Methodology Report

County level Economic & Demographic Forecasts State of California

* * * * * * * *

Structure of the Model, Model Specification, and Case Study

* * * * * * * *

by
Mark Schniepp
Director
California Economic Forecast Project

Final Report
(Task 5)

May 30, 2000

Table of Contents

This report was prepared by the California Economic Forecast Project during the months of April and May 2000. It reflects the status of the model in this initial phase of model development.

The description of the blocks and the equations is subject to revision as the model is enhanced and expanded over time.

The case study empirical section is subject to revision as the databank and model specifications are updated and revised over time.

INTRODUCTION

------ Cal Trans Statement here ----

Purpose of this report

The 58 County, economic forecasting project was conceptualized by the California Department of Transportation to provide an important tool to the local transportation community in each County of the state.

The mission of the project is the development of county-level forecasting models to project general economic activity at the county level on a long term basis. The length of the forecast is 20 years.

The purpose of this methodology report is to explain the method and structure underlying this Project in a thorough, understandable, and comprehensive format.

Objectives

In the development of the County forecasting models, a number of objectives were defined for the project that were deemed important for the long term operation and maintenance of the County level forecasting project.

1) Since cities, counties, and SMSAs are the areal units most often studied by regional economists and planners, it is important that econometric forecasts be prepared for such regions. Consequently, a principal goal is the development of "county level" forecasts for all counties in the State.

2) With 58 Counties in California and a need to develop updated forecasts of county-level economic indicators, a principal objective of the analysis was to develop a generalized approach to the problem of constructing meaningful econometric models for California Counties. Thus, a primary goal of the methodology was to develop a standard framework from which all Counties could be modeled after.

3) While this requirement was adopted during the genesis of the project in order to complete the volume of county forecasts in a timely manner, a flexible structure was adopted as a goal of model development.

Flexibility will enable enhancements and future development of each County model. Conceivably, the development of the models may and probably will become asymmetrical over time. Because a Santa Clara or Los Angeles County model is likely to draw greater attention and use by planners and decision makers in California, these models are likely to become more refined and enhanced over time, vis a vis models for say Solano, Imperial, or Modoc Counties that will generate interest by fewer numbers of individuals.

Consequently, the model structure is intended to be progressive, as further resources and time permit. For this first year and stage in the model development process, the structure is developed using a standard system of equations that are linked together in a similar manner.

Econometric Model: Brief Description

The model is comprised of 6 blocks of equations: 35 stochastic behavioral relationships and 12 accounting identities. The model is characterized by simultaneous interaction and determination of local employment, income, population, wages, and housing demand.

The stochastic equations are estimated as regression equations and the entire system is solved using the Gauss-Seidel algorithm.

The model is a "satellite model," requiring forecasts of various California and U.S. economic variables which are treated as exogenous to the local county areas.

The County-level models are each moderately detailed. The aggregate model is quite large in terms of a complete Statewide forecasting system. The 48 equation system is estimated separately for each County in California. Since there are 58 Counties in California, over 2,000 stochastic equations may have to be evaluated each time new data is introduced into the models or re-specification of the model is undertaken.

The models are County-specific, and the specifications are built with the objective of considering unique attributes of each County economy.

Outputs

The initial economic and demographic indicators that are forecast for each County are shown in Table 1. Forecast values are prepared over a 20 year period beginning with the year in which actual data are not yet available. In year 1 of the project, the initial forecast year was 2000. The terminal year was 2020.

Forecasts are determined for all Counties in California. Due to disclosure, in some Counties there is no separate employment category for mining and construction. These two sectors have been combined. For all other economic indicators, historical information exists to enable a long term forecast.

The forecasted information is assembled in an annual report. Each region of California is allocated its own chapter in the report. There are 49 regions in California consisting of 58 Counties. Two of the regions are PMSAs (primary metropolitan statistical areas) which include 3 Counties. 5 of the regions as SMSAs (standard metropolitan statistical areas) which include 2 Counties. The remaining regions are single County SMSAs or County areas. The report is updated annually, as new information is obtained and the models are updated.

Table 1

The principal economic indicators initially forecasted by the California County econometric model • June 2000

- Non-farm employment by principal one digit SIC sector:
    - mining
    - construction
    - manufacturing
    - transportation, communications, and public utilities
    - wholesale and retail trade
    - finance, insurance, and real estate
    - services
    - government
- Farm employment
- Total wage and salary employment
- Personal Income
- Per capita personal income
- Number of housing units permitted
- Taxable retail store sales
- Population
- Number of households
- Number of vehicle registrations
- Farm production
- Industrial production

Chapter 1

MODEL STRUCTURE

General Characteristics

The County models are a macroeconomic structure consisting of 55 interdependent equations. Each endogenous variable (determined by the model) is a function of other endogenous variables, exogenous variables (determined outside the model), and an error term. Implicitly, each equation may be represented as:

$$Y_{it} = f(Y_{jt}, X_{kt}, u_t)$$

Where

Y_{it} = endogenous variable i in period t
Y_{jt} = endogenous variable j in period t
X_{kt} = exogenous variable k in period t
u_t = error term in period t

The determination of Y_{it} by a variable determined elsewhere in the model, is the essence of a simultaneous equation model. The endogenous variables interact within the model as they do in the real world.

The structure of the model is a simultaneous, arranged in blocks of equations. Each block is comprised of a system of equations that comprise the block, or sector. All sectors are linked, meaning feedback exists between blocks. The equations within each block are either stochastic (that is, measured with error) or deterministic (i.e., are determined by an identity or formula having no measurable error).

The equations have been arranged in 6 blocks to aid in organizing the model.

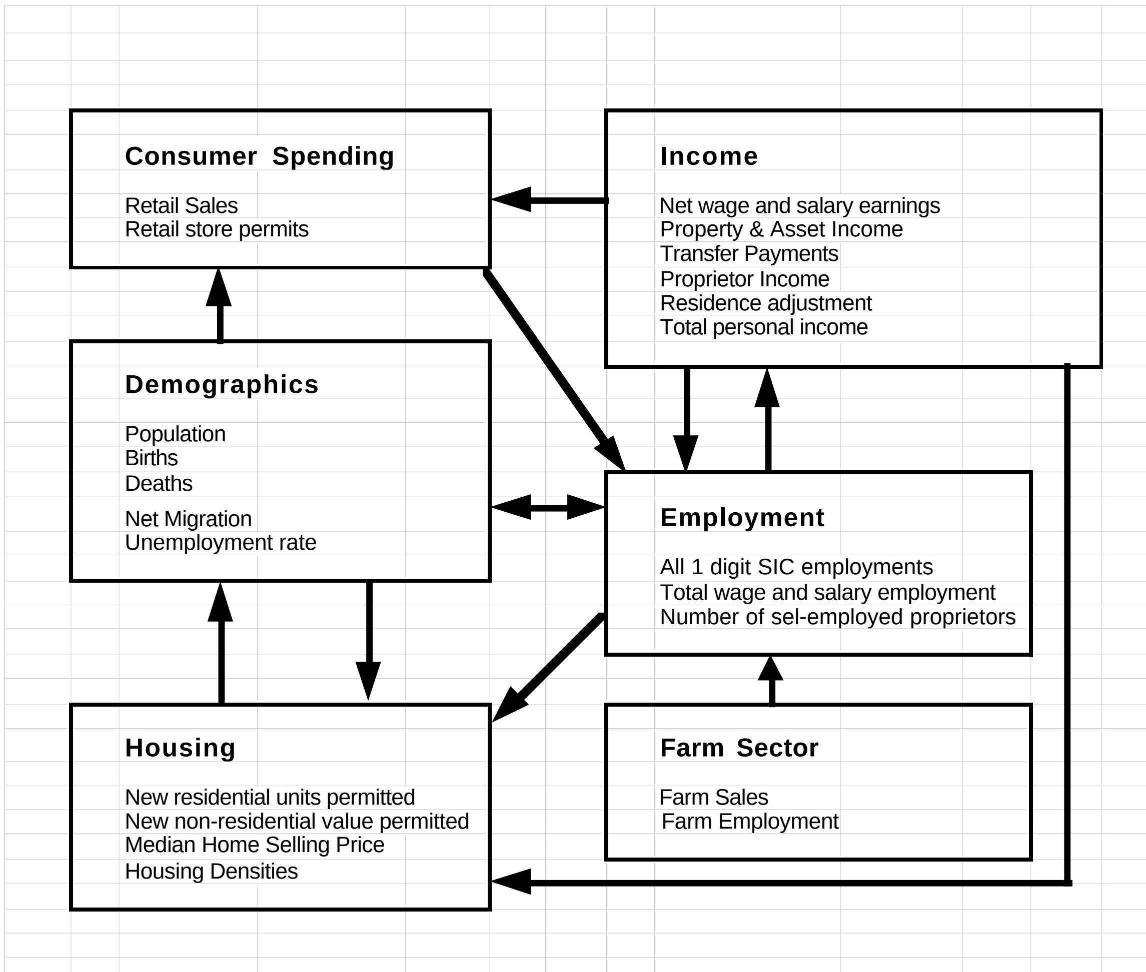
Sector 1: Housing and New Building
Sector 2: Demographics
Sector 3: Income
Sector 4: Consumer Spending
Sector 5: Employment
Sector 6: all other equations including the Farm sector

For each sector, a particular set of endogenous variables are specified to meet the initial objectives of the county forecasting model. A number of other endogenous variables are needed as intermediate stages in the determination of the key variables that are to be reported.

The casual relationships among the endogenous variables for the generalized structure of the model are summarized in Figure 1.

FIGURE 1

Casual relationships between the endogenous blocks of the California County-level Econometric Model



Economic Base Theory

In the earliest stages of regional model-building, Glickman (1971) and Adams, et. al. (1975) developed generalized structures of regional models for Philadelphia and Mississippi, respectively. As a result of their and other pioneering work, it is possible to develop a "typical" structure for a regional model. Much of that typical structure is applied to the development of the California Counties model described here. In general, the model is based on economic base theory.

In its most simple form, the theory underlying this technique holds that the local economy is divided into two producing sectors according to the location of the markets for goods:

(1) goods sold outside the region (exports, called "basic"), and
(2) goods sold within the region (called "non-basic" or service).

The theoretical assumptions associated with economic base theory are:

(a) Regional growth is intimately tied to the growth of the basic or export sectors. Goods sold beyond the region generate income to inhabitants of the region that can then be used to purchase imports of food, raw materials, and final goods and services that are not produced in the region.

(b) An expansion of the export sector will induce the growth of the local non-basic or service sector of the region, which is said to "support" the function of the basic sector. As the export sector increases, so does the non-basic sector, and conversely.

(c) A stable or equilibrium relationship exists between the basic and non-basic sector.

The empirical application of economic base theory is to categorize sectors of the regional model as either basic or non-basic. The principal influences comprising the stochastic relationship describing endogenous variables will be from outside the region (U.S. and Statewide indicators) if the sector is basic. If the sector is non-basic, the principal influences on the endogenous variables will be from within the region, (local income, spending, or production).

Estimation Period

The database associated with each County was assembled from as far back in time that data is currently available to the most current year, 1999. Annual observations are used in the estimation, and forecast.

Due to the varying availability of economic and demographic data the sub-national level, each block in the system has its own number of observations associated with it. Consequently, the estimators calculated for the forecasting equations were derived from varying numbers of observations.

For the **Employment block**, most of the large Counties and SMSAs included data that began in 1972. Some of the smallest counties, employment by industry data does not begin until 1988.

Income data for all Counties starts in 1969, and therefore, the income block includes 31 observations for all 58 Counties in California.

For the **Housing Sector Block**, the number of households and housing stock begin in 1980 for most counties. For some of the smaller counties, the data starts in 1984. The building permit data all begin in 1969 for all Counties in California. Median home selling prices typically begin in 1989 for all Counties. For some of the larger counties including Los Angeles, San Diego, Ventura, and Riverside/San Bernardino, the median price data begins in 1982.

Values have been back-estimated for some of the larger Counties and SMSAs. The backcasting approach adopted in this project typically spanned the 1980 to 1988 period, using time series and behavioral relationships to develop the backcasting model.

The **Consumer spending block** which consists of retail sales and retail store permits begins for all Counties in 1969.

In the **Demographic block**, the observations begin in 1970 or 1980. Population in all cases begins in 1970. Net migration, births, deaths, and population by age also begin in 1970. For some of the large counties, vital statistics data is available from 1947 to present.

For the **Farm sector**, data is available beginning in 1972. The CPI for the north and the southern parts of California, and the California composite CPI is available from 1920 to present. The statewide home mortgage rate begins in 1970.

Estimation Method

The small sample characteristic of estimating regional models is partly motivating the selection of the regression procedure in this model. Since regional models must be estimated from annual data, there will necessarily be few observations, and, few statistical degrees of freedom. If there are T observations and K exogenous variables in a typical equation in the model, the adjusted sample size is T-K. It $T \leq K$, then the least squares estimators cannot be determined.

It is not likely that T will be less than K for most if not all equations in the County model. In the event the K approaches T which may be true of only those counties that are truly small (e.g. Sutter, Yuba, Modoc, Alpine), exogenous variables can be eliminated from the equations under concern. However, misspecification can be a serious problem in small-sample models.

The three principal and well known large sample properties of regression estimating procedures are OLS (ordinary least squares), TSLS (two-state least squares), LISE (limited information single equation), and FIML (full information maximumlikelihood). The Monte Carlo studies indicate that OLS, while often more biased than the other procedures, exhibits the property of minimum mean squared error of the forecasts. Since FIML is very sensitive to specification error which will ordinarily occur in small sample models, it is dismissed along with LISE. TSLS along with the OLS were originally tested in preliminary trials of the model.

Glickman (1971) found that OLS and TSLS produced minimum mean absolute percent forecast errors in the Philadelphia SMSA model. Hall and Licari (1974) also used both OLS and TSLS estimation procedures in the development of their forecasting model for Los Angeles County. They found that the results from both estimation methods were "strikingly consistent." (*ibid*., page 343).

The OLS method of estimation is frequently adopted as the estimation method of choice because of its robustness and relative ease of use in systems of equations with relatively small sample sizes (i.e. T < 50). Theoretical considerations normally direct econometric practitioners to employ a two-stage least squares estimation method to avoid the possibility of inconsistent estimators resulting from the use of OLS in simultaneous equation models.

However, with few exceptions, researchers have estimated the structural form of regional econometric models using Ordinary Least Squares because many of the important problems associated with regional models have revolved around the availability of data.[1] Moreover, it has been found that OLS in small samples produces minimum mean absolute percent errors and is less sensitive to misspecification. Furthermore, there are no theoretical grounds favoring TSLS over OLS in small samples (Johnston [1980], page 16).

The 29 equation Mississippi model developed by Adams et. al. used OLS over an 18 year time period of estimation. Rubin and Erickson (1980) estimated their 97 equation model of the Milwaukee SMSA using OLS. Ballard and Glickman (1977) estimated their 44 equation multi-regional model of the Delaware Valley using OLS. The sample size included 22 years of observations.

In general, data constraints will limit the sophistication of the model for the time being. Nevertheless, steps have been taken to reduce specification error, the bias in the model, and any inconsistencies. This will help the model produce relatively accurate short term forecasts as it is used and enhanced. Until more data are available, regional models will continue to be relatively simple.

For the County level models in the first year of the project, the method of estimation is OLS. TSLS estimation was originally tested but discarded because it failed to produce superior results over OLS. Pindyck and Rubinfeld (1980, page 339) also recommend the use of OLS when the criterion for model evaluation is minimum mean square error

[1] See Glickman (1977). On page 63 he states: "The combination of annual data and few variables with long time series has not only produced small models, but some which are relatively simple–often consisting of sets of bivariate relationships." The evolution of regional models has not necessarily been toward the substitution of alternative estimation methods, but rather, of increasingly complex equations that attempt to model behavioral relationships with more robust specifications.

(i.e., the combination of bias and variance). Furthermore, TSLS requires the specification of instruments which mandates additional effort and data gathering for all Counties in California.

In subsequent stages of this project, and as more data are collected for the smaller regions of California, TSLS will be revisited as the default estimation method, due to its general theoretical advantages over OLS (*ibid*., p 321).

Chapter 2

ENDOGENOUS VARIABLES BY BLOCK

These variables are left hand side variables that are modeled using a behavioral relationship specification comprised of both exogenous factors and other endogenous variables.

Variable pneumonics and definitions follow. The naming conventions generally follow the following rules:

- A name that begins with “R” is a value variable that has been converted to constant 1999 dollars.
- All Employment variables begin with the letter “E”
- All income variables begin with the letter “Y”. Since they are also value variables, they have been converted to constant 1999 dollars and an “R” has been inserted at the beginning of their name.

There are a total of 55 equations in the simulation model applied generally to all Counties. Of the 55 equations, 35 are stochastic, and 20 are deterministic equations (accounting identities).

Sectors of the Model

The model is arranged into 6 sectoral blocks of equations. However the blocks are not recursive, that is, they are not estimated independently and determined (or solved for) sequentially. The models are characterized by simultaneous interaction and determination of local employment, income, population, wages, and housing demand.

Housing and New Building

- The Housing and New Building sector contains 12 equations which explain the variation in housing stock as a result of the development of new homes. The block also explains the average cost to build a home, the median selling values of existing home sales, and the extent of non-residential building in the region.

Stochastic equations

HH = households
SFU = single family units
MFU = multiple family units
RBVRTOT = real residential building value permitted
RBVNRTOT = real non-residential building value permitted
RABVRN = real average building value for new residential units
RHP = real median home selling price

Identities

HS = housing stock: HS = HS(t-1) + UNITS(t-1)
UNITS = new single and multiple family housing permits: SFU + MFU
SFRAT = ratio of single family units to total residential units permitted: SFU / UNITS
RBVTOT = real total building value permitted = RBVRTOT + RBVNRTOT
HPRAT = ratio of county median price to state median selling price: RHP/ RHPCA
where RHPCA = real median home selling price in California

Demographics

• The second sector is the Demographic block which determines population and its components. It also explains total vehicle registrations and unemployment. Population feeds back into the Housing block to determine the demand for housing. This principally occurs through the net migration equation.

Population from the demographics block also determines housing density in the Housing block, and per capita income in the income block. Per capita income is used extensively in the Employment block as part of the economic base theory described above.

Stochastic equations

BIRTHS = births (calendar year series)
DJUL = deaths (July series)
DEATHS = deaths (calendar year series)
NIPJUL = net in-migrating population (July-June series)
VEHICLES = number of registered vehicles
UR = unemployment rate

Identities

POPJUL = population (July 1): = POPJUL(t-1) + BIRTHS – DEATHS + NIPJUL
DPOP = change in population: POPJUL(t) – POPJUL(t-1)
PPV = persons per vehicle: POPJUL/VEHICLES
DENSITY = persons per household: POPJUL / HH

Income

• In the Income block, there are 5 stochastic equations and 4 identities in this sector. The 5 stochastic equations determine the components of personal income and the wage rate. The identities determine total personal income and per capita personal income.

The income block feeds back into every other block that includes non-basic sectors, such as the Housing block, the Consumer Spending block, and the Employment block.

Stochastic equations

RYTP = real transfer payment income
RYDIR = real property income (asset income)
RYPROP = real proprietor income
RYRA = real residence adjustment income
RYEPW = real average earnings per worker (average salary per worker)

Identities

RYTWS= real total wage and salary earnings = ETWS*RYEPW
RYP= real total personal income = RYTWS+RYDIR+RYTP+RYPROP+RYRA
RYPPC = real per capita personal income: RYP / POPJUL
WAGERAT = ratio of local average salary
to the average salary in California: RYEPW / RASALCA
(where RASALCA = real average salary in California)

Consumer Spending (retail sales)

• A fourth sector is the Consumer Spending block. Only 4 equations make up this block at this time. The two stochastic equations explain retail store sales and the number of retail stores reporting sales. The identities explain the size of retail stores in the region and, together with personal income from the Income block, the rate at which the regional population spends its income on local retail goods. Consumer spending feeds back into the employment block to explain the demand for retail sector jobs.

Stochastic equations

RQRS = real retail sales (taxable retail sales)
QRSTORES = number of retail outlets or stores

Identities

RQRSPS = retail sales per store = RQRS / QRSTORES
SALESRATE = ratio of retail sales to personal income = RQRS / RYP

Employment (non-farm sector)

• The Employment sector determines the number of jobs in the region by major industry. All of the principal industry employment equations are stochastic. The block also determines the number of self-employed proprietors. The identities determine total wage and salary employment, new jobs created each year, and the extent to which the region is an employment center or a bedroom community for adjacent employment centers.

The employment block feeds back into every other block except the farm sector block. Total jobs combined with the average salary per worker determine total wage and salary earnings. Employment growth also helps to explain net migration in the demographics block, and the demand for homes in the Housing block.

Stochastic equations

EMIN = employment in mining
ECON = employment in construction
EMFG = employment in manufacturing
EDUR = employment in durable manufacturing
ETPU = employment in transportation, communications, and public utilities
ETRADE = employment in wholesale and retail trade
EFIRE = employment in finance, insurance & real estate
ESERV = employment in services
ESLG = employment in state and local government
EFG = employment in federal government

EPROP = number of proprietors (self-employed individuals)

Identities

EGOVT = employment in government = ESLG+EFG
ETWS = total wage & salary employment =
sum of all non-farm employment sectors plus the farm sector
= EMIN + ECON + EMFG + ETPU + ETRADE +
EFIRE + ESERV + EGOVT + EFARM

DETWS = change in total employment: ETWS(t) – ETWS(t-1)
EMPRATE = employment to population ratio: ETWS / POPJUL

Farm Sector and misc. equations

• The sixth and final block includes the farm sector, the price level, and effective home mortgage rates. The mortgage rate is regional, either northern or southern California. This is also true of the inflation rate. The stochastic equations explain farm sector employment and farm sector production value. There is also a stochastic equation for inflation and the regional effective mortgage rate. The price level feeds back into every block for which there are dollar values.

<u>Stochastic equations</u>

EFARM = wage and salary employment in farming
RCROP = real total agricultural crop value
I = southern or northern California inflation rate
HMRLA = effective mortgage rate, Southern or Northern California

<u>Identities</u>

CPILA (SF) = Consumer Price Index, Southern (Northern) California
= CPILA(t-1)*(1+(I/100))

Chapter 3

EXOGENOUS VARIABLES

There are a total of 102 exogenous variables in the initial development of the model. Not all of these exogenous variables are used. However, these variables have been found to be important in the original specification tests. The exogenous variables will be updated and made available for model development and enhancement over time.

Currently, all blocks are driven by exogenous factors, as well as endogenous factors that are determined in other blocks of the general model.

The exogenous variables include the following:

California economic and demographic variables: There are 70 variables to draw on.

National economic variables: There are currently 22 variables that have been utilized in the model development process.

Local county demographic variables: These factors are age specific population counts from the Department of Finance. The model uses 10 of these to drive various equations in the Employment and Demographic blocks of the model.

The exogenous variables are obtained from the September UCLA Anderson Long Term Forecast for the State and Nation. The local county demographic variables are age specific populations that are estimated by the Department of Finance, Demographic Research Unit every 2 years.

Some naming conventions associated with the exogenous variables:

• All U.S. exogenous variables begin with a “Z”.
• All California exogenous variables end with the letters “CA”.

Chapter 4

ENDOGENOUS EQUATIONS: STRUCTURE & SPECIFICATION

In the base county model, there are 6 sectors comprising the economic structure. The base county model has 55 equations. 35 equations are stochastic, requiring a behavioral relationship. 20 equations are identities, requiring a deterministic relationship. The identities were specified above.

The list below shows the endogenous variables determined by stochastic relationships.

Application of Economic Base Theory

The development of the specifications was motivated by economic base theory. Those economic activities for which output is export oriented are estimated using non-local, state and national exogenous factors. Some of the employment block equations are export oriented such as manufacturing, agriculture, and mining. Industries like construction, retail trade, and government are typically local market oriented and are frequently dependent on local income and spending. This type of classification of the employment equations is consistent with the general literature on regional econometric models. See Milne et. al. (1990, page 175).

Both economic and demographic forces motivate the principal behavioral relationships in the County-level model. A key component of this modeling structure is the inclusion of demographic indicators that influence economic decisions, such as consumption, and income.

Empirical Specifications

The empirical specifications of regional models almost invariably always include a dependent lagged variable on the right hand side of most of the equations. The inclusion of the dependent lag follows from at least two theoretical considerations: partial adjustment and response lags.

Partial Adjustment

The partial adjustment empirical form assumes that the desired level of the endogenous variable is dependent on the current level of exogenous variables, i.e., the true form of the theoretical relationship is:

$$Y'(t) = a + b\,X(t) + e(t),$$

where $Y'(t)$ is the desired level of, say consumption, and $X(t)$ is the current (and actual) level of income. In any given period, the actual level of $Y(t)$ may not adjust completely to the desired level. Lack of information, technical constraints, inertia, bureaucratic delays, or other items might be responsible for partial adjustment from period to period. The process can be represented as:

$$Y(t) - Y(t\text{-}1) = \Omega^*(Y'(t) - Y(t\text{-}1)) \quad \text{where } 0<\Omega<1$$

This equation shows that the change in Y will respond only partially to the difference between the desired stock of Y and last year's value of Y. The rate of response is the factor called Ω. Note that if $\Omega=1$ then adjustment is instantaneous, that is, Y(t) = Y'(t).

The empirical form of the specification reduces mathematically to:

$$Y(t) = å + ßX(t) + wY(t\text{-}1) + \Omega^*e(t)$$

Where $å=a$, $ß=\Omega^*b$, and $w=(1-\Omega)$

If upon estimating the equation above, the estimated coefficients yield w=0, that implies that $\Omega=1$. No dependent lag is important and adjustment occurs instantaneously. The larger the estimated coefficient w, the smaller the implied value of Ω, and adjustment occurs over longer periods of time.

Partial adjustment is very similar in theoretical structure to the adaptive expectations model, and identical to its empirical structure. See Pindyck and Rubinfeld (1997), pps. 232-238.

Koyck transformation

The Koyck transformation is the empirical form of an infinite geometric distributed lag model:

$$Y(t) = a + b(X(t) + wX(t\text{-}1) + w^2X(t\text{-}2) + \ldots) + e(t) \quad \text{where } 0 < w < 1$$

This form is not estimated easily, since it involves an infinite number of X(t-i). However it can be simplified. This theoretical form collapses to the following empirical approximation:

$$Y(t) = å(1\text{-}w) + ßX(t) + wY(t\text{-}1) + \mu(t)$$

This form is appropriate only if w is positive (or zero, meaning no distributed lag), and the response time of the lag can be justified on common sense grounds. The long run response of the X(t) on Y(t) is:

$$ß/(1\text{-}w)$$

Consequently, if the estimated coefficient on the dependent lag is 0.9, the long run response of Y(t) to a continuous one-unit change in X(t) is 10 years. If w=0.1, the response time is about 1 year.

Theoretical Specification of the Stochastic Equations by Sectoral Block

Consumer Spending Sector

The two stochastic equations are RQRS (real retail sales) and QRSTORES (number of retail store outlets). There is generally insufficient data to estimate consumption for county areas. To be consistent with the literature on regional models, retail sales serve an an alternate measure of local consumer spending.[2]

The retail sales equation is modeled as a linear and log-linear function of personal income, and the relative size of the spending population. The equation simply follows the fundamental theory that consumption is directly dependent on income, and the proportional (or absolute) growth of the principal consuming population.

The number of retail stores is dependent on sales and the growth in the population.

RQRS = f(RYP, AFFPRO)

QRSTORES = f(RQRS, DPOP)

where RQRS = real retail sales
RYP = real personal income
AFFPRO=% of population age 45 to 64
QRSTORES = number of retail outlets reporting retail sales
DPOP = change in population = POPJUL(t) – POPJUL(t-1)

Employment Sector

Each of the principal SIC employment sectors is estimated stochastically. The sum of the individual industry employments yields total wage and salary employment (ETWS):

ETWS = EFARM + ECON + EMIN + EMFG + ETPU +
EFIRE + ETRADE + ESERV + EGOVT

where ETWS = total wage and salary employment by place of work

The general specification for the employment equations of the California County econometric model integrates an inverse production function approach using local output where available, local linkages such as personal income, and a partial adjustment factor.

---

[2] Both of the consumer spending specifications that are adopted for the California Counities model are drawn from Ballard and Glickman (1977, page 169).

The partial adjustment model for the employment equations “institutes” the inclusion of a lagged dependent variable. This specification was based on the assumption that most firms are not capable of making immediate employment changes in response to changing levels of demand. Contractual obligations and non-instantaneous mobility of labor constrain the adjustment process, thus necessitating an inertial period. See Adams et. al. (1975) or Glickman (1977). This formulation proved statistically significant in many of the employment equations.

Trade

Trade employment always depends on consumer spending, represented in this model by taxable retail sales. Ideally, all employment equations could be treated as an inverse production function:

Q = f(K,L,I, O) where Q=output, K=capital, L=labor, I=information, O=other

Then:

L = h(Q,K,I,O) where $h = f^{-1}$

Consequently,

ETRADE = h(RQRS, RQRSPS)

Where ETRADE = employment in wholesale and retail trade
RQRS = real retail sales
RQRSPS = real retail sales per store

The spirit of regional econometric models clearly utilizes the inverse production function approach to empirically specifying the employment equations. See for example, Engle (1974, page 263), or Glickman (1977, pps. 86-87) or Rubin and Erickson (1980, pps. 15-16).

Services

Services employment depends on demographic factors and wealth within the region. Services are largely business services, healthcare services, and personal services for most Counties in California. Service sector employment also includes tourism, in the form of hotels, motels, recreation, and amusement services.

The demand for healthcare and household and labor resources is obviously a function of the population in need of healthcare, those principally over the age of 65. This same population also demands proportionately more personal and household services, such as repair, maintenance, and assistance services.

In regions with large central business districts or urban commercial centers, business and legal services will be demanded by the extent of business, represented by the principal workforce, aged 45 to 64. In suburban or rural counties, this population group by itself, will not be as significant a force on the variation in service sector employment. However, local personal income due to the non-basic theory of the model becomes important.

In tourist oriented regions, per capita personal income in California serves as a suitable proxy for visitor demand and spending potential. This is especially true for the Los Angeles and Bay Area regions.

Younger populations also mandate more service oriented consumption in the form of personal services, recreation services, and education services.

For Metropolitan Counties or regions:

ESERV = g(AGE4564, RYPPC, AGE0517)

For Rural and/or suburban Counties or regions:

ESERV = g'(AGE65, RYPPC, AGE0517,

Where ESERV= employment in services
AGE4564 = population age 45 to 64
RYPPC = real per capita personal income
AGE0517 = K-12 school age population
AGE65 = population age 65 and over

Alternatively, RYPPCCA (per capita income, California) can be substituted for RYPPC in principal tourist destinations where the income stimulus is indicative of all Californians and not just residents of the region.

Manufacturing

Consistent with the economic base theory, the manufacturing employment equations are based on the premise that the expansion of manufacturing industries in the region depends on the growth of State manufacturing, and on relative labor costs in the region. The specification is consistent with manufacturing output equations found in Rubin and Erickson (1980, page 19).

