Creating Communities of Place

DISTRIBUTING POPULATION AND EMPLOYMENT FORECASTS TO MUNICIPALITIES

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I. INTRODUCTION

A. Model Purpose

This component of the OSP Computer Model distributes population and employment growth forecasts to the state's 567 municipalities. Growth and decline are allocated among the municipalities based on the historic growth rate of the municipality and an analysis of the municipality's supply of developable land. Currently, the model produces a set of municipal growth forecasts under TREND; a proposed program to generate forecasts under PLAN will use a similar technique.

The municipal forecasts generated by this component of the model are principally used as inputs to the OSP fiscal impact programs. Other uses of the portion of the model are:

1. to develop estimates of housing need;

2. to help local governments develop municipal-level growth forecasts and targets;

3. to simulate various assumptions pr policy alternatives and examine how these might shift the benefits and burdens of growth;

4. to see if sufficient land is available to accommodate growth forecasts.

The current version of the fitting model has undergone an extensive process of academic review. Although the methodology was approved, some reviewers pointed out that the model could be more sensitive to economic incentives in its allocation of growth.

Such a model would be fundamentally different from the one we have created. Ours is a scenario testing tool, not a predictive one. Fundamental relationships such as those between density, available land, and infrastructure systems are testable without numerous economic assumptions. To extent such assumptions are necessary, they are either contained in the published forecasts that are the inputs to our model, or they will be the product of new research described in chapter III of this report.

Diagram 1

POPULATION & EMPLOYMENT DISTRIBUTION MODEL DIAGRAM

Given: COUNTY FORECASTS OF POPULATION AND EMPLOYMENT

Step 1	SELECT A FORECAST YEAR AND A FORECAST OF STATE GROWTH
Step 2	ESTIMATE HOUSING NEED BY COUNTY
Step 3	INITIAL ASSIGNMENT OF HOUSING NEED AND JOB GROWTH TO MUNICIPALITIES
Step 4	GROWTH ASSIGNMENTS FITTED TO AVAILABLE LAND IN EACH MUNICIPALITY (TRENDFIT OR PLANFIT)
Step 5	CONVERT ASSIGNMENTS TO MUNICIPAL FORECASTS OF POPULATION AND JOBS

Results: MUNICIPAL FORECASTS OF JOBS AND POPULATION
TEST OF THE LAND AVAILABILITY TO SUPPORT GROWTH
FORECAST OF HOUSING NEED
TESTING OF PLAN AND POLICY ALTERNATIVES

B. Model Overview

Diagram 1 provides and overview of how the population/employment model works. Forecasts of county population are converted into estimates of housing needs. These estimates of housing needs, along with county job forecasts, are then distributed to municipalities based on historic municipal growth rates.

Next, the model estimates the amount of land required to accommodate the municipal growth in housing and jobs and compares it to an inventory of available land. If sufficient land is available to accommodate the initial projection, then that growth assignment is confirmed.

If sufficient land is not available in any municipality, its capacity for houses and jobs is assigned and surplus growth distributed to other municipalities in a user-defined region. This process continues until all growth is assigned or all available land in the region is consumed.

The resulting "fitted" estimates of municipal housing are converted back to estimates of population. These, together with fitted estimates of municipal jobs, are the final product of the model.

II. Model Description

In this section we describe the inputs, outputs, and algorithms of the population/employment model in more detail. The following description is divided into five "steps" corresponding to tasks that the model performs consecutively. These steps are:

1. Forecast Selection
2. Estimating Housing Need
3. Initial Allocation of Housing and Jobs
4. Testing the Fit
5. Final Allocation of People and Jobs

Appendix B contains a summary of all of the user-selected options described for each step. For a sample of one of the data files referenced below, please see Appendix C.

A. Step 1: Forecast Selection

To begin the modeling process, the user must define the future year for which results are sought and select both a population and employment forecast for that year. There are four dates for which population and employment forecasts can be selected: 1995, 2000, 2005, and 2010. If a user fails to specify one of these dates, the program assumes a default year 2010.

Once a year is chosen, the user is prompted to select from a number of published forecasts that have been made for that year. These forecasts are resident on computer disk and are updated when revisions become available.[1]

Appendix B displays the forecast choices that are currently included in the model. Two types of forecasts are displayed. The first type is statewide, which means that forecasts were prepared for all of the counties in New Jersey. The second type should be considered a hybrid, or composite forecast. These forecasts include one or more regional forecast and a statewide forecast for counties not included in the region. Thus all the selections are designed to provide information on growth statewide.

For example, in the composite forecast "DOL historic migration/DVRPC," the Delaware Valley Regional Planning Commission's growth forecasts are selected for counties in the DVRPC region (Gloucester, Camden, Burlington, Mercer) and the New Jersey Department of Labor Historic Migration forecast is used for all counties not included in the DVRPC forecast. While one could argue that the use of such composites may result in unrelated forecasts being inappropriately combined, their use allows for simulation of the widest possible range of alternative futures.

The user can also modify these forecasts by entering new population and/or employment forecasts for some or all of the counties or municipalities in the State. Even if the focus of the analysis is a particular county or region, the model produces results for all 567 municipalities. The use of statewide "background forecasts" assures that the impact of regional changes can be analyzed. For example, if county A and county B share a sewer plant, then growth in both counties will affect sewer costs. A background forecast assures that all relevant growth information will be available to the OSP fiscal impact models.

