Creating Communities of Place


# EXAMINATION OF RESIDENTIAL LOCATIONAL THEORIES AND FACTORS THAT AFFECT TENURE

**Document #81**

NEW JERSEY OFFICE OF STATE PLANNING
*JANUARY 1992*

# EXAMINATION OF RESIDENTIAL LOCATIONAL THEORIES AND FACTORS THAT AFFECT TENURE

TECHNICAL REFERENCE DOCUMENT # 81

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Department of the Treasury
150 West State Street, CN 204
Trenton, NJ 08625
January 1992

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**ABSTRACT**

This paper describes the research performed to identify the appropriate locational/economic theory which, when incorporated into the Office of State Planning's Population and Employment Distribution (PED) model, is intended to allow forecasted future economic conditions to affect the model's location of future residential development.

The hedonic and sectoring theories were examined. A strong relationship between municipal household income and housing values was established. However, the adoption of a hedonic-based housing locational model is not recommended due to the moderate relationship between municipal household incomes and municipal rental prices. Instead it is recommended that the PED model include a methodology based on the high correlation found between household income and municipal income; a finding consistent with the Sector Theory.

Further research based on Bureau of Labor Statistics data found that the tenure decision appears to be income and age related.

Acknowledgements

This report was prepared by James Reilly of the Office of State Planning. William Bauer provided substantial assistance by providing statistical programming and data collection. David Hojsak, Steve Karp, Teri Schick, Robert Kull and William Bauer assisted in editing and proof reading. Teri Schick was the report editor.

**SUMMARY**

The Office of State Planning (OSP) Population and Employment Distribution model (PED) assigns statewide forecasts to municipalities, based on the history of growth or decline of each municipality and the municipality's supply of developable land to support growth. A criticism of this model's growth assignment method is that it assumes that all land and households are economically homogenous, e.g.. anyone can afford to move anywhere.

The Regional Science literature was reviewed to identify economic - locational theories that might be incorporated into the PED model. Three generalized theories were discovered: centric; hedonic and sectoring. The centric concept postulates a development pattern with one or more major employment concentrations. Land rent declines with distance from employment centers allowing householders to utilize the land cost savings to pay for increased commutation costs and/or larger housing facilities. The hedonic theory envisions housing demand as a function of income, price and other factors. It argues that households choose a location which maximizes their investment in the form of housing and other pleasurable attributes associated with the location of the house, such as better schools, lower crime rate etc. Sectoring proposes that households with similar characteristics, such as income, tend to group together.

An analysis of the centric theory was not performed. Researchers report that although the general findings of the model are accurate, the model does a poor job of predicting the specific price of housing in any municipality. Attention was focused on statistical examinations of the hedonic and sectoring theories.

**Hedonic Theory Analysis**

Research literature reported that the mixture of elements related to housing demand were: income, price and other factors. Several statistical examinations of this relationship were performed. The first examined the relationship between income and price and found a strong correlation between municipal mean household income and the price of owner-occupied housing, but only a moderate relationship between income and contract rent.

Next, the hedonic theory's reported relationship between price, income and other variables were tested. Three types of variables were tried. The effect of *municipal condition* was estimated by first regressing price to the percentage of units built in 1939 or earlier and then by regressing price to municipal occupancy rates. *Proximity to employment* was tested using job-to-household ratios regressed with price. Finally, the effect on price related to *municipal growth or decline* was tested, using both the change in the housing stock and the change in population between 1970 and 1980. Most of these variables were significant, but proved to be poor models by themselves. Only municipal growth and the job-to-household ratio, when related to contract rent, were found to have no significance. Finally, composite models, which included income and the variables found to be significant, were related to housing prices. The resultant relationships were modest improvements over those produced by relating income and price alone.

The examination of the hedonic theory produced surprising results. The strong relationship between income and price suggested that one of these factors might be used to predict the other, and that they might be thought of as synonyms in any locational model. In addition, the inability of the income to price model to produce stronger relationships was assumed to be the result of factors affecting tenure decisions. However, it appeared that it would be very difficult to develop a growth location model based on the hedonic theory.

**Sectoring**

Given the statistical relationship between income and price, the relationship between municipal income and the income groups in the municipality (sectoring) was examined. The representation of each of the eight household income groups was related to the median municipal household and mean municipal per capita incomes. Strong correlations were produced by this method. Since OSP had previously developed a method to estimate future mean municipal per capita and household incomes, the sectoring approach is recommended for inclusion in the Trend version of the PED model.

**Tenure**

To further understand the elements affecting the relationship between tenure and income as suggested by the differing relationships between income and housing value (owner) and contract rent (renters), survey data collected by the US Bureau of Labor Statistics (BLS) was reviewed. OSP was able to construct new tables which combined data from several separately published BLS tables. These OSP-constructed tables showed that tenure was a function of both household income and the age of the head of the household. Table S-1 displays the resulting tenure cohort tables.

**Table S-1**
Estimated Percent of Age-Income Cohorts
Who Rent Their Dwelling Unit

| | **Income Categories** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ***age cohorts*** | **less than $5k** | **$5k > <$10k** | **$10k > < $15k** | **$15k > < $20k** | **$20k > < $30k** | **$30k > < $40k** | **$40k > < $50k** | **$50k or more** |
| ***< 25*** | 99% | 96% | 94% | 92% | 90% | 82% | 50% | 20% |
| ***25 to 34*** | 80% | 75% | 65% | 60% | 50% | 40% | 30% | 20% |
| ***35 to 44*** | 65% | 60% | 55% | 45% | 35% | 20% | 15% | 10% |
| ***45 to 54*** | 55% | 55% | 45% | 35% | 25% | 20% | 15% | 5% |
| ***55 to 64*** | 40% | 35% | 30% | 25% | 20% | 15% | 10% | 5% |
| ***65 >*** | 60% | 50% | 20% | 25% | 35% | 25% | 20% | 10% |

source: BLS Consumer Expenditure Survey:
Integrated Survey Data, 1984 - 86
Tables 2 and 3

**Other Uses for the Findings of this Report**

In addition to providing a method to improve the PED model, two other uses have been identified for the findings contained in this report:

Evaluate Alternative Housing Recommendations for the State Development and Redevelopment Plan - Forecasts of households together with the estimates of income, future location (the result of applying the sectoring findings) and tenure could be converted into an estimate of future housing program. This program estimate could serve as the basis to evaluate alternative policies and applications of the State Development and Redevelopment Plan recommended either through the Cross-Acceptance process or from other sources. For example, if the model forecasts large numbers of low and moderate income households, then the policies of the State Plan and the recommendations of Cross-Acceptance Reports need to be evaluated to insure they can accommodate this future population.

Stimulate the Preparation of Housing Policy Research Papers - Some of the information contained in this report could stimulate the development or refinement of housing policies in the State Development and Redevelopment Plan. The issues discussed in the last section of this report might best be examined through the development of a policy research paper which would discuss the issues, report the policy responses implemented elsewhere, and, report the effectiveness of the alternative policies and their applicability to New Jersey housing issues.

## I. DEVELOPMENT OF THE STUDY CONCEPT

### Expert Review of the OSP Population and Employment Distribution Model

Since the release of the 1987 Draft Preliminary State Development and Development Plan, the Office of State Planning (OSP) has been developing computer models which would allow Plan policies to be tested and evaluated. One of these computer programs is intended to simulate future land use development patterns, assuming that certain historic conditions continued and that projections of population and employment, input to the model, were realized. This Trend growth model, called the Population and Employment Distribution (PED)[1] model, would then form the baseline against which Plan impacts could be evaluated.

The current version of the PED model distributes growth using a two phase process. First, the program takes county estimations of future population and employment and assigns growth to each municipality based on its proportion of growth during a specific user-selected historic period. To assign population, the model first converts future population forecasts into forecasts of future households. The program to convert households to housing need contains the assumption that the sum of the total households, together with adjustments to the existing supply of housing (demolitions and conversions), plus an overbuild allowance for vacancy, would result in an estimate of the total future need for housing. The estimate of new housing construction is derived by subtracting the number of today's houses, that are expected to still exist in the future forecast year, from the total housing need. This county specific estimate of new housing then is assigned to municipalities using a shift share method. For example, if the total future housing growth for a county was forecasted to be 100 new units, and a municipality's share of the county's new housing growth rate for the selected historic period was 10%; then the forecasted allocation of new housing to the municipality would be 10 units (10% of the county's forecasted growth of 100 units). This process of estimating future growth (or decline) is referred to as the **allocation** phase of the model.

The model's second phase estimates the land required by the growth allocation and tests to determine if sufficient developable land is available in the municipality. (OSP has estimated land availability in each municipality by measuring 1986 aerial photographs.[2]) If sufficient land is available then the growth allocation is accepted in the program. If sufficient land is not available then that new growth that can be fitted to the available land is counted; unfitted growth is redistributed to other municipalities in the county where available land exists. This process of testing the growth allocation is referred to as the **fitting** phase of the model.

The PED model has been reviewed twice by panels of academic and professional planners, economist and modelers. Major modification and improvements have been made to various parts of the model as a direct result of this review process. During the last review (April 1990), it was noted that the model assigned and fitted householders to municipalities without regard of the ability of the household to afford housing in the municipalities to which they are allocated. It was recommended that the process of assigning growth needed to be sensitive to local economic considerations, such as the cost of land or housing in a municipality.

### Review of Research Literature

Realtors voice a simple theory about development. They argue that decisions to acquire one site verses another and decisions to pay a specific price for one site while another less expensive site might have many of the same physical characteristics are a result of "location, location, and location." For the purpose of this paper, the difficulty with this theory is that it does not define what is meant by location. Does location refer to a site where regional transportation conditions are optimized, or does it refer to the ambiance of the local area surrounding the site? Are there regional economic theories of land use development that would improve the growth allocations made by the model, or does the process of "fitting" growth allocations need to be upgraded to include local

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[1]New Jersey Office of State Planning. **Draft**: Distributing Population and Employment Forecasts to Municipalities. Trenton, NJ: OSP, 1990

[2]New Jersey Office of State Planning. **Draft**: Estimating Growth and Its Effects, pt 1: Land Availability Analysis. Trenton, NJ: OSP, revised January 1989

economic considerations? These questions of economic scale and locational motive are key to pursuing a solution to the comments offered by the experts.

