot area per dwelling unit in multi-family structures.

now not permitted there. Apartments were restricted to the new A-1 and A-2 districts. In the A-1 district all uses in R-1, R-2, C-1, and C-2 were permitted; in the A-2 district only high-rise apartment and office buildings were permitted. The uses and standards in industrial category I-1 remained unchanged except for the removal of the height limit.

The most significant changes between the 1964 and 1969 ordinances concern the zoning maps. The large vacant areas zoned for 36,000 square feet lots (R-1) in 1964 were changed primarily to A-1 and A-2 districts, although some former R-1 districts were reallocated to other types of districts. The commercial districts along the main roads were extended and widened, but with three exceptions still convey a "ribbon" impression. The northern industrial area is still primarily vacant, and another has been added in the south on land zoned R-1 in 1964.

It appears the 1964 concept of channeling growth into lands zoned for high standard single family homes was abandoned in 1969. The goal of attracting industrial and commercial properties remains with those districts having been extended. If development proceeded according to the current zoning map, Lindenwold would have substantial residential and apartment sectors supplemented by significant commercial and industrial properties to serve the community and help pay for services.

At the meeting in which the new ordinance was passed, all protests focussed on the commercial and apartment areas. Both areas were criticized as being too large. One citizen said Lindenwold's population had doubled and now 50 percent lived in apartments; the A-1 and A-2 districts would attract even more. A more outspoken critic charged "the Mayor and Council sold this town down the drain."

A number of rezoning applications were made during 1970. Two attempts to rezone from residential to apartment were turned down on May 18 and September 1. Two requests to rezone from industrial to apartment were approved unanimously on June 29 and August 24. At the latter a resident complained that "homes there were well developed and there was no room for anything industrial or for apartments." Finally on December 21 a request to rezone from commercial to apartment was approved.

At the September 1, 1970 meeting a new moratorium on apartments was approved. In a resolution, the Council stated it would "withhold its approval of any new apartment construction projects within this municipality in order to afford this municipality time in which to make a full evaluation of the effect such new apartments will have on this municipality." In introducing the resolution Councilman McDade stated "...even though apartments are an asset to the Borough with regards to taxes, etc., ...we should now reevaluate ourselves to protect ourselves against any problems which might arise in the future." The resolution was passed by the majority political party with the other party abstaining.

On December 21 the majority party reported their results: "(We) researched this and found the apartments were not hurting our municipality but were an asset" and (we) "found that there was no increase in pupils in our school system even with the apartments." It was acknowledged that school enrollments were the extent of the research. The moratorium was lifted with the majority party voting for and the minority against. On the same day by an identical vote, the Haines tract was rezoned for apartments and plans for its development including stores were accepted.

The Haines tract, reportedly a $40 million project near Pine Lake, had caused quite a bit of controversy. One elected official published a newspaper, "The Big Democratic Lie," condemning the proposal. The plans as of

October 1970 called for five 17 story high-rise towers with 400 units each, primarily efficiency and luxury. This was unfavorably compared to the lesser densities of the Cherry Hill Towers which have 18 stories and 272 units. In addition, there were to be 200 two-bedroom townhouses, which implied school children, and a parking space ratio of one space per unit, which implied parking problems. A lake on the plan caused a discussion about whether or not another lake, planned elsewhere by the same developer, was a "mudhole" or not.

In the revised plan of December 1970, there were shops, department stores and office buildings in the complex and the apartments were reduced to ten stories but with 520 units per building. The parking ratio remained the same and the townhouses were eliminated.

The Middle Income Housing Issue

On August 3, 1970, Council took action to attract middle income housing ($20,000 to $25,000 homes). In proposing a resolution, which was needed for New Jersey State construction or rehabilitation loans to developers, Councilman McDade stated: "(I) would hope this resolution would encourage the builders to build in our Borough and we would not be in a position of no building going on in our Borough." He continued, "the governing body has control over the builders in the town and makes sure they comply to our high standards in home building." The resolution was unanimously passed, apparently a statement of support for middle income, single family homes.

Yet from a subsequent exchange between Mayor Liss and Councilman McDade, who are of opposing parties, it is unclear if homes are considered good rateables. Liss also mentioned that an investigation was being made of a purchase of Borough land by a close relative of then Mayor LaPorte. This relative was now requesting the Borough to vacate some roads and grant a subdivision to construct "seven or eight homes of $25,000 each." McDade stated that these rateables could help the area. Liss replied, "Some rateables can kill a town," to which McDade retorted he did not feel that "homes are going to kill a town." The request was passed 4-2 along party lines.

Councilman McDade continued the discussion on August 24 with respect to an industrial subdivision request and one by Scarborough, a developer. He accused the Mayor of opposing him on middle income housing "because of the cost of installing streets, sidewalks, and curbs and now not considering this same thing with regard to industries." Later McDade continued, "when Council approves subdivisions, we automatically make certain that requirements for curbing and other necessary improvements are made at the expense of the builder."

The usual complaints about deterioration and school costs were heard again in 1970. On April 20, 1970, some apartment complexes were criticized either because of deterioration or number of school children or both. Apparently, figures from the tax department showed three complexes to be particularly costly. No mention was made of any complex exceeding the maximum number of school children required for the Certificate of Reasonable Occupancy described earlier. However, on September 28, Councilman McDade stated that the Arkay Apartment "owner does not act with good intentions" and the $500 per day fine under the Certificate of Reasonable Occupancy ordinance was invoked. On October 29, a citizen complained that these apartments were roach infested, were inadequately heated and had increased rents. It was also reported that the school tax and fines still had not been paid.

Initiation of Rent Control

In other legislative action, a rent control ordinance was unanimously passed on September 28, 1970. It created the appointed office of rent control officer and gave him the right to declare substandard a building containing three or more dwelling units. If after notice and hearing he still considers the dwelling substandard, he can order the apartment brought up to minimum standards within a reasonable time at the discretion of the Borough Council. Failure to complete improvements "shall be cause to impose rent control." The maximum permissible rent shall provide the owner with "a fair net operating income" which is defined as 20 percent or more of the annual income for a structure with less than five units and 15 percent or more for one with five or more units. Within that limit the rent control officer determines the precise fair net operating income considering "the following items of expense: heating fuel, utilities, payroll, janitorial materials, real estate taxes, insurance, interior painting and decorating, depreciation, and repairs and replacement and additions to furniture and furnishings which shall be deducted from the annual income derived from the multiple dwelling." When he finds the structure no longer substandard, rent control is lifted.

According to Borough Council minutes, the ordinance was passed because of complaints on deterioration and rent increases. This ordinance, which is probably purposely imprecise on the definition of substandard, appears to be designed to protect the community from deteriorating housing. It is a legislative attempt to prevent the "Inner City Slum Syndrome" in the same manner as the Certificate of Reasonable Occupancy. Thus, Lindenwold attempted to shield itself from the negative aspects of the apartments' reputation while benefiting from its allegedly positive aspect as an excellent rateable.

The next year, 1971, was similar: another moratorium on apartments, mixed success of rezoning applications to permit apartments, more legislation to tighten control over development and maintenance, and more speeches, pro and con, on the effects of apartments. On March 15, a moratorium was imposed on the construction of all multiple family dwellings "of every type and description" except those whose plans were previously approved. Three days later, Mr. Carlton Sherwood testified that he would institute a legal suit against the Mayor and Council if they tried to enforce the moratorium. It is not clear whether both or either actions ever occurred. The next month a subdivision request for the Scarborough development was denied unanimously, but McDade asked to have Scarborough informed that "the denial was only until the moratorium was removed and a study on dwellings per acre was reestablished.

On July 7, Scarborough's plan was approved unanimously with two conditions: one building was to be removed and the access road was to be widened by ten feet. On July 19, it was revealed that the FHA had granted $3.8 million to this developer because of the resolution on the need for middle income housing. The plan called for 200 units, 152 one-bedroom units limited to two people, and 48 two-bedroom units limited to four people.

Thereafter came a series of negative comments summarized as follows:

1. Councilman McDade: construction of all apartments should be stopped immediately;

2. Mayor Liss: would like to see zoning changed, thus eliminating the desire on the part of developers to come into the Borough for this type of complex;

3. Citizen: opposed any type of apartment...many of the apartments are being filled with welfare recipients...the proposed builder of the complex...had been picketed for inferior construction on his Ferry Avenue apartment complex in Camden;

4. Freeholder Ernst: governing bodies could put stipulations on developers with respect to FHA grants.

Nevertheless, in the next month, August, an ordinance was passed rezoning some industrial land for apartments in the southwestern area of Lindenwold. However, a similar request in the same area was rejected, but provided an interesting case. Developer Cohan of the Kingsrow Apartments in Lindenwold said that he had read in the local newspaper that the "Father and Sons" needed a recreation field. He publicly offered to build them a $40-50,000 baseball, football, and basketball facility complete with night lights. The Fathers and Sons would take care of maintenance, so the Borough would only have to pay for the lighting. Excerpts from the September 20 Council minutes concerning Cohan's apartment proposal follow:

1. Polilo (president of Fathers and Sons): all the builder requested was a change in zoning for apartments...we have apartments in town now, and more would no doubt be coming into town...Cohan had contacted them as a result of reading of their plight in the newspaper quite a while ago;

2. Citizen A: Would the field be given whether or not the zoning change was approved;

3. Flaharity (Cohan's lawyer): this would be the most ridiculous and ludicrous thing that anyone could say, to stand and say they are going to give you something for absolutely nothing;

4. Heftle: did other developers ever offer the Borough anything? (Answer no). Then why refuse one who did?

5. Citizen B: Other Cohan property (Kingsrow Apartments) is still without required fence;

6. Citizen C: What about drainage?

7. Mihm (Planning Board President): Kingsrow Apartments only added slightly to the drainage problem;

8. Solicitor: Voorhees Township got Rouse Company to donate 10 acres. Gloucester Township got Korman Corporation to donate 10 acres. This man is simply making a proposal; if it is not wanted, it can simply be turned down;

9. Citizen D: Presented a petition from 100 residents against any more apartments around School No. 5;

10. Mandis: Spoke against additional apartments because of demands on schools, ambulance, police, fire, and library facilities.

The request was unanimously sent back to the Planning Board, as it was currently illegal because it had not originated from there. McDade voiced his feeling that the entire area should be rezoned R-2. The next month the Planning Board rejected the zoning change, and the Fathers and Sons lost their field. The Board of Education supported the Planning Board with a motion opposing any future apartments to be built near School No. 5 at Chews Landing Road.

Also in October, the Planning Board notified the Council by letter that

> "it will deny any further zoning changes unless a master plan and expert assistance is made available by appropriation of funds. The Planning Board is given statuatory authority to employ experts and a staff. If the Council seeks to circumvent this decision, legal action is recommended. Any zoning matter referred to the Planning Board must contain a geographical survey of the area...in order to prevent spot zoning."

Reaction to this letter followed party lines. Councilman McDade commented that the last master plan was quite expensive and never adopted. Mayor Liss disputed this saying that with computerization a plan could be worked out in three months at specified costs. McDade made a motion to have residential zoning in the area of Chews Landing and Laurel Road. Liss stated that he was in agreement with the Planning Board and he hoped professional planners would be brought in. Councilman Scheid retorted that $7500 had been put aside in 1957 and four years later the plan was incomplete and the experts had most erroneously zoned 90 percent of the White Horse Pike as residential. At the end of 1971, no professionals had been brought in. McDade's motion had not been acted on and no more zoning changes had been requested.

<u>Additional Regulation of Development</u>

During 1971 Lindenwold passed more legislation regulating development. In January, a townhouse ordinance was unanimously passed which details physical requirements: the complex must be at least ten acres, no more than six units per structure, twelve units per acre, etc. Furthermore, the developer was held responsible for all required improvements: roads, drives, parking, water, sewerage, drainage, and so on. In addition, developments faced new requirements for "space not utilized for location of actual townhouses." Such space is either to be conveyed to the Borough for municipal parks and playgrounds, woodland conservation, pedestrian walkways, stream and drainage control, or public schools, or to be used as a private recreation or nursery facility maintained by the owner. A specific area is designated for one townhouse development by the ordinance.

In August, another rent control ordinance was passed. Whereas the 1970 rent control ordinance was designed to improve maintenance standards, the 1971 ordinance was primarily intended to protect the tenant from rent increases caused by excess demand. It designated a "Housing State of Emergency" when "the percentage of housing space available for rent to tenants which is unoccupied and offered for rent" is less than five percent. At such a time, the Mayor and Council "shall issue a proclamation activating the rent leveling provisions." These provisions limit rent increases at the expiration of a lease to a percentage of the rent not greater than the percentage increase in the Consumer Price Index during the term of the expiring lease.

Two other types of cost increases may also be passed on in rent increases: higher local taxes calculated on a per room basis, and increased costs because of "substantial increases in service." In the latter case, the rent control officer shall determine the amount of rent increase, considering among other "relevant information," the cost, necessity, and benefit to the tenant of the new service.

The rent control bill was submitted to public vote in the November 1971 elections. It received the endorsement of both major political parties and was campaigned for vigorously with billboards and leaflets by the Lindenwold Tenants Association, a voluntary organization of renters. The Association's leaflet read in part "We are not transients - here one year gone the next, but rather concerned taxpayers - residents who call Lindenwold home... The tenants pay for all their own services - trash pickup, street repair, etc. The only services the borough provides are police and fire protection... We pay $3759.58 for every child (we place) in the system... Rent rose an average of $51.00 per month in Camden County last year - highest in the state. In our borough, to rent the same facilities today versus this time last year you would have to pay approximately $70.00 per month more. Therefore we are coming to you, the homeowners, to ask you to help stop this financial disaster by voting "yes".

Rent control was approved in all but one of the seven electoral districts with a total vote of 1,930 in favor to 984 opposed. The largest pluralities of 702 and 89 votes occured in the two districts with the greatest concentration of apartments; the lone defeat occured in the district with the greatest concentration of single family homes. However, it was reported in the following Borough council meeting that the "majority of affirmative votes came from homeowners in the community."

In September, a unanimous ordinance created the Site Plan Review Committee "to provide rules, regulations, and standards to guide land developments." It required that a site plan be submitted for approval prior to the issuance of building permits for multiple family structures of more than five units, commercial and industrial properties, and developments requiring off-street parking and standing areas for more than five vehicles. Consultation was advised for structures with two to five units, or for developments with two to five parking spaces.

Fees for the mandatory site plan review are $50 for less than one acre sites and $25 for each additional or part of an acre. Appeals can be made to the Planning Board. Performance guarantees must be posted for all improvements which must meet design standards. Councilman McDade stated that this procedure would alleviate drainage problems and guarantee performance. In October, Mayor Liss vetoed the Site Plan Review, but was overriden because the veto "did not meet the State Statute 40:935."

Thus Lindenwold made considerable use of its discretionary power to regulate growth, which has been predominately apartments since 1966. Apartment developments came to Lindenwold, but on the Borough's terms for construction and maintenance. Evidently, the developers still found development profitable because they continued to come to the Borough with zoning requests.

In all, sixteen developments with a total of 4,457 units either exist or are under construction. Five of these developments are very large with over 400 units. Six developments, primarily older ones, have less than 100 units; see also Table 8-5 near the end of this chapter.

The Voorhees Zoning and Development Experience

Initiation of Zoning

Next, the development experience of Voorhees Township is considered; the contrast with Lindenwold's experience should be noted throughout. The first zoning ordinance of Voorhees Township was adopted on July 30, 1958. Only three ordinances related to land use were in effect before that date. One, passed in 1951, required that hedges be clipped; the second, passed in 1954, required that permission be obtained from the Mayor and Township Committee to excavate or remove soil or earth except in connection with construction or alteration. The third, also passed in 1954, created the Planning Board of Voorhees Township.

The Planning Board, consisting of the Mayor, a member of the Township

Committee, and three appointed citizens, was given the power and authority "to employ experts and a staff and to pay for their services...not exceeding the amount appropriated by the governing body for the use of said Planning Board." The Planning Board's composition has been changed three times since its creation with the addition of an appointed town official (1955), another appointed citizen (1957) and alternates (1971).

The original zoning map, proposed by the Planning Board and adopted in 1958, is largely still in effect. It established nine districts with requirements as shown in Table 8-4. Among the residential districts, the R.R. rural zone is largest in area covered, requires the largest single-family lots and allows professional offices in the professional's home, farm worker dwellings, farms, parks, playgrounds, public buildings, churches, certain public utilities, farm sales, and sand and gravel excavation. There are some restrictions, however. The last two uses require special permits. Fowl and swine are restricted from the edges of the property line by 50 to 150 feet and swine are prohibited from properties of less than ten acres and restricted to ten head in any case. The number of farm worker dwelling units are limited by formalae related to the size of the farm.

The R-100 zone applies to the western and southeastern parts of Voorhees Township, and has the second largest lot requirements for single family homes. The permitted uses are the same as the RR zone, except for the farm and farm-related uses which are only permitted if they were in existence before 1958. The uses in the R-75 zone are identical to the R-100, but lot requirements are reduced. This zone, covering the least area of the residential zones, applies only to the Kirkwood area which is near Lindenwold Station.

There are four types of commercial zones all of which permit the uses allowed in R-100 zones. The professional office zone (P.O.) also permits

Table 8 - 4

1958 Voorhees Township Zoning Ordinance Requirements

District	minimum lot area (sq.ft.)	minimum lot width (feet)	side/rear years (feet)	front yard set back (feet)	minimum floor area (100's sq.ft.)	maximum height (stories)
R.R.[1]	43,560	200	30/30	50	12	2½
R-100	12,500	100	15/25	30	12	2½
R-75	9,375	75	10/20	30	11	2½
P.O.	12,500	100	10/20	30	5/17[2]	2½
N.B.	12,500	100	8/20	30	5/17	2½
G.B.	12,500	100	8/20	30	5/17	2½
H.B.	12,500	100	8/20	30	10/17	2½

1. see text for meaning of abbreviations
2. area for business/area overall

banks, telephone exchanges, and office buildings for professional occupations. The neighborhood business zone (N.B.) allows home occupations and commercial enterprises in residential buildings as well as "stores for retail sale of goods and provision of services for local needs." These goods and services are listed specifically in the ordinance and include such neighborhood businesses as grocery, drug, newspaper, and liquor stores, barber shops, laundromats, shoe repairs, and gasoline stations (one "for every 200 families within a radius of one-half mile provided that the service may be combined with other permitted uses").

The general business zone (G.B.) allows all of the above as well as "uses generally considered of a commercial, retail, or business character." The ordinance lists as examples: apparel sales, automobile sales, furniture sales, bars, restaurants, funeral homes, auto repair, dog and cat hospitals, bowling alleys, theaters and others. These businesses have a more widely distributed clientele than those of the neighborhood business zone. The highway business zone (H.B.) while including all the above, is also for "activities and establishments devoted to the sale of goods and services to non-resident clientele or to transient highway travellers or which depend upon automobile traffic in bulk." Examples include motels, gasoline stations, restaurants, final assembly of products for on-site sale, carnivals, drive-in theaters, and contractor's offices.

The highway business zones are found on three major thoroughfares: along sections of the Haddonfield-Berlin Road, along the length of the Berlin-Milford Road, and at the intersection of White Horse-Moorestown Road and Evesham-Clements Bridge Road. The general business zones occupy three sections near Mill Road and an area near Kirkwood Lake. There appear to be no professional office or neighborhood business zones. Taken together, the commercial zones occupy relatively little land, being confined to narrow strips along highways, and areas near lakes which are primarily golf courses.

In contrast, the two industrial zones include extensive areas, almost all of which were vacant in 1958. The light industry zone allows business and commercial uses as in the highway business zones and agriculture, residences and sand and gravel mining as in the rural zone. In addition, "activities of a limited industrial nature not involving the emission of any toxic or corrosive fumes, gas, smoke, odor, obnoxious dust or vapor, offensive noise or vibration, glare, flashes or objectional effluents," and "activities of a general industrial nature subject to the issuance of a special use permit by the Zoning Board after study and favorable referral by the Planning Board" are permitted. In applying for the special use permit, proof is required, such as site plans, operation description and sworn statements, that no hazard, nuisance, or pollution will exist. Some uses or activities are specifically prohibited; slaughtering of animals, disposal of liquid effluent, and churches, private and parochial schools, and charitable and philantropic institutions. The last group is probably excluded for their own protection; however, residential uses are permitted. The industrial zone permits those uses prohibited in the light industrial zone. However, proof that no hazard, nuisance, or pollution will result is also required for the necessary permit.

Apartments are not specifically permitted in any of the zones. They may, however, be constructed in any residential or rural zone if a special use permit is obtained. This requires that the development be approved by the Planning Board as:

> "exerting no detrimental effect upon surrounding areas because of poor arrangement, inadequate parking, traffic danger, inadequate provision for light or circulation of air, destruction of neighborhood character" and "being economically stable and advantageous to the community in the light of its need for services and community

> facilities, its capacity to pay for its share of these services through taxation or other means or its capacity to construct and maintain in part or whole the utilities and facilities which it will need."

Thus, Voorhees Township retained the right to consider the neighborhood and budgetary effects of any and all proposed apartment construction. Any apartment construction would require the approval of the Planning Board and a permit from the Zoning Board.

This special use permit is also required for hotels, motels, and "quasi-public institutions" such as churches, schools, hospitals, clubs, nursing homes, and community centers. In all cases specific plans must be submitted indicating "the site to be developed, location of buildings or trailer parking areas, off-street parking facilities, sanitary facilities, and other information deemed necessary." The explicit rationale for these permits is that such construction "within certain senses may be inimical to the general health, safety, and welfare if improperly designed and regulated."

Overall, the zoning ordinance seems to give maximum control and flexibility to the local government. Almost all vacant land is zoned rural, industrial, and light industrial. The rural zone requires one acre lots so it is unlikely to be developed extensively at that density. However, the zoning ordinance explicitly allows any owner of rural property to petition the Planning Board to permit subdivision for residential purposes. If granted, the development need only conform to the R-100 requirements or 12,500 foot lots. The stated criteria for a favorable recommendation to the Township Committee by the Planning Board is that the proposed development is not "inimical to the orderly growth of the township." The same process applies to residential uses in industrial zones. Thus, the local government retains direct power to control all large scale residential development as well as apartment development. Vacant land is zoned in such a way that, in effect, all apartment and residential development, except one-acre lots, require explicit approval.

This flexibility and control over vacant areas appears to have been the main concern of the zoning ordinance. Certainly extensive development was not expected in 1958 in terms of industry and one-acre lots. The desire for commercial and industrial rateables is certainly reflected. Vacant land zoned R-100 is found in the Kirkwood district, the area coming closest to being a residential center in Voorhees. The zoning ordinance thus facilitates the development of this area by more residential construction. It is the only area where small scale residential development could occur without special permits and approval or exceptionally large lots.

The zoning ordinance also established the Zoning Board with five appointed residents of the township, each serving for five years. It has the power to:

1. interpret the law in specific instances where the regulations are in general terms;
2. hear and decide appeals of actions based on the ordinances;
3. grant variances from the ordinances.

Other forms of control were also created by the zoning ordinance. Zoning permits are required before construction for all types of development as are certificates of occupancy before use of any structure. These are issued by the Zoning Officer, if the plans and structure satisfy the requirements of the zoning ordinance.

Non-conforming uses existing prior to the zoning map can be continued, but cannot be rebuilt if more than 50 percent destroyed, except in conformity with the lot requirements, and cannot be extended or altered except in conformity with provisions of the ordinance. Finally, the zoning ordinance of

1958 stipulates a penalty of not more than $200 fine for each day a violation continues. This commences five days after notification of the violation by township officials.

Thus, as of July 1958, Voorhees Township had considerable power to control the pattern, location, composition, and rate of potential local growth. The area available for residential development, other than in one area lots, was small and concentrated. Residential development of any large size, and all apartment development, required the specific approval of the Planning Board and the Township Committee. Hence, all significant development in Voorhees would require the concurrence of the local government.

Amendments to the Zoning Ordinance

There have been few changes since the 1958 ordinance. Small areas were rezoned from rural to industrial in 1959, 1960 and 1965, but most of the industrial zones remain vacant. A general business zone was extended slightly in 1961. Some rural land was rezoned R100 in 1957 and 1962. The minimum floor space in rural zones was increased from 1200 to 1600 square feet in 1960. In 1964, public garages and gas stations were prohibited within 100 feet of a residential district; their entrances were also prohibited within 300 feet of the entrances to a school, church, hospital, fire station, public park, or playground, and within 1000 feet of any other garage or service station.

In 1963, a substantial change was made in the ordinance. All residential uses were prohibited from industrial zones and only combined residential uses were permitted in the business and office zones. Apartments were prohibited from the residential zones. Thus, the local government extended the area for which its approval by variance or zoning change was needed before residential development can take place. Also the large vacant areas were protected from piece-meal small scale residential development.

Also in 1963, the special use permit procedure was amended to require approval of the Zoning Board at a public meeting, after study and recommendation by the Planning Board. In addition, the amendment allows the location in rural zones of those activities requiring the special use permit, if such a permit is secured.

The Township Center Zone and Echelon Mall

The first major zoning map change since 1958 was the creation of the township center zone in August 1968. Its rationale is stated quite nicely in the ordinance:

> "It is recognized that the creation of balanced developments consisting of one or more commercial, limited industrial, public, recreational, and residential uses in convenient and complementary relation to each other and to other districts of the Township may encourage imaginative, efficient and orderly physical growth within the Township to satisfy the increasing demand for goods and services, housing, recreation and employment. The Township Center Zone is hereby established to provide for a balanced combination of commercial, limited industrial, public, recreational, and residential uses in single districts suited by their size, location and topography for unified development as centers of commerce, housing, employment and community life within the Township."

Each such zone "shall have an area of at least 100 acres and shall contain a regional shopping center defined as "a unified development of not less than twenty-five stores, shops or other commercial establishments, together with areas for internal circulation, parking, and other accessory uses...and having therein a building or group of buildings containing not less than 300,000 square feet of net floor area." In addition to the required shopping center, 19 groups of uses are mentioned specifically including professional offices, theaters, hotels, motels, town houses and apartments. Residential density is limited to ten dwelling units per acre based on the total area of the zone including the shopping center. This zoning amendment also states that "no special use permit shall be required for any hotel, motel, apartment building, multiple dwelling group," or other use permitted in the township center zone.