STEP ONE SUMMARY

Inputs: user selection of target year
user selection of published forecasts
user input of own forecasts (optional)

Output: county-level forecasts of population and jobs in target year

B. Step Two: Estimating Housing Need

Any attempt to determine the adequacy of land to accommodate population growth requires that certain assumptions be made about household formation and residential density. Much early work in this area assumed a constant "family size" per dwelling unit. This constant was calculated from current-year or census data, and then applied to the increment in population in order to calculate future housing need.

Tests of this technique on historical data have shown it to be highly inaccurate in an age of rapid demographic changes -- particularly the recent increase in household formation and

[1] For more information on published forecasts of population and employment for New Jersey, please see OSP Technical Reference Documents 88-44, Population Trends and Projections (June 1989) and 88-45, Employment Trends and Projections (upcoming).

corresponding decrease in family size. As a result, OSP researchers have abandoned the average family size method in favor of a technique that uses more detailed forecasts of demographic changes.[2]

Briefly, the present housing need model incorporates a method referred to as "headship" to generate likely future households in each county. The housing need implied by this household forecast is adjusted to account for changes in the base year (1985) housing stock due to demolition's and conversions,[3] and for the existence of a certain number of vacant units in the target year. Finally, the model subtracts persons who will live in group housing (prisons, nursing homes, college dorms, military barracks) so that they do not affect the estimate of housing need.

THE HEADSHIP METHOD

Under the headship method, the population forecast for a county is converted into sub-populations by age cohort (11 five-year classes plus 75+); race (white and non-white); and sex. These breakdowns are calculated to the same level of detail as in the original forecast on which a derivative or hybrid forecast is based. For example, the NJDOT Route 1 forecast uses information about age cohorts, sex, and race taken from the NJDOL economic - demographic forecast from which it was derived and for which detailed information is available.

A "headship rate" is the percentage of persons in a particular subcategory of the population who have declared themselves in the Census to be a "household head."[4] For example, of 5,200 white males aged 20 to 24 in Atlantic County in 1980, 1,692 claimed that they headed households. This results in a headship rate for the group of .325. If one assumes that the social conditions that resulted in these young men heading households were to remain constant, one could then multiply the 1980 headship rate by the number of identical (age, race) future males to determine the number of white males aged 20 to 24 who will head households.

Alternatively, if one assumes that social conditions will change, then a higher or lower headship rate can be used. Thus the headship method utilizes forecasts of the composition of the future county population, as well as assumptions about the tendency of sub-populations to form and head households. (A complete table of 1980 headship rates for New Jersey is reproduced in Appendix C.)

Since each household head represents a distinct household, the calculation of household heads is a major component in the forecast of housing need. The other components of the housing needs step deal with one-household populations, adjust the 1985 housing stock into the future, or

[2] A description of the research performed to identify this method and a test of the model's ability to replicate 1980 housing need using 1970 base data is reported in OSP Technical Reference Document 88-43 (v. 1), Housing Trends and Projections, Chapter IV, "Estimates of Future Housing Demand" published June 1989. (See also Appendix A)

[3] A conversion is the provision of a housing unit through conversion of all or part of a commercial building.

[4] A household is defined in the Census as a group of people living in a common housing unit. There can be only one "head" per household. Thus the headship rate, taken over all groups, serves as a measure of household formation and size.

make allowance for excess supply (vacancy). The following section displays the entire housing need algorithm:

HOUSING NEED ALGORITHM

(All data are for target year unless otherwise specified)

a. Estimate of raw need

Total county population -- total population in group housing (1980 constant)
= county population in households (CPH)

CPH (x) % population in sub-population (x) headship rate in sub-population
= number of heads of households in sub-population (RHD)

b. Adjustment from existing housing stock

RHD - 1985 housing unit + total estimate demolition's 1985 to target year - total estimated conversions 1985 to target year = total new housing needed to house future population (TNH)

TNH x (1 + future vacancy rate)
= total housing to be built between 1985 and future date

USER-SELECTED VARIABLES IN STEP TWO

The housing need algorithm contains four user-selected variables:

- headship
- total demolition's
- total conversions (non residential to residential)
- vacancy rates

Three headship rate alternatives can be selected by the user of the model. All are based on historical headships obtained from the New Jersey Department of Labor, Division of Planning and Research. The alternatives contained in the model are:

1. 1980 Constant - This alternative assumes that the same percentage of household heads that occurred in 1980 will occur in the future.

2. Trended (1970-1980) to 1985 - During the 1970's the composition of New Jersey households changed. Increasing numbers of single persons headed households, including many single females with dependents. This alternative assumes that the rate of change in headship rates exhibited between 1970 and 1980 continues until 1985. The resulting 1995 headship rated are then applies to the forecasts for 1995-2000.

3. Trendfit (1970-1980) to 2000 - This alternative assumes that the rate change in headship rates exhibited between 1970 and 1980 continues until 2000. The resulting 2000 headship rates are applies to the forecasts for 2000-2010.

The model provides several demolition alternatives, as well as the option for the user to enter his/her own estimate of demolitions. Each demolition alternative represents an estimate of the total number of units removed from the housing stock between 1985 and the forecast year. The following briefly describes each of the demolition alternatives:[5]

1. 1986 Constant - Assumes that the number of demolitions made in each county in 1986 will be repeated each year through the forecast year. [Total demolitions = 1986 total x (future forecast year - 1985)].

2. Average 1980's - Assumes that the average annual demolition's recorded for the period 1980-19866 in each county will be repeated each year through the forecast year.

3. Average 1970-1980 - Some as above, but uses an average for the period 1970 through 1980.

4. Average 1950 - 19880 and 1960-1980 - These choices required the use of census data, which combine demolitions and conversions. Extrapolating from these period helps to simulate a high demolitions rate, such as that associated with the urban renewal of the 1960's.

