Creating Communities of Place

REVISIONS TO THE PED MODEL: ANALYSIS OF HOUSING NEED

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ABSTRACT

The Population and Employment Distribution (PED) model has been modified to estimate future incomes. A description of the revised model is provided. The revised PED model then is used to estimate year 2010 incomes, housing needs and housing market characteristics, that result from using two different growth projections; one probably high and the other probably low of where actual growth might occur. Finally, the site program for a prototypical 1000 unit residential development is defined, using the PED model's results. A major design intent of this site program is to adhere to Building Code standards while providing for a high degree of Affordability.

Acknowledgments

This report was prepared by James Reilly. Mr. Reilly also programmed all revisions to the PED model. Chip King converted the model results into the residential site program described in chapter 4. Rebecca Preece was the research librarian for this project. Robert Kull edited and proof read the report.

SUMMARY

Revisions to the PED Model - Analysis of Housing Need

The OSP Population and Employment Distribution (PED) model has been revised so that the exogenous (to the model) projections of population and employment result in estimations of forecast year Per Capita and Household Income, at a state, county and municipal level. The growth assignment algorithms have not been altered. OSP research indicates that, within a county or sub-state economic regions, municipal residential locational shifts as a function of employment shifts, at the same scale, are not evident. The locational effects of shifts in employment by type are reflected in the exogenous projections. However, the issue of altering historic growth rates to account of changes in municipal land supplies needs further research.

The principal benefits from the PED revisions are:

1. More economically consistent growth and impact assessments.

2. The model's development of sufficient market data to allow for more informed residential need assessments and more sophisticated residential program development.

3. Improved Policy testing ability.

The findings presented in this report result from using two different sets of population and employment projections. The first projection was produced and published in 1989 by the New Jersey Department of Labor and reflects the results from their Economic Demographic model. In the forecast year 2010, this model estimates the State population to have grown by 1.226 million people and the State-located non-agricultural employment to have grown by .832 million jobs. The second projection set was prepared by Rutger's University Center for Urban Policy Research (CUPR) in 1991, under contract to the New Jersey Department of Community Affairs (DCA). This CUPR/DCA forecast projects .52 million new persons and .655 million new jobs in 2010, when compared to 1990. These projections likely represent an optimistic growth projection (NJDOL) and a pessimistic growth projection (CUPR).The science of long range growth forecasting is inexact. This problem of accuracy is particularly acute for long range projections; less so for 3 to 5 year estimates.

While i*t is a truism that different projections will result in different results,* the value of the model is its ability to run alternative scenarios and produce a range of results. Within the range of the high and the low projections, the actual future conditions likely are bracketed. Plan policies then should be evaluated for their ability to accommodate these differing future conditions.

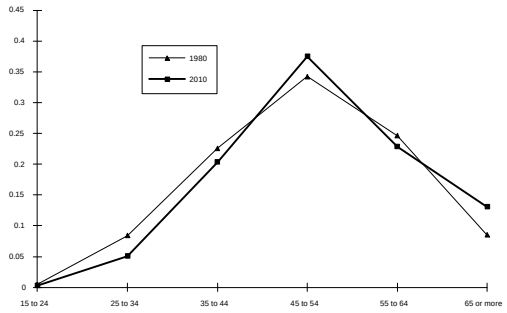
To properly evaluate the model's results, there are other caveats that need to be made clear. First, the future wages assumed for each type of industry were the same for all

income projections. Second, OSP estimated the 2010 employment mix for the NJDOL projection and assumed the employment mix and the demographic make-up of the CUPR/DCA projections were identical to the DOL projection. Finally, OSP used two different headship rate assumptions; the first assuming that the tendency for more single person and non-traditional families continued to increase; the second assumed that households would form more slowly. The first headship rate was used with both the DOL projection and with the CUPR/DCA projection. The second headship rate was only used with the CUPR/DCA projection.

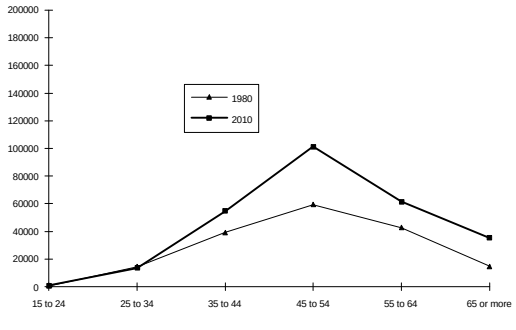
These OSP assumptions can have pronounced impacts. Numeric changes in projections about the number of Jersey locate jobs have a more modest impact on residential incomes than would result from shifts in the nature of the employment. For example, a significant decline in highly paid manufacturing jobs, offset by a corresponding increase in lower paid service jobs, still would result in a decline in Personal and Household incomes. Shifts in demographic composition affect the model's estimates of household income, tenure and size.

Because both projections share demographic make-up assumptions, the following diagram of the DOL-projected population also would apply to the CUPR population reported in this report. At the year 2010, only households headed by persons aged 35 or older will experience numeric increases (compared to 1980). This is due to the aging of the Baby Boomers and the tendency of this group to have fewer children.

Chart 1
STATE OF NEW JERSEY
NJDOL 89 Economic Demographic Projection
COMPARISON OF 1980 AND 2010 HOUSEHOLDER AGE COHORTS



Percentage of Household Heads in each Age Cohort



Number of Household Heads in each Age Cohort

The Following summarizes the major results of the modeling effort, using the revised PED model.

1. Householders -

a. NJDOL Projection - By 2010 there will be approximately 8.86 million householders in New Jersey; an increase of 1.302 million compared to 1990.

b. CUPR/DCA - The lower population projection of the CUPR/DCA model produces a correspondingly lower number of householders. Approximately 8.114 million householders would exist in the State in 2010; a growth of .556 million householders since 1990.

2. Housing Need[1] -

a. NJDOL Projection - A total of 1.07 million new housing units will have to be constructed from 1990 through 2010. A total of 3.8 million units would exist.

b. CUPR/DCA Projections - The first estimate contained household formation assumptions identical to that used in the DOL run. A total of 774,569 new housing units needs to be built by 2010, for a state total of 3.539 million units. The second estimate assumed a less vigorous growth of non-traditional and single person households[2], resulting in a need for 603,164 new housing units. With this lower headship model, total State housing units in 2010 would be 3.228 million.

Average 2010 household size for both set of forecasts using the first headship rate was 2.4 person, down from 2.83 person in 1980 and 2.7 persons in 1990. The forecast that assumed slower household formation resulted in a household size of 2.5 persons.

3. Future Incomes -

a. DOL Projection - Per Capita is expected to increase, in constant dollars, from $23,974 in 1990 to $26,867 in 2010. However, household income will decline or remain stable. The PED model estimates that mean State household income will be $62,583 in 2010.

b. DCA/CUPR Projection - For the projection that assumes non-traditional and single parent households will vigorously grow, PCI in 2010 was $26,400 and Mean Household Income was $61,540. The second DCA/CUPR projection, which estimated

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[1]The housing need estimates include the need for approximately 70,000 to replace existing housing units that would be demolished by 2010.

[2]CUPR might have assumed a different demographic make-up of the 2010 population or an even more conservative rate for the formation of new households. Such a conservative rate might be the result of CUPR's presumed assumption that the current recession continues (the formation of households is constrained during hard economic times). The CUPR estimate is 3.201 million units.

fewer households, produced an estimated PCI of $25,230 and a mean household income of $61,258[3].

For all scenarios Mean Per Capita income increased. On the basis of OSP's estimate of 1990 State mean household income ($60,000), future household income remained stable or experienced a very slight increase. The household income result is consistent with the national trend of household income[4], evidenced since 1973, which show household income increasing very slowly since 1982. The PED model forecast probably reflects both the larger numbers of retired-person households and the trend towards smaller household sizes (more single person households, more single parent households), both factors that would slow household income growth.

The projected stability of the New Jersey's household income suggests that housing prices also will remain stable[5].

The PED model also calculated mean household incomes for each of the Counties. Diagram S - 1 displays each of the county incomes as Z values. Z values express incomes in terms of whether they are lower or higher (by standard deviations) than the mean State Household income.

The Diagrams display several findings. First, the maps show that there is little income difference between the various growth projections. (Again, this could be the result of assumptions made by OSP with regard to the CUPR/DCA projection's demographics and industry types.) The mapping also shows that the income distinction between the "southern" and "northern" parts of the State continue. Most counties (and municipalities) south of the Fall Line have mean household incomes lower than the State Mean household income, while those counties (and municipalities) north of the Fall Line tend to have incomes higher than the mean State household income. The counties located in the Northwestern part of the State also tend to have income less than the State average. The wealthiest counties are those located in the north central part of the State.

4. Household Income Distribution - The OSP model assigns households to income categories, which are characterized as a percentage of the state mean household income. Income groups 1 and 2 have average incomes that are less than 50% of the State mean;

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[3]The slight differences between the two DCA/CUPR income projections result from county-scale differences in the number of households created in each scenario. these differences affect the model's estimation of the relationship between earnings for all jobs located in a county and residential earnings.

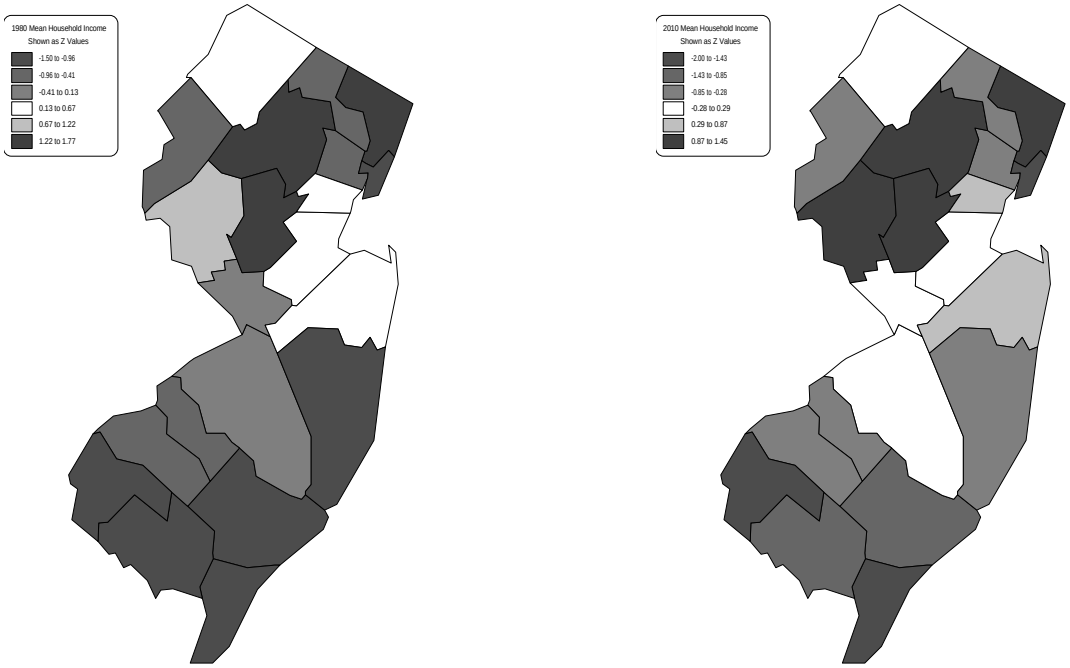
[4]See: Hughes, James W. Housing Policy Debate. "Clashing Demographics: Homeownership and Affordability Dilemmas". Washington. DC. Office of Housing Policy Research, Fannie Mae. Vol. 2, Issue 4, 1991.

[5]Several researchers have speculated that household prices will decline by as much as 40% by 2010, due to declining incomes. The OSP models result is consistent with the forecast published by the Harvard/MIT Joint Center for Housing Studies in the publication "Housing Market Dynamics and the Future of Housing Prices", written by Denise DiPasquale and William C. Wheaton, revised in January of 1991.

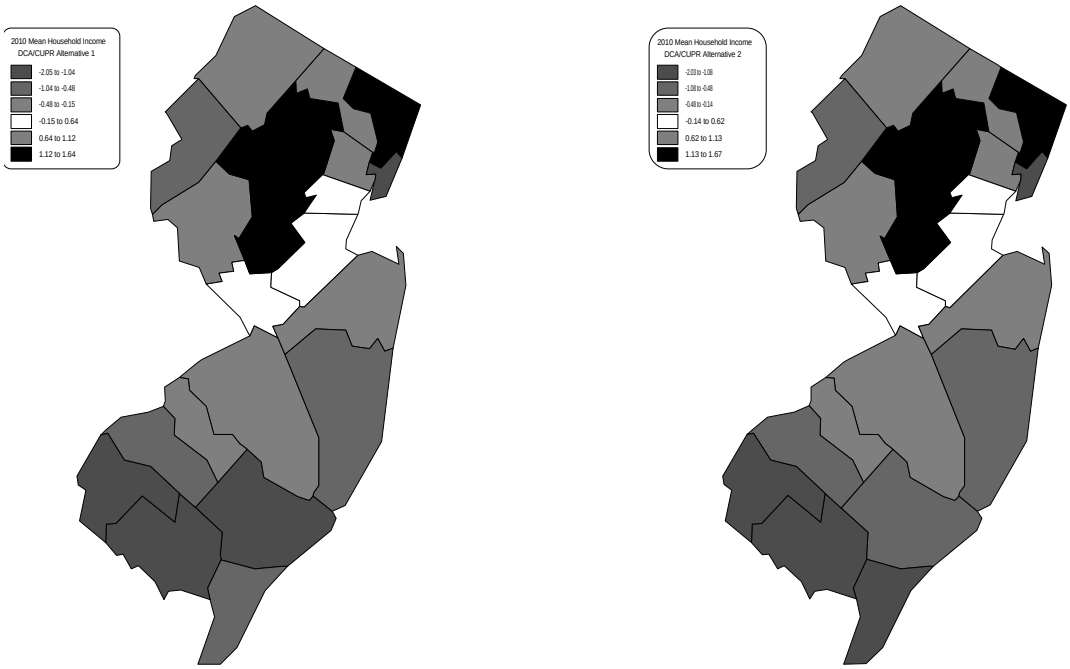
groups 3 and 4 have incomes averaging 50 to 75 percent of the State mean, group 5 averages the State mean; and, groups 6 through 8 earn at least 1.25% of the State mean.

DIAGRAM S - 1

1980 AND 2010 DOL COUNTY MEAN HOUSEHOLD INCOMES
EXPRESSED AS Z VALUES

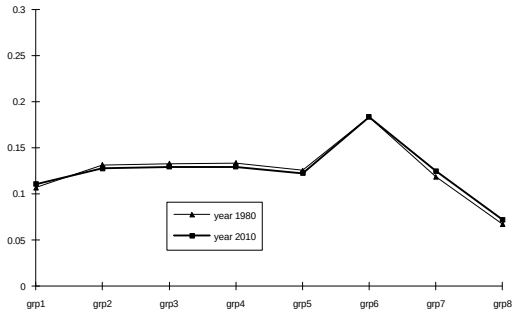


2010 CUPR/DCA COUNTY MEAN HOUSEHOLD INCOMES
EXPRESSED AS Z VALUES

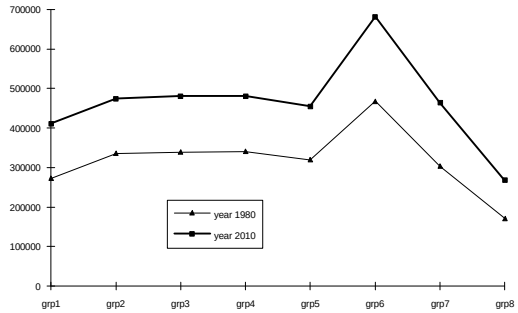


The result of the model is that the income distribution characteristics in 2010 pattern those of 1980, but the demographic composition most income groups have been modified due to the aging of the population[6]. Chart S - 2 and S - 3 displays the DOL forecast only. The CUPR forecast graph would be located about midway between the DOL line and the 1980 line on chart 2, and would differ only in the number of households shown in Chart 3.

CHART S - 2
STATE OF NEW JERSEY
COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES

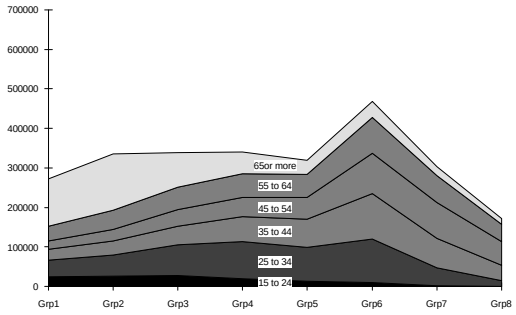


Percentage of Households in each Income Group

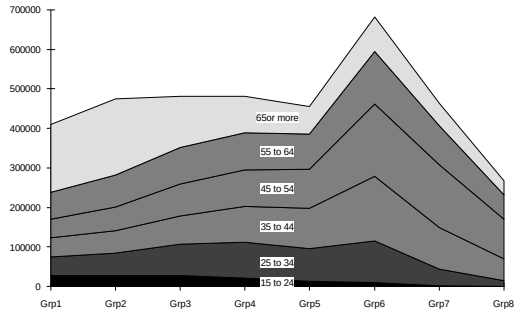


Number of Households in each Income Group

CHART S - 3
STATE OF NEW JERSEY
COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES



Age Cohorts in Each Income Group in 1980



Age Cohorts in Each Income Group in 2010

[6]OSP assumed that households headed by persons 65 or older had higher income distributions than was the case in 1980. Some experts question this assumption, arguing elderly incomes will fall due to likely problems with the Social Security system.

5. Characteristics of 2010 households - *It is important to note that this section displays need based on a base year of 1980. Economic data from the 1990 Census has not been released. Therefore it is impossible to estimate the characteristics of the housing need from 1990 to 2010.*

In 1980 62.3% of the houses were owner occupied and 37.7% were rental units. For all scenarios, the model estimates that in 2010, 64% of the units will be owner occupied and 36% rentals. Principally, this finding is due to the 2010 population having fewer (as a percentage of total households) younger households and a higher number of older households.

Table 4 summarizes the income characteristics of the total 2010 households projected for both the DOL population and for the CUPR/DCA projection that uses the more conservative headship assumption. The table assumes that the income characteristics of the State's 1980 housing stock is replicated in 2010. Most likely such an assumption overestimates the residual supply of lower income housing[7]. The table also displays tenure preference for the DOL forecasted population. Proportional results would be evident if the tenure analysis were applied to the DCA/CUPR projection.

TABLE 4

Estimate of 2010 Income Characteristics and Housing Need by Income Group

	Low Income	Moderate Income	Average Income	High Income
DOL Econ-Demo				
Total Owners	384,667	598,191	310,218	1,167,320
Total Renters	532,900	419,326	164,912	269,858
1980 total	608,238	679,917	319,864	942,271
Need (1980 to 2010)	*309,329*	*322,479*	*155,266*	*475,117*
DCA/CUPR Alt. 2				
Need (1980 to 2010)	*194,007*	*199,262*	*97,348*	*356,401*

In lieu of defining the housing need characteristics from 1990 to 2010, Tables 5 and 6 estimates a typical future housing program, by estimated the income and household size characteristics for a 1000 unit development, assuming the intent of the development was to accommodate a true cross-section of the 2010 household population. In addition, Table 6 displays the mean State household income for each the eight income groups. This mean household income estimate was the basis for the estimates of the amount of square

[7]OSP research conducted to date does not provide strong evidence to support the concept of widespread filtering. If such a concept were valid, given the relationship between income and housing prices, incomes would decline in all slow to moderate growing communities; a result not supported by data.

feet, considered affordable for each income group. This analysis was performed using a financing algorithm, which assumed the following:

1. 10% down payment was available to all households.
2. The structural costs were equal to 50% of the total unit cost.
3. The mortgage amount was equal to household income times 2.6.
4. The cost of unit construction varied by income group, from a low of $30 per square foot for Income group 1, to a high of $50 per square foot for income group 8.