The only township center zone designated to date is a large tract near Ashland Station called Echelon, which is being developed solely by the Rouse Company. The Echelon development plan called for the erection of 3700 dwelling units over an eight year period at a rate of 500 units per year, and a large enclosed shopping center, Echelon Mall. The shopping mall opened in October 1970 with two major department stores and more than 100 smaller shops.

Construction of dwelling units in Echelon began in 1970. By October 1971, 140 units were occupied, and by May 1972, 461 units were completed. As the development plan called for 800 units to be occupied by late 1971, the development was somewhat behind schedule at that time. Of the 461 units, 83 were townhouses, 144 were one-bedroom apartments, 216 were two-bedroom apartments, and 18 were three-bedroom apartments. The allocation by type of unit among the 3239 units yet to be constructed has not been finally determined, although 150 are to be condominium townhouses and some are to be condominium apartments. Adjacent tracts of land were acquired by the Rouse Company in the summer of 1972 and were rezoned to the township center zone classification.

Prior to the approval of the Echelon project, 200 of the 1500 families in Voorhees Township were polled as to their reactions to the project; a township committeeman stated that 82 percent of the respondents favored the mall and apartments, and only 10 percent disapproved. The committeeman felt that the Echelon Mall and Apartments, and apartments in general, were a fiscal asset to the community. He stated that in 1971 with only 140 apartment units occupied, the Echelon complex paid $400,000 in school taxes and $700,000 in total property taxes.

The cost of the mall to the Township was considered to be minimal as a result of cost-revenue comparisons made by the Township for 1971. According to the committeeman, police expenditure was the only function for which costs exceeded revenues. Moreover, the Rouse Company installed a traffic signal, extended sewer trunk lines and donated land for a school site. The Echelon development's impact both on taxes and on municipal and school costs is investigated in more detail in Chapter 9.

Despite the committeeman's overall favoring of apartments, he stated that no more apartments would be approved in Voorhees, except possibly for a luxury high-rise structure. He argued that although apartments were a fiscal plus, they might well be a "social" minus.

Apparently the political party in power believed that more support of apartment development would have undesirable ramifications at election time. This view seemed to be based on the opinion that the opposition party, which has not made a strong showing in recent elections, is considered to be in favor of development.

Additional Regulation of Development

On May 11, 1971, a Site Plan Review Committee was established. The site plans must be approved by the Committee prior to the issuance of a building permit "for any proposed land development including commercial, industrial, multiple family structures containing five or more units, or any land development requiring off-street parking or off-street standing area for an excess of five vehicles." Reasons for disapproval must be presented to the applicant in writing and can be appealed to the Planning Board.

Requirements for driveways, site areas, curbing, acceleration lanes, sidewalks and other features are stated explicitly. Drainage standards, satisfying the township engineer, must also be met. A performance guarantee is required to cover costs of all improvements, on and off the site, and the restoration of natural streams. Failure to comply to the plan and to meet the standards can result in revocation of the building permit, revocation or withholding of the occupancy certificate, and forfeiture of the performance bond. All changes in the plan must be submitted for approval.

This ordinance also assigned to the developer the responsibility for installing curbs, gutters, and sidewalks. Curbs and gutters must be provided along the entire property frontage. This is the only example in Voorhees Township of legislation assigning specific capital costs of new development to the developer.

Comparison of Policies and Development Experiences

The different approaches to control of development created by Lindenwold and Voorhees provide in the final analysis a comparable degree of discretionary power over the rate and form of development to each local government. These controls are reviewed and compared below for single family homes, apartments, commercial and industrial land uses.

Single Family Homes

Neither Lindenwold nor Voorhees has attempted to restrict the number of single family homes, although lot size and other standards have been implemented to regulate their type. Neither municipality requires a site plan review. All zoning ordinances have prohibited non-residential uses in residential areas while permitting residential uses in most non-residential areas.

However, it was observed in both Lindenwold and Voorhees that the residential developer is greeted cautiously. His image is generally one of a greedy outsider, perhaps a step above the insidious land speculator, but similarly only interested in making a profit and leaving town. Zoning ordinances specify minimum standards such as lot and yard size, occupied area, floor space, and building setback line. Any request by a developer for a variance, no matter what its merit, tends to be attacked as an attempted erosion of neighborhood standards.

There is a preference in most communities for better houses which generate more property tax revenue and improve neighborhood character and value. The 1964 zoning ordinance in Lindenwold zoned almost all vacant land at standards more stringent than existed in previously developed areas, which in effect required new housing to be better and more expensive than existing development. Similarly, Voorhees in 1959 zoned most of its vacant land for residential use in one acre lots. Moreover, subdivisions in those areas would have to conform with standards higher than found in most existing developments.

Other than zoning standards, there are few restraints on single family construction. In Lindenwold, large areas were zoned for single family houses in 1964, but there was little subsequent development, probably because of the high standards and general market conditions. By 1969, much of the area zoned residential was occupied by apartments; other areas were rezoned for apartments, industrial and commercial uses. Single family housing requirements in the remaining residential districts were somewhat reduced, as the objectives for single family housing construction became primarily to fill in existing residential areas rather than to attract new, large scale developments.

The Voorhees zoning ordinance enables the township to exercise considerable control over the location of residential development, a matter of less concern in Lindenwold. Voorhees is a large township with much vacant land. An objective of the Township Committee is to channel growth into the Kirkwood and Ashland areas. Thus, land in Kirkwood is zoned for residential use, but almost all other vacant land is zoned either rural or industrial. Since 1963, residential development has been prohibited in industrial districts, and one acre or larger lots are required in rural districts. Anyone wishing to subdivide property in order to construct homes in the rural districts at higher densities must submit a subdivision plan to the Planning Board and request a change in zoning to residential R-100. If the Planning Board determines that the change is "not inimical to the orderly growth of the Township," it recommends favorably to the Township Committee. Thus the township assures its control over the location of most residential development, permitting only one acre lots without its explicit approval.

Voorhees added 500 single family units between 1960 and 1970 and Lindenwold added 288 units. As shown in Table 8-1, the number of building permits issued in each year fluctuated considerably in both jurisdictions. Voorhees issued ten each year in 1969 and 1970 with no less than 44 in the previous four years; however, a development of 200 to 300 houses was authorized in 1972. Lindenwold issued 30 in 1970 with no more than 23 in the previous four years.

Apartments

Apartments have been a controversial land use in many communities for social, political and economic reasons. They are alleged to bring into the community such undesireables as welfare recipients, low income families, unruly tenants, and criminals. Perhaps respectable when new, apartments are expected to deteriorate soon, as no owner-occupied home would, creating center city slum conditions in suburbia. Their tenants are accused of voting and leaving, making decisions which affect the community long after they have moved on. Although apartments may generate surplus revenue in the short run, their expected deterioration, accompanied by an increase in the number of school children, is expected to cause a deficit in the long run. The prospect of slum conditions and budget deficits, however unjustified, have caused local officials to be hesitant in approving apartments. The 1959 Voorhees' zoning ordinance reflects such a concern. Voorhees did not zone any land for apartments. Then as now, a special use permit for apartment construction was required from the Planning Board, after being favorably referred by the Planning Board. The Planning Board would have to approve the proposed development as meeting specified design and plan conditions, as well as:

1. "exerting no detrimental effect upon surrounding areas because of poor arrangement, inadequate parking, traffic danger, inadequate provision for light or circulation of air, destruction of neighborhood character;"
2. "being economically stable and advantageous to the community in the light of its need for services and community facilities, its capacity to construct and maintain, in part or whole, the utilities and facilities which it will need."

These criteria grant Voorhees control over the flow and nature of multiple family housing. Voorhees has not found it necessary to alter its basic system of control since 1959. A site plan review ordinance passed in 1971 requires the Township Committee's approval prior to the issuance of a building permit for multiple family structures of more than five units, as well as commercial and industrial development. The primary significance of this ordinance for apartments is that the Township Committee reviews the site plan for the building permit as does the Planning Board for the special use permit.

The approval of the township center zone in 1968 created a category in which apartments were authorized. However, since the only township center zone was already scheduled for development, this did not constitute any real modification of the requirements for apartment construction.

Lindenwold has also exerted considerable control over apartment development, although less explicitly than Voorhees. The 1964 zoning ordinance only permitted apartments in certain commercial districts which were very small in area. Apartments were originally zoned for only one commercial district, an area two blocks by one block.

Conversion of homes in residential areas and construction of apartments in another commercial district require the authorization of the Zoning Board. Not more than two dwelling units combined with a permitted business use were authorized for a third commercial district. With these minor exceptions a potential apartment developer had to seek a variance or zoning change which required the approval of the local government. Furthermore, the building design and site plans of apartments and all non-residential land uses had to be approved by the Planning Board "giving due consideration to land use, traffic, health, safety, and general welfare."

In contrast, the 1969 zoning ordinance had large areas explicitly zoned for apartments. In most cases this was _ex post facto_ zoning, reflecting existing or approved apartment projects which had been authorized by variances and zoning changes. The exception is land in the immediate vicinity of Lindenwold Station which has been zoned for high-rise apartments. Some of this land belongs to the Borough which unsuccessfully tried to auction 30 acres in 1970 for $100,000. Most of the land is unassembled and its zoning is an attempt by the local government to attract such apartments. The site plan review continues to be required for all apartment projects. All land uses other than industry are permitted in apartment zones, but apartments are not permitted in residential zones.

In addition to controlling their number and location Lindenwold sought to protect itself through legislation from the feared economic and social impacts of apartments. The 1969 zoning ordinance states that no more than 25 percent of the units in an apartment development can be multiple bedroom. Another ordinance in 1969 limited the "number and nature" of occupants in apartment buildings. The number of adults is limited to one per 250 feet of interior floor space and the number of school children is limited to the number whose school costs are covered by property tax revenues for education. A 1965 ordinance withheld garbage service from apartments, as well as commercial and industrial activities. A 1970 rent control ordinance authorized Lindenwold to impose rent controls on all apartment units deemed substandard by an appointed rent control officer and not improved within a reasonable amount of time. In this fashion Lindenwold sought to prevent overcrowded, deteriorating apartments and to ensure a cost-revenue surplus for the school system and local government.

Voorhees states explicitly that apartments must have a favorable economic impact, that is, generate more revenue that expenditure, in order to receive a special use permit. Lindenwold, primarily through legislation, tries to ensure that apartments do have a positive impact. Both systems permit negotiation between the potential developer and the community. The special use permit requirements indicate the consideration of payments for service "through taxation or other means." The developer seeking a permit often finds he has sufficient profit margin to offer the community more inducements, such as land for a public school. Similarly, in Lindenwold developers seeking variances or zoning changes offered inducements to the community ranging from recreation fields to paving public streets and extending public sewer systems. Thus, requiring a special use permit or a zoning variance not only gives the local government authority to reject proposed development, but also gives it the leverage to negotiate for additional benefits to the community.

Lindenwold and Voorhees have used their discretionary power quite differently as indicated by Table 8-5 which shows the number of apartment developments in each. Lindenwold has permitted extensive apartment development, but according to local officials has always examined other projects completed and maintained by a potential developer before granting approval. Voorhees has accepted very little.

It is far more difficult to document that apartment development could have taken place in Voorhees than to show that it has in Lindenwold. Voorhees officials do claim to receive numerous inquiries from potential apartment developers each week, but few inquiries ever reach the formal application stage thereby becoming a part of the public record. The operational policies in Voorhees certainly do discourage formal applications. As in Lindenwold, a developer must show examples of projects he has completed. In addition, the township requires financial statements and letters of commitment to the proposed project.

Finally, the most significant deterrant to formal application is Voorhees' refusal to rezone for agents or land brokers. The developer must own all the land for which he seeks rezoning or a special use permit. Developers usually purchase an option on a site subject to rezoning. The Voorhees application system requires a significant commitment of funds which could result in substantial losses if the land is not rezoned. A hesitancy to

Table 8-5

Opening Year of Rental and Number of Apartment Units

Apartment Development	Approximate Opening Year	Number of Units*	
Lindenwold			
Green Terrace Garden Apartments (Arkay)	1962	24	
White Horse Court	1963	60	
Lindenwold Manor (Joyce Construction Co.)	1964	26	
Lindenwold Arms	1964	18	
Lynnebrook (Overbrook Arms)	1964	51	
Parc One (Barlow Construction Co.)	1967	80	
Coachman (East and Manor)	1967	1600	(800)
Trent Court (first known as Lindenwold Apts.)	1967	412	
Chadwick	1971	136	
Finistierre (Scarborough)	1971	450	(225)
Kingsrow (Cohan)	1971	208	
Kenwood	1971	140	(90)
Pine Lake Village (Haines Tract)	1972	562	(8)
Scandia Hennen	1972	148	(0)
Lindentowne	1972	142	(16)
Lindenhill	1974	400	(0)
Voorhees			
Burnt Mill Arms	1956	112	
Robin Hill	1971	208	
Echelon Mall	1971	3700	(461)

* For apartment developments not yet completed, the number in parentheses gives the number of units completed by Summer, 1972.

apply formally after discouraging informal meetings is certainly credible with this application procedure. However, it is difficult to substantiate the true magnitude of apartment development pressure in Voorhees and, thus, to evaluate the importance of local government resistance as the cause for fewer apartments.

Commercial Development

Commercial development is sought by both Lindenwold and Voorhees except within residential areas where it is forbidden. Such development is recognized as a good tax rateable, but is considered a threat to residential property values and to the neighborhood itself if located among homes. Reflecting this belief, Lindenwold requires a buffer zone at least 25 feet wide planted with "predominantly evergreen type tree or shrubbery" along each property line of a commercial property which is opposite or adjacent to a residential district.

Lindenwold had retained more control over commercial development than Voorhees, but in 1971 Voorhees passed similar powers. All plans are subject to the Building Design and Site Plan Review in Lindenwold according to the 1964 and 1969 Zoning Ordinances and the 1971 Site Plan Review Ordinance. Furthermore any uses not authorized specifically by the 1969 ordinance are permitted "provided that such use is not noxious or hazardous and only when such use or uses are authorized by the Zoning Board of Adjustment as a special exception...or when authorized by the Borough Council upon recommendation of the Zoning Board of Adjustment." Thus beginning in 1964, Lindenwold had the power to evaluate and reject proposed commercial development. Voorhees only took that power in 1971 when it established the Site Plan Review Committee whose approval is required for site plans of all commercial development. Commercial properties in Voorhees did not require the special use permit necessary for apartment, hotels, and industry.

Another strong form of control exerted by both Lindenwold and Voorhees was the severe limitation on the amount and location of land zoned for commercial use. The 1964 ordinance in Lindenwold restricted commercial properties to small strips along major highways; the 1969 ordinance added one triangular tract which was uniquely zoned for offices, stores, shopping center, research laboratories, theater, hotel or motel uses. Voorhees similarly zoned small strips along highways but, in addition, three larger areas already in use as golf courses. The township center zone passed in 1968, the Echelon Mall, permitted a shopping center in conjunction with apartments. For all land not zoned for commercial use, developers have to request variances or zoning changes. Thus, Lindenwold and Voorhees control commercial development in all but relatively small areas zoned commercial and even in these areas the communities maintain certain rights of review mentioned above.

Industrial Development

Industry is desired by most local governments as it is an excellent tax rateable. Both Lindenwold and Voorhees zoned large areas of vacant land industrial. However, each retained the right to evaluate and reject potential projects. In Lindenwold, all proposals are subject to requirements by the Building Design and Site Plan Review Committee. Voorhees requires a special use permit for "activities of a general industrial nature." It is issued by the Zoning Board after proof that the activity does not create either danger, water pollution, or objectionable noise, smell, dust, gas, glare or effluent.

Both communities differentiate among types of industry. Lindenwold explicitly prohibits 41 types and imposes general pollution and traffic restrictions as well as buffer requirements on all others. Voorhees has two industrial zones, light industry and industry. In addition to the special use permit requirements restricting industry, five types are prohibited specifically from the light industry zone. These five are permitted in the industry zone if they qualify for the special use permit.

Conclusion

The growth and development of Lindenwold and Voorhees is succinctly captured in Table 8-6. Both municipalities experienced major growth during this five year period. In Lindenwold, apartment development was a major component together with single family homes. In Voorhees, Echelon Mall and single family homes formed the major growth components. Large scale apartment construction was just getting underway in Voorhees in 1970-1971. However, if presently approved building plans are realized, Voorhees will approach Lindenwold's number of apartment units and total assessed valuation.

To what extent is this development attributable to the High-Speed Line? Was the Line a factor? Almost by definition, yes. Was it the principal cause? In all probability, no. Would this growth have occurred without the High-Speed Line? In Voorhees, probably so, because a large site (the old Echelon airport) was a major factor. In Lindenwold, the High-Speed Line probably helped draw attention to this particular municipality, and it certainly has been a factor in advertising. Nevertheless, the combination of available land and elected officials eager for growth on their own terms, together with an almost unsatiable demand for apartment units, were probably the key factors.

Suppose the High-Speed Line had terminated in Berlin, eight miles to the southeast, or stopped at Ashland. Would the result have been the same for Lindenwold? This is perhaps the most difficult and the key question: to

Table 8-6

Increase in Assessed Valuation in Lindenwold and Voorhees, 1966 to 1971

	Lindenwold			Voorhees		
Land use	1966	1971	increase	1966	1971	increase
Single-family residences	$22,829,643	$29,000,296	$ 6,170,653	$19,285,197	$27,327,412	$ 8,042,215
Apartments	880,190	8,428,023	7,547,833	738,465	1,531,131	792,666
Commercial	1,459,507	3,274,106	1,814,599	2,258,188	27,447,480	25,189,292
Industrial	0	48,739	48,739	801,724	1,281,399	479,675
Total	25,169,340	40,751,164	15,581,824	23,083,574	57,587,422	34,503,848

what extent can growth be guided at the subregional scale by transportation investment. Again it would appear that land availability and local land use policies are the governing factors with transportation being a necessary but not sufficient condition for growth. Had Lindenwold only been another station on the Line to Berlin, its share of the growth might have been diffused, but only if Berlin was receptive to development. For that matter, had Voorhees been eager for the type of development that occurred in Lindenwold, it might well have received a larger share than Lindenwold.

Thus, given a very large demand for apartments and availability of suitable sites, a municipality can have a major voice in the extent and character of its growth. This conclusion seems also to be born out by Table 3-5, which is nearly where this discourse began. Table 3-5 suggests that Lindenwold's apartment boom in the 1960's was not a unique phenonenom; rather, Lindenwold was one of six or eight areas that experienced large scale growth. Another of these, Maple Shade, is an area of comparable size located in the Moorestown corridor, which for this purpose, is a control. Presumably, Maple Shade and the other growth areas had somewhat similar conditions for growth as Lindenwold except for the High-Speed Line: a) available, attractive land; b) plenty of demand; and c) receptive local officials. The reasons why local officials desire growth bring us to the next question of the impact of growth on public finance, which is the subject of Chapter 9.

CHAPTER 9

IMPACT OF GROWTH ON PUBLIC FINANCE

Introduction

Rapid urbanization clearly did occur in Lindenwold Borough and Voorhees Township in the late 1960's and early 1970's, as well as in several other municipalities in South Jersey. The type and character of this growth is the result of many economic and social forces, one of which is the High-Speed Line. Given that urban transportation improvements and other public policies can determine, or substantially influence, the type of development that takes place, then one would like to identify the effect or impact of different types of development in order to improve these policy decisions.

The identification of the full impact of urban development, and the use of such knowledge in improving public policy decisions, is a large and difficult research task. A variety of important equity and distributional questions necessarily arise which are well beyond the resources of this study to pursue. A partial approach was therefore adopted in order to seek answers to some fairly specific questions.

First, this study focuses on the impact of development on costs and revenues of the local governments and local school districts in which the development occurred. No attempt is made to look at costs, or benefits, of the development to other institutions, organizations or groups, such as neighboring municipalities, county and state governments, commerce, developers themselves, and various groups using public and private services and facilities.

Second, the study focuses mainly on the impact of apartment developments relative to single family homes. As above, only the impact on the public sector is examined. The questions addressed by this study are major issues in every jurisdiction facing development pressure. They mainly concern whether a given development will result in a surplus of tax revenues over new costs or a loss. Every elected local official is vitally concerned with this issue.

However, a larger question is not addressed: what type and mix of development is best overall? One aspect of this question concerns what type of residential development is best, say for a given level of household expenditure for housing. Such a question is also extremely difficult to answer. Early in the research effort, it was hoped that some empirical results could be obtained on the total development costs of various types of residential development: single family homes, town houses, garden apartments, high-rise apartments, etc. Even this limited effort turned out to be much too much ambitious because of the lack of suitable data.

The results that have been obtained for Lindenwold and Voorhees, even with this limited scope, reveal much of interest to urban public decision makers. Hopefully ongoing research efforts will be able to extend these initial findings.

This chapter begins with a thorough review of trends since 1960 in Lindenwold and Voorhees on the following topics:

1. population and land use
2. current expenditures by local governments and local school districts
3. capital expenditures by local governments and local school districts
4. capital debt
5. property tax rates
6. expenditures in relation to the value of property

Building on this review, the impact of development on local school expenditures is then considered. A method is presented for separating the effects of inflation, quality increases and increases in demand (i.e. growth) on educational expenditures. Employing this method, school expenditures in the Lindenwold and Voorhees local school districts are analyzed. The contribution of apartments and single family homes to costs and revenues is examined for various funding assumptions.

Municipal expenditures are the second principal topic for analysis. A thorough review and critique of methods for determining the impact of urban development on municipal expenditures is presented. Then, the costs of various municipal functions in Lindenwold and Voorhees are examined, to the extent available data permits, in an attempt to isolate the impact of development. The chapter concludes with an assessment of the findings and their interpretation with regard to urban transportation improvements.

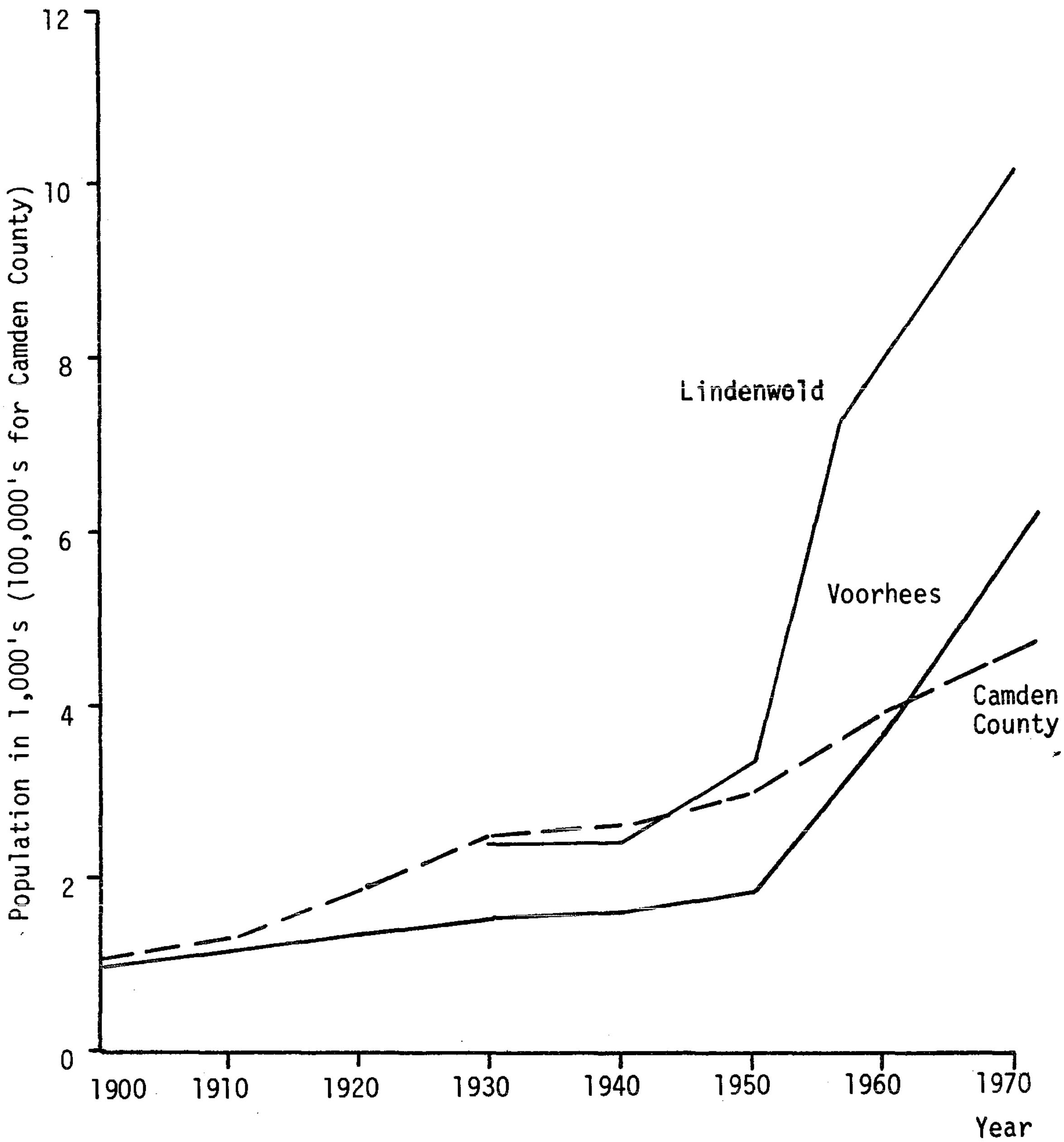
Population and Land Use Trends

Both Lindenwold Borough and Voorhees Township experienced considerable population growth and land development during the 1960-70 decade. The U.S. Census of Population shows a continuation of the rapid growth that began in the 1950-60 period; see Figure 9-1. Lindenwold gained 4,864 residents from 1960 to 1970, as compared with 3,856 residents from 1950 to 1960 to reach a 1970 population of 12,199; Voorhees increased by 2,430 residents from 1960 to 1970, versus 1,961 from 1950 to 1960, to reach 6,214 in 1970. Lindenwold's housing stock increased by 1,805 units during the 1960's, while Voorhees' increased by 616 units during the same period.