5. Trended 1980's - Projects future demolitions by straight line extrapolation of 1980's demolitions, using the method of least squares.

6. User entered demolitions - allows the user to enter his/her own estimates of demolitions by county.

Conversions alternatives allow the user to estimate the number of non-residential buildings in each county converted to residential use between 1985 and the year of the forecast. The source of historical data is the same as for demolitions, and the user- selected alternatives are identical, except that "1970's average" and "trended 1980's" are unavailable.

Vacancy alternatives allow the user to estimate the percentage of units in the future year that would represent an oversupply, and therefore be vacant. Alternatives are in percentages of 0% to 10% in increments of 1%.

STEP TWO SUMMARY

Inputs: county-level forecasts of population and employment for target year
user selections for headship, demolitions, conversions, and vacancy rates

[5] Historic data on demolitions is available from the New Jersey Department of Labor, Division of Planning and Research in the series "New Jersey Building Permits." In addition, historical trends in demolitions can be derived from U.S. Census data. As of 4/25/90, the model incorporates data from both sources.

Outputs: county-level estimates of new housing units that need to be built between 1985 and target year.
county-level estimates of new jobs to target year

C. Step Three: Initial Allocations of Housing and Jobs

Steps 1 and 2 produce estimates of the number of new houses that need to be built and the number of new jobs forecast in each county. Step 3 assigns these county growth forecasts to municipalities based on an analysis of each municipality's historic growth in housing and employment.

Briefly, in this step total growth (housing or employment) is aggregated either at a county or regional (multi-county) level, at the user's discretion. The user selects a historical interval for which municipal growth characteristics are to be projected forward. Municipal growth tendency is defined as that municipality's share of total regional growth in the period selected. This municipal share is then applies to the future regional increment in housing or jobs to yield a raw municipal assignment, as follows:

Raw municipal assignment (calculated separately for housing & employment)
= (municipal growth in historic period/regional growth in historic period)
x (regional growth from 1985 to target year)

where historic period and definition of region are user-selected variables

Under this method, historical shares of regional growth can be negative (e.g., if a municipality declined while its region grew) , or have an absolute value greater than 100% (e.g., if a municipality experienced rapid growth but regional decline offset that growth, and the region emerged with less growth than the municipality alone). These cases can result in what appear to be extreme municipal forecasts; still, even these are an outcome of coherent "trend" growth assumptions. The one extreme we correct for is the case where a municipality would ultimately emerge with negative housing or jobs in the target year. In this case, future municipal housing or employment is held to zero, and the "extra decline" is allocated proportionately to other municipalities in the region. Thus in all cases, initial municipal assignments are controlled to the regional growth forecast, producing a reasonable, trend-base starting point for the fitting analysis described in Step 4 below.

USER-SELECTED VARIABLES IN STEP THREE

In step 3, the user may select from among four regional alternatives:[6]

1. Counties as regions
2. Regions of the New Jersey Council of Affordable Housing

[6] Each region in the model is composed of one or more counties. A description of these regions can be found in OSP Technical Reference Document 88-44, Population Trends and Projections, June 1989, chapter 5.

3. Regions of the Federal Job Placement Training Act
4. Labor Market Areas of the New Jersey Department of Labor

The historic interval alternatives available for projecting municipal growth are:

1. 1960 to 1970
2. 1960 to 1980
3. 1960 to 1985
4. 1970 to 1980
5. 1970 to 1985
6. 1980 to 1985

Municipal changes in housing units over these periods were taken form the U.S. Census series on the number of year-round housing units; 1985 data are from the equivalent series compiled by New Jersey Department of Labor. At -place employment for each municipality was obtained from the Department of Labor's ES 202 records.[7]

STEP THREE SUMMARY

Inputs: county-level forecasts of housing units to be built and jobs to be added by the target year.
user selection of regions in which to control growth
user selections of historical period used to project municipal growth

Output: initial ("unfitted') municipal-level growth assignments for housing units and jobs

D. Step Four: Testing the Fit

This portion of the model takes the initial forecasts of municipal housing and employment growth, converts these forecasts to land requirements, and then tests to see if sufficient land is available to accommodate the forecasts. If the land regard for growth exceeds the municipality's supply, the model assigns the maxim growth capacity to the municipality and assigns the unfitted residual (that part in excess of capacity) to other municipalities in the region. The program makes three attempts to fit growth (known as "fit cycles"). The sum of the houses and jobs fitted in all cycles yields the total growth assigned to any municipality.

[7] Information in these files generally excludes agricultural employment. Where information about government employment was provided in these files, it was used, but government employment for years without ES202 data was estimated by interpolation. It should also be noted that there is a degree of incompatibility between employment data derived from New Jersey Department of Labor ES202 records and employment forecasts prepared by the New Jersey Department of Labor. The forecasts are reliant on information collected in a cooperative program (Current Establishment Survey CES) between the Federal Bureau of Labor Statistics and NJDOL. Unlike ES202 data which represents almost a complete census of employers, CES data is derived from sampling. Although CES data is benchmarked to ES202 data inconsistencies can occur. OSP chose to use the ES202 data, despite the "mix and match" problems that might result, because of the completeness of the data set.

Two major program components are being implemented to handle the sitting step. One component, called" Trendfit," assigned growth to those communities with available land using TREND density assumptions. Trendfit is completed and runs at this time (January 1990).

The other component, called "Planfit," is not finished. Planfit is being designed to simulate selected policies of the Interim State Development and Redevelopment Plan. The following list compares Trendfit and Planfit concepts:

1. Both components test the fit of the municipal forecasts developed in Step 3.

2. Both components use growth regions previously selected by the user.

3. Both components assign housing and employment simultaneously and independently.

4. Trendfit uses total municipal available acres, while Planfit will use arcs by municipality by tier.

5. Trendfit determines acreage needed by using existing housing and job densities in each municipality. Planfit will be able to use this method or Plan-dictated densities.