TABLE 5
Number of Households by Income Group and Household Size
1000 Unit Prototype Development

	Income Groups							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1 person	64	52	38	25	14	10	4	2
2 person	20	44	46	44	39	55	31	18
3 person	12	14	20	24	26	41	28	14
4 person	8	9	14	20	25	43	31	18
5 person	3	5	7	10	12	23	19	11
6+ person	2	4	5	6	7	14	13	9

TABLE 6
Mean Income Estimate by Income Group
Estimate of Housing Space Affordability by Income Group
1000 Unit Prototype Development

	Income Groups							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Estimated Mean Income	$6,664	$19,991	$33,319	$46,647	$59,974	$79,965	$113,285	$133,275
Estimated affordable size (sq. ft)	400	800	1200	1600	1800	2200	2200	3000+

assumes mean Household Income of $62,000

Finally, the housing program contained in Tables 5 and 6 were given to an Urban Designer on the staff of OSP. The housing program data produced by the model were converted into building type and site requirements. Table 7 displays the product of this design exercise. The Urban Designer's description of methodology and site requirements is an appendix to this memo.

TABLE 7

Total Residential Program
1000 Unit Prototype Development

	Garden Apts.	Townhouses	Duplex	Single Family (det.)	Single Family (det.)
Number Units	237	259	123	312	72
Acres	5	20.4	15.7	64	24.8
DU/Acres	47.4	12.7	7.8	4.9	2.9

Total Dwelling Units	1000
Net Acres Residential	129.9
Gross Acres (15% roads & open space)	149.4
Density per Gross Acres	6.7

The results should be viewed as suggestive, rather than absolute. The lack of a time series (1990 data) results in the model's inability to adjust its estimate of household size to reflect the anticipated decline in household size by 2010. The table also *assumes* that the household size of this population is identical to that of the State's entire 2010 household population, and has the same income characteristics. Finally, it is important to note that the Affordability analysis assumes the construction costs will remain constant. The history of construction costs is that the real cost per square foot has been rising. If this happens, then a lower affordable size would result.

The principal finding of this report is that residential density will need to average between 6 and 7 units per gross residential acre, if future development is to be affordable. This density includes the assumption that future units are more modestly sized, with most low income households accommodated in units ranging from 400 to 800 square feet.

I. INTRODUCTION

Purpose of This Paper

The OSP PED model[8] assigns state-wide estimates of population (and employment) to municipalities. The program first converts future population into estimates of future houses by projecting the number of persons who would head households (and by assuming that each future head of household represents the need for a housing unit). To this need for household shelter is added an allowance for vacant units. The sum of total household shelter and total vacant units equals the total future housing units. The estimate of **new** housing units then is derived by subtracting residual housing units[9] from the sum of total housing units. This estimate of new housing is performed at a regional scale; the region consisting of one or more counties. Finally, regional growth is assigned to municipalities using algorithms based on two assumptions:

1. Future municipal growth would be similar in magnitude to the growth that occurred during a specified, user-selected, historic period; and,

2. Growth can only be assigned to municipalities with sufficient land available to accommodate new development, and that any growth in excess of the municipality's land capacity must be reassigned to other municipalities with sufficient land[10].

At the invitation of OSP, various experts have reviewed the PED model. Both of the model's municipal assignment assumptions have been criticized during this process. It was argued that the first growth assumption is insensitive to local land supply conditions. For example, it was proposed that land prices, in all municipalities, might be expected to rise as supply diminished. Since the model does not adjust for price, it might disproportionately assign growth to municipalities that have grown rapidly in the past, but which now have substantially diminish available land supplies[11]. It also was argued that the second growth assignment assumption assumed that all households would have sufficient income to live in the municipality to which they were assigned. Finally, it has been argued that the model's trend-based assignment method is a poor simulation of the real world. Critics of the Trend method report that population growth or decline is a result of

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[8] Reilly, James and Gottlieb, Paul. Distributing Population and Employment Forecasts to Municipalities. Trenton: New Jersey Office of State Planning, 1990

[9] Residual units consist of the total base year supply of housing units less an estimate of units likely to be demolished or otherwise lost, plus an adjustment for housing units created by converting non-residential structures to housing.

[10] A part of the OSP program calculated redeveloped land that could be made available in urbanized areas.

[11] A possible correction to this problem might be to dampen municipal assignments based on the ratio of total land to available developable land, so that the growth rate would be more logistic as opposed to linear. This suggested adjustment to the PED model has yet to be researched.

employment opportunities. Therefore, they argue that the OSP PED model should assign employment first, and then distribute houses around this employment.

In response to these criticisms, two research efforts have been completed. The first project focused on developing a methodology intended to incorporate economics into the OSP modeling. The second research effort was intended to statistically test various theories about the location of residential growth in a region. Both papers discussed theory and in neither paper were there any attempt to redefine the nature of the PED model.

Therefore, this report's primary purpose is to describe how these research findings have been used to refine the PED model. In addition, this paper is intended to accomplish the following objectives:

1. To provide a detailed description of the revised PED model.
2. To present initial results from the model and provide some analysis of this data, and;
3. To use data from this model to estimate future housing needs and a future housing program; both as input to the work of the State Planning Commission and other appropriate State Agencies.

II. REVISIONS TO THE PED MODEL

Review of Regional Locational Models

The OSP Technical Reference document (TRD) Examination of Residential Locational Theories and Factors that Affect Tenure[12] describes three regional science theories that attempt to locate growth. The *Centric* theory argues the land values are affected by proximity to employment concentrations. This travel-cost based theory holds that the highest valued residential land is located closest to the employment center(s) and that land located farthest away from the jobs has the least value. It also argues that lower income households live at high density (a response to the high land values) closest to the job centers and that only the wealthy, who can afford the cost of lengthy work trips, live spaciously at locations farthest from their jobs. By inference the centric theory also implies that people locate to areas with jobs and move away from areas where jobs decline. The *Hedonic* theory argues that land values are a result of local conditions, which are perceived by the buyer as more or less desirable. Residential neighborhoods are presented as a complex fabric consisting of tangible attributes (such as lot size, commuter costs, construction cost) and intangible attributes (such as crime rate, quality of the school system, or an attractive setting). Householders locate where they can maximize their housing investment to obtain those attributes they desire or can afford, thereby establishing the value of real estate in the neighborhood. The *Sectoring* theory states that various businesses enjoy an economic advantage by locating proximate to other related business. For example, retailers clustering into a mall or downtown shopping district gain business from shoppers intending to go to other stores in the facility. The theory also holds that households tend to cluster into areas with similar characteristics, such as income or ethnicity.

Ample national evidence exists to support the centric theory's implicit assumption that households locate to jobs. The rapid increase in New Jersey's non-manufacturing sector following World War II coincided with explosive population growth in the State. However, OSP discovered that this relationship between housing values (and by inference housing location) and job location does not hold at a municipal scale[13]. This finding suggests that while population changes in the State (or even in multi-county regions of the State) are linked to changes in employment, the assignment of households to municipalities cannot be modeled using the Centric theory. Employment locations might be too diffused, the road system too diverse and the boundaries of municipalities too economically arbitrary for the expected results of the theory to be evidenced, if they happen at all at that scale. However, the regional affect of the population responding to employment changes is included in the PED model. The exogenous population and employment projections that drive the model include such considerations at the State and at the county level.

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[12]Reilly, James. Examination of Residential Locational Theories and Factors that Affect Tenure. Trenton: New Jersey Office of State Planning, August 1991

[13]Neither rent nor median housing value as a function of at-place jobs to housing units produced a finding of significance. See Examination of Residential Locational Theories ..., page 13.

Unlike the Centric theory's lack of verification at the municipal scale, the Hedonic and sectoring models' relationship between housing value and household income were related at the municipal scale[14]. This confirms the common sense observation that poorer persons live in municipalities with low mean incomes and that rich folks live in wealthy communities. More importantly, this finding implied that household income affects the location of households at a municipal scale; a finding reported by other researchers[15].

Therefore, the research indicated that the PED model's municipal assignment subroutines should be modified to include the residential locational effects of household income. This modification process consisted of a two phase work task:

1. Estimate future incomes; and,
2. Determine how the model could most appropriately utilize the income information.

Estimating the Distribution of Future Household Incomes

As a first step, a method to estimate county and state scale per capita income and mean household income was defined, given population and employment projections. This method was based on the BEA OBERS model, and is fully described in the OSP TRD Description of the OSP Income Models. The products of this model are county-scale estimates of both per capita income and average household income.

The next step is take the county average household income and assign a likely distribution of incomes to the households in the county (e.g., estimate the number of poor households, the number of wealthy households, etc.). OSP research identified two different methods to accomplish this task. Both methods use the Census-defined convention of categorizing household incomes into eight income groups identified by numeric sequence, with income group 1 being the poorest through income group 8; the wealthiest. The first method, called *sectoring* is named after the locational theory which suggests that persons with similar incomes tend to cluster together. This method estimates the percentage of total households in each of the eight household income groups as a function of mean municipal household income, by using the regression equations reported in the OSP TRD, Examinations of Residential Locational Theories and Factors that Affect Income[16]. The second method to estimate household incomes, referred to as the *demographic* method, was reported in the OSP Technical Reference Document

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[14]Other Hedonic-like indices, such as age of structure, percentage of units vacant, changes in population showed little, if any, significance.

[15]Henry Pollakowski and Susan Wachter. "The Effects of Land-Use Constraints on Housing Prices" Land Economics, Vol. 66. No. 3, pps 315 - 324. The researchers report that housing prices are statistically related to income, distance (to employment in travel time) real mortgage rate and the cost of construction.

[16]Reilly, James. Examination of Residential Locational Theories and Factors that Affect Tenure. Trenton: State of New Jersey, Office of State Planning, 1991.

Description of the OSP Income Models[17]. The demographic model assigns households to one of eight income groups based on the age and racial characteristics of the head of the household.

The sectoring approach is based on statistical analysis of the 1980 Census. Each of the State's households was assigned to one of the eight income groups, defined in the Census, based on the household's reported income. With this data the total number of households in each of the eight income groups in each of the State's 567 municipalities was calculated. Next, in each municipality, the percentage of total households represented by each income group was computed. For example, in the mythical town of Podunk, the data might have showed that 15% of the households had group 1 incomes; 10% of the households have group 2 incomes, and so forth for each of the eight income groups; until 100% of the households in Podunk had been taken into account. Finally, for each income group, the percentage of total households in that income group was correlated to the mean household income of the municipality. The result of this analysis was to document the common sense observations that in poorer communities, a high percentage of households had low household incomes and in wealthy communities a large part of the total households had incomes in the higher income groups. The results also demonstrated that households in the middle income groups tended to be represented in most municipalities, with more lower middle incomers in less wealthy communities and more higher middle incomers in more affluent communities.

The product of the statistical research was equations, which allowed the estimation of the percentage of households in each of the eight income categories in any municipality, given the municipality's mean household income. Therefore, in a model such as the PED, one could take the number of households assigned to a municipality, the estimated mean municipal income of the municipality, and with these two sets of data determine the number of municipality-based households in each of the eight income groups. These equations were termed "sectoring equations", after the locational theory, because the equations were based on the tendency of persons with similar characteristics, in this case income, tend to group together.

The demographic method assumes that changes in future income distribution are affected by the changes in the age and race characteristics of the future population. The approach captures the "income life cycle", where most young and old households earn less than do middle-aged households and it reflects income differences characterized by race. For example, (money) income for households headed by persons aged 65+ is less than that of households headed by persons aged 45 to 54, probably as a result of the loss of full time employment income, due to the tendency to retire at age 65. Data from the 1980 Census was used to construct "incomeship" tables that display the percentage of each age/race cohort in each of the eight income groups[18].

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[17]Reilly, James. Description of the OSP Income Models.. Trenton: State of New Jersey, Office of State Planning, 1991.

[18]Reilly, James. Description of the OSP Income Models. Trenton: State of New Jersey, Office of State Planning, 1991.pp 23.

Both of the income estimation methods have strengths and weaknesses. The advantage of the sectoring model is that it allows municipal income distribution projection, and is based on significant statistical relationships. However, the sectoring model is insensitive to life cycle changes to the future population. It also includes the unlikely assumption that a future population has demographic characteristics identical to those exhibited in the 1980 State Population, the basis for the model's equations. The demographic model's main strength is its sensitivity to changes to life-cycle income changes. The method's major flaw is that it is capable of income projection only at county or regional scales, where sufficient projected demographic data is available. Another weakness results from the model's reliance on "incomeship" tables based solely on the 1980 Census. Therefore, the model assumes that age-race groups will not change their income distribution characteristics[19].

Therefore, the OSP Income model estimates average county incomes, using a BEA OBERS like model. The distribution of household incomes could be estimated at the county scale using demographic methods or at the municipal scale by using the sectoring method.

The final step in the PED model revision process is to determine how the income distribution projections could be used to affect residential locations.

Utilizing the Income data - The Income Fitting Paradigm

Two paradigms for using the income estimation methodology have been identified. In the first paradigm, income is used to determine the municipalities to which households would be assigned. For example, households with high future incomes would be assigned to wealthy communities, and households with low future incomes would be assigned to poor municipalities. Research to support this model would consist of the statistical relationship between income and home value, and the weaker but still significant relationship between income and rent[20]. With this model, income data constitutes two of the variables that determine growth assignments. The following equation describes the model.

$$MH^{t+i} = MH^{t+i}(RH^{t+i}, L^{t}, Y^{t}, RY^{t+i})$$

where:

MH^{t+i}	= Houses in a municipality at time t+i
RH^{t+i}	= Total new houses to be built in a region by time t+i
L^{t}	= Land available for development at time t
Y^{t}	= Municipal household income at time t
RY^{t+i}	= Regional households by income group at time t+i

[19]When comparable 1990 Census data is available, alternative age-race and income tables can be constructed to incorporate and trend any changes between the data sets.

[20] Reilly, James. Examination of Residential Locational Theories and Factors that Affect Tenure. Trenton: State of New Jersey, Office of State Planning, 1991.pp 8 - 10.

This equation states that the future number of households in any municipality is a function of the following variables: total number of new houses to be built in the region in which the municipality is located; the existing (base year) inventory of municipal land available for development; the existing mean municipal income; and, the estimated future year number of households in each of the income groups in the region. For example, wealthy households would be assigned to municipalities with high household incomes and would begin to consume the available developable land. Only when all of the higher income households had been assigned could households with lower incomes be assigned to municipalities with residual land available to accommodate growth. This *income-driven* assignment paradigm would continue until all regional growth had been assigned.

The second paradigm uses the income forecasting methods only to describe the income characteristics of the assigned population. This second model has several sequential steps.

1. $MH^{t+i} = MH^{t+i}(RH^{t+i}, TR, L^t)$
2. $POP^{t+i} = POP^{t+i}(MH^{t+i})$
3. $Y^{t+i} = Y^{t+i}(DPOP, DEMP, Y^t, DENSITY^t)$
4. $YGroups = YGroups(Y^{t+i})$

where:

MH^{t+i} = Houses in a municipality at time t+i
RH^{t+i} = total houses in a region at time t+i
L^t = land available for development at time t
TR = municipal trend growth rate
Y^t = municipal household income at time t
Y^{t+i} = municipal household income at time t+i
POP^{t+i} = Municipal population at time t+i
DPOP = Change in municipal population between time t and time t+i
DEMP = Change in municipal employment between time t and time t+i
DENSITY = Municipal density at time t
YGroups = Number of households in each income group

With this scenario, the first two equations assign households to municipalities based on historic growth rates and land availability, and then the resultant total future municipal households are converted into an estimate of municipal population. (These parts of the model are identical to the original PED model). The third equation uses the future population and employment estimates to forecast future mean municipal income[21]. This equation allows changes in population and/or employment to alter the base year income of a municipality; thereby producing the forecast year municipal income estimate. Once mean municipal income is determined, the distribution of income groups within the municipality

[21] You, Jong Keun. "Understanding Uneven Regional Growth." 19th Annual Report of the Economic Policy Council and Office of Economic Policy. Trenton: State of New Jersey, 1987, pp. 1-31

can be determined using the sectoring equations. Unlike the first paradigm where income affects location, this model assigns growth, then describes the income characteristic of the assigned population; hence the name *income descriptive* for this paradigm.

The first paradigm was not adopted for several reasons; all of which are related. The following description of how the model might work illustrate the problems.

> The first model assigns households with specific income characteristics to municipalities populated with households with compatible incomes. Therefore, one might assign the wealthy first, since it could be argued that they have the money to live where they please. Rich households then would be assigned to the available land in rich communities. Once this land was consumed, rich households would be assigned to available land in somewhat poorer, but still wealthy communities. Next, one might assign less wealthy families to the residual available land, continuing to fill land in municipalities on a wealth-driven priority system. Ultimately, the poor would be assigned to whatever residual land remained; all likely located in poor communities.

The first problem with this model is that it must assign *all* households to municipalities. While it is possible to estimate the income characteristics of future population and even to estimate the income characteristics of future households, a method of identifying those characteristics of the households *who would need new housing* is not known. Even if one were to look at changes in headship rates between different age cohorts (of the head of the household), this method at best would identify the incremental number of householders who would occupy shelter between the base year and the future year. Secondly, the model implies that changes in household income are solely a result of changes in population. Research published by the Office of Economic Policy (OEP) demonstrates that changes in employment alone are sufficient to alter mean municipal incomes[22]. Finally, the method of assignment likely would result in municipalities with very homogenous income characteristics. Research conducted by OSP found that municipalities tend to have a mix of income groups in them, although it is heavily weighted in very poor or very rich communities.

Therefore, the income distributive paradigm was adopted for use in the OSP PED model. However, the income distribution methodology developed for use in the revised PED model represents a blending of the two income estimation methods. This blending is intended to emphasize the best aspects of both methods. On a regional basis, the total number of households within each of the eight income groups is estimated using the *demographic* method[23]. From the total number of regional households in any income

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[22]You, Jong Keun. "Understanding Uneven Regional Growth." 19th Annual Report of the Economic Policy Council and Office of Economic Policy. Trenton: State of New Jersey, 1987, pp. 1-31

[23] Changes in the regional economy are accounted in the calculation of income. The mean income values assigned to each of the eight income groups is controlled so that total household income is equal to the

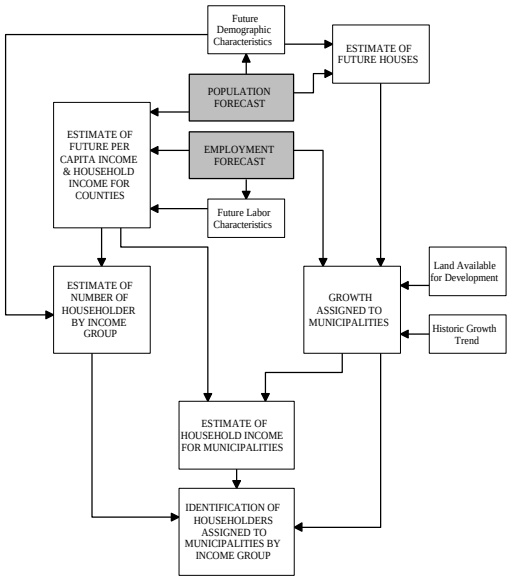
group, municipal household assignments are income-identified using a modification of the *sectoring* method. This modified sectoring method utilizes the 1980-based sectoring equations to identify the municipality's share of the regional supply of households in each of the eight income groups.

Revisions to the PED Model

The four part income descriptive paradigm has been incorporated into the PED model. Illustration 2 diagrams the revised PED program and displays the major steps of the model as equations.