The demand for housing has been the subject of substantial research efforts. Several planning and economic theories, frequently referred to as 'models', have been published which provide a framework for estimating either price differences and/or growth locations in a region. In general all of these theories have been described[3] as variations of three generalized theories: Centric, which includes both monocentric and a modified monocentric; hedonic; and sectored.

Centric Theories

A classic monocentric model is based on the template of a city where the center contains all of a region's employment and where housing is assigned to the land surrounding this Central Business District (CBD). Other assumptions are that commuting cost is a function of distance to the CBD and is the same in all directions, and that land is uniformly developable in all directions. It also is frequently assumed that households are the same throughout the region (Muth, 1985).

In a modified monocentric model, other non-CBD employment concentrations are allowed, and transportation cost can be irregular, allowing, for example, commuter cost saving that might result from the construction of a highway or transit line. Some modified models also allow for households with different incomes.

Both of these models then propose that residential locational decisions and real estate prices are a function of transportation cost, land costs (and, in the case of some models, the price of all other goods), and household income. In the classic monocentric model, land prices are highest in the CBD and decline with distance from the CBD. In modified models, land price "reflects competition by housing suppliers for the available land",[4] and vary relative to distance from employment concentrations and relative to the cost of transportation. Either type of monocentric model predicts the highest density of housing and the highest land prices closest to the employment concentrations, and the lowest density and lowest land price farthest from employment concentrations. The models also predict that lower income persons live closest to employment, while wealthier persons can afford the larger lot sizes and greater commuting costs associated with greater distances from their jobs[5]. While such model results can be viewed as theoretically elegant, they, by themselves, have not proven to produce reliable results (Muth 1985).

Hedonic Theory

Another theory, which does not necessarily attempt to assign development locations, but which attempts to describe the local conditions which result in the determination of price, is termed "hedonic," since the idea is that locations and prices are determined by a complex set of attributes which please the person or business moving into the municipality. For example, the theory would argue that the price one is willing to pay for housing is the result of a rational economic decision intended to optimize a family's budgeted ability to pay for both tangible costs, such as those associated with lot size, housing construction costs, commuter costs, and the intangible costs that might be associated with the property. This addition of intangible costs recognizes that the buyer might be willing to pay more for a house in a location with neighborhood traits, deemed desirable by the purchaser, such as a low crime rate, a better school system, or a more attractive setting.

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[3]Richard F. Muth. "Models of Land-Use, Housing, and Rent: an Evaluation". Journal of Regional Science 25.4 (1985): 593

[4]Mahlon R. Straszheim. An Econometric Analysis of the Urban Housing Market. National Bureau of Economic Research. New York: Columbia University Press, 1975. p15.

[5]James L. Altmann. "Analysis and Comparison of the Mill-Muth Urban Residential Land Use Simulation Models", Journal of Urban Economics 9 (1981): 365 - 380.

The normal hedonic equation includes social variables, income, and local price of housing as the major ingredients of any definition of housing demand[6]. The following is a standard expression[7] of the elements that affect housing demand:

$$Q = Q(Y, P, Z)$$

Where:

Q = flow of housing services demanded
Y = some representation of income
P = relative price of housing or rent
Z = other variables

Candidates for the "Z" variable in the demand equation have been producing academic interest for some time. Some of the factors that have been reported as significant include: family size, investment objective, tax policies, race, interest rates, education of the head of the household, and the sex of the householder.

Several other factors are reported to affect hedonic demand modeling, such as definitional issue of income, price and the mathematical nature of the relationship between the demand elements.

Mayo[8] argues that current income is most predictive only with those income groups where income is relatively constant. He argues that demand calculations are more reliable with the use of permanent income, which includes both current income and other forms of income, such as anticipated (average or lagged) income and transitory income. Goodman[9] finds that when demographic variables, especially age of the household head, are introduced into the demand equation, current income produces the best results, but that permanent income is most predictive in estimating tenure. Goodman's argument exposes another aspect of the income research, which is whether income has its major impact in determining demand or whether income's major impact is to influence tenure choice decisions.

Research differences also exist regarding the definition of price. Mayo (1981), in summarizing the findings of several researchers, reports demand differences resulting from: prices based on Bureau of Labor Statistics (BLS) "family workers" budgets; prices based on the parameters of housing production; prices based on a "hedonic" index of housing services; and, prices based on variable rent rebates.

Even the form of the demand equation which describes the relationship between income and price is the subject of debate. Mayo (1981) reports the use of linear, log-linear and semi-logarithmic functional forms. After examining the issue he concludes: "It appears that the linear expenditure equation fits no worse than a log-linear demand equation in most analysis where alternative specifications have been tried, and often fits distinctly better... It is to be expected that when the range of income and price variability in analysis is limited, log-linear and linear equations will tend to produce similar results."[10]

This is not to say that correlations have not been established between income, price and the resulting demand for housing, it is only to say that these factors alone do not provide perfect correlations. Clearly other factors have an effect, which the social scientists would like to quantify. However, this search for scientific understanding is complicated. One form of complication concerns the nature of the relationships in the equation, e.g. is age an independent variable in the demand equation, or does it only affect income, and by affecting income, alter the demand equation. Another factor which muddies the research water is the issue of time. For example, the

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[6]Stephen K. Mayo. "Theory and Estimation in the Economics of Housing Demand," Journal of Urban Economics 10 (1981), 95 - 116.

[7]Allen C. Goodman. "An Econometric Model of Housing". Journal of Urban Economics 23, (1988) p.327-353

[8]Stephen K. Mayo. "Theory and Estimation in Housing Demand". Journal of Urban Economics 10, (1981) p.95-116

[9]Allen C. Goodman. "An Econometric Model of Housing". Journal of Urban Economics 23, (1988) p.327-353

[10]Stephen K. Mayo. "Theory and Estimation in Housing Demand". Journal of Urban Economics 10, (1981) p.107

costs for mortgages have shifted dramatically since the 1970's and have likely had an effect on the relationship between income and price. If a person bought a house during a time of high interest rates, high lending fees and large down-payment requirements, that person likely could afford less housing than could a person with identical income who purchased at a time of low interest, fees and down-payment requirements. So an analysis of income and price using home buyers who bought at the same time might report a strong correlation, but a sample of home buyers containing persons who bought homes at different times, and under different financing conditions, may not find as strong a correlation. Therefore, correlation imperfections in the demand model might only reflect the collective chaotic pattern of numerous variables affecting numerous home demanders separately.

Sectoring

The clustered model refers to the economic advantage of certain businesses to locate in proximity to other related business. A subset of this idea is described as "sectoring," an example of which would be persons of a specific income or background locating to areas with similar characteristics. In effect, the theory argues that wealthy persons live in municipalities with high incomes and poorer persons live in municipalities with lower average incomes. Therefore, if the wealth of the community can be estimated, then households with similar incomes can be reasonably assigned to these places.

**Study Definition**

While the demand for housing is viewed as a function of income, price and other variables, the decisions pertaining to housing demand have been defined[11] as: 1. household formation; 2. tenure choice; and 3. the amount of housing to consume. To these decisions should be added: 4. the location of the housing unit.

Currently, some of these demand elements already are estimated or simulated in existing OSP models. The OSP PED model contains a sophisticated model to estimate household formation and to estimate the total need for housing. The OSP Income Estimation models produce various forecasts about the future income characteristics of municipalities and the mix of household incomes. However, if this income and household information is to be used effectively, the OSP PED model needs to have some basis for assigning households with specific incomes to municipalities. If the OSP model were to include hedonic-like algorithms to make housing assignments, the fundamental relationship between income and price would need to be evaluated. In addition, some analysis of other factors that effect the Hedonic relationship would need to be undertaken. If the OSP model were to utilize a sectoring methodology, then the statistical basis for this theory needs to be determined and the relationships between household and municipal income defined.

[11]Richard J. Kent. "The Relationship between Income and Price Elasticities in Studies of Housing Demand, Tenure Choice, and Household Formation". Journal of Urban Economics 13, (1983) p. 196-204

## II. EXAMINATION OF THE HEDONIC THEORY

### Hedonic Theory Relationships - Income and Price

The purpose of this statistical examination[12] is to test the validity of the relationship between price and income, and to identify what other variable are significant in the demand equation.

The first analysis tests the relationship between income and price reported in the research literature. A second purpose of these regressions is to determine the extent to which changes in the type of municipal income used on the relationship (mean per capita or mean household) would affect the model's ability to predict changes in the median value of the municipality's housing values or median contract rent.

Total percapita income is equal to the sum of total household income and total income of all persons living in group quarters, divided by the total population. Total household income is equal to the sum of all income from all persons living in houses and all persons living in rental units. Therefore, one might expect a better correlation between household income and housing values or rent than that which would result from the use of per capita income. Municipal data which described the per capita income, median household income, median contract rent, and median housing value were taken from the 1980 Census. Tables 1 and 2 displays the results using per capita income and Tables 3 and 4 report the results using household income.

A strong relationship was found between both types of incomes and housing values, and a moderate relationship was displayed between both types of income and contract rent. Because the research literature suggested that the form of the equation might affect the relationship, a regression of the natural log of Rent as the dependant variable and the natural log of mean per capita income as the independent variable was performed. The resultant $R^2$ was .52326[13].

Because of the similarity in the correlations using household income and per capita income, comparisons of household income to per capita income were performed. The resultant $R^2$'s were .637024, for the regression comparing household income to per capita income and .662179 for the comparison of the natural log of household income to the natural log of per capita income.

The results of the analysis are the finding that an income driven model would strongly predict housing values, and that while an income model would correlate well with contract rent, it would be less predictive. The strong relationship between income and price was somewhat surprising, since the hedonic equation supports a relatively weak relationship between these factors. The theory would argue that the weak relation between income and price, by place, would be the result of additional price variation explained by amenity.

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[12]All of the OSP statistical analyses in this report were performed using SAS Version 5-18 software running on OSP's Prime mini computer. Regressions reported in this publication were prepared using SAS's GLM (General Linear Model) procedure. While only selected summary statistical data are displayed in the text of this report, the entire GLM report and data plot are included in Appendix A of this report. Unless noted otherwise in the text or tables, data from all 567 New Jersey municipalities were used in all of the regression analyses.