6. Trendfit simultaneously assigns jobs and housing based on their historic ratios. Planfit will allow the user to specify new ratios of houses to jobs.

7. Trendfit typically assigns growth to areas with a history of decline only when land in growing areas has been filled. Planfit will permit growth assignments based on policy choice rather than history.

(Since Trendfit is the only component running, the remainder of this section will describe Trendfit.)

In each of its three fit cycles, Trenfit estimates the land required by growth assignment, tests for available land, assigns some or all of growth, and reassigns any surplus. By default, the first fit cycle in Trendfit uses the growth assignment generated by Step 3: a straightforward unfitted assignment. However, during the second fit cycle, the assignment conditions (which determine how much growth is assigned to each municipality before fit is checked) can be user-selected as follows:

1. Residual growth in a region is assigned to any municipality with a history of growth.

2. Residual growth is assigned to municipalities in a region that have grown in the past and have residual land (land not consumed in the first cycle).

3. Residual growth is assigned to any municipality with available land (same assumption as third cycle).

For the third fit cycle, the program assigns residual growth to municipalities proportionate to their supply of available land, regardless of the municipalities' history of growth.

In addition to the choices offered the user with respect to the second fit cycle, Trendfit also allows the user to decrease or increase the existing housing and/or employment densities of the State's municipalities up to 15% for purposes of future growth assignment. The purpose of this adjustment is to allow a user to simulate market density adjustments likely to happen even under TREND conditions.

STEP FOUR SUMMARY (TRENDFIT VERSION)

Inputs: initial, unfitted forecasts of municipal housing and employment growth
user-selected statewide density increase/decrease
method of assigning growth in second fit cycle

Output: fitted municipal level forecasts of housing and job growth
available land remaining (optional)

E. Step Five: Final Allocation of People and Jobs

The product of the model through step 4 is an assignment of housing growth and job growth to municipalities. This last phase accomplishes two things:

1. It adds back the 1985 base supply of housing and the 1985 estimate of employment to the municipal growth assignments produced in the model.

2. It converts the estimate of total housing in a municipality to an estimate of total population.

Adding back year 1985 quantities is implied accounting. Population and employment forecasts were user-selected or entered during the first step of the model. In Step 2, the existing supply (1985) of housing and at-place employment were subtracted from the county forecasts. Therefore during step 3 & 4 only "new" growth was assigned and fitted. This was done because existing people and jobs had been accounted for in areas identified in the aerial mapping as already developed.[8] The idea of the fitting portion of the model is to test the fit of new growth to land mapped as available. Therefore after new growth is fitted, the number of houses and jobs existing in 1985 must be added back to get municipal totals for the target year.

Adding 1985 base totals yields municipal at-place employment and an estimate of the total number of dwelling units in the target year. While at-place employment can be utilized by the OSP fiscal impact models, and an estimate of future dwelling units is valuable, it is necessary to convert housing units to population in order to fully use the fiscal impact components of the model.

The conversion of houses to people was actually begun during Step 2. Products of the section of the model include:

[8] The aerial map set was photographed in the first quarter of 1986. Please see OSP Technical Reference Document, Estimating Growth and its Effect on Municipalities under the Preliminary Plan, Part I: Land Availability Analysis (January 1988, updated May 1989).

- total “householders” by county (total future population-group housing)
- total housing need by county (including vacancies)

From these data, the program calculates the average number of persons who will live in a dwelling unit in each county in the state in the target year:

total householders/total housing units = average persons per unit

This county-specific average from Step 2 is multiplied by the number of dwelling unit in each municipality calculated in Step 5. The result is the number of householders in each municipality. To this estimate, the municipality's 1980 group housing total is added to yield total population. (Group housing is 1980 data taken from the Census. It is assumed constant throughout the program.) Statistical research on historic data validates this people-to-house and houses-to-people methodology.

STEP FIVE SUMMARY

Inputs: fitted municipal-level forecasts of housing and job growth

Output: final municipal-level population and employment forecasts in target year
people and jobs left unfitted (optional)

III. FUTURE RESEARCH

Methodologies incorporated into the model reflect the judgments of its authors that these methods are the best available procedures. Also it should be recognized that the model was developed for specific purposes and that efforts were deliberately focused to achieve these ends. However, with the model’s substantial completion, reflection has identified several areas that might be improved, as well as several new research avenues that might be pursued using the model as a base.

A. Demography: Headship and Group Living

TRADITIONAL FAMILY HEADSHIP ALTERNATIVE

The number of alternatives to the user-selected headship rates could be enlarged to include one or more alternatives that reflect a return to more traditional family groups. Perhaps this need could be met by using headship rates developed from data in the 1970 and 1960 census. In addition to increasing the rank of user-selected options, use of a traditional base rate and the “trended to 2000” rate would define the low and high ends of housing demand for any forecast.

GROUP HOUSING ESTIMATE AS A FUNCTION OF FUTURE DEMOGRAPHY

The model now assumes group housing to be a 1980 constant at the municipal and county scale. A more satisfying method might be partially based on an analysis of those persons who constitute group housing (especially those in nursing homes) and their representation in the population. For example, if most nursing home residents are elderly and their representation as a percentage of their population cohort determined, a methodology similar to headship might be tested for validity.