Illustration 2

The Revised OSP PED Model as a Diagram and Equation



1. $MH^{t+i} = MH^{t+i}(RH^{t+i}, TR, L^t)$
2. $POP^{t+i} = POP^{t+i}(MH^{t+i})$
3. $Y^{t+i} = Y^{t+i}(DPOP, DEMP, Y^t, DENSITY^t)$
4. $YGroups = YGroups(Y^{t+i})$

where:

MH^{t+i} = Houses in a municipality at time t+i
RH^{t+i} = total houses in a region at time t+i
L^t = land available for development at time t
TR = municipal trend growth rate
Y^t = municipal household income at time t
Y^{t+i} = municipal household income at time t+i
POP^{t+i} = Municipal population at time t+i
DPOP = Change in municipal population between time t and time t+i
DEMP = Change in municipal employment between time t and time t+i
DENSITY = Municipal density at time t
YGroups = Number of households in each income group

The following sections provide brief descriptions of each of the models four main steps. Persons interested in a more technical discussion of any of these processes are invited to read the appropriate article(s) or OSP Technical Reference Document, referenced in each of the following sections. It should be noted that the following descriptions are for part of the trend simulation. Plan simulations might contain alternative density and growth assignment assumptions.

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sum of the number of households in each income group times the mean income value for each income group.

- Step 1 - Assigning Growth to Municipalities

Both population and employment projections are exogenous to the PED model. Model users are prompted to select a forecast from the several contained in the model, or to enter their own estimate of future population and/or employment. Forecast years currently include 1995, 2000, 2005 and 2010.

Housing need is estimated from the population forecast, using a modified "Headship" method. An estimate of future population living in group housing (as opposed to households) is subtracted from the total population estimate, to identify the future household population. This household population forecast for each county is further specified into the number of persons in each of 88 age, race and sex differentiated cohorts. The total householders in each adult cohort then is multiplied by a "headship" factor, which represents the percentage of persons in the cohort likely to head their own household at the forecast year. The model contains several headship rate tables, each embodying different assumptions about household formation tendencies. The model prompts the user to select a headship rate alternative. The result is an estimate of the number of persons who head households in each county at the forecast year. It is assumed that the total "headed" households is equal to the total number of households, and that each household represents a housing shelter need.

Total future houses are estimated by adding a vacancy factor to the total housing shelter need. The model allows the user to select a vacancy factor which ranges for a low of zero to a high of 10% of the total future housing stock.

The next portion of the program estimates the number of future total houses that will be newly constructed between the model's base year of 1986 and the forecast year. The total 1986 existing housing stock is used as the base to determine residual housing, defined as the number of today's houses remaining in the forecast year. First, the model user determines the number of 1986 houses that would be demolished, burnt or otherwise lost, by selecting from several demolition alternatives contained in the PED model. Next the user decides the number of non-residential units that will have been converted into housing use; again by selecting from conversion alternatives contained in the PED model. Residual housing is determined by subtracting demolitions from the 1986 housing stock base and then adding to the remainder the total units converted[24]. Total new housing constructed between the base year and the forecast year is the difference between the total houses and the total residual houses.

New houses and new jobs (the difference between base year employment and the projected employment) are assigned to municipalities based each municipality's trend growth rate and supply of available vacant land. The supply of vacant developable land in

[24]Failure to adjust the base year housing supply for demolition and conversions can result in substantial errors. OSP calculated it's demolition and conversion tables from several sources, including the Census and NJDOL-collected building permits. Based on these sources, the annual changes to the state's housing stock range from almost -3000 units a year to a high of about -12,500 units a year.

each municipality was determined for the base year 1986 through photo interpretation of 1: 24,000 aerials. This analysis[25] was performed by OSP. The density used to assign houses and jobs was derived from this photo analysis. OSP measured the total developed land in each municipality. Using municipal based employment estimates (based on ES 202 data) and industry specific estimates of land per employee, land used by non-agricultural employment was identified and subtracted from each municipality's developed land. The resulting non-industrial developed land residual was divided by the total housing units in the municipality to yield Trend residential density per non-industrial acre. From this methodology a specific employment and housing density was used for each of the State's 567 municipalities. The program also allows the user to alter this 1986 estimated density by as much as plus (denser) or minus (less dense) 15% to fit future housing.

The municipality's rate of trend growth can be user selected for any decenial period or combination of 10 year Census year periods from 1950 through 1980. This trend growth rate is expressed as a percentage of a region's growth share; the region consisting of one or more counties. Therefore, each municipality's trend share of the regional growth is tested to see if sufficient developable land is available in the municipality by multiplying the growth by the municipal-specific residential or employment density and comparing this result to the municipal supply of developable land. If sufficient municipal land exists, then the regional growth share is assigned to the municipality. If insufficient land exists, the growth that can be accommodated is fitted and the remainder reassigned to other municipalities in the region.

The results of this phase of the model are forecast year estimates of housing and employment for each of the State's 567 municipalities. A detailed description of this portion of the PED model can be found in the OSP publication Distributing Population and Employment Forecasts to Municipalities[26].

- Step 2 - Convert municipal housing assignments to population estimates

As currently constructed the PED model uses the 1980 Census enumerated group housing data as a constant[27]. Municipal households are converted into municipal estimates of householders by multiplying the number of households by a county specific factor. This factor is derived by dividing the county's total forecast year household population by the county's total forecast year housing units. To this municipal scale estimate of householders is added the municipality's estimates of residents who live in group housing (1980 group quarters population).

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[25]Office of State Planning. Estimating Growth and its Effects, pt1: Land Availability Analysis. Trenton: State Of New Jersey, 1989.

[26]Reilly, James and Gottlieb, Paul. Distributing Population and Employment Forecasts to Municipalities. Trenton: New Jersey Office of State Planning, 1990.

[27]The limitation of this method is recognized, especially in light of the 1990 Census report that group housing in New Jersey increased by almost 50%. OSP has identified the need to develop a more sophisticated method to estimate future group housing needs.

- Step 3 - Estimate Forecast Year Municipal Income

Two models are used to estimate forecast year municipal income. First, Per Capita income, Group Housing income and Household income for each county are estimated using an OSP developed model, based on the Bureau of Economic Analysis' OBERS model. This model takes forecast year projections of employment and population and estimates state and county future incomes from this data. The second model estimates forecast year municipal incomes based on municipal changes in population and employment, the density of the municipality and the base year per capita income of the municipality. The PED model then adjusts the municipal income estimates so the they sum to the county income estimates produced by the OBERS-like model.

A detailed description of the OBERS based model is in the OSP Technical Reference Document Description of the OSP Income Models. Two descriptions of the municipal income estimating model exist: "Understanding Uneven Regional Growth" published in the report 19th Annual Report of the Economic Policy Council and Office of Economic Policy; and, the OSP TRD Projecting State and Local Operating Budgets Under Various Growth Scenarios[28].

The OSP-OBERS model first estimates forecast year county personal income, by separately estimating money income from earnings, property and proprietary income and transfer payments. The exogenous employment forecast (selected by the model user in step 1) provides county specific projections of forecast year employment for each of the ten general types of industries (two digit SIC's). The employment then is multiplies by county specific estimates of future wages for each of these types of industries. The result is an estimate of future county specific earnings for all jobs located in each county. From this county job-located earning estimate, projected social Security is deducted. Finally, county residential earnings are estimated based on statistically based adjustments to the historic county-specific ratio between residential earning and job-located earnings. Property and Proprietary income is assumed to be a fixed percentage (22%) of county residential earning. The three types of Transfer payments, Social Security income, pension income and Public assistance, are separately calculated. Social Security is assumed to equal a fixed percentage (.043) of residential earnings. Pension income was calculated by multiplying the county specific number of persons aged 65+ by an income factor, based on estimated future total county estimated personal income. Public Assistance payments were calculated by multiplying a per capita payment by the number of forecast year persons in a statistically related (to welfare payments) population cohort. The sum of all these county specific incomes equals total forecast year personal income for the county. Average future per Capita income is determined by dividing the total personal income by the county's forecast year population. Forecast year total group housing income and total household incomes were estimated by assuming the existing (1980) ratio between group housing income and household income would remain constant. Forecast year average household

[28]Gottlieb, Paul. Projecting State and Local Operating Budgets Under Various Growth Scenarios. Trenton: New Jersey Office of State Planning. 1990.

income was derived by dividing total future household income by the forecasted number of household, determined in step 1. Average forecast year household incomes for the State and for each County were calculated.

The New Jersey Office of Economic Policy (OEP) model calculates mean municipal per capita income, based on statistical relationships between changes in municipal population and employment, the base year municipal density and the base year municipal per capita income. Changes in municipal population and employment, produced by step 1 of the PED model, were input to this econometric equation. However, the model's results were adjusted so that the sum of OEP model's municipal per capita incomes was equal to the total future per capita income estimated by the OSP OBERS-like model. This adjustment was necessary because the OBERS-like model is sensitive to sectorial changes in employment and the OEP model is not. The adjusted average municipal per capita income was used to estimate both total municipal group housing income and total municipal household income. Finally, mean forecast year municipal household income was calculated using the future number of municipal specific households produced in step 1 of the PED model.

- Step 4 - Estimate the Distribution of Income groups in each municipality

The method to estimate the distribution of household income groups uses a multi-phase process. First, the forecast year households, grouped into age-race (of head of household) cohorts, are multiplied by incomeship factors, to identified the number of households in each of the eight income groups in each county. .

Second, forecast year mean household incomes for each of the eight income groups then are estimated. The forecast year State mean household income is multiplied by eight factors, each expressing the 1980 household income group's mid-point value divided by the 1980 mean state household income. For each county, the resulting estimate of the mid-point for each of the State's income groups then is adjusted so that the sum of each county's total number of households in each income group times the adjusted mid-point income for each group is equal to the total household income for the county, as estimated in step 3.

Finally, the number of households in each municipality in each income group is estimated. The sectoring equations are applied to the mean municipal household income, estimated in Step 3. The resulting "raw" estimates then are adjusted to insure that county and municipal mean household incomes can be derived. In addition, the county estimates of the total number of households in each income group are used to adjust sectoring equation-based estimates of the number of households in each income group in each municipality. Surprisingly, these consistency adjustments result in very small changes to the "raw" sectoring results.

If the PED Municipal Assignments didn't change - Why all this Effort?

The original criticism of the OSP PED model was that income would affect the location of households. As revised, the PED model allows employment to affect population at a regional scale; and to the extent that earnings are a major part of income the model allows economics to affect residential location. However, with respect to municipal assignments, the model assumes that persons of similar incomes tend to live together but that the evidence for making assignments based on income is insufficient. If this is so, then one may wonder to what purpose all of the econometric information is to be applied. Three general uses for the income data are evident:

1. Market Research - Information about future incomes and the location of future incomes is valuable for both residential and non-residential planning purposes. The model estimates the number of future houses that will need to be constructed and provides information about the incomes of future households. Later in this report, a first cut effort will be made to use the data to estimate a forecast year housing program. Many types of employment, especially retail trades and certain types of service industries locate to growing population areas. The model located where these areas are and provides sufficient income data to allow a fairly complete market feasibility study to be performed.

2. More economically consistent Impacts - Currently, the OSP Operation and Maintenance model estimates the fiscal impacts of growth on local and State levels of government. In the past the model calculated municipal incomes (and therefore tax revenues) solely on the basis of OEP equation. The addition of the OSP Income model to the PED provides for a greater degree of economic consistency for this impact evaluation component. OSP research for a water demand model also shows that water consumption is income dependent[29]. This research finding also suggests that wastewater generation might be income related.

3. Improved Policy alternative testing - The PED model's original justification was that it would provide a way to evaluate the impacts of plan policies by allowing their comparison to trend impacts. The addition of economic forecasting data only enhances this capacity. For example, an early use of the model's economic data caused a rethinking of the 1987 Draft Preliminary Plan concept that the health of cities would be improved by increasing their population[30].

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[29]Dziegielewski, Benedyki, Boland, John and Baumann, Duane. An Annotated Bibliography on Techniques of Forecasting Demand for Water. Ft. Belvior, Virginia: U.S. Army Engineering Institute for Water Resources. 1981.

[30]See Gottlieb, Paul. Projecting State and Local Operating Budgets under Various Growth Scenarios. Trenton: New Jersey Office of State Planning. 1990, section 4.

III. MODEL RESULTS - HOUSING NEED AND FUTURE INCOMES

DESCRIPTION OF THE POPULATION AND EMPLOYMENT ASSUMPTIONS

Different population and employment forecasts will produce different growth patterns and different economic characteristics of the future population. Therefore, before the results of any particular run of the model are presented, it is appropriate to briefly discuss the nature of the population and employment projections and other assumptions and caveats that influenced the results of this model run.

a. Two Growth Projections Used

The findings presented in this report result from using two different sets of population and employment projections. The first projection was produced and published in 1989 by the New Jersey Department of Labor[31] and reflects the results from their Economic Demographic model. In the forecast year 2010, this model estimates the State population to have grown by 1.226 million people and the State-located non-agricultural employment to have grown by .832 million jobs. The second projection set was prepared by Rutger's University Center for Urban Policy Research (CUPR) in 1991, under contract to the New Jersey Department of Community Affairs[32] (DCA). This CUPR/DCA forecast projects .52 million new persons and .655 million new jobs in 2010, when compared to 1990. Table 1 displays the numeric differences between the two projections.

The science of long range growth forecasting is inexact. National and International events, which cannot be forecasted or controlled at a State or local level, will intervene and cause the assumptions used in these forecasts to be questioned. This problem of accuracy is particularly acute for long range projections; less so for 3 to 5 year estimates. Recent advances in other forms of long range forecasting are reporting that models based on statistical smoothing and linear trends are less reliable than models based on chaotic, or unpredictable, curves. Because of the uncertainty, it would be circumstantial if any one of the projections reviewed in this memo proved to be highly accurate.

Current thinking is that the DOL projection, prepared prior to the release of the 1990 Census might be optimistic. For example, the NJDOL Economic - Demographic Projection's estimate of 1990 population was higher than the population reported in the 1990 Census[33]. The CUPR/DCA estimate reflects the population results from the 1990 Census, which recorded that the decade 1980 to 1990 was one of the slowest growth period in the State's history. The growth recession found in the 80's is projected by

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[31]New Jersey Department of Labor, Labor Market and Demographic Research. Population and Labor Force Projections for New Jersey: Volumes I & II. Trenton: New Jersey Department of Labor. 1989.

[32]New Jersey Department of Community Affairs et al. State of New Jersey Comprehensive Housing Affordability Strategy (CHAS). Trenton: New Jersey Department of Community Affairs. 1991.

[33]The NJDOL Econ-Demo 1990 population estimate was approximately 7.814 million persons and the 1990 Census counted 7,730,188 persons.

Table 1
COMPARISON OF ALTERNATIVE PROJECTIONS
POPULATION AND EMPLOYMENT IN 2010

	Employment			*Population*		
	90 Census	NJDOL 89	CUPR/DCA	90 Census	NJDOL 89	CUPR/DCA
Statewide	*7,730,188*	*8,996,500*	*8250,260*	*3,665,300*	*4,497,000*	*4,320,100*
Atlantic	224,327	294,500	235,751	141,078	196,000	148,267
Bergen	825,380	896,400	723,600	457,000	591,900	506,360
Burlington	395,066	492,400	453,794	158,984	191,300	236,172
Camden	502,824	597,100	534,643	216,533	265,000	283,901
Cape May	95,089	130,100	122,199	35,522	48,600	31,563
Cumberland	138,053	158,500	170,670	59,600	65,900	98,790
Essex	778,206	846,200	600,092	385,331	451,000	320,353
Gloucester	230,082	260,200	261,963	74,782	81,100	98,537
Hudson	553,099	572,600	631,420	247,600	289,000	300,280
Hunterdon	107,776	132,200	154,191	38,007	48,400	65,619
Mercer	325,824	409,200	380,870	198,300	243,600	248,060
Middlesex	671,780	804,200	864,942	365,220	432,700	550,363
Monmouth	553,124	697,700	578,498	218,791	276,000	285,018
Morris	421,353	481,800	411,729	257,398	334,600	274,565
Ocean	433,203	567,700	576,332	115,209	154,800	157,792
Passaic	453,060	531,200	472,250	196,200	245,400	161,230
Salem	65,294	69,700	63,970	23,800	25,900	23,570
Somerset	240,279	286,600	310,697	145,073	162,200	241,829
Sussex	130,943	165,600	163,447	30,034	38,800	32,643
Union	493,819	506,900	418,322	267,337	315,500	212,649
Warren	91,607	95,800	102,880	33,500	39,300	42,540

CUPR to continue until the period 2000 to 2005. It might be appropriate to consider the CUPR projection as being conservative. For example, the State growth projection published by Harvard/MIT Joint Center for Housing Studies[34] tends to split the difference between the DOL and the CUPR estimates. At the year 2000 (the outer edge of the Harvard forecast), DOL projected total population to be 8.5 million; Harvard projected 8.145 million; and CUPR projected 7.88 million.

b. Two Headship Rates

Headship rates represent the percentage of a specific population cohort that is expected to head a household. The PED model categorizes the future population into 88

[34]Masnick, George S. Joint Center for Housing Studies - Working Paper Series, "New Projections of Population and Households for States and Regions". Boston: Harvard University. Working Paper W89-9.

distinct cohorts, identified by race, age and sex. Then each of these cohorts is multiplied by a factor (decimal 0 >= 1), which represents an estimate of the percentage of persons in each of the cohorts expected to head a household. The sum of persons resulting from this "headship" analysis is equal to the number of future households. Headship rates are used so that forecasts of households can be sensitive to demographically driven life cycle changes in the population. For example, as the Baby Boomers aged to adulthood in the 1970's, their increased demand for housing was partly replicated by the increased headship rate of the young adult age cohorts.

Alternative headship rates are used to reflect either continuations of, or changes to, the tendency for any cohort, or group of cohorts to change social arrangement that affect their household formation trends. For example, one might increase the headship rate for males aged 25 to 34 if one felt that more members of this cohort were more likely to live on their own, than is evidenced historically. The PED allows the model user to select from several headship rate alternatives, each of which incorporate unique groups of assumptions about the continued or changing trends[35] that affect the formation of households.

The headship rate used in this report was prepared by the New Jersey Department of Labor and is referred to as the "1995 Trended" rate. It assumes that New Jersey household formation annualized trends evidenced from 1970 to 1980, would continue until they stabalized in 1995. This alternative assumed more single person households, especially those headed by females and more rapid growth of non-traditional households than was evident in the decade of the 80's. Possible justification for this assumption is that the economic hard times of much of the 80's make it more difficult for these persons to secure employment, thereby lowering the household growth rate of this segment. Over the next twenty years, improved economic conditions will correct the current (1980's) imbalance. The second headship rate assumes a more moderate growth rate for single person and non-traditional households.