[13]The SAS Introductory Guide reports that "in general, the larger the value of the $R^2$, the better the model's fit". SAS Introductory Guide, Third Edition. Cary, NC: SAS Institute Inc. (1985) p.64

**Table 1**
Regression Results: 1980 Municipal Median Housing Values
as a Function of 1980 Municipal Mean Per Capita Income

Dependent variable: Housing Values 1980 (HVAL80)
Independent Variables:

| VARIABLE | PARAMETER EST. | S. E. | PROB >T |
|---|---|---|---|
| Intercept | -12305.22191888 | 1908.46701911 | 0.0001 |
| PCI80 | 8.00564545 | .19040732 | 0.0 |

F - value: 1767.77 PR > F: 0.0
Sample size: 563
Degrees of Freedom: 562
R-Squared: .758774

**Table 2**
Regression Results: 1980 Municipal Median Contract Rent
as a Function of 1980 Municipal Mean Per Capita Income

Dependent variable: Median Contract Rent 1980 (RENT80)
Independent Variables:

| VARIABLE | PARAMETER EST. | S. E. | PROB >T |
|---|---|---|---|
| Intercept | 110.82622139 | 6.58676287 | 0.0 |
| PCI80 | 0.01524224 | .00065698 | 0.0 |

F - value: 538.25 PR > F: 0.0
Sample size: 564
Degrees of Freedom: 563
R-Squared: .488764

**Table 3**

Regression Results: 1980 Municipal Median Housing Values
as a Function of 1980 Municipal Median Household Income

Dependent variable: Housing Values 1980 (HVAL80)
Independent Variables:

| VARIABLE | PARAMETER EST. | S. E. | PROB >T |
|---|---|---|---|
| Intercept | -8553.26586818 | 2062.86787161 | 0.0001 |
| HHINC | 3.29989192 | .08906959 | 0.0 |

F - value: 1372.59 PR > F: 0.0
Sample size: 563
Degrees of Freedom: 562
R-Squared: .709499

**Table 4**

Regression Results: 1980 Municipal Median Contract Rent
as a Function of 1980 Municipal Median Household Income

Dependent variable: Contract Rent (RENT)
Independent Variables:

| VARIABLE | PARAMETER EST. | S. E. | PROB >T |
|---|---|---|---|
| Intercept | 104.17605057 | 6.23733181 | 0.0 |
| HHINC | 0.00693483 | .00027063 | 0.0 |

F - value: 656.63 PR > F: 0.0
Sample size: 564
Degrees of Freedom: 563
R-Squared: .538383

**Hedonic Assumptions - Other Variables**

Research literature identified other significant demand elements. Some of these variables, such as investment objective or changes in the mortgage rate over time, would be difficult to include in a forecasting model. However, the data sets already used in the model also contain factors which could affect housing prices. From this existing data three tests were created to quantify the relationship between housing values and rent to: municipal growth; the relative condition of the municipality; and proximity to employment.

Growth

The growth analysis compared the changes in contract rent and housing values between 1970 and 1980 to changes in population and the number of housing units during the same time period. All data used in the test were taken from the 1970 or the 1980 US Census. The idea was to test the hypothesis that where population declined, prices declined perhaps due to a decline in demand; and where growth occurred (as in suburbanizing townships) the influx of new housing units might have caused prices to increase. Table 5 displays the resultant $R^2$'s from the analysis.

**Table 5**
Regression Results: Changes in Contract Rent and Median Housing Values
as a Function of Changes in Population or the Number of Housing Units

| Dependent Variable | Independent Variable 1 | Independent Variable 2 | $R^2$ |
|---|---|---|---|
| Change in Municipal Median Contract Rent 1970 to 1980 (DRENT) | Change in the number of housing units 1970 to 1980 (DHOUS) | | .000344 |
| Change in Municipal Median Contract Rent 1970 to 1980 (DRENT) | | Change in the population 1970 to 1980 (DPOP) | .020147 |
| Change in Municipal Median Housing Values 1970 to 1980 (DVAL) | Change in the number of housing units 1970 to 1980 (DHOUS) | | .000029 |
| Change in Municipal Median Housing Values 1970 to 1980 (DVAL) | | Change in the population 1970 to 1980 (DPOP) | .023283 |

source: US Census 1980

The results of the analysis indicate that changes in population and the number of housing units as a model to predict changes in rent or housing values would result in very poor predictions. More pointedly, other results (PR>F) in the full analysis, indicate that there is no significance between the dependent and independent variables.

Condition

Two tests of the physical condition of a municipality were constructed. The first relates the percentage of housing units that are not occupied to housing price. The hypothesis is that in places where vacancy is high, market prices might be lower; and in municipalities with little vacancy, higher prices might be found. The second test of municipal condition compares an index of age of structure to price. The index of age used in the analysis is the percentage of housing units reported in the Census as having been constructed prior to 1939. The idea being

tested is that places with mostly older housing might have lower prices than would places with newer homes. Table 6 presents the results of the analysis.

While none of the variables do a good job of describing the housing value data, all of the variables (except HVAL as a function of POCC) have some significance according to their PR > F[14] scores of 0.0001 the results of the PR > T[15] tests.

**Table 6**
Regression Results: Changes in Contract Rent and Median Housing Values
as a Function of Occupancy Rates or Percent of Units Constructed Prior to 1939

| Dependent Variable | Independent Variable | Independent Variable | $R^2$ | PR>T | PR>F |
|---|---|---|---|---|---|
| Municipal Median Contract Rent 1980 (RENT) | Percent of total units occupied in 1980 (POCC) | | .028052 | 0.0001 | 0.0001 |
| Municipal Median Contract Rent 1980 (RENT) | | Percent of Units Constructed before 1939 (PR39) | .027949 | 0.0001 | 0.0001 |
| Municipal Median Housing Values 1980 (HVAL) | Percent of total units occupied in 1980 (POCC) | | .000238 | .7147 | .7147 |
| Municipal Median Housing Values 1980 (HVAL) | | Percent of Units Constructed before 1939 (PR39) | .036089 | .0001 | .0001 |

Proximity to Employment

A long held concept in regional modeling is that price is a function of proximity to employment. The employment proximity model argues that the cost of the work commute is an important factor in determining the residential location. These theories predict that housing prices would decrease as distance from employment increased, since the high cost of commuting long distances to work would influence the price of houses distant to jobs. The test that was devised compared prices to the ratio of jobs to housing units, based on municipal data found in the 1980 Census. The test assumed that if fewer jobs were located in a municipality, as expressed by a lower job to household ratio, then prices should vary proportionate to the job to household ratio.[16] Table 7 reports the findings of this analysis.

[14]"If the significance probability, labeled PR>F, is small, it indicates significance."SAS Introductory Guide, Third Edition. Cary, NC: SAS Institute Inc. (1985) p.64

[15]" Thus, a very small value for this probability indicates that ... the independent variable contributes significantly to the model." SAS Introductory Guide,Third Edition. Cary, NC: SAS Institute Inc. (1985) p.65

[16]Regardless of the direction of price to employment shift, some correlation should be found, if the theory is correct.

**Table 7**
Regression Results: Changes in Contract Rent and Median Housing Values
as a Function of the Ratio of At-Place Jobs to Housing Units

| Dependent Variable | Independent Variable | $R^2$ | PR>F | PR>T |
|---|---|---|---|---|
| Municipal Median Contract Rent, 1980 (RENT) | Ratio of at-Place jobs to housing units, 1980 (JOBHH) | 0.003866 | 0.1399 | 0.1399 |
| Municipal Median Housing Values, 1980 (HVAL80) | Ratio of at-Place jobs to housing units, 1980 (JBHH80) | 0.0454080 | 0.0001 | 0.0001 |

The result shows that neither model provides a reliable representation of the real world. However, there appears to be some significance to the variable "ratio of jobs to housing units" and its effect on median housing values.

The analysis of these other variables demonstrated that none of these factors by themselves produced a predictive model of housing price. However, several variables were identified as significant, which raises the question, `Are these variables of importance?'. To see if these significant variables could be important elements of a model, attempts were made to improve the predictive quality of the relationship between income and housing prices by adding to the income-price model some of the other variables for which significance had been found. The following tables display the results of adding the age and condition variable to the income and price relationship models. Table 8 displays the relationship of these composite variables to rent and Table 9 displays the results obtained when the variables are used to predict median housing value.

**Table 8**
Regression Analysis: Income and Condition
as a Function of Contract Rent

| Dependent Variable | Independent Variable #1 | Independent Variable #2 | Independent Variable #3 | $R^2$ |
|---|---|---|---|---|
| Median Municipal Contract Rent | Median Household Income | | | .538383 |
| Median Municipal Contract Rent | Median Household Income | % Units built <1939 | | .547045 |
| Median Municipal Contract Rent | Median Household Income | % Units built <1939 | % units occupied | .619502 |

source: 1980 US Census

**Table 9**
Regression Analysis: Income and Condition
as a Function of Median Housing Value

| Dependent Variable | Independent Variable #1 | Independent Variable #2 | Independent Variable #3 | Independent Variable #4 | $R^2$ |
|---|---|---|---|---|---|
| Median Municipal Housing Value | Median Municipal Household Income | | | | .709499 |
| Median Municipal Housing Value | Median Municipal Household Income | % Units built <1939 | | | .712302 |
| Median Municipal Housing Value | Median Municipal Household Income | % Units built <1939 | % Units occupied | | .757247 |
| Median Municipal Housing Value | Median Municipal Household Income | % Units built <1939 | % Units occupied | Job to Household Ratio | .776193 |

source: 1980 US Census

All of the models relating income to contract rent were improved by the addition of one or more of the other variables. The F test for all of these variables continued to show significance. The biggest improvement occurred in the model relating rent to income and condition, but the overall ability of this improved model to account for the real data remains at about 62%.

Some improvement also was exhibited in the models relating income and most other variables to median municipal housing values. The variable 'percent of housing units built before 1939' produced F test results ranging from .2436 to .8749 indicating that this variable was not significant. However, the addition of these significant factors did little to improve the predictive ability of the model. For example, the model that stated that income is directly related to median housing values accounted for 70.9% of the data reported in the Census. Adding the significant variable of condition, 'percent occupied', only increased the model's $R^2$ to .7123; while the model which argues that median housing values are a function of income, condition and proximity to employment increased the model's ability to account for about 78% of the actual municipal data set. Therefore, all of the models which relate income to price can be seen to work better with home owners (median housing value) than with renters.