The effect of such a method would be to develop a more demographically sensitive group housing forecast to be applied to the housing need forecast. A large effect from this adjustment seems unlikely. However, such a methodology might make for a more consistent housing model and a better understanding of future geriatric needs.

B. Housing Supply: Demolitions and Density

DEMOLITIONS BASED ON BUILDING AGE

The current estimate of housing demolitions is based on permits reported to NJDOL or on census data on net changes in housing stock. There is no way to verify that permitted demolitions actually occurred, nor is there any way to determine if all demolitions were permitted. Demolitions, especially those publicly funded, tend to be highly reliant on the availability of state and federal grants. Therefore, their occurrence might only reflect temporary funding availability which might be inadvertently reflected in the projection's trend period.

A better prediction might be devised using census information on the number of structures and their age. Analysis of this information might result in the development of a demolition probability method. Such a method makes intuitive sense, since its underlying assumption is that houses need repair as they get older and that older houses not properly maintained will end their economically useful lives in larger numbers than new or newer houses.

REFINEMENT TO THE ANALYSIS OF EXISTING MUNICIPAL DENSITIES

The model currently takes 1985 at-place private sector employment, and, from further detail in the ES 202 records, identifies the number of jobs in manufacturing and retail. The model then uses statewide constants (employees/per acre) to convert these employment categories into acres. The result is an estimate of the total gross acres in the municipality developed for employment. By subtracting this estimate from the total acres developed, as mapped by OSP from 1st quarter 1986 aerials, gross residential acres can be determined. It should be noted that the residential acres really are gross, in that they include all development <u>except</u> private sector job-related development. The result of the modeling is an estimate of employment density (all jobs/estimated job acres) and gross residential and residential<u>-related</u> density (total units/acres estimated as non-job) for each municipality in the state.

Review of this methodology by a 1988 (March) technical committee resulted in the following recommendations:

- Expand the employment-by-type breakdown to include warehousing employment such as wholesale trade. Categories then would be manufacturing, retail, wholesale and office.

- Use a range of employee/acre densities that might be user selected.

In addition to these recommendations, the Middlesex, Somerset, Mercer (MSM) Regional Council in March 1989 published updates to its Regional Data Book. This publication reports on non-residential development by municipality. Data includes acres developed and square feet built for the following employment types: manufacturing, office, warehouse, retail and other. Information in the Data Book could be the basis (together with additional research) for model revisions.

C. Housing Demand: Income, Density and Price

During the work on headship rates, it seemed that this methodological approach might have other applications. Examinations of the census for compatible data sets (information reported by age, race and sex) identified income as well. An income analysis could be incorporated in the housing need section of the model to yield housing need by income group. Ultimately, this analysis might permit a kind of "market study" of housing need by cost, density or location.

Two approaches seem feasible. The first method would use census data about household income distributed as a function of age, race, and sex to develop "incomeship" tables, much like the headship rate tables. Alternative tables could be generated by using other census years of by extrapolating from two or more census years. The incomeship table would reflect the percentage of households in a specific population group by census-defined income categories. (Categories could be expressed as percentage of median income to avoid using non-constant dollars.) Summarized, the results would be housing need categorized by household income.

A second, more complicated, method would attempt to reconcile incomes with employment forecasts. NJDOL and other currently forecast county employment by sector (two digit SIC). The intent of the modeling would be to adjust incomes to reflect forecasted employment shifts. For example, if a hypothetical county has many high-paying manufacturing jobs and the forecast is for manufacturing to decline and be replaced by lower paying service jobs, then incomes would be adjusted by the model.

Several applications of "incomeship" can be imagined. First, the information about housing need by income group might provide insight into the housing type/density planning program of the future. In effect the model's product could be used as a market study. From this full analysis might spring density guidelines for the Interim Plan's regional design system.

D. Growth Allocations under PLAN and TREND

NON-PLAN AREAS

The State Planning Act states: "Nothing in the Act shall be construed to affect the plans and regulations of the Pinelands Commission pursuant to the New Jersey Pinelands Protection Act (P.L. 1979, c.111), the Hackensack Meadowlands Development Commission pursuant to the Hackensack Meadowlands Development Act (P.L. 1968, c. 404), or the Department of Environmental Protections pursuant to the Coastal Area Facilities Review Act (P.L. 1973, c. 185). The State Planning Commission shall rely on the adopted plans and regulations of these entities in developing the State Development and Redevelopment Plan."

After the model develops unfitted forecasts, growth is currently assigned to municipalities with land available for development. OSP mapped available developable land in that portion of the State under State Planning Commission jurisdiction (about 2/3's of the State). However, land under the jurisdiction of the Pinelands Commission (Pines), Hackensack Meadowlands Development Commission (HMDC) and DEP (Coastal Area Facilities Review Act [CAFRA]) have not been completely mapped. This results in anomalous results, since no growth is assigned to any of these areas (the model "thinks" no land available). Therefore, growth for Burlington County is assigned to municipalities or parts of municipalities not in Pines or CAFRA areas. It is probable that too much growth is assigned to Plan areas and too little to non-Plan areas in those counties that are split between the two.

To correct this problem, OSP opened growth forecast discussions and correspondence with DEP, Pinelands Commission and HMDC staff. None of these agencies were able to produce growth forecasts that were appropriate for use by OSP. DEP commissioned a study published in April 1989 entitled Stormwater Management in the New Jersey Coastal Zone. Included in that study were municipal population forecasts (1995 and 2005) for the counties of Atlantic, Monmouth, Ocean and Burlington. No employment forecasts were included. Pinelands Commission staff provided growth capacity estimates for the regional growth area portion of Burlington, Camden, and Gloucester counties. No capacity data was provided for other Pineland zones or development areas, nor did the Pinelands Commission have a growth forecast. Commission staff did provide guidance (too high or too low) with respect to unfitted Pinelands population growth allocations generated by OSP for Burlington, Camden and Gloucester counties.[9]

There are several ways to resolve the non-Plan area problem. All would calculate growth in the non-Plan areas, subtract this growth from total regional growth, and then fit what remains to mapped, SDRP portions of the State.

