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MODELLING NEW ONE-FAMILY HOUSE CONSTRUCTION AT THE STATE AND THE COUNTY LEVEL

by

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Abstract

MODELLING NEW ONE-FAMILY HOUSE CONSTRUCTION

AT THE STATE AND COUNTY LEVEL

by

Jonah Otelsberg

Adviser: Professor Georgios Sphicas

The purpose of the study was to develop models for new one-family house construction at the state and county level. Construction in general, and one-family houses in particular, have long been recognized as important leading indicators of economic activity. They are used in almost all econometric models concerned with predicting the state of the economy on a national level. However, many decision makers need data for smaller geographic units in order to be able to make and evaluate marketing decisions such as: forecasting future sales of their product, determining sales quotas, designing sales territories, and evaluating the sales organization's performance. It is the needs of middle management, involved with this kind of decisions, that the models developed are aimed to satisfy.

The procedure employed in developing the models was to proceed from establishing the theoretical foundations for the model building effort, evaluation of the state of the art in housing models

and methods of small area estimating, to building of the models themselves.

Box-Jenkins' iterative approach was utilized in building the models.

The hypotheses set forth in terms of coefficients of determination postulated that estimates based on a concurrent sample of permits are superior to estimates based on concurrent measures of explanatory variables, these in turn are superior to estimates utilizing lagged measurements of the explanatory variables.

To test these hypotheses, two types of models were presented: the county model, in which estimates are based on direct measurement of activity in the largest permit issuing jurisdictions; and the state model, which utilized explanatory variables in obtaining estimates.

Two basic principles underlie the building of the state model:

- in selecting variables to be included in the model, those for which direct measurement is available are to be preferred to those which represent estimates made by other researchers
- the principle of parsimony -- use the smallest possible number of parameters for adequate presentation.

Nineteen variables were selected for consideration in the model. They were assumed to represent the demand and supply of one-family houses. In general, they represented the socio-economic conditions, availability and cost of mortgage funds, and measures of construction activity.

The number of observations used for the variables selected depended on availability of data on a state level. An attempt was made to balance stability over time with corssectional analysis.

Observations made in the period 1968-1973 were used in the analysis. Factor analysis and regression analysis were performed on the data. The hypotheses postulated were supported by the analysis.

During the analysis, it became apparent that a single variable -- -- square feet of non-residential floor area -- explained 86% of the variance of one-family house construction. Since for this variable timely measurements are available by county, it is a most desirable estimator of one-family house construction activity. Thus, all the final equations were computed using this variable alone.

The purpose of the county model is to provide a measure of one-family house construction activity by month, by county.

The performance of the two models was tested by comparing estimates for 1973 obtained utilizing them, to reports received by the Bureau of the Census. The best estimate with $R^2 = .96$ was obtained by using the county model. The hypotheses that the county model will provide better estimates than the state model was supported by the comparison. In addition to providing better annual estimates by state, the county model provides monthly estimates by county.

Both the state and the county model provided adequate state estimates of one-family house construction activity. Both utilized direct measurement in the period to be estimated in order to obtain the estimates. The county model, however, has means of providing monthly estimates by county, while the state model was developed using annual state data.

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CHAPTER I

INTRODUCTION

The Problem

One-family house construction activity has long been considered by economists a barometer for the economy as a whole. It is a leading economic series especially sensitive to economic forces such as availability of credit. The need for one-family house information is not limited to economists. Government on various levels -- federal, state, and local need this information to plan community services, and,in the case of local governments, estimate their receipts. In addition, the business community needs the information for planning and monitoring its marketing function. Local governments and business in particular, need the data for small areas, since these are their decision making components.

The information that is currently available as measure of one-family house construction activity comes mainly from the Bureau of the Census who produces three statistical series:

- building permits
- housing starts
- value put in place.

The permit series provides annual reports by permit place six to eight months after the closing of the year.

The starts series provides estimates of starts by month for the four Census Regions.

The value put in place series provides monthly estimates by the four Census Regions.

Thus, monthly data is not available for geographical breakdowns smaller than the Census Regions, while data for smaller geographical entities is available on an annual level only, six months after the end of the period.

The purpose of this study is to fill the void by providing means of obtaining estimates of one-family house construction activity for small areas to be available shortly after the closing of the period.

Review of Existing Literature

The American Statistical Association, through the Committee for Small Area Statistics, has been conducting full day conferences on small area statistics.[1] Most of these conferences were dedicated to problems with producing small area statistics. Government programs, such as revenue sharing, have increased the interest in small area population statistics. So far, little has been done to generate housing models for local areas.

Among the existing national housing models at the one hand stand econometric models, at the other, judgmental models.

All the known econometric models include the housing sector, for example, Brookings, DHL III, FAIR, FRB-MIT-PENN, OBE, WHARTON. Most of these models are quarterly and they use housing starts as a measure of housing activity. While some, such as Brookings, decompose

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[1] American Statistical Association, Proceedings of the Business and Economic Statistics Section. See also Small-Area Statistics Papers, series GE-41, U.S. Department of Commerce.

the starts by type of unit: one-family, two-family, multi-unit; others do not make the distinction.[2] The independent (exogenous) variables used to explain starts by the different models can be grouped into the following categories:

- Interest Rates
- Credit Availability
- Existing Inventory of Housing
- Income and Wealth
- Demographic Data

Not all of the models reviewed use all of the groups, but most do; even though the variables representing the groups vary from model to model. Series used to express the housing inventory, income, and population do not represent direct measurement, but estimates made either by the issuing agency (population, for example) or by the researcher himself, such as housing inventory.[3]

Judgmental housing models are represented by the work of Robinson Newcomb. Newcomb is an acknowledged authority on housing and has frequently appeared as expert before congressional committees. His approach to housing models is less rigorous mathematically,

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[2]Bruce R. Ricks (ed.), National Housing Models, Lexington, Massachusetts: Lexington Books, 1973, passim.