Property assessment data available for most of the 1960 decade document both this general growth experience, and the results of the land use control practices discussed in Chapter 8. Each municipality in New Jersey undertakes

Figure 9-1

Population of Lindenwold and Voorhees, 1900 to 1970



the assessment of real estate within its boundaries. Also, because reassessments are not made annually, assessed values of property in different jurisdictions tend not to be comparable. For this reason and others, each year the State of New Jersey determines the ratio of actual value, i.e., sales value, to assessed value for each municipality. This ratio may be used to estimate the actual value of real estate in each municipality, given the assessed value. This estimate is referred to as the state equalized valuation; see also Chapter 5 for a discussion of this procedure.

Figure 9-2 shows the steady growth in total value of real property in Lindenwold and Voorhees from 1961 to 1971. Lindenwold and Voorhees had almost identical valuations of approximately $43.4 million in 1970, increasing from $18.3 million and $15.3 million respectively in 1961. However, Lindenwold's growth leveled off in 1971, whereas Voorhees increased its rate of development.

The percentage composition by land use category of the property valuations of these two municipalities is quite varied, reflecting their different regulatory practices; see Figure 9-3. Most noticeably, apartments increased in Lindenwold from 3.3 percent of assessment in 1966 to 18.9 percent in 1971; during the same period commercial properties increased in Voorhees from 8.7 percent to 43.9 percent. The 1971 figures show the importance of apartments to Lindenwold's property tax base and the importance of the Echelon Mall shopping center to Voorhees' tax base.

Current Expenditures Trends

Local Governments

As a basis for examining the impact of this growth, trends in municipal expenditures by Lindenwold and Voorhees during this decade of growth are examined next. Figure 9-4 reveals upward trends in expenditure by both munici-

Figure 9-2

Total State Equalized Assessed Valuation, 1961 to 1971

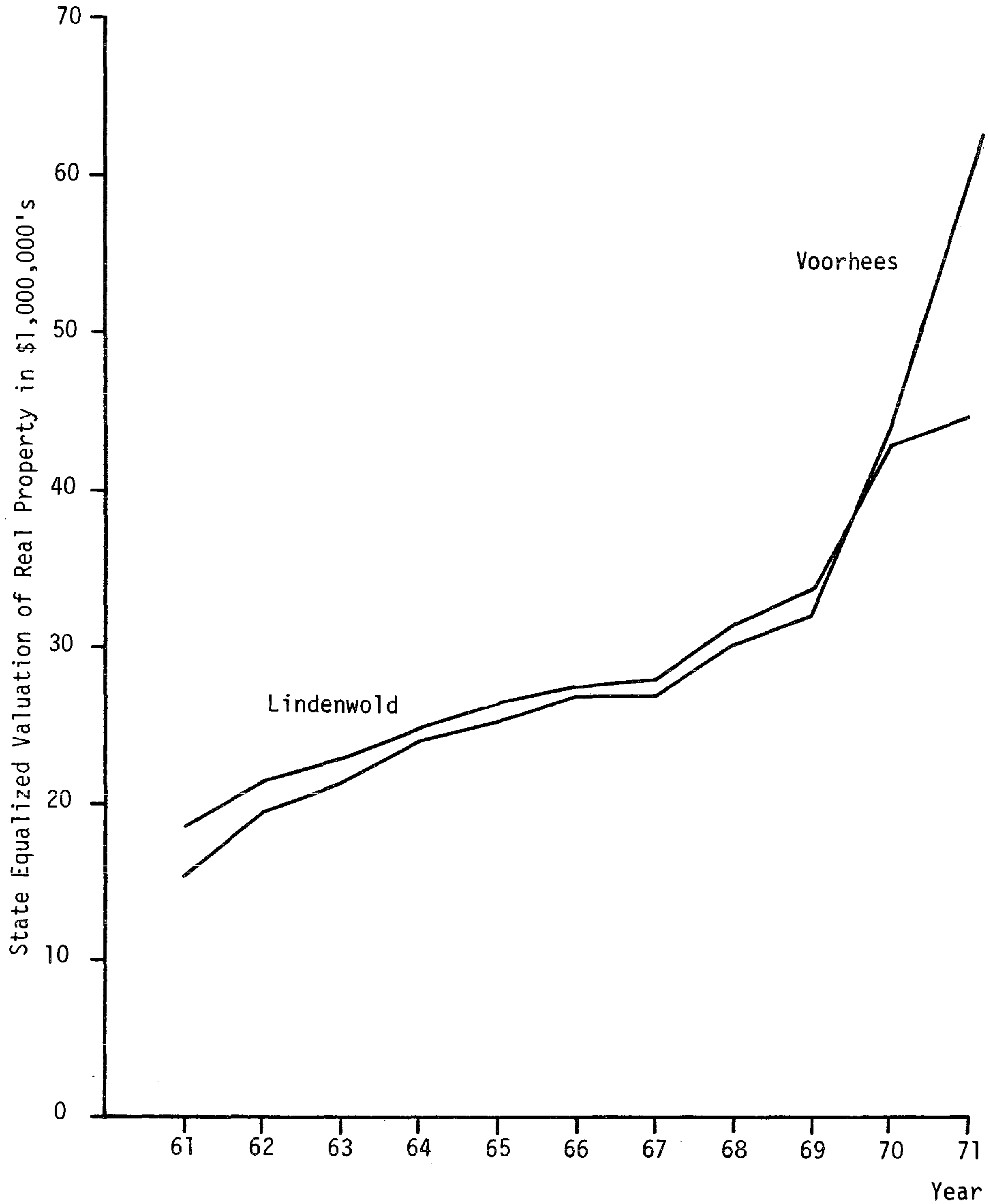


Figure 9-3

Share of Total Assessed Valuation by Land Use, 1965 to 1971

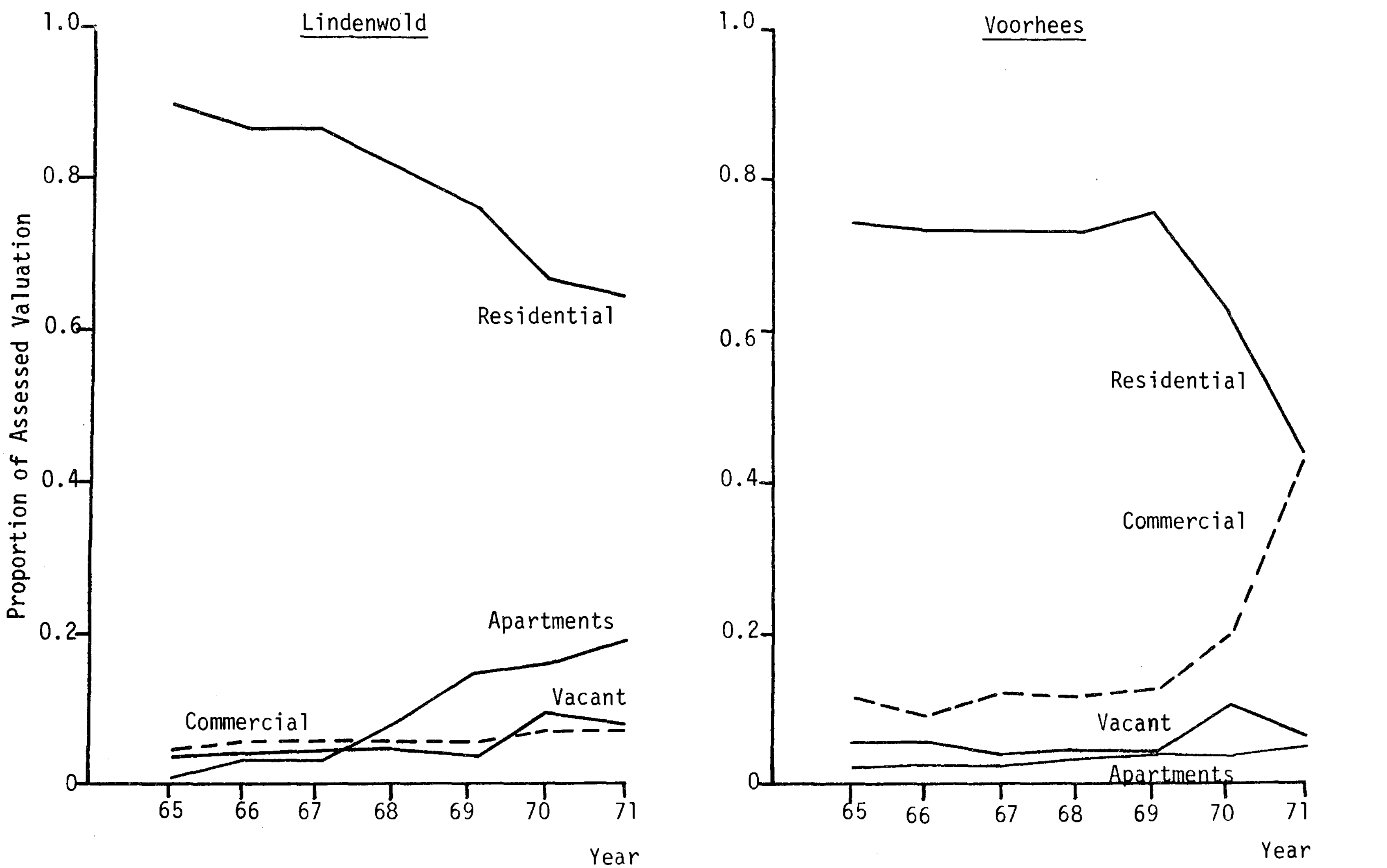
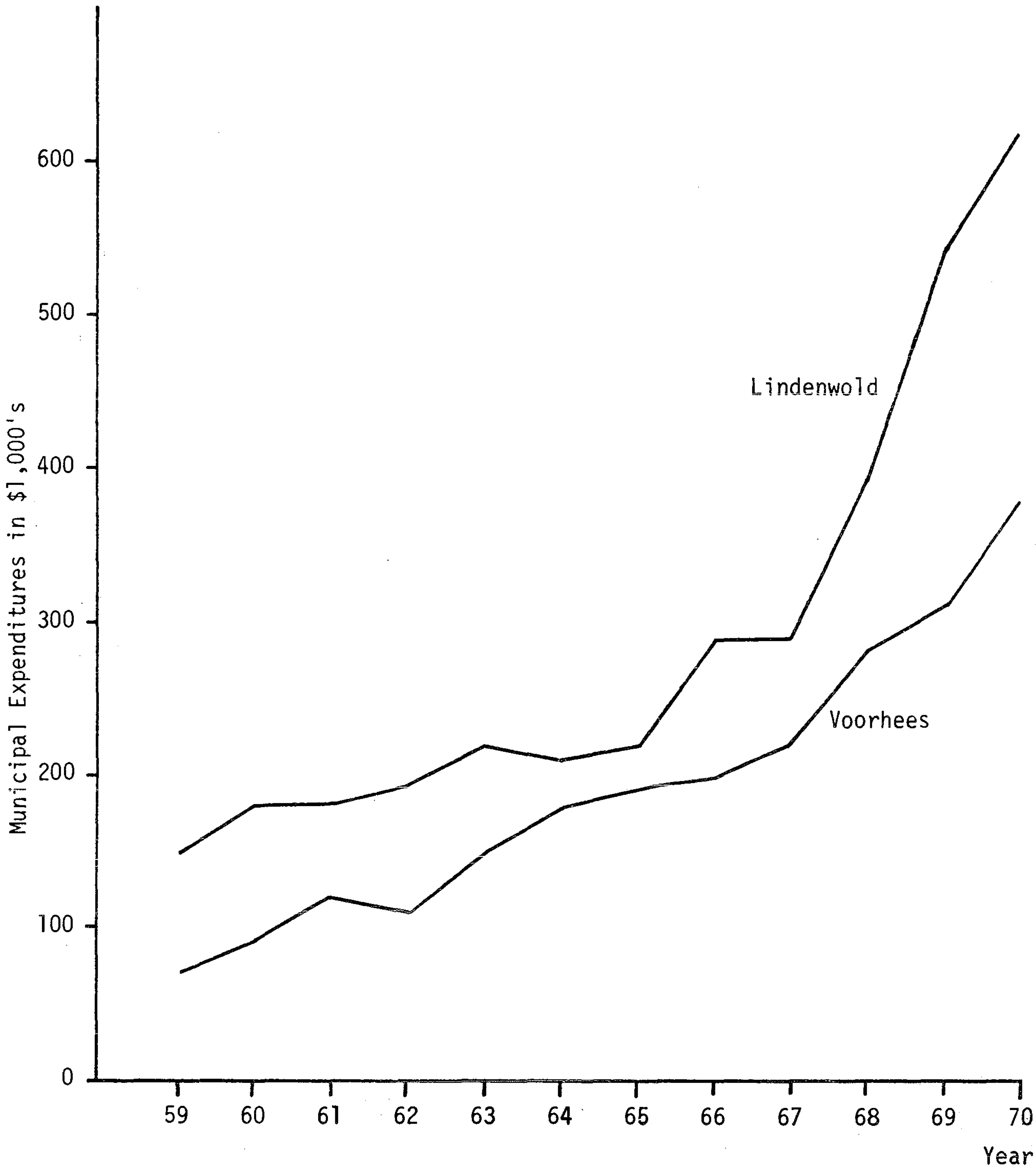


Figure 9-4

Total Expenditure for Municipal Functions and Debt Service, 1959 to 1970



palities with a noticeable take-off in Lindenwold in 1968. The largest increases in both were for police, general government, streets and roads, garbage and trash collection, and statutory expenditures. This can readily be seen in Figure 9-5 showing expenditure trends by category.

One method of comparing municipal budgets is to calculate the level of expenditures on a per capita basis. This comparison can best be made in 1960 and 1970, the years of the decennial Census of Population. In the following discussion, a change in per capita expenditures is simply the difference in per capita expenditures between 1960 and 1970. Total expenditures per capita for municipal functions and debt service increased by $26.28 in Lindenwold and $36.57 in Voorhees from 1960 to 1970. Fire protection is funded independently in Voorhees, so to compare Lindenwold and Voorhees total expenditure levels, fire expenditures must be deducted from Lindenwold's total, lowering its per capita increase to $25.16. Almost half of Voorhees per capita increase went to police expenditure, as did more than a third of Lindenwold's increase.

Table 9-1 shows per capita expenditures by category for 1960, 1970, and the change from 1960 to 1970. In 1960, Lindenwold spent more than Voorhees on a per capita basis for all functions except general government and garbage and trash collection. However, by 1970 Voorhees spent more per capita for all functions except streets and roads, health, and welfare, and more in absolute terms for recreation, education, and debt service. Voorhees had larger per capita increases for all categories except streets and roads.

Local School Districts

A similar strong upward trend from 1959 to 1971 is evident for current expenditures on local schools by both Lindenwold and Voorhees; see Figure 9-6. These data refer only to local district schools, kindergarten through eighth

Figure 9-5

Municipal Expenditure by Function, 1959 to 1970

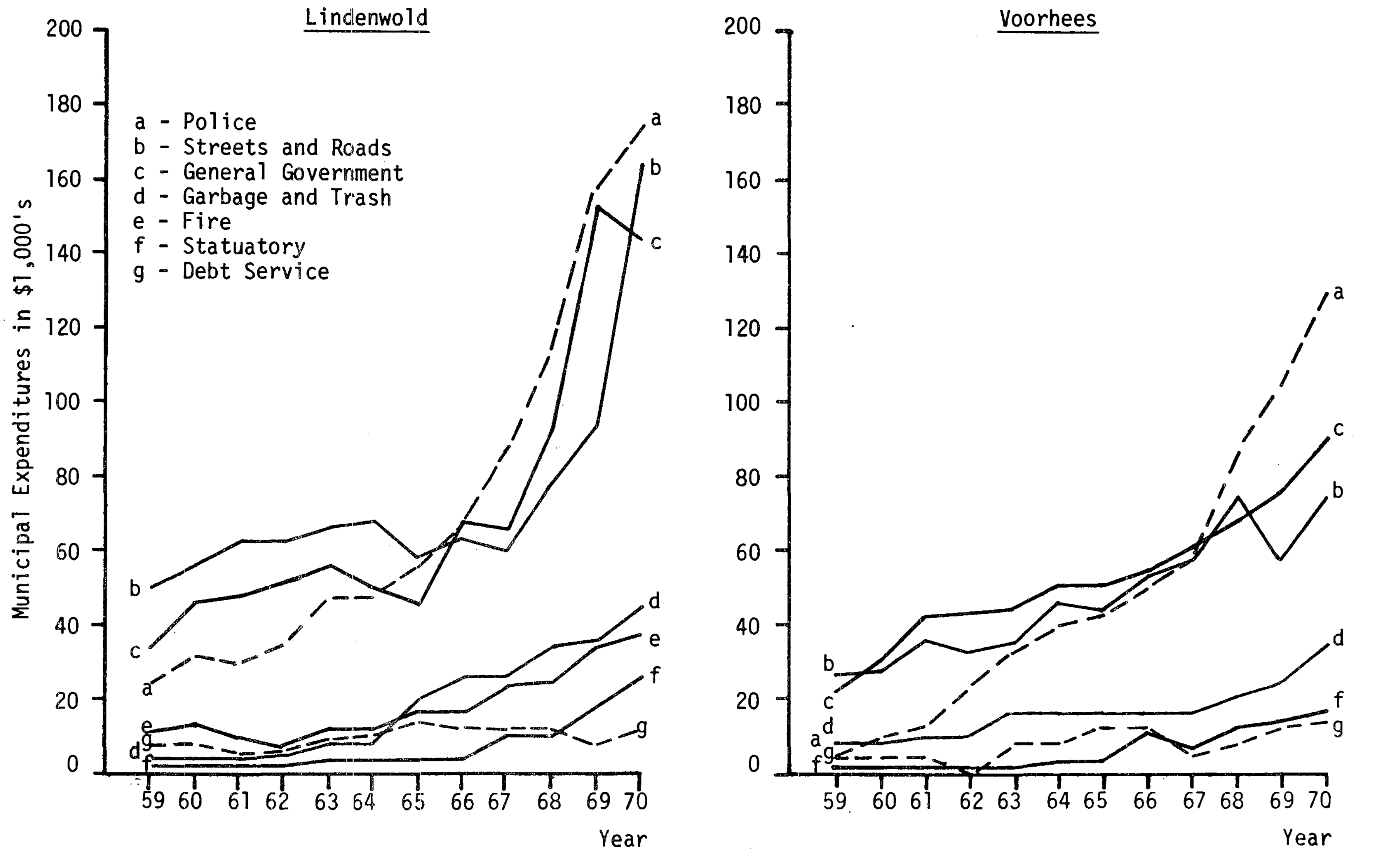


Table 9-1

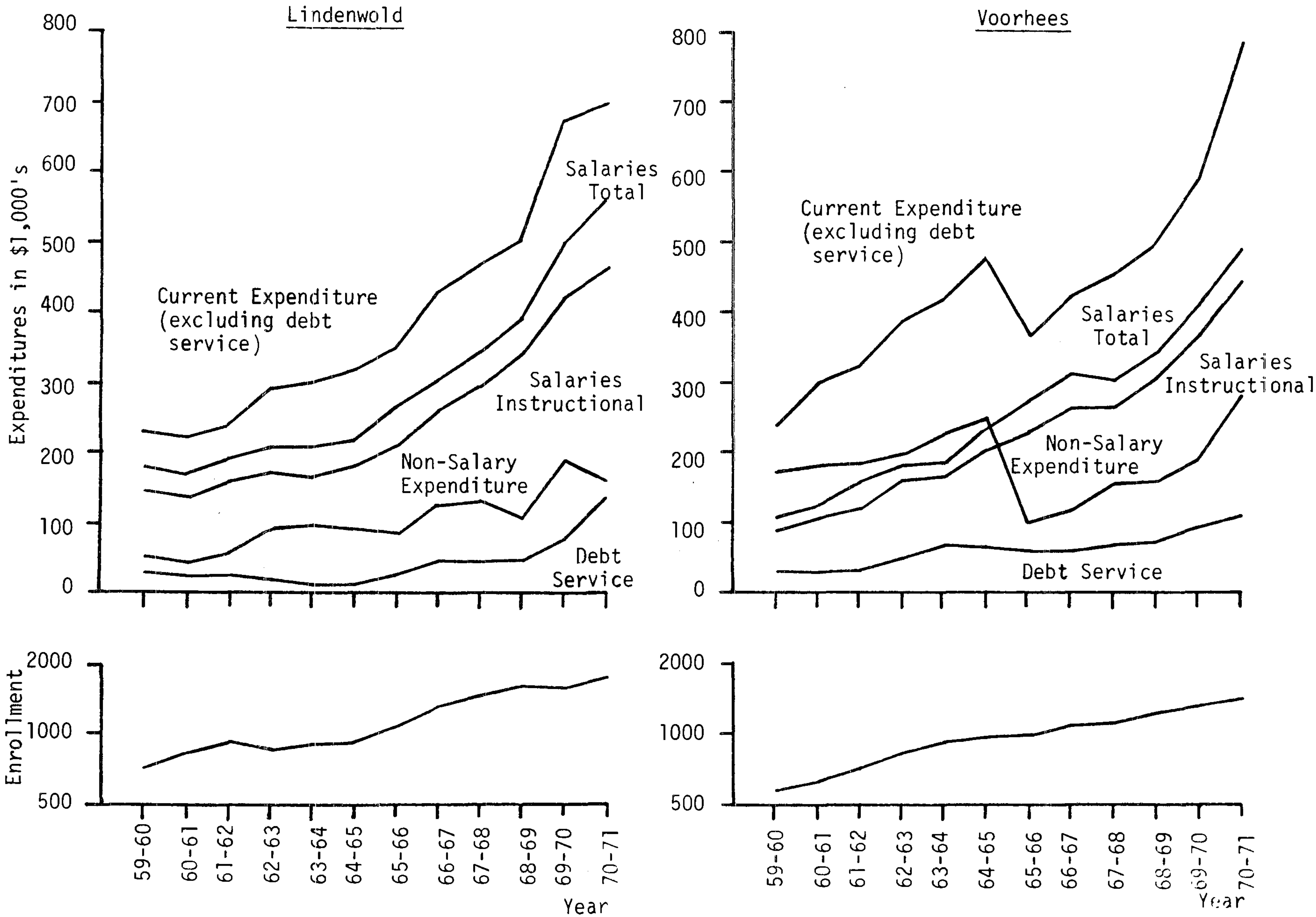
Per Capita Expenditures by Municipal Function, 1960 and 1970

	1960		1970		1960-70 Change	
	Lindenwold	Voorhees	Lindenwold	Voorhees	Lindenwold	Voorhees
General government	$ 6.22	$ 7.93*	$11.74	$14.41*	$ 5.52	$ 6.48*
Police	4.43*	2.73	14.22	20.86*	9.79	18.13*
Fire	2.00	-	3.12	-	1.12	-
Other public safety	0.80*	0.65	0.28	0.56*	-0.52	-0.09*
Streets and roads	7.52*	7.51	13.31*	11.77	5.79*	4.26
Sanitation	-	2.00	-	-	-	-2.00
Health	0.41*	0.05	0.61*	0.36	0.20	0.31*
Welfare	0.78*	0.35	0.38*	0.16	-0.40	-0.19*
Garbage and trash collection	0.63	1.84*	3.55	5.50*	2.92	3.66*
Recreation	0.48*	-	0.46	1.46*	-0.02	1.46*
Education excluding schools	0.04*	-	0.38	0.84*	0.34	0.84*
Statuatory	0.30*	0.25	2.11	2.70*	1.81	2.45*
Debt service	1.21*	1.11	0.90	2.37*	-0.31	1.26*
Total municipal functions	24.77*	24.42	51.05	60.99*	26.28	36.57*
Total less fire and sanitation	22.77*	22.44	47.93	60.98*	25.16	36.57*

* denotes larger expenditure per capita of the two municipalities

Figure 9-6

Expenditure and Enrollment for Local Schools, 1959-60 to 1970-71



grade. High school students residing in Lindenwold attend Eastern Camden County Regional High School; those in Voorhees attend Lower Camden County Regional High School.

Expenditures increased monotonically every year with one exception in each case. In Lindenwold, a slight decrease occurred from 1959-60 to 1960-61 because of a reduction in the number of teachers; in Voorhees, a sharp decrease occurred from 1964-65 to 1965-66 because of a decrease in tuition paid to other school districts. Figure 9-6 also shows clearly the dominant share of local school expenditures represented by salaries, particularly instructional salaries.

School enrollment grew steadily during this period from 771 in 1959-60 to 1356 in 1970-71 in Lindenwold, and from 675 to 1211 in Voorhees as also shown in Figure 9-6. However, the expenditure increase is far greater in percentage terms than the student increase: 197 percent increase in expenditures versus 76 percent increase in enrollment for Lindenwold, and 210 percent in expenditures versus 79 percent in enrollment for Voorhees. Thus, the increase in expenditures is not merely proportional to increased enrollment.

Table 9-2 shows 1959-60 and 1969-70 local school expenditures on a per capita per dwelling unit, and per student basis. Note that Voorhees spent considerably more than Lindenwold on a per capita and per dwelling unit basis in 1969-70 to attain almost identical per student levels. Also, Lindenwold had a far greater increase in per student expenditure with smaller increases in per capita and per dwelling unit expenditure. This result is caused by Voorhees' far higher ratio of students per capita (0.19 versus 0.11 in Lindenwold in 1970) and students per dwelling unit (0.70 versus Lindenwold's 0.34). The different zoning policies of these municipalities toward apartments are reflected by a 0.03 decrease in students per dwelling unit from 1960 to 1970

Table 9-2

Current Expenditures for Local Schools, 1959-60 and 1969-70

year	per capita	per dwelling unit	per student
1959-60			
Lindenwold	$ 32.12	$112.45	$305.54
Voorhees	63.60	226.19	410.69
1969-70			
Lindenwold	54.99	171.99	501.70
Voorhees	95.41	352.91	506.31
Increase			
Lindenwold	22.87	59.54	196.16
Voorhees	31.81	126.72	95.62

in Lindenwold, and a 0.15 increase in Voorhees during the same period.