The first method assumes that the unfitted, initial growth forecast (output in Step 3) is accurate for non-Plan areas. Growth for non-Plan municipalities would be summed and subtracted from the initial regional growth allocation. Further refinement of this method might allow the user to assign growth targets to the non-Plan portions of counties. These targets might provide a

[9] Letter from Pinelands Commission dated November 21, 1989 in response to OSP letter dated January 19, 1989.

regional control for initial municipal growth forecasts, in much the same way that regional forecasts serve as a control in Step 3.

A second approach would involve the mapping of non-Plan areas of the State. Available, developable land would be mapped according to the planning categories of the appropriate agency. Growth forecasts would be fitted to land designated for growth by each agency. In effect, Planfit simulation modules would be developed for the Pinelands, CAFRA, and HMDC areas of the state. This approach might also be modified by the use of target forecasts.

LOCATION DECISIONS UNDER TREND

As suburbs densify, increasing prices of local growth controls may force new growth to "leapfrog" the urban fringe in search of cheap, unconstrained land. The predictable economic and political behavior may lead to a different regional patter of growth than is projected by the TRENDFIT model, which relies on available land and municipal growth history to allocate growth.[10]

As stated earlier, the model's focus on scenario testing rather than prediction make such detailed economic modeling a low priority. History has shown that certain areas become "hot" or "cool" real estate markets for reasons that are nearly unpredictable. Nevertheless, additional research and historical back-testing could reveal whether adding a land-price factor to TRENDFIT would increase the accuracy of location prediction. Information on land markets generated by the TREND portion of the upcoming economic impact assessment could also shed light on this important modeling question.

ASSIGNING GROWTH UNDER PLAN: JOB -TO-HOUSEHOLD RATIOS

The future simulation of PLAN intent in the PLANFIT module raises a number of issues that have yet to be addressed by researchers or policy makers. For example, under both TREND and PLAN, the model must make certain assumptions about the ratio of job to household growth by locality. Research is currently underway to determine what ratios might be desirable, especially for purposes of suburban mobility. The results of this research will be provided to the Planning Commission. If adopted, such ratios will be programmed into the PLANFIT portion of the model in order to better simulate growth in PLAN world.

[10] See, for example, Benjamin Chinitz, "Growth Management: Good for the Town, Bad for the Nation?" APA Journal, Winter 1990, pp. 3-8.

IV. CONCLUSION

The population and employment distribution portion of the OSP computer model have five main steps. In the first step, the user selects a forecast year and a set of published forecasts for that year. This provides the model with statewide set of county-level population and employment forecasts to distribute.

In the model's second step, county level population forecasts are converted to forecasts of housing need. A method known as "headship" is used. This method utilizes detailed information on the demography of future and the tendency of various sub-populations to form and head households. Information on likely changes in the existing housing stock is added to information on households. The results of this step is an estimate of the increment in housing units that need to built in each county.

The third step of the model takes the forecasted county increment in housing units and jobs, and assigns portions of this increment to municipalities in each county or region. At this stage, the assignment is based solely on historical growth trends, and incorporates no information on land available for development. Thus this assignment of growth is called the "initial"" assignment.

In the model's fourth step, initial growth assignments are compared to an inventory of available land in each municipality. Under "Trendfit," each municipality's existing residential and employment densities are used as the basis to measure its capacity for new growth. Under "Planfit," the user will be able to override these densities in order to simulate PLAN recommendations.

The model's fifth and final step converts municipal housing back into population and adds growth increments to the 1985 base. The result is a final forecast of municipal population and jobs.

This portion of the OSP Computer Model has a number of uses that go beyond the preparation of municipal forecasts or the analysis of land available for growth. Because of the large number of the user-selected options, a user may test the land-use implications of numerous published forecasts, changing household formation, higher or lower future densities, and trends related to the existing housing stock. The model also allows for a variety of assumptions about what constitutes an economic region, and what constitutes and appropriate historical period for trending growth.

No doubt, there are potential uses for the model that have yet to be explored. One possibility would be to add data on likely future incomes of the housing demand module, so that market demand can be matched against assumed futures densities or housing types. The population and employment distribution portion of the OSP Computer Model promises to be a valuable planning tool through Cross-Acceptance and beyond.

REFERENCES

Chinitz, Benjamin. "Growth Management: Good for the Town, Bad for the Nation?" APA Journal (Winter 1990).

Housing Trends and Projections. OSP Technical Reference Document 88-43 (June 1989).

Employment Trends and Projections. OSP Technical Reference Document 88-45 (forthcoming).

Estimating Growth and its Effect on Municipalities under the Preliminary Plan, Part I: Land Availability Analysis. OSP Technical Reference Document 88-28 (March 1989).

Population Trends and Projections, OSP Technical Reference Document 88-44 (June 1989).

Appendix A -- Origins and History of the Population/Employment Fitting Portion of the OSP Model

The current version of this model is a third generation effort to address a criticism of the April 1987 version of the Draft Preliminary State Development and Redevelopment Plan. In particular, critics questioned whether the State Planning Commission could demonstrate that sufficient land for development had been designated to absorb the Plan's growth targets. A corollary criticism was that the April Draft Plan underestimated the future demand for housing.