The first headship rate has been used with both the NJDOL and the CUPR/DCA projections. The second headship rate has only been used with the CUPR/DCA projection; thereby producing the lowest household growth scenario.

c. NJDOL Employment by Type of Industry Estimated by OSP

As part of its projection series, NJDOL included year 2010 employment estimates. Total state-located non-agricultural employment in the year 2010 is projected to be 4,496,800 jobs[36]. Between 1980 and 2010 approximately 1.4 million new jobs would be

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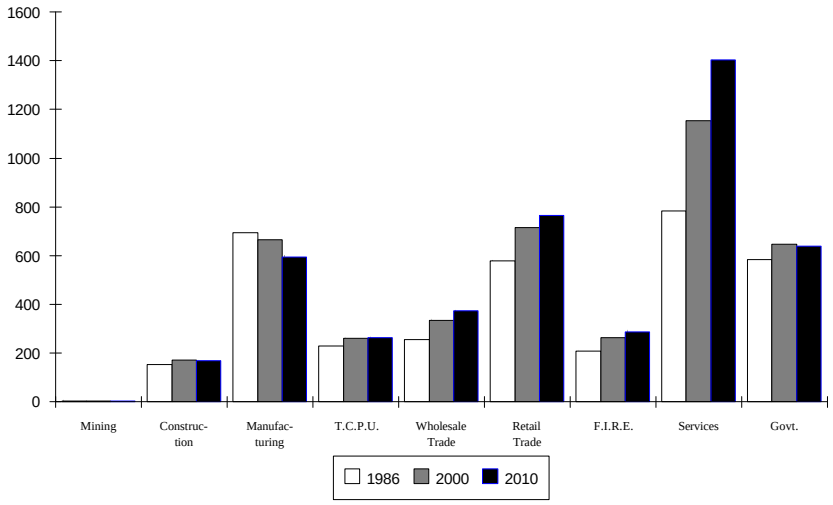
[35]According to George Masnick, in his paper "U.S. Household Trends: The 1980's and Beyond", Working Paper W89-1, Harvard University Joint Center for Housing Studies, five trends will be influential. These trends are: the existence of adverse economic conditions; the decline in household size; the aging of the baby boomers; the continued delay in marriage and family formation; and, the increase in households headed by the elderly.

[36]This employment estimate series was provided by NJDOL at the request of OSP. It is likely that printed copies of this projection series have never been published by NJDOL.

created. However, NJDOL never published its estimate of 2010 employment, identified by type of industry.

To accomplish the projection of employment by type of industry, OSP utilized the New Jersey Department of Labor's[37] 1986 and year 2000 projections of employment, by industry type, for New Jersey and its counties. Then OSP interpolated the growth rate from 1986 through the year 2000 for each major industry type. Finally, OSP used the 1986 to 2000 growth rates to prepare preliminary estimate the total year 2010 employment for each major industry. The resulting preliminary estimates were then constrained to the long range New Jersey Department of Labor non-farm wage and salary employment projection total for the year 2010. The chart 1 displays the nature of the projected year 2010 employment growth, compared to the years 1986 and 2000.

CHART 1
NEW JERSEY EMPLOYMENT BY TYPE OF INDUSTRY



d. CUPR/DCA Projection Employment and Population Assumptions

CUPR (at the time this report was being written) has not released estimates of the future demographic composition of its population projection nor has it released estimates of the types of employment existent in its 2010 projection. Without this type of detail, the OSP PED model can not produce results. Therefore, OSP assumed that the CUPR/DCA projection had the same employment type representation and the same demographic

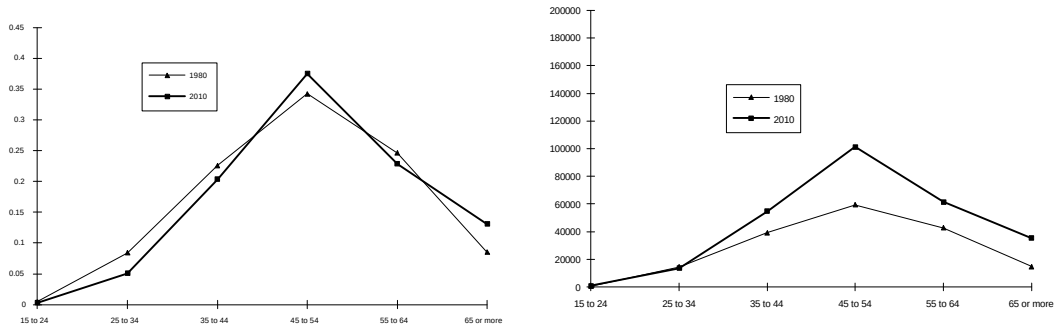
[37]NJ Department of Labor, Labor Market and Demographic Research. Employment Projections Volume III: Industrial Outlook for Counties of New Jersey 1986 - 2000. Trenton: New Jersey Department of Labor. 1989.

characteristics as those in the NJDOL projection. OSP also was forced to assume that the demographic mix in the CUPR and the DOL projections was identical.

These OSP assumptions can have pronounced impacts. Numeric changes in projections about the number of Jersey locate jobs have a more modest impact on residential incomes than would result from shifts in the nature of the employment. For example, a significant decline in highly paid manufacturing jobs, offset by a corresponding increase in lower paid service jobs, still would result in a decline in Personal and Household incomes. Shifts in demographic composition affect the model's estimates of household income, tenure and size.

Because both projections share demographic assumptions, the following diagram of the DOL-projected population also would apply to the CUPR population reported in this report[38]. At the year 2010, only households headed by persons aged 35 or older will experience numeric increases (compared to 1980). This is due to the aging of the Baby Boomers and the tendency of this group to have fewer children.

Chart 1
STATE OF NEW JERSEY
NJDOL 89 Economic Demographic Projection
COMPARISON OF 1980 AND 2010 HOUSEHOLDER AGE COHORTS



Percentage of Household Heads in each Age Cohort Number of Household Heads in each Age Cohort

e. <u>With All These Assumptions - What's the Point?</u>

As is evident from the preceding section, the projections used in this report contain several assumptions about the society and the economy that may not prove to be correct in 2010. To those who then would ask "Why focus our attention on such academic forecasting exercises?", the following justifications for the modeling effort are offered.

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[38]The CUPR forecast would result in fewer households headed by persons 15 to 34 than was evident in 1980. Other households would exceed the 1980 level but be less than the NJDOL level displayed in the chart. The diagram of "percentages" would be identical to that shown in Chart 1.

First, any one result of the model has so many policy variables in it, that it is only circumstantially likely to be a completely accurate prediction of the future. However, baring cataclysmic events, it is completely likely that future conditions will result from modifications to the State's existing population and employment base aged into the future. The only uncertainty is the degree of change that will occur. The OSP PED model can be used to simulate the range of changes by using alternative population and employment, and other, assumptions. The effects of Plan and Trend then could be viewed over the range of possible future alternatives. Such an approach has intuitive appeal since the State's future largely will be determined by decisions and event exogenous to the State. Second, while the model's numerous assumptions might be viewed as "unnecessarily" complicated by some model critics, the real strength of the model is in its sensitivity to a variety of alternative policy and social conditions. Finally, the model provides a rational, replicable method to produce both Trend and Plan future land use patterns. Together with the other OSP Impact Assessment Models programs the effects of Plan can be tested. As such, the model will facilitate the legal justification of Planning Commission decisions.

MODEL RESULTS

a. Estimate of Future Householders

Householders are those persons in the population who live in households, as opposed to living in group quarters such as nursing home, school dormitories, prisons, etc. OSP assumed that the total future group quarters population was equal to the 1980 group quarter population; a total of 136,533 persons. The group quarters assumption reflects the fact that this subject needs to be studied, not any insight on the part of OSP. For example, the 1990 Census reports a total of 171,368 persons living in group quarters out of a total population of 7.73 million. In 1950, the group quarters population was 176,930 persons out of a total population of 4.84 million.

While the choice to use the 1980 group quarters population was arbitrary, the group quarters assumption should not be dismissed as an insignificant small number. While the state's population grew by only 365,365 persons between 1980 and 1990, the State's group quarters population increased from 136,533 persons in 1980 to 171,368 persons in 1990. More importantly, it is likely that a significant portion of the persons living in group quarters are elderly. Not only is this segment of the population projected to grow by 2010, but given the very high headship rate associated with this population group, its impact on housing demand could be substantial. An underestimation of group quarters results in an overestimation of new housing that is need and could result in understating the need for residential care facilities for the elderly; an activity licensed by the State.

The NJDOL Projection results in an estimate of approximately 8.86 million householders in New Jersey by 2010, an increase of 1.302 million compared to 1990. The lower population projection of the CUPR/DCA model produces a correspondingly lower number of householders. Approximately 8.114 million householders would exist in the State in 2010; a growth of .556 million households since 1990.

b. Estimate of Future Housing Need

Housing need is estimated by multiplying householder population with the headship rate to result in an estimate of the number of persons who would head households. It is assumed that each household head represents the need for one housing unit. In addition to providing for this housing shelter need, the PED model provides for housing unit vacancy, and estimates the need to revise the base year housing stock to account for demolition and conversion.

In all of the following estimates of housing need, vacancy was assumed to be five (5%) percent. The demolition and conversion alternative[39] used with all the projections is based on the 1986 NJDOL compiled record of demolition and conversion permits. It was assumed that this annual change would continue, resulting in a total deficit of almost 70,000 units by 2010 (demolitions exceeded conversions). Therefore, an additional 70,000 units would need to be constructed to bring the residual housing stock to base year (1986) levels.

The NJDOL projection produced a year 2010 estimate of 3.8 housing units[40]; an increase of 1.07 million units compared to 1990. Two CUPR/DCA estimates were produced. The first using the 1995 trended headship rate (same as used with the NJDOL projection) resulted in a total of 3.539 million housing units; an increase of 774,569 units compared to 1990. The second CUPR/DCA projection used the more conservative headship rate. Because of the lower rate of household formation a total of 3.228 million[41] units were forecast in 2010; an increase of 603,164 units over 1990.

Dividing the number of persons living in households by the number of households produces the average households size. Average 2010 household size for both set of forecasts using the first headship rate was 2.4 person, down from 2.83 person in 1980 and 2.7 persons in 1990. The forecast that assumed 1980 constant headship rate resulted in a household size of 2.5 persons.

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[39]Other OSP alternatives are in the model and were based on other NJDOL permit time series and on the US Census reports. The 1986 constant requires the least replacement. The highest replacement level is based on the Census for the period 1960 through 1980; it forecasts the need to replace almost 300,000 units by 2010.

[40]This estimate conforms very well to the estimates published by the NJ Department of Community Affairs, which also is based on the NJDOL population projection. NJDCA's estimates ranged from a 2010 low of 3,677,700 households to a high of 3,982,100 households. See: Dolan, Larry W. New Jersey's Housing Needs 1990 to 2010. Trenton: NJDCA 1990 p.108.

[41]CUPR might have assumed a different demographic make-up of the 2010 population or an even more conservative rate for the formation of new households. Such a conservative rate might be the result of CUPR's presumed assumption that the current recession continues (the formation of households is constrained during hard economic times). The CUPR estimate is 3.201 million units.

c. State Mean Income Forecasts

The amount of money that an average household makes principally is a function of the employment assumptions used in the model and, to a lesser extent, the demographic characteristics of the population.

The 1980 Census reported the Mean Per Capita Income for New Jersey to be approximately $13,570 in 1989 dollars. By 1990 the Mean Per Capita Income has been estimated by NJDOL[42] to have increased to $23,764, expressed in 1989 dollars. The OSP Income model, using the NJDOL Economic-Demographic projections for population and employment, produced a year 2010 State Mean Per Capita Income estimate, also in 1989 dollars, of $24,867[43]. Because of the alternative headship rate, two Per Capita incomes were produced for the CUPR/DCA projection. For the projection that assumes non-traditional and single parent households will vigorously grow, PCI in 2010 was $26,400. The second CUPR/DCA projection resulted in a mean PCI of $25,230.

Per Capita income includes all personal income divided by the State's total population. The mean household income also was calculated by subtracting the estimated income of all persons living in group quarters from total personal income. The resultant total householder income is divided by the total number of households to produce the estimate of mean household income.

The NJDOL projection produced a mean household income of $62,583. The CUPR/DCA projection using the 1995 Trended headship resulted in a mean household income estimate of $61,540. The second DCA/CUPR projection, which estimated fewer households, produced an estimated PCI of $25,230 and a mean household income of $61,258[44]. The OSP PED model's Per Capita Income estimate was compared to other published income projections, and found to produce results consistent with these other forecasts[45].

To compare the PED model's income projection, OSP tried, but was unable, to obtain a current 1990 estimate of mean state household income. Woods & Poole (1990) estimated 1990 mean household income to be $69,500, but it is unclear if this estimate was based on fact or their modeling (which over-estimated both 1990 population and 1990 jobs). It also is possible to crudely estimate 1990 Household Income by multiplying the

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[42]NJ Department of Labor. "Economic Briefs," New Jersey Economic Indicators. Trenton, NJ : NJDOL, May 1990 p. 9. In the June 1991 issue of New Jersey Economic Indicators, NJDOL reports the US Department of Commerce, Bureau of Economic Analysis 1990 estimates of PCI. New Jersey's PCI is reported to be $24,968 (1990 dollars).

[43]See the OSP TRD # 80, Description of the OSP Income Model, for a description of how the model works and for a description of the other assumptions included in this model result.

[44]The slight differences between the two DCA/CUPR income projections result from county-scale differences in the number of households created in each scenario. these differences affect the model's estimation of the relationship between earnings for all jobs located in a county and residential earnings.

[45]See the OSP TRD # 80, Description of the OSP Income Model, p. 20.

mean household size with 1990 Per Capita Income. This process results in an estimate of household income of $64,230, although this figure likely is overstated due to the inclusion of group householder income. A likely estimate of 1990 Household income is $60,000.

For all scenarios Mean Per Capita income increased, yet Mean Household income remained stable, or experienced a very slight increase. The household income result is consistent with the national trend of household income[46], evidenced since 1973, which show household income increasing very slowly since 1982. The PED model forecast probably reflects both the larger number of retired-person households and the trend towards smaller household sizes (more single person households, more single parent households), both factors that would slow household income growth.

d. The Distribution of State Mean Household Income

Once, mean household income has been estimated, the estimation of the number of total state-wide households in each of the eight income groups is a function of the age and racial cohorts of the heads of each household. It was generally assumed that the age/race cohort income distribution characteristics for the year 2010 would be identical to those that existed in 1980. This means that for any given age/race identified group of households, the percentage used to assigned to any of the eight income groups would be the same as that reported in the 1980 Census. The exception to this 1980 income-constant assumption was that households headed by persons aged 65 and older would be somewhat wealthier[47] than was the case in 1980. The following series of charts displays the year 2010 income distributions for each of the model's six head of household age cohorts. Variance in the percentage of total households in any the income group is the result of shifts in the racial composition of the cohort's household heads. As previously mentioned, the change in the cohort aged 65 or older is due to an income distribution assumption.

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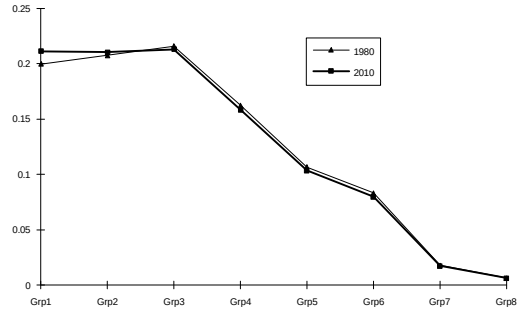
[46]See: Hughes, James W. Housing Policy Debate. "Clashing Demographics: Homeownership and Affordability Dilemmas". Washington. DC. Office of Housing Policy Research, Fannie Mae. Vol. 2, Issue 4, 1991.

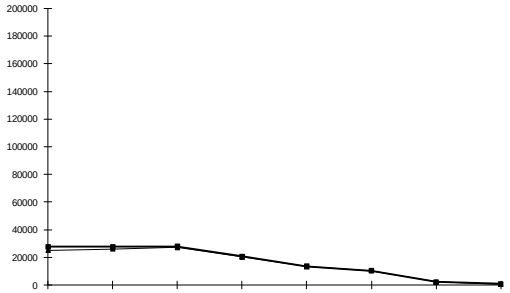
[47]This modification was made on the assumption that the year 2010 older households would increase their money income via increased capitalization of real assets, such as the use of equity loans to generate income from homes. This assumption has its critics, who argue that year 2010 older households will have less income due to the assumed failure of the Social Security system. The model allows for alternative assumptions and should be used to identify the range of likely outcomes as the basis for planning.

CHART 3

STATE OF NEW JERSEY
COMPARISON OF 1980 AND 2010 INCOMES DISTRIBUTIONS FOR
HOUSEHOLD HEADED BY PERSONS AGED 15 TO 24

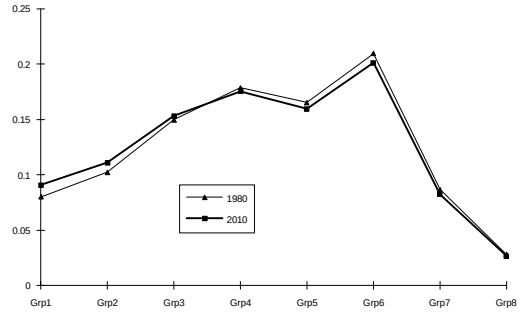


Percentage of Age Cohort in each Income Group

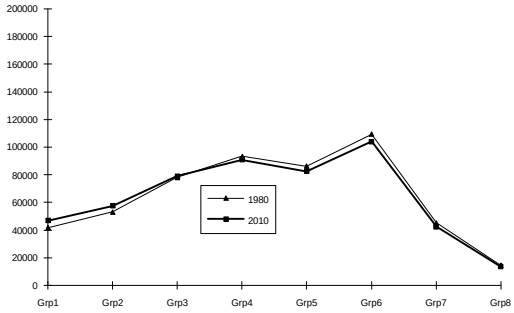


Number of Age Cohort in each Income Group

STATE OF NEW JERSEY
COMPARISON OF 1980 AND 2010 INCOMES DISTRIBUTIONS FOR
HOUSEHOLD HEADED BY PERSONS AGED 25 TO 34

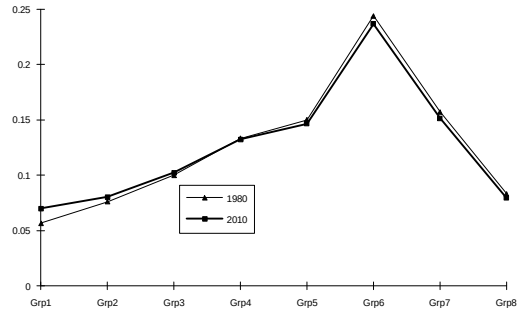


Percentage of Age Cohort in each Income Group

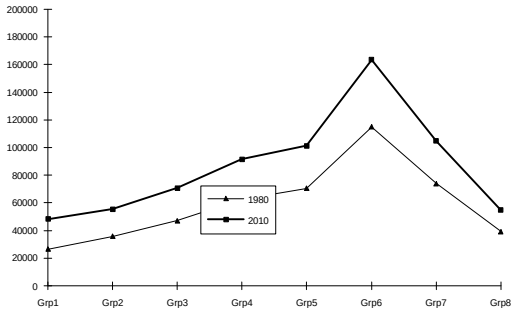


Number of Age Cohort in each Income Group

STATE OF NEW JERSEY
COMPARISON OF 1980 AND 2010 INCOMES DISTRIBUTIONS FOR
HOUSEHOLD HEADED BY PERSONS AGED 35 TO 44



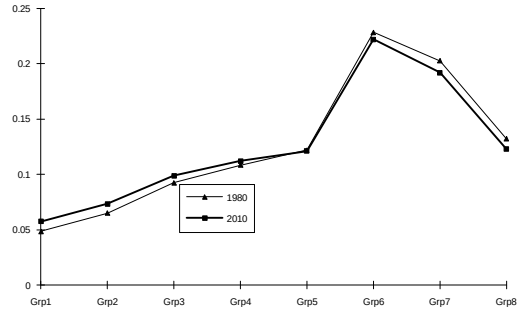
Percentage of Age Cohort in each Income Group



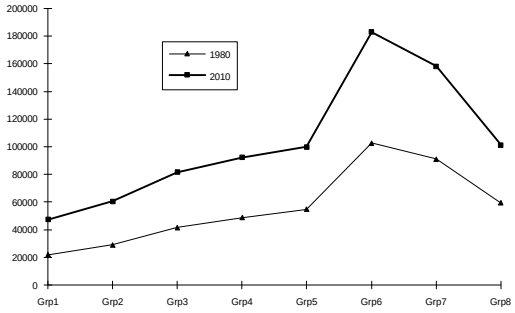
Number of Age Cohort in each Income Group