Comparing school and municipal per capita expenditure increases, expenditures for school districts are about five dollars less than for total local municipal functions in both communities. As noted previously, however, high school district expenditures are not included in the totals.

Capital Expenditure Trends

Local Governments

Capital outlay by Lindenwold and Voorhees fluctuated considerably during the 1959-1970 period; see Table 9-3. In those twelve years, Lindenwold outspent Voorhees, $3,312,904 to $1,652,302. The principal difference in expenditures was for sanitary sewers; Voorhees spent $1,339,701 and Lindenwold spent $3,100,000. Lindenwold's sewer expenditures were actually financed through the Lindenwold Municipal Utility Authority, but are combined with municipal capital expenditures here for comparative purposes. Excluding sewer systems, Voorhees outspent Lindenwold, $312,601 to $212,904. The sewer systems of both communities are discussed in more detail in a subsequent section of this chapter.

The Division of Local Finance in the Department of Community Affairs of the State of New Jersey defines capital outlay as expenditure by ordinance (bonds) or budget appropriation for the construction, purchase, or improvement of fixed assets such as buildings, equipment, and vehicles. Before 1968 only such expenditure by ordinance was included in capital outlay, so in Table 9-3 the years 1959 to 1967 may be underestimated relative to the years 1968 to 1970.

Nevertheless, there is no trend of expenditure increases in recent years as was observed for current expenditure. Capital expenditure varies greatly

Table 9-3

Local Government Capital Expenditures, 1959-1970

Year	Total capital outlay	Buildings and equipment	Parks and playgrounds	Sanitary sewers	Streets and roads	Other	Year as percent of total
Lindenwold							
1959	310	310					
1960							
1961							
1962	9,645	9,645					0.3
1963	45,042	44,500			542		1.4
1964	3,101,767	75		3,100,000	1,692		93.6
1965	12,248	1,634			10,614		0.4
1966	52	52					
1967	43,492		5,509		37,983		1.3
1968							
1969	92,334	30,175	32,067		26,642	3,642	2.8
1970	8,014	8,014					0.2
1959-70	3,312,904	94,405	37,576	3,100,000	77,281	3,642	100.0
Percent	100.0	2.9	1.1	93.6	2.3	0.1	
Voorhees							
1959	23,811	23,811					1.4
1960	10,602	10,602					0.6
1961	137,312	13,754		111,838	11,720		8.3
1962	129,002			111,580	17,422		7.8
1963	65,786	19,663		4,754	41,369		4.0
1964	3,731			15	3,716		0.2
1965	23,143				23,143		1.4
1966	15,806				1,577	14,229	1.0
1967	45,421				38,555	6,866	2.7
1968	105				105		
1969	171,218	19,703		125,256	25,619	640	10.4
1970	1,026,365	26,673		986,258	13,434		62.2
1959-70	1,652,302	114,206		1,339,701	176,660	21,735	100.0
Percent	100.0	6.9		81.1	10.7	1.3	

from year to year. Although $92,334 or 2.8 percent of its total capital outlay was spent by Lindenwold in 1969, nothing was spent the year before and only $8,014 the year after. Voorhees spent over two-thirds of its total outlay in 1969 and 1970, but if sewer expenditure is excluded from those years and the total, the fraction falls to about one-quarter.

Neither community made any capital expenditure for water supply as both are served by the New Jersey Water Company which contracts directly with users. Water supply, sewers, roads, and other services are considered in more detail in subsequent sections of this chapter.

Local School Districts

Capital expenditure by the local school districts also fluctuated considerably; see Table 9-4. Lindenwold built a new school in 1964 and additions to two schools in 1969. Voorhees built additions in 1961 and 1966 and a new school in 1969. This construction and other more minor improvements to buildings account for almost 90 percent of total school capital expenditure in the communities.

Total school capital expenditure from 1959 to 1970 was similar for both with $1,327,434 in Lindenwold and $1,357,034 in Voorhees. The Department of Education, State of New Jersey, collects school district expenditure data. All capital expenditure is assigned either to capital outlay or improvements authorized, depending on how it was funded. Improvement authorizations are supported by bonds or notes, whereas capital outlay is supported directly by revenues from the current budget. Capital outlay, which amounted to 5.9 percent of Lindenwold's and 3.4 percent of Voorhees' capital expenditure usually consists of minor remodeling of buildings, small site improvements, and primarily new equipment. Improvement authorizations are usually major projects such as building programs or site acquisitions. The small expenditures in

Table 9-4

Local School District Capital Expenditures, 1959-1970

	Capital Outlay				Improvement Authorizations				Total capital expenditures	Year as percent of total
Year	Sites	Buildings	Equipment	Total	Sites	Buildings	Equipment	Total		
Lindenwold										
1959	1,031		388	1,419					1,419	0.1
1960	496	846	1,909	3,251					3,251	0.2
1961	3,883	1,827	563	6,273					6,273	0.5
1962			3,136	3,136					3,136	0.2
1963	423	625	911	1,956	15,000			15,000	16,959	1.3
1964			3,871	3,871		352,160		352,160	356,031	26.8
1965	100			100	2,717	4,815	16,570	24,102	24,202	1.8
1966	10,070			10,070	2,866	1,625	1,071	5,562	15,632	1.2
1967			18,066	18,066	650		1,925	2,575	20,641	1.6
1968			15,447	15,447	41,079			41,079	56,526	4.3
1969			4,995	4,995		793,739		793,739	798,734	60.2
1970		9,202		9,202		15,428		15,428	24,630	1.9
1959-70	16,003	12,500	49,286	77,789	62,312	1,167,767	19,566	1,249,645	1,327,434	100.0
Percent	1.2	0.9	3.7	5.9	4.7	88.0	1.5	94.1	100.0	
Voorhees										
1959			3,149	3,149	403	739	432	1,574	4,723	0.3
1960										
1961		814	1,612	2,426	2,414	322,386	20,943	345,743	348,169	25.7
1962					19,204	18,760	19,134	57,098	57,098	4.2
1963					235	3,007	5,606	8,848	8,848	0.7
1964	3,254		6,666	9,920					9,920	0.7
1965	1,347	2,519	2,933	6,799					6,799	0.5
1966			4,834	4,834		208,057		208,057	212,891	15.7
1967			3,929	3,929		15,698		15,698	19,627	1.4
1968		744	3,039	3,783	1,322	40,296	307	41,925	45,708	3.4
1969			3,959	3,959	10,881	581,745		592,626	596,585	44.0
1970	1,150		6,062	7,212		13,798	25,656	39,454	46,666	3.4
1959-70	5,751	4,077	36,183	46,011	34,459	1,204,486	72,078	1,311,023	1,357,034	100.0
Percent	0.4	0.3	2.7	3.4	2.5	88.8	5.3	96.6	100.0	

this category in Table 9-4 are the result of surplus funds from larger projects authorized in earlier years.

The number of classrooms in use jumped in the years immediately following the construction projects mentioned above. Lindenwold had 26 classrooms in use in 1963-64, 40 in 1964-65 and 70 in 1970-71. Voorhees used 21 classrooms in 1961-62, 35 in 1962-63, 37 in 1968-69 and 49 in 1970-71. Construction from 1959 to 1971 totaled approximately 40 classrooms in Lindenwold and 31 in Voorhees. The Lindenwold school district rents two old schools with four rooms each to the Borough for use as the Borough Hall and a recreation center. The Voorhees school district has given away two schools with a total of six rooms. These figures indicate that capital expenditure in both districts was undertaken primarily to increase the number of classrooms rather than to replace older facilities.

Capital Debt, Issued and Outstanding

Capital debt in Lindenwold and Voorhees has increased considerably in recent years. Table 9-5 shows the principal amount of all capital debt issued and unpaid in Lindenwold and Voorhees according to three categories: (a) school debt of the local school districts, which are corporations separate from the borough or township; (b) utility debt of the municipally operated utilities, which is liquidated with revenues from the operation of the utilities, not from local tax revenues; (c) other debt of the municipality itself. These distinctions are made because all debt is not treated similarly in determining the debt limit set by the state as discussed below.

School debt is by far the largest of the categories in both communities. Its most notable increases occurred in Lindenwold in 1968 and 1969 and in Voorhees in 1965 and 1969. These years do not correspond precisely to the years

Table 9-5

Capital Indebtedness, 1961-1970

	Capital Debt, Issued and Outstanding			Percent Indebtedness	
	School	Utility	Other	Gross	Net
Lindenwold					
1961	882,591		37,000	5.91	0.50
1962	875,446		32,000	6.38	0.51
1963	772,404		72,500	4.31	0.36
1964	635,251		67,500	4.47	0.28
1965	951,990		57,000	4.06	0.23
1966	889,647		47,000	3.67	0.18
1967	812,789		37,000	7.62	0.14
1968	1,539,817		27,000	9.50	1.96
1969	2,481,469		90,500	8.80	1.72
1970	2,591,841		85,500	7.45	1.04
Voorhees					
1961	315,000	*	150,000	8.51	7.26
1962	770,000	*	258,500	10.54	7.77
1963	750,687	*	297,800	11.80	3.92
1964	861,231	*	267,800	8.15	1.29
1965	1,459,880	*	212,000	7.11	0.67
1966	1,424,163	140,000	42,000	6.55	0.23
1967	1,358,503	120,000	82,220	7.12	0.71
1968	1,545,340	100,000	77,220	8.50	2.44
1969	2,358,930	390,000	81,937	16.37	6.82
1970	2,327,318	1,370,000	98,631	10.86	1.27

* included in "Other" in 1961-1965.

of largest capital outlay by the school districts. The debt figures only include bonds, thus excluding short term notes. Frequently, municipalities will take short term loans while waiting for better rates on the bond market. Therefore, a program may originally be funded with notes which are later liquidated by a bond issue under more favorable market conditions. The capital debt figures, then, reflect not only new capital projects financed with bonds, but also older projects refinanced with bonds. On the other hand, debt service expenditure reflects payments on both bonds and notes; see Figure 9-6.

Lindenwold itself has no utility debt, and Voorhees had none until 1966. This follows from the different organizational structures of their utility systems. Lindenwold's sewers are operated by the Lindenwold Municipal Utility Authority whereas Voorhees' are operated by the municipality itself. Apparently, bonds for the sewer system in Voorhees were placed on a self-liquidating basis in 1966. In effect, they would be paid off directly from utility revenues rather than from the township budget. The new sewer system is reflected by the large increases in debt in 1969 and 1970.

The category, other debt, shows considerable fluctuation. Lindenwold's reached its highest levels in 1969 and 1970, following a steady decrease from 1963 to 1968. Voorhees' figures are inflated by a sewer debt until 1965, but increased substantially in 1967.

The State of New Jersey limits municipal debt to three and one-half percent of the average equalized valuation of the three preceeding years. However, certain deductions from all capital debt, issued and authorized, (gross debt) are made to determine the debt which counts toward this limit (net debt). The deductions include all school debt within the statuatory limit for school debt which in school districts such as Lindenwold and Voorhees is three percent of the average assessment. All utility or self-liquidating debt is deducted if the utility is operating profitably and the debt is being liquidated without support from the local budget. If the utility is not self-sustaining, the operating deficit is capitalized at five percent and becomes a charge against the debt limit. Deductions from other debt are based on funds on hand, accounts receivable, and similar specific items allowable as deductions. Waivers of the net debt limit require the approval of the State's Local Government Board following public hearings.

Lindenwold has been well within the three and a half percent limit on net debt during the entire decade, 1961-1970. Voorhees exceeded the limit in 1961, 1962, 1963, and 1969 as also shown in Table 9-5. The figures for gross percent indebtedness are a means of comparing the growth of capital debt in bonds and average equalized assessment. Lindenwold's debt grew faster than assessment from 1966 to 1968, but not from 1968 to 1970. Lindenwold had a greater percent indebtedness from 1967 to 1970 than before this period of accelerated growth in valuation. Voorhees had its lowest percent indebtedness in the years 1965 to 1966, attaining its highest levels in 1962, 1963, 1969, and 1970.

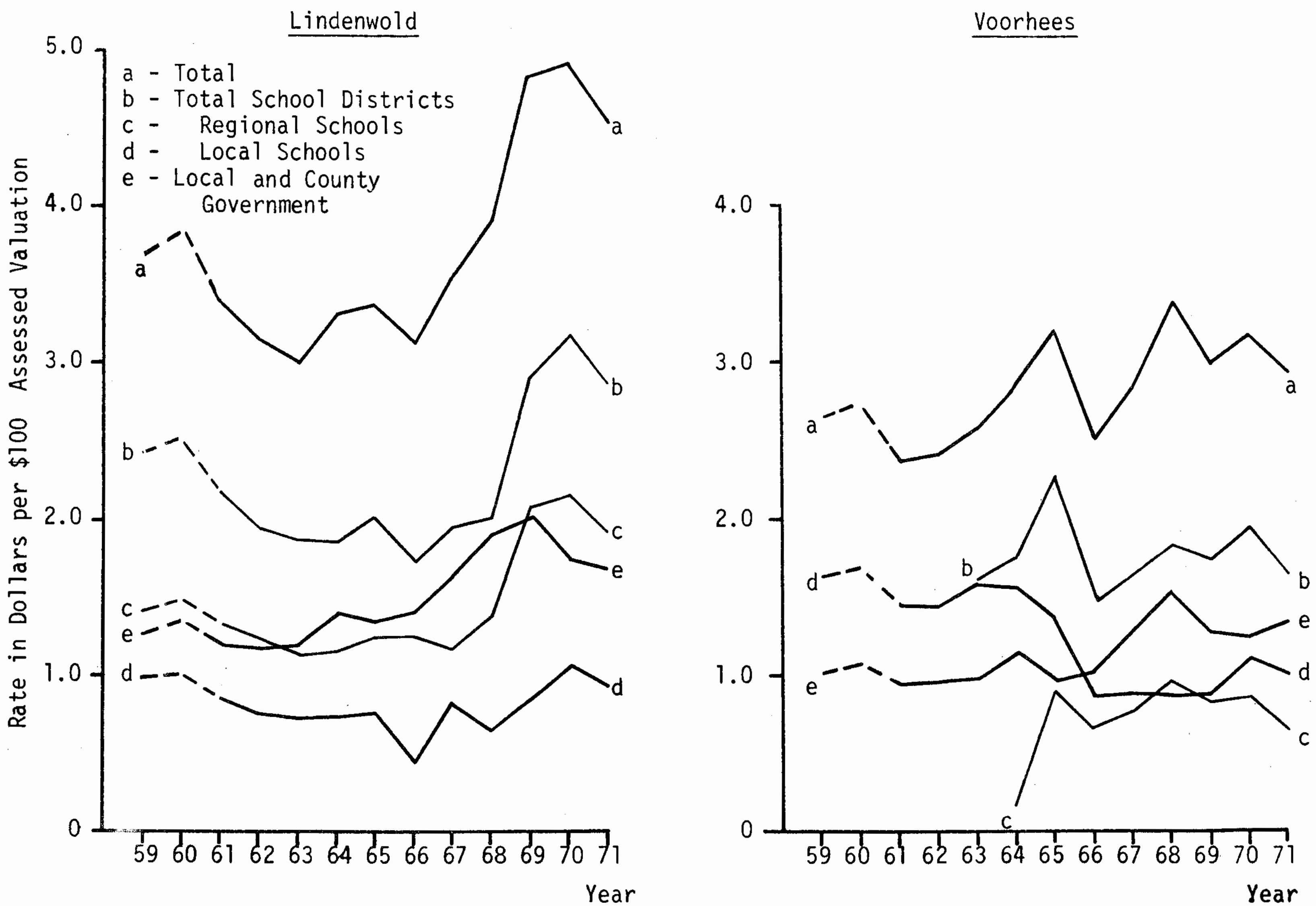
Taxation Trends

Figure 9-7 shows property tax rates from 1959 to 1971 for Lindenwold and Voorhees. Included are the total tax rate and its components, the school district rates and the combined county and local rates. It has proven very difficult to collect data enabling the separation of the county and local rate. The tax rates are equalized, and thus are the rates that would apply if property was assessed at true value; the points for 1959-60 are less reliable.

The total tax rate for schools and combined local and county functions for both municipalities fluctuate considerably from 1961 to 1971. The 1971

Figure 9-7

Equalized Tax Rates, 1959 to 1971



rates are higher than 1961 rates, but are not the highest rates during the period. From 1966 to 1971, a period of almost continuous growth in total assessed value and in expenditure, the rates in Lindenwold increased in all years except 1971, whereas in Voorhees they decreased in 1969 and 1971.

The trends for combined local and county government rates are also mixed, with the 1971 rates again higher than 1961, but not the highest ones. With one exception in each case, increases are monotonic until 1968 in Voorhees and 1969 in Lindenwold. Over the rapid real estate growth period 1966 to 1971 the trend is generally slightly increasing.

The total school tax trend varies for these two municipalities. Lindenwold's rate increased steadily from 1966 until 1971 with the largest part of the increase caused by the regional school. Voorhees has an irregular trend for both local and regional districts. Its local school rate is lower at the end of the decade than in the beginning.

Comparing the levels of tax rates, the Lindenwold resident has always paid less for local schools but more for combined local and county government, regional schools, and in total than has the Voorhees resident with a home of equal actual value. The difference between the communities' total tax rates has grown considerably from 1968 to the present.

Data available for 1969 and 1970 and shown in Table 9-6 which separates county and local taxes indicates that:

1. Lindenwold had roughly three times the Voorhees equalized local tax rate;
2. Lindenwold had a lower county tax rate in 1970;
3. the county tax rate was about one-half of the combined local and county rate in Lindenwold and about three-quarters of the combined rate in Voorhees.

Table 9-6

Equalized Local and County Tax Rates for Lindenwold and Voorhees, 1969 and 1970

	Lindenwold		Voorhees	
	1969	1970	1969	1970
Local municipal purposes taxes	8.10	5.40	2.10	1.60
Veteran and senior citizen taxes	1.50	1.20	1.00	0.80
Subtotal - combined local taxes	9.60	6.60	3.10	2.40
County taxes	9.40	7.80	9.40	8.80
County library taxes	0.20	0.20	0.20	0.20
Total	19.20	14.60	12.70	11.40

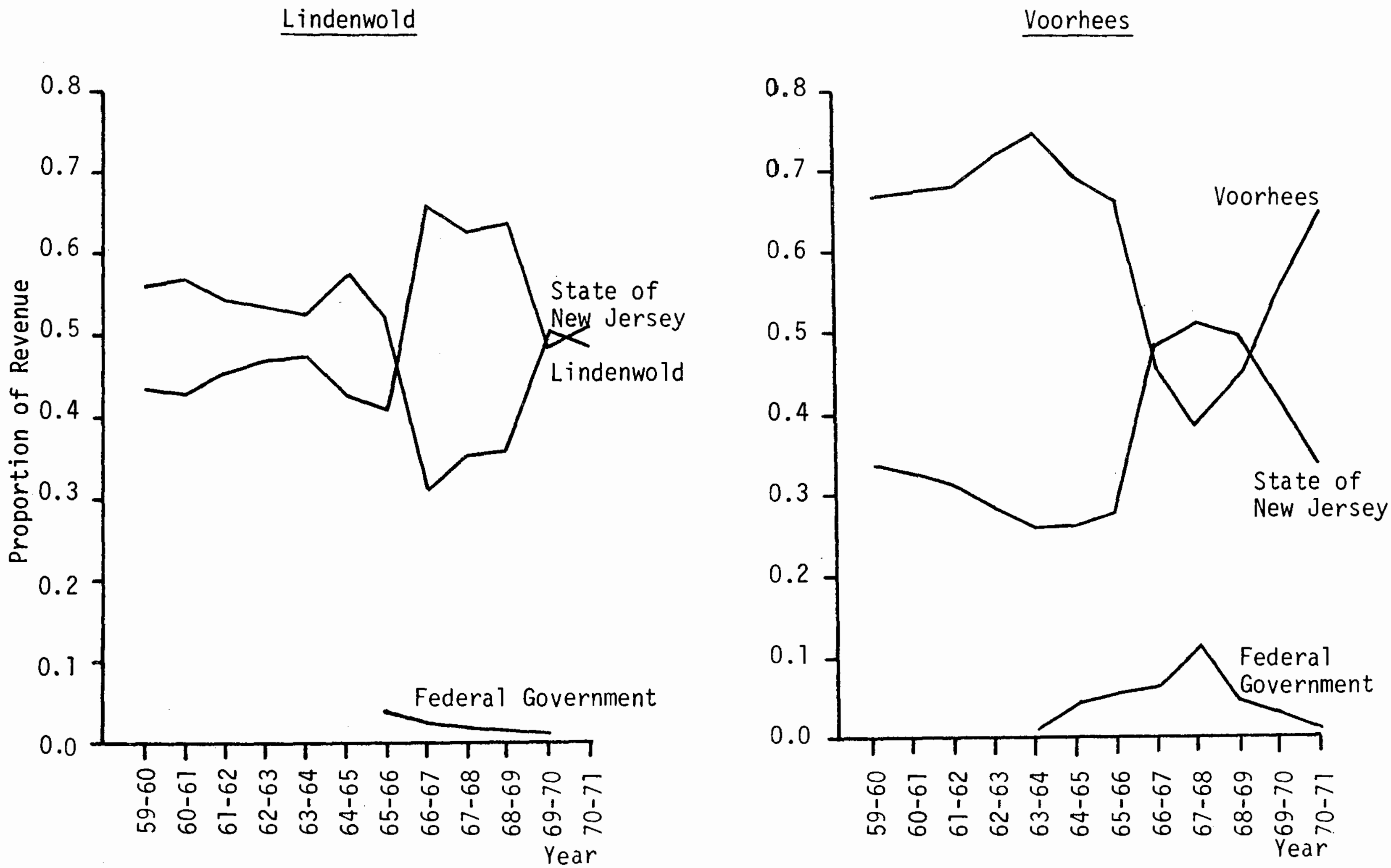
The comparison over time and jurisdiction of taxation rates does convey an impression of how tax burdens have changed over time, and of how the burdens differ among places. It does not answer the question: has new real estate development caused an increase or decrease in local property tax rates? Changes in expenditure result from increases in wages and prices, provision of new kinds of services, and improved quality of existing services, as well as the extension of services to new development and people. Similarly the observed tax rate trend represents the resolution of a number of forces other than the relative growth of tax base and its resultant expenditure. The trend is affected by changes in other sources of revenue, in wages and prices, and in kinds and levels of service. For example, if the state increases its contribution to educational expenditure, the burden on the property tax diminishes and the rate necessary to balance school budgets may be lower. In this case, the contribution of the State to municipal expenditures has been less than three percent of the total revenue during the entire 1959-1971 period, and there has been no direct Federal contribution. However, both the State and Federal governments make significant contributions to education. Figure 9-8 shows considerable fluctuation among the sources of revenue for local school education from 1959-60 to 1970-71 in the case study communities. Note that the sharp decreases in the share of local sources of revenue in 1966 are mirrored by sharp declines from 1965 to 1966 in local school district tax rates in both Lindenwold and Voorhees; see Figure 9-7.

Property Tax Rates Holding Constant the Distribution of Revenue Sources

Given actual expenditure levels, the effects on property tax rates of changes in (a) the distribution of revenues from local, State and Federal governments and in (b) the degree of local government's reliance on the

Figure 9-8

Shares of Local School District Revenue by Source, 1959-60 to 1970-71



property tax can be eliminated. The ratio of expenditures to equalized property valuation for a given year is the "necessary property tax rate" which would have to be levied in order to balance the local budget in the absence of alternative sources of revenue. If this ratio increases over time, property tax rates would have to increase to cover expenditures unless there were an increase in non-property revenue. The level of the ratio enables one to determine if increases in the property tax base from one year to any other are sufficient to cover increases in expenditures without an increase in property tax rates or other sources of revenue.

Table 9-7 shows the ratios of the sum of current expenditures and debt service to equalized valuation for municipal functions and local schools. This ratio, which is the property tax rate per $1000 actual value, differs from the actual tax rates in that capital expenditures are not included and non-property tax revenues are ignored.

Municipal and school expenditures in Lindenwold and Voorhees increased faster than the property tax base during the 1961-70 decade and the 1966-70 growth period with the exception of Voorhees' school expenditure. However, these results are sensitive to the considerable fluctuation of the necessary tax rate and its particularly high levels in the base year 1961.

The necessary tax rates for specific municipal functions are shown in Table 9-8. All categories do not conform to the trend in total municipal functions and do not follow the same trend in both Lindenwold and Voorhees.

Police expenditure increased faster than property valuation in every year but one in both Lindenwold and Voorhees. Statuatory expenditure, primarily pensions, increased faster in all but one year in Voorhees and two in Lindenwold. The relationship for all other categories was more irregular.