[3]Ibid.

but he is more sensitive to the deficiencies in the data he uses. In developing the model, he takes into consideration:

- The state of the economy
- Household formation
- Proportion of household and public income alotted to new housing
- The types of housing the market will support
- Public and private funds available for new home financing
- The cost of new house financing[4]

In developing regional housing models, Crow and Marcin extend the relationship found on the national level to the regions.[5,6]

No body of theory was developed in the field of small area estimating. The Population Division of the Bureau of the Census uses several methods for obtaining annual estimates of population by county; the final estimate is a simple average of all these methods.[7]

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[4] Robinson Newcomb, "Housing and Other Construction," Methods and Techniques of Business Forecasting, Englewood Cliffs, New Jersey: Prentice Hall, 1974, pp. 373-390.

[5] Robert Thomas Crow, "A Nationally-Linked Regional Econometric Model," Journal of Regional Science, 1973, Vol. 13, No. 2, pp. 187-203.

[6] Thomas C. Marcin, Projections of Demand for Housing by Type of Unit and Region, Agriculture Handbook, May 1972, No. 428, U. S. Department of Agriculture -- Forest Service

[7] U. S. Bureau of the Census, Current Population Reports, Federal State Corporation Program for Population Estimate, P26, No. 21, April 1973, p. 2.

Dr. Eugene Ericksen has recently developed a regression method which incorporates sample information along with the methods currently used by the Bureau of the Census, Population Division.[8]

Significance of the Study

As we have seen, in the preceeding section, little work has been done in providing timely local area estimates of one-family house activity. This study will attempt to develop a method which will provide local area estimates of one-family house construction activity for the use of government and business.

The importance of Housing Construction as a leading economic indicator is widely accepted; to this attest the fact that Housing Starts are included in all publications listing economic indicators and are invariably included in econometric models of the economy. Many industries' demand is directly related to Housing Starts as suppliers of building materials, household equipment, or services.

Small area housing information is especially important to marketing and sales management in:

- Obtaining sales forecasts
- Formulating sales goals and strategy
- Determining sales quotas
- Measuring sales performance

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[8] Eugene P. Ericksen, "A Method for Combining Sample Survey Data and Symptomatic Indicators to Obtain Population Estimates for Local Areas," Demography, Vol. 10, May 1973, pp. 137-160.

- Determining salesmen compensation
- Controlling the sales effort
- Manpower planning

Monthly data are essential to control functions of marketing management such as:

- Evaluation of sales performance of various organizational units
- Comparison of performance with forecasts and quotas
- Assessment of market penetration
- Short range adaptability to changing market conditions.

In addition to providing marketing management with means of obtaining monthly county estimates of one-family house starts, the methodology developed for the study may be applicable to obtaining periodic small area estimates for other time series.

Aside from business and economists, governments at different levels also have need for one-family house information

Federal Government

The Bureau of the Census is required by act of Congress to monitor the development of trends in major areas of the society. One of the major responsibilities of the Construction Division of the Bureau of the Census is to measure housing activity and to report monthly on value of new housing put in place and housing starts. This information is utilized by other government bodies in performing their own functions; it is of major importance to HUD, HEW, Departments of Commerce, Labor, Transportation, Defense, and the EPA.

State and Local Governments

The closer the government to the area in which construction is actually being performed, the more important the information to its planning. In planning local services such as:

- roads
- water supply
- sewer lines
- garbage collection
- health services
- welfare services
- size and location of schools
- shopping facilities
- community facilities
- zoning regulations

data on new construction is invaluable.

Since a large proportion of local governments' income consists of real estate taxes, both the receipts and the disbursements of local governments depend on new construction.

Each level of government needs data appropriate to its area of jurisdiction. While the federal government's needs may be satisfied by national or regional figures, state and local governments need data at the state and local level.

Available Measures of One-Family House Construction

The Construction Division of the Bureau of the Census issues three measures of new construction of one-family houses:

- Permits issued within permit issuing jurisdictions
- Housing starts
- Value of construction put in place

We will now discuss each one of these measures with regard to:

- Timing of issue
- Geography covered
- Extent to which it is based on direct measurement

Permits. The permits series is issued annually six to nine months after the closing of the year. The report shows the number of permits issued within the year by each of the 14,000 permit issuing jurisdictions. All jurisdictions report annually, a sample of about 3,000 permit places reports monthly. The construction which takes place outside the permit issuing jurisdiction, in what is known as non-permit areas, is not accounted for.[9]

Starts. The starts series is issued monthly about four weeks after the closing of the month to which it pertains. It provides starts for the nation and the four census regions.

The start series is derived using the permit series. From a

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[9] Housing Authorized by Building Permits, Construction Reports, C40, U. S. Department of Commerce, Bureau of the Census.

sample of permits the period which elapses between the time a permit is being taken out and actual start of construction is estimated. This estimate is applied to estimates of permits issued and a figure representing "starts" in permit issuing jurisdictions is obtained.

Starts in non-permit issuing areas are estimated on the basis of an area sample.[10]

Put in Place. The put in place series represents the value of one-family house construction put in place in a given month. It is available about four weeks after the closing of the month of interest.

The geography for which an estimate is issued is the same as for starts -- national and four census regions.

The figures are based on a sample of builders who report to the Bureau of the Census on their monthly expenditures from start of construction to completion.[11]

Of the three measures the only one which provides a measure for local areas is the permit series. The permit series is also the only one which is based on direct measurement of construction activity. It is, therefore, the most appropriate measure of one-family house construction.

The drawback of the permit series is that it does not provide a measure of activity in non-permit areas.

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[10] Housing Starts, Construction Reports, C20, U. S. Department of Commerce, Bureau of the Census.

[11] Value of New Construction Put in Place, Construction Reports, C50, U. S. Department of Commerce, Bureau of the Census.

Scope of the Study

The purpose of the study is to develop a method of obtaining estimates of one-family house construction for local areas, as measured by building permits, prior to availability of these measures from the Bureau of the Census.

Estimating methods were explored on two levels: state and county. At the state level, an attempt was made to express one-family house building permits in terms of other variables. The criteria for selection of variables for consideration in the model were:

1. Assumed relationship to demand or supply, or both, of one-family house construction.
2. Availability of annual data on a state level for the period 1968-1973.
3. No change in definition of the series within the period of study.

Nineteen variables satisfying these criteria were selected for further analysis. The final regional and national estimating equations were obtained utilizing factor analysis and regression analysis.