One explanation for this lack of predictability might be that other factors affect tenure choice. For example, Goodman[17] reports that until the advent of the condominium market, an advantage of renting was that it represented a more efficient way to obtain just the amount of space desired. While such a theory might appear to argue that one might expect to find a greater relationship between rent and income, such an efficiency might also allow renters more freedom to spend more or less of their income on shelter; thereby producing a less tight income to price relationship. Such results suggest the need to perform an analysis of the variables affecting tenure.

[17]Allen C. Goodman. "An Econometric Model of Housing". Journal of Urban Economics 23, (1988) p.335.

## III. EXAMINATION OF THE SECTORING THEORY

### Relationship Between Household Incomes and Municipal Incomes

Given a strong relationship between income and price, which is to say that in municipalities with low incomes low housing prices prevailed and vice versa, then one could perceive housing prices as a simple reflection of household incomes. Therefore, the modeling process might not be one of fitting predicted incomes to predicted prices, but rather one of fitting the distribution of household incomes to municipalities based on their estimated municipal income, and then estimating how this mix of incomes express their housing preferences (tenure). To test this theory, the following eight income groups, defined in Table 244 of the 1980 Census, were used:

Group 1 : all households earning less than $5,000
Group 2 : all households earning $5,000 to $9,999
Group 3 : all households earning $10,000 to $14,999
Group 4 : all households earning $15,000 to $19,999
Group 5 : all households earning $20,000 to $24,999
Group 6 : all households earning $25,000 to $34,999
Group 7 : all households earning $35,000 to $49,999
Group 8 : all households earning $50,000 or more

The percentage of each income groups' households in each municipality was calculated by dividing the number of households in any income group by the total number of households. Median municipal household income then was regressed as a function of the percentage of each income group in the municipality. Already, it has been demonstrated that income and price are related, this model tests to determine if this relationship holds for all income groups in all municipalities. Both Linear and Log-log forms of these relationships were prepared. In addition to the regression results, displayed in Table 10, the (linear form) data plots are presented in Charts 1 through 8.

**Chart 1**

Plot of the Relationship of Median Municipal Household Income
as a Function of the Percentage of Households in Income Group 1

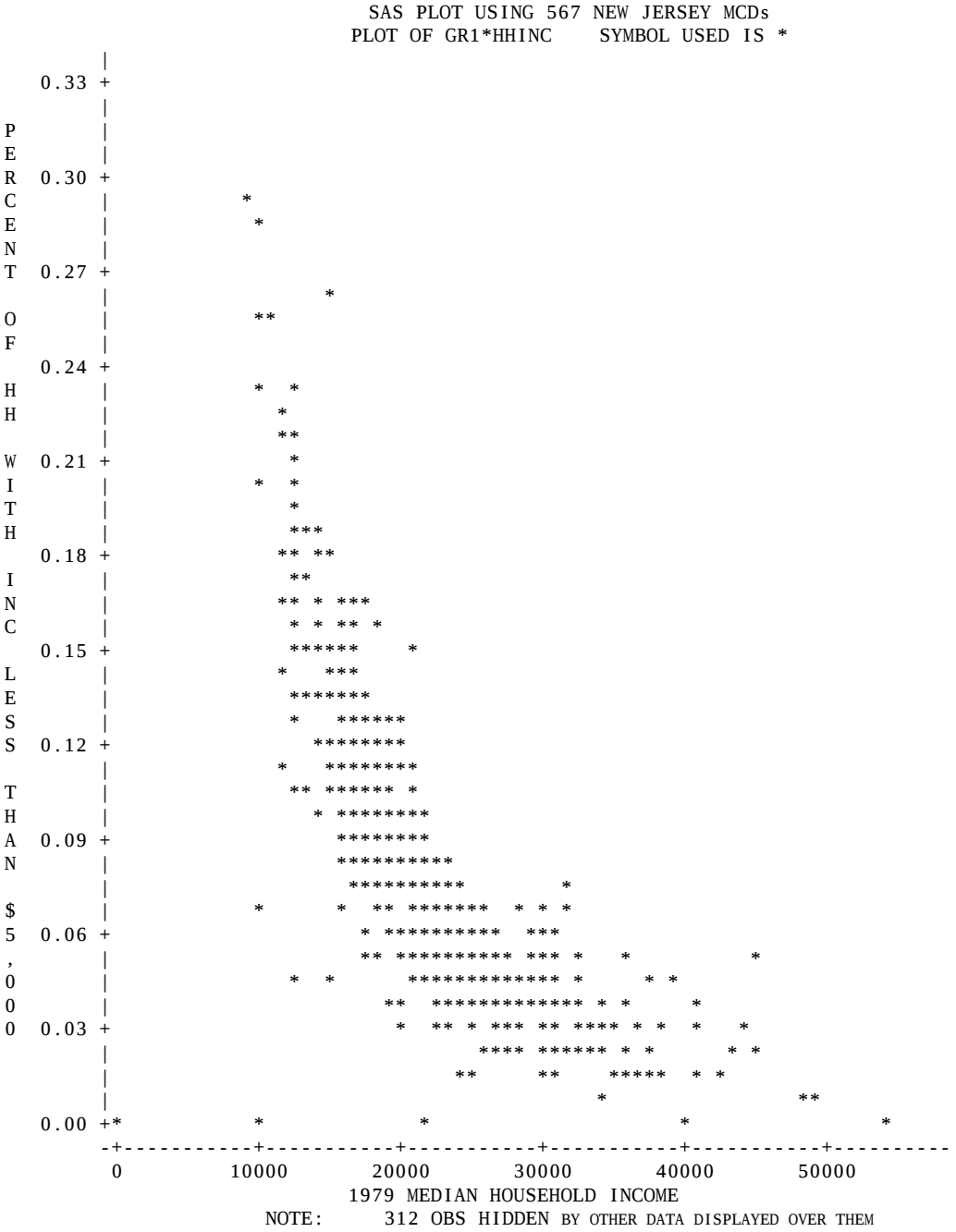

**Chart 2**

Plot of the Relationship of Median Municipal Household Income
as a Function of the Percentage of Households in Income Group 2

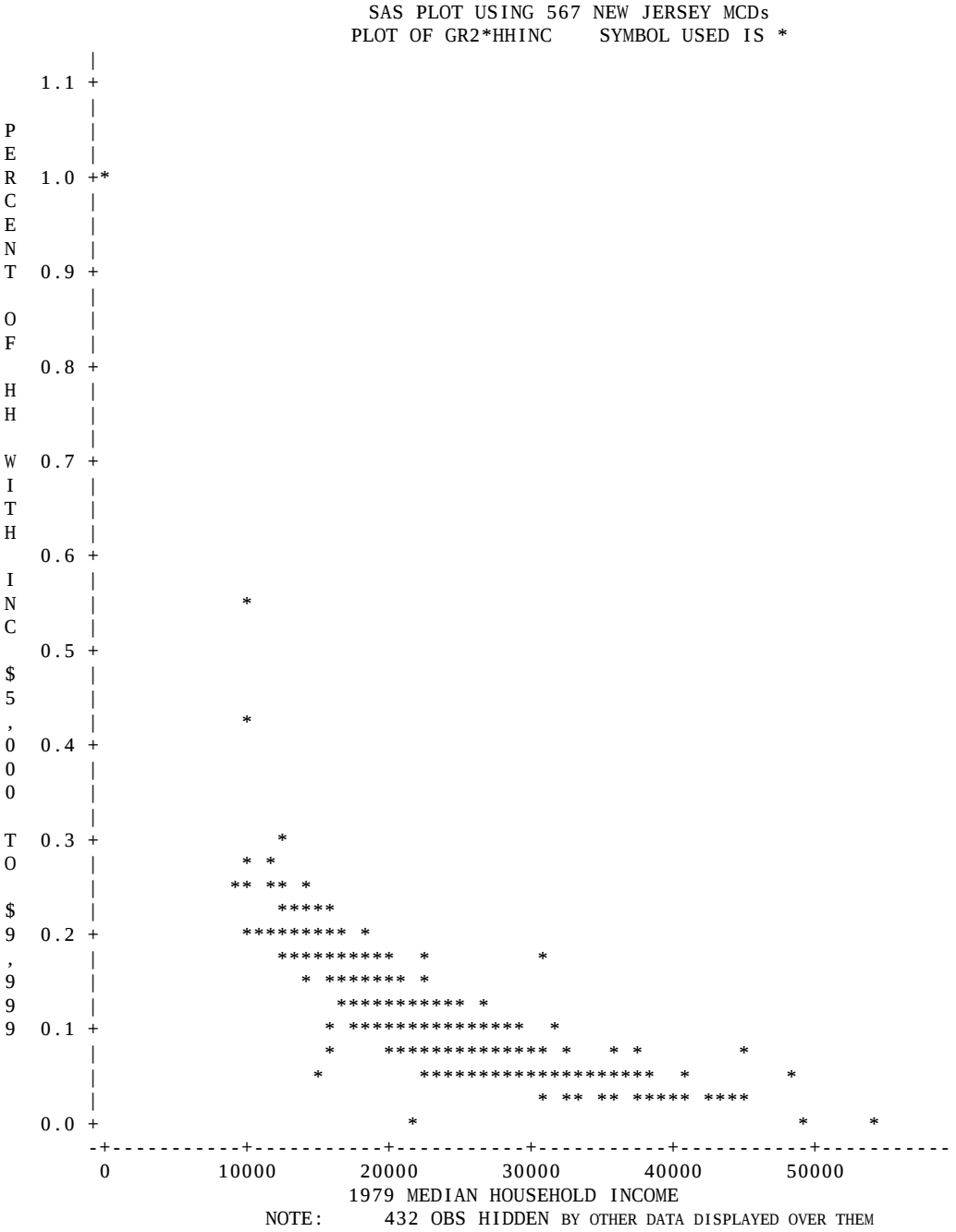

**Chart 3**

Plot of the Relationship of Median Municipal Household Income
as a Function of the Percentage of Households in Income Group 3