Manufacturing employment depends on national influences, such as exports (U.S. Export growth), the general national economic climate (Real U.S. GDP), and the trend that has been indicative in the State of California, due to changes in the defense budget.[3] The influences on manufacturing vary with the type of manufacturing located in the County. In general however, employment in manufacturing is always a function of the durable side of manufacturing. That then leaves the variation attributable to the non-durable side to be explained by other variables in the equation:

---

[3] The general specification of regional models assumes that demand for manufactured goods is a national demand that generates output which is allocated by region. Milne, et. al. (1990, page 175).

EMFG = f(EDUR, WAGERAT, RGSPCA or RCROP)

Where EMFG = employment in manufacturing
EDUR = employment in durable manufacturing
WAGERAT = RYEPW/RASALCA =
ratio of real wages in the region to real wages
in the state of California
RGSPCA = real gross state product, California
RCROP = real crop value

Real crop values are used to capture the non-durable manufacturing component which is largely food processing in many California Counties. Much of the food is produced in the same County in which food manufacturing also occurs. The national or statewide gross domestic product is also used to capture the general economic climate that influences the business cycle-sensitive manufacturing sector.

Durable manufacturing employment is also modeled from Statewide trends and influences, such as aerospace employment or high tech manufacturing employment.

In all cases, a partial adjustment factor is added to incorporate the delays associated with labor mobility.

EDUR = f(EDURCA or EAEROCA, HPRAT, ZRDE, WAGERAT)

Where EDUR = employment in durable manufacturing
EDURCA = employment in durable manufacturing in California
EAEROCA = employment in aerospace in California
HPRAT = ratio of median home price in the region to the State
= RHP/RHPCA
ZRDE = real defense expenditures, U.S.
WAGERAT = RYEPW/RASALCA =
ratio of real wages in the region to real wages
In the state of California WAGERAT =

For all Southern California Coastal Counties including Los Angeles County, manufacturing is largely aerospace. In the Inland Empire, manufacturing is largely, lower technology injection molding or fabricated metals. In Ventura County and Santa Clara County, electronics is the principal durable manufacturing sector including semi-conductors. In general however, the expansion of manufacturing depends on the growth of the relevant State market and on the relative or competitive cost of labor in the region.

Construction

Construction employment is determined by the amount of both residential and non-residential construction in the county. The equation follows the inverse production function theory that the demand for inputs (construction labor) depends on output (permitted residential or non-residential development):

ECON = f(UNITS, RBVNRTOT)

Where ECON = employment in Construction
UNITS = number of residential units permitted
RBVNRTOT = real non-residential investment

Mining

Mining in California is generally one of three raw materials: petroleum, metals (such as gold and silver), and other miscellaneous mineral products such as diatomaceous earth or borax.

Employment is determined by national and world oil prices in oil producing Counties, such as Kern, Los Angeles, Orange County, Riverside/San Bernardino, Monterey, Santa Barbara, and Ventura Counties. In non-oil producing counties, mining employment is related to a composite of factors, proxied here by broader mining demand for employment in California.

EMIN = k(ZOILPRE, EMINCA)

Where EMIN = employment in mining
ZOILPRE = West Texas Intermediate Crude Oil Price
EMINCA = employment in Mining in California

Transportation, communications, and public utilities

Following economic base theory, the transportation and public utility industries which are service or non-basic sectors, are largely influenced by basic sectors of the region. Basic sectors always include manufacturing and mining, but they now include much of the Services Industry in the form of the computer and information processing sector, other business research and development services, healthcare, legal, and amusement and recreation services when the region is a tourist destination.

With the growth of the basic sector, the service sectors also grow to provide support to the basic sectors, principally in transportation and infrastructure support.

Retail sales serve as a proxy for all consumer spending, including spending on transportation services (airlines and trains), and increased telecommunications usage.

ETPU = f(EMFG and/or ESERV, RQRS)

Where ETPU = employment in transportation, comm. & public utilities
EMFG = employment in manufacturing
ESERV = employment in services
RQRS = real retail sales

Finance, Insurance and Real Estate

Finance and real estate also depend on population expansion, additional housing, and higher home prices which are the result of home demand growing faster than housing supply. The finance, and real estate sector is directly influenced by the number of homes it must support, and the turnover of homes though escrows, title searches, and like activities.

EFIRE = f(HPRAT, UNITS(t-1), NIPJUL)

Where EFIRE = employment in finance, insurance and real estate
HPRAT = RHP/RHPCA = ratio of median home price to
Median home price in California
UNITS = total residential units permitted
NIPJUL = net in-migrating population

Government

The sector is divided into local government (State and Local Government) and federal government.

The principal variation over time in local government employment is due largely to the public schools which usually represent the majority component of public sector employment in a county. Furthermore, as the principal revenue sources rise in the County, i.e., sales taxes and property taxes from taxable sales and property values respectively, more government jobs can be accommodated.

Sales taxes rise with retail sales growth, and property taxes rise as median home selling values increase. Both are therefore used with a lag as proxies of changing tax conditions.

Federal government employment within Counties of California is largely military civilian employment at Naval, Marine, or Air Force installations or stations. Variations in federal government employment are largely influenced by the defense budget

ESLG = j(AGE0517, RHP, and/or RQRS $_{t-1}$)

EFG = j'(ZRDE, EFGCA)

Where ESLG = employment in state and local government
AGE0517 = K-12 school age population
RHP = real home median price
RQRS = real retail sales
EFG = employment in federal government
ZRDE = real defense expenditures, U.S.

Self Employed Proprietors

Proprietors are individuals reporting schedule C income on their tax returns. Empirically, it was found that self employment was directly dependent on the availability of wage and salary employment opportunities, and, of course, the size of the labor force. However, interestingly, proprietor employment was found to be directly correlated with the unemployment rate in California and inversely correlated with the unemployment rate nationwide. This is a form of the discouraged worker hypothesis.

Within the state, fewer wage and salary employment opportunities would push individuals into self-employed endeavors, especially if general economic conditions in the nation warranted such a move. But if economic conditions nationwide signal economic slack, there are fewer opportunities by which self-employment is sustainable. This relationship held strong for the empirically estimated proprietor equations in many Counties.

EPROP = f(URCA, ZUR, AGE1864-ETWS)

Where EPROP = number of proprietors
URCA = unemployment rate, California
ZUR = unemployment rate, U.S.
AGE1864 = population, aged 18 to 64
ETWS = total wage and salary employment

Housing and New Development Sector

Households and Housing Stock

The number of households are determined by the amount of housing in place in the County and the relative tightness of the housing market. Under a full utilization scenario, HH = HS. The difference between households and the housing stock is housing vacancy. The Housing stock in any given year t, is equal to the housing stock that prevailed last year (t-1) plus any new homes during the year: UNITS(t-1).

HH = f(HS,)

Where HH = households
HS = housing stock = HS(t-1) + UNITS(t-1)

The housing sector is largely the result of land use policies and/or controls prevailing by county. With many growth restrictions in place, and relatively onerous building environments in coastal California Counties, new (or incremental) residential and non-residential development is not entirely free-market driven.

Consequently, the number of homes or the level of non-residential building may be introduced into the model as an exogenous factor, if a reasonable profile of housing and/or commercial development can be constructed over the 20 year forecast horizon of the model. The model will allow for this capability.

However, as a default specification, both single family units and multiple family units are modeled, according to the following general structure:

UNITS = SFU + MFU

SFU = f(NIPJUL,

MFU = f(DETWS, AGE2029, RHP)

Where SFU = single family units permitted
NIPJUL = net in-migrating population
MFU = multiple family units permitted
DETWS = wage and salary jobs created
AGE2929 = population aged 20 to 29
RHP = real median price of single family homes

Residential development depends on market demand in an unconstrained environment. Demand for housing rises with net in-migration, the home-buying age population, the apartment renting population (ages 20 to 29), and job creation, enabling the resident population to purchase and/or rent housing.

Housing supply generally rises with home prices and declines as the cost of building increases. For some regions, total residential units are modeled instead of SFU and MFU:

Units = f(NIPJUL, Age2029, DETWS, RHP, RABVRN)

Where UNITS = total residential units
NIPJUL = net in-migrating population
AGE2929 = population aged 20 to 29
DETWS = wage and salary jobs created
RHP = real median price of single family homes
RABVRN = real average building value (cost) of new residential units

Residential and Non-residential Investment

Real average building costs are originally derived from total residential building value permitted divided by the number of units permitted. The average cost of building a home in the region is influenced by relative wages in the region, relative selling prices of homes reflecting permitting fees and mitigations, and the extent to which the homes are single family versus multiple family structures.

RABVRN = f(WAGERAT, HPRAT, SFRAT, RHP)

Where RABVRN = real average building value (cost) of new residential units

WAGERAT = ratio of the average local wage to the general wage
Rate prevailing in California = RYEPW/RASALCA
HPRAT = housing price ratio: ratio of the median price in the region
to the median price in California
SFRAT = single family ratio: proportion of units permitted that are
single family.

Real total residential building permit value is the sum of new residential permit value plus the construction valuation from renovations and remodels of the existing housing stock or:

RBVRTOT = RABVRN * UNITS + Renovation/Alteration value

Currently, there is not an equation to forecast Renovations and alternatives value. RBVRTOT is therefore estimated stochastically by including UNITS, RABVRN, and other factors to explain the variation in remodel activity:

RBVRTOT = f(UNITS, RABVRN, RHP or HPRAT, RYPPC)

Where RBVRTOT = real total building value permitted of residential structures
UNITS = total new residential units permitted
RABVRN = real average building value (cost) of new residential units
RHP = real home median price
HPRAT = housing price ratio: ratio of the median price in the region
to the median price in California
RYPPC = real per capita personal income

Non-residential development depends on the local economic climate, principally on job growth (DETWS). New non-residential structures are generally needed to house workers in some of the larger employment sectors, such as durable manufacturing and services (EDUR, ESERV).

Statewide economic conditions proxied by real gross state product (RGSPCA) influence regional development activity. Complementary residential development also serves as an influence on non-residential investment. Hence the inclusion of UNITS into the specification. This is consistent with the contract construction equation specification developed by Duobinis (1981, page 300).

RBVNRTOT = f(DETWS or EDUR or ESERV, RGSPCA)

Where DETWS = change in total wage and salary jobs
EDUR = employment in durable manufacturing
ESERV = employment in services
RGSPCA = real gross state product, California

Housing Prices

Fundamental economics explain the variance in housing prices over time. As prices rise, demand growth is greater than supply growth, and conversely. Consequently, rising real home prices nearly always imply increased home sales. Stable or falling real home prices imply that supply growth of the housing stock is adequate or rising faster than demand growth.

Home prices are influenced by availability of housing (supply and demand forces) and home price trends in the State. The statewide home price movements embody other information that does not have to be explicitly accounted for in the local home price equation. Those factors include the general economic climate in the State and consumer confidence, both factors which have been shown elsewhere to have significant impact on consumer spending behavior.

The equation to explain variation in home prices follows the general form of:

RHP = f(RHPCA, Y, UNITS, HMRLA)

Where RHP = real median home selling price
RHPCA = real median home price in California
Y = a measure of income or affluence in the region, i.e.,
RYPPC = real per capita income, or
AFFPRO = affluent proportion of the population, age 45 to 64
UNITS = total units permitted during the year
HMRLA = home mortgage rate

Demographic Sector

Population and its components

Though the Department of Finance population is used as the officially reported population forecast in the model output, an endogenous population is also determined by the model. Population takes on the accounting identity:

POPJUL = POPJUL(t-1) + BIRTHS(t-1) - DEATHS (t-1) + NIPJUL(t-1)

The endogenously derived population is what is used to calculate all of the ratios of the model that require population, such as housing density, per capita personal income, and persons per vehicle.

It became imperative that an updated and endogenously determined population be modeled because (1) the actual value of POPJUL is updated each year through the year 2000 by the Department of Finance, and (2) The forecast of POPJUL is determined from the endogenously derived net migration.

The Department of Finance population forecast is not revised each year, and therefore a discontinuity between the actual updated population series and the forecasted series is created. Furthermore, the DOF population forecast is not a function of net migration that is determined within the model by economic forces.

In later versions of this model, a complete cohort survival model of each County will be used to forecast births and deaths.[4] For the current model however, the specifications adopted for the California County model are modeled after a number of sources. There is precedent in the literature for estimating population, births, and deaths using regression equations. For example, see Glickman (1977, page 95), or Taylor (1982, page 430).

Births

Births are determined by the fertile age population, disaggregated by fertile age group. An income variable may also be a relevant explanatory variable of births in some regions. Following Taylor, income or the rate of unemployment may be an important causal factor in some regions. It is hypothesized that income and fertility are inversely correlated, and unemployment and fertility are directly correlated.

BIRTHS = f(AGE1821, AGE2224, AGE2544, Z)

Where BIRTHS = number of live births
AGE1821 = population aged 18 to 21
AGE2224 = population age 22 to 24
AGE2544 = population aged 25 to 44
Z = an economic factor, such as RYPPC (real per capita income) or UR (the unemployment rate)

Deaths

Deaths are determined by the size of the elderly population. Two equations for deaths had to be constructed: DJUL and DEATHS. DJUL is the July 1 to June 30 for which there is ample time series data for counties. However, because the measure of births in the accounting equation is in calendar years, it is important to capture the number of deaths by calendar year: A behavioral equation for DJUL is constructed and a bridge equation for DEATHS is estimated so that calendar year deaths can be forecast.

DJUL = g(AGE65, Time)

DEATHS = h(DJUL)

Where DJUL = number of resident deaths (July-June series)
DEATHS = number of resident deaths (calendar year)
AGE65 = population aged 65 and over
TIME = a time trend or the dependent lag to specify trend or adjustment of the death rate to aging populations.

Net In-migration

[4] A basic explanation of the cohort survival method and how it is integrated into a regional model is described in Mansell and Wright (1980), page 5. Currently, the California Economic Forecast Project has a working version of such a model which will be tested in later versions of the forecast.

Net migration is influenced by a number of economic factors including relative wages, relative home prices, income, the availability of housing, and the price of housing. Relative economic indicators have traditionally been successful in predicting net migration trends. See for example, Duobinis (1981, page 302), Taylor (1982, page 430), and Saltzman and Chi (1977, page 60):

NIPJUL = f(WAGERAT, HPRAT, DETWS, UNITS, RHP, RYPPC)

Where NIPJUL = net in-migrating population (July series)
WAGERAT = ratio of the regional wage to the state wage rate =
RYEPW / RASALCA where RASALCA =
real average wage/salary rate in California
(RYEPW is explained below)

DETWS = new wage and salary jobs created (or lost)
UNITS = new residential units permitted
RHP = real median home selling price
RYPPC = real per capita personal income

Number of Registered Vehicles

Vehicles ownership in the U.S. is dominated by the working age population, or the population aged 18 to 64. However, the population that is most likely to own one or more automobiles during their lifecycle is the union of the population that is both working and indicative of larger households. A proxy for larger household families is the population aged 25 to 44. An alternative measure that proved successful in the County models was housing density. More people per house generally translates into more people per vehicle; consequently in higher dense counties, the number of vehicles will not rise proportionately with the population.

VEHICLES = f(ETWS, AGE4564, DENSITY, RYPPC)

Where VEHICLES = number of registered vehicles
ETWS = total wage and salary employment
AGE2544 = population aged 25 to 44
DENSITY = household density: POPJUL / HH
RYPPC = real per capita personal income

The Unemployment Rate

The regional unemployment rate equation has been formulated as a function of the state unemployment rate, and regional total employment. The dependence of local unemployment trends on those of the state reflects the strong interregional labor market linkages and the mobility of labor in California. The specification follows the theoretical explanation attributable to Rubin and Erickson (1980, page 24), and Adams, et. al. (1975, page 290):

UR = f(URCA, DETWS)

Where URCA = unemployment rate, California
DETWS = new wage and salary job creation

The unemployment rate is determined in the model because it is needed as an important explanatory variable in other endogenous equations of the model, such as NIPJUL, and the RYEPW and RYTP equations explained below.

Income

General Personal Income Framework

In the Nation, any State or any region, wealth or personal income is an accounting identity:

PY = YTOTWS + YOLI – PCSI + YNW

Where PY = personal income
YTOTWS = total wages and salaries
YOLI = other labor income
YPCSI = personal contributions to social insurance (social security deductions)
and YNW = non-wage income = YDIR + YTP + YRA + YPROP
YDIR = property or asset income (dividends, interest, & rental income)
YTP = transfer payment income
YRA = residence adjustment
YPROP = proprietor income

Average Earnings per Worker and Labor Income

Labor income or "earnings" is the sum of wages and salary plus other labor income less personal contributions for social insurance (OASDI = old age survivor and disability insurance):

YTWS = YTOTWS + YOLI – YPCSI

Labor earnings divided by total wage and salary employment produces earnings per worker, or YEPW. Adjusting for inflation yields the variable RYEPW:

RYEPW = YEPW*CPILA(Base Year)/CPILA

Where the base year in the current model is 1999

Real earnings per worker (the average wage and salary in the region) is modeled as a function of the State wage rate, thus reflecting the dependence of local wages on state labor market conditions, a dependence generated by labor mobility. However, regional differentials do exist, and wage rates are partly determined by local labor market conditions. Hence, a local variable such as the regional unemployment rate is also tested in the County real earnings per worker equation. This follows the general "Philips Curve" specification that was convincingly validated empirically across a 21 sub-regions in Izraeli and Kellman (1979). Also, see Mathur (1976) for an earlier work which included national and statewide variables:

W(t) / P(t) = a + b P(t-2) + c U(t) + d X(t) + e(t)

Where W(t) = wage or salary, P(t) = price level, U(t) = unemployment rate, X(t) = national or statewide factor, such as wages or salaries, and e(t) is the residual; a,b,c and d are the estimated parameter values.

The following specification was adopted in the California County models:

RYEPW = f(RASALCA, UR)

Where RYEWP = real earnings per worker
RASALCA = real average salary (earnings per worker) in California
UR = unemployment rate

The forecast of total labor (or wage and salary) earnings is derived by combining RYEPW and total wage and salary employment:

RYTWS = RYEPW * ETWS

Historically, RYTWS comprises between 50 and 80 percent of total personal income in California Counties. The other components of personal income contribute the remaining 20 to 50 percent.

Other components of Personal Income: Non-Wage Income

In much of the literature, other components of personal income have been combined into one "Non-Wage Income" equation. See Crowe (1975, page 191) Rubin and Erickson (1980, page 25), and to some extent, Duobinis (1981, page 303). Since the historical income data are available for every County in the State, and exogenous forecasts exist from the UCLA Anderson Forecast for each component of income, each of the components of personal income was modeled separately.

The remaining components of total personal income were estimated largely from California income determinations combined with demographic forces. Taylor (1982, page 432), Adams, et. al. (1975, page 290) and Glickman (1977, pps 88-89).

Property Income

Property income is influenced largely by rental income and equity markets. Equity market returns are inherent in total California property income, as are interest rate influences. Rental income is related to local rents, which in turn are highly correlated with current home prices in the region.

RYDIR = f(RYDIRCA, RHP)

Where RYDIR = real property or asset income
RYDIRCA = real property income, California
RHP = real median home selling price

Transfer Payment Income

Transfer payments include 2 principal sources of income: (1) public and private pension income distributed to the retired population, and (2) public relief payments such as aid to families with dependent children and unemployment insurance. Hence:

RYTP = f(AGE65, AGE0517, UR)

Where RYTP = real transfer payment income
AGE65 = population aged 65 and over
AGE0517 = school age population, aged 5 to 17
UR = unemployment rate

However, the use of the corresponding statewide measure, RYTPCA will embody the general trend in retirement pension distributions and public assistance distributions. Since regional variation can differ from Statewide variation in transfer payment income, local variables are further included. An alternative specification used in the County model is:

RYTP = f(RYTPCA, UR)

Where RYTPCA = real transfer payment income, California

Proprietor Income

Proprietor or schedule C income is correlated with the size of the population that files schedule C income, largely the 45 to 64 year old labor force that has started second careers, added second jobs, or quit conventional employment arrangements. Retail sales, a strong proxy for consumer spending, is an index of expenditure by consumers on products and services in the region.. Most proprietorships rely on consumer spending. This form of the specification is consistent with the models developed by Glickman (1977) for the Philadelphia region. Rubin and Erickson (1980) also hypothesized that non-wage income components vary directly with the overall level of regional economic activity (*ibid.*, page 25).

Alternatively, because they embody a number of factors that would also influence regional proprietor activity, state or national level proprietor income is frequently used in the general specification.[5]

[5] In the literature, non-wage components are often either grouped together or individually specified using very simple bivariate relationships. Furthermore, they are frequently treated as an afterthought in the models and allocated only a terse explanation of exact equation specifications. However, now that more

RYPROP = f(AGE4564, RQRS) or RYPROP=f'(RPROPCA, RQRS)

Where RYPROP = real proprietor income
AGE4564 = population aged 45 to 64
RQRS = real retail sales
RPROPCA = real proprietor income, California

Residence Adjustment

The residence adjustment is an adjustment for allocating labor income by place of work to place of residence. Since wage and salary income is measured by place of work, the residence adjustment reallocates this income into or out of the region, depending on whether regional wage and salary employment is principally served by residents of the region, or commuters from another region.

A number of indicators is generally used to model the residence adjustment, including net migration, total job creation, housing units permitted, and trend. For the California County models, the following specification was generally adopted:

RYRA = f(NIPJUL, DETWS, UR)

Where RYRA = real residence adjustment
NIPJUL = net in-migration
DETWS = new jobs created in the region
UR = unemployment rate

Farm Sector and other miscellaneous equations

Farm Sector

The literature was devoid of farm sector relationships, especially agricultural crop values or sales.

Farm employment is influenced by agricultural output. Agricultural output is determined largely by weather, the national and international economic climate, and world prices for crops and agricultural commodities.

RCROP = f(ZPPI, ZRGDP)

Where RCROP = real agricultural crop value
ZPPI = farm producer price index, U.S.
ZRGDP = real gross domestic product, level or percent changes, U.S.

---

data are now available to regional models than during the 1970s and early 1980s when much of the theoretical work was initially performed, non-wage components are more often estimated separately and with significantly more attention to rigor. See Milne, et. al. (1990, page 179).

Farm employment is modeled after the inverse production function theory described above. The level of output in the current period will directly effect the inputs in the current year assembled to produce that output.

EFARM = f(RCROP)

Where EFARM = employment in the farm services and production sector
RCROP = real agricultural crop value

Inflation and Interest Rates

The local inflation rate and effective mortgage rate are influenced by the inflation and mortgage rate forecasts in the State and Nation. This kind of influence is consistent with the literature on modeling regional inflation and interest rates. See Taylor (1982, page 433), Duobinis (1981, page 312), Glickman (1977, page 89), Engle (1974, page 264).

Consequently, state and national forecasts of inflation and interest rates are used to project regional rates. The specification is linear:

I = a + b*ICA

Where I = regional inflation = [{CPIR-CPIR(-1)}/CPIR(-1)]
ICA = inflation in California = [{CPICA-CPICA(-1)}/CPICA(-1)]
CPIR = regional consumer price index, either LA or SF
CPICA = consumer price index, California (weighted average of (the Southern California and Northern California CPIs)
a, b = parameters to be estimated

Similarly, regional mortgage rates are a direct function of U.S. rates, and the composition of the size of the mortgage loans made in the region.

HMRLA = f(ZMORT, HPRAT or RHP/RHPCA)

Where HMRLA (SF) = effective home mortgage rate in Southern California (LA) or Northern California (SF)
HPRAT = ratio of RHP to ZRHP
= ratio of regional median home price to national median home price
RHP/RHPCA = ratio of regional median home price to statewide median home price

Chapter 5

OTHER INFORMATION

Forecasts

All of the exogenous variables during the forecast period are taken from the UCLA Long Term Forecast for the State and Nation. Typically, this forecast is produced once a year in September. The UCLA Anderson Forecast then updates their forecasts of State and National variables over the short term (3 years out) in December, March, and June.

To make certain that the most current economic forecasts of the U.S. and California are used in the determination of the County level forecasts, the short term forecast revisions made during the year by UCLA are used to revise the long term forecasts. This exercise is warranted when the County models are updated after the release of the December forecast or prior to the release of the new long term forecast in September.

The system of equations is solved using the Gauss Seidel iterative simulation algorithm.

Database, Data Sources

The database is an extensive collection of County-level economic and demographic variables from a myriad of sources in California. The database spans the period: 1947 to 1999.

Indicator	Primary Data Gathering Source
Taxable Retail Sales	State Board of Equalization
Retail Store Outlets	State Board of Equalization
Personal Income	Department of Finance, Economic Research Unit*
Components of Pers. Inc.	Department of Finance, Economic Research Unit*
Employment	Employment Development Department, LMID
Unemployment Rate	Employment Development Department, LMID
Vehicle Registrations	Department of Motor Vehicles
Births, Deaths	Department of Health Statistics
Population, Net Migration	Department of Finance, Demographic Research Unit
Residential building permits	Construction Industry Research Board
Non-residential bldg. Permits	Construction Industry Research Board
Median Home Selling Price	California Association of REALTORS©
Farm Sales	California Agricultural Commissioner
Households	Department of Finance, Demographic Research Unit
Housing Stock	Department of Finance, Demographic Research Unit

* obtained from the Department of Commerce, Bureau of Economic Analysis

Constant Dollars

All county-level dollar variables are deflated using the local consumer price deflator or the statewide implicit price deflator. The base year is 1999.

Each year the base year will change to the last year of history.

Software

The database software used is MICROSOFT Excel, versions Office 98 and Office 2000. All of the endogenous and exogenous variables are stored in Excel spreadsheets.

The econometric modeling software used is EVIEWS, version 3.1.

All of the reports are prepared using MICROSOFT WORD, version Office 98. The final reports are displayed in Aldus Pagemaker, version 6.

word count (first 5 Chapters): 11,028

REFERENCES

Adams, Gerard F., Carl G. Brooking, and Norman J. Glickman, "On the Specification and Simulation of a Regional Econometric Model: A Model of Mississippi," Review of Economics and Statistics, Vol. 57, No. 3, August 1975, pps 286-298.

Ballard, Kenneth, and Norman J. Glickman, "A Multiregional Econometric Forecasting System: A Model for the Delaware Valley," Journal of Regional Science, Vol. 17, No. 2, 1977, pps 161-177.

Bell, Frederick W., "An Econometric Forecasting Model for a Region," Journal of Regional Science, Vol. 7, No. 2, 1967.

Crow, Robert Thomas, "A Nationally-Linked Regional Econometric Model," Journal of Regional Science, Vol. 15, No. 2, August 1973, pps. 187-204.

Duobinis, Stanley, F. "An Econometric Model of the Chicago Standard Metropolitan Statistical Area," Journal of Regional Science, Vol. 21, No. 3, 1981, pps 293-319.

Engle, Robert F., Issues in the Specification of an Econometric Model of Metropolitan Growth," Journal of Urban Economics, volume 1, 1974, pps 250-267,

Glickman, Norman J., "An Econometric Forecasting Model for the Philadelphia Region," Journal of Regional Science, Vol. 11, No. 1, 1971, pps 15-32.

Glickman, Norman J., *Econometric Analysis of Regional Systems: Explorations in Model Building and Policy Analysis*, Academic Press, New York,1977.

Izraeli, Oded, and Mitchell Kellman, "Changes in Money Wage Rates and Unemployment in Local Labor Markets: The Latest Evidence," Journal of Regional Science, Vol. 19, No. 3, 1979, pps 375-387.

Hall, Owen P, and Joseph A. Licari, "Building Small Region Econometric Models: Extension of Glickman's Structure to Los Angeles," Journal of Regional Science, Vol. 14, No. 5, 1974, pps 337-353.

Johnston, J., Econometric Methods, 3rd Edition, McGraw-Hill: New York, 1980.

Johnston, J., Jack Johnston, and John Dinardo, Econometric Methods, 4th Edition, McGraw-Hill: College Division, 1996.

Klein, Lawrence, R. "The Specification of Regional Econometric Models," Papers of the Regional Science Association, Volume 23, 1969, pps 105-115.

Mansell, Robert, L., and Robert W. Wright, "A Model of the Alberta Economy," paper presented at the Computer Model Conference, Jasper Park, Alberta, Canada, April 20-23, 1990, pps 1-26.

Mathur, V.K., "The Relationship Between Rate of Change of Money Wage Rates and Unemployment in Local Labor Markets: Some New Evidence," Journal of Regional Science, Vol. 16, No. 3, 1976, pps 389-398.

Milne, William J., Norman J. Glickman, and F Gerard Adams, "A Framework for Analyzing Regional Growth and Decline: A Multiregion Econometric Model of the United States," Symposium on Multiregional Forecasting and Policy Simulation Models: Journal of Regional Science, Vol. 39, No. 2, 1990, pps 173-189.

Pindyke Robert, and Daniel Rubinfeld, Econometric Models & Economic Forecasts, 2nd Edition, McGraw Hill, New York, 1981.

Pindyke Robert, and Daniel Rubinfeld, Econometric Models & Economic Forecasts, 4th Edition, McGraw Hill, New York, 1997.

Rubin, Barry M., and Rodney A. Erickson, "Specification and Performance Improvements in Regional Econometric Forecasting Models: A Model for the Milwaukee Metropolitan Area," Journal of Regional Science, Vol. 20, No. 1, 1980, pps. 11-35.

Saltzman, Sidney, and Hua-Shan Chi, "An Exploratory Monthly Integrated Regional/National Econometric Model," Regional Science and Urban Economics, Volume 7, 1977, pps 49-81.

Taylor, Carol A., "Econometric Modeling of Urban and Other Substate Areas," Regional Sciences and Urban Economics, Volume 12, 1982, pps 425-448.

UCLA Anderson Forecast, *The Long Term Macroeconomic Forecast for the State and Nation*, volume 48, September 1999.

<end of references>

APPLICATION OF THE MODEL
TO THE SAN FRANCISCO-SAN MATEO-MARIN COUNTY REGION

This section presents the results of the estimated equations, actual and fitted values, and forecast values of all stochastically determined endogenous variables in the County model.

For this example, the San Francisco-San Mateo-Marin Counties Region is arbitrarily used to demonstrate the empirical specification of the model.

All Counties are generally structured after the default specifications described in this report. However, there will always be some differences in the final empirical form of the specifications from County to County.

Alternative functional forms and lag structures associated with economic relationships endemic to a particular County will mandate differences in the exact specifications used to produce the forecast system of equations in all counties.