On the county level, the concern was to develop a model that would provide decision makers with monthly measures of one-family house construction at the time when they are needed for decision making. Since no data, on the variables used in the development of the state model, was available on the county level, the model is based on the one-family house permits series itself. In the model that emerged one-family house permits issued during a given month within a given county are obtained using direct reports received from permit issuing jurisdictions which issued at least fifty permits a year, and an estimate of permits issued in smaller places, which issued less than fifty permits annually.

Limitations

Not all jurisdictions in the United States require building permits to be taken out prior to construction. For these areas, no direct measurement of construction activity exists and they will not be included in the analysis. The activity of non-permit issuing areas is estimated to account for about 15% of the total number of one-family houses built within a year in the United States. Through the efforts of the Bureau of the Census, however, the importance of these areas is steadily diminishing, as new permit issuing jurisdictions are being established.

Methodology Employed in the Study

Now we turn to the methodology employed in developing estimating models for one-family house construction.

Hypotheses. In general, the hypotheses represent the philosophy that concurrent measurements are superior in obtaining estimates to measures made in the past. When relationship to other variables is postulated, variables on which direct measurement is available are superior to variables which represent estimates made by others. The criterion measure in testing the hypotheses is the coefficient of determination which represents the proportion of total variance explained by the model. The coefficients of determination are defined below:

R_1^2 = coefficient of determination obtained using a sample of permit places.

R_2^2 = coefficient of determination obtained using variables measured directly in the period being estimated.

R_3^2 = coefficient of determination obtained from equation using variables selected for inclusion via factor analysis.

R_4^2 = coefficient of determination obtained using lagged independent variables.

R_5^2 = coefficient of determination obtained using regional estimating equations.

In terms of these coefficients of determination the following hypotheses were postulated:

1. State estimates of the number of one-family house permits obtained using direct reporting from a sample of permit issuing places are superior to estimates using explanatory variables.

$$R_1^2 > R_2^2, R_3^2$$

The estimates based on direct reporting from a sample of the largest permit places can be expressed by the equation:

$$Y_t = f(LPP_t)$$

Underlying this hypothesis is the assumption that current measurement on the dependent variable, even if it is only a sample, will be superior to estimates based on relationships with other variables.

2. State estimates obtained using explanatory variables for which direct measurement, for the period being estimated, are available, are superior to estimates obtained utilizing variables not directly measured during this period.

$$R_2^2 > R_3^2$$

The estimates obtained from direct measurement can be expressed by

$$Y_t = f(X_{ti})$$

If a variable is not directly measured in the period of interest it has to be estimated, thus adding estimating error to the already existing measurement error. Thus estimates of Y which are not based on estimates of other variables should be superior to those that are.

3. State estimates obtained utilizing regional estimating equations are superior to estimates obtained using national equations.

$$R_5^2 > R_2^2, R_3^2, R_4^2$$

The regional estimates can be expressed by the formula

$$Y_R = f(X_{Ri})$$

This hypothesis is based on the assumption that there exist regional differences in the relationship of one-family house permits to other variables. These differences are assumed to be significant enough to improve the quality of estimates, if they are introduced.

4. Estimates based on lagged independent variables are inferior to estimates based on concurrent measures of these variables.

$$R_2^2 > R_4^2$$

The formula to express the lagged relationship is

$$Y_t = f(X_{i(t-s)})$$

One-family house construction is a leading series and it is more likely to lead the explanatory variables than to follow them. Thus, the closer the measurement to the current period the better the estimates obtained.

In general the philosophy underlying these hypotheses is that the closer the measurement to the period being estimated, the better the estimate.

Thus, it is expected that R_1^2 will be larger than R_2^2 which in turn will be larger than R_3^2.

To test the hypotheses two types of models were developed.

- County Model
- State Model

County Model. The county model is based on the assumption that current county activity can be estimated on the basis of direct measurement of current activity in the largest permit issuing places and past activity in small permit places.

$$Y_c = f(LPP_c, SPP_c)$$

Where:

Y_c -- estimate of one-family house construction within a county.

LPP_c -- measured activity in Large Permit Places (places issuing fifty or more permits annually) within the county.

SPP_c -- estimate of activity in Small Permit Places (places issuing less than fifty permits annually) based on past activity of these places and rate of change in LPP_c from the base period into the current period.

The county model is described in detail in Chapter VI.

State Model. The development of the state model proceeded through the following stages:

1. Selection of variables to be included in analysis.
2. Factor analysis in order to identify the structure underlying the variables selected.
3. Regression analysis to obtain estimating equations.

The state model is described in detail in Chapter III.

Procedure Followed

The approach employed was to proceed from establishing the need for one-family house construction activity information, through conceptual foundations of the study, towards building of the models and evaluation of results.

In this chapter the importance of one-family house construction activity data is discussed. Government at different levels -- federal, state and local need the information for planning services and estimating receipts. The business community needs the data mainly for marketing decisions in estimating the demand for its products, setting sales goals, evaluating the sales force's performance, etc. The available measures of one-family house construction were presented. Of the three:

- building permits
- starts
- value put in place

building permits were selected since they provide direct measurement of one-family house construction for small areas. The other two measures represent estimates made by the Bureau of the Census on the basis of permit information.

The "state of the art" is presented in Chapter II. The existing housing models, on national and regional levels, are discussed and current methodology used in small area estimating is presented.

Two models were developed to provide one-family house estimates; the state model utilizes independent variables in obtaining one-family house estimates. The conceptual development of the state model are described in Chapter III. Two types of multivariate analysis were employed in building that model: factor analysis and regression analysis.

The results of factor analysis are described in Chapter IV.

Regression analysis and the test of hypotheses involving the state model are described in Chapter V.

The county model is described in Chapter VI; after the need for monthly county information is established, the model is presented. The results of the analysis of deviations of estimates obtained using the model from actual reports received by the Bureau of the Census are discussed.

The estimates obtained by both models are compared to actual Census reports in Chapter VII.

Chapter VIII contains the summary, conclusions, and recommendations for future research.