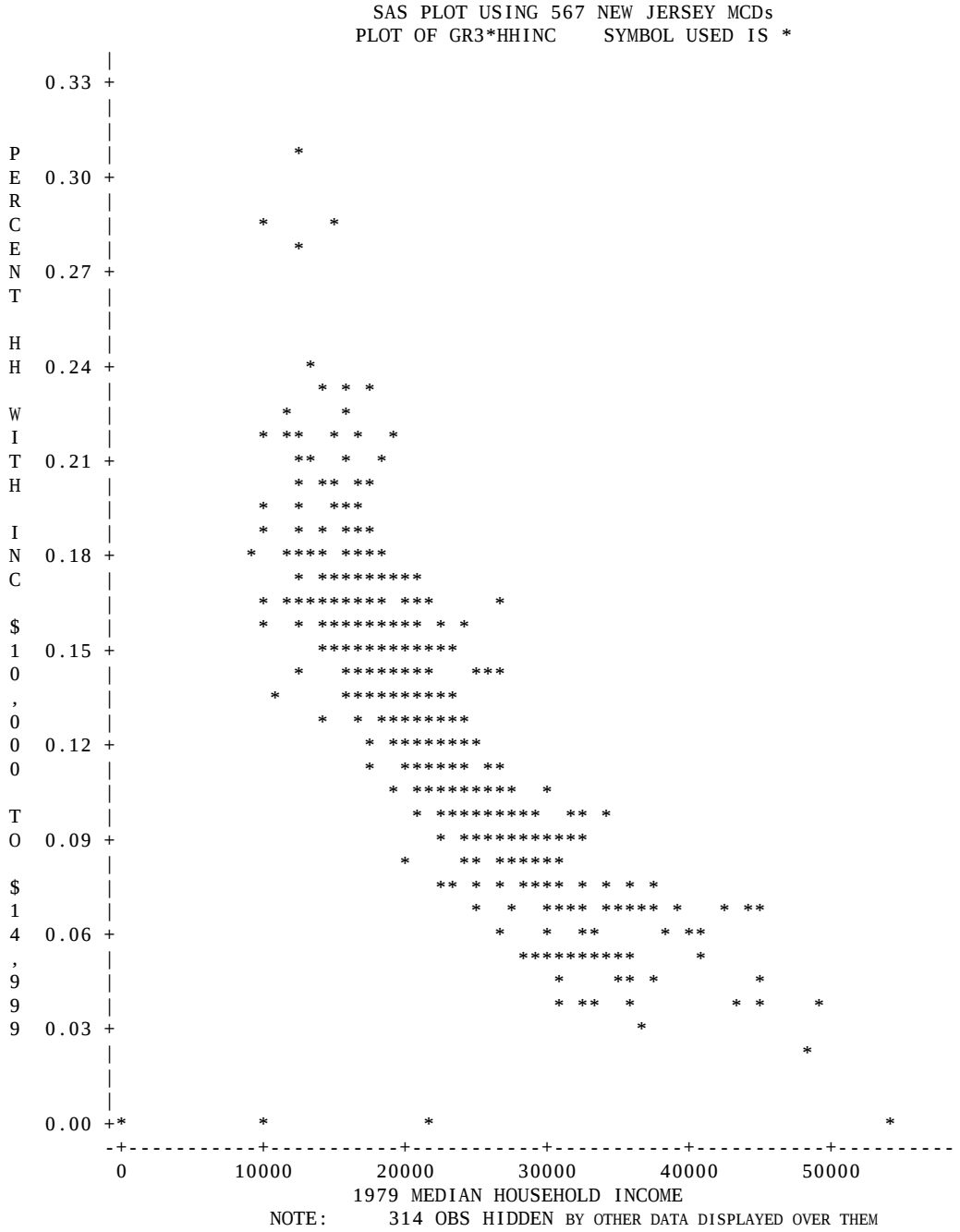

**Chart 4**

Plot of the Relationship of Median Municipal Household Income
as a Function of the Percentage of Households in Income Group 4

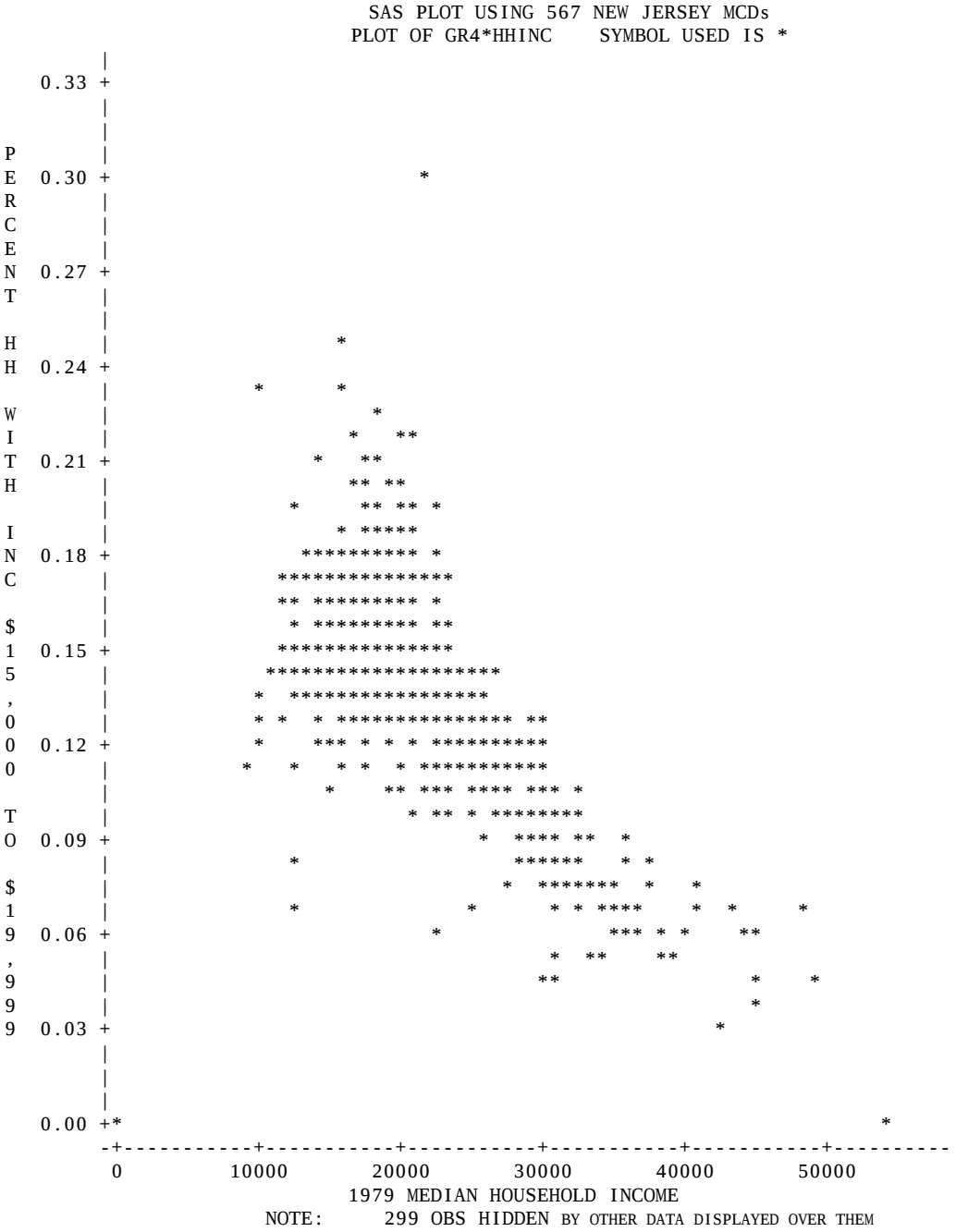

**Chart 5**

Plot of the Relationship of Median Municipal Household Income
as a Function of the Percentage of Households in Income Group 5

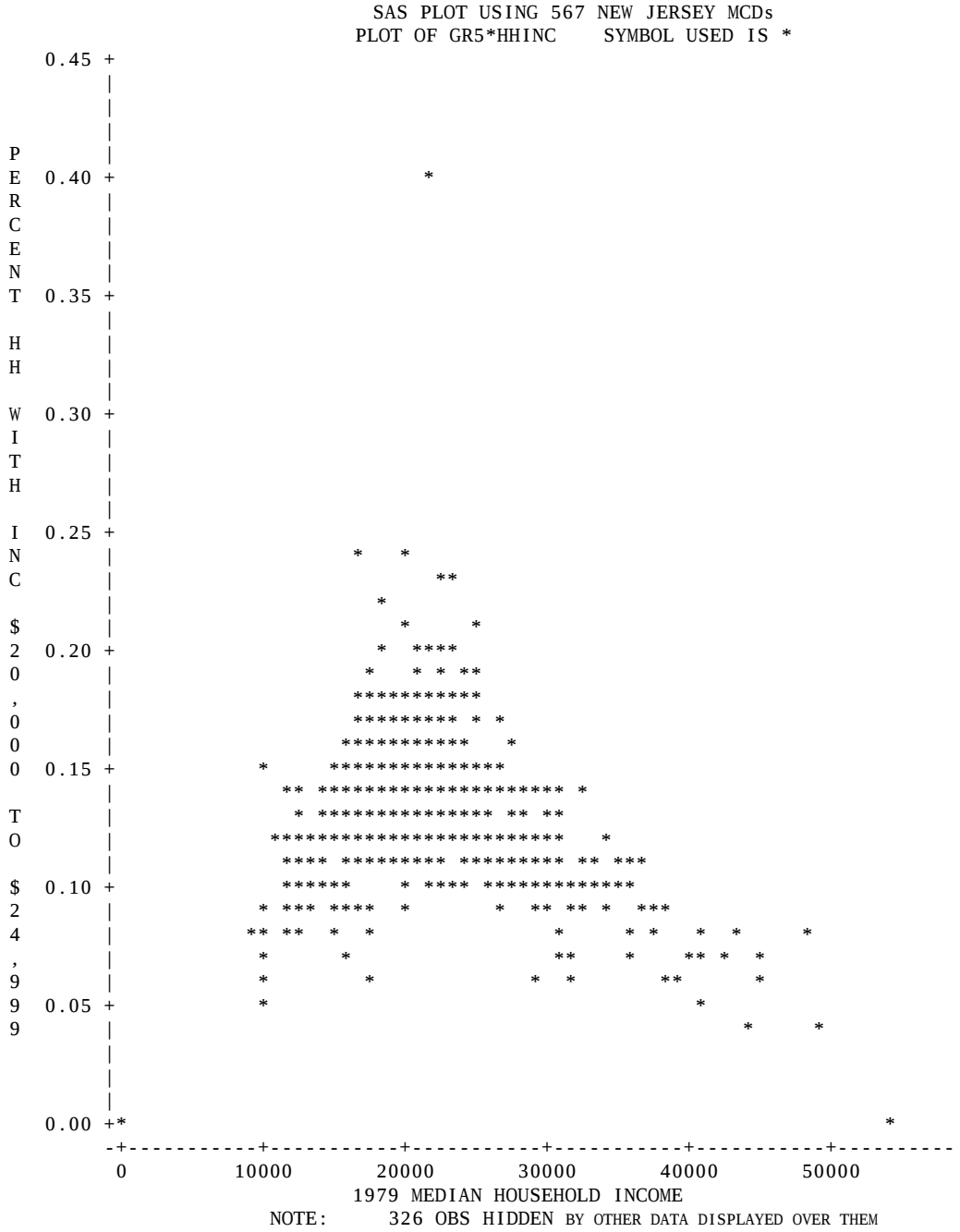

**Chart 6**

Plot of the Relationship of Median Municipal Household Income as a Function of the Percentage of Households in Income Group 6