Blocks and equations presented in this section:

Consumer Spending

- Real retail sales
- Retail store outlets

Housing and New Development

- Number of households
- Single family units
- Multiple family units
- Real average building cost per new residential unit
- Real total residential building value permitted
- Real total non-residential building value permitted
- Real median home selling price

Employment

- Mining
- Construction
- Manufacturing
- Durable Manufacturing
- Transportation, communications & public utilities
- Finance, insurance, and real estate
- Trade

Services
State & local government
Federal government
Number of proprietors

Income

Real earnings per worker
Real property and asset income
Real transfer payment income
Real proprietor income
Real residence adjustment income

Demographics

Births
Deaths (July series)
Deaths (calendar series)
Net in-migrating population
Unemployment rate
Number of registered Vehicles

Farm Sector and Miscellaneous

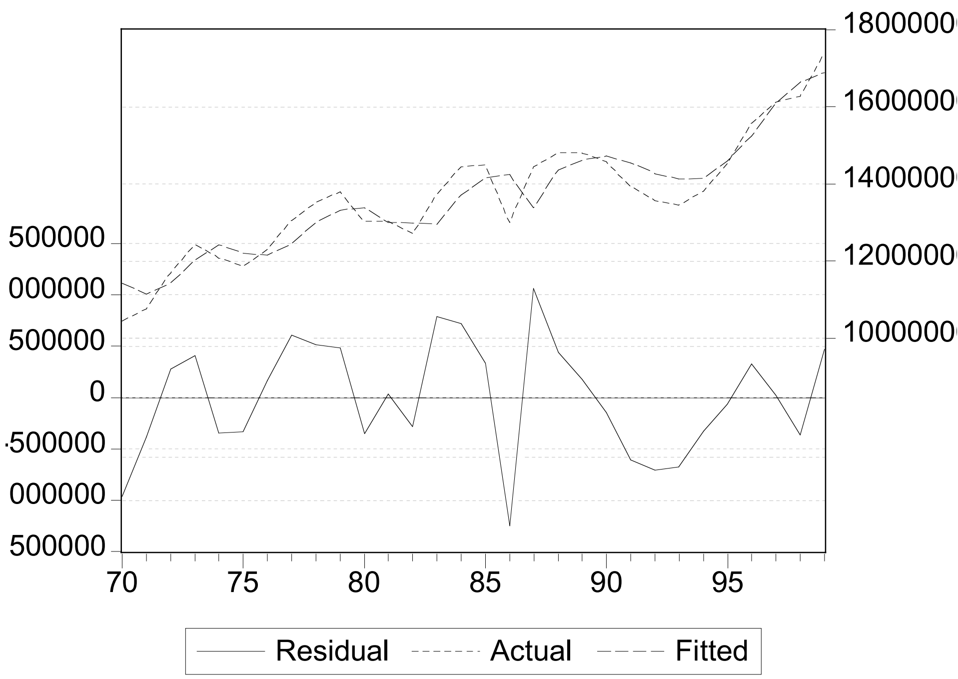
Farm employment
Real farm sales or crop value
Inflation (regional)
Home mortgage rate

Consumer Spending Block

Dependent Variable: RQRS - Real Retail Sales
Method: Least Squares
Date: 04/18/00 Time: 12:25
Sample(adjusted): 1970 1999
Included observations: 30 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	355217.6	2939661.	0.120836	0.9047
AFFPRO	100954.9	109877.4	0.918796	0.3666
RYP	0.062865	0.022767	2.761262	0.0104
RQRS(-1)	0.577142	0.164750	3.503147	0.0017

R-squared	0.876915	Mean dependent var	13653446
Adjusted R-squared	0.862712	S.D. dependent var	1560557.
S.E. of regression	578222.8	Akaike info criterion	29.49687
Sum squared resid	8.69E+12	Schwarz criterion	29.68370
Log likelihood	-438.4531	F-statistic	61.74514
Durbin-Watson stat	1.600812	Prob(F-statistic)	0.000000



Right hand side variables

AFFPRO = ratio of affluent age population (age 45-64) to total population
RYP = Real Personal Income
RQRS(-1) = dependent lag

Short Description of the Equation

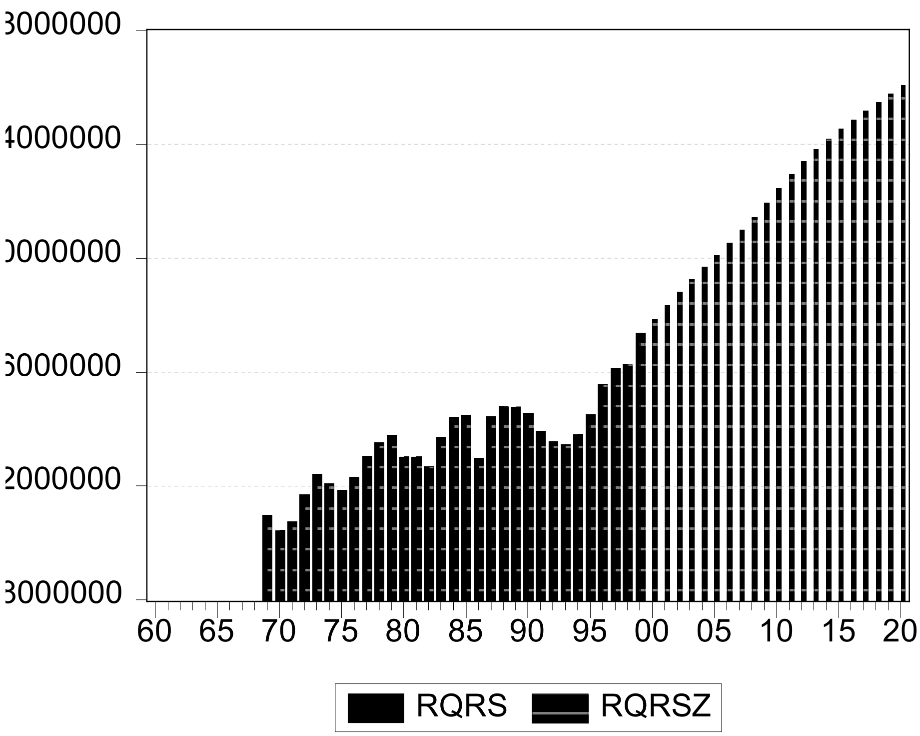
Consumption is principally a function of income.

Consumer spending on taxable retail goods (consumption) is linearly influenced by total regional income, the proportion of the population in their prime affluent and spending years, and a partial adjustment factor (the dependent lag).

The partial adjustment factor compensates for consumption being a function of income accumulated over a number of years rather than limited to the current year.

Special features

None.



Dependent Variable: QRSTORES - Retail Store Outlets
Method: Least Squares
Date: 03/16/00 Time: 08:13
Sample(adjusted): 1969 1999
Included observations: 31 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-265394.9	27896.48	-9.513564	0.0000
LOG(RQRS)	17197.37	1706.828	10.07563	0.0000
DPOP	0.085639	0.022871	3.744462	0.0009
DUM9295	4409.200	498.4808	8.845275	0.0000

R-squared	0.928887	Mean dependent var	18322.45
Adjusted R-squared	0.920985	S.D. dependent var	3254.238
S.E. of regression	914.7529	Akaike info criterion	16.59510
Sum squared resid	22592867	Schwarz criterion	16.78013
Log likelihood	-253.2240	F-statistic	117.5585
Durbin-Watson stat	1.719998	Prob(F-statistic)	0.000000

Right hand side variables

Log(RQRS) = natural log of real retail sales
DPOP = increase in population: POPJUL(t) – POPJUL(t-1)
DUM9295 = binary variable for the 1992-95 period (=1, 0 otherwise)

Short Description of the Equation

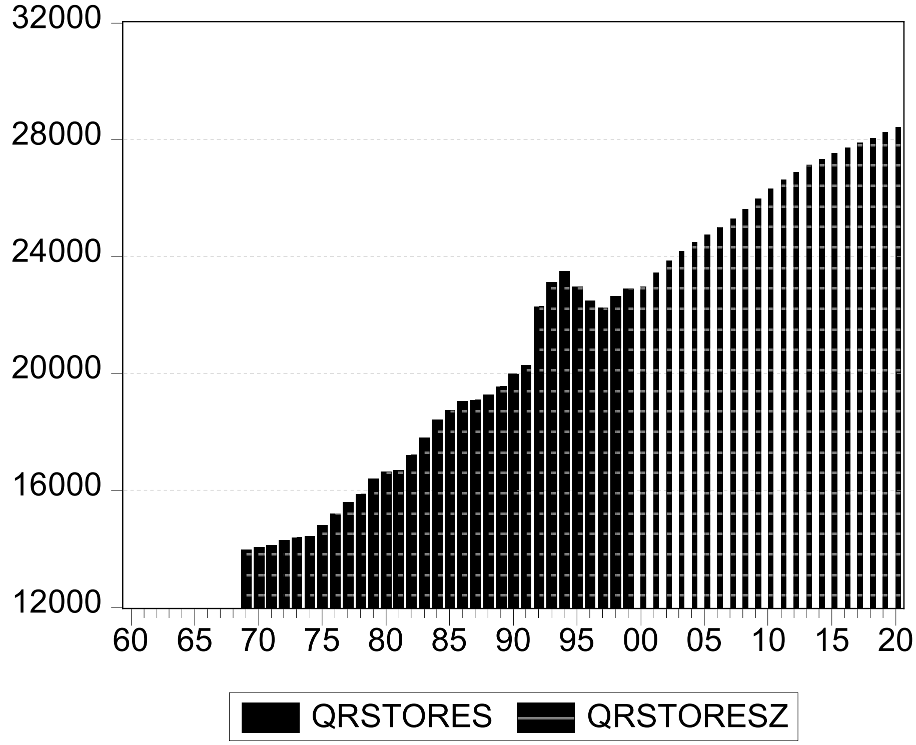
Sales growth induces entry of new retail stores.

Retail store outlets are a semi-log function of retail sales. This functional form accounts for the recent trend in larger big box stores accounting for a greater proportion of retail sales in a region. As consumption increases over time, there is a need for more stores, but at a diminishing rate.

Store openings are also influenced by population growth in the region. A binary variable for the 1992 to 1995 period was inserted to compensate for the non-market-explainable "surge" in stores allocated to the region during this time period.

Special features

None.

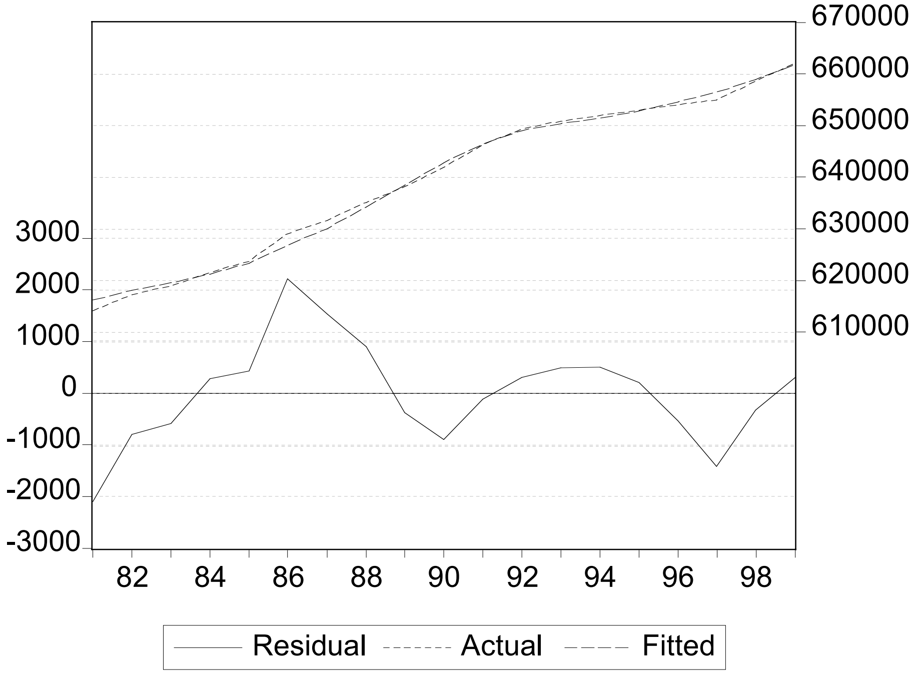


Housing and New Development Block

Dependent Variable: HH – Number of Households
Method: Least Squares
Date: 03/15/00 Time: 17:44
Sample(adjusted): 1981 1999
Included observations: 19 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	116341.8	8236.259	14.12557	0.0000
HS	0.774926	0.012193	63.55658	0.0000

R-squared	0.995809	Mean dependent var	639596.9
Adjusted R-squared	0.995563	S.D. dependent var	15385.41
S.E. of regression	1024.880	Akaike info criterion	16.80184
Sum squared resid	17856437	Schwarz criterion	16.90125
Log likelihood	-157.6175	F-statistic	4039.438
Durbin-Watson stat	0.690648	Prob(F-statistic)	0.000000



Right hand side variables

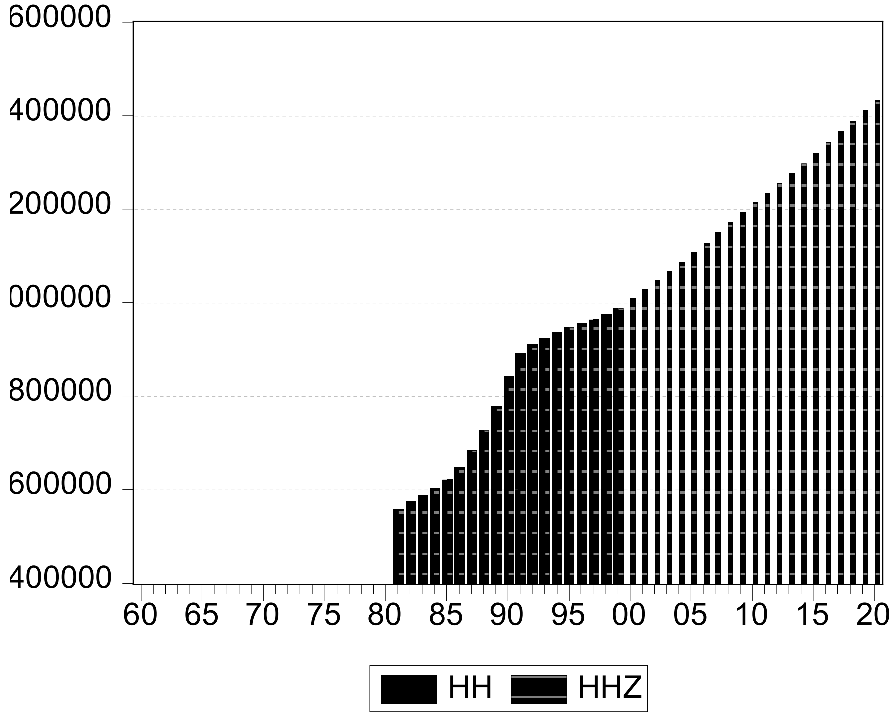
HS = housing stock

Short Description of the Equation

The number of households is directly and linearly related to the number of homes in the region.

Special features

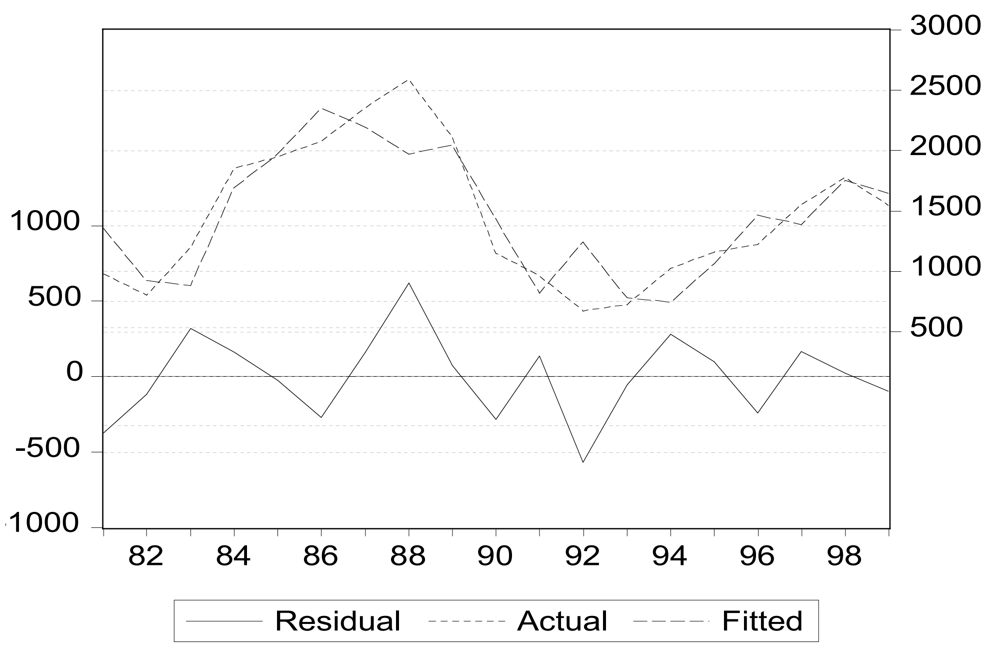
None.


600000
400000
200000
000000
800000
600000
400000
60 65 70 75 80 85 90 95 00 05 10 15 20
HH
HHZ

Dependent Variable: SFU – Single Family Units Permitted
Method: Least Squares
Date: 04/18/00 Time: 07:51
Sample(adjusted): 1981 1999
Included observations: 19 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3556.900	3961.703	-0.897821	0.3856
RABVRN	-13.76766	4.168664	-3.302654	0.0057
SFU(-1)	0.613948	0.152595	4.023386	0.0014
RHP/RHPCA	-851.5330	738.4562	-1.153126	0.2696
NIPJUL(-1)	0.010785	0.015984	0.674745	0.5117
DENSITY	3072.421	1930.490	1.591523	0.1355

R-squared	0.769409	Mean dependent var	1457.895
Adjusted R-squared	0.680721	S.D. dependent var	576.4778
S.E. of regression	325.7376	Akaike info criterion	14.66215
Sum squared resid	1379365.	Schwarz criterion	14.96039
Log likelihood	-133.2904	F-statistic	8.675396
Durbin-Watson stat	1.884522	Prob(F-statistic)	0.000838



Right hand side variables

RABVRN = real average building cost of new residential structures
SFU(-1) = dependent lag
RHP/RHPCA = ratio of real median price in region to real median price in California
NIPJUL(-1) = net migration into the region, lagged one year
DENSITY = household density: population to household ratio

Short Description of the Equation

The demand and supply of single family homes is influenced by prices, building costs, and population pressures.

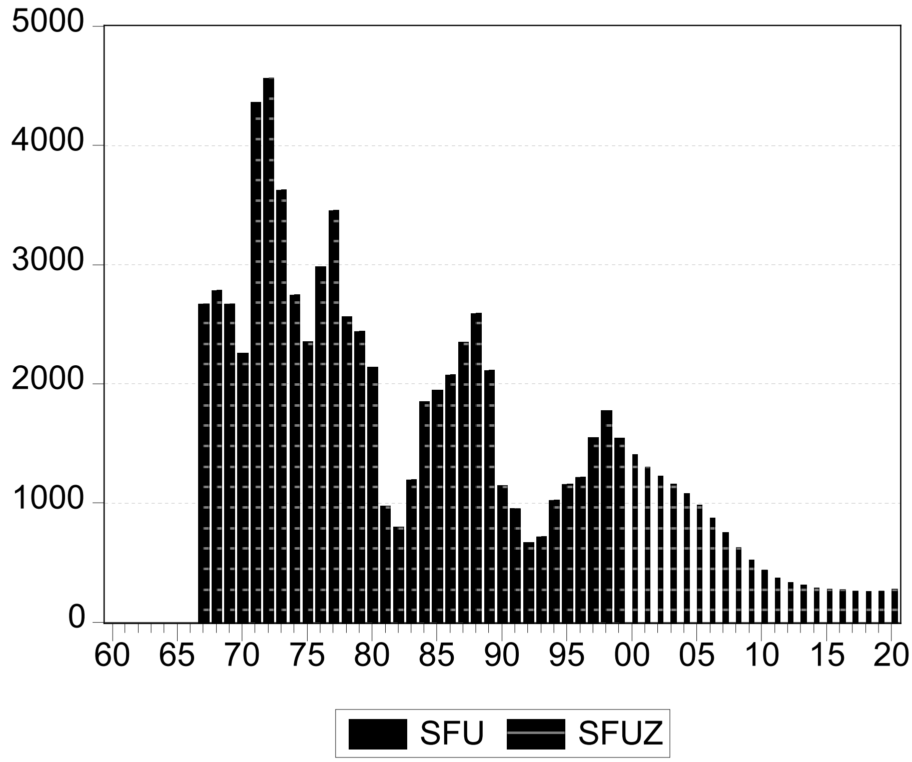
The decision to go forward with residential development depends on building cost and the relative value of homes in the region.

The partial adjustment factor accommodates the fact that the permit of homes occurs in project phases that can easily span 1 or more years. Not all homes in an approved project of 200 units are usually permitted in a single year.

Net migration represents relatively instant demand for housing. The lag adjusts for data reporting differences between calendar and fiscal years. Rising household densities generally signal the need for more housing.

Special features

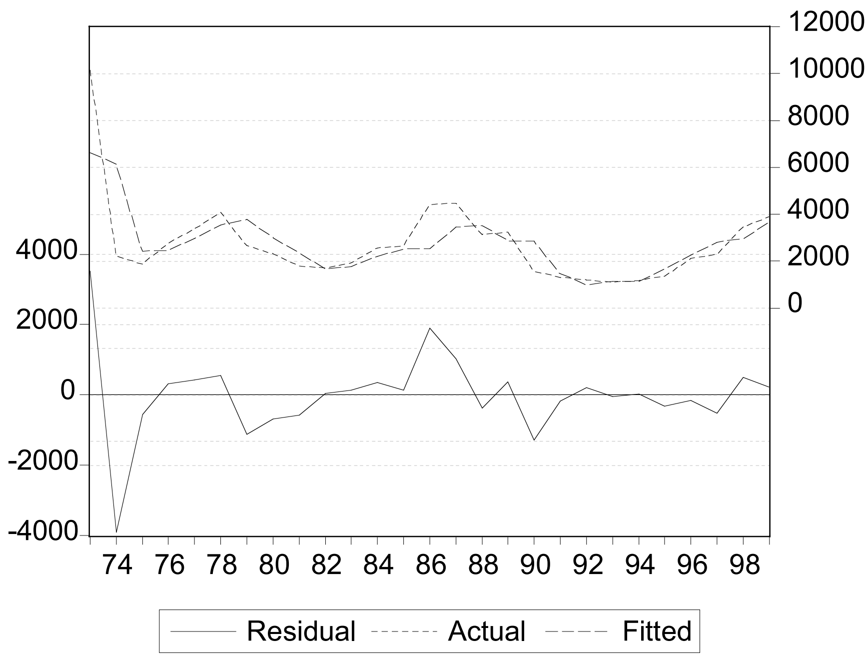
None.



Dependent Variable: MFU – Multiple Family Units
Method: Least Squares
Date: 04/18/00 Time: 07:53
Sample(adjusted): 1973 1999
Included observations: 27 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	26512.86	44040.52	0.602011	0.5533
DETWS	13.48584	8.35523	1.475603	0.1390
MFU(-1)	0.482821	0.124566	3.876041	0.0008
AGE2029	0.207724	0.355086	0.584997	0.5645
AGE2029^2	-4.17E-07	7.06E-07	-0.589903	0.5613

R-squared	0.637365	Mean dependent var	2764.963
Adjusted R-squared	0.553249	S.D. dependent var	1782.230
S.E. of regression	1317.827	Akaike info criterion	17.37093
Sum squared resid	38206724	Schwarz criterion	17.61090
Log likelihood	-229.5076	F-statistic	6.388410
Durbin-Watson stat	2.168114	Prob(F-statistic)	0.001436



Right hand side variables

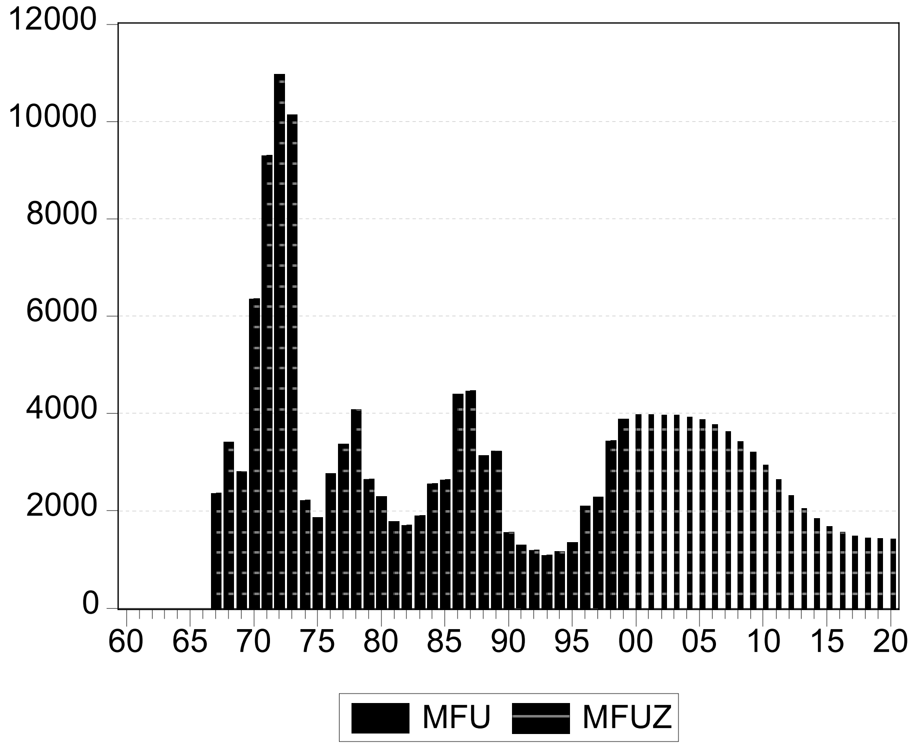
DETWS = new job creation = ETWS(t) – ETWS (t-1)
MFU(-1) = dependent lag
AGE2029 = population aged 20 to 29
AGE2029^2 = square of population aged 20 to 29 (quadratic term)

Short Description of the Equation

The demand for multiple family homes (apartments) is influenced by job creation (DETWS), and the principal age demographic of apartment renters, that is, 20 to 29. A dependent lag is included to capture partial adjustment.

Special features

In this specification, a quadratic functional form was fit and found to be an accurate predictor of apartment unit demand.

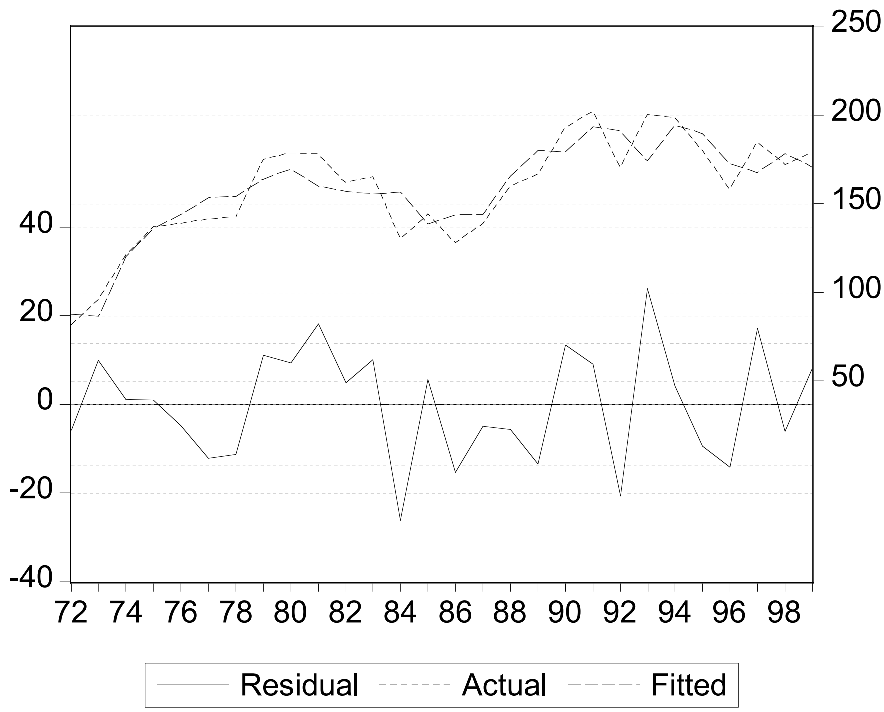


Dependent Variable: RABVRN – Real Average Building Value of New Residential Structures

Method: Least Squares
Date: 04/18/00 Time: 07:50
Sample(adjusted): 1972 1999
Included observations: 28 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-127.6179	72.63627	-1.756945	0.0922
RHPCA	0.000368	0.000120	3.072499	0.0054
SFRAT	77.27165	34.90906	2.213513	0.0371
RABVRN(-1)	0.512022	0.124242	4.121173	0.0004
WAGERAT	85.45566	62.92828	1.357985	0.1876

R-squared	0.819703	Mean dependent var	158.0394
Adjusted R-squared	0.788347	S.D. dependent var	30.02303
S.E. of regression	13.81233	Akaike info criterion	8.249432
Sum squared resid	4387.948	Schwarz criterion	8.487326
Log likelihood	-110.4921	F-statistic	26.14181
Durbin-Watson stat	2.366910	Prob(F-statistic)	0.000000



Right hand side variables

RHPCA = real median home selling price, California
SFRAT = ratio of single family homes permitted to multiple family homes permitted
RABVRN(-1) = dependent lag
WAGERAT = RYEPW/RASALCA = unit labor cost ratio = ratio of real average earnings per worker in the region to real average earnings per worker in the State

Short Description of the Equation

The median home price in the state for existing resales influences general building values for new housing throughout the state and region.

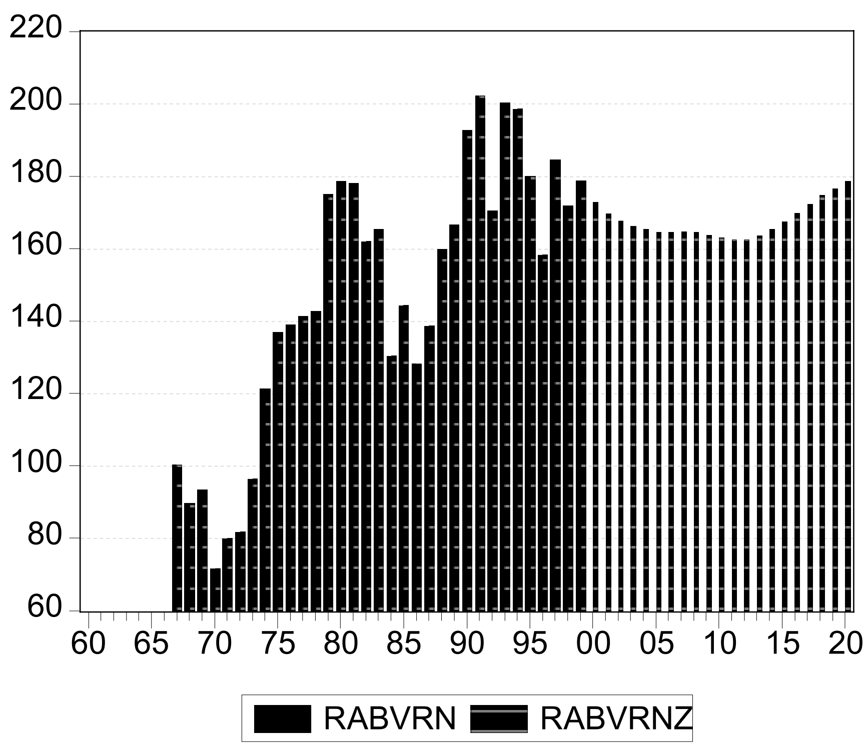
The ratio of single family homes permitted to multiple family homes permitted directly impact the average per unit cost to build a structure.

Relatively higher labor costs affect the construction industry and raw materials industries and therefore building costs.

The dependent lag accommodates partial adjustment.

Special features

The San Francisco Bay Area was one of the few areas in the State that showed a recent decline in real per unit building costs. This can be simply explained by the relatively larger number of multiple family homes now being built in the region. Apartment units (or attached 2- or 4-plex condominiums) cost less per unit to construct than single family homes. Because of land use restrictions, this trend is likely to continue for a number of years.