CHAPTER II

CURRENT STATE OF THE ART

The art which is the concern of this chapter, is that of estimating housing, by county, by month. At the present, this combination does not exist, but there exist housing models (some monthly), and there are in existence methods of obtaining county estimates -- albeit not by month and not for housing. Thus, what we will attempt here is to describe the state of art of estimating housing and the state of the art of obtaining county estimates for other phenomena.

Existing Housing Models

As in every estimating, the methods used for estimating housing run the gamut from "hard" methodology applied to "soft" facts to "soft" methodology applied to "hard" facts. The most sophisticated methodology is used in econometric models -- sometimes with very "soft" facts, the least sophisticated methodology is that of judgmental models.

National models will be discussed on two levels:

- Econometric Housing Models
- Judgmental Housing Models

This will be followed by a review of regional models.

Econometric Housing Models: On March 4th and 5th 1971 a conference on housing models was held in Washington D. C. under the sponsorship of of the Federal Home Loan Bank System. The sponsors invited researchers known to have worked in the field. As a result of the conference National Housing Models was created.[1] To date it represents the only description of the state of the art in estimating housing. As the title implies, the book deals with national models, recently some work has been done on regional models but the results have not yet been published in books or professional publications and are usually available only as handouts at the conferences at which they are presented.

Of the eleven models presented in the book, one is monthly, nine are quarterly, and one is annual.

Other characteristics of the models are summarized in the following tables.

Table 2.1 shows for each model the type of period covered, number of observations used in deriving the model, number of exogenuous variables used, and the method of estimating used in deriving the model.

The period covered for the purpose of the model ranges from 8-1/2 years used in the DHL III model to 16 years used in the WHARTON

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[1]Bruce R. Ricks (ed.), National Housing Models, Lexington, Massachusetts: Lexington Books, 1973.

TABLE 2.1

CHARACTERISTICS OF NATIONAL HOUSING MODELS

MODEL	TYPE OF PERIOD COVERED	NUMBER OF OBSERVATIONS	NUMBER OF EXOGENOUS VARIABLES	METHOD OF ESTIMATION
BRADY	QUARTERLY	40	7	OLS and Two Stage Least Squares
BROOKINGS	QUARTERLY	48	8	OLS
DHL III	QUARTERLY	34	5	OLS
DRI	QUARTERLY	70	7	OLS
FAIR	MONTHLY	127	18 (11 monthly seasonal dummy variables, 1 working day in month)	Restricted Two Stage Least Squares
FRB-MIT-PENN	QUARTERLY	56 to 59	17	OLS
HUANG	QUARTERLY	51	10	OLS and Two Stage Least Squares
MAISEL	QUARTERLY	60	8	OLS
OBE	QUARTERLY	45	14	OLS
WHARTON ANNUAL	ANNUAL	16	12	OLS
NEW WHARTON QUARTERLY	QUARTERLY	64	8	OLS

Source: Ricks, R. Bruce (ed.). National Housing Models. Lexington, Massachusetts: Lexington Books, 1973. pp. 137-152.

models. The calendar period included in the models consists of late fifties and the sixties.

The number of exogenous variables varies from 5,used in the DHL III model,to 17,used in the FRB-MIT-PENN model. While the FAIR monthly model uses 18 exogenous variables 12 of them are dummy variables built into the model due to its monthly character, thus only 6 exogenous variables represent real phenomena observations. All of the models used least squares as the estimation method, two of the models - BRADY and HUANG supplemented the Ordinary Least Squares method by the Two Stage Least Squares method. FAIR used Restricted Two Stage Least Squares in his model. Thus the methods used are the traditional methods used in deriving econometric models.

Table 2.2 describes the nature of starts variables used by the models. Five of the models: DHL III, DRI, FAIR, MAISEL, and WHARTON ANNUAL use total starts without decomposing them by type.

Four of the models: FRB-MIT-PENN, HUANG, OBE, WHARTON QUARTERLY use unit value variables derived from the units started series. Of these three decompose the total by type of structure, one decomposes by farm and nonfarm housing.

The remaining two models: BRADY and BROOKINGS decompose starts by type of structure.

Table 2.3 lists the exogenous variables used by the various models. The variables are grouped into 7 major categories: Interest Rates, Credit Availability, Rationing, Capital Stock and Inventory, Income and Wealth, Demographics,and Time Trend.

All models have a variable indicating the interest rate level,

TABLE 2.2

START VARIABLES USED IN NATIONAL HOUSING MODELS

MODEL	# OF START VARIABLES	START VARIABLES
BRADY	7	Total Starts, Total Starts Excluding Mobile Homes, Total Single Family Starts, Conventional Single Family Starts, FHA Multifamily Starts, VA Multifamily Starts, Mobile Homes Starts
BROOKINGS	5	Total Nonfarm Starts, Single Family Nonfarm Starts Two Family Nonfarm Starts Single and Two Family Nonfarm Starts Multiunit Nonfarm Starts
DHL III	1	Total Nonfarm Starts
DRI	1	Total Starts
FAIR	1	Total Nonfarm Starts
FRB-MIT-PENN	2	Start Value Variables: Real Value Per Person (25-64) Expected to Live In One and Two-Family Units and Mobile Homes Real Value Per Person (20-24, 65+) Expected to Live in Multifamily Units
HUANG	4	Real Expenditure Demand Functions: Single Family Units Multifamily Units Real Construction Expenditure Supply Function Single Family Units Multifamily Units
MAISEL	1	Total Starts
OBE	2	Real Value Variables Real Value Per Person (25-64) Expected to Live in One- and Two-Family Units Real Value Per Person (20-24, 65+) Expected to Live in Multifamily Units

TABLE 2.2 -- Continued

START VARIABLES USED IN NATIONAL HOUSING MODELS

MODEL	# OF START VARIABLES	START VARIABLES
WHARTON ANNUAL	1	Total Nonfarm Units
NEW WHARTON QUARTERLY	5	Expenditure Variables Real Nonfarm Residential Construction Expenditure Total Real Residential Expenditure Nonfarm Residential Expenditure Farm Residential Expenditure Total Residential Expenditure

Source: Ricks, R. Bruce (ed.). National Housing Models. Lexington, Massachusetts: Lexington Books, 1973.

all but three (DHL III, DRI, FAIR) use various indices to represent prices. BRADY, FAIR, FRB-MIT-PENN, HUANG, and MAISEL use variables to ascertain availability of mortgages from various sources.