CHART 3 (CONTINUED)

STATE OF NEW JERSEY
COMPARISON OF 1980 AND 2010 INCOMES DISTRIBUTIONS FOR
HOUSEHOLD HEADED BY PERSONS AGED 45 TO 54

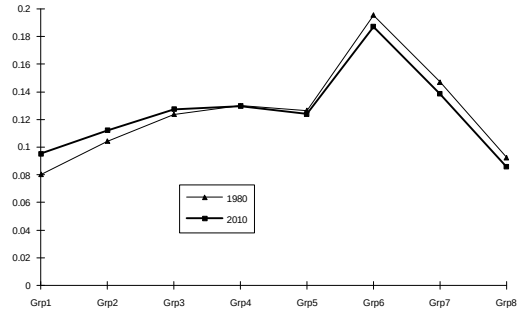


Percentage of Age Cohort in each Income Group

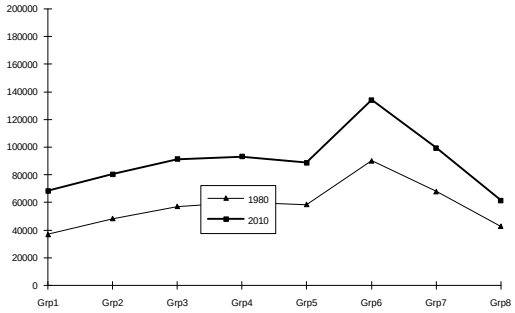


Number of Age Cohort in each Income Group

STATE OF NEW JERSEY
COMPARISON OF 1980 AND 2010 INCOMES DISTRIBUTIONS FOR
HOUSEHOLD HEADED BY PERSONS AGED 55 TO 64

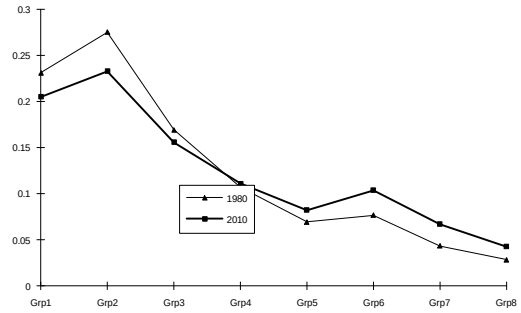


Percentage of Age Cohort in each Income Group

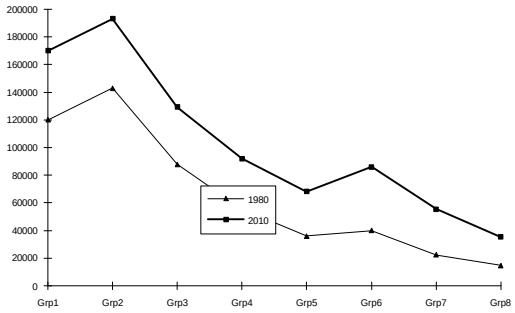


Number of Age Cohort in each Income Group

STATE OF NEW JERSEY
COMPARISON OF 1980 AND 2010 INCOMES DISTRIBUTIONS FOR
HOUSEHOLD HEADED BY PERSONS AGED 65 AND OLDER



Percentage of Age Cohort in each Income Group

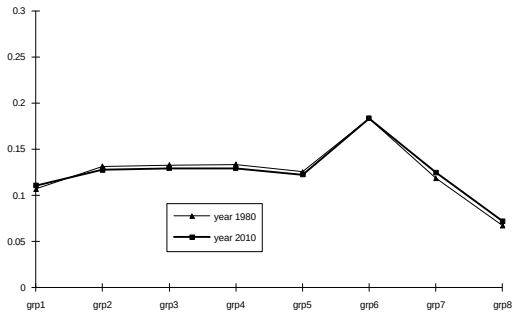


Number of Age Cohort in each Income Group

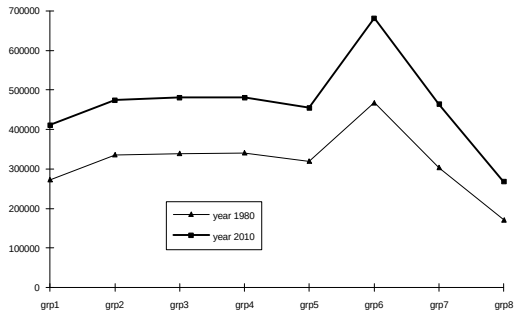
The mix of different number of household cohorts, together with the income characteristics of each age cohort, affects the total number of households in each of the income groups. Typically, a majority of the incomes for households headed by persons aged 15 to 24 are clustered in the lower income groups. Because of the use of the 1980 income distribution constant, this pattern is continued. However, the small number of households in this cohort reduces the affect of this lower income-concentrated group. Conversely, the increases in the number of households headed by persons aged 25 through 64 would cause more of the State's households to have the higher income characteristics common to these households. Finally, the very large number of households headed by persons 65 or older, tends to increase the state's total number of households in the lower income groups.

Chart 4 combines represents the statewide combined result of all the income demographic mixing. As displayed in Chart 4, the 1980 and 2010 graphs of the percentage of total households in each of the income groups appear to be very similar. However, it can also be seen that the number of households in each income category has increased. Chart 5 displays the mix of age cohorted households in each of the income groups. It is assumed that the distribution characteristics of the CUPR/DCA projections would pattern the results shown in both charts, since this projection is assumed to have the same demographic composition as the NJDOL projection. The ratio of household by type would be the same, only the numbers of households would decline by about half.

CHART 4
STATE OF NEW JERSEY
COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES

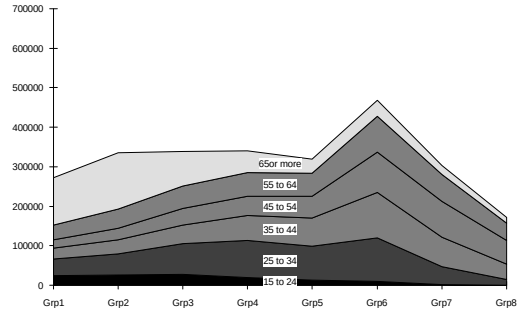


Percentage of Households in each Income Group

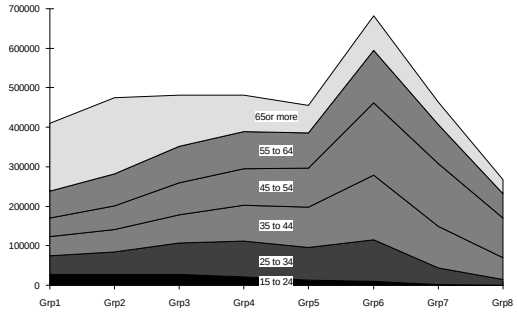


Number of Households in each Income Group

CHART 5
STATE OF NEW JERSEY
COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES



Age Cohorts in Each Income Group in 1980



Age Cohorts in Each Income Group in 2010

The results displayed in charts 4 and 5 are significant. The stability of the State's Mean household income coupled with the income distribution pattern similar to that found in 1980 suggest that housing prices also will remain stable[48]. The results shown in Chart 4 and 5 also refute another popular social theory; that incomes will become more bipolar in the future. In effect, the rich will get richer, the poor will get poorer and the middle class will decline in numbers. This income shifting is not evidenced in either Chart 4 or Chart 5.

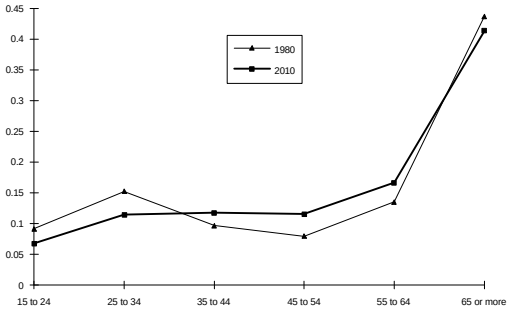
To further investigate if income bipolarization is evident, Chart 6 displays the age cohort constituency of each of the income groups. These graphs do evidence shifts in the demographic makeup of the income groups. In particular, if the series presenting the percentage of households in each cohort for each income group is viewed, the graphs show that the households headed by persons aged 45 to 54 will be more prominent in all of the income groups. The same graphs also show that the elderly are more prominent in the income groups 4 through 8. If the series presenting the number of households in each income group is viewed, then two patterns emerge. First, the numeric increase of households headed by persons aged 35 and older can be seen to be reflected in increased representation in all income groups. Second, most of the numeric increases are in the income groups 3 through 8.

[48]Several researchers have speculated that household prices will decline by as much as 40% by 2010, due to declining incomes. The OSP models result is consistent with the forecast published by the Harvard/MIT Joint Center for Housing Studies in the publication "Housing Market Dynamics and the Future of Housing Prices", written by Denise DiPasquale and William C. Wheaton, revised in January of 1991.

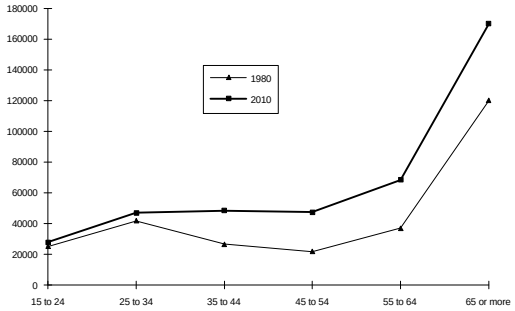
CHART 6

STATE OF NEW JERSEY

COMPARISON OF 1980 AND 2010 HOUSEHOLDS IN INCOME GROUP 1



Percentage of Household Heads in each Age Cohort

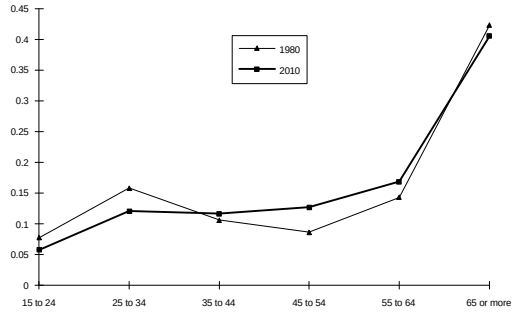


Number of Household Heads in each Age Cohort

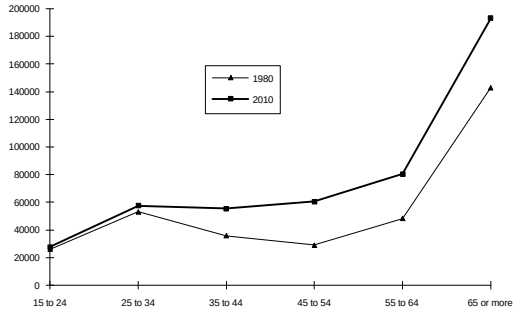
CHART 6 (CONTINUED)

STATE OF NEW JERSEY

COMPARISON OF 1980 AND 2010 HOUSEHOLDS IN INCOME GROUP 2



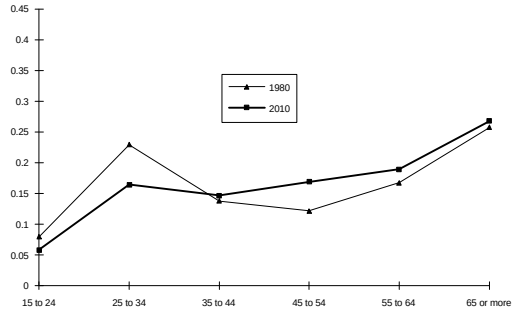
Percentage of Household Heads in each Age Cohort



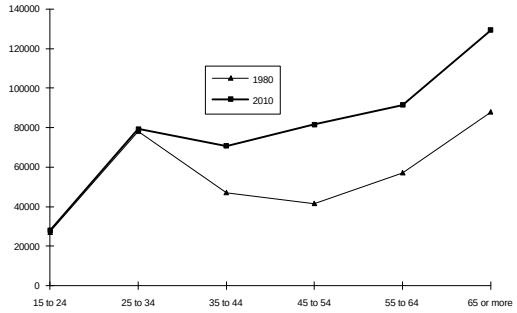
Number of Household Heads in each Age Cohort

STATE OF NEW JERSEY

COMPARISON OF 1980 AND 2010 HOUSEHOLDS IN INCOME GROUP 3



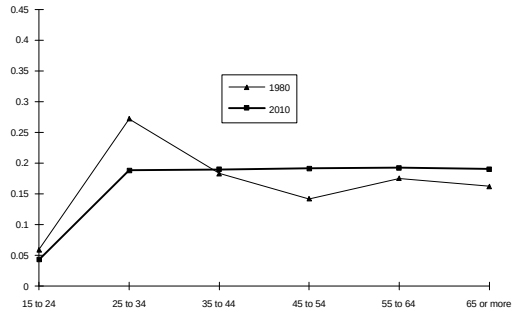
Percentage of Household Heads in each Age Cohort



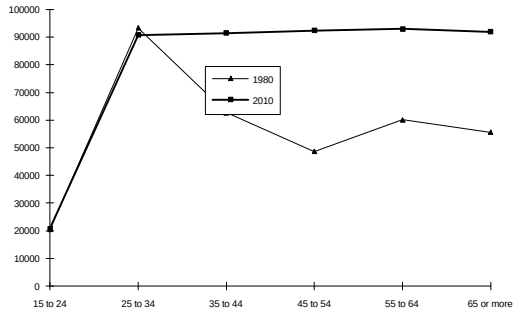
Number of Household Heads in each Age Cohort

STATE OF NEW JERSEY

COMPARISON OF 1980 AND 2010 HOUSEHOLDS IN INCOME GROUP 4

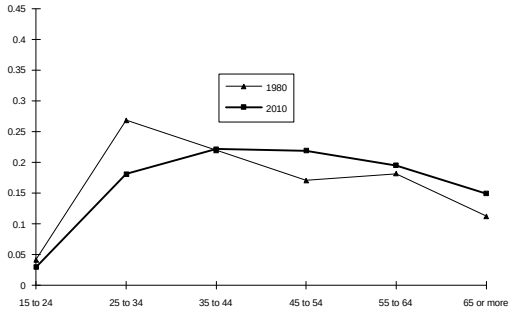


Percentage of Household Heads in each Age Cohort

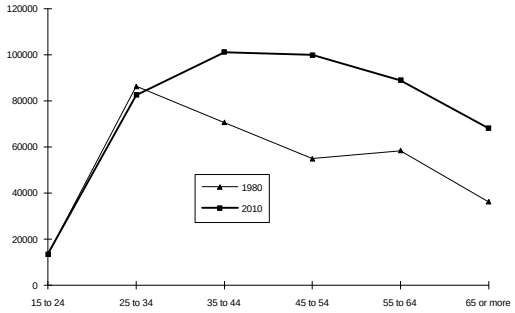


Number of Household Heads in each Age Cohort

CHART 6 (CONTINUED)
STATE OF NEW JERSEY
COMPARISON OF 1980 AND 2010 HOUSEHOLDS IN INCOME GROUP 5

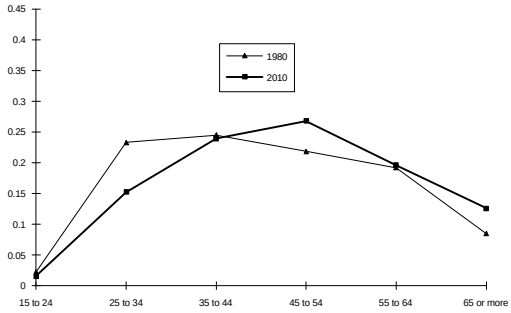


Percentage of Household Heads in each Age Cohort

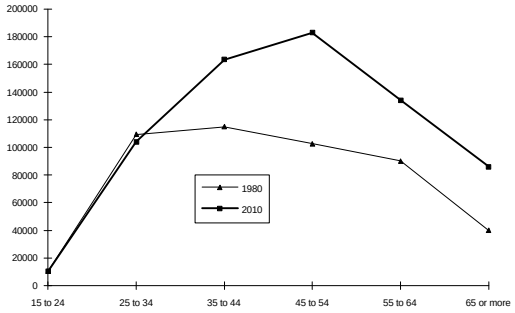


Number of Household Heads in each Age Cohort

STATE OF NEW JERSEY
COMPARISON OF 1980 AND 2010 HOUSEHOLDS IN INCOME GROUP 6

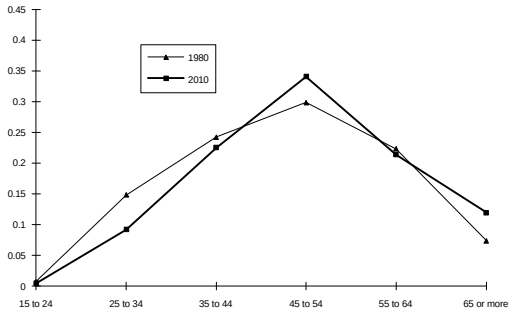


Percentage of Household Heads in each Age Cohort

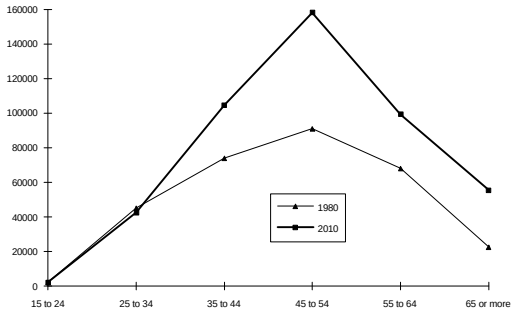


Number of Household Heads in each Age Cohort

STATE OF NEW JERSEY
COMPARISON OF 1980 AND 2010 HOUSEHOLDS IN INCOME GROUP 7

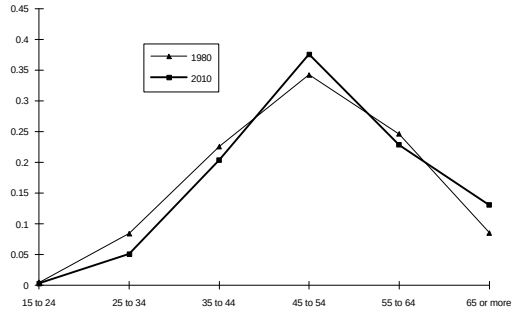


Percentage of Household Heads in each Age Cohort

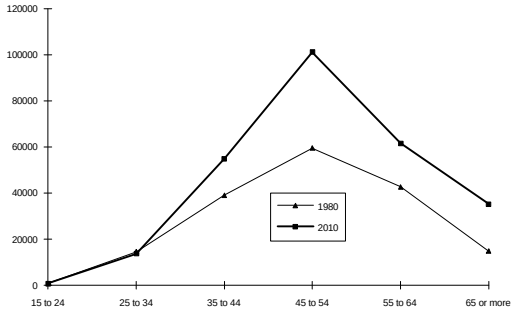


Number of Household Heads in each Age Cohort

CHART 6 (CONTINUED)
STATE OF NEW JERSEY
COMPARISON OF 1980 AND 2010 HOUSEHOLDS IN INCOME GROUP 8



Percentage of Household Heads in each Age Cohort



Number of Household Heads in each Age Cohort

e. <u>County Income and Income Distribution Forecasts</u>

State income projections are a function of the future employment and demographic condition; largely specified by the population and employment forecasts exogenous to the model. Once Statewide forecasts are determined, county income forecasts are produced by the model as a function of the specific county's future employment and demographic conditions. Again these county scale income estimates are largely the result of the county scale forecasts of population and employment assumed by the model user. However, county mean incomes are sensitive to regional wage adjustments and to estimates of the ratio between county-located jobs and total residential earnings.

Table 1 presents the OSP PED model's estimates of year 2010 Mean Households income, expressed in *1990 Dollars*. Also included in this Table are the year 2010 Mean household income estimates produced by the econometric firm of Woods and Poole, and the OSP PED model's estimate of County mean household income for 2010, using the Woods and Poole population and employment forecasts. The Woods and Poole estimates and the OSP PED model's results using the Woods and Poole population and employment number are presented for comparison only.

