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PROJECTIONS MODELLING SYSTEM
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This projection system, designed to predict growth and distribution of population, households, employment, income, and labor force characteristics, is structured around three components. These are: a) the regional economic and demographic forecasting system; b) the county employment, population, and income forecasting system; and c) the distribution of jobs and households as a function of available land, assumptions about density and travel demand within counties in the region. The distribution of jobs and households, as well as the total growth forecast, is heavily influenced by information gathered in the Local Policy Survey.

Regional Economic-Demographic System

The projection of regional employment, income, output, population, labor force, and occupational demand is performed by the Regional Economic-Demographic System (REDS). REDS is an analytical and econometric model, which uses a non-survey input/output (I/O) model to drive the interaction in the system. A general overview of the model can be found in "The Design and Implementation of a Regional Economic-Demographic Simulation Model," by R. Brady and C. M. Yang in the Annals of Regional Science, November 1983.

The basic equations and input/output model are updated every two years. The most recent update occurred in 1995. The user of REDS may change up to sixteen variables to affect the model's projection behavior. The system is designed to be user friendly. REDS divides the economy into thirty-five industry sectors, and predicts the output, job demand, and capital requirements of each sector. The demand for jobs drives the labor force model, which interacts with the migration model. The population model is a Cohort-Survival Model.

REDS has approximately thirty-three equations in the system. Some are statistical equations developed from time series data and hence constantly updated; others are analytical equations based upon observed behavior in the economy. The latter equations are either differential or difference equations.

County Employment Forecasting System

The projections of employment and income for each of the nine counties of the Bay Area were obtained from the County Employment Forecasting System (CEFS). CEFS is an econometric model that makes efficient use of the limited employment data available at the sub-regional level. It produces county forecasts consistent with the regional employment forecasts of REDS. A complete and thorough discussion of the model can be found in "Industrial and Spatial Interdependency in Modeling: An Empirical Forecasting Model for the Counties in the San Francisco Bay Region" by P. Prastacos and R. Brady in the Annals of Regional Science, July 1985.

CEFS recognizes thirty-two sectors, each sector representing a two-digit SIC code sector or a major industrial group. There is one equation for each sector and county. The equations were specified to account for the industrial and spatial interdependency of activities. Jobs in a particular sector are often dependent on job levels in other sectors in the same county and the region. Spatial interaction is determined by linking employment growth in competing counties, and in the entire region, with that of employment growth in the dependent counties. "Local serving" employment is more heavily dependent upon local population and income levels.

CEFS uses ordinary-east-squares technique to develop predictive equations with data from the County Business Patterns reports for years 1964 to 1992. The results of the regressions were very good and indicate that the relationships depicted in the equations are of empirical value and that they do reflect the economy of the counties. Both the R-squares for the equations and the t-values for the individual coefficients were acceptable. Additionally, a dynamic simulation of the estimated model over the period 1964 to 1992 showed that the employment levels forecasted by CEFS are close to actual data. After updating the statistical equations, ABAG produces a report that provides both the statistical information and the updated equations. The most recent update was released in August 1994. The report title and author are CEFS, A County Employment Forecasting System for the San Francisco Bay Region, by E. K. Caindec.

Population and Household Forecasts

ABAG uses trend analysis to determine long-term growth forecasts for each county's population and households. The latest time series uses data from 1975 to 1994. Linear, exponential, and geometric regression time series equations are used to predict future growth. The results of these trend equations are summed and averaged.

Trend data are constrained by local development policies, which limit housing production, and hence household growth. In several counties, household and population growth in the forecast exceed the aggregate of local policies over the long term. Short-term growth, however, closely follows development policies.

Sub-county Allocation System

The allocation of population, housing, and employment at the sub-county (zonal) level was carried out using the Projective Optimization Land Use Information System (POLIS). POLIS, a land use and transportation model, has replaced the PLUM and BEMOD models which were used at ABAG prior to 1980 for land use and zonal population and employment projections. A discussion on the structure of POLIS can be found in the ABAG reports A Description of POLIS: The Projective Optimization Land use Information System by P. Prastacos & E. K. Caindec, 1995, and The Basics of POLIS, by E. K. Caindec, 1991.

The allocation process in POLIS is based on several criteria, some reflecting the behavior of individuals and some describing physical and planning constraints. Travel-to-work and shopping

behavior; the availability and attractiveness of housing; and the current levels of nearby employment determine residential choice. Retail activity is located in proximity to population centers to maximize sales revenue. The locational patterns of the other industries are influenced by the accessibility to labor supply, the proximity to other similar industries and local development policies.

POLIS is a structured mathematical programming, optimization problem. That is, the allocation of population and employment is optimized with respect to an objective function or goal while at the same time satisfying planning constraints. POLIS converges after several iterations on a solution that optimally allocates jobs and households, subject to the constraints. It results in housing; employment and trip flow patterns which are consistent with each other and the land use constraints.

The form of the objective function in POLIS is derived from the random utility theory and describes the behavior of individuals (employees) to select among a set of alternatives the one maximizing their utility. The constraints of the model describe the housing and land supplies the development policies of the different cities, and the employment/housing to be allocated among all the zones within a county.

The Bay Region is subdivided into 119 zones in the POLIS system. Job data are derived from the County Employment Forecasting System (CEFS). The thirty-two employment categories in CEFS are aggregated separately for each county into four sectors: 1) Manufacturing and Wholesale Trade; 2) Transportation, Communications, Utilities (TCU) and Finance, Insurance, and Real Estate (F.I.R.E.); 3) Retail Trade; and 4) Services. Countywide estimates of household demand, population, and employed resident growth are also provided. Finally, detailed land use information on potential growth by employment type is provided as input to the system.

Recent calibrations of POLIS indicate that the mathematical structure reasonably simulates historical behavior. ABAG has just completed the process of re-calibrating POLIS using the 1990 Journey to Work and data collected and provided by the Metropolitan Transportation Commission. This calibration was completed in 1994.

Review of Forecasts

Local planning agencies review drafts of all the ABAG county and sub-regional forecasts. This review process has several objectives. First, forecasting for 126 cities and unincorporated areas and nine counties is a complicated process. Although the models ABAG uses are state-of-the-art, models are imperfect replications of reality. Second, review by local governments helps ABAG to identify problems at the small area forecast level.