The Capital Stock and Inventory Factors variables used by the models are derived, since there is no direct measure available of housing inventory over time.

All models, with the exception of BRADY and FAIR use disposable income or consumption as measures of Income and Wealth.

In reviewing the variables used in the models, both as dependent and independent, one is struck by the amount of "soft" data. Most variables used are not directly measured but represent estimates made either by the researcher himself or somebody else. Is there value in using rigorous mathematical methods on "soft" data? Should not the effort be first directed towards generating reliable data series? I think it should.

Since a large number of observations is needed in order to achieve stability, the econometric models covered a fairly long span of time. It is questionable whether the economic conditions within these periods justify their extrapolation into the future.

Judgmental Housing Models: Robinson Newcomb has long been acknowledged as an expert on the construction industry. His method of estimating construction activity is less formal than the econometric methods used in the previously described models. In long range

TABLE 2.3

EXOGENOUS VARIABLES USED IN NATIONAL HOUSING MODELS

Model	Interest Rates	Prices	Credit Availability: Change in Flows	Credit Availability: Rationing
BRADY	Conventional mtg FHA ceiling	Construction cost	FHLBB advances	Loan/value ratio
BROOKINGS	Bill rate	Real value per start	Only through bill rate levels	
DHL III	(See credit)	None		Interest rate inequality
DRI	New corporate	None		Interest rate inequality
FAIR	FHA new home	None	S&L, mutual savings banks, FHLBB advances	Change in FHA new home interest rate
FRB-MIT-PENN	Cost of capital	Housing services construction cost	S&L mtg. com., FNMA acq., MSB mtg. com., life ins. new mtg. com.	Dummy for 1966
HUANG	Commercial paper	Rent/house price Rent/CPI; house price	Free reserves	Loan/value ratio amortization period
MAISEL	Conventional mtg. FHA 203 new	Rent/construction cost	FNMA acq., FHLBB advances, est., invest in mtg. S&L and MSB life ins. net acq. mtg.	
OBE	Cost of capital	Housing services/ construction cost		Interest rate inequality
WHARTON ANNUAL	(See credit)	Housing services/ construction cost	Interest rate differential	
NEW WHARTON QUARTERLY	(See credit)	Rent/ construction cost	Interest rate differential	

TABLE 2.3 -- Continued

EXOGENOUS VARIABLES USED IN NATIONAL HOUSING MODELS

Model	Capital Stock and Inventory Factors	Income & Wealth	Demographic
BRADY	None	None	None
BROOKINGS	Lagged starts vacancies	Real disposable income per household	Only in income
DHL III	Lagged starts	Real disposable income per household	None
DRI	Change in real stock; lagged starts	Real disposable income change	Marriages
FAIR	Lagged starts as stock	None	None
FRB-MIT-PENN	Real stock	Net worth change and real consumption per capita	Age Groups
HUANG	Value of excess supply; lagged demand & starts values	Real disposable income	None
MAISEL	Lagged starts vacancies	Real disposable income per household	Only in income
OBE	Real stock	Real consumption per capita	Age Groups
WHARTON ANNUAL	Real stock	Real disposable income change	None
NEW WHARTON QUARTERLY	None	Real disposable income	None

forecasting of residential construction he uses information on:

- The state of the economy
- Household formation
- The proportion of household and public income alotted to housing
- The types of housing the market will support
- Public and private funds available for new home financing
- The cost of new home financing

In short range forecasting, Newcomb recommends basically the same approach, but stresses the unavailability of the necessary data and the delayed availability of the series that do exist. He feels that mathematical approaches to short range forecasting are inadequate due to the following data limitations:

1. Data on which forecasts are to be based are not available on time.
2. The data that do become available, are highly questionable (because they are usually not based on measurement, but rather represent projections derived by the issuing agency)
3. The significance of the data varies from year to year.

Thus, Newcomb's recommendation for short range forecasting is extrapolation of the long term trend based on what is believed to be the state of economy, politics, and financial conditions.[2]

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[2]Robinson Newcomb,"Housing and Other Construction", Methods and Techniques of Business Forecasting, Engelwood Cliffs, New Jersey: Prentice Hall, 1974, pp. 373-390.

Regional Models: The problems of data availability, timeliness, and reliability -- mentioned by Newcomb are even more acute when regional estimates are required.

Crow built a nationally linked model for the Northeastern Corridor of the United States. The states included in the Corridor are from north to south:

New Hampshire

Massachusetts

Rhode Island

Connecticut

New York

New Jersey

Pennsylvania

Delaware

Maryland

District of Columbia

Virginia

The model was built to be compatible with the WHARTON QUARTERLY model. Crows regional model is unidirectionally linked with the national WHARTON model -- i.e. it is assumed that national activity determines regional activity but not vice-versa.

The residential construction series, in Crow's model, is dependent on only Disposable Personal Income, since the national annual interest and price variables (included in the WHARTON model) did not improve the equation. The residential construction equation was derived by two stage least square method and was based on annual data for the period 1949-1963.[3]

Marcin, in projecting the demand for housing by type of unit and region for the U. S. Department of Agriculture followed the same approach -- relationships found on national level were extrapolated to the regions.[4]

Methodology Used in Small Area Estimates

Despite the interest in, and the need for, small area statistics, there is no literature on methodology. The only available formal description of methodology is that of the Population Division of the Bureau of the Census. The methods used by the Population Division are described below as a statement of the current "state of the art" in Small Area Estimating.

Throughout the years the Population Division of the Bureau of the Census has developed several methods for obtaining annual series of population estimates by county. The four currently in use are:

1. The Vital Rates Method
2. The Regression (ratio-correlation) Method
3. Component Method II
4. The Composite Method[5]

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[3]Robert Thomas Crow, "A Nationally-Linked Regional Econometric Model," Journal of Regional Science, 1973, Vol. 13, No. 2, pp. 187-203.

[4]Thomas C. Marcin, Projections of Demand for Housing by Type of Unit and Region, Agriculture Handbook, May 1972, No. 423, U. S. Department of Agriculture -- Forest Service.