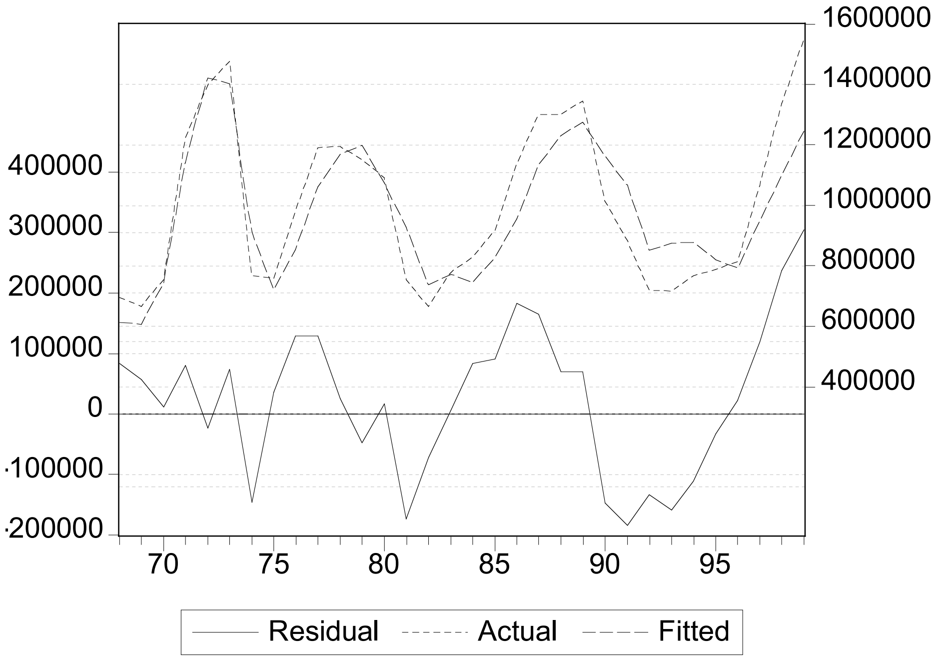


Dependent Variable: RBVRTOT – Real Total Residential Building Value

Method: Least Squares
Date: 03/16/00 Time: 12:56
Sample(adjusted): 1981 1999
Included observations: 19 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1233587.	197578.4	-6.243533	0.0000
UNITS	159.8582	16.73614	9.551675	0.0000
RABVRN	5349.299	1021.003	5.239258	0.0001
RHP/RHPCA	243889.5	90524.92	2.694170	0.0175
RBVRTOT(-1)	0.297007	0.080253	3.700888	0.0024

R-squared	0.967252	Mean dependent var	983023.7
Adjusted R-squared	0.957895	S.D. dependent var	268399.4
S.E. of regression	55074.26	Akaike info criterion	24.89169
Sum squared resid	4.25E+10	Schwarz criterion	25.14022
Log likelihood	-231.4710	F-statistic	103.3755
Durbin-Watson stat	1.384981	Prob(F-statistic)	0.000000



Right hand side variables

UNITS = total new residential units permitted
RABVRN = real average building value of new residential structures
RHP / RHPCA = ratio of real median home selling price to real median home selling price in California
RBVRTOT(-1) = dependent lag

Short Description of the Equation

Most of the variation in total building value can be explained by the variation in the components that account for new residential building value, i.e., UNITS and RABVRN. The left over variation is attributable to residential renovation and alteration permit value.

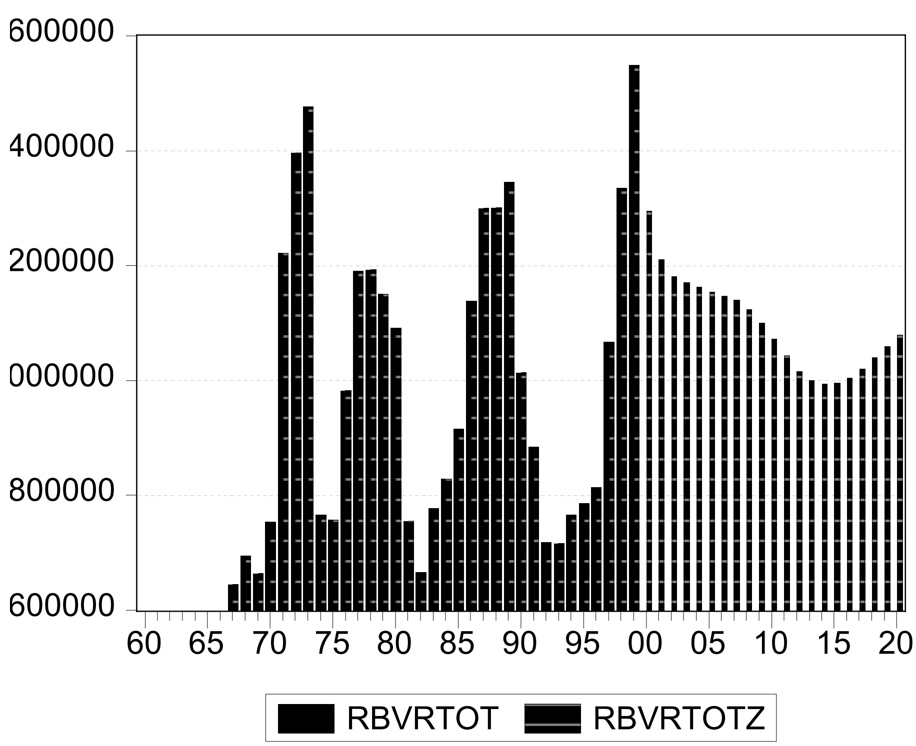
Renovation activity of existing residential structures is influenced by the value of those structures, especially that value which is extraordinary to the region. That is why the ratio of the median home price relative to the value of residential structures in the State is used in this equation.

The hypothesis that as the relative value of existing homes varies, the demand for renovation and remodel also varies in direct proportion is confirmed by the results of the estimated equation.

The dependent lag accommodates partial adjustment.

Special features

As noted previously in this report, much of the variation in total residential building value can be explained by the variation in new residential building value, UNITS*RABVRN. Those components can alternatively be added to the equation as a single explanatory variable. Either way, they necessarily explain most of the variation in the endogenous variable.



Dependent Variable: RBVNRTOT – Real Non-Residential Building Value Permitted

Method: Least Squares
Date: 03/17/00 Time: 07:15
Sample(adjusted): 1976 1999
Included observations: 24 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	365075.6	145610.5	2.507207	0.0209
(DETWS(-1)+ DETWS(-2) + DETWS(-3))/3	9169.147	3578.646	2.562183	0.0186
(RGSPCA-RGSPCA(-1)) /RGSPCA(-1)	2787634.	742100.4	3.756411	0.0012
RBVNRTOT(-1)	0.435978	0.143701	3.033924	0.0066

R-squared	0.630719	Mean dependent var	1007663.
Adjusted R-squared	0.575327	S.D. dependent var	317562.7
S.E. of regression	206945.8	Akaike info criterion	27.46931
Sum squared resid	8.57E+11	Schwarz criterion	27.66566
Log likelihood	-325.6318	F-statistic	11.38645
Durbin-Watson stat	1.946642	Prob(F-statistic)	0.000142

Right hand side variables

(DETWS(-1)+ DETWS(-2) + DETWS(-3))/3= three year moving average of new jobs created in the region
(RGSPCA-RGSPCA(-1)) /RGSPCA(-1) = percent change in gross state product
RBVNRTOT(-1)= dependent lag

Short Description of the Equation

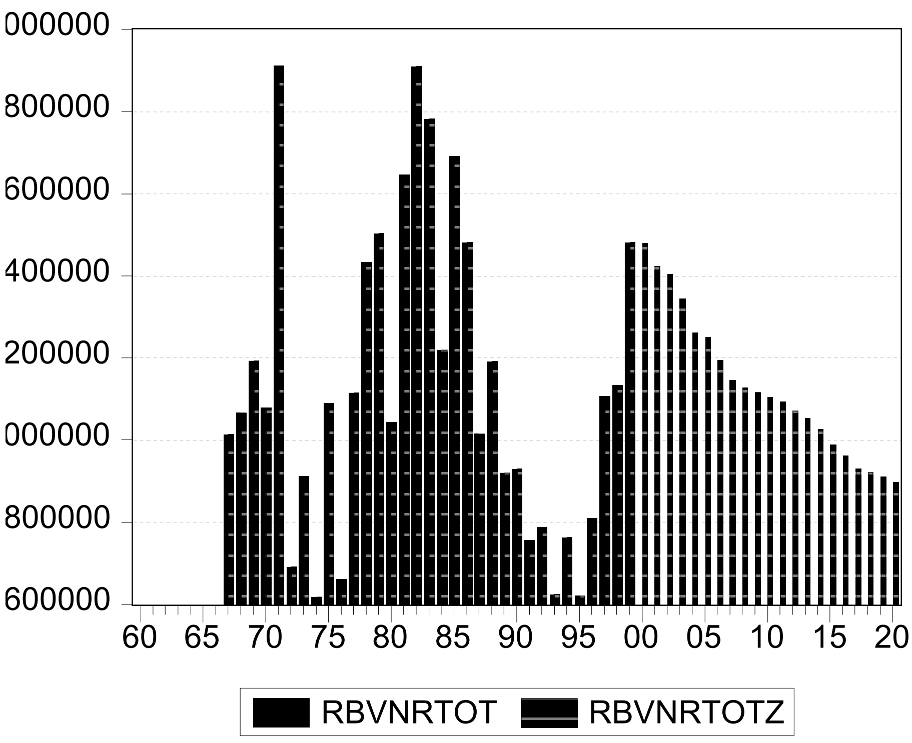
Non-residential development is directly impacted by the need for office and industrial space, i.e., vacancy conditions prevailing in the region. A surrogate for tightening vacancy is new firm creation and/or job creation. Longer-term momentum in labor market conditions also serves as a surrogate for general economic conditions prevailing in the region.

A 3-year moving average of job creation is used to surrogate the momentum in labor market growth producing a longer trend in prevailing regional economic conditions. The growth of gross state product is included to account for general economic conditions in the state, including all of the other factors that are embodied in a general statewide indicator, i.e., interest rates, access to capital, and consumer confidence.

The dependent lag accommodates partial adjustment.

Special features

None.

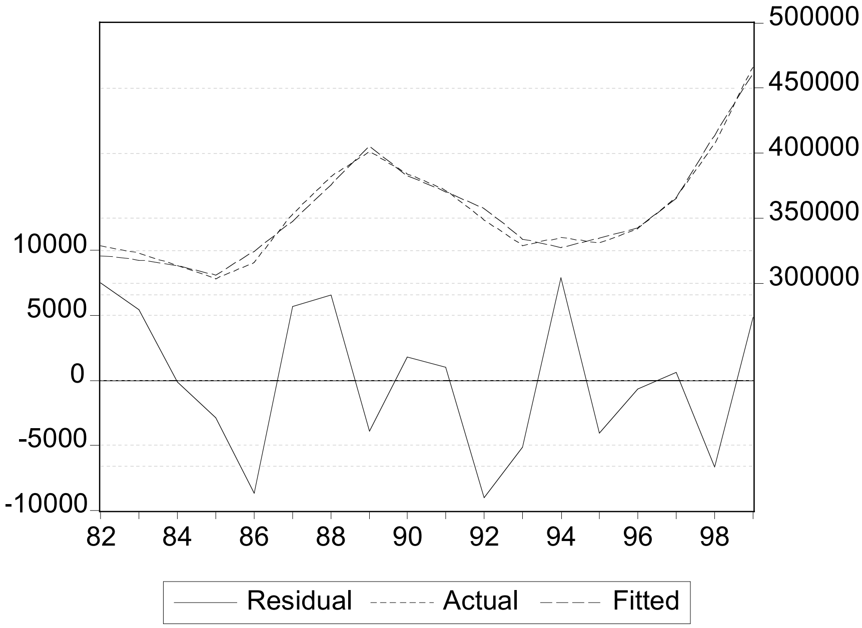


Dependent Variable: RHP – Real Median Home Selling Price

Method: Least Squares
Date: 03/17/00 Time: 07:30
Sample(adjusted): 1982 1999
Included observations: 18 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-400235.0	116254.9	-3.442737	0.0044
RHPCA	1.265926	0.359802	3.518396	0.0038
DETWS	524.1701	266.7404	1.965095	0.0711
AFFPRO	18486.88	2506.264	7.376272	0.0000
RHP(-1)	0.255996	0.254010	1.007817	0.3319

R-squared	0.993042	Mean dependent var	355532.4
Adjusted R-squared	0.963208	S.D. dependent var	41054.15
S.E. of regression	14618.50	Akaike info criterion	22.24810
Sum squared resid	2.78E+09	Schwarz criterion	22.49542
Log likelihood	-195.2329	F-statistic	30.26950
Durbin-Watson stat	0.596306	Prob(F-statistic)	0.000002



Right hand side variables

RHPCA = real median selling price, California
DETWS = new wage and salary job creation
AFFPRO = proportion of the population aged 45 to 64 = AGE4564/POPJUL
RHP(-1) = dependent lag

Short Description of the Equation

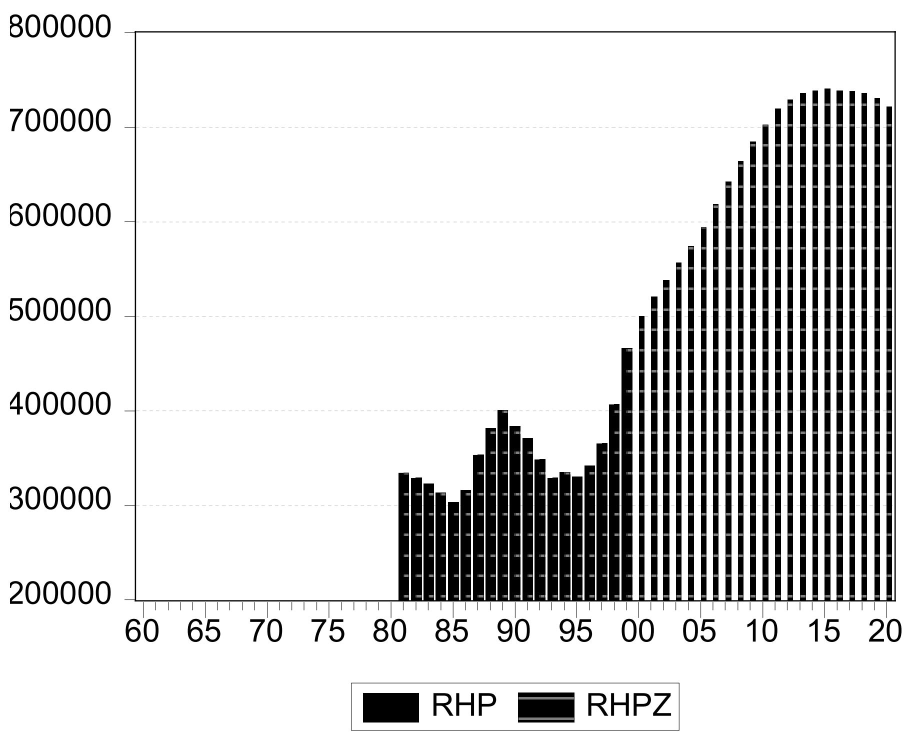
Home prices are in part, directly correlated with broader housing price trends in the State since Statewide prices embody general information about consumer demand for housing in California.

Regional factors such as the rate of new job creation directly influence the demand for local housing. Furthermore, the need for housing and the ability to finance the relatively higher prices for housing in the West Bay area are correlated with the size of the proportion of the population in its most affluent stage of life.

The dependent lag accommodates partial adjustment.

Special features

Home prices currently exceed $500,000 in Main and San Mateo Counties. Due to demand and supply conditions in the West Bay region, the forecast shows that median home selling prices will continue to rise, in tandem with Statewide median home prices (RHPCA) that rise an average of 4 percent per year over the forecast period. Real home prices plateau after 2010 and actually may decline over the long term because job growth (DETWS) diminishes in the out years of the forecast.



Employment Block

Dependent Variable: EMIN – Employment in Mining
Method: Least Squares
Date: 03/16/00 Time: 12:51
Sample(adjusted): 1973 1999
Included observations: 27 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.364177	0.072642	-5.013284	0.0000
ZROILPRE	0.030238	0.003566	8.478521	0.0000
EMIN(-1)	0.545776	0.059420	9.185127	0.0000

R-squared	0.965332	Mean dependent var	1.100000
Adjusted R-squared	0.962443	S.D. dependent var	0.787889
S.E. of regression	0.152689	Akaike info criterion	-0.816386
Sum squared resid	0.559536	Schwarz criterion	-0.672404
Log likelihood	14.02121	F-statistic	334.1442
Durbin-Watson stat	1.307964	Prob(F-statistic)	0.000000

Right hand side variables

ZROILPRE = real oil price per bbl, west Texas intermediate crude
EMIN(-1) = dependent lag

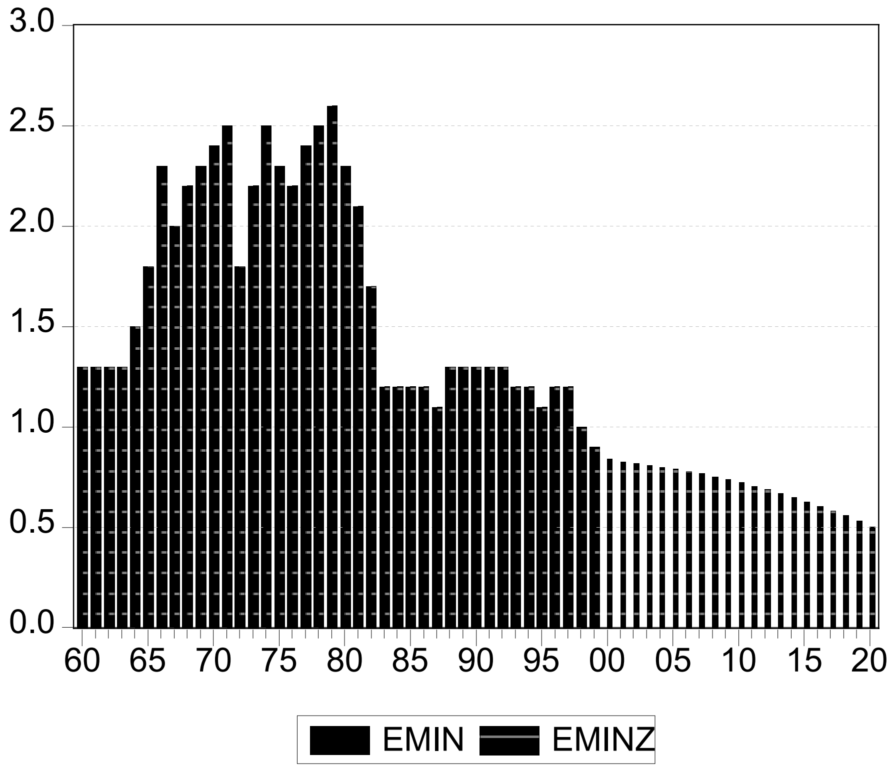
Short Description of the Equation

Mining employment is relatively unimportant in the Bay Area, largely administrative jobs associated with oil and gas extraction. Domestic oil prices proved to be an important factor explaining employment variability.

The dependent lag is included as a Koyck transformation. The Koyck specification accommodates the cumulative (distributed lag) effects oil price behavior.

Special features

none

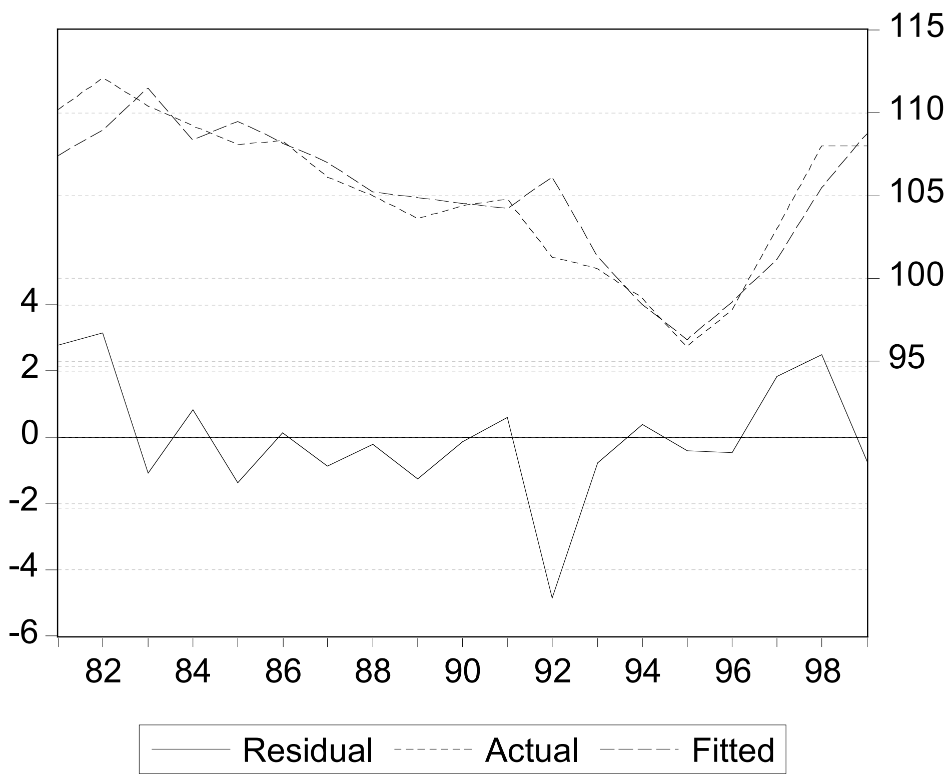


Dependent Variable: EFIRE – Employment in Finance, Insurance and Real Estate

Method: Least Squares
Date: 05/24/00 Time: 16:28
Sample(adjusted): 1981 1999
Included observations: 19 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	19.38177	16.35468	1.185090	0.2634
NIPJUL	0.000214	7.99E-05	2.679977	0.0231
UNITS(-1)	0.000825	0.000400	2.062341	0.0661
EFIRE(-1)	0.720161	0.151552	4.751901	0.0008
RHP/RHPCA	4.871538	3.503571	1.390449	0.1861

R-squared	0.868616	Mean dependent var	103.6000
Adjusted R-squared	0.816063	S.D. dependent var	3.951311
S.E. of regression	1.694635	Akaike info criterion	4.154013
Sum squared resid	28.71786	Schwarz criterion	4.390030
Log likelihood	-26.15510	F-statistic	16.52823
Durbin-Watson stat	1.701588	Prob(F-statistic)	0.000013



Right hand side variables

NIPJUL = net in-migrating population
UNITS(-1) = total residential units permitted, year ago
EFIRE(-1) = dependent lag
RHP/RHPCA = ratio of regional median home price to California median home price

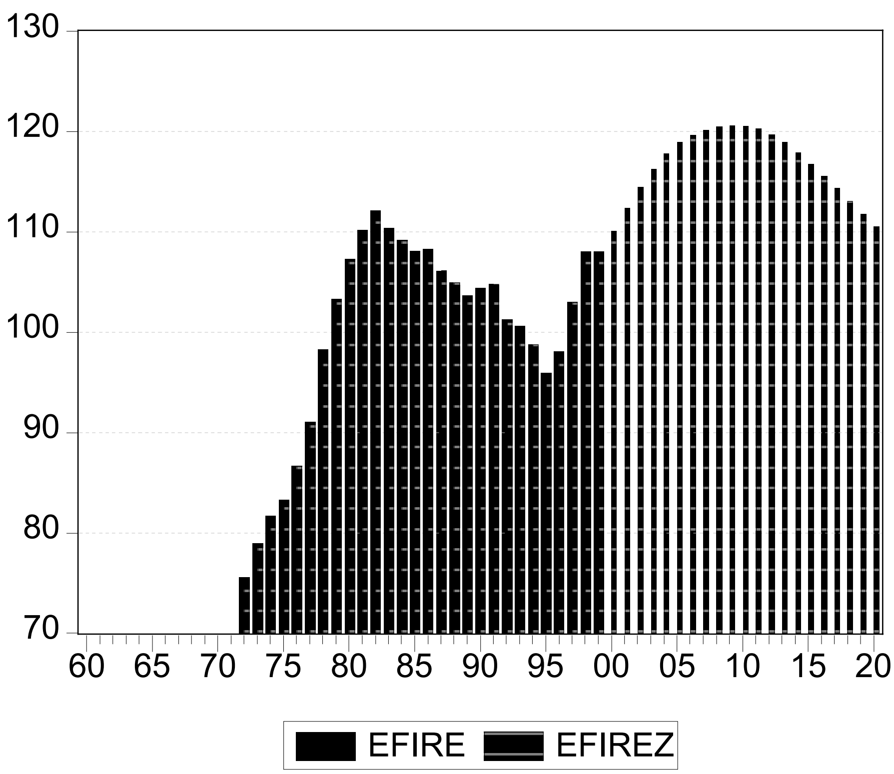
Short Description of the Equation

Finance, Insurance, and Real Estate Job demand is dependent on new housing stock, and the growth of the County by net in-migration. New in-migrants need housing and other services immediately, relative to natural population growth.

The dependent lag is included as a partial adjustment factor or a Koyck transformation. The Koyck specification accommodates the cumulative (distributed lag) effects of net migration and residential development.

Special features

none



Dependent Variable: EDUR-EDUR(-1) - Employment in Durable Manufacturing

Method: Least Squares
Date: 05/25/00 Time: 07:50
Sample(adjusted): 1982 1999
Included observations: 18 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.478559	7.572813	0.723451	0.4822
ZAAACBR(-1)	-0.392505	0.164041	-2.392720	0.0325
EDURCA-EDURCA(-1)	0.013305	0.004600	2.892487	0.0126
RHP-RHP(-1)	-9.04E-07	1.01E-05	-0.089344	0.9302
RYEPW-RYEPW(-1)	-4.48E-04	0.000143	-3.313158	0.7591

R-squared	0.710872	Mean dependent var	-0.344444
Adjusted R-squared	0.621910	S.D. dependent var	1.191747
S.E. of regression	0.732794	Akaike info criterion	2.446229
Sum squared resid	6.980833	Schwarz criterion	2.693555
Log likelihood	-17.01606	F-statistic	7.990699
Durbin-Watson stat	1.557391	Prob(F-statistic)	0.001766

Right hand side variables

ZAAACBR(-1) = Moody's AAA Corporate Bond Rate Yield
EDURCA = employment in durable manufacturing, California
EDUR(-1) = lag of employment in durable manufacturing
RHP = real median home selling price
RYEPW = real wage and salary or "earnings per worker"

Short Description of the Equation

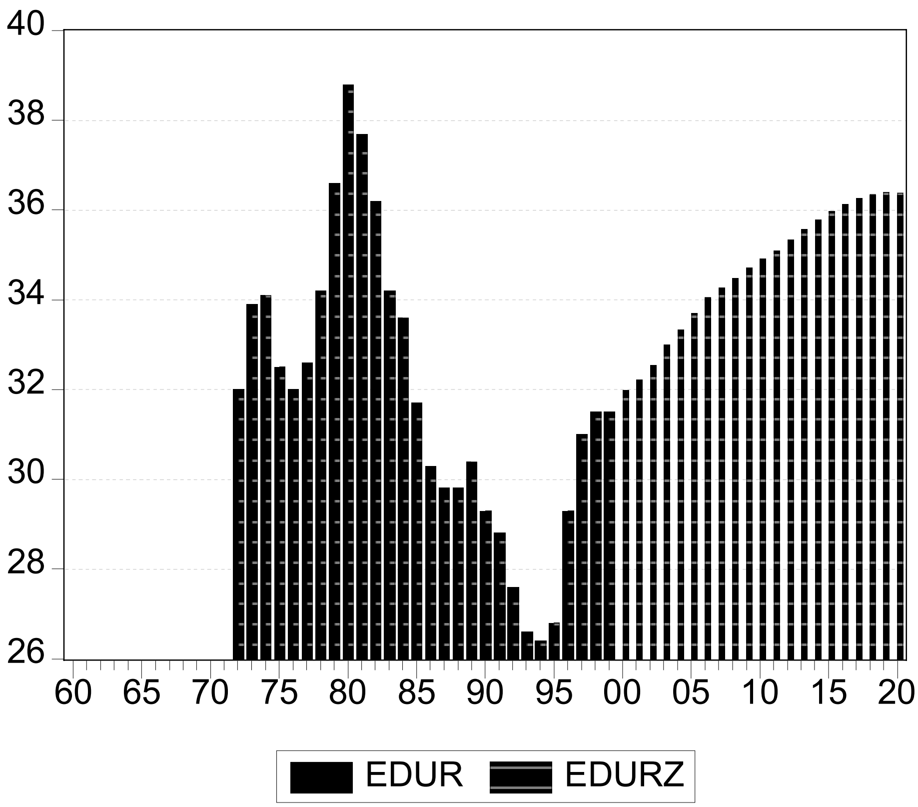
Durable manufacturing in the West Bay area follows the general trend of durable manufacturing in the State. However, interest rates---in this case the conventional corporate bond yield rate---representing the general cost of equipment and venture capital, was found to influence the industry in an incremental fashion, vis a vis Statewide durable manufacturing.

Home prices and real wage rates in the region were included as part of the inverse production function relationship.

Special features

Due to non-stationarity, the equation had to be estimated as a first difference. Real wages were fond to be statistically significant and to produce a more reasonable forecast of austere employment growth in the Bay Area over the long term.

In the West Bay region, home prices are the highest in the State of California. This cost represents a barrier to entry into the region by many workers. Home prices were empirically found to contain the forecast in the out years, and produce a slightly better fit over the estimation history.