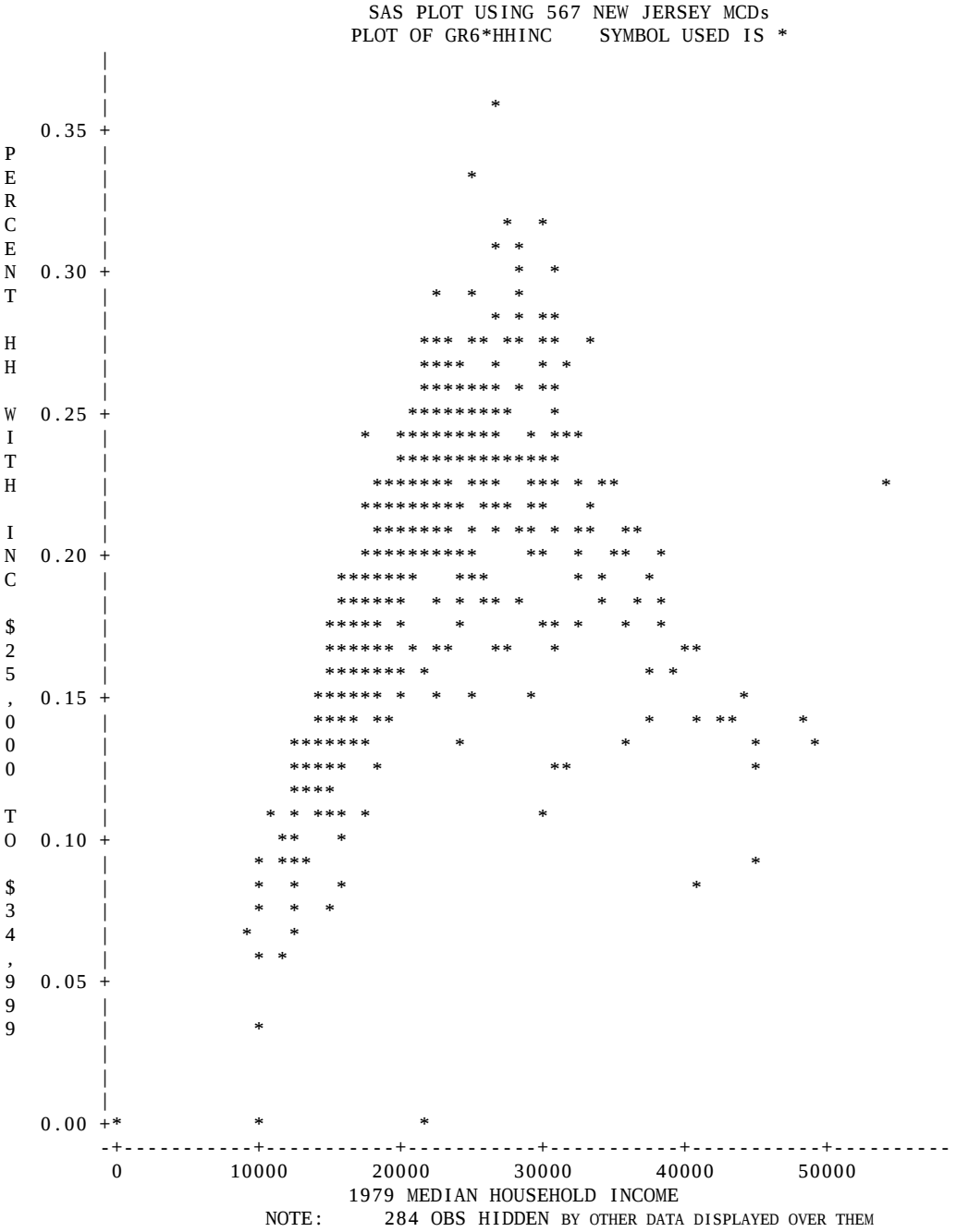

**Chart 7**

Plot of the Relationship of Median Municipal Household Income
as a Function of the Percentage of Households in Income Group 7

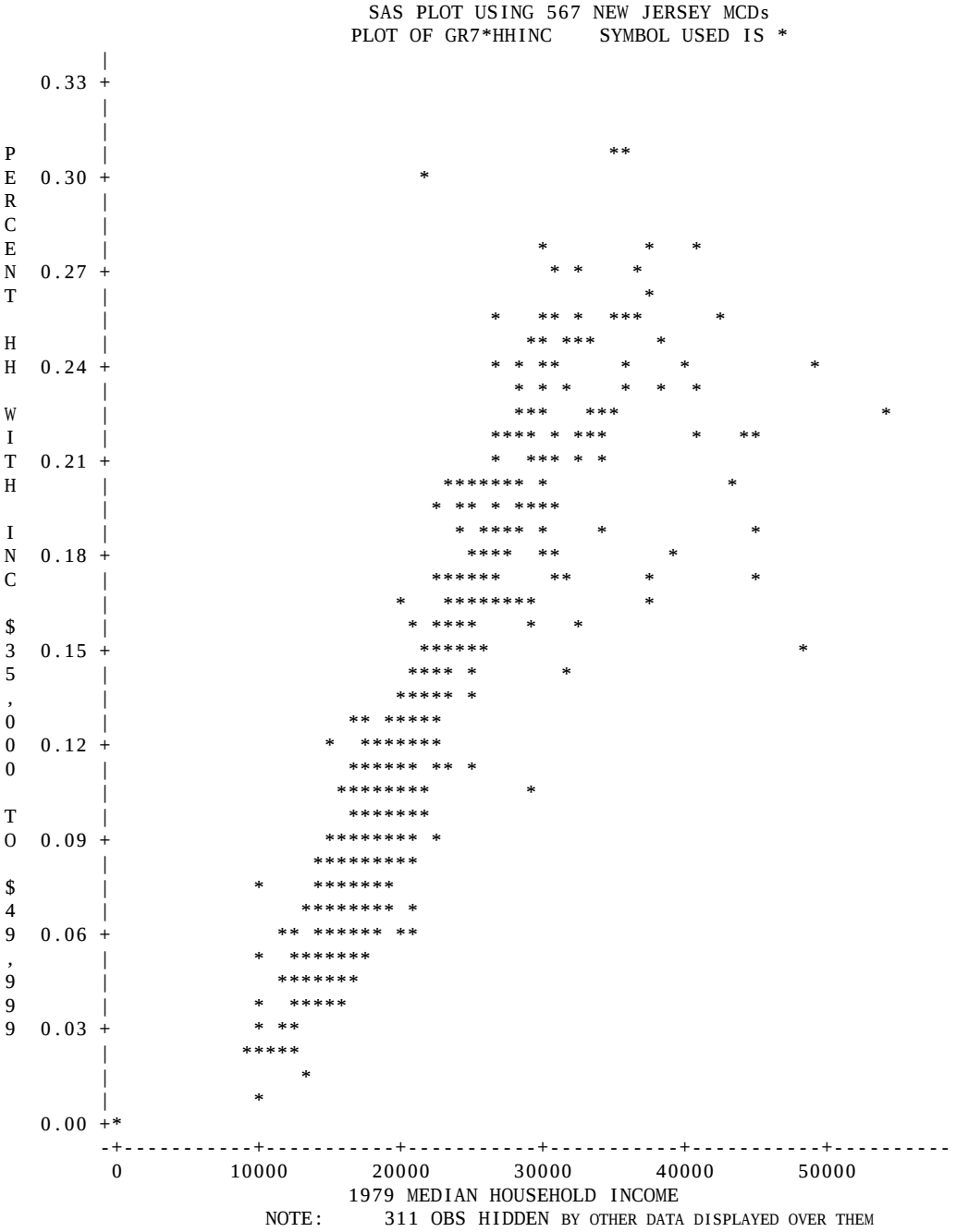

**Chart 8**

Plot of the Relationship of Median Municipal Household Income as a Function of the Percentage of Households in Income Group 8