[5]U. S. Bureau of the Census, Current Population Reports, Federal State Cooperation Program for Population Estimates, P26, No. 21, April 1973, p. 2.

A method of combining sample survey data with symptomatic indicators was developed by Dr. Eugene Ericksen.[6]

The problem that population estimators address themselves to, is obtaining county population for years between decennial population censuses. All methods used attempt to arrive at population estimates at a given time using information obtained from the last available Census of Population and current data on variables believed to be related to population.

The Vital Rates Method uses local birth and death statistics in obtaining local population estimates. The assumption underlying these estimates is that the relationship between the local and national birth and death rates remains constant since the last Census of Population.[7]

The Regression (ratio-correlation) Method offers multiple regression estimates of change in proportion of the state's population in the county using as independent variables change in the county's proportion in the state total of several indicators which reflect population change. This method assumes that, within the state, the relationship between the indicators and population remains constant.[8]

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[6]Eugene P. Ericksen, "A Method for Combining Sample Survey Data and Symptomatic Indicators to Obtain Population Estimates for Local Areas," Demography 10, May 1973, pp. 137-160.

[7]Donald L. Bogue, "A Technique for Making Extensive Population Estimates," Journal of the American Statistical Association, Vol. 4J, No. 250, April 1950, pp. 149-163.

[8]Peter A. Morrison, Demographic Information for Cities: A Manual for Estimating and Projecting Local Population Characteristics, Rand Report R-618-HUD, June 1971, pp. 18-23, 142-149.

Component Method II has been used by the Bureau of the Census in its state estimates for the past twenty years. The method compares actual school enrollment data to enrollment expected on the basis of the most recent Census and the birth rate since then.[9]

The Composite Method derives estimates of various age groups separately. The county estimate is the sum of the group estimates. Different indicators are used for the different sub-groups.[10]

Dr. Ericksen's method consists of estimating population on the basis of a sample of counties and symptomatic data such as that used by the population division in their estimates i.e. birth, death and school enrollment.[11]

The Bureau of Economic Analysis makes estimates of personal income by counties. These estimates are based on data collected from different sources, directly or indirectly, related to personal income. First, national and state estimates are obtained and these are allocated to counties on the basis of available county information. There is no formal uniform method in allocating income to counties -- different allocation methods are used for different states.[12]

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[9]U. S. Bureau of the Census, Current Population Reports, Series P.2J, No. 427, 436.

[10]Donald J. Bogue and Beverly Duncan, "A Composite Method for Estimating Postcensal Population of Small Areas by Age, Sex, and Color," in National Office of Vital Statistics, Vital Statistics--Special Reports, Vol. XLVII, No. 6, August 1959.

[11]Ericksen, op. cit.

[12]By Personal Communication.

The most widely known and most frequently used by business of all local area estimates are those appearing in the Annual Survey of Buying Power published by Sales Management. Despite the fact that county estimates of population, household income, and retail sales components such as, food, general merchandise, furniture and household appliances, automobiles and drugs are being published, the sources of the data and the methodology of obtaining it are not specified.[13]

There is no monthly data available on house construction activity by county. The Construction Division of the Bureau of the Census provides monthly information on Housing Starts for regions and the United States as a whole. The estimates provided are based on permit place information and a sample of areas in which local authorities do not require building permits.[14]

Reports on the number of building permits issued by selected permit places are issued monthly by the division two to three months after the closing of the month. The Division also issues annual reports on the number of the building permits issued by all fourteen thousand permit places.

Since not all counties are completely permit covered neither the monthly, nor the annual report, provides county data.[15]

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[13]Sales Management, 1973, Survey of Buying Power, July 1973.

[14]U. S. Bureau of the Census, Construction Reports, C20.

[15]U. S. Bureau of the Census, Construction Reports, C40.

Thus, the state of the art emerging from the above can be summarized as follows:

- While national econometric models of housing exist, their use of series usually based on estimates rather than direct measurements, put in question their usefulness. They tend to find relationships among assumptions made by the estimators of the series, rather than the phenomena themselves.
- Methods that take into consideration the quality of data used, such as recommendated by Newcomb, seem more appropriate.
- What regional work has been done so far, was basically an extrapolation of national relationships into the regions, thus the deficiencies of the national models are carried over, plus the assumption that relationships found to hold on the national level continue to be valid on the regional level.
- No body of theory has been developed so far for obtaining county estimates. The methods that exist seem to be ad hoc.
- There is no county data available on housing by month by county at a time needed for decision making.

CHAPTER III

STATE MODEL

Conceptual Framework

The state model was developed by assuming a functional relationship between the dependent variable = one-family house permits and other variables believed to be related to level of one-family house permits. $y = f\ (x_1 \ldots x_n)$

In developing the models we will follow the iterative stages in the selection of a model proposed by Box and Jenkins.

1. Based on theory and practice select a "useful class of models" for the problem at hand.
2. Using data and knowledge of the system, identify a model to be tentatively entertained.
3. Fit the model to data and estimate its parameters.
4. Through diagnostic checking ascertain how well the model fits the data.
5. If model is found to be adequate, use it in forecasting and control.[1]

In this chapter we will be concerned with the first step -- the identification of a "useful class of models" appropriate for the problem at hand. The two classes of models to be considered are those relating to:

- time series analysis, and
- multivariate techniques

[1]George E. P. Box and Gwilyn M. Jenkins, Time Series Analysis Forecasting and Control, San Francisco, California: Holden-Day, 1970, pp. 18-19.

Time Series Analysis

There are two main approaches to time series analysis:

- components analysis
- stochastic process analysis

Components Analysis, regards the time series as being composed of several influences or components which are generally taken to be trend and cyclical, seasonal, and irregular or random movements. Thus, the time series is represented by one of the models:

$$Y = T \times C \times S \times I \text{ or } Y = T + C + S + I$$

Where:

Y -- the observed value

T -- trend component

C -- cyclical component

S -- seasonal component

I -- irregular or residual component

When dealing with annual data the model becomes

$$Y = T \times C \times I \text{ or } Y = T + C + I$$

In this approach, trend and seasonal influences are often modeled in a deterministic manner; trend may be regarded as a polynomial of a given degree and the seasonal component may be modeled by a trigonometric function with given period and amplitude. Random influences are usually assumed to have a simple probability structure, and are treated as independent, identically distributed random variables having zero mean and finite variance. Because of the simple role of probability in this approach estimation of the trend and cyclical component, as well as the seasonal component, is carried out using fairly simple filtering procedures such as differencing, forming moving averages, considering ratios involving moving averages, and other similar methods rather than by using parametric statistical estimation procedures.