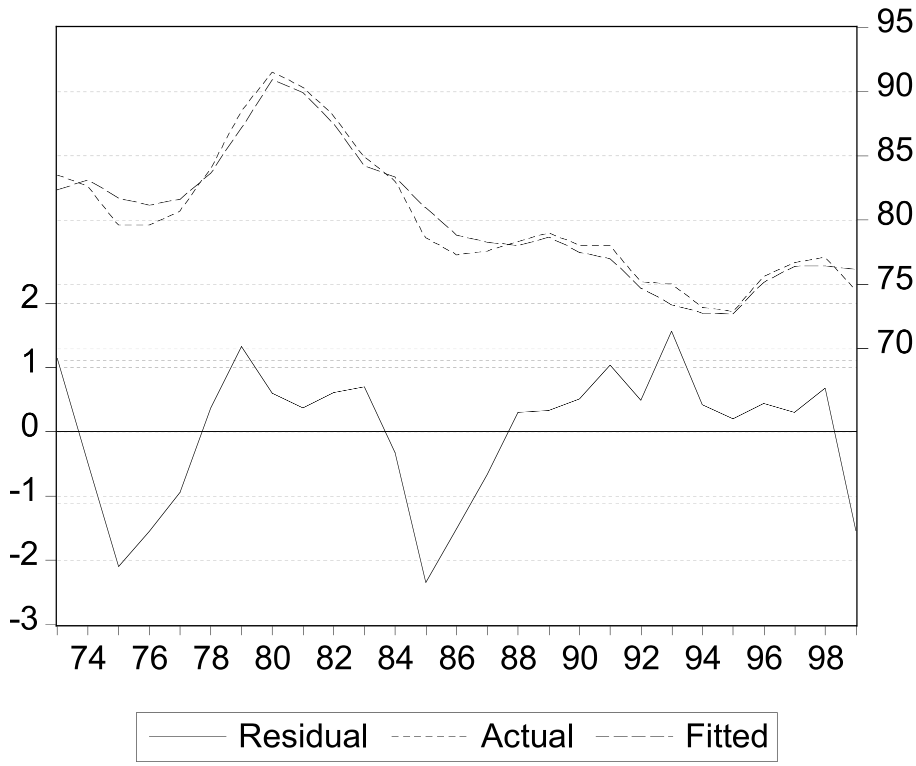


Dependent Variable: EMFG – Employment in all Manufacturing

Method: Least Squares
Date: 05/25/00 Time: 08:03
Sample(adjusted): 1973 1999
Included observations: 27 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	60.76304	6.910762	8.792523	0.0000
EDUR	1.174440	0.084486	13.90106	0.0000
RCROP	7.44E-09	6.51E-09	1.142525	0.2650
RYEPW	-0.000478	9.55E-05	-4.999831	0.0000

R-squared	0.958487	Mean dependent var	80.12593
Adjusted R-squared	0.953072	S.D. dependent var	5.129147
S.E. of regression	1.111121	Akaike info criterion	3.184570
Sum squared resid	28.39558	Schwarz criterion	3.376546
Log likelihood	-38.99170	F-statistic	177.0132
Durbin-Watson stat	0.881075	Prob(F-statistic)	0.000000



Right hand side variables

EDUR = employment in durable manufacturing
RCROP = real farm crop value
RYEPW = real wage and salary or “earnings per worker”

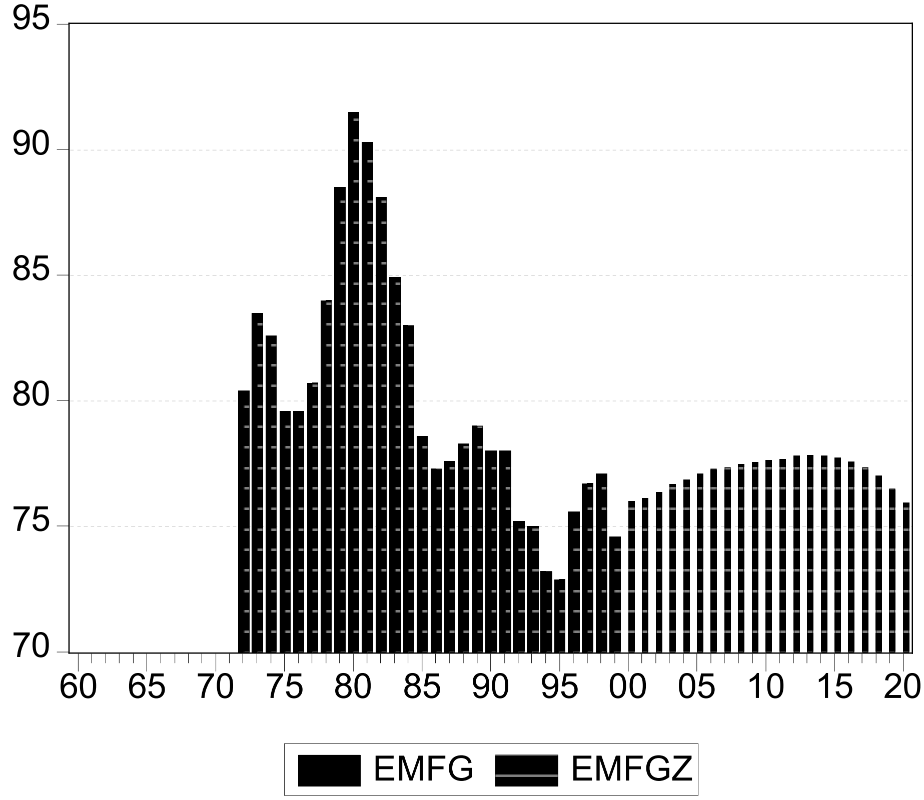
Short Description of the Equation

Nearly 70 percent of total manufacturing employment in the Bay Area is durable manufacturing. Hence, it's dominance in the equation explaining all manufacturing in the region. The non-durable component is explained by agricultural crop value, since indigenous food manufacturing comprises the principal sector of non-durable manufacturing in the region.

Real wage rates in the region were included as part of the inverse production function relationship. As hypothesized, they are negatively correlated with manufacturing employment demand.

Special features

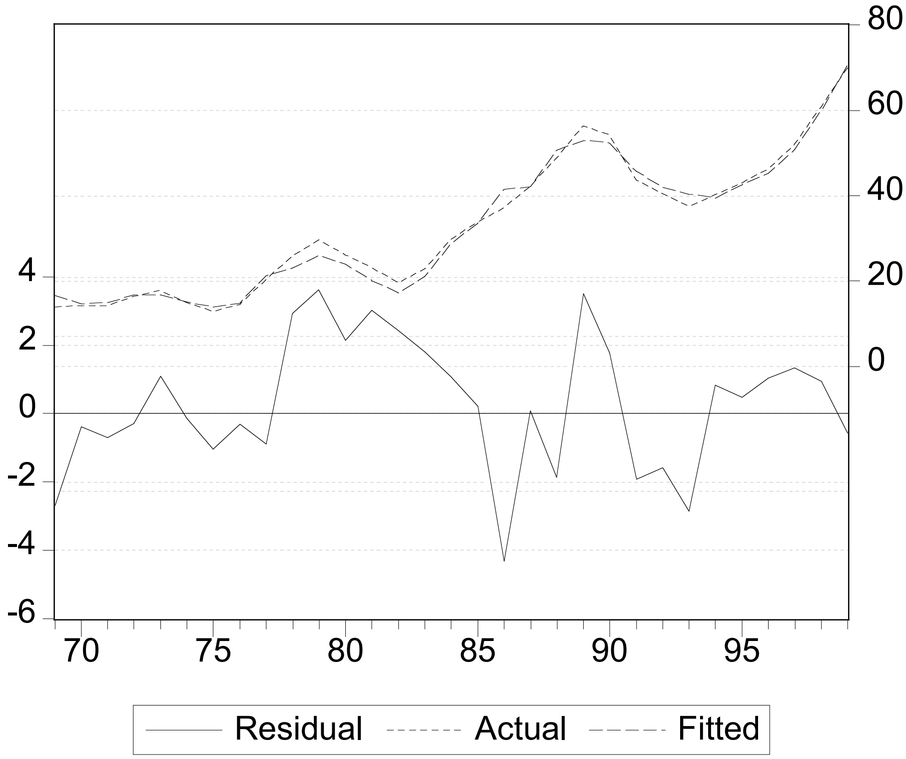
None.



Dependent Variable: ECON – Employment in Construction
Method: Least Squares
Date: 04/11/00 Time: 16:37
Sample(adjusted): 1983 1999
Included observations: 17 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	145.4100	22.62999	6.425542	0.0000
HMRLA(-1)	-0.724973	0.392415	-1.847466	0.0895
RBVTOT	2.29E-06	3.34E-07	6.849626	0.0000
WAGERAT	-155.6913	27.45963	-5.669826	0.0001
ECON(-1)	0.527808	0.078927	6.687273	0.0000

R-squared	0.971695	Mean dependent var	44.66471
Adjusted R-squared	0.962260	S.D. dependent var	11.64624
S.E. of regression	2.262481	Akaike info criterion	4.710729
Sum squared resid	61.42582	Schwarz criterion	4.955792
Log likelihood	-35.04120	F-statistic	102.9892
Durbin-Watson stat	1.775242	Prob(F-statistic)	0.000000



Right hand side variables

HMRLA(-1) = effective home mortgage rate, lagged 1 year
RBVTOT = real total investment in both residential and non-residential building
WAGERAT = ratio of average wage and salary to average wage and salary in California
ECON(-1) = dependent lag

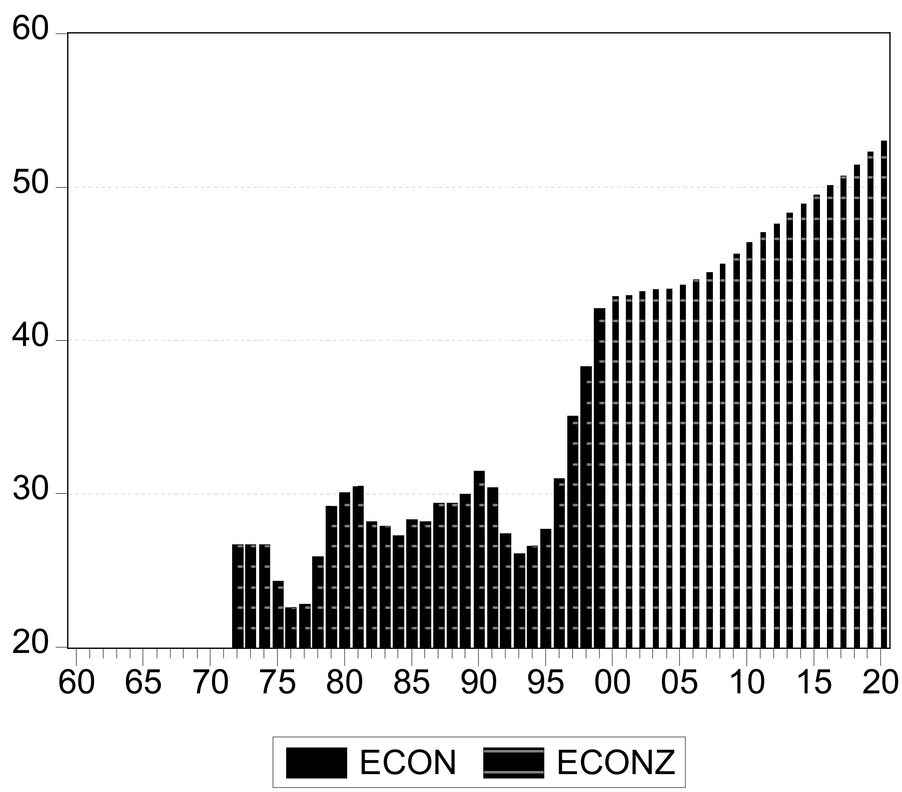
Short Description of the Equation

The inverse production function drives the empirical specification of the equation. The demand for construction employment is inversely related to higher costs, that is, higher mortgage rates and higher labor costs, represented by the relative labor unit cost ratio. Employment is directly influenced by output, in this case, residential and non-residential building permit valuation.

The dependant lag enables partial adjustment. This is especially important in contract construction where building projects, presented by permit activity, can span multiple years.

Special features

None.

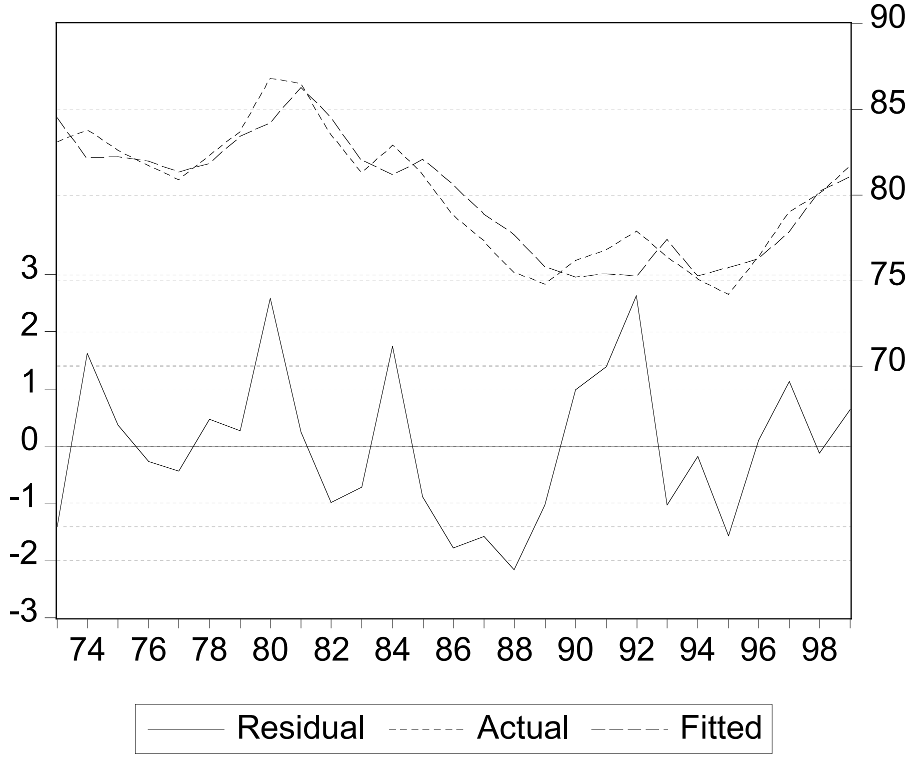


Dependent Variable: ETPU – Employment in Transportation Communications and Public Utilities

Method: Least Squares
Date: 03/16/00 Time: 12:32
Sample(adjusted): 1973 1999
Included observations: 27 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.334911	11.66893	-0.028701	0.9774
EMFG-EMFG(-1)	0.218609	0.151501	1.442955	0.1631
ESERV-ESERV(-1)	0.090126	0.069580	1.295291	0.2086
ETPU(-1)	0.958219	0.102460	9.352122	0.0000
RQRS	2.03E-07	3.49E-07	0.582404	0.5662

R-squared	0.870591	Mean dependent var	80.01852
Adjusted R-squared	0.847062	S.D. dependent var	3.607368
S.E. of regression	1.410746	Akaike info criterion	3.691690
Sum squared resid	43.78446	Schwarz criterion	3.931659
Log likelihood	-44.83781	F-statistic	37.00078
Durbin-Watson stat	1.545780	Prob(F-statistic)	0.000000



Right hand side variables

EMFG-EMFG(-1)= change in manufacturing employment
ESERV-ESERV(-1) = change in service sector employment
RQRS = real retail sales
ETPU(-1)= dependent lag

Short Description of the Equation

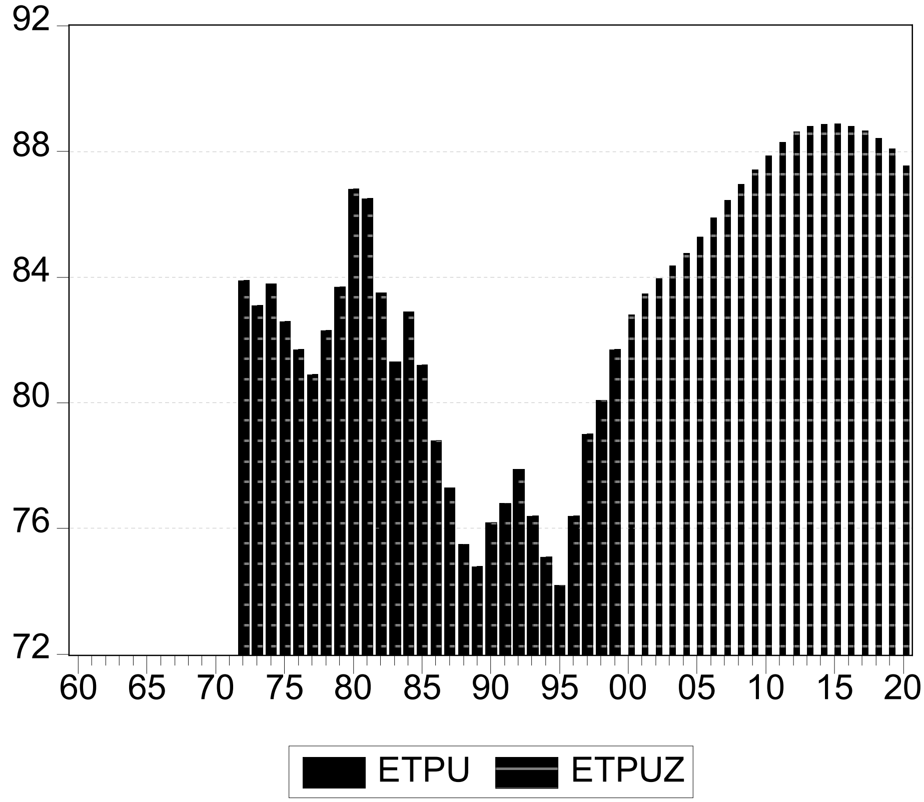
Basic sector employment—manufacturing and services—directly influences support sector employment, in this case, in the transportation, communication, and public utility sectors. A change is used to reduce the effects of multicolinearity and scale in the equation.

Retail sales provide a proxy for the extent of all consumer spending in the regional economy. It is assumed that consumer spending on measurable retail goods varies directly with consumer spending on transportation services, communications services, and infrastructure.

The dependant lag enables partial adjustment. This is important in a support sector where multiplier effects from the basic sector activity occur over a number of years.

Special features

None. The dependant lag is quite large, indicating that the response time of the support industry in the region to changes in the basic industry is spread over many years.

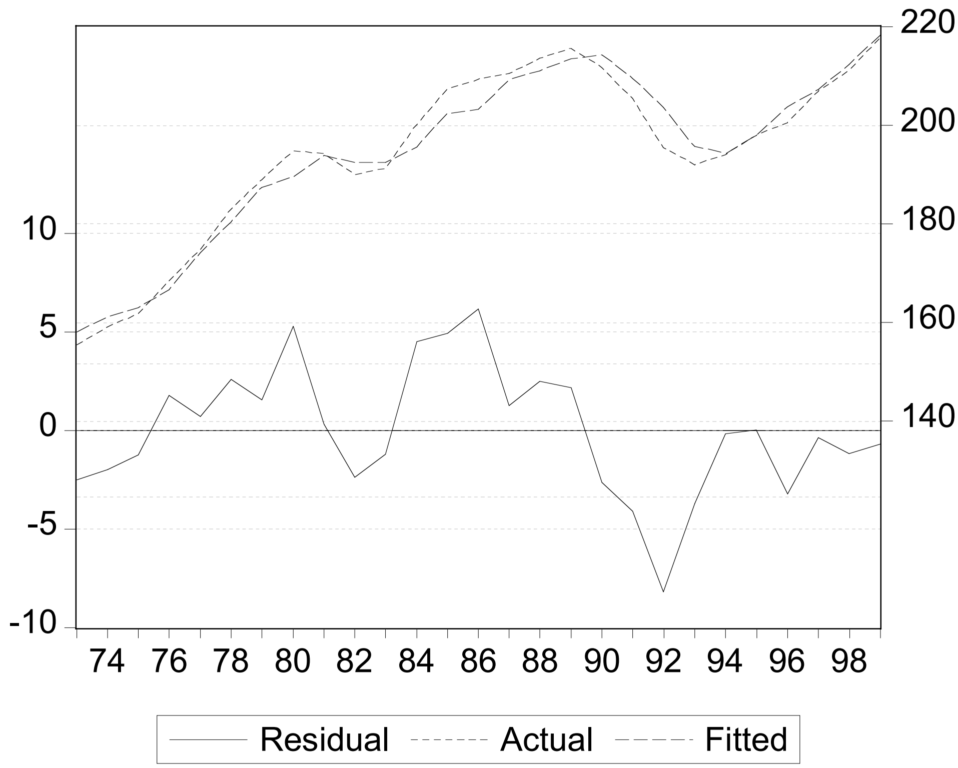


Dependent Variable: ETRADE – Employment in Retail and Wholesale Trade

Method: Least Squares
Date: 03/16/00 Time: 12:40
Sample(adjusted): 1973 1999
Included observations: 27 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-644.1995	158.2249	-4.071418	0.0004
LOG(RQRS)	42.19775	10.01902	4.211764	0.0003
ETRADE(-1)	0.753585	0.049326	15.27774	0.0000

R-squared	0.966157	Mean dependent var	194.4963
Adjusted R-squared	0.963337	S.D. dependent var	17.57552
S.E. of regression	3.365308	Akaike info criterion	5.369355
Sum squared resid	271.8072	Schwarz criterion	5.513337
Log likelihood	-69.48630	F-statistic	342.5765
Durbin-Watson stat	0.798735	Prob(F-statistic)	0.000000



Right hand side variables

LOG(RQRS) = natural log of real retail sales
ETRADE(-1)= dependent lag

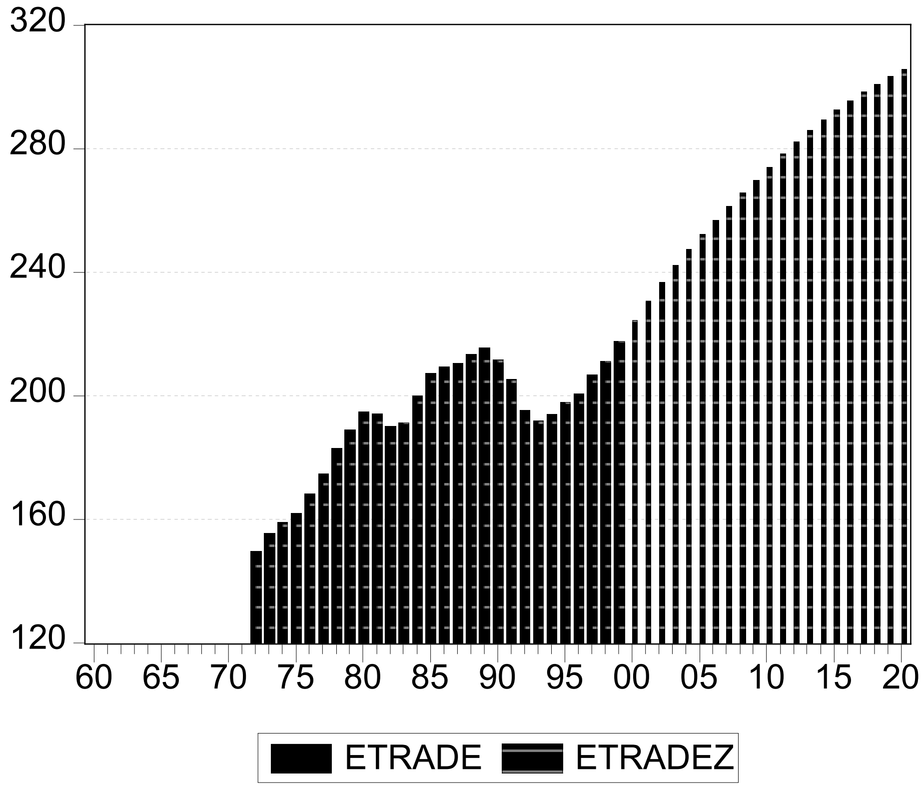
Short Description of the Equation

Basic economic theory explains this simple specification: labor demand is a function of output, drawn directly from the inverse production function theoretical design.

The dependant lag enables partial adjustment over time.

Special features

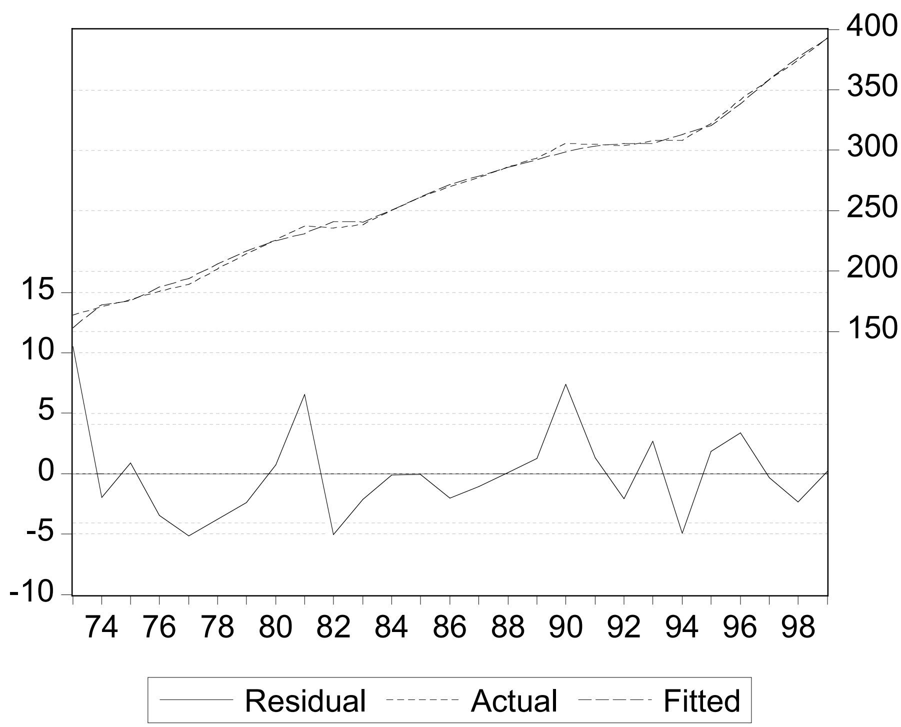
The log linear functional form of the relationship between employment and sales is consistent with recent trends in the industry toward larger size-higher volume retail establishments. Because the retail industry now operates on lower cost and at lower margins, the trend has clearly been toward higher sales per worker.



Dependent Variable: ESERV – Employment in Services
Method: Least Squares
Date: 04/18/00 Time: 12:04
Sample(adjusted): 1973 1999
Included observations: 27 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2132.104	212.7094	-10.02355	0.0000
LOG(AGE4564)	95.26814	59.13539	1.611017	0.1214
LOG(RYPPCCA)	129.2520	25.53739	5.061284	0.0000
LOG(ESERV(-1))	209.1755	20.53914	10.18424	0.0000
LOG(AGE0517)	40.98083	41.17449	0.995297	0.3304

R-squared	0.996551	Mean dependent var	266.4444
Adjusted R-squared	0.995924	S.D. dependent var	63.90840
S.E. of regression	4.079965	Akaike info criterion	5.815630
Sum squared resid	366.2145	Schwarz criterion	6.055600
Log likelihood	-73.51100	F-statistic	1589.337
Durbin-Watson stat	1.708218	Prob(F-statistic)	0.000000



Right hand side variables

LOG(AGE4564)= natural log of real retail sales
LOG(RYPPCCA) = natural log of real per capita persona income, California
LOG(ESERV(-1) = natural log of dependent lag
LOG(AGE0517) = natural log of population aged 5 to 17

Short Description of the Equation

The large and affluent 45 to 64 year old age cohort of the Bay Area population imparted a very significant influence on the service sector. Residents in that age group demand most of the services and have driven the growth of the sector over time.

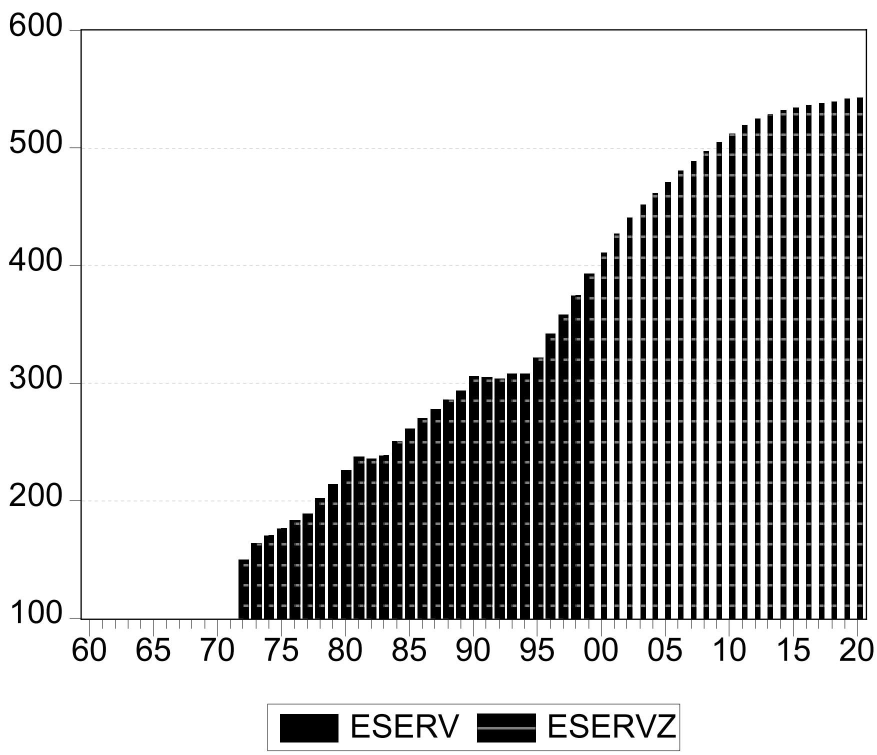
Per capita income of Californians is a proxy for the wealth of visitors to the area, and the attendant variation of the service sector explained by tourism in the Bay Area.

The school age population was included into the equation to control for special services provided 5 to 17 year olds, such as private education services, more concentrated in the Bay Area than other regions of the State, and recreation services.

The dependant lag enables partial adjustment over time.

Special features

The semi-log functional form of the relationship provided the best historical fit of services employment to the explanatory variables. That relationship implies that the growth rate of service sector jobs diminishes over time with the growth of the causal factors.