To address the issue of adequate land for development, OSP's consultants Wallace, Robert & Todd (WRT) estimated the Plan's development capacity by measuring the area of the (April 1987) tiers and estimating that portion of land available for development using planemetric data and study maps (Scale 1:250,000) developed from USGS quad maps (scale 1:24,000).

To facilitate the analysis of the Draft Plan's land requirements, WRT used the following algorithm:

(DOL 2010 Pop Forecast - 1985 OP est.) x % growth assigned by tier

x % tier population multifamily or single family

divided by persons per DU
(Constant for SF 3.08; constant for MF 2.4)

= units by tier (SF, MF)

x acres/unit by tier (SF, MF)

= acres developed by tier

While this short term estimate was being prepared, OSP staff began a more rigorous analysis as part of work to provide a revised Draft State Development and Redevelopment Plan. The work plan called for the creation of two products:

1. Detailed mapping of available land based on 1986 aerials at a scale of 1:24,000. This work measured land already developed and land unavailable for development (wetlands, public parklands, hazardous waster sites, lake surfaces, etc.). The result of this effort was the identification of acres of land available and suitable for development in each municipality. Tiers also were identified and mapped at this scale, resulting in the compilation of developable land by tier for each municipality in the State.

2. A computer model took Department of Labor forecasts of population and employment, developed municipal growth allocations for Trend and Plan (using policies of the January 1988 Draft SDRP) and tested the "fit" of these estimates using the aerial mapping developed by OSP. This model began development in August 1987 and was fully operational of March 1988. A

separate model component which estimated fiscal impacts of growth alternatives, based on the "Comparable Cities Model" of Burchell and Listokin, also was developed and made operational.[11]

A brief review of the modeling and aerial mapping was presented to the State Planning Commission during the March 1988 meeting. Comments of the Commission concerning the model were noted.

In addition to the State Planning Commission's comments, a committee of planning, modeling and demographic experts was assembled to review the computer model. Members of this technical committee were composed of staff members from the following organizations:

- Rutgers University Center for Urban Policy Research
- State of New Jersey, Department of Commerce and Economic Development, Office of Economic Policy
- State of New Jersey, Department of Labor, Division of Planning and Research
- State of New Jersey, Department of Community Affairs

The comments of the State Planning Commission and the Technical Committee were reviewed and became the basis for a work program begun in June 1988 resulting in the current version of model. The major changes to the program were:

1. Program Environment. The WRT model was a single Lotus 1-2-3 spreadsheet. The first OSP model consisted of 19 spreadsheets prepared using Microsoft Multiplan. The current version consists of 28 files written using Microsoft Excel. Excel allows for more structured programming; has data base capabilities; allows for the creation of user-interactive dialog boxes (which allows the user to select alternatives or enter new options); and allows the program to be used by non-programmers. Of the 28 files, eight are data files, four are program code files and the rest are algorithm spreadsheets.

2. Housing Component. The first two models estimate housing need by dividing population by assumed average family size. The current model estimates the number of houses needed for future populations based on estimated demographic changes.

3. Growth Allocation. The current version allows for user selection of various historic periods as the basis for municipal growth assignment. The model also allows for growth to be distributed within counties or regional (multi-county) growth areas. The model originally contained one growth forecast; it now contains several, as well as allowing users to enter their own estimates.

4. User Selected Variables. The model incorporates multiple dialog boxes (input screens) that prompts users to select from a range of alternatives. This allows users more flexibility in specifying future conditions (e.g. more or fewer single-parent households) and will allow user to test alternative policies when the Plan simulation component is completed.

5. Fiscal Impact Analysis. The model replaces the "Comparable Cities" method, which was based on information from the 1972 Census Governments, with up-to-date, New Jersey-specific data on operating budgets and capital systems.

[11] Robert Burchell and David Listokin, The Fiscal Impact Handbook (New Brunswick: Center for Urban Policy Research, 1978), chapter 5.

Appendix B -- User Selections Available in the Population/Employment Fitting Portion of the Model.

The following lists the inputs, and displays the choices for each input, required to use the Population Distribution/Fitting portion of the OSP computer model. Default selections are marked by an asterisk.

1. Select a Forecast Year

1995
2000
2005
2010 *

2. Select a Population Forecast and an Employment Forecast for use Statewide.

For the year 1995:

Population	Employment
DOL Economic Demographic *	NJDOT Route 1
DOL Historic Migration	Woods & Poole
NJDOT Route 1	NJDOT Rt1 w/ PANYNJ
Woods & Poole	Woods & Poole w/ PANYNJ
DOL Eco. Demo. w/ DVRPC	NJDOT Rt1 w/ MTC
DOL Hist. Mig. w/ DVRPC	Woods & Poole w/ MTC
NJDOT Rt1 w/ DVRPC	DOL Economic Demographic *
Woods & Poole w/ DVRPC	DOL Eco-Demo w/ PANYNJ
DOL Eco. Demo. w/ PANYNJ	DOL Eco-Demo w/ MTC
DOL Hist. Mig. w/ PANYNJ	
NJDOT Rt1 w/ PANYNJ	
Woods & Poole w/ PANYNJ	
DOL Eco. Demo. w/ MTC	
DOL Hist. Mig. w/ MTC	
NJDOT Rt1 w/ MTC	
Woods & Poole w/ MTC	
DOL Eco. Demo. w/ DVRPC/MTC	
DOL Hist. Mig. w/ DVRPC/MTC	
NJDOT Rt1 w/ DVRPC/MTC	
Woods & Poole w/ DVRPC/MTC	
DOL Eco. Demo. w/ DVRPC/PANYNJ	
DOL Hist. Mig. w/ DVRPC/PANYNJ	
NJDOT Rt1 w/ DVRPC/PANYNJ	
Woods & Poole w/ DVRPC/PANYNJ	