Developing suitable estimates of components is a delicate problem in time series analysis and these estimates obviously influence whatever forecasting model is developed subsequently. Despite important shortcomings, which include lack of rigorous definitions for TC and S and the fact that many unresolved inference problems remain, components analysis continues to occupy an important place in time series analysis. The literature is large and for over 70 years has received wide attention in both theoretical and applied fields.[2]

Stochastic Process approach regards a time series as an observed sample function representing a realization of an underlying stochastic process. A stochastic process can be stationary or non-stationary; it can be a moving average process, an autoregressive process, or one which involves both autoregressive and moving average terms. Moreover, associated with a stochastic process are the mean and autocovariance functions, the autocorrelation function, and its power spectrum. When two or more processes are considered, their cross-correlation functions, cospectra, and other characteristics may be examined. This injects a full array of probabilistic concepts and methods into time series analysis

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[2]W. Allen Spivey and William J. Wrobleski, Analyzing and Forecasting Time Series, Part I: Methodology, Working Paper No. 91. Bureau of Business Research, Graduate School of Business Administration, University of Michigan, Ann Arbor, Michigan, August 1974, pp. 1-7.

and forecasting. The more elaborate probability framework permits a more complete consideration of statistical estimation than is generally considered in components analysis.

Among stochastic process models we distinguish:

- Power spectra and Covariance Stationary Processes [3]
- Moving Average Processes [4]
- Autoregressive Processes [5]
- Autoregressive Moving Average Processes[6]
- Exponential Smothing Models [7]
- Box Jenkins Model [8]

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[3]R. B. Blackman and J. Tukey, The Measurement of Power Spectra, New York: Dover Publishing, 1959.

[4]M. G. Kendall and A. Stuart, The Advanced Theory of Statistics, Vol. 3, New York: Hafner Publishing Company, 1968.

[5]Box and Jenkins, op. cit.

[6]Ibid.

[7]Robert G. Brown, Smoothing Forecasting and Predictions of Discrete Time Series, Engelwood Cliffs, New Jersey: Prentice Hall, 1962.

[8]Box and Jenkins, op. cit.

The Box-Jenkins ARIMA model is the most sophisticated of stochastic process models. The Box-Jenkins procedure requires one to analyze the underlying probability structure of the time series by employing statistical inference.

In all time series analyses, we attempt to define the past observations in terms of a model of the series. When the parameters obtained via analysis of past data are used in forecasting, we assume that they are as applicable to the future as they were to describing the past. In times of drastic change this assumption is not realistic.

Another fallacy in using time series in forecasting is that the larger the number of observations used in developing estimates of parameters, the more stable the parameters, but not necessarily applicable to forecasting of the future.

In practice the time series in question often does not exist long enough in its present form to allow the researcher the development of stable parameters.

Multivariate Techniques

Time series analysis is concerned with the problem of expressing a variable in time "t" in terms of observations on this variable in periods "t-k".

$$Y_t = f(Y_{t-k})$$

Where:

t = the period of interest

k = 1, 2, ...n

In multivariate analysis the variable of interest is expressed in terms of other variables.

$$Y = f(X_i)$$

The explanatory variables may be developed from the data or selected a-priori. When the researcher has a set of variables and is interested in discovering the underlying structure of this set, he will use Factor Analysis.

When he is interested in expressing one variable in terms of others he will use Regression Analysis.

When his interest lies in testing for equality of means, he will use Analysis of Variance.

The general form of the multivariate model is:

$$Y_i = \sum bX_i + e_i$$

For the model to be valid the following assumptions are made:

1. The relationship is linear with respect to the b coefficients.
2. The X_i are independent normally distributed random variables.
3. The e_i are normally distributed with $E(e) = 0$ and known variance homoscedasticity.
4. The covariance e_{ij} is equal to zero when $i \neq j$ -- the error terms are independent.

Problems of usefulness of results arise when these assumptions are violated. In using the models, tests of the assumptions should be performed; if they indicate violation of the assumptions, transformations of the original data series will usually eliminate the problem.[9]

When time series are used in multivariate analysis, special problems arise with regard to the assumptions. If the X_i are not independent, assumption 2 is violated and there is multicolinearity in the system. Johnston lists the following consequences of multicolinearity:

1. The precision of estimation falls so that it becomes very difficult, if not impossible, to disentangle the relative influences of the various X variables. This loss of precision has three aspects: specific estimates may have very large errors; these errors may be highly correlated, one with another; and the sampling variances of the coefficients will be very large.
2. Investigators are sometimes led to drop variables incorrectly from an analysis because their coefficients are not significantly different from zero, but the true situation may be not that a variable has no effect but simply that the set of sample data has not enabled us to pick it up.
3. Estimates of coefficients become very sensitive to particular sets of sample data, and the addition of a few more observations can sometimes produce dramatic shifts in some of the coefficients.[10]

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[9]M. G. Kendall and A. Stuart, op. cit., Vol. 2; Donald F. Morrison, Multivariate Statistical Methods, New York: McGraw-Hill, Inc., 1967.

[10]J. Johnston, Econometric Methods, Second Edition, New York: McGraw-Hill, Inc., 1972.

The assumption of homoscedasticity is often violated when economic time series are used in analysis. Tests for identifying heteroscedasticity have been devised by Goldfield and Quandt[11] and Glejser.[12] Transformation of the data should be used in order to eliminate the problem.