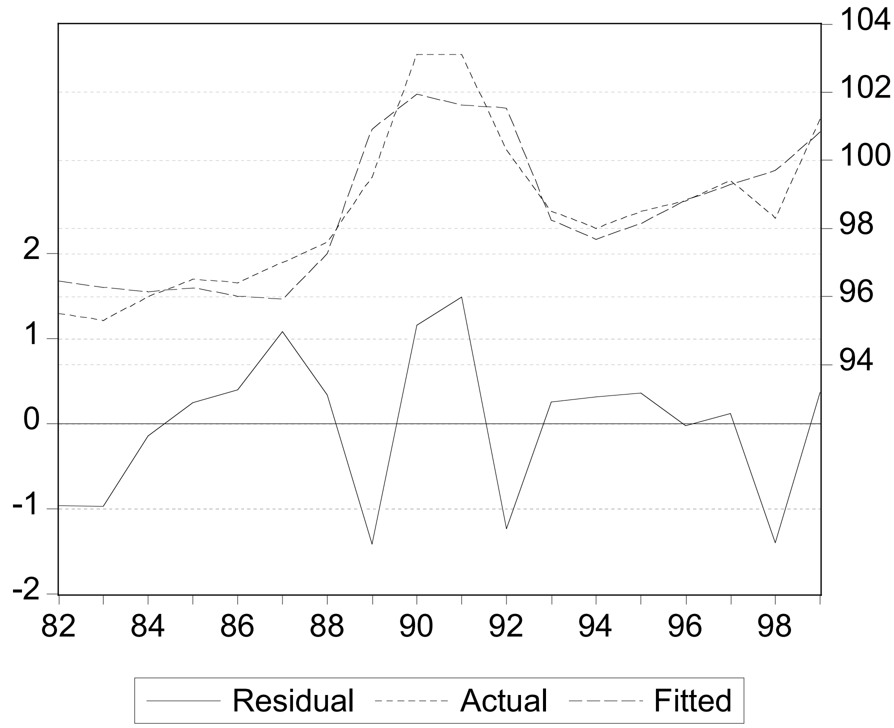


Dependent Variable: ESLG – Employment in State & Local Government

Method: Least Squares
Date: 04/18/00 Time: 08:05
Sample(adjusted): 1982 1999
Included observations: 18 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	84.05638	4.367953	19.24388	0.0000
RQRS(-1)	1.69E-07	3.39E-07	0.499652	0.6257
RHP(-1)	3.18E-05	1.36E-05	2.343329	0.0357
AGE0517-AGE0517(-1)	0.000156	5.55E-05	2.800233	0.0150
DUM8992	2.585285	0.826151	3.129314	0.0080

R-squared	0.860444	Mean dependent var	98.50000
Adjusted R-squared	0.817503	S.D. dependent var	2.326320
S.E. of regression	0.993795	Akaike info criterion	3.055561
Sum squared resid	12.83917	Schwarz criterion	3.302887
Log likelihood	-22.50005	F-statistic	20.03812
Durbin-Watson stat	2.090598	Prob(F-statistic)	0.000018



Right hand side variables

RQRS(-1)= real retail sales, 1 year lag
RHP(-1)= real median home price, 1 year lag
AGE0517-AGE0517(-1) = 1 year change in population, aged 5 to 17
DUM8992 = binary variable for 1989-1992 period: 1989-92 = 1; 0 otherwise

Short Description of the Equation

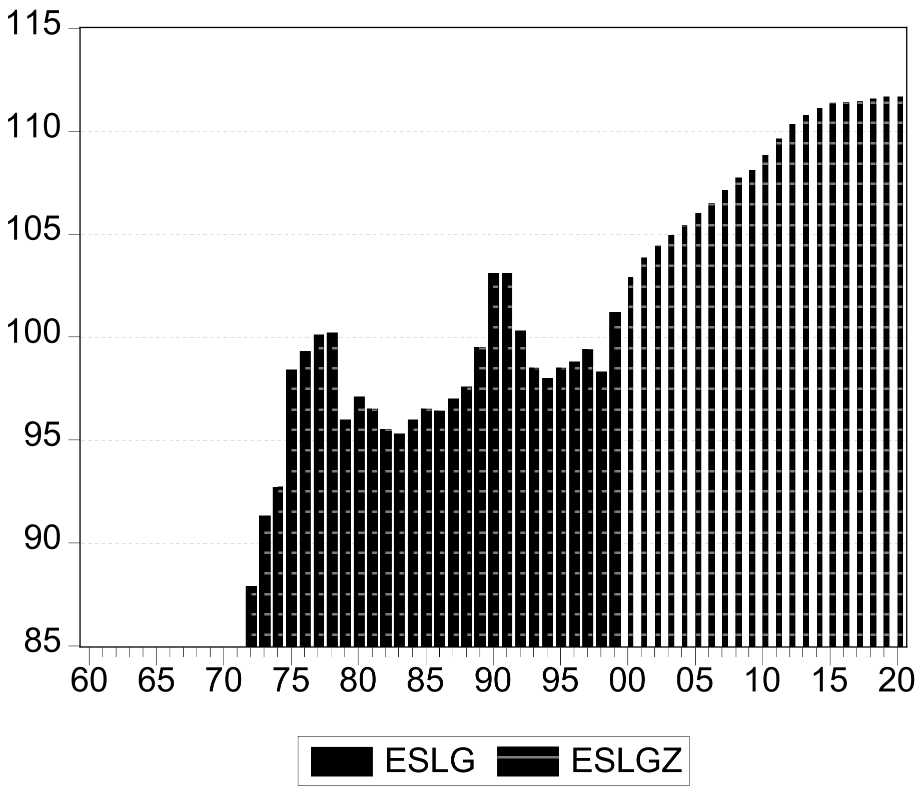
Principal economic revenue sources for local government, retail sales taxes and property taxes, enter into the equation through strong proxy variables (RQRS, and RHP) with a sufficient lag (1 year).

The student population directly affects local public sector employment that is associated with the K-12 schools. In the San Francisco region, as in virtually all areas of California, the majority of Sate and Local government workers are faculty, staff, and administrators of local K-12 school systems.

The dummy variable is added to compensate for an extraordinary temporary increase in public sector employment occurring between 1989 and 1992. This increase was probably special project or state budget related.

Special features

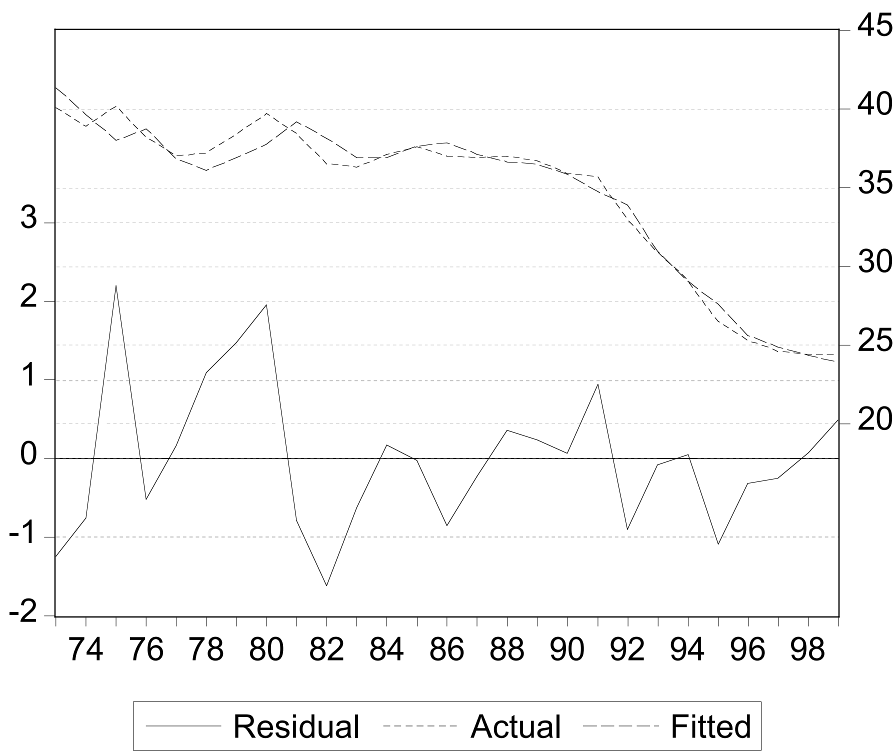
The change in school age population produced the most statistically desirable results in the estimated equation (as opposed to the level), indicating that employment increases in the schools are impacted by incremental student growth rather than magnitude.



Dependent Variable: EFG – Employment in Federal Government
Method: Least Squares
Date: 04/18/00 Time: 10:54
Sample(adjusted): 1973 1999
Included observations: 27 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	33.43832	12.27348	2.724438	0.0121
EFG(-1)	0.876594	0.055329	15.84328	0.0000
EAEROCA	0.014372	0.004137	3.474379	0.0021
CPISF / ZCPI	-33.31695	11.94387	-2.789461	0.0104

R-squared	0.968714	Mean dependent var	34.55556
Adjusted R-squared	0.964633	S.D. dependent var	5.236582
S.E. of regression	0.984800	Akaike info criterion	2.943197
Sum squared resid	22.30611	Schwarz criterion	3.135173
Log likelihood	-35.73316	F-statistic	237.3818
Durbin-Watson stat	1.630875	Prob(F-statistic)	0.000000



Right hand side variables

EAEROCA = employment in aerospace, California
CPISF / ZCPI = ratio of local consumer price index to national consumer price index
EFG(-1) = dependent lag

Short Description of the Equation

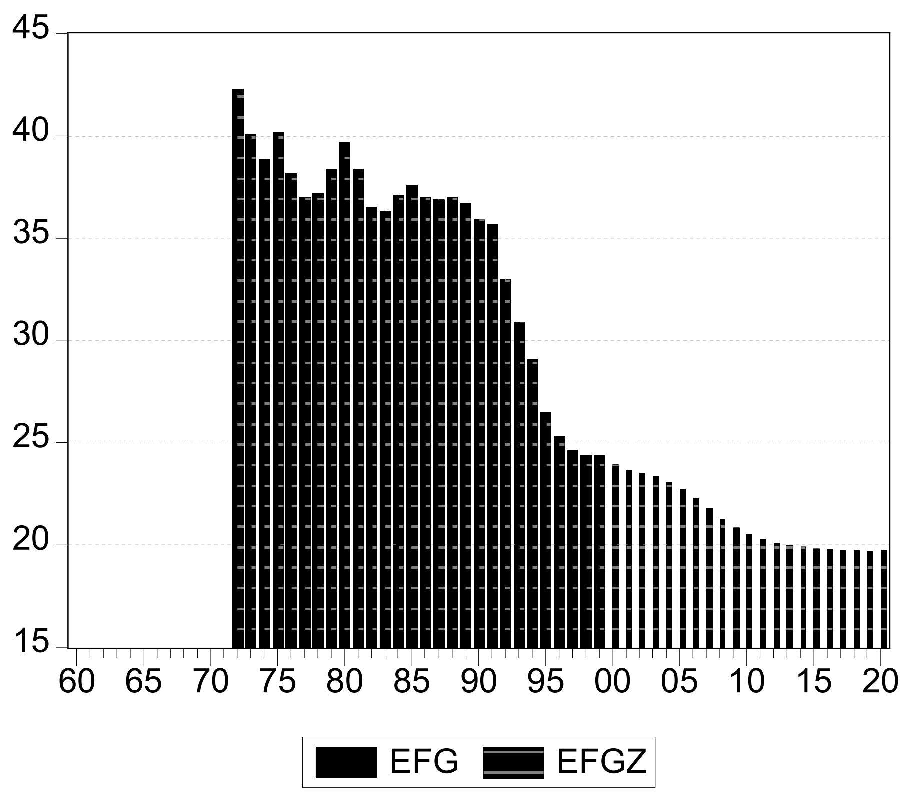
Downsizing of the private sector defense industry in California is assumed to occur hand-in-hand with federal military and civilian downsizing. The federal civilian employment in the Bay Area was largely defense related (i.e., the presidio and other base closures in the region).

Federal government employment is also downsized in higher cost areas due to wages and housing costs. The price ratio was introduced to capture the higher cost Bay Area location decisions that impact federal operations.

The dependent lag reflects the Koyck transformation of the specification.

Special features

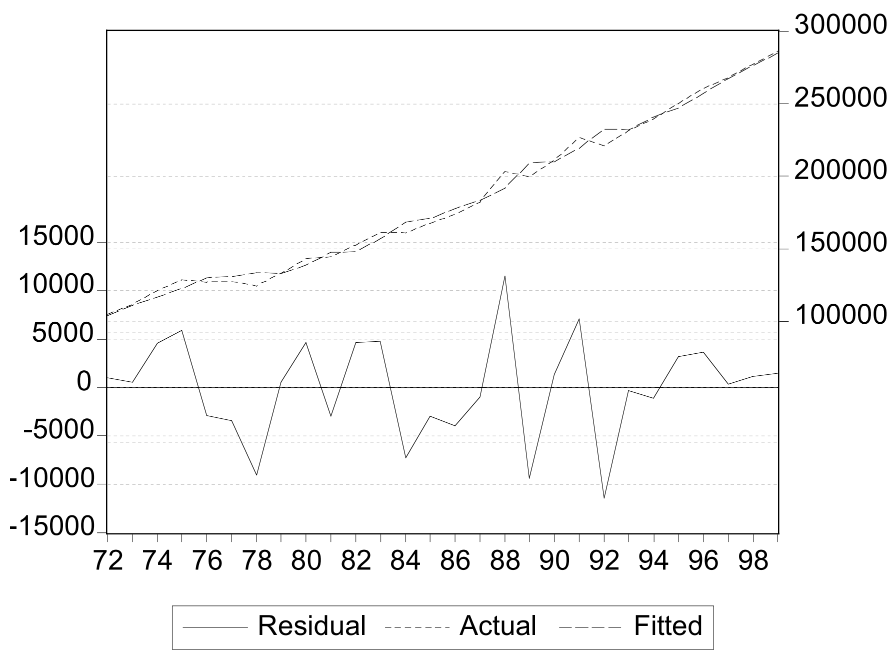
None.



Dependent Variable: EPROP – Proprietor Employment
Method: Least Squares
Date: 05/26/00 Time: 11:44
Sample(adjusted): 1972 1999
Included observations: 28 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-148671.7	86224.48	-1.724241	0.0981
AGE1824+AGE2544+ AGE4564-ETWS	0.223907	0.122662	1.825394	0.0810
URCA	1083.882	1583.345	0.684552	0.5005
ZUR	-2415.423	1935.240	-1.248126	0.2245
EPROP(-1)	0.699965	0.177158	3.951069	0.0006

R-squared	0.991004	Mean dependent var	183468.2
Adjusted R-squared	0.989440	S.D. dependent var	55404.67
S.E. of regression	5693.474	Akaike info criterion	20.29246
Sum squared resid	7.46E+08	Schwarz criterion	20.53035
Log likelihood	-279.0945	F-statistic	633.4576
Durbin-Watson stat	2.371189	Prob(F-statistic)	0.000000



Right hand side variables

AGE1824 = population aged 18 to 24
AGE2544 = population aged 25 to 44
AGE4564 = population aged 45 to 64
ETWS = total wage and salary employment
URCA = unemployment rate, California
ZUR = unemployment rate, U.S.
EPROP(-1)= dependent lag

Short Description of the Equation

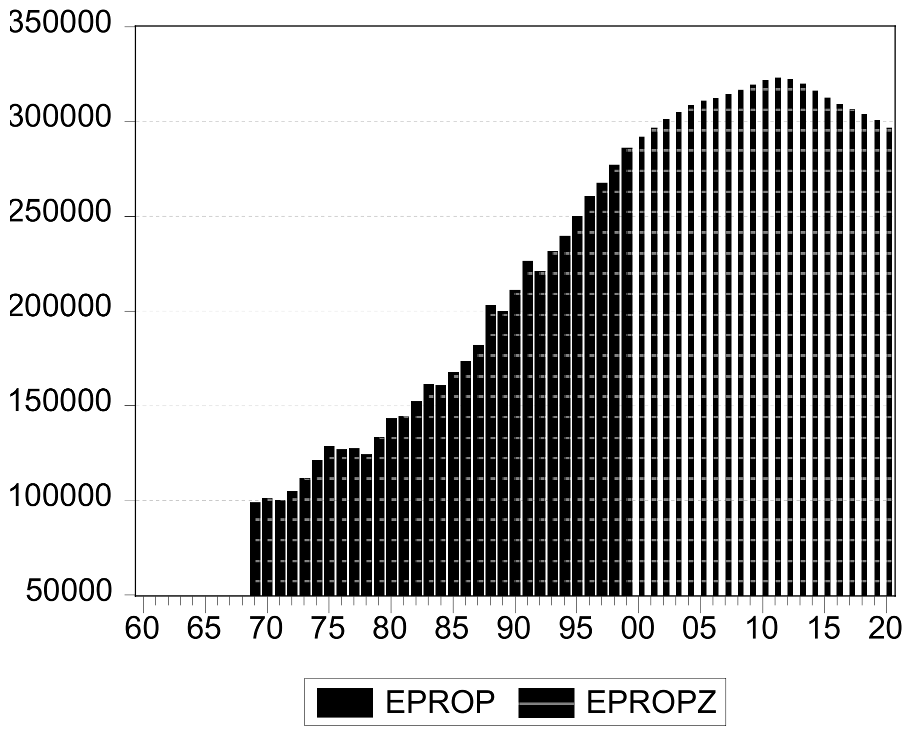
The labor force aged population that is not in the traditional wage and salary employment sector is the candidate population for self-employment. The sum of the population cohorts that comprise the labor force eligible population, less total wage and salary employment, yield the candidate population that become proprietors.

Both unemployment rates associated with California and the U.S. provide influence on the decision to accept proprietorship opportunities in the region. Statewide unemployment variations can push idled wage and salary workers into or out of self-employment. Broader national economic cycles will also influence the decision to become self-employed but in the opposite direction as the State economic cycle, providing they differ.

The dependent lag is included to accommodate partial adjustment.

Special features

None.



Demographic Block

Dependent Variable: NIPJUL – Net In-migrating Population
Method: Least Squares
Date: 04/18/00 Time: 11:27
Sample(adjusted): 1975 1999
Included observations: 25 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-52150.38	21215.18	-2.458163	0.0232
DETWS(-1) + DETWS(-2)	42.74142	40.70622	1.049997	0.3062
RHPCA	-0.123133	0.055747	-2.208764	0.0390
RYPPC/RYPPCCA	58.72307	17.01114	3.452035	0.0025
NIPJUL(-1)	0.100290	0.197391	0.508079	0.6170

R-squared	0.610671	Mean dependent var	4792.000
Adjusted R-squared	0.532805	S.D. dependent var	7959.696
S.E. of regression	5440.585	Akaike info criterion	20.21802
Sum squared resid	5.92E+08	Schwarz criterion	20.46179
Log likelihood	-247.7252	F-statistic	7.842603
Durbin-Watson stat	1.635066	Prob(F-statistic)	0.000569

Right hand side variables

DETWS(-1) + DETWS(-2) = job creation over the last 2 years
RHPCA = real median home price, California
RYPPC / RYPPCCA = ratio of real per capita personal income in region to California
NIPJUL(-1) = dependent lag

Short Description of the Equation

Economic forces are principal factors affecting net migration into a region. Job opportunities directly correlate with net migration, especially if the resident population is unable to fill those jobs.

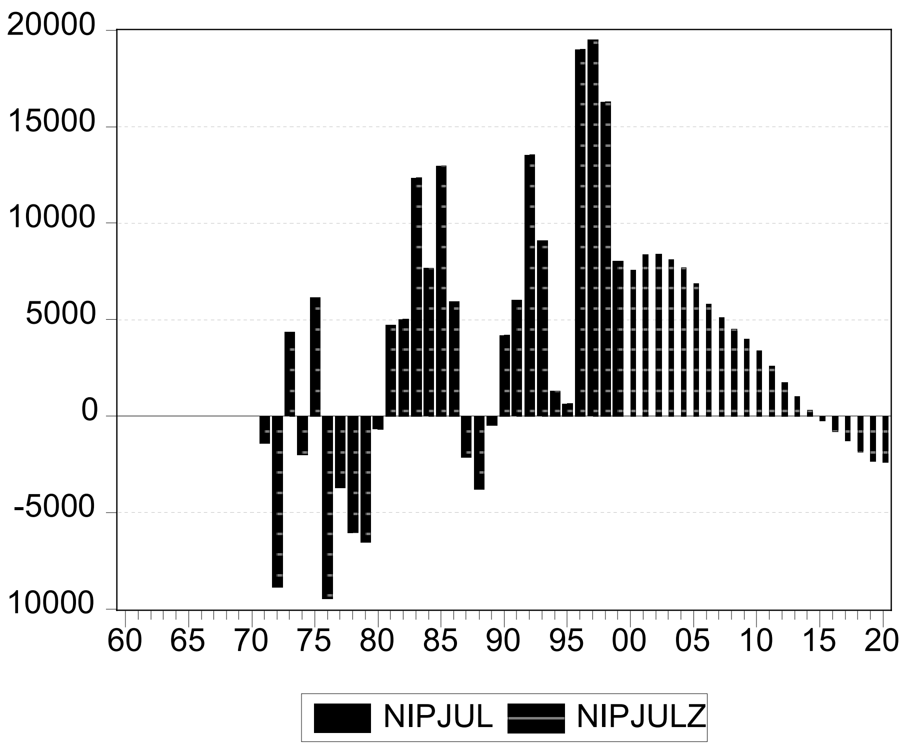
The overall statewide median home price acts as a discouraging factor to new migrants into the state, and high home prices discourage interstate in-migration.

The relative affluence of the region works as a strong regional attraction of those migrants moving from other counties in the State or from other States.

The dependent lag is included to accommodate partial adjustment.

Special features

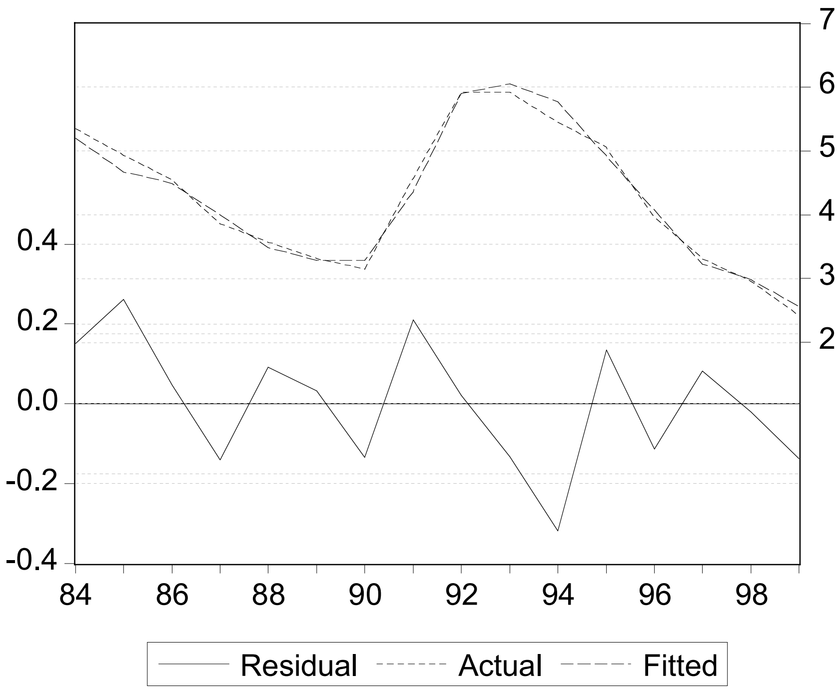
None. The forecast of job growth slows in the out years. Together with high forecasted home prices, net migration is forecast to turn negative in 2015 and thereafter.



Dependent Variable: UR – Unemployment Rate
Method: Least Squares
Date: 03/16/00 Time: 15:02
Sample(adjusted): 1984 1999
Included observations: 16 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.372616	0.312485	1.192430	0.2561
URCA	0.314070	0.057033	5.506801	0.0001
DETWS	-0.024351	0.003691	-6.596788	0.0000
UR(-1)	0.437008	0.057961	7.539736	0.0000

R-squared	0.979681	Mean dependent var	4.266299
Adjusted R-squared	0.974601	S.D. dependent var	1.101678
S.E. of regression	0.175575	Akaike info criterion	-0.429188
Sum squared resid	0.369917	Schwarz criterion	-0.236040
Log likelihood	7.433501	F-statistic	192.8593
Durbin-Watson stat	1.965036	Prob(F-statistic)	0.000000



Right hand side variables

URCA = unemployment rate, California
DETWS = new wage and salary job creation
UR(-1) = dependent lag

Short Description of the Equation

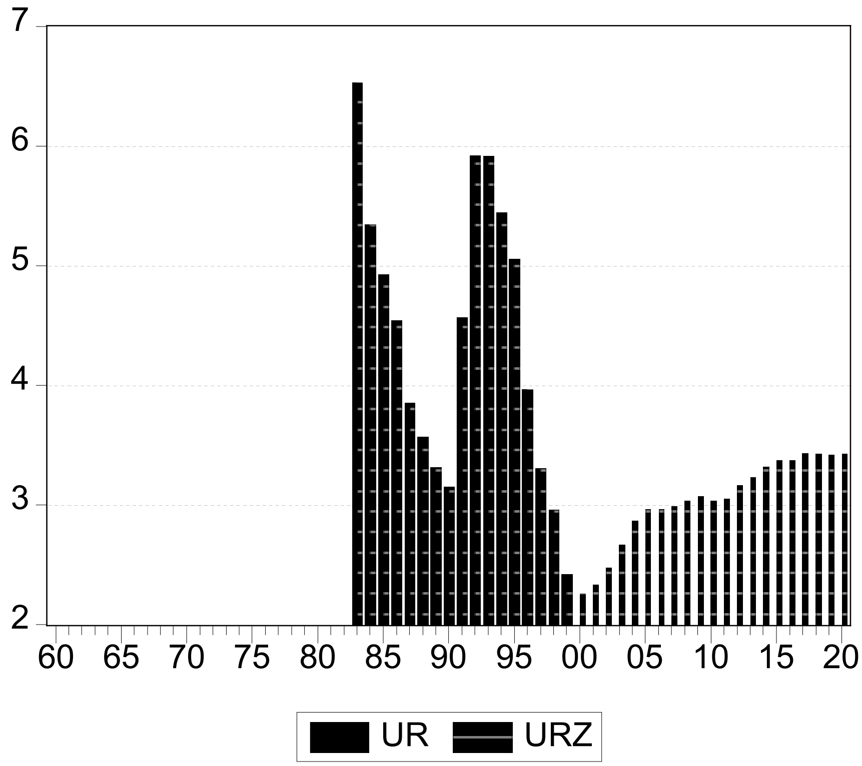
The unemployment rate in the region follows labor market tightness or slackness in the state, due to labor mobility within the State.

Job creation in the region will not necessarily cause the unemployment rate to fall, though it virtually always does. More local job creation is nearly analogous to reducing the resident pool of unemployed workers; hence the decline in the unemployment rate.

The dependent lag is included to accommodate partial adjustment of the unemployment rate over time. The relatively free mobility of labor does not imply that workers adjust to labor market conditions instantaneously, especially interregional ones where a household move is required, or other delays affect rapid transition.

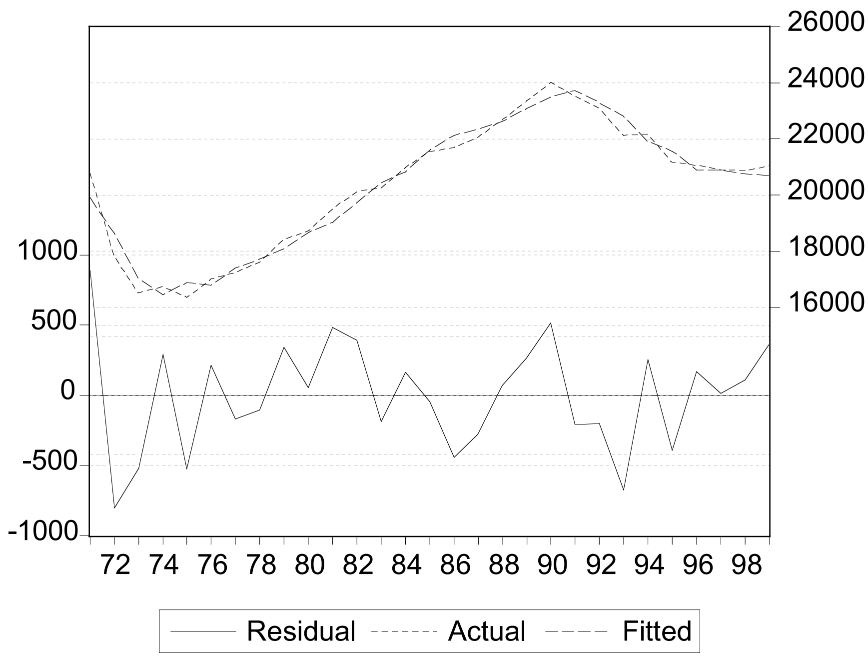
Special features

None. The forecast shows that unemployment rates at current levels are not sustainable. The forecast indicates a return to unemployment rates between 3 and 3.5 percent over the long run.



Dependent Variable: BIRTHS – Live Births
Method: Least Squares
Date: 03/16/00 Time: 17:49
Sample(adjusted): 1971 1999
Included observations: 29 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-9970.648	2223.329	-4.484559	0.0002
AGE1821	0.038277	0.018590	2.058979	0.0505
AGE2224	0.032150	0.017213	1.867735	0.0741
AGE2544	0.022300	0.002399	9.296246	0.0000
BIRTHS(-1)	0.612888	0.059291	10.33690	0.0000
R-squared	0.970773	Mean dependent var		20325.23
Adjusted R-squared	0.965902	S.D. dependent var		2285.715
S.E. of regression	422.0730	Akaike info criterion		15.08382
Sum squared resid	4275496.	Schwarz criterion		15.31956
Log likelihood	-213.7154	F-statistic		199.2896
Durbin-Watson stat	2.064805	Prob(F-statistic)		0.000000



Right hand side variables

AGE2544 = population aged 25 to 44
AGE1821 = population aged 18 to 21
AGE2224 = population aged 22 to 24
BIRTHS(-1) = dependent lag

Short Description of the Equation

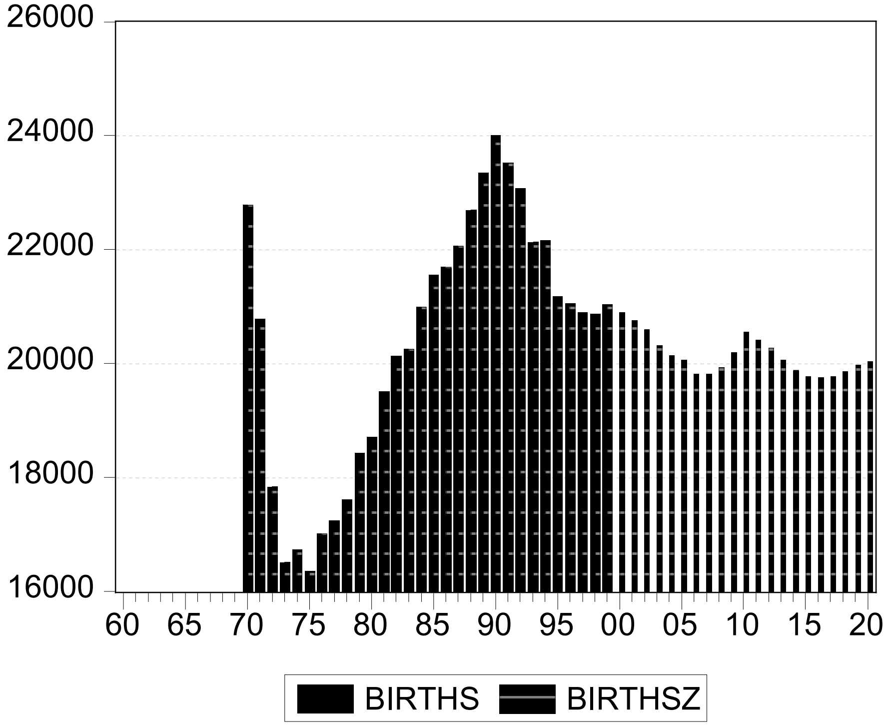
The variance in births is directly related to fertility rates of the regional population and the size of the fertile populations within the region.

Fertile age groups are introduced into the equation as the principal causal variables of Births. Historically, the most fertile age group, judging by the size of the coefficient, is the population aged 18 to 21, followed by 22 to 24 year olds.

A dependent lag accommodates partial adjustment.

Special features

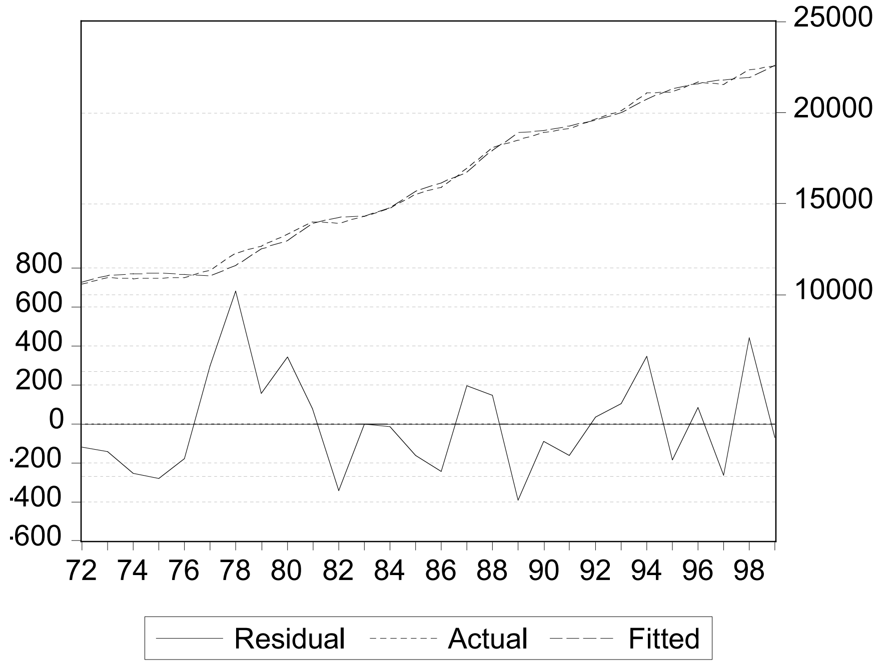
With the stability of fertile age populations in the region for the next 20 years, births are not expected to increase. The population growth forecast is very modest for the West Bay region over the range of the forecast.