TABLE 1

MEAN HOUSEHOLD INCOMES FOR NEW JERSEY COUNTIES IN THE YEAR 2010

(1990 constant Dollars)

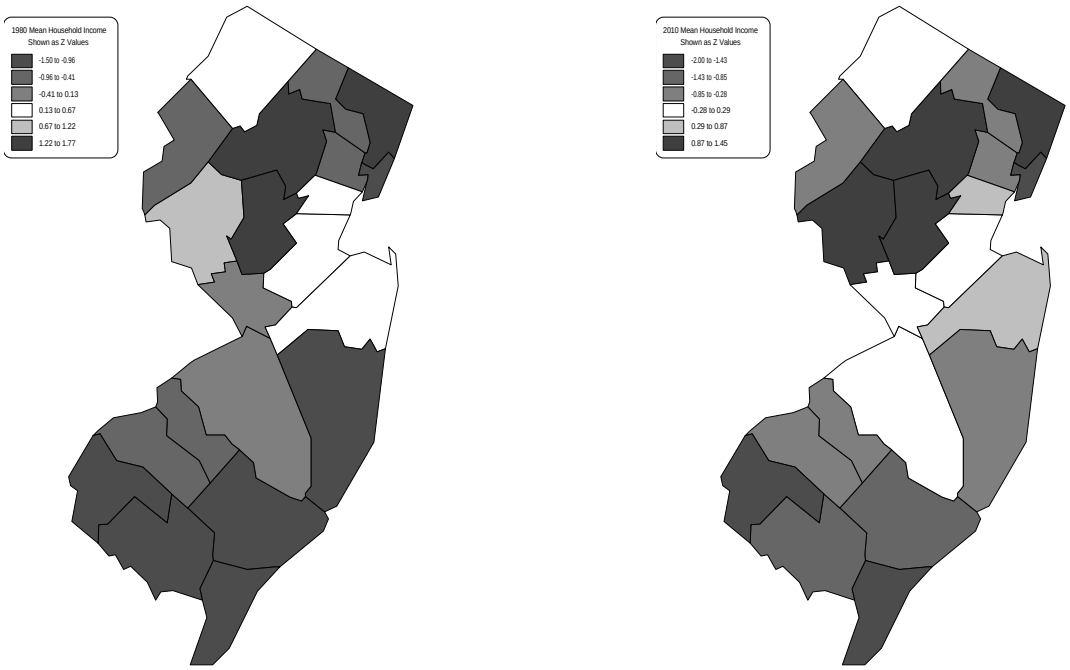
COUNTY	Woods & Poole	OSP (Woods & Poole)	NJDOL	CUPR/DCA alternative 1	CUPR/DCA alternative 2
Atlantic	$49,877	$51,275	$51,514	$51,085	$51,150
Bergen	$80,785	$71,059	$73,441	$72,448	$71,891
Burlington	$63,402	$59,425	$61,207	$58,932	$58,679
Camden	$56,720	$57,714	$58,129	$57,718	$57,591
Cape May	$46,553	$45,238	$47,545	$51,433	$50,707
Cumberland	$50,022	$48,555	$48,064	$48,857	$49,076
Essex	$58,502	$57,702	$56,994	$56,924	$56,768
Gloucester	$60,358	$53,404	$54,791	$53,755	$53,600
Hudson	$55,882	$48,983	$47,307	$46,666	$46,857
Hunterdon	$102,434	$64,190	$74,226	$70,099	$69,133
Mercer	$59,860	$59,885	$60,344	$60,070	$59,944
Middlesex	$77,462	$63,520	$64,180	$63,780	$63,688
Monmouth	$68,119	$65,102	$71,726	$67,762	$67,095
Morris	$91,585	$75,664	$77,012	$77,357	$76,839
Ocean	$55,650	$51,729	$56,015	$55,818	$55,307
Passaic	$74,060	$57,535	$57,714	$57,565	$57,493
Salem	$52,855	$46,446	$41,777	$41,573	$42,195
Somerset	$85,085	$73,092	$77,885	$73,171	$72,678
Sussex	$93,970	$53,421	$65,528	$71,608	$69,584
Union	$65,963	$67,648	$67,496	$67,026	$67,041
Warren	$57,450	$54,894	$55,135	$54,969	$55,010

Source: Woods & Poole. 1990 State Profile. Washington, DC, Woods and Poole Economics, May 1990.

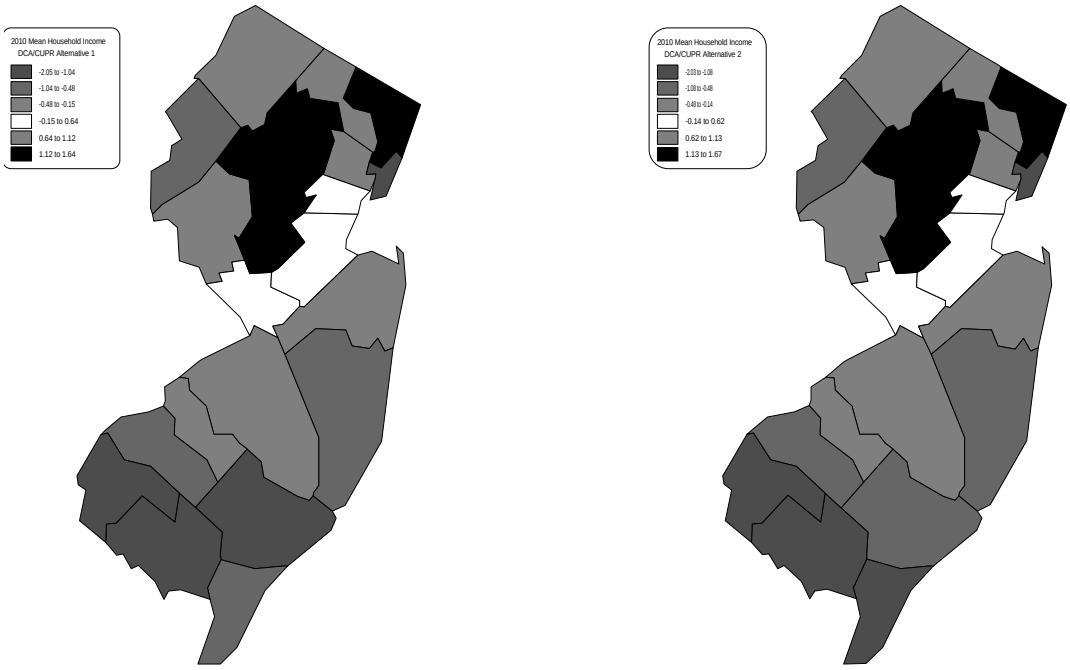
Diagram 1 displays each of the county incomes as Z values. Z values express incomes in terms of whether they are lower or higher (by standard deviations) than the mean State Household income. Counties with Z values less than 0 have mean household incomes less than the State mean income and those with Z values greater than 0 have higher-than-the-state-mean household incomes. Diagram 1 displays real money differences.

DIAGRAM 1

1980 AND 2010 DOL COUNTY MEAN HOUSEHOLD INCOMES
EXPRESSED AS Z VALUES



2010 CUPR/DCA COUNTY MEAN HOUSEHOLD INCOMES
EXPRESSED AS Z VALUES



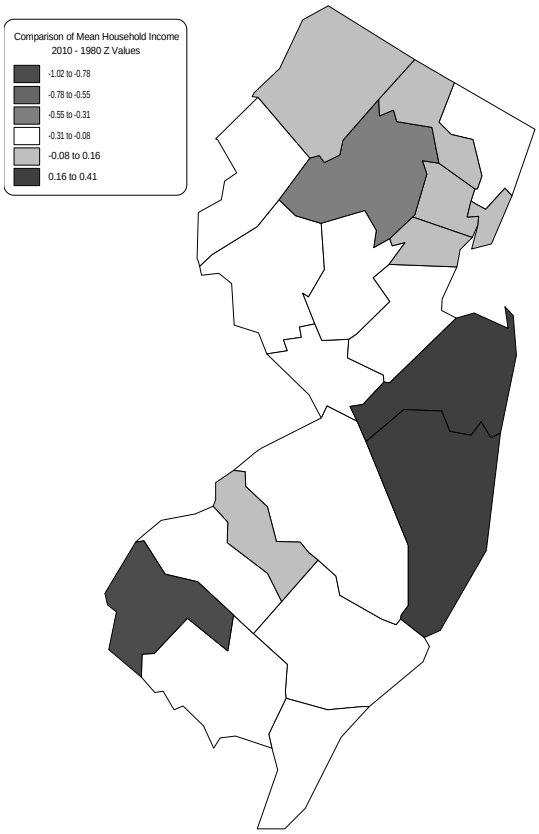
Source: 1980 Census of Population, General Social and Economic Characteristics - New Jersey, Tables 71 & 180

The Diagrams display several findings. First, the maps show that there is little income difference between the various growth projections. (Again, this could be the result of assumptions made by OSP with regard to the CUPR/DCA projection's demographics and industry types). The mapping also shows that the income distinction between the "southern" and "northern" parts of the State continue. Most counties (and municipalities) south of the Fall Line have mean household incomes lower than the State Mean household income, while those counties (and municipalities) north of the Fall Line tend to have incomes higher than the mean State household income. The counties located in the Northwestern part of the State also tend to have income less than the State average. The wealthiest counties are those located in the north central part of the State.

Diagram 2 compares each county's relative income (relative to the state mean household income) in 1980 to its relative income in 2010, as determined using the NJDOL projection. Diagram 2 illustrates each county in terms of whether its relative 2010 mean household income improved or decline relative to the county's 1980 mean household income Z value. The diagram shows that the relative mean household income in the counties of Ocean, Monmouth, Sussex, Passaic, Essex, Hudson, Union and Camden experienced moderate real increases in household income. Morris and Salem county's mean household income Z values decline. The same pattern likely would result if the CUPR values were substituted, due to the fact that all estimates of county mean household income tended to conform.

DIAGRAM 2

COMPARISON OF 1980 AND 2010 COUNTY MEAN HOUSEHOLD INCOMES
CHANGES IN 2010 AND 1980 Z VALUES



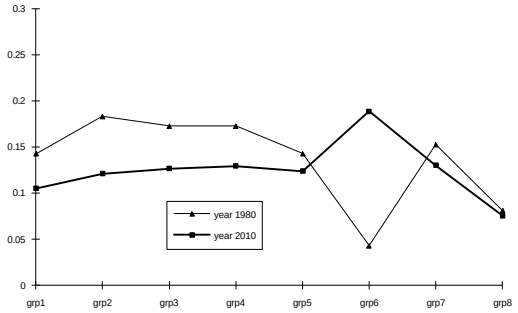
In addition to the analysis of mean household income values, the OSP PED model uses the demographic characteristics of the county's future population to estimate the distribution of income to each of eight income groups. Chart 7 displays the percentage of households in each of the eight income groups for each of the counties. In addition, the number of households in each income group is shown. Both the graph of percent and the graph of number of households by income group shown the 2010 pattern contrasted with 1980 data.

This analysis has only been performed for the NJDOL projection, due to the lack of demographic data furnished for the CUPR/DCA projection. The results of this projection could be used to estimate each county's housing need and market values. For example, Hudson County's projection shows a decline in the number of households with low incomes (groups 1 & 2) and an increase in the percentage and number of households with high incomes (groups 6, 7 and 8). Somerset County displays an increase in the number and percentage of low income households and a marked decrease in the number of very high income households.

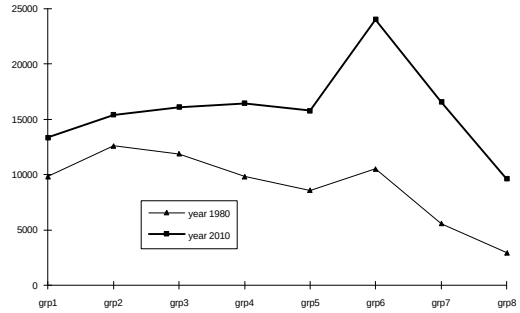
CHART 7

ATLANTIC COUNTY

COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES



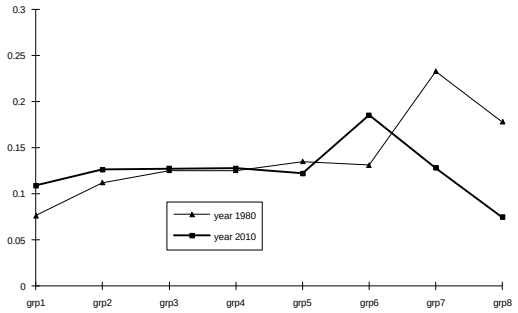
Percentage of Households in each Income Group



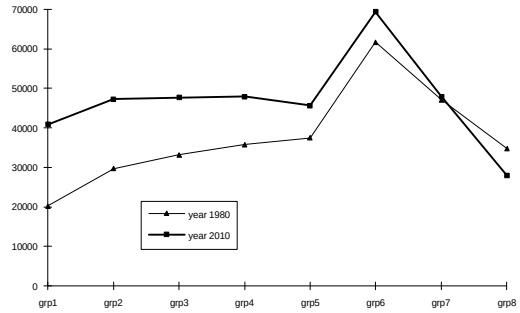
Number of Households in each Income Group

BERGEN COUNTY

COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES



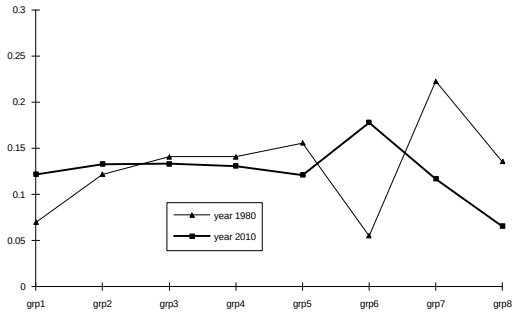
Percentage of Households in each Income Group



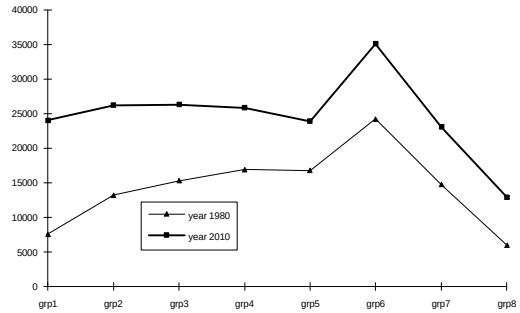
Number of Households in each Income Group

BURLINGTON COUNTY

COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES



Percentage of Households in each Income Group

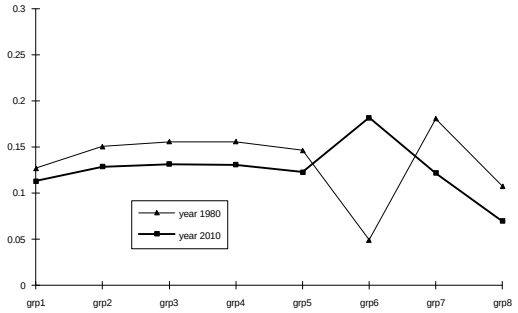


Number of Households in each Income Group

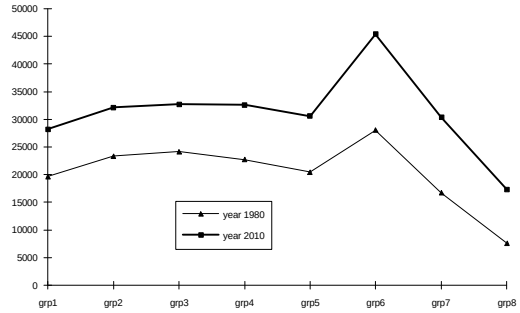
CHART 7 (CONTINUED)

CAMDEN COUNTY

COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES



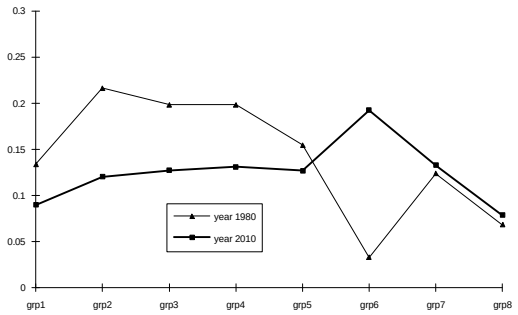
Percentage of Households in each Income Group



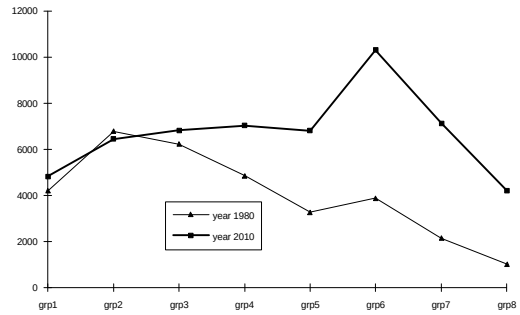
Number of Households in each Income Group

CAPE MAY COUNTY

COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES



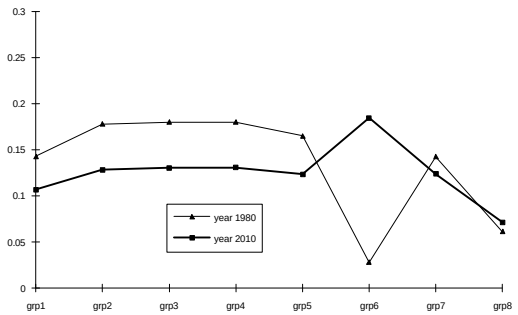
Percentage of Households in each Income Group



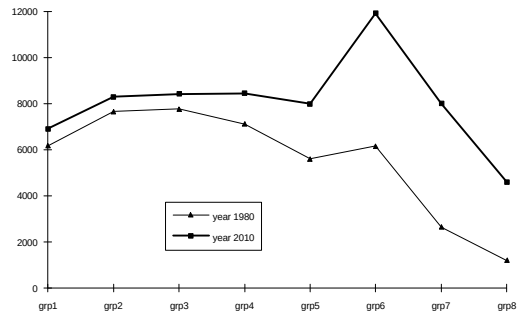
Number of Households in each Income Group

CUMBERLAND COUNTY

COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES

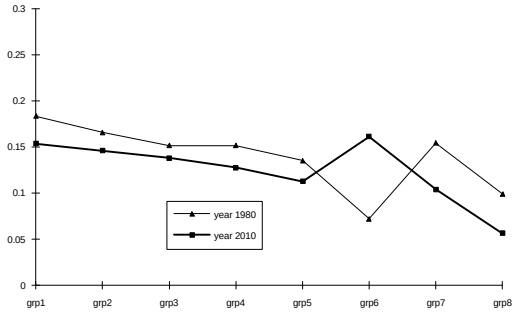


Percentage of Households in each Income Group

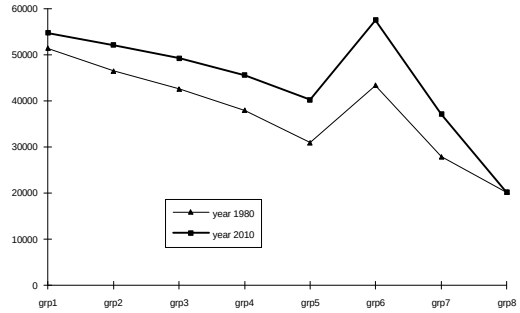


Number of Households in each Income Group

CHART 7 (CONTINUED)
ESSEX COUNTY
COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES

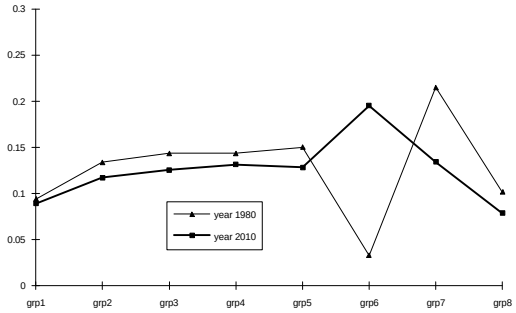


Percentage of Households in each Income Group

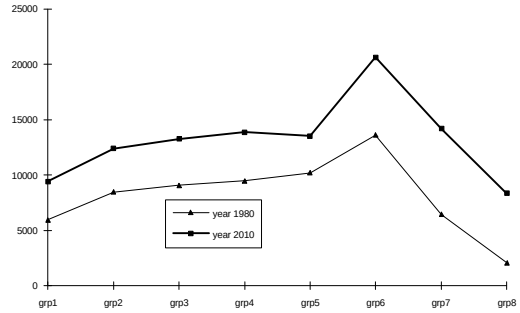


Number of Households in each Income Group

GLOUCESTER COUNTY
COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES

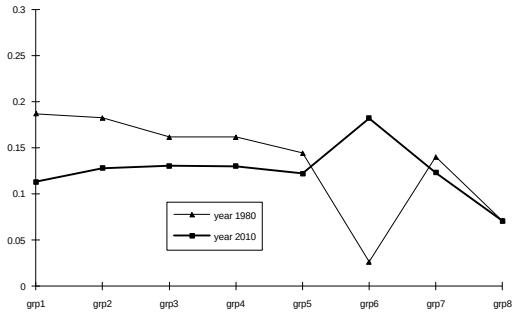


Percentage of Households in each Income Group

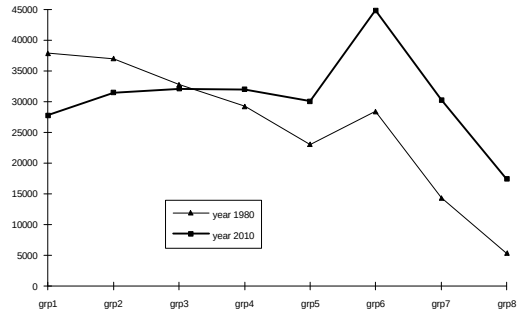


Number of Households in each Income Group

HUDSON COUNTY
COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES

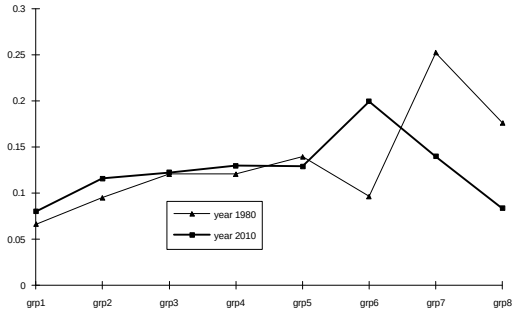


Percentage of Households in each Income Group

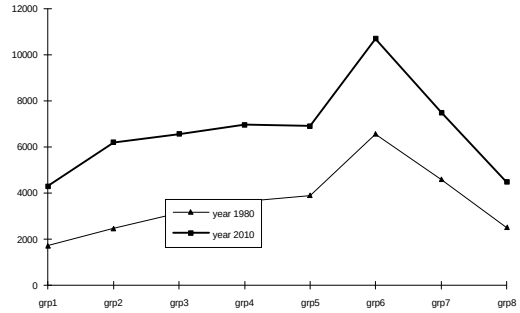


Number of Households in each Income Group

CHART 7 (CONTINUED)
HUNTERDON COUNTY
COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES

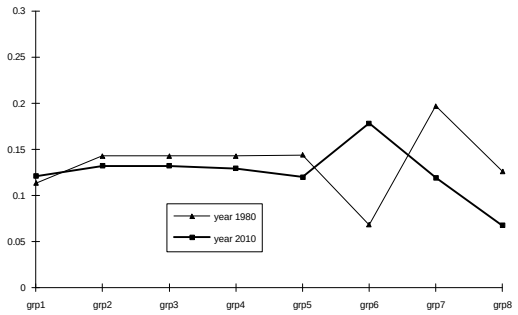


Percentage of Households in each Income Group

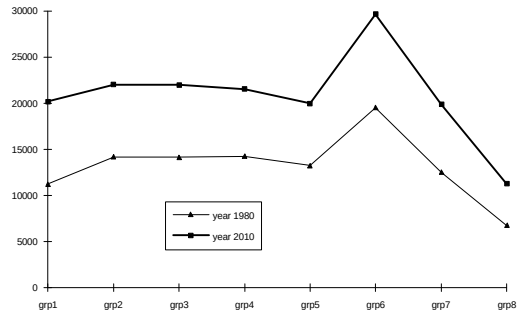


Number of Households in each Income Group

MERCER COUNTY
COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES

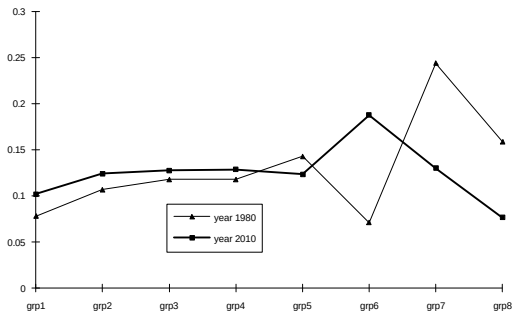


Percentage of Households in each Income Group

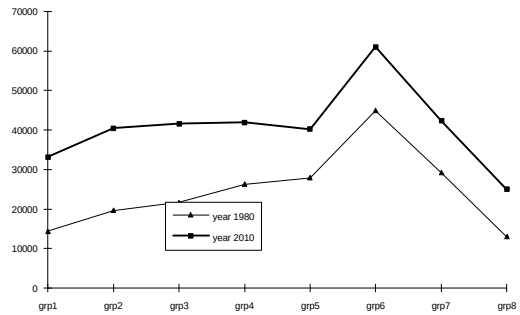


Number of Households in each Income Group

MIDDLESEX COUNTY
COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES

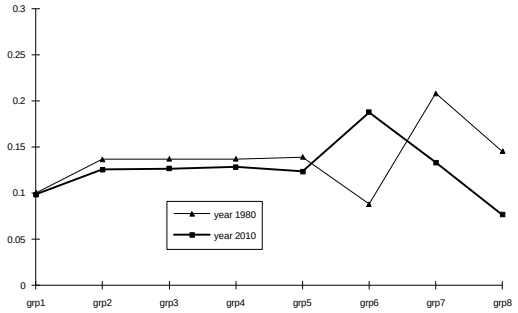


Percentage of Households in each Income Group

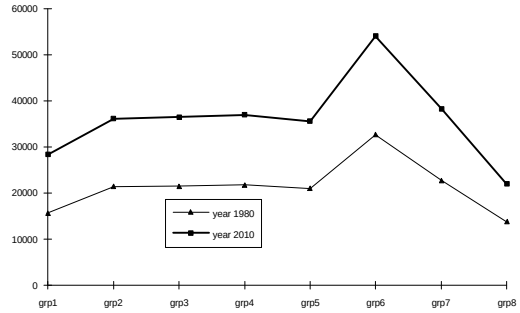


Number of Households in each Income Group

CHART 7 (CONTINUED)
MONMOUTH COUNTY
COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES

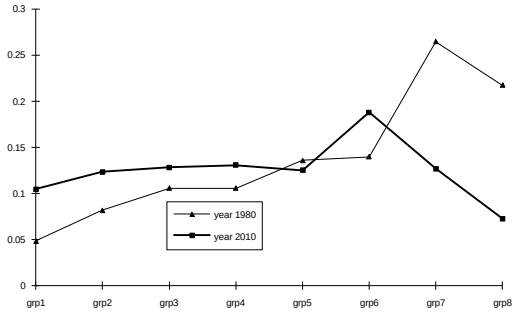


Percentage of Households in each Income Group

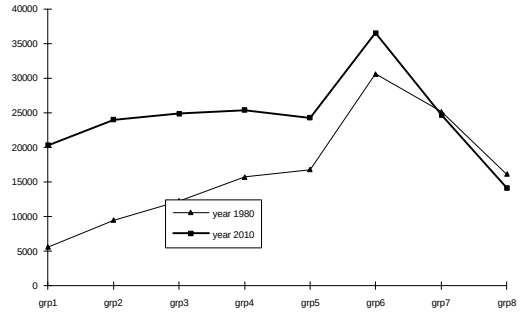


Number of Households in each Income Group

MORRIS COUNTY
COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES

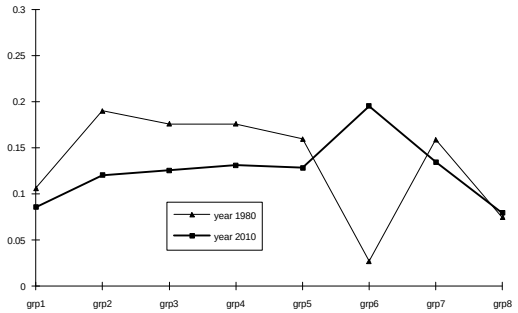


Percentage of Households in each Income Group

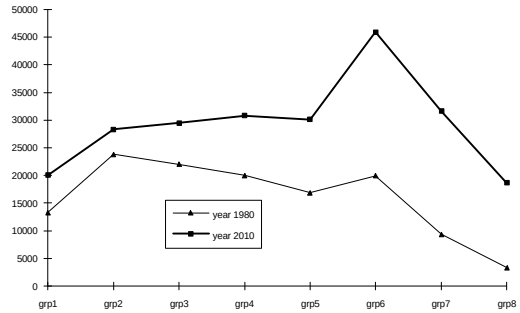


Number of Households in each Income Group

OCEAN COUNTY
COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES

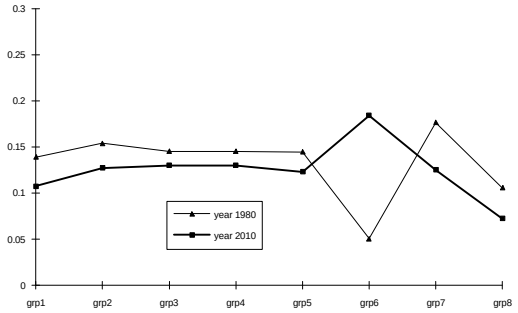


Percentage of Households in each Income Group

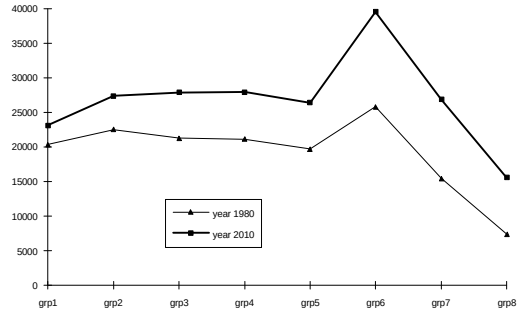


Number of Households in each Income Group

CHART 7 (CONTINUED)
PASSAIC COUNTY
COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES

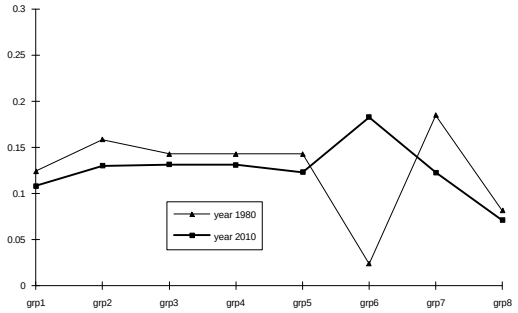


Percentage of Households in each Income Group

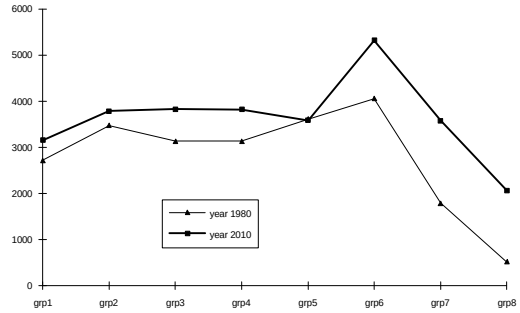


Number of Households in each Income Group

SALEM COUNTY
COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES

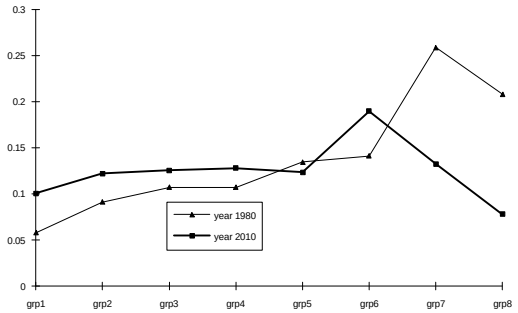


Percentage of Households in each Income Group

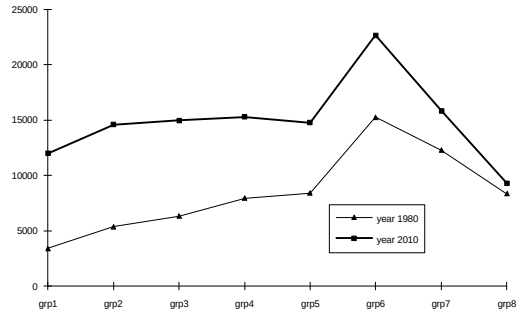


Number of Households in each Income Group

SOMERSET COUNTY
COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES



Percentage of Households in each Income Group

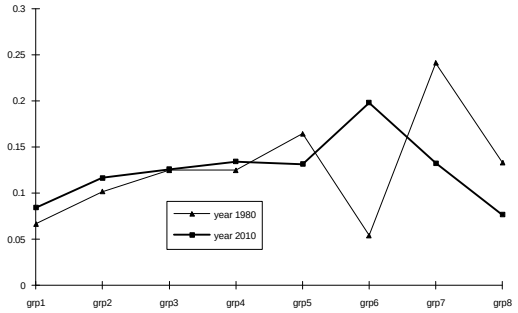


Number of Households in each Income Group

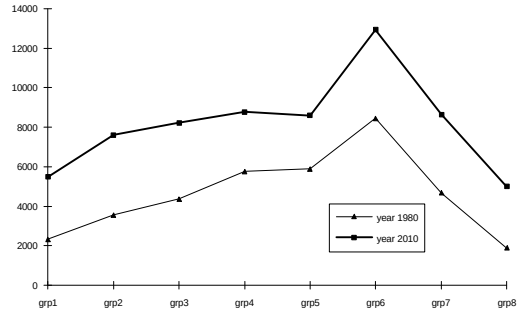
CHART 7 (CONTINUED)

SUSSEX COUNTY

COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES



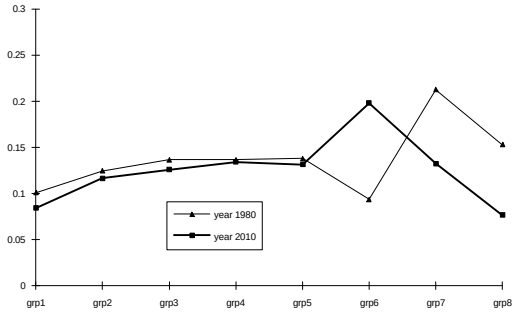
Percentage of Households in each Income Group



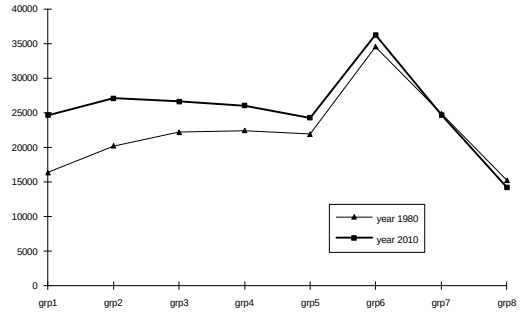
Number of Households in each Income Group

UNION COUNTY

COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES



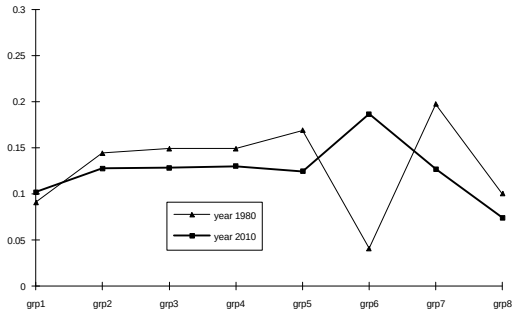
Percentage of Households in each Income Group



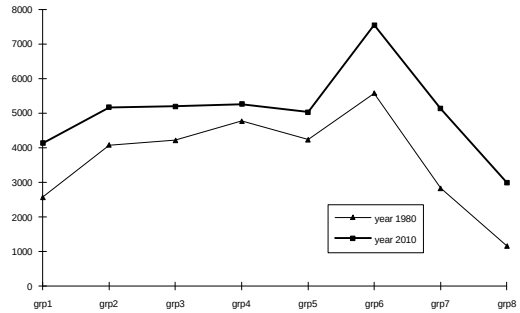
Number of Households in each Income Group

WARREN COUNTY

COMPARISON OF 1980 AND 2010 HOUSEHOLD INCOMES



Percentage of Households in each Income Group



Number of Households in each Income Group

f. Trend Municipal Growth and Income Projections

All of the information presented in this paper up to this point is a result of economic decision primarily contained in the population and employment projections. In other words, it is always assumed that the projected level of growth would occur by the horizon year. This assumption implies that the effect of the State Plan would be to shift the location of growth at a sub-regional level and that any plan would not affect the overall intensity of regional or state growth. This is an interesting assumption that deserves some consideration.

The April 1987 version of the State Plan proposed that development be constrained in areas termed "Limited Growth" tiers, and that growth be concentrated into "growth" tiers. In the terminology of the time, growth that would be "pushed down" in limited growth areas was expected to "pop up" in areas where growth was to be encouraged. This concept meant that regional growth projections would be affected by Plan; it even meant that State growth projections might be altered by Plan. For example, the consultants to the SPC compared alternative regional growth scenarios, by evaluating their impact of the State's growth projections[49]. The affect of the plan on State growth was viewed as a result of the plan's restriction of the supply of land for development.

Several objections were raised to this "push-down pop-up" theory. In particular, the NJ Economic Policy Council suggested that such a policy might have unpredictable and potentially injurious effect on the State's economic well-being. In response, subsequent versions of the SDRP moved way from this concept and adopted plan policies intending to reshape regional growth, nor redefine regional growth. The plan intent was to accommodate all future growth, but to do so in ways that resulted in public efficiencies. Substantial SPC effort has been devoted to the issue of designating sufficient additional land as developable and desirable, to insure that land scarcity does not result in increased land prices, as a result of the Plan.