In Lindenwold expenditures grew faster than real estate property from 1961

Table 9-7

Equalized Tax Rate Per $1,000 Assessed Valuation Necessary for Current Expenditures and Debt Service

	Lindenwold			Voorhees		
Year	Municipal	Local Schools	Total	Municipal	Local Schools	Total
1961	$ 9.79	$13.81	$23.60	$7.77	$21.41	$29.18
1962	8.88	12.75	21.63	5.78	18.30	24.08
1963	9.64	13.86	23.50	6.96	20.43	27.39
1964	8.60	12.85	21.45	7.63	20.42	28.05
1965	8.42	12.62	21.04	7.48	21.69	29.17
1966	10.97	14.18	25.15	7.49	16.30	23.79
1967	10.73	17.36	28.09	7.97	18.13	26.10
1968	12.49	16.61	29.10	9.31	17.37	26.68
1969	15.98	16.27	32.25	9.47	17.59	27.06
1970	14.36	17.27	31.63	8.73	15.82	24.55
1971		18.57			14.16	

$$\text{necessary tax rate} = \frac{\text{expenditures in year t}}{\text{total assessment in year t}}$$

Table 9-8

Equalized Tax Rates per $1000 Valuation Necessary for Current Expenditures

Year	General government	Police	Fire	Other public safety	Streets and roads	Trash collection	Health	Welfare	Recreation	Education	Statutory	Debt Service
Lindenwold												
1961	2.61	1.65	0.54	0.23	3.43	0.23	0.12	0.29	0.14	0.05	0.12	0.30
1962	2.44	1.68	0.39	0.13	2.93	0.25	0.11	0.31	0.05	0.04	0.11	0.30
1963	2.44	2.11	0.48	0.27	2.88	0.30	0.12	0.30	0.07	0.11	0.14	0.34
1964	2.05	1.90	0.49	0.14	2.72	0.32	0.08	0.22	0.12	0.05	0.13	0.29
1965	1.76	2.09	0.60	0.12	2.22	0.75	0.12	0.21	0.12	0.11	0.12	0.49
1966	2.56	2.57	0.62	0.46	2.40	1.00	0.23	0.14	0.14	0.21	0.15	0.44
1967	2.42	3.12	0.90	0.14	2.24	0.91	0.33	0.08	0.04	0.11	0.33	0.41
1968	2.93	3.66	0.76	0.12	2.49	1.07	0.14	0.14	0.11	0.23	0.34	0.35
1969	4.51	4.81	1.06	0.20	2.78	1.07	0.18	0.13	0.21	0.21	0.55	0.23
1970	3.30	4.00	0.87	0.07	3.74	0.99	0.17	0.10	0.12	0.10	0.59	0.25
1970/1961	1.26	2.42	1.61	0.30	1.09	4.30	1.42	0.34	0.86	2.00	4.92	0.83
1970/1966	1.29	1.56	1.40	0.15	1.56	0.99	0.74	0.71	0.86	0.48	3.93	0.57
Voorhees												
1961	2.59	0.96	-	0.11	2.33	0.62	0.01	0.02	0.00	0.00	0.08	0.26
1962	1.68	0.16	-	0.14	1.65	0.47	0.01	0.02	0.00	0.00	0.09	0.02
1963	2.05	1.37	-	0.10	1.61	0.72	0.01	0.02	0.00	0.10	0.12	0.35
1964	2.08	1.65	-	0.10	1.90	0.68	0.02	0.03	0.08	0.05	0.13	0.34
1965	1.95	1.70	-	0.08	1.71	0.60	0.03	0.03	0.11	0.07	0.14	0.50
1966	1.95	1.90	-	0.10	1.92	0.58	0.03	0.03	0.05	0.08	0.39	0.41
1967	2.19	2.16	-	0.16	1.78	0.62	0.05	0.03	0.12	0.10	0.31	0.23
1968	2.28	2.83	-	0.14	2.44	0.65	0.04	0.03	0.13	0.10	0.36	0.26
1969	2.34	3.24	-	0.09	1.79	0.75	0.04	0.03	0.17	0.13	0.45	0.38
1970	2.06	2.98	-	0.07	1.68	0.78	0.05	0.02	0.20	0.12	0.48	0.33
1970/1961	0.77	3.10	-	0.64	0.72	1.26	5.00	1.00	-	-	6.00	1.27
1970/1966	1.06	1.57	-	0.70	0.88	1.34	1.67	0.67	4.00	1.50	1.23	0.80

to 1970, for general government, police, fire, streets and roads, garbage and trash collection, health, education excluding schools, and statuatory requirements. Those expenditures growing slower in Lindenwold were for public safety other than police and fire, welfare, recreation, and debt service. In Voorhees, expenditure for police, garbage and trash collection, health, statuatory, and debt service grew faster than real estate property from 1961 to 1970.

Increases in the necessary tax rate should not be taken to indicate that real estate development caused more expenditures than it generated in property tax revenue. The increases in expenditures have been caused by (a) increases in wage and prices for services to the entire community and (b) changes in the type and quality of services provided to the entire community, as well as (c) the extension of services to new real estate development. Table 9-9 shows the general upward direction of wages and salaries for local government officials and employees during the 1960 decade.

Analysis of Educational Expenditure

Methods

There are two stages to the analysis of educational expenditure. In the initial stage, the increase in expenditure caused by changes in the quality of service is identified and subtracted from actual expenditure. The remainder is the level of expenditure necessary to maintain a constant quality of service. This expenditure figure is used to calculate the necessary tax rate for a constant service level. Changes in this necessary rate determine if property valuation grew as fast as that part of school expenditure which represented a constant level of service. If this rate increases, the growth of the property tax base caused by new construction and increasing property values has not kept pace with the increase in expenditure caused by the extension of existing levels of service to new population and property, and by increases in wages

Table 9-9

Annual Wages and Salaries for Selected Municipal Employees

Position	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Lindenwold												
Tax Collector	-	-	-	-	5,350	5,550	4,000	4,000	4,400	4,600	5,300	5,900
Borough Clerk	-	-	-	-	3,400	3,640	3,800	4,100	4,680	5,200	6,200	6,700
Tax Assessor	-	-	-	-	2,400	2,000	2,000	2,00	3,000	4,000	5,000	7,000
Treasurer	-	-	-	-	-	-	1,500	1,500	2,000	3,000	4,000	5,000
Building Inspector	-	-	-	-	500	500	500	500	900	1,200	1,600	1,800
Mayor	-	-	-	-	0	0	0	0	0	1,000	1,000	1,000
Councilman	-	-	-	-	0	0	0	0	0	750	750	750
Police Chief	-	-	-	-	6,500	6,500	6,500	7,500	8,000	11,000	11,000	11,500
Patrolman - first year	-	-	-	-	5,000	5,000	5,000	5,500	6,000	6,250	7,000	7,500
Laborer (per hour)	-	-	-	-	2.00	2.10	2.25	2.25	2.40	2.55	2.75	3.10
Voorhees												
Tax Collector	1,900	3,000	3,000	3,000	3,500	3,500	3,750	4,000	4,200	4,700	5,100	6,000
Township Clerk	1,000	3,000	3,000	3,000	3,500	3,500	3,750	4,000	4,200	4,700	5,400	5,700
Tax Assessor	900	900	1,050	1,500	1,500	1,500	1,760	1,750	1,800	2,500	3,000	4,000
Treasurer	900	950	1,000	1,000	1,200	1,300	1,400	1,600	1,800	1,800	2,000	2,000
Building Inspector		1,500	1,500	1,000	1,000	1,000	1,100	1,100	1,150	1,450	1,550	1,750
Committeeman	350	350	350	350	500	500	500	500	500	500	600	1,000
Police Chief	600	4,900	5,200	5,700	6,150	6,850	7,350	7,800	9,850	10,050	10,850	11,400
Patrolman (part-time)	360	480	600	600	600	720	840	1,664	1,784	1,904	2,000	2,150
Patrolman - first year (full-time)									6,150	6,755	7,000	7,500
Laborer (per hour)	1.25	1.25	1.25	1.50	1.55	1.60	1.70	1.70	1.95	2.05	2.17	2.50

and prices. Increases in the necessary tax rate also indicate the need to increase actual tax rates if there are no other sources of revenue or, more interestingly, if other revenues remain unchanged. In the latter case, if property tax revenues are, for example 80 percent of total revenue, the change in the actual tax rate would be 80 percent of the change in the necessary tax rate.

The most important change in expenditure resulting from increased quality of education is the cost of lowering the student-teacher ratio. The method used to identify this cost is quite straightforward. Let b represent the year for which the base value of the standard is determined, and t the comparison year:

1. Calculate the student-teacher ratio for year b;

2. Divide the number of students in year t by the ratio for year b, yielding the number of teachers needed in year t to maintain the student-teacher ratio of year b;

3. Deduct this "constant quality level" requirement from the actual number of teachers in year t, yielding the quality increase or decrease in the teaching staff size;

4. Multiply this quality change by the average teaching salary in year t, yielding the cost or saving from the change in student-teacher ratio.

Other quality changes, particularly those unrelated to manpower, are more difficult to determine as there is no appropriate index analogous to the student-teacher ratio. For supplies, operations, and maintenance there are only expenditure data. Using textbooks expenditures as an illustration, to calculate the textbooks per student the price per book is necessary; to calculate the textbook expenditure per student in constant dollars, a price index is necessary. However, even if a price index is used, an increase identified as a quality increase might simply be caused by actual prices increasing by more than the price index. In view of the dubious correspondence between price indices readily available and prices paid by Lindenwold and Voorhees, and the high proportion of increased expenditure explained by teachers' salaries, it was decided to identify only the quality changes represented by the student-teacher ratio.

The second stage of analysis of educational expenditure is the cost-revenue study at one point in time of single family homes and apartments. This is done for each of these residential categories _in toto_ and for each apartment complex. The cost assigned to a residential category or complex is the per student expenditure multiplied by the number of enrolled students housed therein. The actual tax is used to determine if a category or complex generates sufficient property tax revenue to cover these costs and the necessary tax rate is used to determine if it would generate sufficient revenue or be subsidized with the property tax as the sole source of revenue.

A study of educational cost-revenue impact would not be complete without considering changes in nonlocal sources of revenue; the significant and fluctuating role of state revenue sharing for education was shown in Figure 9-8. The formulae used by the State of New Jersey have changed a number of times from 1960 to 1972, most noteably in 1966 when a subsidy of $25.00 per student was added, producing a sharp rise in the state's contribution and a drop in the local taxes, and in 1972 when students were weighted by the grade levels. The recent formulae for state aid are detailed below. State aid received by residential category or complex is added to actual property tax revenue for the cost-revenue comparison. These formulae and the tax rates are also used to calculate the break-even assessment per student for a single family home or apartment unit.

<u>Analysis of Educational Expenditure: Lindenwold</u>

Three main observations have been made about the expenditures and revenues of local school districts in Lindenwold from 1960-61 to 1970-71, the most recent school year for which data are currently available:

1. expenditure has increased steadily at a greater rate than enrollment (see Figure 9-6);
2. the property tax base generally increased at a slower rate than expenditure levels (see Table 9-7);
3. the share of expenditures supported by revenue from the State has fluctuated considerably (see Figure 9-8).

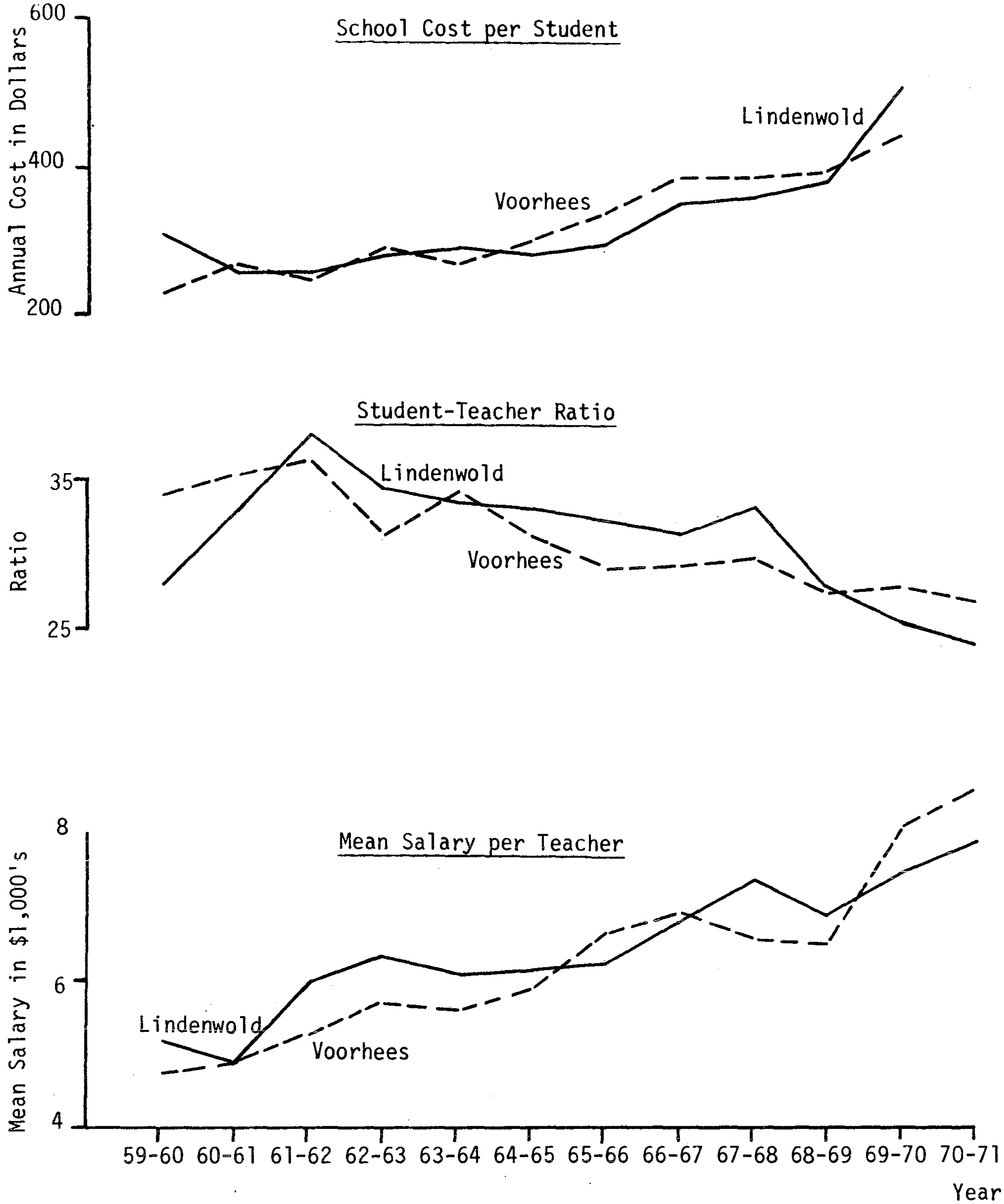
In this section the cost of quality changes in the school system is identified, and expenditure net of quality change is compared to the property tax base. These analyses answer two questions: (a) could local school taxes have decreased if Lindenwold had chosen not to improve its school system? and (b) could new development, which brought more students and more revenues, have lowered tax rates and increased school quality? Finally, this impact of growth <u>in toto</u> is separated into single family homes and specific apartment complexes to determine the effect on the local budget of these different kinds of housing.

During the 1960 decade, and particularly from 1967 on, the quality of Lindenwold's schools, as measured by the student-teacher ratio, increased considerably. Figure 9-9 shows an almost monotonic decrease in the student-teacher ratio beginning in 1961-62, following two years of sharp increases. Nevertheless, it was not until 1969-70 that the ratio fell below the low 1959-60 level. Increases in total teaching salaries account for 65 percent of the increase in current expenditure from 1960-61 to 1970-71. This expenditure increase resulted from (a) larger enrollments, (b) higher salaries per teacher, and (c) lower students-teachers ratios; see Figures 9-6 and 9-9.

Changes in expenditure resulting from the lower student-teacher ratios, i.e. quality improvements, are identified using the method outlined above. The years 1960-61 and 1965-66 are selected as base years because they represent the beginning of the 1960 decade and the beginning of accelerated apartment

Figure 9-9

Indices of School Cost and Quality, 1959-60 to 1970-71



growth, respectively. With 1960-61 as year b and 1969-70 as year t, the calculations are as follows:

1. Student-teacher ratio in 1960-61: 32.6
2. Number of teachers necessary to maintain 32.6 ratio in 1969-70: 41.0
3. Actual number of teachers in 1969-70: 52.0
4. Number of teachers representing quality increase: 11.0
5. Cost of quality increase: $82,016

If $82,016 is subtracted from total current expenditure plus debt service for the year 1969-70, the necessary equalized tax rate for local schools for that year drops from $17.27 to $15.38. As the 1960-61 necessary rate was $13.81, the necessary tax rate for local schools would have increased by less than half of its increase over the decade if the Lindenwold School District has maintained its 1960-61 student-teacher ratio. Similarly, if there were no changes in the student-teacher ratio and in the local property tax revenue-total revenue ratio, the actual tax rate would have increased by less than half its actual increase.

These calculations are now repeated using 1965-66 as the base year. Table 9-10 shows that when expenditure net of quality change is used to calculate the necessary tax rate, the gross rate's increase of $4.39 from 1965-66 to 1970-71 is reduced by 56 percent to an increase of $1.91. Increases in the net necessary tax rate occur from 1965-66 to 1966-67, from 1968-69 to 1969-70, and from 1969-70 to 1970-71 as was the case using expenditure per se, but they are more moderate.

Data for current school expenditure is now examined to determine if apartments and single family homes would generate revenue equal to their share of current expenditures with the property tax as the sole source of revenue. There were 127 students enrolled from apartments in September, 1971, and 166

Table 9-10

Analysis of Decrease in Student-Teacher Ratio for Lindenwold, 1965-66 to 1970-71

		Number of Teachers							
	Student Teacher Ratio	Constant Quality	Actual	Quality Increase	Mean Salary	Cost of Quality Increase	Expenditure, Net of Quality Increase	Net Necessary Tax Rate*	Gross Necessary Tax Rate*
1965-66	32.2	34.0	34		6,187		380,224	14.18	14.18
1966-67	31.2	36.8	38	1.2	6,806	8,031	465,872	17.07	17.36
1967-68	33.0	39.0	38	-1.0	7,386	-7,091	524,759	16.84	16.61
1968-69	28.0	40.8	47	6.2	6,824	42,377	503,217	15.01	16.27
1969-70	25.7	41.5	52	10.5	7,456	78,213	670,633	15,47	17.27
1970-71	24.2	42.1	56	13.9	7,958	110,616	717,584	16.09	18.57

* Expenditure in year (t)-(t+1)/Valuation in year (t+1) = Necessary tax rate in year (t+1).

in February, 1972; data for earlier years are not readily available. Since there was considerable apartment growth in 1970 and 1971, 127 is used as an estimate of the upper limit of the number of school children living in apartments in the school year 1970-71. In that year the mean per student cost including debt service, but excluding capital expenditure, was $610.77; therefore, the share of costs for 127 students was $77,567. At the 1971 necessary rate of $18.57 per $1,000, apartments would have generated $156,514, or a surplus of $78,946.

Single family residences must have been the homes of a minimum of 1229 students in 1970-71; the total number of students enrolled in the Lindenwold school system was 1356, less the maximum from apartments, 127. Therefore, their share of costs was $750,636. Single family homes would have generated $538,534 with the 1971 necessary tax rate for a deficit of $212,102. Thus, single family homes would have had to be subsidized by other land uses, including apartments, if the property tax were the sole source of revenue, or if school children from single family homes were not the source of other school district revenues.

In order to determine the actual costs and revenues of apartments and single family homes, the actual equalized tax rate for the 1970-71 school year, $9.50 per $1000, must be used. Also, certain expenditures should be deducted from total expenditure. Improvements authorizations are deducted because they are funded with notes and bonds, not current revenue. Three-quarters of transportation expenditure is deducted because it is reimbursed by the state. Expenditures for programs funded entirely by the federal government are deducted as well. Expenditure net of these deductions was $586.08 per student for the 1970-71 school year. Using this average cost and the actual tax rate, apartments generated costs of $74,433 and revenues of $80,069 for a surplus of

$5,636; single family homes generated costs of $720,295 and revenues of $275,513 for a deficit of $444,782. The deficit was in fact subsidized by property taxes on other land uses and other revenue sources.

Table 9-11 shows the 1971 school taxes actually paid and students actually enrolled in September 1971 for each apartment complex in Lindenwold. These taxes total $96,370 which is a surplus of $21,937, and $16,301 larger than the surplus calculated above. The discrepancy stems from the methods used. The first method used the equalized tax rate, revenue which was in effect from July 1, 1970, to June 31, 1971, and the equalized assessment on October, 1970. The second calculation used actual revenue for the period January 1, 1971, to December 31, 1971, which was based on equalized tax rates of $9.50 from January 1 to June 31 and approximately $11.30 from July 1 to December 31. Moreover, as some apartments were still under construction in 1971, their assessments for the February, May, August, and November, 1971, tax bills were higher than their assessments in October 1970. In addition, taxes on vacant sections of apartment complexes were included as revenue from apartments in the second calculation, but not in the first. Both methods clearly show that apartments _in toto_ generated more revenue than costs, particularly since the number of school children from apartments is definitely overestimated.

However, this is not so for each individual complex. Five of the thirteen did not generate sufficient property taxes to cover the total average costs of the students living there, even when the higher estimate of revenues is used; see Table 9-11. However, if only that share of costs which is supported by local current revenues (41.1%) is compared to property tax revenues, only two complexes do not generate revenue equal to costs. Green Terrace Garden Apartments, the oldest apartment building in Lindenwold, has a very high proportion of two-bedroom apartments, and therefore a large proportion of

Table 9-11

School Children and Revenue From Each Apartment Complex: Lindenwold, 1970-71

	Opening Year	Number of Units	Students Per Unit	Number of Children Sept., 1971	Share of Total School Expenditure	School District Taxes, 1971	Taxes less Share of Expenditure	Share of Locally Funded School Expenditure	Taxes less Share of Local Expenditure
White Horse Court	1963	60	0.02	1	586	3,046	2,460	243	2,803
Lindenwold Arms	1964	18	-	-	-	1,102	1,102	-	1,102
Lindenwold Manor	1964	26	0.15	4	2,374	1,343	-1,031	971	372
Green Terrace	1962	24	0.54	13	7,618	1,210	-6,408	3,155	-1,945
Parc One	1967	80	0.14	11	6,446	4,454	-1,992	2,670	1,784
Lynnebrook	1964	51	0.10	5	2,930	5,269	2,339	1,218	4,051
Fairway Pharmacy		2	0.50	1	586	1,167	581	243	924
Kingsrow	1971	*	-	18	10,548	9,511	-1,037	4,387	5,124
Finistierre	1971	*	-	2	1,172	3,831	2,659	487	3,344
Chadwick	1971	*	-	18	10,548	2,416	-8,132	4,387	-1,971
Trent Court	1967	*	-	12	7,032	10,353	3,321	2,913	7,440
Coachman	1967	*	-	42	24,612	54,776	30,164	10,194	44,582
Kenwood	1971	*	-	-	-	307	307	-	307
Total				127	74,432	96,370	21,948	30,825	65,545

* Development not completed by October 1971.

school children. Chadwick was not completed, so its deficit may only be temporary.

An educational cost-revenue study cannot be complete without considering those state revenues which are affected by enrollment and assessment. For the 1970-71 school year state aid to local school districts was based on four formulae. The district received either "equalization aid" or "minimum aid", whichever was greater, plus "additional aid" and "building aid". Equalization aid is calculated as follows:

$$EQ_t = \$400\begin{pmatrix}\text{September 30}\\ \text{enrollment}\end{pmatrix}_{t-1} - 0.0105\begin{pmatrix}\text{equalized}\\ \text{valuation}\end{pmatrix}\left(\frac{\text{local students}}{\text{local and regional students}}\right)$$

Minimum aid is simply \$75 per student enrolled at t-1; additional aid is \$25 per student at t-1. Building aid is calculated by the same formula as equalization aid, with \$45 instead of \$400, and 0.00075 instead of 0.0105.

Since state aid depends on the number of students and value of real estate, both apartment and single family home construction affect its level. To determine this impact, the amount of aid that would have been received were there no apartments and no single family homes, respectively, is calculated and compared to the amount of aid actually received. The number of students housed in each residential category is subtracted from total enrollment and the valuation of the category is subtracted from total valuation. Then state aid is recalculated with the reduced enrollments and valuations.

Enrollments of September 30, 1969 were used by the state to calculate aid for the 1970-71 school year. Of those students, 40 regional students came from Lindenwold's apartments, but as the number of local students is not known, 127 students, the enrollment from apartments on September 30, 1971, is again used as the maximum estimate.

The calculations shown as Table 9-12 indicate that state aid increased

Table 9-12

Impact of Apartments and Single Family Homes on State Aid: Lindenwold, 1970-71

	Actual	Net of Apartments	Net of Single Family Homes
Enrollment, September 30, 1969			
Total	2,190	2,042	148
Local	1,285	1,177	108
Regional	905	865	40
Assessment, 1969	$33,348,454	$28,824,022	$7,868,227
Assessment $\left\{\frac{\text{Local Students}}{\text{Total Students}}\right\}$	19,567,473	16,614,041	5,741,679
Formula Aid	308,542	296,353	-17,087
Minimum Aid	96,375	88,275	8,100
Additional Aid	32,125	29,425	2,700
Building Aid	43,149	39,735	1,227
Total Aid	383,816	365,513	12,027

Change in Total Aid because of Apartments: Actual - Net of Apartments = $18,303

Change in Total Aid because of Single Family Homes: Actual - Net of Single Family Homes = $371,816

$18,303 because of Lindenwolds' apartments and $371,816 because of Lindenwolds' single family homes. If these sums are added to the surplus ($5,636) and deficit ($444,782) from the real estate taxes, apartments generated a total surplus of $23,939 and single family homes a total deficit of $72,966.

Use of the September 1971, enrollment from apartments to assign shares of total costs to apartments and single family homes was explained above as determining a maximum for apartments' share of costs and a minimum for single family homes' share. However, since state aid increases with the number of students, the above aid figures also represent a minimum for single family homes' contribution to aid and a maximum for apartments. Therefore, another calculation of cost and revenue is presented using a lower estimate for enrollment from apartments. The number of regional high school students from Lindenwolds' apartments increased from 40 in September 1969 to 47 in September 1971. The ratio of those enrollments is multiplied by the number of local school students from apartments in September 1971 to yield on estimate of September 1969, enrollment of 108 students.

This enrollment estimate is based on the assumption that the number of school children from apartments in local and regional schools increased proportionally. There are grounds to question this assumption. However, the calculations of state aid with this estimate indicate that the results are not sensitive to downward adjustment of the number of students from apartments. The change in aid caused by apartments and single family homes only decreased $769 and increased $646, respectively. Thus, it can be concluded that despite overestimating school district costs caused by apartments, they return a surplus to Lindenwold of over $20,000 while single family homes cause a deficit of at least $70,000.