Dependent Variable: DJUL – Deaths (July series)
Method: Least Squares
Date: 02/22/00 Time: 16:02
Sample(adjusted): 1972 1999
Included observations: 28 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6285.974	1450.275	-4.334333	0.0002
DEATHSCA	56.30108	12.29107	4.580651	0.0001
DJUL(-1)	0.719139	0.064595	11.13299	0.0000

R-squared	0.996056	Mean dependent var	16206.82
Adjusted R-squared	0.995740	S.D. dependent var	4116.819
S.E. of regression	268.6955	Akaike info criterion	14.12599
Sum squared resid	1804932.	Schwarz criterion	14.26873
Log likelihood	-194.7639	F-statistic	3156.604
Durbin-Watson stat	1.670157	Prob(F-statistic)	0.000000



Right hand side variables

DEATHSCA = deaths in California
DJUL(-1) = dependent lag

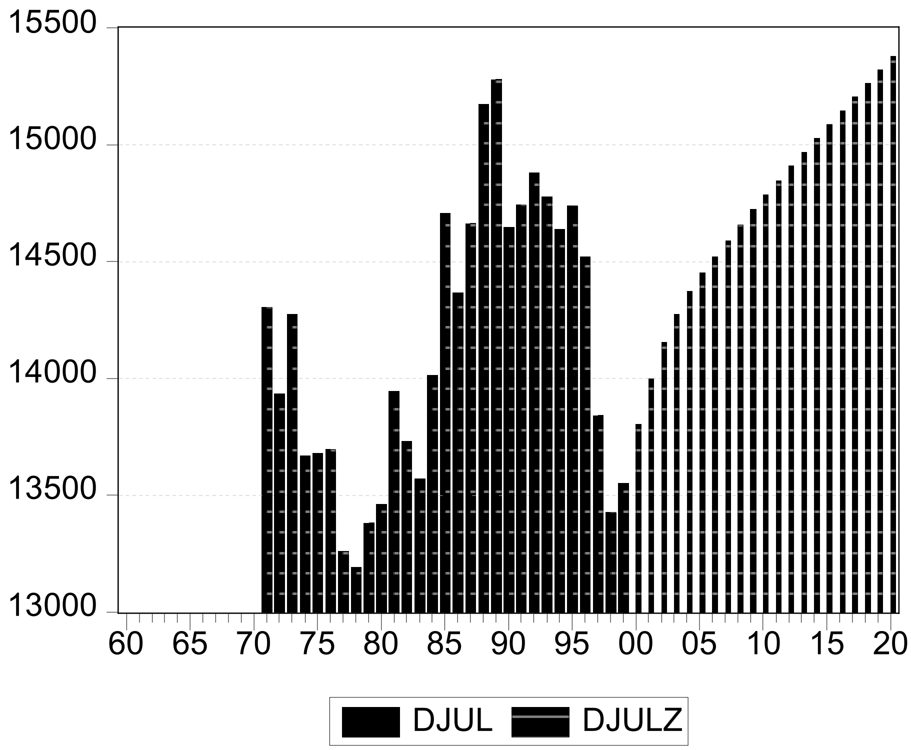
Short Description of the Equation

Deaths in the region are modeled after the variability of Deaths in California. This implies that death rates in the region can be proxied by death rates in the State as a whole.

A dependent lag accommodates partial adjustment. The adjustment factor indicates that the mean response time of deaths in the region to deaths at the statewide level is 3.6 years.

Special features

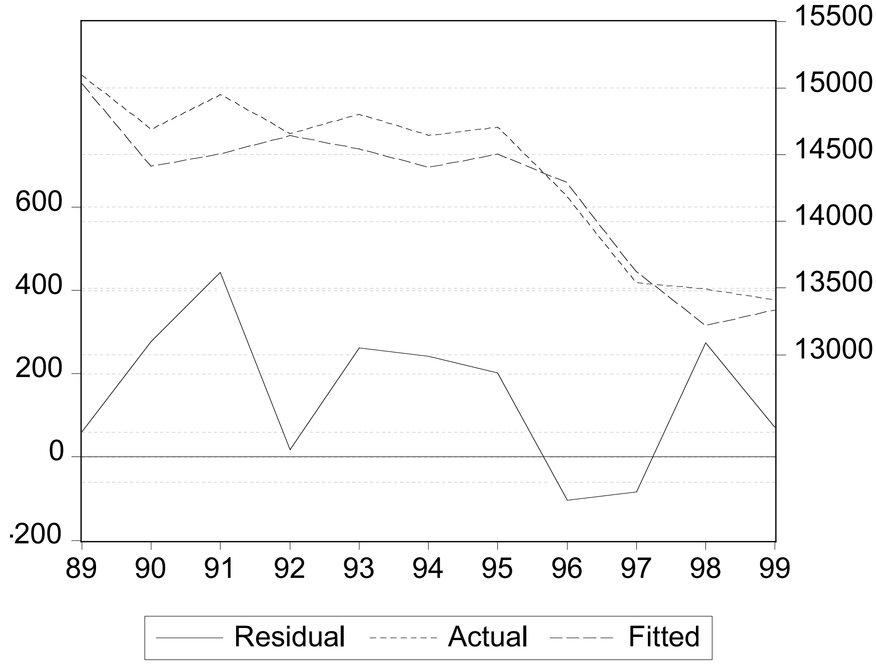
The specification used in the model is a special adjustment for the San Francisco MSA. In nearly all other Counties, the equation is modeled as a linear relationship with AGE65, the population 65 and over. In nearly all Counties this relationship proved to be successful as a sound behavioral equation producing a close historical fit and reasonable forecasts. However, in the West Bay region, deaths have curiously been in a dramatic decline since 1995, (as the chart below shows) contrary with the growth of the elderly population. As that population ages further, more deaths will occur in the region over the next 20 years as the forecast demonstrates.



Dependent Variable: DEATHS – Deaths (calendar year)
Method: Least Squares
Date: 03/08/00 Time: 07:09
Sample(adjusted): 1971 1999
Included observations: 29 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	61.89336	96.93268	0.638519	0.5285
DJUL	0.979746	0.039098	25.05843	0.0000

R-squared	0.958774	Mean dependent var	2474.941
Adjusted R-squared	0.957247	S.D. dependent var	288.6888
S.E. of regression	59.69159	Akaike info criterion	11.08273
Sum squared resid	96203.33	Schwarz criterion	11.17703
Log likelihood	-158.6996	F-statistic	627.9250
Durbin-Watson stat	2.714912	Prob(F-statistic)	0.000000



Right hand side variables

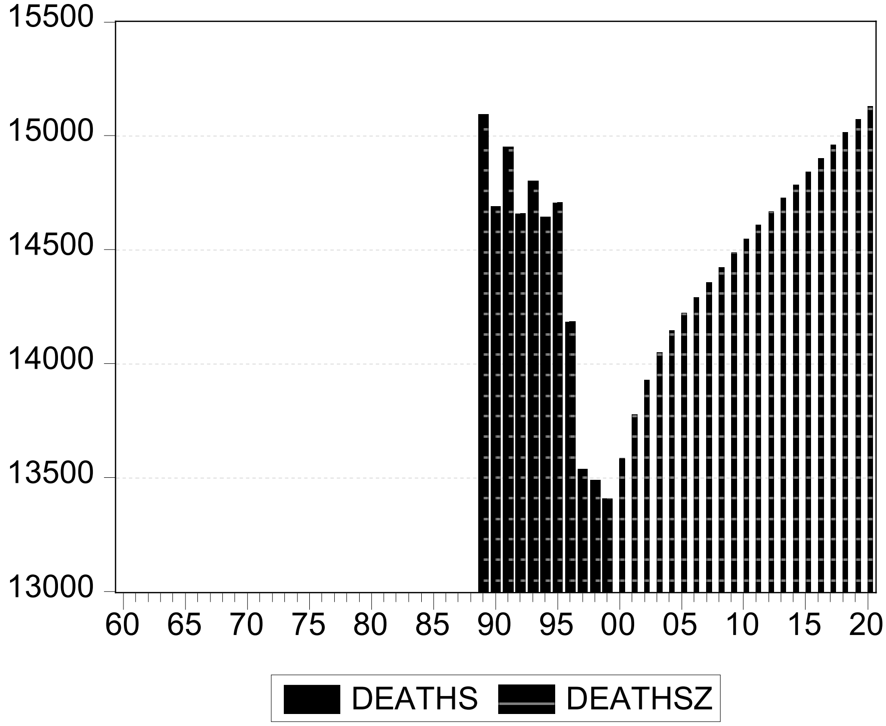
DJUL = deaths (July series)

Short Description of the Equation

The equation is a bridge that enables calendar year deaths to be forecast from fiscal year deaths.

Special features

None.


15500
15000
14500
14000
13500
13000
60 65 70 75 80 85 90 95 00 05 10 15 20
DEATHS
DEATHSZ

Dependent Variable: VEHICLES – Number of Registered Vehicles

Method: Least Squares
Date: 03/17/00 Time: 07:42
Sample(adjusted): 1972 1999
Included observations: 28 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	66489.80	52042.79	1.277599	0.2131
AGE2544	1.541861	0.156959	9.823345	0.0000
ETWS	329.0520	130.3709	2.523968	0.0183

R-squared	0.971529	Mean dependent var	
Adjusted R-squared	0.969252	S.D. dependent var	
S.E. of regression	24529.72	Akaike info criterion	
Sum squared resid	1.50E+10	Schwarz criterion	
Log likelihood	-321.1576	F-statistic	
Durbin-Watson stat	1.663358	Prob(F-statistic)	

Right hand side variables

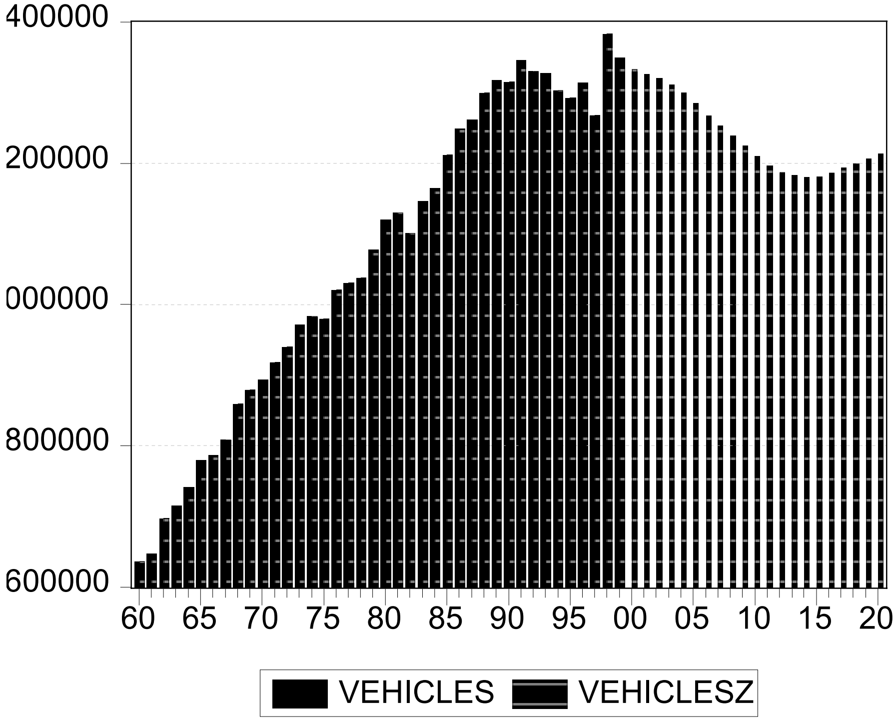
AGE2544 = population aged 25 to 44
ETWS = total wage and salary jobs in the region

Short Description of the Equation

The number of registered vehicles relies on the principal population owning them. Vehicles are primarily owned and accumulated by both the working population and the population most likely to have families. Ownership of vehicles declines with age.

Special features

None.

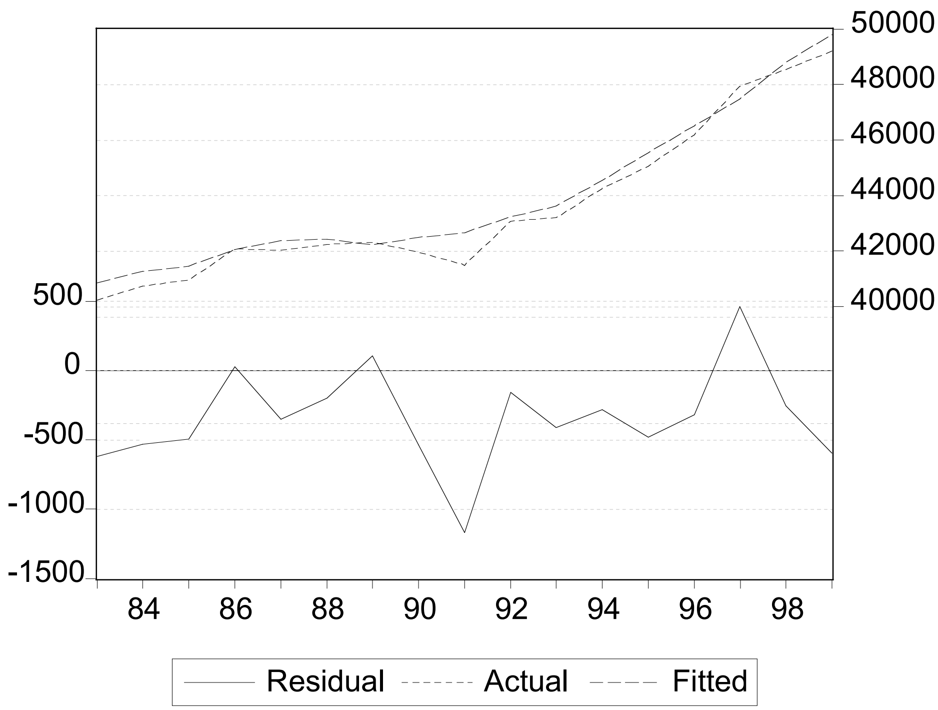


Income Block

Dependent Variable: RYEPW – Real Earnings per Worker
Method: Least Squares
Date: 05/09/00 Time: 15:52
Sample(adjusted): 1983 1999
Included observations: 17 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	33041.89	8653.792	3.818197	0.0024
RASALCA	390.0084	333.5505	1.169264	0.2650
AGE2029	-0.060391	0.004052	-14.90566	0.0000
ZARASAL	837.7385	548.0816	1.528492	0.1523
UR	-323.3326	186.9082	-1.729900	0.1093

R-squared	0.986171	Mean dependent var	43618.06
Adjusted R-squared	0.981561	S.D. dependent var	2807.711
S.E. of regression	381.2560	Akaike info criterion	14.96475
Sum squared resid	1744273.	Schwarz criterion	15.20981
Log likelihood	-122.2004	F-statistic	213.9360
Durbin-Watson stat	2.085157	Prob(F-statistic)	0.000000



Right hand side variables

RASALCA = real average salary (earnings per worker), California
ZARASAL = real average salary (earnings per worker), U.S.
AGE2029 = population aged 20 to 29
UR = unemployment rate

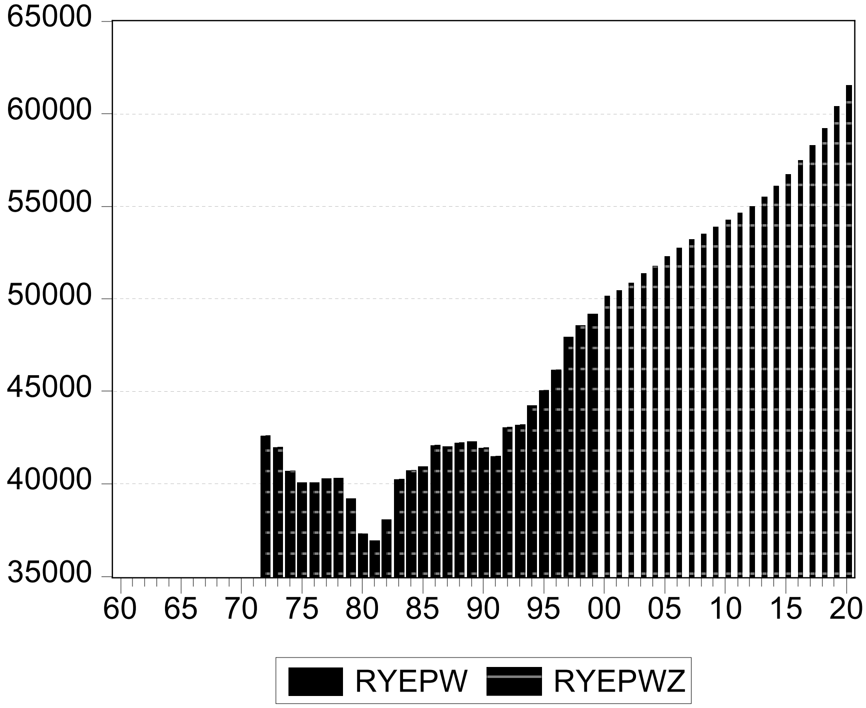
Short Description of the Equation

Average salaries in the region are directly influenced by average salaries in the State and Nation (due to labor contracts and the mobility of labor between regions).

The inclusion of the unemployment rate captures the relative labor slack or tightness in the region. The 20 to 29 age population is a close surrogate of the entry level labor force. As expected, average salaries in the region have an inverse relationship with the size of the entry level labor force.

Special features

The specification is drawn directly from the early literature on regional wage movements.

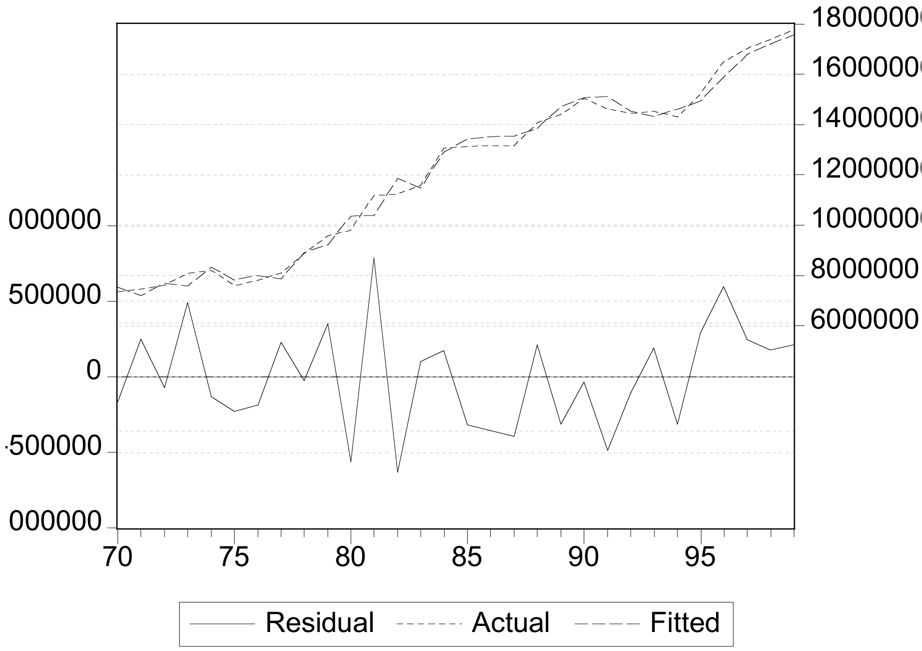


Dependent Variable: RYDIR – Real Total Property or Asset Income

Method: Least Squares
Date: 04/14/00 Time: 18:20
Sample(adjusted): 1970 1999
Included observations: 30 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	216454.5	245190.0	0.882803	0.3851
RYDIRCA	45887.54	8665.582	5.295379	0.0000
RYDIR(-1)	0.559799	0.087599	6.390445	0.0000

R-squared	0.989511	Mean dependent var	12072430
Adjusted R-squared	0.988734	S.D. dependent var	3381906.
S.E. of regression	358953.4	Akaike info criterion	28.51441
Sum squared resid	3.48E+12	Schwarz criterion	28.65453
Log likelihood	-424.7162	F-statistic	1273.607
Durbin-Watson stat	2.537440	Prob(F-statistic)	0.000000



Right hand side variables

RYDIRCA = real average salary (earnings per worker), California
RYDIR(-1) = real average salary (earnings per worker), U.S.

Short Description of the Equation

The specification of this equation is precisely consistent with specifications drawn from the literature. The variation in regional property income is influenced by the variation in state or national income of the same measure.

The broader state and national indicators will embody the myriad of other influences that directly impact asset income flows to individuals and corporations. These include interest rates (affecting the interest component of property income), the stock market (affecting the dividend and capital gains component of property income), and the general economic climate (affecting the rental component of property income).

A dependent lag was included to accommodate partial adjustment. The speed of adjustment was estimated at just under 2 years.

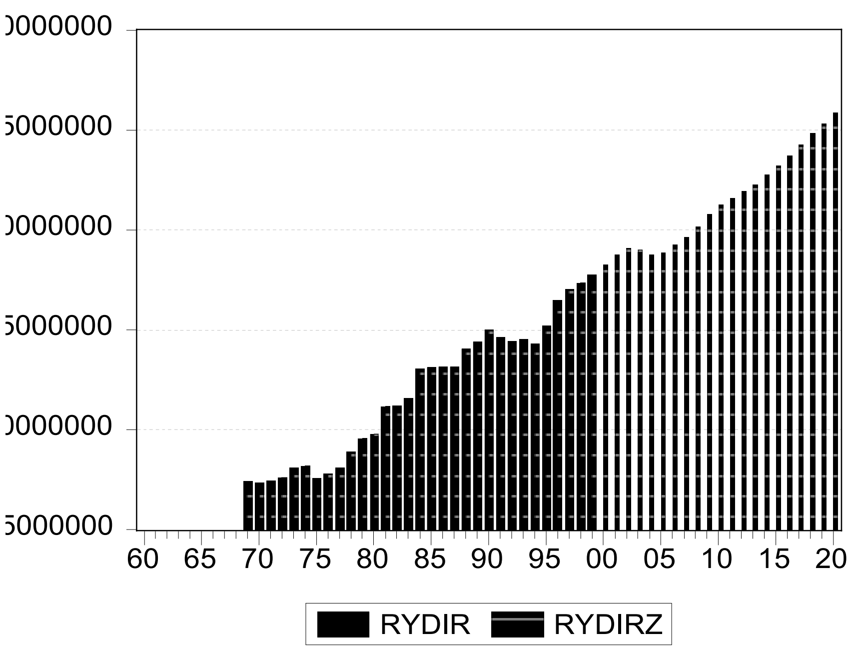
Special features

No regional indicator was required in the empirical specification associated with the San Francisco region. The regional variation in RYDIR was fit with remarkable precision (99 percent) by the statewide variation in RYDIR. The alternative specification which included RHP (real median home selling price) is show below.   In many of the other County equations, the housing price variable was included as an explanatory variable to capture the variation in RYDIR due to rental income.

This alternative specification of RYDIR in the SF-San Mateo-Marin Model was not used in the final forecasting model, but will be tested further in future updates of the model:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2313246.	1313271.	-1.761439	0.0961
RYDIRCA	44385.10	10534.39	4.213353	0.0006
RHP	10.69693	6.836778	1.564616	0.1361
RYDIR(-1)	0.304936	0.149300	2.042437	0.0569

R-squared	0.966903	Mean dependent var	7251724.
Adjusted R-squared	0.961062	S.D. dependent var	1314779.
Durbin-Watson stat	2.283720	Prob(F-statistic)	0.000000

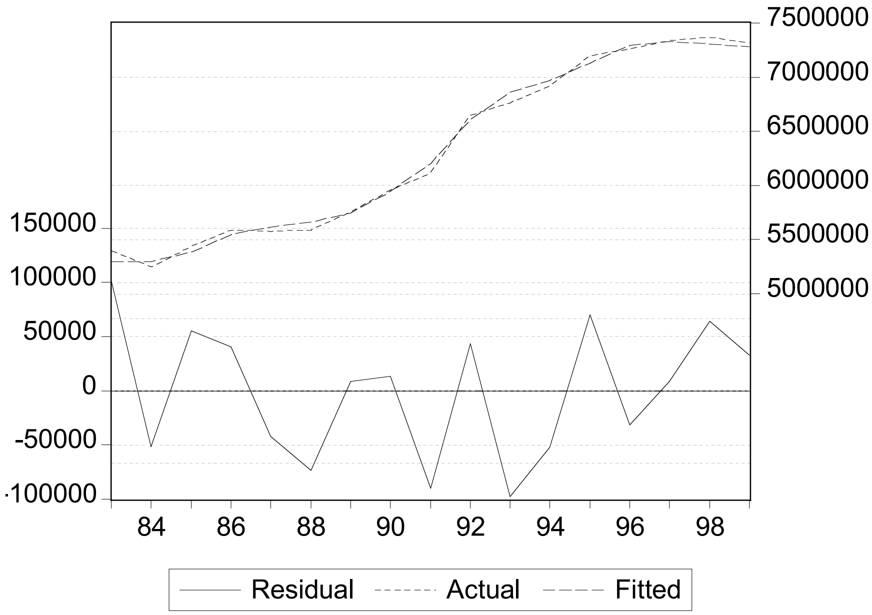


Dependent Variable: RYTP – Real Transfer Payment Income

Method: Least Squares
Date: 04/18/00 Time: 11:32
Sample(adjusted): 1983 1999
Included observations: 17 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1112164.	251894.1	4.415205	0.0007
UR	8686.619	16505.31	0.526292	0.6075
RYTPCA	28857.03	3998.873	7.216291	0.0000
RYTP(-1)	0.317247	0.098751	3.212598	0.0068

R-squared	0.994337	Mean dependent var	6321621.
Adjusted R-squared	0.993030	S.D. dependent var	803157.7
S.E. of regression	67052.43	Akaike info criterion	25.26666
Sum squared resid	5.84E+10	Schwarz criterion	25.46271
Log likelihood	-210.7666	F-statistic	760.8603
Durbin-Watson stat	2.239567	Prob(F-statistic)	0.000000



Right hand side variables

UR = unemployment rate
RYTPCA = real transfer payments, California
RYTP(-1) = dependent lag

Short Description of the Equation

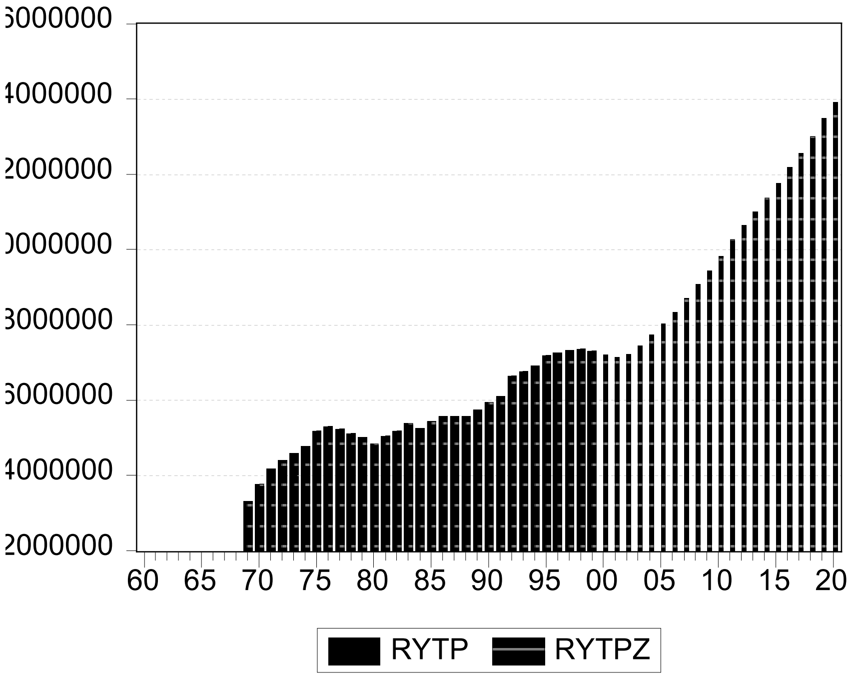
Transfer payment income in the region follows the statewide trend, since AFDC, unemployment insurance, general relief, and food stamp programs that are implemented in the region are Statewide programs.

The inclusion of the unemployment rate captures the degree to which there are unique circumstances in the region regarding the population in need of public transfer income. Both AFDC and unemployment insurance payments are positively correlated with the rate of unemployment.

A partial adjustment factor accommodates the lagged adjustment by local governments and private organizations to transfer income to residents in the region. The average response time is 1.45 years.

Special features

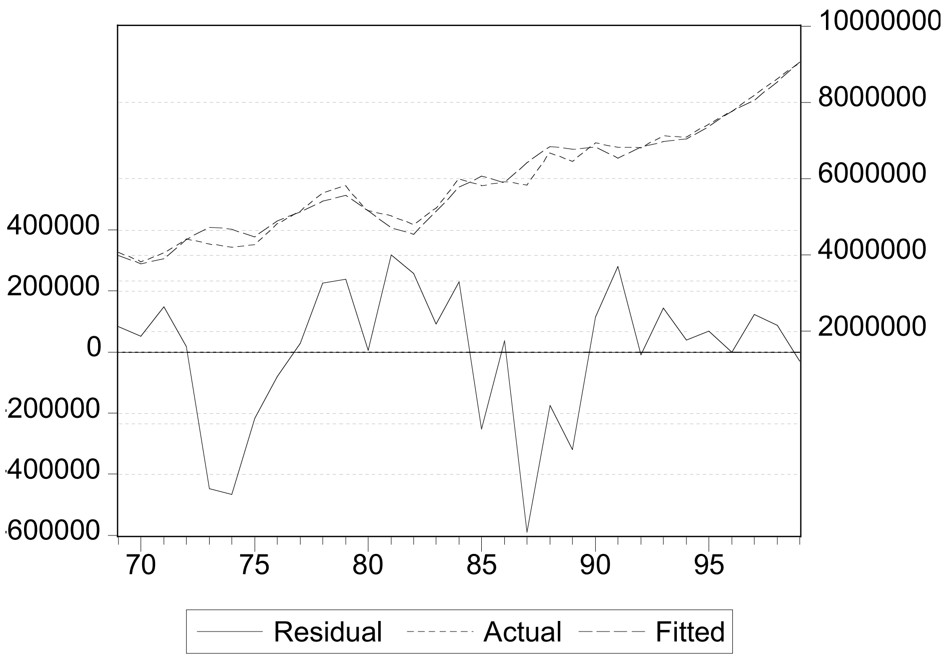
As the retiring population becomes prominent over the forecast period, private and government pension income are forecast to rise in an unprecedented fashion.