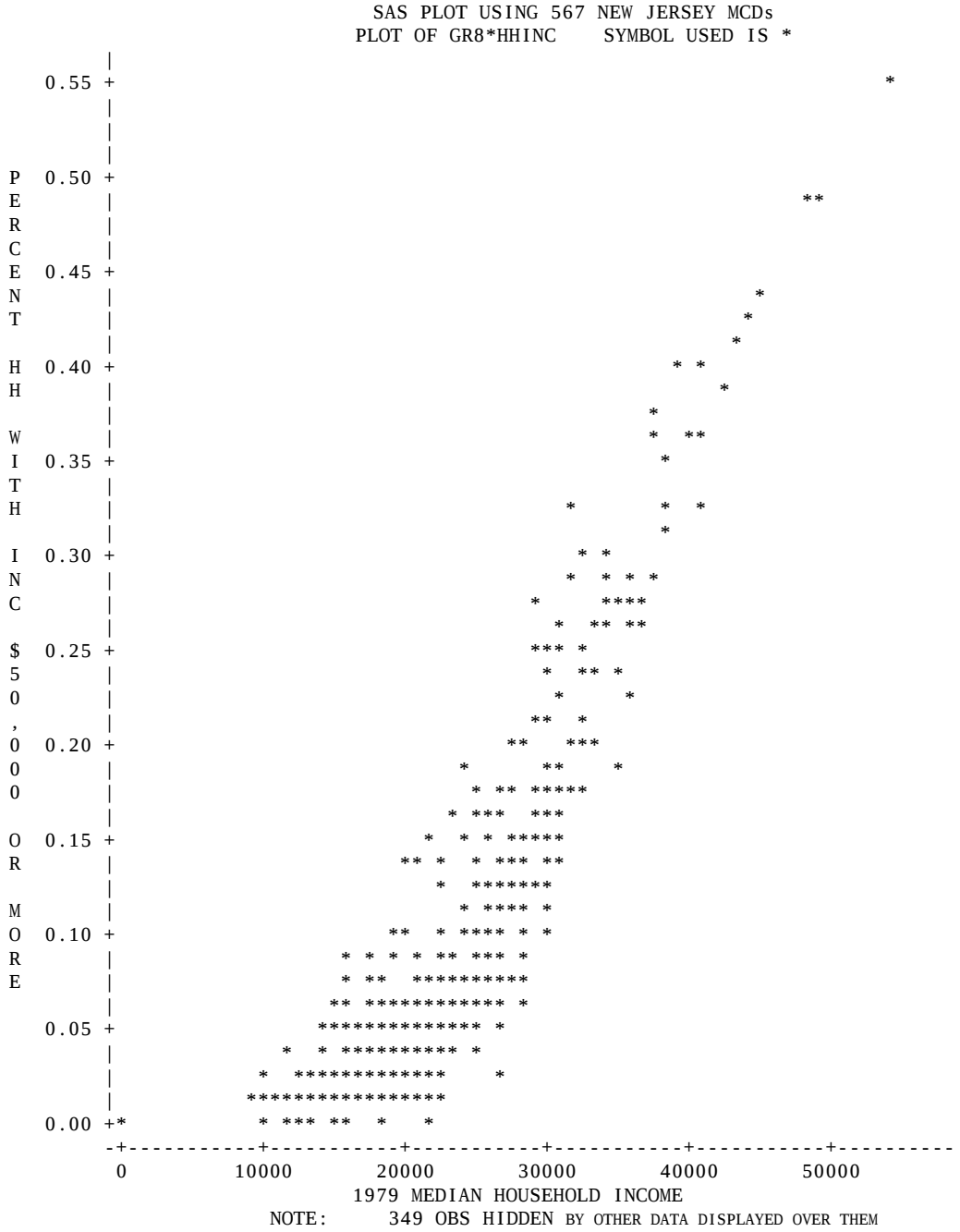

**Table 10**

Regression Analysis: Median Municipal Household Income
as a Function of the Percentage Total Households in Each Income Group

| Dependent Variable | Independent Variable | $R^2$ | $R^2$ (Log-log form) |
|---|---|---|---|
| Median Municipal Household Income (HHINC) | % Income Group 1 | .564471 | .753636 |
| Median Municipal Household Income (HHINC) | % Income Group 2 | .577089 | .812525 |
| Median Municipal Household Income (HHINC) | % Income Group 3 | .651405 | .773422 |
| Median Municipal Household Income (HHINC) | % Income Group 4 | .479845 | .484460 |
| Median Municipal Household Income (HHINC) | % Income Group 5 | .070434 | .037306 |
| Median Municipal Household Income (HHINC) | % Income Group 6 | .219286 | .358775 |
| Median Municipal Household Income (HHINC) | % Income Group 7 | .766931 | .797674 |
| Median Municipal Household Income (HHINC) | % Income Group 8 | .805179 | .751344 |

source: 1980 US Census

Table 10 shows that, with the exception of income groups 5 and 6 (and perhaps income group 4), the representation of low and high income groups is strongly correlated to median municipal household income. That is, lower income groups comprise a high proportion of the total households in municipalities that exhibit low median incomes while higher income groups are a large percentage of the households in municipalities with high median incomes. This finding appears to be what might be expected, which is, that if large numbers of lower/high income persons do not live together, then municipalities with low/high median incomes would not exist. What is exciting, is the degree that the models account for the data, as shown in Charts 1 through 8 and the high $R^2$'s in Table 10. Examination of the data plots that display households with income groups 5 and 6 show that these income groups tend to distribute themselves into all municipalities. The bell-shaped curves of income groups 5 and 6 are particularly striking.

**Findings**

These results suggest several findings. First, the analysis suggests that income sectoring or clustering was common in 1980. Municipalities with lower incomes consisted of large numbers of households represented from the lower income groups and some households from the middle income groups. Conversely, municipalities with high income groups consisted of large numbers of households from income groups 7 and 8 and some households from the middle income groups. Only municipalities with mid-range median household incomes consisted of a mix of households from all income groups.

Second, a Trend model attempting to use household incomes to predict the median municipal contract rent or median municipal housing values cannot match it's data set as well as a model which uses median household income to predict the representation of the different income groups, because of the poorer relationship between income and contract rent. The low $R^2$'s displayed for income groups 4, 5 and 6, in light of the data plots, simply suggest that the form of the relationship may not be appropriate. For example, OSP obtained an $R^2$ of .5925, and an adjusted $R^2$ of .5910, for a model which predicted median household income as a function of the percentage of income group 6, by expressing the relationship as a polynomial[18].

Finally, the data suggest that since income groups distribute themselves in regular ways that can be predicted given the municipality's median household income, then in a free market situation there should be a strong relationship between household income and all forms of housing price, if tenure is strictly a function of income. Since the relationship between household income and rent is not as predictive as is the relationship between household income and housing value, further research into understanding tenure, especially rent, is needed.

[18] $y = -4.13379E\text{-}10(x^2) + .000009756(x) + .03205949$, where y = % income group 6 and x = household income

## IV. FACTORS THAT AFFECT TENURE

### Income and Age - Analysis of BLS Data

The research literature, reviewed as part of this study, identified the importance of income and age as factors that influence tenure. To study this phenomenon, OSP utilized data collected and published by the Bureau of Labor Statistics in their publication Consumer Expenditure Survey: Integrated Survey data, 1984 - 86.[19] In this report, BLS provides separate tables which describe the percentage of consumers who rent or own their dwelling units, categorized by their income group[20] and the percent of consumers who rent or own their dwelling unit categorized by age cohort.[21] (See Appendix B for copies of these tables.)

Two assumptions were made about the BLS data. The first assumption was that a consumer, as identified by BLS, would have to be a head of a household, as defined in the Census. Second, although a different number of consumers provided data for each table, it was assumed that cross-comparison of the data would produce reliable findings given the large number of consumers surveyed for each table (the tenure by income table summarizes the data collected from 84,565 consumers, while the tenure by age cohort table summarizes the data collected from 94,044 persons).

Given these assumptions, a consolidated age-income matrix was prepared, using the BLS data and attempting to replicate the individual findings reported by BLS in the two tables. To prepare the consolidated table, a computer program was prepared that the user to substitute estimates of the percentage of rent or owner for each age-income cohort cell in the consolidated matrix. The program then calculated the resultant total percentages for each row and column. These row and column results should have equaled or closely approximated the results published by BLS. Table 11 displays the resultant age-income table. Table 12 compares the OSP consolidated matrix and the actual results published by BLS.

As displayed in Table 12, the OSP estimates compare very favorably with the actual results published by BLS. The missing BLS data for the age cell "65 +" and for the income cell "50 or more" results from the fact that BLS published the results for two cohorts and that OSP could not combine these results.

The finding displayed in Table 11 is that tenure appears to be a function of both income and age. This finding agrees with the research reported earlier in this report. Perhaps the most interesting aspect of Table 11 is that it displays a life cycle tenure preference. Households headed by younger persons tend to rent in large numbers. Since most householders in these age brackets would be at the beginning of their careers, incomes would be lower and perhaps family sizes might be smaller. As age increases to the middle years, the percentage of renters decreases. Corresponding increases in income also reduce the tendency to rent. Finally, as the householder approaches retirement age, the percentage of renters increases.

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[19]US Department of Labor, Bureau of Labor Statistics. Consumer Expenditure Survey: Integrated Survey Data, 1984 - 86. Washington, DC : GPO August 1989.

[20]US Department of Labor, Bureau of Labor Statistics. Consumer Expenditure Survey: Integrated Survey Data, 1984 - 86. Washington, DC : GPO August 1989. Table 2, p.10 (By a happy coincident, the income groups used by BLS are identical to those used in Table 10 of this report)

[21]US Department of Labor, Bureau of Labor Statistics. Consumer Expenditure Survey: Integrated Survey Data, 1984 - 86. Washington, DC : GPO August 1989. Table 3, p.14

**Table 11**
Estimated Percent of Age-Income Cohorts
Who Rent Their Dwelling Unit

| | **Income Categories** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ***age cohorts*** | **less than $5k** | **$5k > <$10k** | **$10k > < $15k** | **$15k > < $20k** | **$20k > < $30k** | **$30k > < $40k** | **$40k > < $50k** | **$50k or more** |
| ***< 25*** | 99% | 96% | 94% | 92% | 90% | 82% | 50% | 20% |
| ***25 to 34*** | 80% | 75% | 65% | 60% | 50% | 40% | 30% | 20% |
| ***35 to 44*** | 65% | 60% | 55% | 45% | 35% | 20% | 15% | 10% |
| ***45 to 54*** | 55% | 55% | 45% | 35% | 25% | 20% | 15% | 5% |
| ***55 to 64*** | 40% | 35% | 30% | 25% | 20% | 15% | 10% | 5% |
| ***65 >*** | 60% | 50% | 20%[22] | 25% | 35% | 25% | 20% | 10% |

source: BLS Consumer Expenditure Survey:
Integrated Survey Data, 1984 - 86
Tables 2 and 3

**Table 12**
Comparison of OSP Estimations and BLS Published Results
Percentage of Cohort who Rent Their Dwelling Unit

| ***Age Cohorts*** | **OSP Est.** | **BLS Actual** | ***Income Groups*** | **OSP Est.** | **BLS Actual** |
|---|---|---|---|---|---|
| ***<25*** | 92% | 88% | ***<5*** | 60% | 61% |
| ***25 to 34*** | 55% | 54% | ***5 to 9.9*** | 53% | 53% |
| ***35 to 44*** | 34% | 32% | ***10 to 14.9*** | 41% | 46% |
| ***45 to 54*** | 26% | 23% | ***15 to 19.9*** | 39% | 46% |
| ***55 to 64*** | 22% | 19% | ***20 to 29.9*** | 33% | 37% |
| ***65+*** | 39% | | ***30 to 39.9*** | 23% | 25% |
| | | | ***40 to 49.9*** | 16% | 18% |
| | | | ***50 or more*** | 7% | |

source: BLS Consumer Expenditure Survey:
Integrated Survey Data, 1984 - 86
Tables 2 and 3

[22]The reason for this decline in renters is mysterious and does not conform to the published findings of other researchers, who report a more gentle slope from the high rentership of lower income households towards the lower rentership exhibited by the wealthier elderly households.