The break-even equalized valuation for a dwelling unit with one local student can be determined by equating the average cost of educating that student to the sum of local tax, equalization aid, additional aid and building aid:

$$C = tV + (400 - 0.0105Vp) + 25 + (45 - 0.00075Vp) \qquad (9\text{-}1)$$

where C = average cost per student

t = equalized local school district tax rate

V = break-even valuation

p = ratio of local to local plus regional school students

Thus, tV = local tax revenue from the break-even unit

$(400 - 0.0105Vp)$ = equalization aid, given that $V \leq 30{,}952/p$; otherwise, equalization aid = \$75.

25 = additional aid

$(45 - 0.00075Vp)$ = building and, given that $V \leq 60{,}000/p$; otherwise, building aid = 0.

Solving the above equation for V,

$$V = \frac{C - 470}{t - 0.01125p} \qquad (9\text{-}2)$$

Substituting Lindenwold's values for 1970-71 for the parameters, as follows,

C = \$586

t = 0.0095

p = 0.5867

the break-even valuation is \$40,000, and the limits for V stated above are satisfied. However, a dwelling unit built after October 1969 would not be included in the valuation and enrollment figures used to calculate state aid for the 1970-71 school year. Thus, a student from a new dwelling unit would only be supported by the property tax for the first year. The break-even valuation for that year would simply be

$$V = \frac{C}{t} = \frac{\$586}{0.0095} = \$61,684$$

Therefore, to support one local school child in 1970-71, a dwelling unit completed before October, 1969, would have had to be valued at $40,000 and one completed after October, 1969, had to be valued at $61,684. Apartments *in toto* in October 1970, had a value of $66,365 per student living in them, which is consistent with their surplus found above. In contrast, single family homes *in toto* had a value of $23,597 per student.

This last result can also be shown in another way. Using April 1, 1970 Census of Housing data for number of units, and October 30, 1970 data for valuation, single family homes and apartments had an average valuation of $12,170 and $5,556 per unit, respectively. The cause of their respective surplus and deficit is the number of students per unit, 0.516 per single family homes and 0.084 per apartments. If the break-even valuation for a residential unit with one student, $40,000, is multiplied by the average number of students per unit, the average break-even valuations are found: $20,640 for single family homes and $3,360 for apartment units. The former is well above the actual average valuation of single family homes; the latter is below the valuation for apartment units, indicating again their respective deficit and surplus.

Caution should be exercised in generalizing these conclusions to other jurisdictions or years. The results depend on Lindenwold's expenditures, enrollments, tax rates, and valuation, as well as the state aid formulae which frequently change. Indeed, aid for the 1971-72 and 1972-73 school years was based on another system. However, it is clear from Lindenwold's experience that a municipality can subsidize deficits from single family homes by encouraging the construction of apartments with a low proportion of multiple bedroom units and, therefore, few students per unit.

Analysis of Educational Expenditure: Voorhees

The same methods are used to study local school expenditure in Voorhees. As in Lindenwold, this expenditure increased steadily and the proportion of state to total revenue fluctuated considerably from 1960-61 to 1970-71; see Figures 9-6 and 9-8. The student-teacher ratio generally decreased during the decade following initial increases, while the average teaching salary increased sharply, as shown in Figure 9-9. Increases in total teaching salaries account for 53 percent of the expenditure increase from 1960-61 to 1970-71. In contrast to Lindenwold, the Voorhees property tax base grew faster than local school expenditure from 1960 to 1971 and from 1966 to 1971; see the gross necessary rate on Table 9-7.

If the cost of improved quality of education is deducted from current expenditure using the methods described for Lindenwold, this last result becomes more pronounced. Comparing first 1960-61 and 1969-70, the "constant quality" teaching staff would require 33.0 members in 1969-70; in fact, Voorhees had 42.4 teachers in 1969-70, or a quality increase of 9.4 teachers. This increment to the teaching staff was paid $76,228 at the average salary of $8,075. Without this quality change, the 1970 necessary equalized tax rate would drop from $15.82 to $14.06 per $1,000, a level less than two-thirds of the 1960 rate.

An analysis of the 1966-71 period using 1965-66 as the base year is shown in Table 9-13. For every year since 1966-67 the net necessary tax rate decreases, if quality is held constant. In other words, the property tax base grew more rapidly than net expenditure in every year. This was true also for gross expenditure with the exception of 1968-69. Therefore, actual tax rates

Table 9-13

Analysis of Decrease in Student-Teacher Ratio for Voorhees, 1965-66 to 1970-71

		Number of Teachers							
	Student Teacher Ratio	Constant Quality Level	Actual	Quality Increase	Mean Salary	Cost of Quality Increase	Expenditure, Net of Quality Increase	Net Necessary Tax Rate*	Gross Necessary Tax Rate*
1965-66	28.9	34.0	34.0		6,661		435,710	16.30	16.30
1966-67	28.9	35.0	35.0		6,911		490,104	18.13	18.13
1976-68	29.7	36.3	35.4	-0.90	6,779	-6,236.68	528,321	17.58	17.37
1968-69	27.3	39.0	41.4	2.38	6,698	15,941.24	552,338	17.10	17.59
1969-70	27.6	40.5	42.4	1.90	8,075	15,342.50	670,896	15.46	15.82
1970-71	26.9	41.9	45.0	3.11	8,607	26,767.77	859,162	13.73	14.16

* Expenditure in year (t)-(t+1)/Valuation in year (t+1) = Necessary tax rate in year (t+1).

could have decreased every year but one since 1966-67 if property tax revenue were a constant proportion of total revenue, and every year if there had been no quality increase in 1968-69. However, the actual rate did increase for part of this period as shown in Figure 9-7, largely because of lower revenue from the State; see Figure 9-8.

Apartments did not generate any school costs, as there were no school children from apartments during the 1970-71 school year. Burnt Mill Arms is comprised solely of one-bedroom units; the other two developments, Robin Hill and Echelon, did not open until Summer, 1971. On the first day of school in September 1971, there were eleven students from Robin Hill and Echelon, and by May 1972, there were ninety-nine. Since 1971-72 expenditure data and 1972 assessments are not yet available, the Voorhees school cost-revenue calculations do not include these effects of recent apartment construction.

In 1971 at the necessary equalized tax rate of $14.16 per $1,000, apartments generated $21,681. As there were no students living in apartments, this revenue subsidized the education of students from single family homes. Single family homes, as the source of all students but only a fraction of the total assessed valuation, do ipso facto generate a deficit if the property tax is the sole source of revenue; it was $490,047 in 1971 with revenues of $386,833 and costs of $876,930.

Using the actual equalized tax rate for the 1970-71 school year, $10.10, and the expenditure net of improvements authorized, federally financed projects, and transportation (75%), apartments generated property tax revenues of $15,465 in 1971 and single family homes generated revenues of $275,954 for a deficit of $546,960 in 1971. The State aid formulae generated $257,427 in 1970-71, as shown in Table 9-14. Since higher valuation leads to less aid, the apartments caused a reduction of $8,830, reducing their surplus to $6,635. It

Table 9-14

Impact of Apartments and Single Family Homes on State Aid: Voorhees, 1970-71

	Actual	Net of Apartments	Net of Single Family Homes
Enrollment, September 30, 1969			
Total	1,510	1,510	
Local	1,117	1,117	
Regional	393	393	
Assessment, 1969	$32,152,629	$31,090,160	$7,953,834
Assessment $\left\{\frac{\text{Local Students}}{\text{Total Students}}\right\}$	23,784,429	22,998,481	5,883,730
Formula Aid	197,063	205,316	
Minimum Aid	83,775	83,775	
Additional Aid	27,925	27,925	
Building Aid	32,439	33,016	
Total Aid	257,427	266,257	

Change in Total Aid because of Apartments: Actual - Net of Apartments = -$8,830

Change in Total Aid because of Single Family Homes: Actual = $257,427 makes little sense to recalculate state aid without students and valuation of single family homes, as there would be no students. Assigning the entire actual aid to single family homes reduces their deficit to $289,543. Thus, as in Lindenwold, apartments *in toto* return a surplus and family homes *in toto* cause a deficit.

The break-even valuation for a dwelling unit with one student in Voorhees in 1969-70 is $58,639, or nearly 50 percent higher than for Lindenwold in 1970-71. Average costs are much higher in Voorhees, $680 versus $586 for Lindenwold; in addition, the ratio of local to total students is higher, 0.7397 versus 0.5867 for Lindenwold. Because these two parameters are larger, the limit on equalization aid is reached, and the $75 minimum aid replaces that term in equation (9-1). However, the limit on building aid is not surpassed. Therefore, the revised formula is

$$V = \frac{C - 120}{t - 0.00075p} \qquad (9\text{-}3)$$

If the break-even valuation is multiplied by Voorhees' students per unit ratio, 0.714, it yields the average valuation necessary for single family homes *in toto* to break-even: $41,868. Compared to the actual average valuation $11,076, the need for subsidies from other forms of land use is clear. Similarly, the break-even valuation per student, $58,639, can be compared directly to the actual valuation per student of $15,513.

Since the break-even valuation is so sensitive to expenditure levels, Table 9-15 was constructed to examine the variation in Lindenwold's and Voorhees' per student expenditure. Nearly a third of the difference is accounted for by instruction salaries. Whereas Voorhees has a higher student-teacher ratio, which would lead to a lower per student cost, it has a much higher mean salary. It is difficult to explain the other components. The larger expenditures for transportation may reflect Voorhees' larger area; for supplies,

Table 9-15

Expenditure Per Student, 1970-71

Function	Lindenwold	Voorhees	Voorhees less Lindenwold
Administration	32.51	30.75	-1.76
Instruction, Salaries	335.30	365.79	30.49
Instruction, Supplies	17.79	36.54	18.75
Attendence and Health	9.97	15.06	5.09
Transportation	4.94	16.56	11.62
Operation	53.18	55.65	2.47
Maintenance	10.28	16.15	5.87
Fixed Charges	19.47	24.60	5.13
Tuition	9.39	20.01	10.82
Capital Outlay	6.79	5.96	-0.83
Debt Service	86.06	91.68	5.62
Other	0.38	0.80	0.42
Total*	586.08	679.53	93.47

its new affluence and opening of a new school; and for tuition, more students sent to adjoining districts. More cannot be said about the difference in expenditure between these school districts without a more detailed study.

In conclusion, Voorhees, like Lindenwold, depends on other land uses to subsidize the deficit from single family homes. For the 1970-71 school year, commercial properties, principally the Echelon Mall, generated more than $275,000 in local school district property taxes, almost enough to balance the single family homes' deficit after state aid of $289,543. It remains to be seen if Voorhees' new apartments and townhouses maintain a low student per unit ratio and become the source of a surplus, or if they too will have to be subsidized by Voorhees' significant commercial tax base.

Analysis of Local Government Expenditure

Methods

The identification of quality improvements and their costs is not easily accomplished for municipal functions. In the case of education, the student-teacher ratio is a suitable quality index, and student enrollment data is available on an annual basis. However, municipal employees per capita can only be calculated for the census year, and the relationship of this ratio to quality of service may be less direct than in the case of students per teacher.

Moreover, the relationship of services to the tax base is more difficult to specify. In the case of educational expenditure, the dwelling unit of the student who receives the service provides a direct connection to the tax base. Of course, as is widely appreciated, society as a whole benefits from the education of each child. Using this approach, the education analysis section answered two specific questions:

1. Do single family homes and apartments generate sufficient revenue at prevailing tax rates to cover total average costs of their students?

2. Could they individually generate sufficient revenue if the property tax were the sole source of local revenue?

The analysis has not concerned itself with who should pay. Its focus is the narrower one of the budgetary impact of growth on these two municipalities. The students entered the school system because they were residents; therefore, in discussing budgetary impact, the students' costs are assigned to their residences.

However, for municipal functions recipients of services cannot be as readily identified. In effect, educational expenditures are treated here as a private good with a user charge. Theoretically, police, fire, welfare, and recreation could be treated similarly. For example, the ratio of police expenditures to total police calls, or cost per call, could be the basis for a user charge for apartments, given the number of calls. Likewise, sources of fire calls, individuals on welfare, and users of recreational facilities and libraries could be tabulated and costs assigned to land use categories.

This approach, as well as the use of average costs for the education analysis, can be criticized from the viewpoint of public good pricing. If the public good is not congested, the marginal cost of using it approaches zero. Should the adult visiting the library at off-peak hours be allocated a charge identical to that of a child after school, if peak service demands immediately after school require an additional number of librarians? Should a new student be assigned a cost as high as the total average cost, if the classroom he enters is not full?

Such discussion is mainly of theoretical concern since local governments do not keep records which identify expenditure by source of demand. Useable data are not available for police and fire calls, residences of welfare recipients, residences of library users or other services. However, with cooperation of local government officials and with considerable research, it would be possible to construct these indices from police and fire logs, welfare reports, and other itemized records.

There are three shortcuts for allocating expenditures if an actual detailed survey is too time consuming or costly, as is the case here. First, total expenditures can be allocated to the number of housing units. Using this method, apartments in Lindenwold would be assigned 38.9 percent of expenditure in 1970, as there were 1517 dwelling units in multiple family structures and 3900 dwelling units in total; single family units, or 2383 of 3900 dwelling units, would be assigned the remaining 61.1 percent of expenditure. Apartments in Voorhees would be assigned 6.9 percent of expenditure in 1970 and single family homes the remaining 93.1 percent, as apartments were only 116 of 1,680 units. However, with this method, all non-residential land uses, including industrial and commercial uses, are assumed to have no expenditure impact. Moreover, a comparison of the share of costs to necessary tax revenues could be used to determine if a given land use pays its own way with only the property tax; however, the results of this analysis do not really answer the question of interest as shown below.

Define:

$$\text{Cost per Unit} = \frac{\text{Total Cost}}{\text{Total Units}}$$

$$\text{Necessary Tax Rate} = \frac{\text{Total Cost}}{\text{Total Valuation}}$$

Then, units of type i pay their own costs if:

$$\frac{\text{Total Cost}}{\text{Total Units}} \text{ (No. of type i units)}$$

$$\leq \frac{\text{Total Cost}}{\text{Total Valuation}} \text{ (Valuation of type i units)}$$

However, by rearranging terms, it can be shown that

$$\text{Total Cost}\left(\frac{\text{No. of type i units}}{\text{Total Units}}\right)$$

$$\lesssim \text{Total Cost}\left(\frac{\text{Valuation of type i units}}{\text{Total Valuation}}\right)$$

or,

$$\frac{\text{No. of type i units}}{\text{Total Units}} \lesssim \frac{\text{Valuation of type i units}}{\text{Total Valuation}} \qquad (9\text{-}4)$$

Thus, if apartments, or single family units, have a greater share of total dwelling units than of total assessed valuation, no matter what the expenditure level, this method indicates they do not "pay their own way", a clearly not very meaningful result. In the case of Lindenwold, using this method, apartments generate a larger share of expenditure than revenue (38.9 percent of expenditures versus 15.7 percent of revenue in 1970) while single family units do not (61.1 percent of expenditures versus 67.7 percent of revenues). In Voorhees, neither apartments nor single family homes generate sufficient revenue (6.9 percent versus 2.0 percent for apartments and 93.1 percent versus 62.3 percent for single family homes).

If a large industrial or commercial development had been on the assessment rolls, the proportion of assessment in single family homes and apartments would have automatically dropped, perhaps changing the single family conclusion. Thus, the result of this method can be affected by factors other than the cost impact of dwelling units.

A variation on this method is to charge residential land uses only for the proportion of expenditure equal to the ratio of residential (both single family and apartment units) to total property revenue. If only a given fraction of total revenue comes from residential sources, apartments and single family homes need only supply their share of total residential revenue for the municipality to break even.

The usual formulation of this method is as follows:

$$(\text{Cost per unit})(\text{No. of type i units})\left(\frac{\text{Residential tax revenue}}{\text{Total tax revenue}}\right)$$

$$\lesseqgtr (\text{Necessary tax rate})(\text{Valuation of type i units})$$

This can be written as:

$$\text{Total cost}\left(\frac{\text{No. of type i units}}{\text{Total units}}\right)\left(\frac{\text{Residential valuation}}{\text{Total valuation}}\right)$$

$$\lesseqgtr \text{Total cost}\left(\frac{\text{Valuation of type i units}}{\text{Total valuation}}\right)$$

or,

$$\frac{\text{No. of type i units}}{\text{Total units}} \lesseqgtr \frac{\text{Valuation of type i units}}{\text{Residential valuation}} \qquad (9\text{-}5)$$

With this method, the result is determined by the relative size of the ratio of number of units and the ratio of apartment or single family valuation to total residential valuation. Specifically, if apartments or single family units have a greater share of units than residential valuation, they do not pay their own way. Thus, one type of residence always pays its own way, while the other does not. If single family units are a larger share of total units than of total residential valuation, it follows that apartments have a smaller share of total units than of valuation. In 1970 in Lindenwold, apartments were 38.9 percent of all units and 18.8 percent of residential valuation; in Voorhees apartments were 6.9 percent of all units and 3.1 percent of residential assessment. Thus, apartments generated a larger share of expenditure than of residential revenue.

In contrast to the first method an increase in non-residential valuation has no direct impact on the result. Yet, here the result is predicated on the fact that the mean value of apartment units is less than the mean value of single family units. The apartment unit is assigned the same average cost as the single family unit, whereas it has a lower average revenue. Thus, the entire conclusion rests on the unproven assumption that an apartment unit has the same cost impact as a single family unit. Also, the use of the residential to total revenue ratio in calculating the impact of new development assumes that all other revenues increase sufficiently to maintain current residential to total revenue ratios.

A third method is to allocate expenditure among all land uses by proportion of assessed valuation. The implication is that each dollar worth of property, regardless of land use, receives the same service. This assertion can perhaps be defended for property services such as police, fire and streets and roads, but not for services such as welfare, recreation, and education. The formula for the property services would be

$$\frac{\text{Total Cost}}{\text{Total Valuation}}(\text{Valuation of land use i})$$
$$\lesseqgtr (\text{Necessary Tax Rate})(\text{Valuation of land use i}) \qquad (9\text{-}6)$$

This expression is an identity, since by definition the necessary tax rate is total cost/total valuation; the identity follows directly from the use of valuation as the basis of both cost and revenue allocation. Each land use category's share of cost is equal to its share of revenue, since its proportion of total valuation is the basis for determining both shares.

Thus all three methods suggested to determine if apartments and single family homes pay their own way, if the local property tax were the sole source of revenue, depend entirely for their results on the relative shares of total expenditure and valuation which the categories represent. Actual levels of expenditure do not affect the results; since it is assumed that

1. the costs of servicing an apartment and single family home are equal, or

2. a dollar's valuation of each type of development has the same servicing cost,

neither do actual differences in the cost impact of each. Only if accurate cost figures for all land use categories were generated, would these cost-revenue calculations give reliable information on which categories subsidize others, and to what extent. Moreover, the actual tax rate must be substituted for the necessary rate to determine if a land use category generates sufficient property tax revenue to pay its share of expenditure with the existing fiscal system.

The actual tax rate is related mathematically to the necessary tax rate as follows:

$$\text{Actual tax rate} = \frac{\text{Property tax revenue}}{\text{Total valuation}}$$

$$= \frac{\text{Property tax revenue}}{\text{Total expenditure}}\left(\frac{\text{Total expenditures}}{\text{Total valuation}}\right)$$

$$= \frac{\text{Property tax revenue}}{\text{Total expenditure}}\ \text{(Necessary Tax Rate)}$$

The ratio, $\frac{\text{Property tax revenues}}{\text{Total expenditure}}$, is only greater than or equal to one if the property tax generates revenues greater than total expenditure or is the only source of revenue with balanced budget. Under the existing fiscal system in New Jersey, other revenue sources contribute to local revenue, and therefore the ratio is always less than one. Therefore, the actual rate is always less than the necessary rate.

Table 9-16 shows cost, actual revenue, and their difference for single family and apartment units. There are three cost estimates for each residential category:

1. (Cost per unit) (No. of units); see equation (9-4)

2. (Cost per unit) (No. of units) $\frac{\text{Residential property tax revenue}}{\text{Total property tax revenue}}$; see equation (9-5)

3. (Cost per dollar valuation) (Valuation); see equation (9-6)

The headings of Table 9-16 correspond to these three methods. Revenue was calculated for each category as the product of its equalized valuation and the actual equalized tax rate. Both cost and revenue calculations are based on 1970 data, the most recent year for which information on the number of residential units is available. There is one exception to the three formulae. Since garbage and trash collection is not provided to apartments by either Lindenwold or Voorhees, the entire cost of this service is allocated to single family units in all three calculations.

Table 9-16 shows that neither apartments nor single family homes in Lindenwold and Voorhees generated sufficient property tax revenue to cover costs, regardless of which cost formula is used. This result is not surprising. In 1970, local real estate property tax revenue was only 37.2 percent of expenditure in Lindenwold and 18.2 percent in Voorhees. If the cost allocations are multiplied by those percentages, the share of costs met by the property tax can be compared to property tax revenues for each land use category; this is also shown in Table 9-16.

Apartments in Lindenwold and Voorhees generated sufficient revenue only when the third valuation method of allocating costs met by property tax is usec Single family homes in Lindenwold generate sufficient revenue only when the unit methods are used; and single family homes in Voorhees only do so when the second unit method is used.

These results should be viewed with considerable skepticism. As has beei mentioned earlier, the method of allocating total costs between apartments and

Table 9-16

Residential Share of Municipal Costs and Contributions to Revenues, 1970

type of unit	residential revenue	(cost/unit)(no. of units) share	(cost/unit)(no. of units) surplus	(cost/unit)(no. of units)(res. revenue/total revenue) share	(cost/unit)(no. of units)(res. revenue/total revenue) surplus	(cost/valuation)(residential valuation) share	(cost/valuation)(residential valuation) surplus
Lindenwold							
single family	$157,009	397,392	-240,383	331,266	-174,257	435,541	-278,532
apartment	36,367	225,413	-189,046	187,904	-151,537	90,851	- 54,484
Voorhees							
single family	42,933	355,138	-292,205	228,425	-188,492	249,009	-206,076
apartment	1,408	23,805	- 22,397	15,311	- 13,903	7,046	- 5,638
Share of cost reduced by proportion of total expenditures supported from property taxes							
Lindenwold (37.2%)							
single family	157,009	148,014	+ 8,995	123,385	33,624	162,224	- 5,215
apartment	36,367	83,958	- 47,591	69,988	- 33,621	33,838	2,529
Voorhees (18.2%)							
single family	42,933	64,602	- 21,669	41,552	1,381	45,296	- 2,363
apartment	1,408	4,330	- 2,922	2,785	- 1,377	1,282	126

single family homes proportionally to the number of units is quite arbitrary. It is a technique born of convenience and the availability of such data. Its underlying assumption, that service costs to an apartment unit and single family home are identical, has not been proven and, moreover, is not even intuitively appealing. In addition, allocating all costs among only residential units assigns residences the costs of servicing nonresidential properties, and thus certainly overestimates their share of costs.

The main appeal of assessment figures to allocate expenditure is also convenience. It is a standard on which data is available for both residential and nonresidential properties. Neither the assessment nor the per unit allocation of expenditure is a reliable method to determine the costs of services by land use categories. Furthermore, these results do not consider the effect of residences on nonproperty tax revenues.

Various analysts have collected expenditure, population, income, density, and other descriptive data, and have made linear and nonlinear regression estimates of per capita expenditure; Table 9-17 summarizes the results of these studies, together with a list of references. The table shows that population density tended to be negatively correlated with per capita expenditure at the state level, but positively correlated at the local level. Population size, or change in population, was generally positively correlated with per capita expenditure. Some studies concluded that population increases caused per capita expenditure increases because of the positive coefficient. For example, an in-increase of one hundred residents was predicted to cause a per capita expenditure increase of one hundred times the linear regression coefficient of the population variable. This conclusion appears unwarranted because cross-section data are used to predict changes over time. In effect, the cross-section regression describes the statistical relationship among the localities included in the

Table 9-17

Summary of Regression Studies of Per Capita Municipal Expenditure Versus Local Characteristics

Category of per capita expenditure	Studies conducted on data aggregated to the state level: density	income	percent urban	change in population	Studies conducted on metropolitan area and municipal data: density	income	population
General	- 4 1	+ 6 0	+ 2 2	0 1	+ 1 2	+ 2 0 - 1 0	+ 1 1
Education	- 4 0	+ 4 0	0 3	+ 1 0		+ 1 0	
Highways	- 1 2	+ 4 0	- 3 1	- 2 0	- 1 2	+ 1 1	0 1
Welfare	- 1 2	+ 1 2	+ 3 0	0 1	0 1	0 1	
Health	0 3	+ 4 0	0 3	0 1	+ 2 0	0 2	
Police	+ 1 3	+ 2 1	+ 2 1	+ 1 0		+ 1 0	+ 1 2
Fire	- 1 1	+ 2 1	+ 3 0	+ 1 1	+ 1 0	+ 1 0	- 2 1
General contingency	+ 1 2	+ 3	- 1 2	+ 1 0			
Interest and other	0 2	+ 1 1	0 1	+ 1 0	+ 1 1		

Key: (a) the first entry is the sign of the relationship, if statistically significant;
(b) the second entry is the number of studies with significant coefficients of the sign shown;
(c) the third entry is the number of studies with insignificant coefficients.

This table is based on studies by Adams (1965), Bahl (1969), Bahl and Saunders (1965,1966), Davis and Haines (1966), Fabricant (1957), Fisher (1964), Hirsch (1959,1964,1965), Kee (1965,1968), Kurnow (1963), Morss (1966), O'Brien (1971), and Sachs and Harris (1964).

data base. Using the regression estimate for prediction implies that as a given locality grows it will become more like the larger localities in the sample, which may or may not be correct. The regression coefficients for population, and thus the expenditure predictions, vary with (a) the choice of other independent variables, (b) the localities in the data set, and (c) the year of the data. There is no a priori way of defining the best set of variables and localities, and the independent variables are often available only in Census years.