This assumption that the Plan would not affect state or regional growth also is included in the CUPR Impact Assessment. Instead of assuming a growth forecast, the CUPR model starts with its own econometric input-output model, products of which are forecasts of future state and county population and employment. Both the economists at Rutger and the State Planning Commission recognize that future growth of New Jersey primarily is the result of events and decisions exogenous to the SDRP. Therefore, the growth projections and the resulting state and county demographic and economic projections produced by the OSP PED would have to be conditions common to both a Plan and a Trend growth scenario. In addition, just as it would be illogical to assume that Plan restricts regional growth, it would be equally illogical to assume that either plan or Trend could accommodate different amounts of growth. This type of outcome can result in the more urbanized counties, which have more limited supplies of available, developable

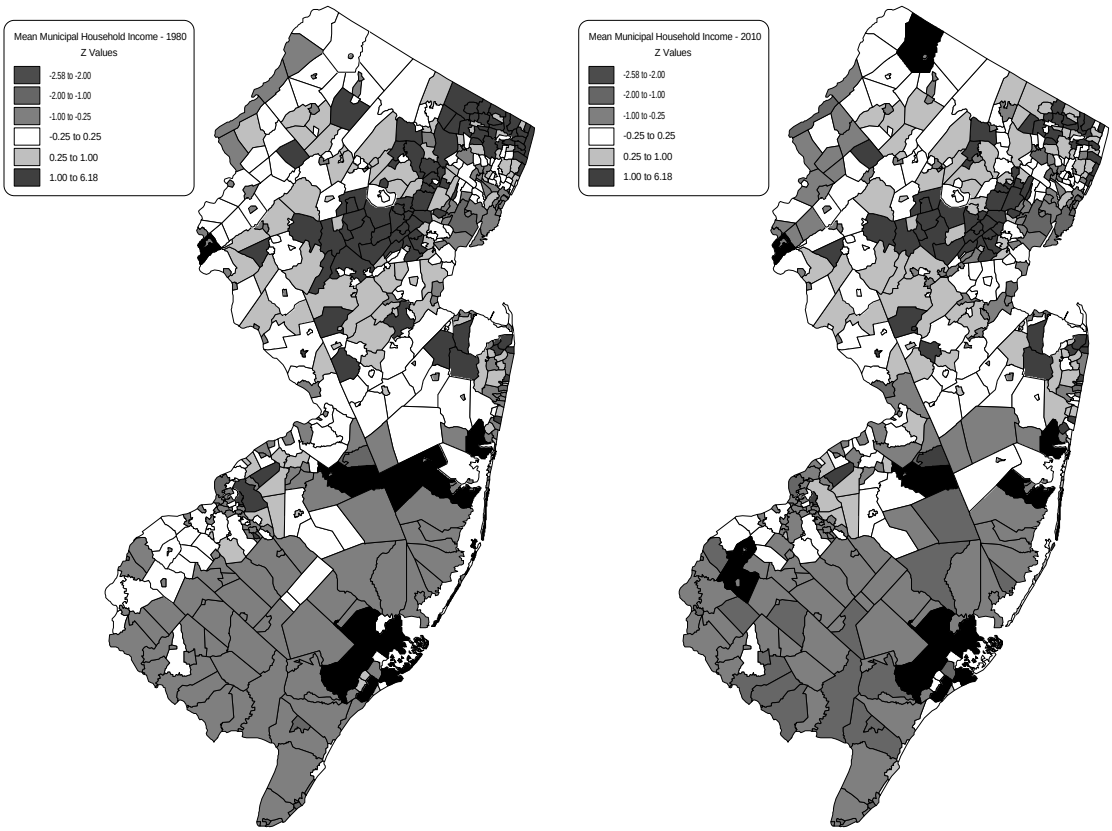
[49]Wallace, Roberts and Todd. The New Jersey Development and Redevelopment Plan: Technical Memoranda "Delineation and Comparison of Alternative Futures". Trenton: New Jersey Office of State Planning, June 1987, revised January 1988.

land. Since growth cannot fit into the regional supply of land, it is assumed that the regional growth (and perhaps the state growth) declines. In fact, the only logical model assumption is that growth occurred, but did so as redevelopment not as available-land-consuming new development.

The OSP PED model distributes future population and employment to municipalities making its initial growth assignment contingent on each municipality's estimated supply of available, developable land and its history of past growth. Because of the model's reliance on historic growth data, this growth assignment replicates TREND growth. Ultimately, OSP will prepare a Plan simulation model; but this has not been done as of yet for the current version of the SDRP.

Appendix A displays the resulting year 2010 municipal estimate of total population and total employment. The PED model then uses these future estimates to project municipal Mean Per Capita income and Mean household Income. Appendix A also includes both the 1980 mean municipal incomes and the 2010 mean municipal income estimates. To assist with the analysis of the municipal data, Diagram 3 presents the 1980 and the 2010 mean municipal incomes mapped as Z values. Again, only the NJDOL projection has been mapped. Because of the lack of demographic and economic detail available for the CUPR projection and it's assumed similarity to the NJDOL projection, the CUPR/DCA incomes would result in a pattern very similar to that produced by the NJDOL projection, shown in the following diagram.

DIAGRAM 10
1980 AND 2010 MUNICIPAL MEAN HOUSEHOLD INCOMES



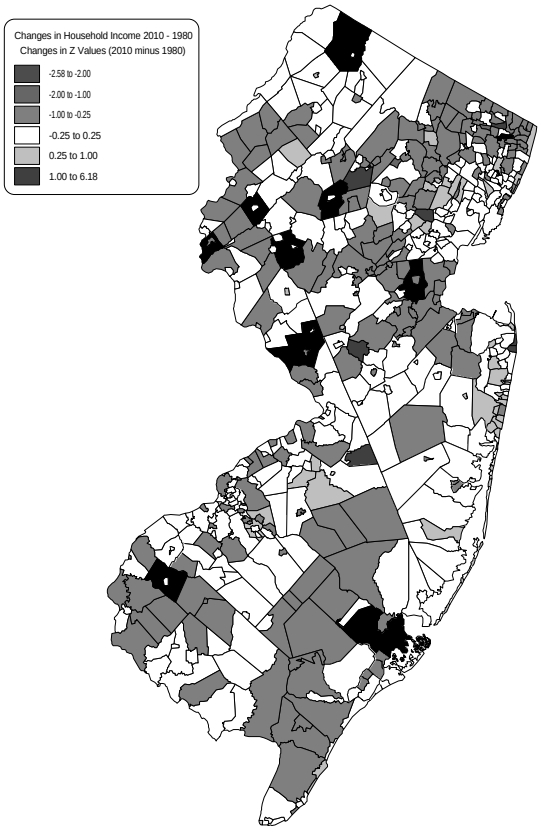
The pattern of household incomes displayed in the County Household Income series (Diagram 1) is patterned in the municipal income map. Most of the municipalities south of the Fall Line (so-called "Southern New Jersey") can generally be characterized by mean household incomes lower than the State mean. Municipalities in so-called "Northern" New Jersey (plus part of Camden, Burlington and Monmouth counties) are characterized by mean household incomes above the State Mean Household Income. In general, the 1980 pattern of income geography can be seen to be replicated in 2010. However, the number of municipalities in the highest Z value category declined and the number of municipalities categorized by the Lowest Z value have declined.

Diagram 4 displays the difference in each municipality's relative income, by comparing each municipality's 1980 Z Value to its 2010 Z Value. The pattern that emerges is one where most of the municipalities have remained stable or have declined. Such a result is seemingly surprising since the State mean PCI increased and mean household income was stable. Again, the diagram does not show increases or decreases in real income, compared to the State mean. The changes are relative to the municipality's mean household income in 1980. So it is possible that the municipal household incomes increased compared to the State mean, but relatively speaking these incomes declined. Such a result might be expected given the increased elderly population.

Another observation about the analysis is that changes evidenced in Diagram 2, which presents the same analysis at a county scale, now can be seen to be the result of a few municipalities influencing county average incomes.

DIAGRAM 4

COMPARISON OF 1980 AND 2010 MEAN MUNICIPAL HOUSEHOLD INCOMES
CHANGES IN 2010 AND 1980 Z VALUES



IV. PROTOTYPICAL 2010 HOUSING PROGRAM

CHARACTERISTICS OF THE 2010 HOUSING NEED

a. Tenure

In 1980 62.3% of the houses were owner occupied and 37.7% were rental units. For all scenarios, the model estimates that in 2010, 64% of the units will be owner occupied and 36% rentals. The OSP tenure model[50] is based age/income based data, and the demographic shift in the population causes this result. Principally, this finding is due to the 2010 population having fewer (as a percentage of total households) younger households and a higher number of older households.

However, the OSP tenure model is based on a short time series (1984 to 1986) during which public policy subsidized rental shelter and did not provide comparable assistance which would allow low and moderate income families to own shelter. Therefore, the model has a bias which assigns more poorer households to rental units, than might be warranted by future market conditions[51].

b. Housing Need by Income Category

It is important to note that this section displays need based on a base year of 1980. Economic data from the 1990 Census has not been released yet, therefore it is impossible to estimate the characteristics of the housing need from 1990 to 2010.

Table 4 summarizes the income characteristics of the total 2010 households projected for both the DOL population and for the CUPR/DCA projection, which uses the more conservative headship rate. The table assumes that the income characteristics of the State's 1980 housing stock is replicated in 2010. The table also displays tenure preference for the DOL forecasted population. Proportional results would be evident if the tenure analysis were applied to the DCA/CUPR projection.

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[50]see: Reilly, James. Examination of Locational Theories and Factors that Affect Tenure. Technical Reference Document #81. Trenton: Office of State Planning 1992 pp. 31 - 35.

[51]William C. Apgar Jr., Henry O. Pollakowski et al.. "The declining Supply of Low-Cost Housing" Cambridge Mass: Joint Center for Housing Studies of Harvard University. Working paper W87-6. The authors argue that the public policy to provide rental subsidies was strongly influenced by rental price stability reported in the CPI. However, these researcher argue that the CPI failed to include all rental costs; excluding such items as tenant paid electric, utilities and heat. Therefore, while public policy makers thought rentals were declining, they actually were increasing and decreasing with other business cycles.

TABLE 4

Estimate of 2010 Income Characteristics and Housing Need by Income Group

	Low Income	Moderate Income	Average Income	High Income
DOL Econ-Demo				
Total Owners	384,667	598,191	310,218	1,167,320
Total Renters	532,900	419,326	164,912	269,858
1980 total	608,238	679,917	319,864	942,271
Need (1980 to 2010)	*309,329*	*322,479*	*155,266*	*475,117*
DCA/CUPR Alt 2				
Need (1980 to 2010)	*194,007*	*199,262*	*97,348*	*356,401*

Most likely the preceding table underestimates the need for lower income housing because it overestimated the residual supply of low income housing. Research conducted at the Joint Center for Housing Studies of MIT and Harvard University[52] suggest the potential decline of substantial portions of the low income housing stock. The researchers argue that much of the nations' supply of substandard housing was located in rural areas. With the advent of sub urbanization, this rural housing has been demolished or renovated; forcing low income households to migrate to urban areas[53]. At the same time, traditional indices of housing condition, such as lack of plumbing might give a false impression of the condition and durability of the urban housing stock. More appropriate measure would use the Annual Housing Survey data to indicate the level of maintenance and repair of a structures (does the toilet work?, does the roof leak?, are there holes in the walls or ceiling?). Using this data, the Center reports that for the period 1974 to 1981, units lacking plumbing, kitchens and baths declined but the number of occupied units lacking adequate maintenance increased. Failure to maintain low income units will reduce their economic life span.

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[52]Apgar, William C. Jr. "Recent Trends in Housing Quality and Affordability: a Reassessment". Cambridge Mass: Joint Center for Housing Studies of MIT and Harvard University. Working Paper W85-5. 1985

[53]OSP research conducted to date does not provide strong evidence to support the concept of widespread filtering. If such a concept were valid, given the relationship between income and housing prices, incomes would decline in all slow to moderate growing communities. This result is not supported by data in most suburban areas, but is supported in the older urbanized cities. Such a finding is consistent with the Harvard "rural gentrification" theory.

PROTOTYPICAL HOUSING PROGRAM

In lieu of defining the housing need characteristics from 1990 to 2010, OSP developed a typical future housing program, by estimated the income and household size characteristics for a 1000 unit development, assuming the intent of the development was to accommodate a true cross-section of the 2010 household population.

The resultant housing and site program should be viewed as suggestive, rather than absolute. The analysis of household size by income group is based on 1980 Census data. The lack of a time series (1990 data) results in the model's inability to adjust it's estimate of household size to reflect the anticipated decline in household size by 2010. The analysis also *assumes* that the household size of this prototypical population is identical to that of the State's entire 2010 household population, and has the same income characteristics. Finally, it is important to note that the Affordability analysis assumes the construction costs will remain constant. The history of construction costs is that the real cost per square foot has been rising. If this happens, then a lower affordable size would result.

a. Estimating the size of future households

The percentage of households in each of the eight income groups was identical for all population and employment projections, since the demographic composition of the population was assumed to be identical for all projection. Only the number of households in each income group changed. OSP then use the 1980 Census data contained in Table 244 to a table which represents the percentage of total households in each income group in each of 7 household size categories. The total 2010 population of households by income group then was multiplied by the Census derived table to yield an estimate of the total number of households, by size of households, in each income group. Finally, the results were scaled to represent a total household population of 1000, although the actual table and program total to 1003 households, due to rounding. The resultant development program is displayed in the following table.

TABLE 5
Number of Households by Income Group and Household Size
1000 Unit Prototype Development

	Income Groups							
	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***
1 person	64	52	38	25	14	10	4	2
2 person	20	44	46	44	39	55	31	18
3 person	12	14	20	24	26	41	28	14
4 person	8	9	14	20	25	43	31	18
5 person	3	5	7	10	12	23	19	11
6+ person	2	4	5	6	7	14	13	9

b. Estimating Housing Unit Sizes

A design intent of this program exercise was to provide housing that met minimum size requirements and that was affordable. OSP investigated the existence of minimum housing unit size guidelines. It was discovered that such standards are not promulgated by COAH, NJ Department of Community Affairs or US. Department of Housing and Urban Development. However, the Building Code of New Jersey did contain minimum size standards, which can be found in Appendix B of this report.

Having established the minimum legal housing unit size standard, OSP next calculated a mean affordable structural size for each of the eight income groups. The first step in this process was to determine mean household income for each of the eight income groups. This mean household income estimate was the basis for the estimates of the amount of square feet, considered affordable for each income group. This analysis was performed using a financing algorithm, which assumed the following:

1. 10% down payment was available to all households.
2. The structural costs were equal to 50% of the total unit cost.
3. The mortgage amount was equal to household income times 2.6.
4. The cost of unit construction varied by income group, from a low of $30 per square foot for Income group 1, to a high of $50 per square foot for income group 8.

the following table the mean State household income for each the eight income groups and the resulting estimate of affordable residential (new construction) space.

TABLE 6
Mean Income Estimate by Income Group
Estimate of Housing Space Affordability by Income Group
1000 Unit Prototype Development

	Income Groups							
	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Estimated Mean Income	$6,664	$19,991	$33,319	$46,647	$59,974	$79,965	$113,285	$133,275
Estimated affordable size (s ft)	400	800	1200	1600	1800	2200	2200	3000+

assumes mean Household Income of $62,000

Households were assigned their "affordable" residential footprint, if this unit size met or exceed building code requirements. Out of the total 1003 household program, only 13 households needed larger, not affordable units. Only the group 1 income households with household sizes larger than 3 persons were found to be unable to afford code or larger housing units. These "unaffordable" households were assigned housing units that

conformed to Code requirements. The following table displays the total number of residential square footage required to accommodate the number of households, organized by income group and household size.

TABLE
Net Square Feet Required by Code and Affordability Analysis
1000 Unit Prototype Development

	Income Groups							
	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***
1 person	9,600	41,600	45,600	40,000	25,200	22,000	8,800	6,000
2 person	5,000	35,200	55,200	70,400	70,200	121,000	68,200	54,000
3 person	4,200	11,200	24,000	38,400	46,800	90,200	61,600	42,000
4 person	3,600	7,200	16,800	32,000	45,000	94,600	68,200	54,000
5 person	1,650	4,000	8,400	16,000	21,600	50,600	41,800	33,000
6+ person	1,300	3,200	6,000	9,600	12,600	30,800	28,600	27,000

c. Definition of Unit Types

Finally, the housing program contained in Tables 5 and 6 were given to an Urban Designer on the staff of OSP. Five types of housing units were defined to accommodate the space requirements of this development. The Zoning regulations of Flemington, NJ were used to guide site coverage and building scale considerations. The following describes the five building type and the program assigned to each type of structure.

Garden Apartment - These two story 100 by 60 foot structure contain an average of 14 dwelling units, for a total of 4,400 square feet of livable space and 1,600 square feet of circulation and HVAC. One car per unit parking is provided for each building for a total of 4,900 square feet of surface parking for each building. Total site coverage is 85%, which includes the building footprint and the parking requirement. All households in income groups 1 and 2 are assigned to the Garden Apartments; for a total program of 237 housing units and 147,350 square feet of livable space. Seventeen building need to be constructed on a total of five acres.

Townhouses - The townhouses are programmed to accommodate the 259 households with group 3 and 4 incomes. Five units are located in each building, with each unit being either 1200 or 1600 square feet, located on a building lot of 110 feet by 155 feet (17,050 square feet). The total townhouse program requires 52 building (886,600 square feet) located on 20.4 acres.

Duplexes - Designed to accommodate the 123 households with average incomes (income group 5), each unit is 1800 square feet. A total of

123 households would live in 62 building, each on a lot of 11,000 square feet. The total townhouse program of 682,000 square feet of space would be built on a total of 15.7 acres.

Single Family Detached (type 1) - A total of 312 units would be constructed at a density of 5 houses to the acre. These 2,200 square foot houses would accommodate households with incomes in groups 6 and 7.

Single Family Detached (type 2) - A total of 72 units, each with 3000 square feet of livable space would be built on 15,000 square foot lots. Almost 25 acres are required for this housing type.

d. Total Site Program

In addition to the land required for the five types of housing, 15% of this net site was allocated for internal roadways and open space. The following table summarizes the program for the 1003 unit development.

TABLE 7
Total Residential Program
1000 Unit Prototype Development

	Garden Apts.	**Townhouses**	**Duplex**	**Single Family (det.)**	**Single Family (det.)**
Number Units	237	259	123	312	72
Acres	5	20.4	15.7	64	24.8
DU/Acres	47.4	12.7	7.8	4.9	2.9

Total Dwelling Units	1000
Net Acres Residential	129.9
Gross Acres (15% roads & open space)	149.4
Density per Gross Acres	6.7

V. FUTURE RESEARCH

HOUSING AND EMPLOYMENT ISSUES

a. Group Housing

The identity and demographic pattern of persons living in group quarters needs to be determined. From this effort, methods to project the future number of group quarters residents, identified by demographic characteristics needs to be developed. This work effort will result in two beneficial products. First, a more sophisticated housing need estimate can be projected. Second, the shelter needs of the group quarter residents, including persons in Nursing Homes, can be projected.

b. Land Absorption Variables

Currently, the PED model assigns growth using historic growth rates. This assumes that the demand for land occurs at a constant rate; regardless of supply. The focus of this research effort would be to better understand how land supply affects the demand. The result of the research would be more accurate program algorithms to allocate population and employment.

c. Construction Costs

The housing program included in this report assumes that construction costs remain constant. Yet for the past 20 years construction costs, expressed as the cost of a housing unit divided by the square footage of the structure, have increased at a rate far exceeding the rate that household income has grown. It would be useful to examine the constituent cost elements associated with residential construction; to examine how these cost elements have changed over time; and to gain informed insights into the likely direction these costs might take in the future. If costs are to increase, the densities need to increase to insure affordability. Conversely, if costs might decrease, then public subsidy programs might accrue savings.

d. Analysis of the 1990 Census

Several of the data sets used in the revised PED model are based on 1980 Census data only. While the data is cross-sectional, the affects of change could be better simulated if the comparable 1990 data were used to prepare a time series data set. The incomeship, tenure and household size models all are reliant on 1980 data only. An additional use for the 1990 data would be: revisions to the PED model's trend growth assignment process; review and construction of headship rate; and, adjustment of the model to a 1990 base year.

PROGRAMMING REVISIONS

a. Technical Programming Revisions

The PED model now requires an hour to run, using a fast 386 computer. Revisions to the programming code could reduce the running time by as much as twenty percent. Additional segmentation of some of the longer programs also will facilitate future program revisions. Finally, although the PED model has been revised, those program segments that produced the residential program need to be collected and added as an alternative model result.

b. Development of a Plan Simulation

A plan simulation program module needs to be developed and added to the PED model.