For the year 2000:

Population	Employment
DOL Economic Demographic *	DOL Economic Demographic *
DOL Historic Migration	NJDOT Route 1
NJDOT Route 1	Woods & Poole
Woods & Poole	DOL Eco-Demo w/ MTC
DOL Eco. Demo. w/ DVRPC	NJDOT Rt1 w/ MTC
DOL Hist. Mig. w/ DVRPC	Woods & Poole w/ MTC
NJDOT Rt1 w/ DVRPC	DOL Eco-Demo w/ DVRPC
Woods & Poole w/ DVRPC	NJDOT Rt1 w/ DVRPC
DOL Eco. Demo. w/ MTC	Woods & Poole w/ DVRPC
DOL Hist. Mig. w/ MTC	DOL Eco-Demo w/ DVRPC/MTC
NJDOT Rt1 w/ MTC	NJDOT Rt1 w/ DVRPC/MTC
Woods & Poole w/ MTC	Woods & Poole w/ DVRPC/MTC
DOL Eco. Demo. w/ DVRPC/MTC	
DOL Hist. Mig. w/ DVRPC/MTC	
NJDOT Rt1 w/ DVRPC/MTC	
Woods & Poole w/ DVRPC/MTC	

For the year 2005:

Population	Employment
DOL Economic Demographic *	DOL Economic Demographic *
DOL Historic Migration	NJDOT Route 1
NJDOT Route 1	Woods & Poole
Woods & Poole	DOL Eco-Demo w/ MTC
DOL Eco. Demo. w/ MTC	NJDOT Rt1 w/ MTC
DOL Hist. Mig. w/ MTC	Woods & Poole w/ MTC
NJDOT Rt1 w/ MTC	
Woods & Poole w/ MTC	

For the year 2010:

Population	Employment
DOL Economic Demographic *	DOL Economic Demographic *
DOL Historic Migration	Woods & Poole
NJDOT Route 1	DOL Eco-Demo w/ MTC
Woods & Poole	Woods & Poole w/ MTC
DOL Eco. Demo. w/ DVRPC	DOL Eco-Demo w/ DVRPC
DOL Hist. Mig. w/ DVRPC	Woods & Poole w/ DVRPC
NJDOT Rt1 w/ DVRPC	DOL Eco-Demo w/ DVRPC/MTC
Woods & Poole w/ DVRPC	NJDOT Rt1 w/ DVRPC/MTC
DOL Eco. Demo. w/ MTC	Woods & Poole w/ DVRPC/MTC
DOL Hist. Mig. w/ MTC	
NJDOT Rt1 w/ MTC	
Woods & Poole w/ MTC	
DOL Eco. Demo. w/ DVRPC/MTC	
DOL Hist. Mig. w/ DVRPC/MTC	
NJDOT Rt1 w/ DVRPC/MTC	
Woods & Poole w/ DVRPC/MTC	

3. Select a Regional Control. (This selection affects both local growth assignments and how impacts are reported. If a county wants to evaluate only its growth, then it should select "county" control.)

    County *
    COAH
    JPTA Regions
    DOL Labor Market Areas

4. Select a Headship Rate Alternative.

    1980 Constant Headship Rates *
    Headship Rates trended to 1995, then Constant
    Headship Rates trended to 2000, then Constant

5. Select a Demolition Alternative

    1986 Constant Demolitions *
    Average for the 1980's
    Average for the 1970's and 1980's
    Average 1950-1980
    Average 1960-1980
    Trended 1980's

6. Select a Conversion Alternative

    1986 Constant Conversions *
    Average for the 1980's

7. Select a Vacancy Rate

    2%
    3%
    4%
    5% *
    6%
    7%
    8%
    9%
    10%

8. Select a Period of time for Trending Growth

1960-70
1960-80
1960-85
1970-80 *
1970-85
1980-85

Appendix C -- 1980 Headship Rates for New Jersey

(Table not included in electronic version.)

Appendix D: Technical Review Committee

A draft of this (and four other) Technical Reference Document (TRD) was sent to a volunteer committee for their review. The members of that committee were selected by OSP for their expertise in subjects related to the material discussed in one or more of the TRD's. The committee met at an all day technical workshop, held March 6th 1990.

Many of the committee's recommendations have been incorporated into this version of the Technical Reference Documents. Nothwithstanding the committee's valuable contributions, the committee is not responsible for the model's products. Other committee comments have become the basis for further OSP research efforts.

OSP wishes to acknowledge this panel of experts and to thank them for their generous contributions of both time and ideas. The following is a list of the committee members who assisted OSP in the review of the Technical Reference Documents.

Dr. Thomas Bogart	Princeton University, Dept. of Economics
Dr. Robert Burchell	Rutgers University, Center for Urban Policy Research
Dr. Michael Danielson	Princeton University, Woodrow Wilson School
Mr. James Diffley	NJ Dept. of Treasury, Office of Tax Analysis
Dr. Larry Dolan	NJ Dept. of Community Affairs, Housing Research
Mr. John Moore	NJ Dept. of Transportation, Planning and Research
Mr. Marc Pfeiffer	NJ Dept. of Community Affairs, Local Government Services
Dr. Julian Wolpert	Princeton University, Woodrow Wilson School
Dr. Francis Tannian	University of Delaware, College of Urban Affairs and Public Policy
Dr. Jong You	NJ Dept. of Commerce and Economic Development, Office of Economic Policy
Mr. Lou Young	NJ Office of Legislative Services