If the linear regression coefficient for population is used to predict the expenditure impact of an increase in population, the identical expenditure impact is predicted for all localities, a quite unlikely result. Moreover, the addition of 100 high income families will have different effects on the levels of average income and density in a low income rural township than in a high income established suburb. The effect of the anticipated new population on the magnitude of other independent variables must also be considered.

Even if used with sophistication, these coefficients are a crude, oversimplified way of examining the impact of growth on local expenditure. The impact of growth in a particular community depends on political decisions, fiscal resources, existing capacities and current service levels. Although it might be argued that income, race, education, and other socio-economic variables underlie these factors, such a relationship is not tested explicitly by fitting a regression equation to cross-section data, nor of course does such an equation tell us how the process functions.

The budgetary processes in Lindenwold and Voorhees indicate that there is no direct formula used by local officials to relate growth to new needs and services. New residential units do not cause clearly identifiable needs which result in specific new expenditure. Employees are not hired by a ratio formula. One Lindenwold official described the budgetary process in this way: "The councilman who is committee head for each department, e.g. welfare, public safety, or recreation, makes a budget request anticipating needs. We total up all the requests and estimate the tax rate necessary to cover it all. If the rate must be increased, we start chopping. We chop down and cut services until we reach an acceptable tax rate. We just go through and pull out where we can. Generally, we try to increase salaries with the cost of living." A department head had this view: "We hoped and prayed each year that we would get what we asked for. Six more men right now would be a godsend. We show the Council an itemized cut of the year when we make our requests. We go by what you can afford and what you get. Figures don't help if you don't have money."

There is no simple way to allocate costs to land use categories or to calculate the impact of new development. As discussed above, it is necessary to conduct a very thorough examination of the delivery process of each service in order to determine which land use categories receive what services. Even after careful analysis the allocation must be arbitrary to some degree because of the public good nature of some local services. To determine marginal costs, or the cost impact of new development, it is not only necessary to anticipate service needs, but also to determine excess capacity and, most importantly, to anticipate political reaction. For example, a municipality gaining 100 families may hire new policemen, or simply keep the existing force. A new sewer treatment plant may be built, or the quality of effluent be permitted to fall. Parks and libraries may be enlarged, or become overcrowded. Far more work, well beyond the scope of this study, must be undertaken before the recipients of services can be specified and the political reaction to growth can be anticipated. Revenue shares and contributions from the property tax and other sources could more easily be traced in considerable detail. However, it is hardly worth undertaking a detailed study of revenue if the results are only to be compared to the most crude estimations of cost.

Also if a detailed study is undertaken to determine the "profitability" of certain kinds of land use, the results are not necessarily valid for other municipalities. Profitability of a given structure is determined by expenditure, total valuation, other revenue sources and the tax rate. These may be different among municipalities.

The concluding sections of this chapter analyze the municipal service sectors based on interviews with local officials, local salary ordinances, and detailed budgets. As the discussion proceeds service by service, describing what changes have occurred as these municipalities grew, it should be clear implicitly that the local governments exercised considerable discretionary power. They made choices determining which services would be increased and how. In essence, the new development brought not only new needs but also new revenues which permitted changes in service levels. Again, it will be noted that service levels are the results of political decisions made within revenue constraints, and are not the results of calculations using simple formula undertaken by local officials.

Analysis of Local Expenditure: Lindenwold

General Government Assessment and collection of taxes, financial administration, and such administrative and executive activities as planning and zoning, legal consultation, elections, and duties of the Borough Council and Clerk comprise general government. In 1964, Lindenwold had two full-time and 15 part-time paid employees including the mayor and six councilmen who were unsalaried in 1964. Solicitors were salaried in 1964, but all except one were hired by contract with a law firm in 1971, and are not considered part-time employees. Table 9-18 lists all employees for general government services in 1964 and 1971 as well as their salaries. Primarily, deputies and assistants were added and some part-time positions were increased to full-time during that period.

The changes from 1964 to 1971 are the result of a series of additions and deletions occurring in each year. In 1965, the positions of physician, secretary, and solicitor of the Board of Health were abolished together with that of sewage, drainage and plumbing inspector; in addition, the registrar of vital statistics began to be paid on a fee basis. In 1966, the position of secretary of the Board of Welfare was also abolished but those of treasurer ($1500) and solicitor ($500) of the Zoning Board were created. In 1967, a deputy borough clerk ($2/hr.), a deputy treasurer ($2/hr.), a clerk of the Zoning Board ($200), and an engineer ($300) were added. In 1968, the positions of physician ($250), secretary ($2080), and solicitor of the Board of Health ($600) and plumbing inspector ($800) were recreated and the positions of deputy tax assessor ($2/hr.), solicitor of the planning board ($600), custodian ($1200), municipal improvement search clerk ($300), and public information officer ($1000) were created. In 1969, the mayor ($1000) and six councilmen ($750 each) began drawing salaries; the positions of engineer and public information were abolished; the four solicitor positions were abolished in favor of a contract with a law firm and deputy borough clerk ($3640) became a full time position. In 1970 the position of solicitor ($800) of the Board of Health was recreated and assistant plumbing inspector ($250) was added. In 1971 there were no changes.

It is impossible to determine on an a priori basis if the personnel increases were a reaction to needs arising from growth, or an improvement in quality of services because more revenue could be generated at a given "accept-

Table 9-18

General Government Employees and Salaries for Lindenwold, 1964 and 1971

Position	Annual salary, except as noted 1964	1971
Tax Collector	$5,350	$5,900
Tax Search Clerk	650	500
Deputy Tax Collector	2.00/hr.	5,200
Tax Assessor	2,400	7,000
Deputy Tax Assessor	none	5,700
Assessor's Clerk	1.50/hr.	2.40/hr.
Borough Clerk	3,400	6,700
Deputy Borough Clerk	none	5,200
Solicitor	2,400	contract
Treasurer	none	5,000
Deputy Treasurer	none	250
Physician, Board of Health	200	250
Secretary, Board of Health	300	2,400
Solicitor, Board of Health	200	1,000
Registrar of Vital Statistics	100	fees
Welfare Director	250	2,400
Secretary, Board of Welfare	250	none
Solicitor, Zoning Board	none	contract
Clerk, Zoning Board	none	350
Solicitor, Planning Board	none	contract
Custodian	none	1,800
Building Inspector	500	1,800
Heating Inspector	350	1,200
Plumbing Inspector	350	1,200
Assistant Plumbing Inspector	none	500
Sewage and Drainage Inspector	200	none
Municipal Improvement Search Clerk	none	300
Mayor	no salary	1,000
Councilmen (six)	no salary	750

able" tax rate. When asked this question, one Lindenwold official replied that the growth of the Borough required more staff, "but now everyone is better off." He claimed that earlier paperwork was not getting done and was "very messy". Another quality improvement benefiting the whole municipality has been the extension of hours of all offices to include Tuesday night.

Police The Lindenwold Police Department more than doubled in size from 1967 to 1970. There were eight full-time police officers in 1967, 10 in 1968, 13 in 1969, and 16 in 1970. In addition, two full-time civilian secretaries were added in 1968. Police cars were increased from one in 1964 to three in 1971. A detective bureau and a K-9 corps detachment were also added.

This large, more versatile department has had to contend with more and different criminal activity, in part resulting from the High-Speed Line station and the new apartments. The Line has been used in several armed robbery cases as a getaway mode to reach a car parked at an outlying station, such as Lindenwold. Auto car thefts from the Lindenwold Station parking lot which peaked at a level of five per day, decreased to five per week by November 1971 as a result of increased surveillance. Conversely, cars stolen in Philadelphia have been recovered in station parking lots. Tires, hubcaps and others parts are also often stolen.

Port Authority police turn over most suspects they arrest to the Lindenwold police, as Lindenwold is the terminal station. This adds considerable paperwork for Lindenwold, which must process 30 to 40 extra warrants or summons per month.

Traffic has doubled at the intersection of Laural Road and Chews Landing since the Line commenced service. The police department has provided three additional manned crossing posts and is negotiating with the State for a traffic light estimated to cost about $16,000. The application itself requires considerable paperwork and manpower, as forms and traffic counts must be prepared.

Police Chief Ray Wilson noted that the burglary and robbery rates have increased considerably and cited apartments as being particularly burglary prone, with multiple entrances and basement storage rooms contributing to their vulnerability. Coin boxes in laundry rooms have also been rifled. The anonymity of the apartment tenant is another factor. As Chief Wilson explained, "In the old (single family) neighborhoods, if someone was walking outside with a TV, the neighbors would know if he belonged there or not. Today if you stop him and it's his, he gets really upset. We can't ask everyone who lives there to wear badges."

Further illustrating the new roles of the police, Chief Wilson stated, "Now we have to be policeman, lawyer, doctor, and Indian chief. There are lots of unmarried people living together in apartments. We get calls from one to throw the other one out. Then we have to decide whose lease it is. Or the landlord calls to say people who owe him money are moving.... We know there are narcotics in the high school and junior high, but just try to find them. Everyone here is known, so how do we hide a detective in a small town? We are trying to get municipalities around here to swap their detectives."

The uniform crime statistics, collected and published by the New Jersey State Police since 1967 and available through 1970, support Chief Wilson's observations. Table 9-19 indicates that auto theft increased from eight in 1967 and 1968 combined to 121 in 1969 and 1970 combined; breaking and entering from 89 to 158; and larceny from 171 to 342. Only one nonproperty related crime, nonatrocious assault, increased as much as the property crimes noted above: it increased from 62 to 117. Other crimes do not show a rising trend. The total crime rate increased from 167 in 1967, to 179 in 1968, 337 in 1969, and 408 in 1970. The total crime index (all crimes except manslaughter, non-

Table 9-19

Crime Statistics, Lindenwold and Voorhees, 1967-70

	Lindenwold				Voorhees			
	1967	1968	1969	1970	1967	1968	1969	1970
Total Crime Index	89	92	179	277	36	89	101	168
Murder	1	2						
Manslaughter				3		1		
Forcible Rape - Total	3					2		1
Rape by force						1		
Attempted rape	3					1		1
Robbery - Total	1	1	1	1		1	1	1
Armed, any weapon	1	1	1	1		1	1	1
Strong arm								
Assault - Total	37	33	61	58	30	23	19	18
Gun	1		1			1	1	1
Cutting instrument		1		1				2
Other weapon	2	1			1			
Hands, feet, etc.	3							
Non-atrocious	31	31	60	57	29	22	18	15
Breaking and entering - Total	49	40	64	94	22	42	52	73
Forcible entry	32	35	58	89	22	36	41	60
No force	7	1		3		6	6	11
Attempted forcible entry	10	4	6	2			5	2
Larceny theft - Total	69	102	178	164	26	53	44	94
$200 and over	6	114	15	16	4	7	6	19
$50-$200	16	32	65	77	8	26	26	38
Under $50	47	56	98	71	14	20	12	37
Auto theft	7	1	33	88	1	10	15	33
Total	167	179	337	408	79	132	131	220

Table 9-20

Ratio of Mean 1969 and 1970 Crime Levels to Mean 1967 and 1968 Crime Levels

	State of New Jersey	Southwest Region	Camden County	Lindenwold	Voorhees
Total Crime Index	119	129	136	252	215
Breaking and entering	108	126	136	322	195
Larceny, $50 and over	137	141	134	254	198
Auto theft	116	122	144	1513	436

atrocious assault, and larceny under $50) increased from 89 in 1967, to 92 in 1968, 179 in 1969, and 277 in 1970.

The rate of increase of crime in Lindenwold is far greater than the state, region, or county average, as shown in Table 9-20, which compares mean crime levels for 1967 and 1968 with mean levels for 1969 and 1970. The use of mean crime levels over two years controls in part for possible randomness in the location of criminal activity. The southwest region consists of Mercer, Burlington, Camden, and Gloucester counties. In examining these results, it is important to note the effect of small base figures on percentage calculations.

Another data series indicates the crime growth rate may be leveling off. The Lindenwold Police Department submits a monthly activity report to the Borough Council. Data from these reports enables a comparison of the first four months of 1970 and 1971. Auto thefts dropped from 33 to 21; criminal investigations decreased from 70 to 62; and complaints received and serviced increased from 1,392 to 1,420, an increase of only 28 calls, or less than three percent. Nevertheless, the rate and nature of criminal activity has changed considerably in Lindenwold in recent years.

Court Expenditure for the municipal court of Lindenwold has increased in recent years: from $4460 in 1968 to $5150 in 1969, $6300 in 1970, and an estimated $7700 in 1971. Both salaries and the number of employees have increased. The municipal judge was paid $600 in 1964, $1200 in 1968 and 1969, $2000 in 1970, and $3000 in 1971. The clerk was paid $750 in 1964, $900 in 1968, $1400 in 1969, $1600 in 1970, and $1800 in 1971. A prosecutor was first hired in 1968 and was paid $900 in 1968 and 1969, $1000 in 1970, and $1200 in 1971. A violations clerk was first hired in 1966 and was paid $350 in 1966, $400 in 1967 and 1968, $600 in 1969 and 1970, and $800 in 1971. Supplies range within $800 to $1100 from 1968 to 1971. Until April, 1972, the court met twice each month and heard both traffic and criminal cases at each station. Now two sessions each month are held solely for traffic cases and one solely for criminal cases.

A large share of gross court receipts pass on to the state and county. For example, in October 1971 Lindenwold retained only $45 of $2057 in traffic fines, $400 of $755 in criminal penalties, and $560 in total revenues. Nevertheless, court revenues retained by Lindenwold have increased recently as shown by the following revenue data made available by court officials:

	April	May	June	July	October	November	December
1971	n.a.	$305	$451	$105	$560	$600	$260
1972	$925	1070	1055	895	n.a.	n.a.	n.a.

The average of the six months in 1971 is $380 suggesting annual revenue of about $4500. This amount would be insufficient to cover 1971 expenditure; however, the average revenue for the four 1972 months, $486, indicates that 1972 revenue may cover 1972 expenditure.

The revenue increase stems from more traffic and criminal cases and a higher assessment of court costs, which the state recently raised from $5 to $25. According to a court official, the increase in cases is related primarily to the increase in population, as there are now more family and neighborhood disputes in the court. These represent the largest share of criminal cases, although as mentioned earlier people arrested by the Port Authority police are frequently turned over to the Lindenwold police. The increase in traffic court cases is attributed to increased traffic and population, as well as a larger police department which can monitor traffic offenses more effectively.

Fire Lindenwold has three volunteer fire companies which annually submit their budgets for equipment to the Borough Council. Although each company does not receive the same appropriation, there is no differentiation in property taxes among residents of the three districts. Purchases of major equipment, such as fire trucks, are often funded by issuing bonds.

The fire companies now have better trucks and equipment than in past years, according to local officials. A snorkle fire truck costing more than $100,000 was ordered in 1971. This truck is somewhat like a crane which lowers a basket, and helps the fire department reach greater heights than conventional equipment. For fighting apartment fires this can be a considerable asset. However, one official said he "can't say the snorkle truck is primarily for apartments. It is better to get on top of fires and flood them." He explained that during a recent store fire Lindenwold had to call in a fire company from Pine Hill, a neighboring community. This would not be necessary with their own snorkle truck.

Streets and Roads The Department of Streets and Roads repairs, cleans, and plows Borough roads. Resurfacing of roads is contracted to private firms, but the Department fills potholes and makes smaller repairs. In 1970, Lindenwold hired a supervisor of public works at a salary of $11,000 in 1971; he embarked on an ambitious program of resurfacing Borough streets using cold patch, chip and oil, which cost $34,794 in 1971. It is hoped that eventually all streets will be resurfaced. No special charge is levied on residents of the resurfaced roads.

The cold patch method is less permanent than other more expensive systems which would require sidewalks and curbs. When residents along one street were asked if they would agree to pay for curbing and sidewalks if the Borough used a better method to make the road permanent, only two of 100 replied affirmatively.

Apartment development has had little effect on expenditure for streets and roads. Apartments are required to construct and maintain interior roads as well as links with Borough roads. Developers of single family homes are required to provide curbs and sidewalks and to cut the street; the Borough then provides a chip and oil surface. However, there is often a negotiated agreement committing the developer to chip and oil at least a portion of the street.

The increase in traffic resulting from the apartments and the High-Speed Line might be expected to cause an increase in the need for road maintenance. The roads bearing the brunt of the traffic increase, according to local officials, are the White Horse Pike, Gibbsboro Road, Linden Avenue from the White Horse Pike to the railroad, Blackwood-Clementon Road, Chews Landing Road, and Laural Road. The White Horse Pike is a state road and the others are county roads; therefore, direct cost effects of additional traffic are not borne by the Borough. Local officials consider the deterioration of local roads as a result of increased traffic to be minimal.

In general, the roads of Lindenwold are now in better condition than they were a few years ago. Local officials consider maintenance service to be much better; in the words of one, "potholes are filled when they develop instead of waiting a few years."

<u>Garbage and Trash Collection</u> Until 1968 Lindenwold advertised for bids each year and signed annual contracts for garbage and trash collection with private companies. The lowest bid increased considerably each year prompting Lindenwold to begin its own service; see Figure 9-5. A garbage truck was purchased and operated by men from the Department of Streets and Roads. In 1971 a second truck was added for the peak Christmas period which has since enabled twice weekly service.

As described in Chapter 8, an ordinance was passed in 1965 excluding apartments, industry, and businesses from the municipal garbage service, unless they contracted with the local government. All apartments have chosen to provide their own service or contract with private companies; however, Lindenwold has contracted service to schools and a few small stores.

Sewers Lindenwold's sewer system commenced operation in early 1965. It has a capacity of 1,250,000 gallons per day and was pumping an average of 1,000,000 gallons per day in June 1972. The system now consists of one plant and eleven pumping stations, including one pumping station paid for by a developer and added to the original system. The system operated by the Lindenwold Municipal Utility Authority, is independent of the local budget and financed by user charges. A connection fee of $200 per residential unit and a deposit of $250 to defray costs of laterals are imposed. The deposit is partially reimbursed if costs are less. Annual charges per residential unit are $64 plus $8 for a garbage disposal and $32 or $64 for a washing machine depending on its size.

When development occurs where there are no sewer lines, the Authority decides whether to extend its service. If it does, a contract is negotiated between the developer and the Borough to build an extension to be paid for by the developer unless he is constructing only one home. No cesspool or septic tanks are allowed, so the Borough can regulate growth by refusing to extend sewer lines; however, some units are serviced by the Clementon and Stratford sewer systems. A developer who connects to lines originally paid for by another developer pays him a proportionate share of the extension costs. The owner of a previously existing home also shares the cost of the extension when he connects.

In most cases others soon join an extension, but this depends on the land use pattern along the line. An extension and pumping station for Kenwood Apartments in 1971 picked up only three other units. Generally, according to a former mayor, "new sewer and water lines provided by developers have enabled the municipality to extend and improve its own service."

Water Water is purchased by the individual dwelling unit from the New Jersey Water Company, a statewide subsidiary of the United States Water Company. Both Lindenwold and Voorhees are entirely in the Haddon Division of the company, so the same rate structure applies to both. Part of Lindenwold was once served by the Clementon Water Company, but those lines were purchased by the New Jersey Water Company in 1970 after a three year delay because of legal proceedings over their ownership.

Where water mains exist, the Company provides service to the curb line of public roads. The consumer must supply feeder lines to the house or other structure and apply for the installation of a water meter. The water meter charge is $30 for three-quarter inch service and $35 for one inch service. Furthermore, the individual is charged a street opening fee which is passed on to the local government having jurisdiction over the street. On local roads Voorhees charges a $10 fee and Lindenwold a $1 fee; on county roads Camden County charges $10; and on state roads there is no fee. There is no connection charge other than road opening and meter installation in areas where lines exist.

Where there are no water mains, a developer may contract with the water company for their installation. He is billed for the full cost of extending service, so the Water Company itself does not directly finance main extensions. However, the developer is reimbursed when other users are connected to the mains he financed. The Water Company returns to the developer five times the first year's revenue from new customers joining his extension until the total originally paid by the developer is reached or ten years have elapsed.

Thus, the cost of extending service is initially borne by the developer who requests that the lines be extended. Any other developer or home owner previously in the area, who subsequently joins the line contributes nothing toward the cost of the extension. He pays only his meter installation and monthly bill as if he had connected to older water lines. However, since the water company may eventually repay the developer who extended the line, the rates paid by all users reflect the additional costs and revenues caused by extending water service.

The same user charges are applied to residential, apartment, commercial, and municipal customers throughout Lindenwold and Voorhees and the entire Haddon division of the company, which also includes part or all of 22 other localities in Burlington and Camden Counties. The price per gallon decreases after 2,500 gallons per month subject to the minimum monthly charges which increase with the size of meter. The price per 1000 gallons ranges from $0.864 for the first 2,500 gallons per month to $0.29 for all water over 333,333 gallons per month. A special flat rate of $0.175 per 1000 gallons is offered "for water supplied for resale purposes to other water utilities or to public authorities which take their entire water requirements from the company."

Another rate schedule is applied to water for private fire protection facilities. A flat quarterly rate ranging from $59.50 for a four inch connection to $196.00 for an eight inch connection is charged for water "to be used exclusively for the extinguishment of fires". No additional charge is made for sprinkler heads, fire hydrants, or other fire fighting facilities which may be attached to the connection, and no charge is made for water used in extinguishing fires or for insurance tests.

Rates were increased in 1963, 1967, and 1971. The last increase to present levels amounted to approximately fifteen percent. All rate increases are approved by the New Jersey Public Utility Commission and must be justified by company expenditure increases.

Most apartment complexes in Lindenwold did extend the water lines. The number of other users joining these extensions varied with the length of the line and the number of houses between the apartments and the former end of the line. Frequently, home owners use wells until large scale developers extend the lines. Thus, as in the case of sewers, the apartment complexes have enabled other residents to receive better service.

Other Functions Table 9-21 shows annual current expenditure from 1959 to 1970 for education (excluding schools), recreation, health, and welfare. Education and health expenditure have been somewhat higher in more recent years; welfare has been somewhat lower; and recreation has fluctuated.

Total annual current expenditure for these four services has been about $10,000 higher in 1968-70 than in 1959-65. However, they now constitute a smaller share of total current expenditure for municipal functions: 8.8 percent in 1959 versus 3.7 percent in 1971.

The education category in Lindenwold includes primarily expenditure for local and county public libraries and celebration of public events and holidays. Lindenwold has been celebrating Independence Day with parades, fairs, beauty contests or other activities since before the 1950's. A Borough library was opened in 1968 staffed by a part-time librarian paid $300 in 1968, $500 in 1969, $1350 (12 hours/week @ $2.25/hour) in 1970, and $1440 (12 hours per week @ $2.40/hour) in 1971. Capital expenditures totaling $7693 were made in 1968, primarily for rennovations of the library facility.

The recreation category primarily includes expenditure for playgrounds and parks. Lindenwold has opened five small parks in recent years; some include basketball courts and athletic fields. Capital expenditures of $32,067 were made for parks and playgrounds in 1969.

The health category primarily includes expenditure for the Board of Health

Table 9-21

Current Expenditure for Selected Services, Lindenwold and Voorhees, 1959-1970

Year	Education	Recreation	Health	Welfare	Total	Percent of total current expenditure
Lindenwold						
1959	300	5,000	1,585	5,700	12,585	8.8
1960	300	3,530	2,970	5,700	12,400	7.2
1961	1,000	2,700	2,330	5,375	11,405	6.6
1962	1,000	1,210	2,405	6,730	11,345	6.2
1963	2,670	1,597	2,925	6,850	14,042	6.6
1964	1,330	3,000	2,215	5,650	12,195	5.9
1965	3,119	3,225	3,440	5,750	15,534	7.1
1966	5,770	4,000	6,221	3,850	19,841	7.0
1967	3,090	1,096	9,009	2,401	15,596	5.4
1968	7,200	3,661	4,582	4,610	20,053	5.3
1969	7,100	7,201	6,351	4,400	25,052	4.7
1970	4,650	5,601	7,452	4,601	22,304	3.7
Voorhees						
1959			255	1,320	1,575	2.3
1960			205	1,320	1,525	1.7
1961			205	435	640	0.6
1962			205	435	640	0.6
1963	2,240		255	435	2,930	2.1
1964	1,321	2,000	575	885	4,781	2.7
1965	1,920	2,900	975	985	6,780	3.9
1966	2,220	1,500	900	985	5,605	3.0
1967	2,820	3,500	1,365	985	8,670	4.2
1968	3,120	4,000	1,225	1,035	9,380	3.5
1969	4,320	5,700	1,480	985	12,485	4.3
1970	5,220	9,060	2,225	1,013	17,518	4.8

and Vital Statistics, partially discussed above under general government, and mosquito control. Board of Health expenditure increased from $3053 in 1968 to $4206 in 1970 with salaries and wages increasing $911 and other expenses increasing $2141. Expenditure for mosquito control was $1834 in 1968, $2182 in 1969, and $1200 in 1970.

The welfare category consists of administration of public assistance, and the assistance payments themselves, which are provided through a state aid agreement. Administration expenditure increased from $1106 in 1968 to $2013 in 1970 with wages accounting for all but $7 of the increase. Public assistance payments decreased from $3500 to $2501 during the same period.

Analysis of Local Expenditure: Voorhees

General Government In 1961, Voorhees had two full-time and eleven part-time employees providing general government services. By 1964 there were three full-time and 14 part-time employees, and in 1971 there were three full-time and 19 part-time. In addition, the five Township Committeemen drew salaries over the entire period and Board of Health members were paid $5 per meeting in 1971. Table 9-22 lists all employees in 1961, 1964, and 1971 together with their salaries. Between 1961 and 1964, a full-time bookkeeping machine operator was added, the disposal engineer was discontinued, and five part-time positions with annual salaries totaling $2000 were created. Between 1964 and 1971 six additional part-time positions with annual salaries totaling $1070 were created and one part-time position, township physician, was discontinued. Also, two positions on a fees basis were established. Generally, the additions from 1961 to 1964 were related to zoning and construction inspection, whereas those from 1964 to 1971 involved inspection and clerical assistance.