**Analysis of the Income-Age Correlation**

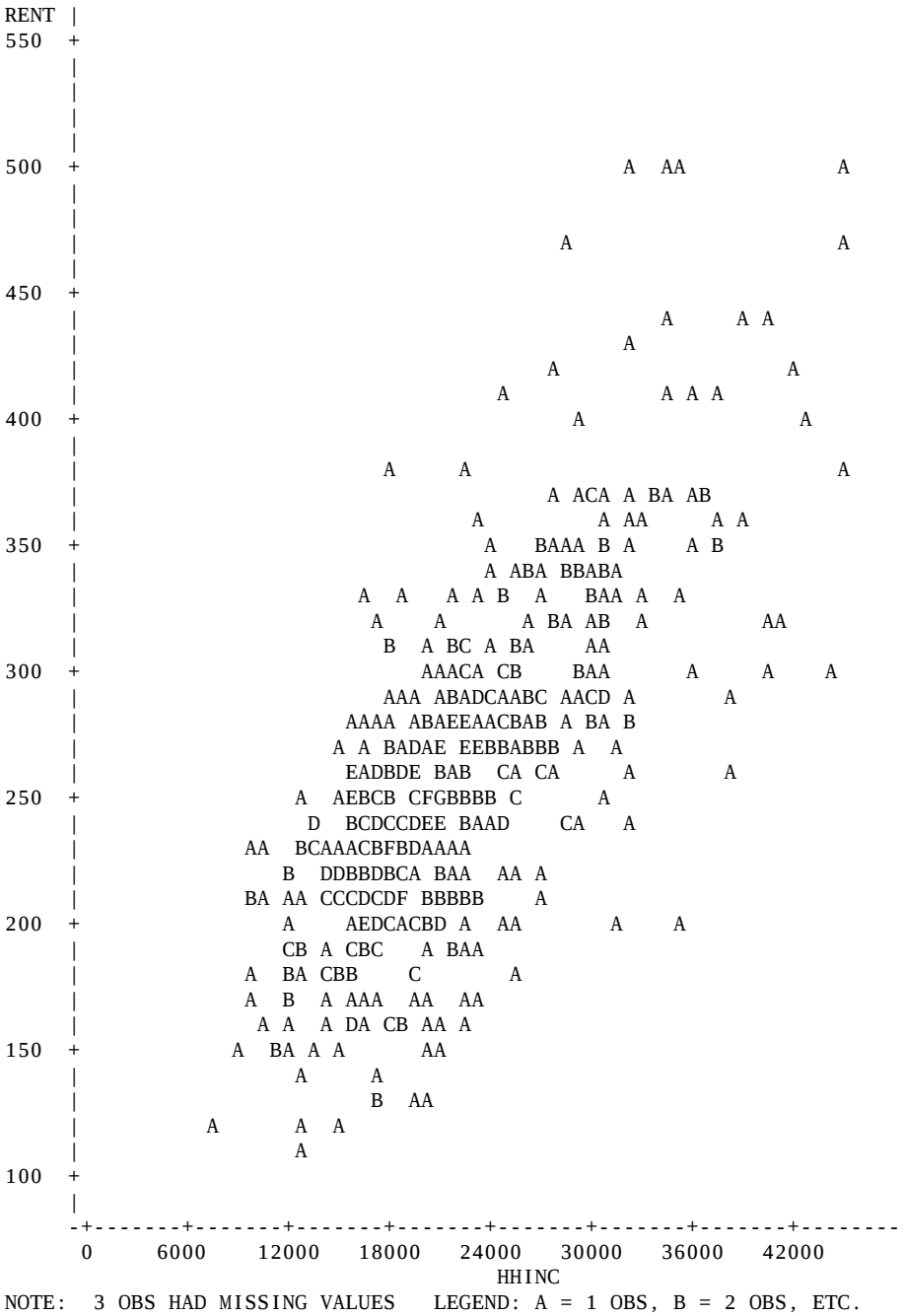
While the finding that tenure is age-income linked is interesting, it also raises other questions. Since tenure is income linked, why is there not a stronger relationship between income and contract rent? This question is particularity troublesome given the regularity of distribution of income groups into municipalities with median household incomes. For example, although in wealthy municipalities one might expect a larger percentage of the housing units to be owner occupied, the regularity of the income group distribution would suggest that those rental units in high income areas would supply the rental demand of wealthier persons; with at least the likely prospect that the rent would somehow correspond to the income of the renter. Regressions of income and housing value (owner occupied units) results in a highly predictive model. Yet, similar comparisons of income to contract rent are less predictive.

Chart 9 is a plot of the relationship between contract rent (RENT) and the median municipal household income (HHINC). As displayed in this graph, the model seems to be more predictive for municipalities with lower and middle-level median household income than in municipalities with higher median household incomes. Several explanations of this phenomenon are possible.

First, Table 11 reports that households with lower incomes and households headed by older consumers are more likely to rent. One could suppose that these groups might be less likely to own or regularly operate a personal car and therefore more transit dependent. If this hypothesis is correct, then more of the renters from all income groups might be located into areas better served with bus service, such as the denser, more populated, portions of the State. While this might result in more renters being located in urban areas, this explanation does not fit the data very well. If older and poorer consumers lived together, regardless of income, then the plot of rent to income would fit less well in municipalities with lower to moderate median household income and better in high income municipalities.

**Chart 9**

Plot of the Relationship Between
Median Municipal Contract Rent and Median Municipal Household Income



A second hypothesis argues that the plot is the function of the income group distribution. The plots displayed in Chart 9 show that municipalities with middle to high incomes consist of a mix of middle and high income groups. Because of this income mix, contract rents also are mixed. The counter argument to this theory is that the plot should converge to the predicted best fit line in municipalities with lower incomes, and the highest incomes, since it is assumed that rent units serve both income groups. Again, the theory does not fit the actual data very well.

Finally, it could be that the amount one spends on rent, expressed as a percentage of income, varies with income. In other words, less wealthy consumers might pay more or less of their income as rent than higher income consumers. To test this hypothesis, a new age-income consolidated table was constructed from information provided by BLS.[23] Table 13 displays the OSP estimates of the percentage of income that rental payment represents. It should be noted that for many of the lower incomes, BLS reported expenditures far greater than income, probably the result of transfer payments such as public assistance. Such transfer payments are not reflected in the following tables.

**Table 13**
OSP Estimate of the Percentage of
Money Income Spent as Rental Payment, 1986

| | **Income Group** ($,000) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ***age cohort*** | **<5k** | **5 to 9.9** | **10 to 14.9** | **15 to 19.9** | **20 to 29.9** | **30 to 39.9** | **40 to 49.9** | **50 or more** |
| *<25* | 7% | 8% | 9% | 10% | 10% | 12% | 13% | 20% |
| *25 to 34* | 9% | 10% | 16% | 23% | 25% | 20% | 20% | 20% |
| *35 to 44* | 9% | 15% | 20% | 20% | 17% | 17% | 20% | 30% |
| *45 to 54* | 10% | 17% | 20% | 20% | 15% | 15% | 15% | 30% |
| *55 to 64* | 17% | 20% | 20% | 20% | 15% | 15% | 15% | 15% |
| *65 +* | 20% | 26% | .25% | 20% | 16% | 14% | 12% | 15% |

source: BLS Consumer Expenditure Survey:
Integrated Survey Data, 1984 - 86
Tables 2,3 and 4

Table 13 demonstrates that, with the exception of the oldest two age cohort groups, the percentage of money income spent on rent increases as incomes increase. This finding suggests that the plot of contract rent as a function of municipal median household income may not be linear, but should curve upward. While some of this upward curve is evident, a substantial number of data points shown in Chart 9 are located at other locations. However, this variation might be due to the mix of middle and high income groups found in wealthier communities, and the predicted likelihood that more of the middle income consumers would rent and more of the higher income consumers would own.

[23]US Department of Labor, Bureau of Labor Statistics. Consumer Expenditure Survey: Integrated Survey Data, 1984 - 86. Washington, DC : GPO August 1989. Tables 2,3, and 4

## V. RESEARCH CONCLUSIONS

1. There is a strong relationship between income and the housing values and a moderate relationship between income and rent.

2. The addition of other factors into a model relating income to price, produces modest improvements in the model's ability to account for actual data. It is possible that many of the factors, such as those describing the municipal condition (occupancy and age of buildings) are surrogates for income.

3. A hedonic-based model which predicts future housing values, given estimates of future municipal income, would likely be less predictive, given the problem of relating income to rent.

4. An more viable alternative to a hedonic model's procedure of fitting income to price would be a sectoring model which fits household income groups to municipalities, based on the estimated mean Per Capita or Household income of the municipality.

5. Tenure choice is income and age linked.

## VI. FUTURE RESEARCH

### Housing Policy Issues

Some of the data discussed in this report suggest the need for further policy research efforts. The tenure preference table displays the high reliance on rental units displayed by lower income households. This high reliance suggests that either persons in these income groups truly prefer rental units; or that there is a market dysfunction which is causing a shortage of affordable units.

If there is a problem in the market, several causes can be hypothesized. One cause might be policies which provide rental subsidies, but not adequate ownership subsidies. Another cause might be related to the supply, or lack thereof, of long term financing for households with limited incomes. Another problem might related to land use constraints, expressed in terms of density, minimum lot or minimum structure size requirements, which might constrain the construction of small footprint units.

These issues should be researched to determine the cause or causes. Once the problems are identified, research should focus on policy solutions that have been attempted elsewhere, and the success of these policies. Findings about successful policies should include the criteria for success, a qualification of the degree to which the policy improved circumstances and an assessment of the applicability of the policy to New Jersey.

**APPENDIX A**

**STATISTIC DATA**

**APPENDIX B**

**BLS TABLES**

**APPENDIX C**

**1980 CENSUS TABLE 244**