Dependent Variable: RYPROP – Real Proprietor Income
Method: Least Squares
Date: 03/16/00 Time: 08:16
Sample(adjusted): 1969 1999
Included observations: 31 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1021300.	495167.3	-2.062534	0.0485
RQRS	0.237155	0.054269	4.369993	0.0002
RYPROPCA	58459.04	4801.008	12.17641	0.0000

R-squared	0.974930	Mean dependent var	5909028.
Adjusted R-squared	0.973139	S.D. dependent var	1425602.
S.E. of regression	233647.5	Akaike info criterion	27.65278
Sum squared resid	1.53E+12	Schwarz criterion	27.79155
Log likelihood	-425.6181	F-statistic	544.4258
Durbin-Watson stat	1.214088	Prob(F-statistic)	0.000000



Right hand side variables

RQRS = real retail sales
RYPROPCA = real proprietor income, California

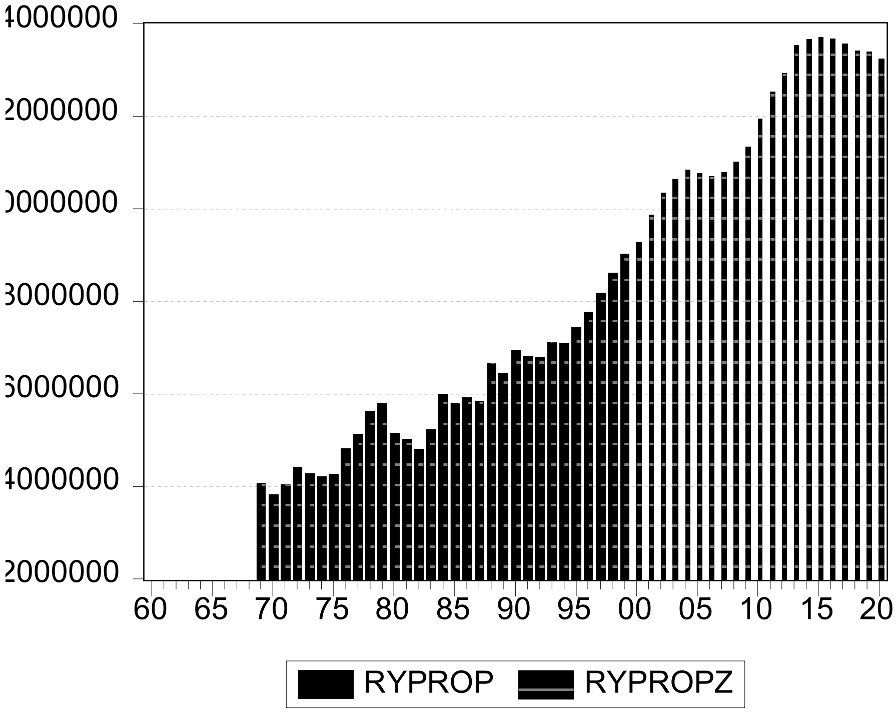
Short Description of the Equation

The specification of the equation follows exactly that of Glickman (1977, page 89). The larger California component of proprietor income embodies other influences that affect the regional measure, including the general economic climate, consumer confidence, and the business cycle.

Local retail sales represent in large part, local consumer spending. Proprietor income in the form of net business income or profits is largely a consequence of consumer spending in the region.

Special features

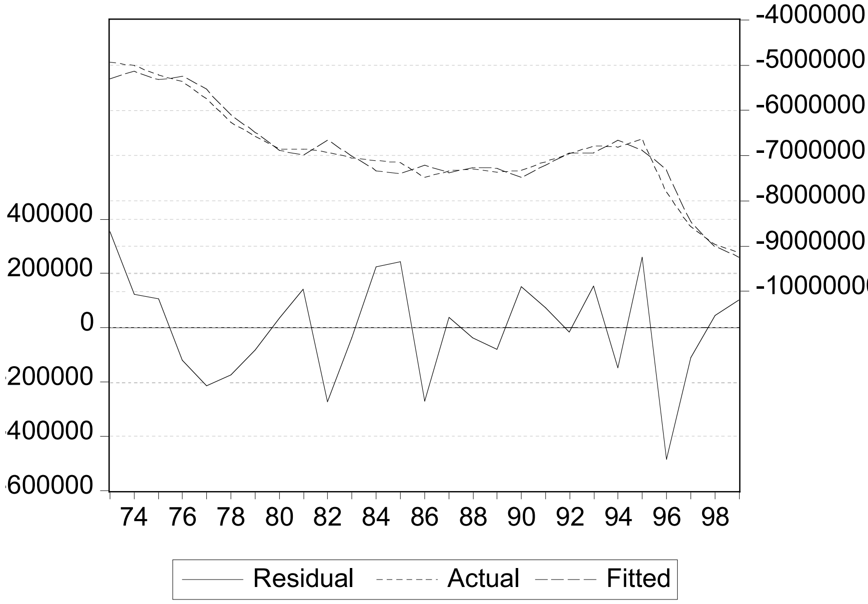
A dependent lagged variable is normally included in the equation. It was not necessary in this simple specification of real proprietor income. In other Counties, a dependent lag accommodates partial adjustment.



Dependent Variable: RYRA – Real Residence Adjustment
Method: Least Squares
Date: 03/16/00 Time: 08:28
Sample(adjusted): 1973 1999
Included observations: 27 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-468332.3	290787.9	-1.610563	0.1209
NIPJUL	-19.01447	5.837836	-3.257109	0.0035
RYRA(-1)	0.917059	0.044007	20.83878	0.0000
DETWS	-13052.10	2508.277	-5.203609	0.0000

R-squared	0.967289	Mean dependent var	-6917814.
Adjusted R-squared	0.963022	S.D. dependent var	1050454.
S.E. of regression	201998.1	Akaike info criterion	27.40586
Sum squared resid	9.38E+11	Schwarz criterion	27.59783
Log likelihood	-365.9791	F-statistic	226.7083
Durbin-Watson stat	2.006723	Prob(F-statistic)	0.000000



Right hand side variables

NIPJUL = net in-migration
RYRA(-1) = dependent lag
DETWS = new jobs created in the region

Short Description of the Equation

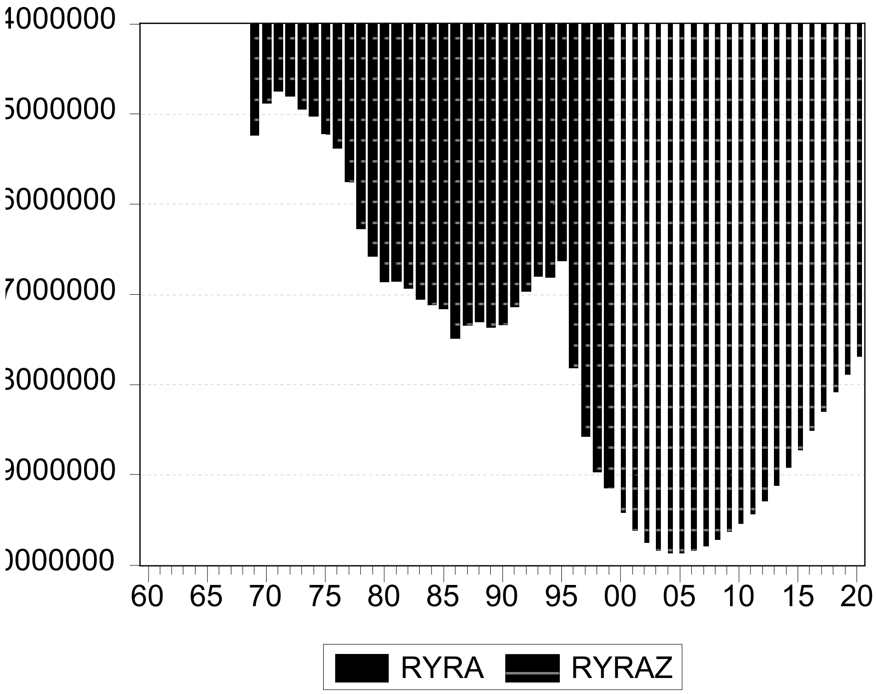
The residence adjustment is another bridge equation. Labor income earned outside the region and brought into the region by residents is an adjustment to personal income estimated by the U.S. Department of Commerce.

Net in-migrating populations affect the adjustment because their payroll income becomes counted in labor earnings by place of work in the region. More jobs created in the region will influence the amount of the adjustment, either positive or negative depending on where workers live. The empirical results indicate that the job market largely encourages commuters, which is generally true from the East Bay.

The dependent lag is included to accommodate partial adjustment of net migration and new jobs created in the region.

Special features

With the recent surge in job creation in the West Bay region, the residence adjustment has sharply increased in a negative direction. This magnitude is expected to continue for the next several years as jobs are created in the region but housing is not. Income earned in the region is then “adjusted” out of the region and into the region of workers’ residences, which in this application, is largely the Counties of Alameda and Contra Costa.

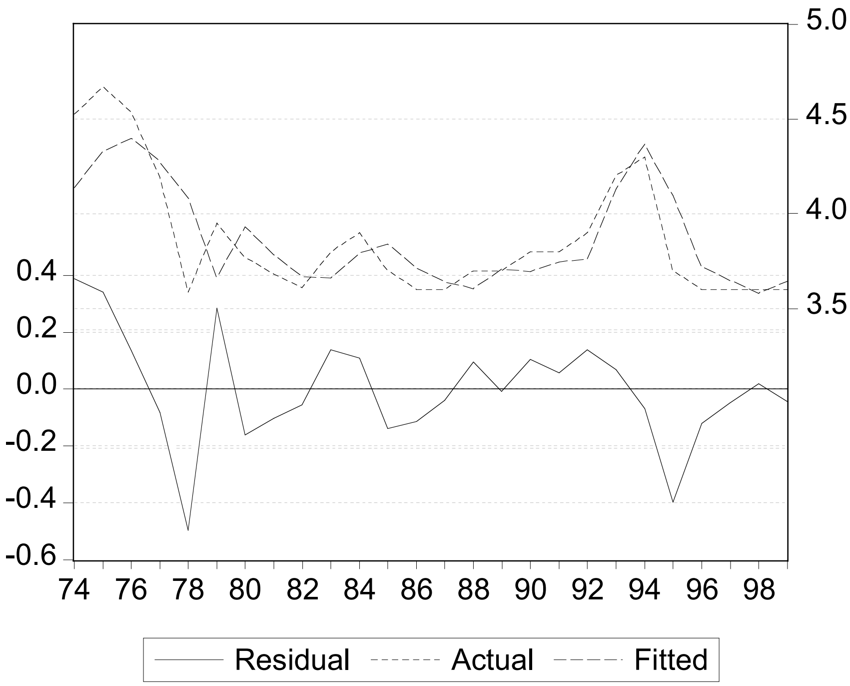


Farm Sector Block,
and other miscellaneous equations

Dependent Variable: EFARM – Farm Employment
Method: Least Squares
Date: 03/16/00 Time: 13:12
Sample(adjusted): 1974 1999
Included observations: 26 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.085310	0.490299	2.213570	0.0375
DUM9394	0.292174	0.154823	1.887151	0.0724
EFARM(-1)	0.708449	0.125712	5.635518	0.0000
RCROP-RCROP(-1)	1.48E-09	2.42E-09	0.612172	0.5467

R-squared	0.643261	Mean dependent var	3.869885
Adjusted R-squared	0.594614	S.D. dependent var	0.327315
S.E. of regression	0.208401	Akaike info criterion	-0.158063
Sum squared resid	0.955485	Schwarz criterion	0.035490
Log likelihood	6.054824	F-statistic	13.22322
Durbin-Watson stat	1.529649	Prob(F-statistic)	0.000038



Right hand side variables

DUM9394 = binary variable for 1993-94 period;
the value is 1 if year=1993 or 1994; 0 otherwise
EFARM(-1) = dependent lag
RCROP-RCROP(-1) = 1 year change in real crop value

Short Description of the Equation

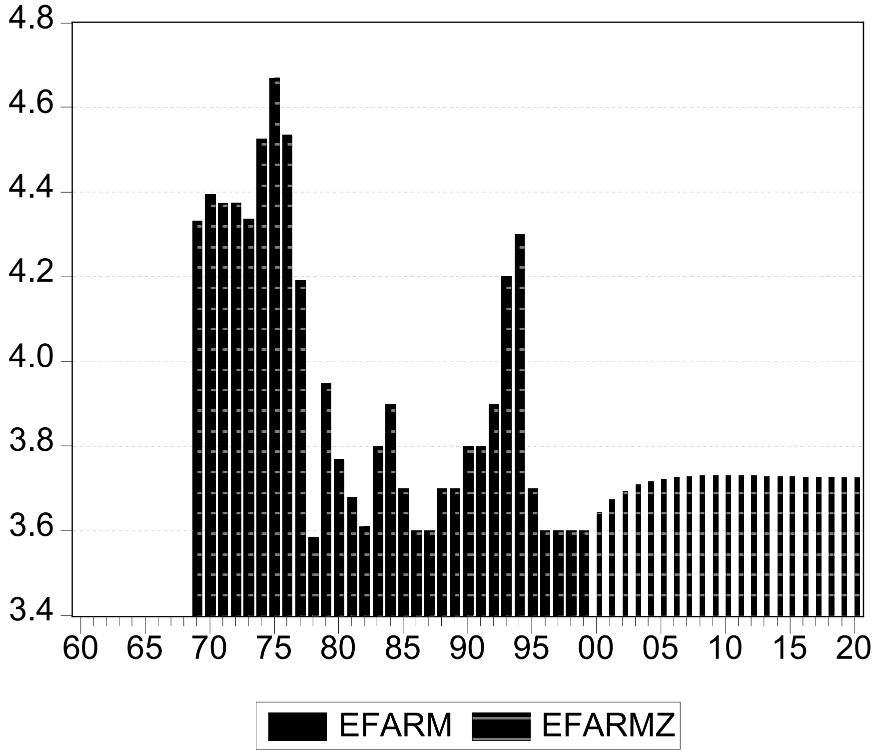
The equation follows an autoregressive structure with some intervention from the dollar value of crops in the region.

The change in crop value has a positive effect on employment. The significance of the estimated parameter value has been affected by multicolinearity that occurs with the inclusion of the dependent lag.

The dependent lag is included to accommodate partial adjustment of crop valuation in the region. A binary variable for the 1993-94 period compensates for a surge in hiring due to weather or other non-market factors.

Special features

None. The forecast is principally driven by the autoregressive component, the dependent lag. The long run response is the mean of the series, about 3,700 workers in the region.



Dependent Variable: RCROP – Real Agricultural Crop Value

Method: Least Squares
Date: 03/16/00 Time: 12:30
Sample(adjusted): 1974 1999
Included observations: 26 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	36292630	27739143	1.308354	0.2031
RCROP(-1)	0.877786	0.093447	9.393441	0.0000

R-squared	0.786166	Mean dependent var	2.95E+08
Adjusted R-squared	0.777257	S.D. dependent var	35986977
S.E. of regression	16984309	Akaike info criterion	36.20728
Sum squared resid	6.92E+15	Schwarz criterion	36.30406
Log likelihood	-468.6947	F-statistic	88.23673
Durbin-Watson stat	1.804436	Prob(F-statistic)	0.000000

Right hand side variables

RCROP(-1) = dependent lag

Short Description of the Equation

The equation follows a simple autoregressive structure of the first order. Regional farm activity is correlated with last year's activity.

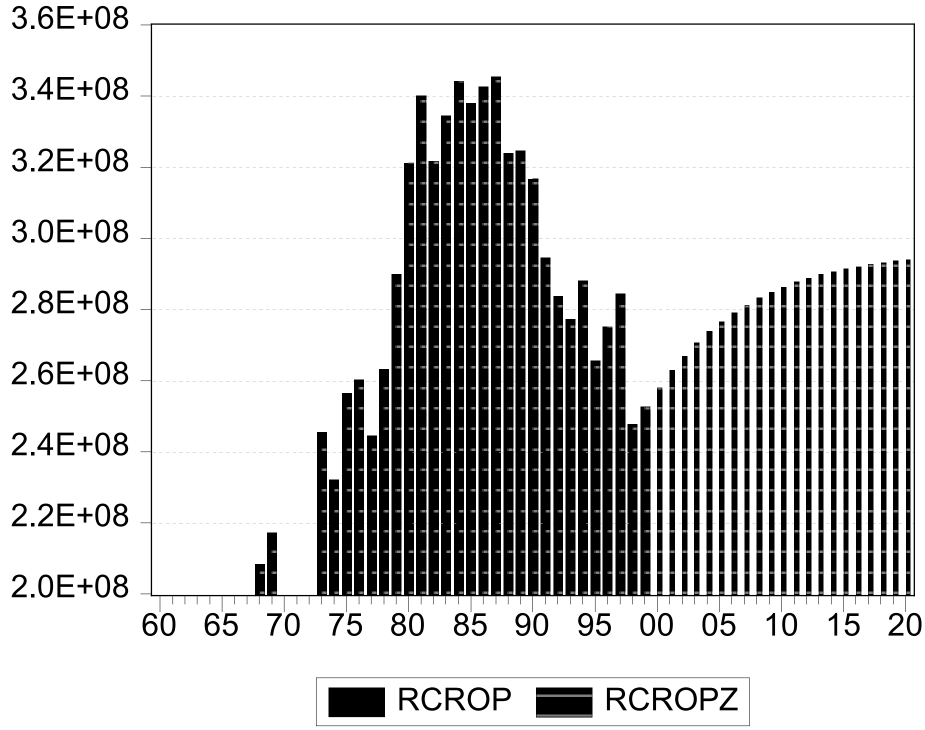
Evidence was not found that local crop values were correlated with U.S. agricultural markets or aggregate farm price trends.

Special features

Crop value was not correlated with any economic factor, either at the state or national level. It can be hypothesized that values for crops in this region are the result of random or weather-related forces.

Generally, regional farm activity is correlated with U.S. farm prices, export activity, or the general U.S. economy (reflecting higher export activity). In other Counties, the empirical form of the forecasting equation includes the U.S. farm producer price index, the exchange rate index, or real GDP.

The forecast of real crop value converges to the mean of the series.

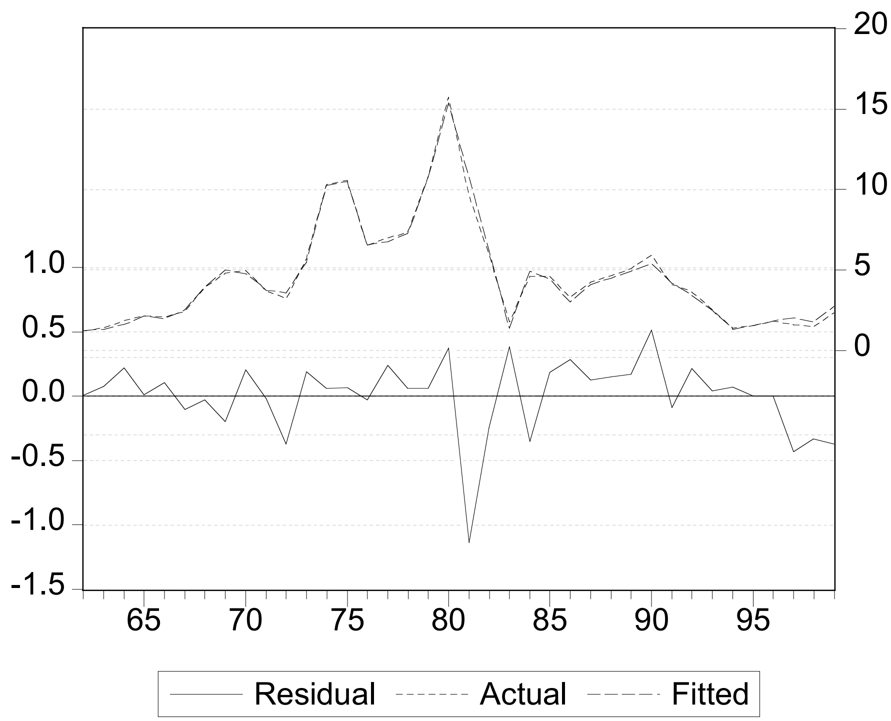


Dependent Variable: I – Inflation (regional)
Method: Least Squares
Date: 02/21/00 Time: 17:04
Sample(adjusted): 1962 1999
Included observations: 38 after adjusting endpoints
Convergence achieved after 8 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.160542	0.105880	-1.516259	0.1384
ICA	1.007235	0.018239	55.22541	0.0000
AR(1)	0.200907	0.175701	1.143459	0.2606

R-squared	0.991927	Mean dependent var	4.624280
Adjusted R-squared	0.991466	S.D. dependent var	3.273676
S.E. of regression	0.302423	Akaike info criterion	0.521679
Sum squared resid	3.201096	Schwarz criterion	0.650962
Log likelihood	-6.911896	F-statistic	2150.266
Durbin-Watson stat	1.940989	Prob(F-statistic)	0.000000

Inverted AR Roots .20



Right hand side variables

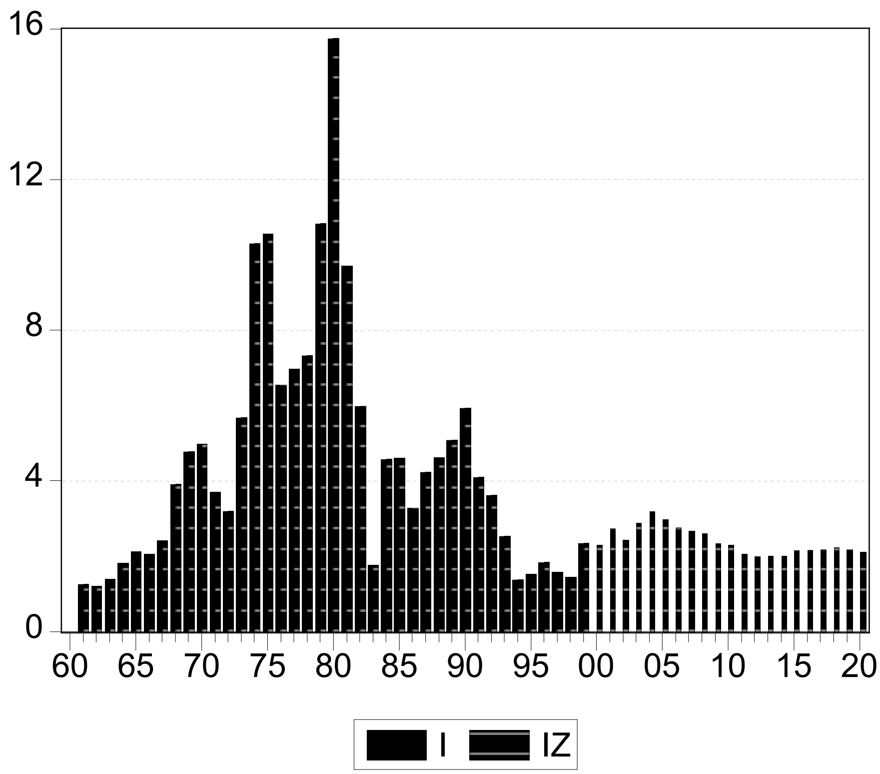
ICA = inflation in California
AR(1) = first order autoregressive term

Short Description of the Equation

The equation is modeled after inflation in California, which in part, embodies inflation in the Bay area economy. An adjustment for autocorrelated errors is added. The adjustment produces a white noise (random) disturbance process.

Special features

The coefficient on ICA is essentially 1, indicating a one to one response between inflation at the State and regional levels. It should be noted that inflation at the Statewide level is approximately one-third determined by inflation in the Bay Area economy. The remaining two-thirds is attributable to Southern California price level movements.

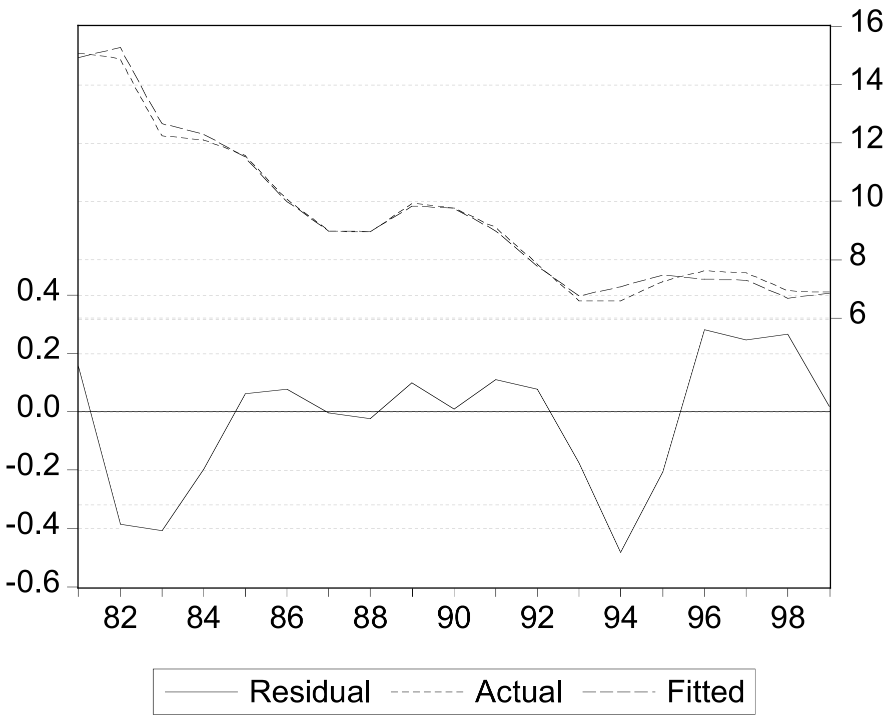


Dependent Variable: HMRLA --- Effective Home Mortgage Rate (regional)

Method: Least Squares
Date: 05/29/00 Time: 15:42
Sample(adjusted): 1981 1999
Included observations: 19 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.961748	0.659074	-1.459240	0.1639
ZMORT	1.023134	0.021018	48.67786	0.0000
RHP/RHPCA	0.240675	0.345294	0.697014	0.4958

R-squared	0.993502	Mean dependent var	9.465866
Adjusted R-squared	0.992690	S.D. dependent var	2.643620
S.E. of regression	0.226024	Akaike info criterion	0.007587
Sum squared resid	0.817388	Schwarz criterion	0.156708
Log likelihood	2.927928	F-statistic	1223.210
Durbin-Watson stat	1.238012	Prob(F-statistic)	0.000000



Right hand side variables

ZMORT = effective mortgage rate in the U.S.
RHP/RHPCA = ratio of real home price in the region to the real home price in California

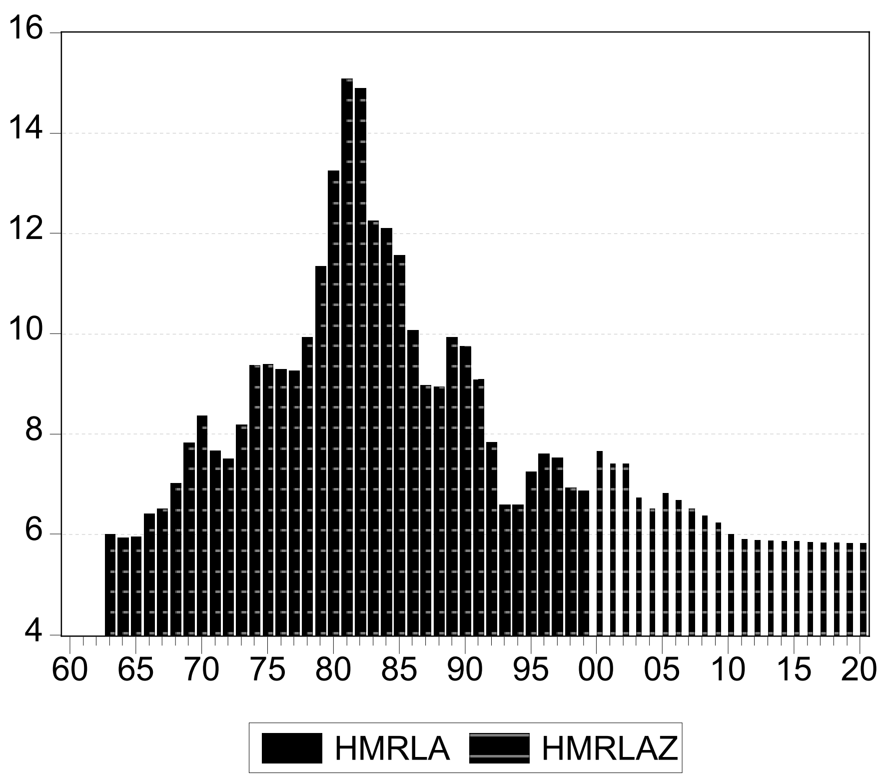
Short Description of the Equation

Regional effective mortgage rates move in tandem with the effective mortgage rate for all regions in the nation.

Any differential can be explained by extraordinary home price valuations which affect the effective nature of mortgage rates. That effect is captured by the ratio of local housing prices to statewide home prices. Higher regional home prices would raise interest rates because jumbo loans have a slight risk premium associated with them.

Special features

None.



----- end of application section -----

Total word count --- entire document: 19,544

Appendix A

San Francisco Region Simulation Model Program
EVIEWS version 3.1

SFREGION00 **AAMODEL**

```
------------------------
'     Retail Sales
'------------------------

:eqrqrs
:eqqrstores
rqrsps = rqrs/qrstores

'------------------------
'     HOUSING
'------------------------
rbvtot=rbvrtot+rbvnrtot
hs = hs(-1) + units(-1)
'sfu=units-mfu
units=sfu+mfu
sfrat=sfu/units
:eqhh
:eqmfu
'mfu=mfu(-1)
':equnits-conunits
:eqsfu
:eqrabvrn
:eqrbvrtot
:eqrbvnrtot
:eqrhp

'------------------------
'     Income
'------------------------
:eqrydir
:eqrytp
:eqryprop
:eqryepw
:eqryra
RYTWS=ETWS*RYEPW
RYP=rytws+rydir+rytp+ryprop+ryra
RYPPC=RYP/POPJUL
WAGERAT=RYEPW/(1000*RASALCA)
```

```
'-------------------------
'    Demographics
'-------------------------
AFFPRO=100*(AGE4564/POPDOF)
:eqbirths
:eqdjul
:eqdeaths
:eqnipjul
:equr

Popjul = popjul(-1) + births - deaths + nipjul
dpop=popjul-popjul(-1)
density = popjul/hh
:eqvehicles
ppv = popjul/vehicles

'-------------------------
'    Employment
'-------------------------
etws = efarm+econ+emin+emfg+etpu+efire+etrade+eserv+egovt
detws=etws-etws(-1)
egovt=efg+eslg
:eqefarm
:eqecon
:eqemin
:eqemfg
:eqedur
:eqetpu
:eqefire
:eqetrade
:eqeserv
:eqefg
:eqeslg
:eqeprop

'---------------------------------------
'   Farm Sector
'---------------------------------------
:eqrcrop
:eqi
:eqisf
:eqhmrla
CPISF=CPISF(-1)*(1+(i/100))
hprat = RHP/ZRHPM
Salesrate=RQRS/RYP
emprate=100*etws*1000/popjul                    <end of program>
```