These changes occurred in more of a step-wise pattern with fewer positions

Table 9-22

General Government Employees and Salaries, Voorhees, 1961, 1964, and 1971

Position	1961	1964	1971
		Annual salary, except as noted	
Tax Collector	$3,000	$3,500	$6,000
Tax Assessor	900	1,500	4,000
Bookeeping Machine Operator	none	3,000	5,400
Township Clerk	3,000	3,500	5,700
Solicitor	600	1,000	1,000
Treasurer	950	1,500	4,000
Township Physician	none	50	none
Secretary, Board of Health	none	none	60
Election Registrar	none	none	200
Registrar of Vital Statistics	none	none	50
Public Information Officer	none	none	360
Director, Welfare	350	400	400
Zoning Officer	none	500	1,300
Solicitor, Zoning Board	none	400	900
Secretary, Zoning Board	100	350	600
Solicitor, Planning Board	300	400	1,000
Secretary, Planning Board	350	350	600
Building Inspector	1,500	1,000	1,750
Assistant Building Inspector	none	none	200
Heating and Plumbing Inspector	none	750	1,500
Assistant Heating and Plumbing Inspector	none	none	200
Sanitary Inspector	none	300	900
Municipal Improvements Clerk	none	none	fees
Tax Collector Searches	none	none	fees
Board of Health Members	unpaid	unpaid	5/meeting
Disposal Engineer	1,000	none	none
Engineer	100	400	400
Committeemen	350	500	1,000

being created and later discontinued than was the case in Lindenwold. This may reflect the continuity of the major political party's control. In 1962, the engineer's position was abolished. In 1963 the zoning officer, solicitor of the Zoning Board, plumbing and heating inspector, and a tax clerk were added. In 1964, the tax clerk was replaced by the bookkeeping machine operator, and the disposal engineer was added again. In 1968 the secretary of the Board of Health was added. In 1970 the municipal improvement clerk, the election registrar, the deputy election registrar, the tax collector searches, and the registrar of vital statistics were added and the Board of Health members became salaried. Finally in 1971 the township physician and the deputy election registrar were discontinued and the public information officer was added.

Police The Voorhees Police Department more than doubled in size from 1967 to 1970. It had five full-time officers in 1967, seven in 1968, eight in 1969, and 11 in 1970. In addition, three full-time civilians, dispatchers and secretaries, were added in 1970. Previously, the Laural Springs police dispatcher served Laural Springs, Lindenwold, Stratford, Somerdale, Hi-Nella, Pine Hill, Clementon, Berlin Borough, Berlin Township, and Magnolia (which also dropped in 1970). The department has also added more vehicles and organized itself by a platoon system.

The local dispatcher is often cited by officials as an important improvement in police service. The Laural Springs dispatcher (in 1970 one person for ten communities, now two people) was allegedly so overburdened that the Voorhees police often never received calls.

As in Lindenwold, a larger, more versatile police force has had to contend with more and different criminal activity. The Ashland Station, like the Lindenwold Station, is cited as the location of auto thefts, larceny, and disorderly behavior, as well as a source of traffic congestion.

Table 9-19 documents the increase in crime in Voorhees. Auto thefts increased from 11 in 1967 and 1968 combined to 48 in 1969 and 1970 combined; breaking and entering increased from 64 to 125; and larceny increased from 79 to 138. All crimes against persons, in contrast to those against property above, either decreased or remained random. The total crime increased from 79 in 1967, to 132 in 1968, 131 in 1969, and 220 in 1970. The total crime index increased from 36 to 89, 101, and 168 from 1967 to 1970. The rate of increase in crimes was greater than the New Jersey, Southwest Region, and Camden County rates, but less than the Lindenwold rate; see Table 9-20.

Voorhees which did not add any apartments from 1956 to 1970 also suffered a sizeable increase in breaking and entering and larceny. However, it should be noted that the increase in auto thefts, breaking and entering, and larceny is particularly evident in Voorhees in 1970. The opening of the Echelon Mall Shopping Center on September 30, 1970, may be responsible to a large degree for this increase.

Data collected by the Voorhees Police Department from September 30 to December 31, 1971, support the hypothesis of a high crime impact of Echelon Mall. Without specifying the base period, their report notes: "since the opening of the Mall our total calls serviced has increased 33 percent, accidents increased 220 percent, and criminal activities increased 200 percent." A breakdown of 327 "incidents" at the mall in this period reveals in part the following:

45 accidents

15 ambulance calls

10 breaking, entering and larceny

17 disorderly conduct

10 frauds

15 larceny

20 stolen cars

14 mislocated cars

4 cars stolen elsewhere recovered in parking lot

10 stolen bikes

21 larceny from automobiles

16 shoplifting

9 malicious mischief

11 suspicious characters or vehicles

Thus, 72 cases of breaking and entering or larceny including stolen bicycles and shoplifting occurred within three months at the Mall as contrasted with only 71 additional cases in these categories from 1969 to 1970. The 20 stolen cars represent two more than the entire increase in that category from 1969 to 1970.

Almost a year later in an interview, Police Chief White indicated that this criminal activity has continued at even higher levels with shoplifting now at six per week. As did his colleague in Lindenwold, he stated that local growth and anonymity have brought different types of crime: "before with the neighborhood business, the proprietors knew everyone and there was no shoplifting... A stolen car used to be like a homocide, now there are five a week... The mall is a perfect place to pass narcotics, but with one detective, we can't do undercover work, so we work with the state police... The apartments in the mall have only been there two months. It's too soon to tell their impact. Everyone is happy fixing up their apartments, but apartments bring unknowns and domestics."

Court Expenditure for Voorhees' municipal court increased from $5910 in 1968 to $6809 in 1969, $7310 in 1970, and an estimated $8200 in 1971. Salaries account for most of the total expenditure and the increase. The judge was paid $700 in 1960, $1000 in 1964, $1500 in 1968, $1900 in 1969, $2100 in 1970 and $2500 in 1971. The violation clerk was paid $650 in 1960, $3000 in 1964, $3700 in 1968, $4100 in 1969, $4400 in 1970, and $4900 in 1971.

According to local officials revenues increased from $7500 in 1970 to $14000 in 1971. Voorhees receives $5 from each traffic violation with the state and county receiving the rest, and collects a fine for criminal action of $100 the first time, $200 the second, and $300 the third. A local official commented, "We prefer fines to probation. We are rough on shoplifters, who are mainly from the Mall."

Fire Voorhees has four fire districts, three have volunteer companies and the fourth pays Berlin Township for protection. The three volunteer companies were formed well before the recent growth: Ashland No.1 in 1913, Kirkwood No.2 in 1915 and Kresson No.3 in the 1930's. The companies are also social clubs sponsoring beer, bingo and other activities. The Ashland and Kirkwood companies continue to have "plenty of volunteers", but the Kresson company, located in the area of least growth, "is having a bit of trouble getting men." Of the two larger companies one consists of mainly older, retired men, while the other has younger members; the older group covers the day while the younger men are at work. However, when there is a fire, all three Voorhees companies and neighboring townships answer the alarm.

In contrast to Lindenwold where all properties pay the same tax rate for fire protection, in Voorhees each district elects its own commissioner, and sets its own rate which must be approved by its voters. The districts pay gas, oil, and rent, and buy their trucks or hire an outside company from their revenues. The men are unpaid volunteers. The water commissioner, in charge of hydrants in each district, is usually the same man as the fire commissioner. He determines the necessity of adding fire hydrants and divides its cost among those properties within 1000 feet of the new hydrant. The fire and hydrant taxes are collected for the fire districts by the Township Committee together with other property taxes.

According to local officials, tax rates in each district have been going down while revenue has been increasing. Ashland generated $24,000 in 1970 and $51,000 in 1971. Kresson generated $9000 in 1971 and is expected to generate $18,000 in 1972. The companies have been able to pay for new equipment in cash from surplus revenue. However, if the Ashland company buys a snorkle truck, which will cost $108,009, it may pay by bond or a combination of bond and surplus. Local officials feel Voorhees has much better service now than in earlier years, because of better equipment, better water supply, and lower tax and insurance rates.

Streets and Roads The Department of Streets and Roads patches, sweeps, and plows Township roads. Resurfacing is contracted to private firms, and amounts to about $8,000 per year. There have been no major Township resurfacing or road building programs in recent years.

New construction has had little effect on Voorhees' expenditure for streets and roads. Developers are required to build roads meeting Township specifications within their development; such roads are rarely publicly dedicated. However, the main roads through the Echelon Mall will be dedicated, but have not yet been accepted by the Townsnip.

The increase in traffic resulting from the Echelon Mall and the High-Speed Line have not caused a significant increase in maintenance needs, according to local officials. The majority of traffic is on county roads with very little on the secondary Township roads. The need to install two new traffic signals is attributed directly to the Mall, but the developer installed one of them at a cost in excess of $10,000.

Garbage and Trash Collection In 1969 Voorhees ceased using a private contractor and commenced its own garbage collection service. In 1971 it operated two trucks using nineteen man-days per week, three men working five days and two men working two days. The 1970 expenditure was $34,187 for this service; a township official stated the 1971 expenditure would be "about $30,000 which includes amortization on the trucks, gas, oil, and labor."

As in Lindenwold, apartments and business are not provided garbage service by the Township. Since only single family homes receive this service, there has hardly been an expansion of service. However, the Township provides twice a week service, whereas the contractor only picked up once. A local official explained that the changes were implemented "because we had the revenues and could provide the better service without increasing the rate."

Sewer Voorhees' municipal sewer utility operates two independent systems. The older system, which has two pumping stations, was built in 1957-58. The newer one, which has two pumping stations and a third projected, commenced operation in 1970. The older system with a capacity of 150,000 gallons per day was processing between 350,000 and 400,000 gallons per day in July 1972. The newer one with a capacity of 500,000 gallons was processing 200,000 to 250,000 gallons per day in July 1972. An official commented, "We get all sorts of quality criticisms on the old one. It will be cheaper to replace it when the time comes."

Sewer trunk lines were extended and a new pumping station was added by the Rouse Company as a part of the Echelon development, thereby enabling Voorhees to extend sewer service to 225 additional dwelling units. As a result, according to Township officials, 75 percent of the Township's residential units are now served.

The sewer utility is separate from the general budget. It is funded through user charges which are determined by costs. The older system has no connecting fee but a $35 per year user charge; the newer system has a $225 connection fee and a $65 per year user charge. Garbage disposals cost $15 extra per year on either system. Apartments are charged these fees for each unit.

Developers are required to put in all mains and laterals, even if there are no trunk sewers to connect to. There is no ban on septic tanks, as there is in Lindenwold. As recently as 1971 a development was approved with septic tanks, but it also provided mains and laterals for an eventual connection to the system.

Developers are not required to extend trunk lines; where the local government determines to extend them can become a controversial matter. The projected third pumping station on the newer system is intended to serve an area being developed as a hospital and medical center. Residents of a nearby residential area are currently protesting vigorously the failure of Township plans to include their homes on the new extension.

Water Water services in Voorhees are subject to the same conditions and prices as described above for Lindenwold. Both the Robin Hill Apartments and the Echelon Mall paid to extend water lines, which enabled earlier residents to have water service at no cost to them other than the standard meter installation, road opening, and user charges. As the water company only installs lines on public streets, the two main roads within the Mall complex will be publicly dedicated.

Other Table 9-21 shows annual current expenditure for education (excluding schools), recreation, health and welfare. Annual expenditure for these four services combined increased noticeably in recent years from $9380 in 1968 to $12,485 in 1969, and $17,518 in 1970. From 1959 to 1971 it ranged from 0.6 percent to 4.8 percent of current expenditure for all municipal functions. As the largest shares are for 1969 to 1970, expenditure for these services grew faster than the average of all other services.

However, the pattern varies considerably among these services. Voorhees made no expenditure for education until 1963 and none for recreation until 1964. Afterwards, education and recreation expenditure generally increased each year attaining their highest levels in 1969 and 1970. Health expenditure was stable from 1959 to 1963, but increased gradually every year thereafter. Welfare expenditure was fairly stable with a low of $435 (1961-63), a high of $1320

(1959-60), and a range from 1964 to 1970 of $885 (1964) to $1035 (1968).

Voorhees opened its library, staffed by a part-time librarian, in 1963 and Camden County opened a branch library in Echelon Mall in 1970. However, recreation has had the largest increases in expenditure. Part-time recreation leaders for summer sports were hired in 1970 and a full-time summer recreation coordinator was added in 1971. Also in 1971 Voorhees opened three basketball courts, tennis courts, athletic fields with night lights, and a YMCA branch with a day care service.

Conclusion

The studies presented in this chapter have investigated a broad range of fiscal impacts of development in Lindenwold and Voorhees during a period of rapid development. Since this development is presently continuing apace, any conclusions reached at this time must be considered tentative. Moreover, the absence of comparable case studies for both established and rural jurisdictions makes any generalization of these results hazardous.

The results obtained for educational expenditures are much easier to interpret because of the availability of a quality index, however crude. Based on these findings there seems little doubt that the apartments constructed in Lindenwold and Voorhees have generated tax revenues well in excess of costs. As compared with the fiscal position of single family homes, apartments are indeed a favorable type of development.

Two notes of caution need to be expressed in this regard. First, the apartments on which these analyses were based are primarily one-bedroom units. The low number of school children is an effect of this size constraint. These results clearly would not apply to apartment projects offering a broader range of unit sizes.

Second, because the projects are quite new, the socio-economic composition of the households is heavily skewed toward the younger age group. Whether this composition will prevail in the long run remains to be seen. Changes in this composition could substantially alter the costs imposed on government by these units.

The interpretation of the analysis of municipal costs imposed by this growth is less clear. In part the costs revealed by the analysis are the result of urbanization, and not the particular form of urbanization that is occurring in this instance. Aside from relatively minor costs associated with the High-Speed Line itself, there is little evidence that the cost of growth in Lindenwold and Voorhees is much different than elsewhere. In particular, little evidence was found that apartments have generated different costs than single family development.

However, a secondary effect of apartments on local government is beginning to be noticed which may affect costs substantially in the long run. As has been documented in Chapter 8, apartment residents are typically relegated to the status of second class citizens by single family based suburban power structures. This may mean that apartments receive far fewer services and benefits than do single family units. Withdrawal of garbage collection services from apartments in Lindenwold is a notable example.

As the number of apartment units increases, this situation could well be reversed. Already, there is evidence in Lindenwold that apartment residents are gaining a substantial voice in local government. Well-organized tenant associations further increase the power of apartments relative to less-organized single family neighborhoods.

If apartment residents do capture control of the local government, or at least amass enough power to achieve a fair share of governmental benefits, the true costs of apartments might increase substantially. For example, Lindenwold has almost no public open space, in part because single family residents have opposed it on the narrow grounds that they provide their own. Why shouldn't an apartment controlled Council develop fine parks and recreation areas for the benefit of its constituents. If this were to take place in both Lindenwold and Voorhees, and it seems reasonable to expect that in time it will, then quite a different cost structure may well emerge.

CHAPTER 10

PROPOSED PHASE TWO RESEARCH PROGRAM

Introduction

The research undertaken during Phase One of this study has probed into two broad areas:

1. impact of the Line on residential property values of single family housing units;

2. impact of the Line on municipal land development policy, including the impact on municipal finance.

As summarized in Chapter 1, these studies have identified a significant impact of the Line on residential property values. The amount and extent of the impact appears to be consistent with the capitalized value of actual or potential savings available to users of the Line. The case studies of municipal land development policy suggest that the Line was one of several factors resulting in large scale apartment construction near the Lindenwold and Ashland Stations. However, the policies of Lindenwold Borough and Voorhees Township were the decisive factors in determining the type and extent of development that has occurred. The fiscal impact studies document to a considerable extent why Lindenwold perceived apartments to be an excellent tax rateable.

The research proposed for Phase Two will complement and extend these findings in the following areas:

1. impact of the Line on vacant land value, including residential building lots, commercial sites, and larger tracts held for sale to developers;

2. analysis of trends in municipal finance to determine the impact of the Line, directly and indirectly;

3. analysis of 1970 Census data for sample questions (Fourth Count Tape):

a) place of work
b) choice of mode for journey to work
c) age of housing stock
d) migration trends

4. extensions of the spatial-temporal analysis of Chapter 6 to include:

a) Gloucester County, as well as Camden County
b) fiscal 1972 sales
c) sales classified as "non-useable" because of reassessment or new housing for 1965 to 1972

5. completion of analysis of FHA Mortgate Appraisal Files

Studies planned for Phase Three include the following:

1. analysis of apartment construction throughout the three-county South Jersey area with respect to impact of the Line on location, type, rent, occupancy, etc.

2. analysis of trends in educational finance and enrollments to determine the direct and indirect impact of the Line;

3. extension of the analyses of residential property values, as approached in both Chapters 6 and 7, to include Burlington County and fiscal 1973 sales;

4. assessment of the overall indirect benefits and impact of the Line, incorporating the various results and findings of all three phases into a final report.

The above items constitute an updating of the broad outline in the original proposal of April 1971, and represent the current recommendations for the research program of Phases Two and Three. The program for Phase Two is now described in more detail.

Phase Two - New Studies

Impact on Vacant Land Value

A thorough investigation of the impact of the Line on vacant land sales prices is proposed, complementing the Phase One research on residential land prices. This study will examine the type, pace and intensity of vacant land development in the market area of the High-Speed Line and in control areas defined on hypothetical transit lines. The study will analyze various influences affecting the price of vacant land, with particular emphasis on those factors related to the Line.

The current data base for this study consists of all useable vacant land sales in Camden and Gloucester Counties in fiscal 1960 and 1965 to 1971, or about 2850 transactions. Each sale has been classified by Census block group; lot size and 1972 land use are known from the county tax assessor's files. The land use classification permits sales to be analyzed by type of development, for those cases in which development has occurred. Sales for fiscal 1972 will be added to this file when the tapes become available in October 1972.

Other variables to be added for each parcel are the following:

1. daily savings from the High-Speed Line;
2. distances to principal shopping centers;
3. distances to freeways and principal arterials;
4. zoning classification, if readily available;
5. on-site characteristics, if available;
6. socio-economic neighborhood data, in particular 1970 census variables such as household income;

Additional variables may be added as suggested by the results of the analysis and availability from new sources.

The statistical analysis will largely follow the regression analysis approach of Chapter 7. Vacant land sales prices will be related to the above variables, and to year and neighborhood type using dummy variables. The analysis will be stratified by type of development, where known, and by location with respect to the extent of development. The effect of planning and zoning will also be considered.

Some care will be required to separate transactions for speculative investment from sales for immediate development. Subdivision records may be helpful here, as well as the tax records which indicate whether development has occurred.

Relationship of the parcel to High-Speed Line stations is, of course, of principal interest. The savings variable and the distance to nearest station will play an important role here. The market and control area concepts defined in Chapter 4 will also be tested.

Fiscal Impact on Adjacent Municipalities

In Phase One, an exploratory study of the impact of the Line on municipal finance was made using Lindenwold and Voorhees as case studies. This study has identified several questions for additional study, as well as an excellent data base for a more comprehensive analysis.

The State of New Jersey began compiling reports on revenues and expenditures for each municipality and county in the State in 1938. Copies of these reports for nearly all years have been obtained for the use of the project. In 1968, the reporting procedure was extended in detail, and the data were key-punched to facilitate analysis and report production. Machine readable files have been obtained from calendar years 1968, 1969 and 1970 for all municipalities (over 500).

Expenditures are reported for each municipality for the following major categories:

1. general government
2. judiciary
3. fire protection
4. police protection
5. other public safety
6. streets and drainage
7. sewers and sewage processing
8. garbage and trash removal
9. other public works

10. health services
11. welfare and public assistance
12. recreation
13. education, excluding schools
14. statuatory expenditures (pensions, F.I.C.A., etc.)
15. capital improvements
16. debt service

These uniform classifications of expenditure permit comparison of level of expenditures across governmental units and years. More detailed classifications are also available, but may not be valid for comparative studies because of differences in reporting.

An analysis by year, municipality and type of expenditure will be made to identify municipalities whose expenditures are increasing faster or slower than the overall trend. The three causes of rapid increases in expenditures identified in Chapter 9 will be considered to explain deviations from the overall trend:

1. inflation;
2. increased quality of services demanded;
3. increase in amount of service required because of population increases or increased activity levels.

Cost of police protection, and streets and drainage, will be examined in particular to determine whether jurisdictions with High-Speed Line stations or traffic tend to have higher costs. The 1968 data will serve as a reference year for these studies; data from earlier years will be added if needed. The effect of the Line on municipal tax revenues will also be examined if time and resources permit.

Analysis of 1970 Census Data

The Phase One research has made extensive use of the Bureau of the Census tract and block system and block group coordinates, but only limited use of the 1970 Census data; see, in particular, Chapter 7. A principal reason for this emphasis is that the most interesting census results are not yet available. These data are the responses to the sample census questionnaires as tabulated on the Fourth County Summary Tape. These results, which are compiled for census tracts, will be available shortly.

Analyses of several items on this tape are proposed for Phase Two. These analyses are limited in many respects; in particular, the cross-section nature of the data is restrictive. Nevertheless, these data, collected 14 months after initiation of service on the Line, provide a very useful benchmark, and warrant careful analysis. The most interesting data for studying impact of the Line are as follows:

1. place of work, recorded by county and probably by Philadelphia CBD
2. mode of journey-to-work
3. age of housing stock
4. place of residence in 1965

The first two items, of course, are directly related to impact of the Line. Unfortunately, a cross-classification of the two items will not be available. In any event, the work place of employees residing in census tracts in the Line's market area can be compared with adjoining areas. Some comparisons with 1960 Census data may be possible here to detect major shifts in work place location. Then, the proportion of workers using the Line can be compared with the proportion working in Philadelphia CBD to determine roughly how the capture rate of the Line declines in relation to (a) distance from stations, and (b) level of savings as derived from the station choice model.

The age of housing variable will be analyzed in order to further interpret the results reported in Chapter 6 in which the decomposition analysis appeared to be contrasting older block groups with newer ones. The migration data and related demographic characteristics of the population will be useful in contrasting the households occupying apartments in Lindenwold with those located elsewhere throughout South Jersey.

Phase Two - Continuing Studies

During Phase Two, continuing analysis of the New Jersey Real Estate Transactions File is proposed. This file will be extended during Phase Two in three ways:

1. useable sales during fiscal 1972 will be added in October 1972, bringing the number of years in the file to eight;
2. sales classified as non-useable because of reassessment of a municipality will be retrieved for fiscal 1965-1967, 1970 and 1972 for Camden County and for 1965-1972 for Gloucester County; these sales were retrieved for 1968, 1969 and 1971 for Camden County during Phase One;
3. sales classified as non-useable because the property had not been assessed (normally new houses) will be added for all years for both counties; this addition will permit a much more satisfactory analysis of block groups developed during the 1965-1972 period.

Sales will be obtained for all property types. Vacant land sales will be added to the data proposed for vacant land analysis. Residential sales will be added to the data files analyzed in Phase One. These data will extend the number of years to eight and the number of block groups to over 400.

The analysis of residential sales will extend the results of Chapter 6 to include (a) Gloucester County sales, 1965-1971, (b) 1972 sales for both Camden and Gloucester Counties, and (c) consideration of time intervals of less than one year, such as three months and six months. The extension of this analysis to Gloucester County is considered to be a major advance, as the results will permit the hypothetical Woodbury market area block groups to be contrasted with the Lindenwold market area block groups, which are largely in Camden County.

The addition of Gloucester County, and the 1972 sales, should result in a larger interaction effect, if such an effect exists as hypothesized in the savings model. The addition of non-useable sales throughout the time period will permit the inclusion of more block groups than would otherwise be possible because of sample size problems. Shorter time intervals will permit the inflationary effects to be traced out more carefully, particularly during the interval when the Line began operation.

In addition, an analysis of useable residential sales by municipality and year for the entire state, or all of South Jersey is recommended. The data for this analysis are presently available for 1965-1971. This analysis, conducted at a more aggregate scale, should be very useful in interpreting the block group by time period analyses. In particular, the estimates of the year effects, which are related to inflation, will be checked.

Finally, a complete report on the analyses of the FHA mortgage application data for Camden County will be included in the Phase Two Report. These studies were begun during Phase One, but were not completed in time for full documentation in this report.

Phase Three Studies

Only a very brief discussion of the recommended Phase Three research is necessary, mainly to clarify the reasons for the items outlined in the first section of this chapter. One major portion of Phase Three will be devoted to analysis of apartment construction, complementing the studies of single family sales and extending the Lindenwold and Voorhees case studies to the entire three county area. These studies will require a substantial amount of data collection at the municipal level based on building and occupancy permits. These data will augment 1960 and 1970 Census of Housing data and limited data files available from the State of New Jersey.

A second analysis will extend the municipal finance studies of Phase Two to education. Excellent data for this purpose are available by school district and year, but unfortunately these data are not keypunched. However, the number of categories is reasonably small, and some excellent results extending the findings of Chapter 9 should be forthcoming.

Another principal part of Phase Three will be the inclusion of Burlington County sales in the statistical studies of sales prices. These sales have not been included to date, and are not proposed for inclusion in Phase Two, because a computerized tax assessor's file is not yet available. This file is essential to obtain property characteristics of the sales. The firm under contract to prepare this file has indicated that it will surely be available by 1973. Accordingly, the extension of the sales files to Burlington County is regarded as a high priority work item for Phase Three. Analyses paralleling Chapters 6 and 7 of this report and the vacant land study of Phase Two are contemplated.

Finally, the preparation of a final report covering all three phases will be a product of the third phase. This report will integrate all of the findings obtained in the three-phase study, and will seek to draw conclusions concerning the overall indirect benefits of the Line to that date. To the extent feasible, the final report will incorporate other analyses of the impact of the Line.

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Note on Sources of Tables and Figures

Many of the tables and figures of this report have been drawn from published data sources, such as the U.S. Bureau of the Census, and unpublished sources such as the records of DRPA and PATCO. Time has not permitted the proper specification of the source of the materials in each table and figure. The principal investigator will be pleased to furnish this information on request.

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