In discussing time series analysis, we have seen that autocorrelation is used to advantage; in regression analysis, however, it presents a serious problem.[13] Test for autocorrelation have been devised by J. Von Neumann, Durbin and Watson, H. Theil, and others.[14]

If two series, with substantial autocorrelation coefficients, are used in regression analysis, the error estimates are not applicable. Methods of adjusting for autocorrelation have been developed by Bartlett and Wald.[15]

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[11] S. M. Goldfield and R. E. Quandt, "Some Tests of Homoscedasticity," Journal of American Statistical Association, Vol, 60, 1965, pp. 539-597.

[12] M. Glejser, "A New Test for Heteroscedasticity" Journal of American Statistical Association, Vol. 64, 1968, pp. 316-323,

[13] The terms "autocorrelation" and "serial correlation" are used interchangeably in literature. When cross sectional analysis is performed, it is customary to refer to the phenomenon as "autocorrelation," when analysis is performed on time series data, the term "serial correlation" is used.

[14] Johnston, op. cit., pp. 243-266.

[15] Mordicai Ezekiel and Karl Fox, Methods of Correlation and Regression Analysis, New York: John Wiley and Sons, Inc., 1959, p. 325.

One simple way of reducing the effects of autocorrelation is to use the series of first difference instead of the original values, i.e. a series of changes in the phenomena from one observation to that immediately following it.[16]

Econometric models are a special case of regression models. Evans defines econometrics as the use of statistical and mathematical techniques to measure results hypothesized by economic theory. Equations included in econometric models may be either stochastic (include error terms) or identities.[17] Since econometrics deals with economic time series it is also concerned with autocorrelation and heteroscedasticity of error variances.

In order to obtain meaningful estimates from a regression equation the new observations should be within the range of the observations in the sample, otherwise the estimates would not be within the error estimates obtained from the sample, since there is no assurance that the new observations belong to the same universe from which the sample has been drawn.

Since the distribution of a time series is not likely to be normal (assumption 1),the applicability of equations derived to future observations is questionable.

Selection of Variables. The variables to be included in a regression equation can be selected in various ways:

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[16] Ezekiel, op. cit., pp. 322-340.

[17] Michael K. Evans, Econometric Models, Methods and Techniques of Business Forecasting, William F. Butler, Robert A. Kavesh, Robert B. Platt, Engelwood Cliffs, New Jersey: Prentice Hall, 1974, 161.

- All variables are selected a-priori and only the coefficients S_{yx}, and R^2 are estimated in the analysis. This method of selection is often utilized by economists who specify the relationship among the variables prior to the analysis.
- Use of factor analysis. Factor analysis reveals the latent structure of a system of variables. The results of the analysis can be used directly in estimating, or the variables, with the highest loadings on a given factor,selected to be included in a regression equation.
- Use of techniques which allow inclusion of variables which contribute most to the explained variation. The major methods used are: forward inclusion, backward elimination, stepwise solution, and optimal selection.

In forward inclusion variables are selected one by one for inclusion in the equation so as to maximize the increment of variance explained. In backward elimination one starts with an equation which includes all variables. Variables are eliminated from the equation when they do not contribute enough to the explained variation. The stepwise solution incorporates forward inclusion and backward elimination.

All of the methods of variable selection discussed so far took into consideration variables one at a time. These procedures may not select the best possible subset of variables. Beale, Kendall and Mann proposed a tree search algorithms to obtain an equation which includes the optimal set of variables.[18]

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[18]E. M. L. Beale, M. G. Kendall, and D. W. Mann, "The Discarding of Variables in Multivariate Analysis," Biometrica, Vol. 54, No. 3, pp. 357-366.

Boyce, Farhi, and Weischedel have written a computer program which accomplishes the optimal selection recommended by Beale et altera.[19]

So far in this chapter we considered the statistical models available for derivation of an estimating model for one-family house construction activity. Time series analysis provides means of developing a model based solely on the series of one-family house activity, but requires a large number of observations and its predictive power is difficult to assess. Multivariate techniques allow development of a model based not only on the series itself, but also on other variables.

Since time series analysis requires a large number of observations it was not considered an adequate method to develop a model of one-family house permits. Especially since the nature of the series has changed over the years as new permit issuing jurisdictions were being included in the series. Thus, over a long period of time, the series was not covering the same universe.

Multivariate techniques, on the other hand, allow use of explanatory variables to explain variation in permits over a shorter time span within which the series remain homogeneous.

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[19] O. E. Boyce, A. Farhi, and R. Weischedel, Optimal Subset Selection Multiple Regression, Interdependence, and Optimal Network Algorithms. Berlin: Springer-Verlag, 1974.

Following Box and Jenkins' iterative steps, the rationale used in building a state model of one-family house construction activity is presented.

The purpose is to build a model for estimating one-family house construction which will provide timely estimates for local areas. Local areas will be defined as areas equal to or smaller than a state, by timely estimates we mean estimates which are available prior to the time when measures of one-family house construction are available from the Bureau of the Census.

In building the model, an attempt will be made to obtain estimates based on direct measurements of independent variables and not on variables which themselves represent somebody's estimates.

Another principle proposed by Box and Jenkins will be utilized in building the model: the principle of parsimony. This principle requires to employ the smallest possible number of parameters, whose values must be estimated from the data, for adequate presentation.[20]

Selection of Variables

Criterion Measurement

In Chapter I the possible measures of one-family house construction activity were presented. It was shown that of the three

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[20] Box and Jenkins, op. cit., p. 17.

measures:

- permits issued
- starts
- value put in place

permits were the most desirable, because they were available for local areas and were based on direct measurement. Thus, permits will be our criterion measure, i.e. the dependent variable in the model.

Independent Variables.

In reviewing existing housing models in Chapter II, we saw that the econometric models described included variables which measured:

Interest Rates
Credit Availability
Capital Stock
Income and Wealth
Demographic Characteristics

These categories represent mostly supply variables and contradict Huang's statement that "analysis in the housing field placed almost total reliance on factors influencing demand."[21]

It is conceivable that the emphasis of economists has changed since the sixties; Huang's statement was based on Grebler's and Maisel's

[21] David S. Huang, "A Study of the Market for New Housing Units," 1969 Proceedings of the Business and Economic Statistics Section, American Statistical Association, Washington, D.C., 1969, p. 747.

review summarizing the experience prior to 1963.[22]

Most of the models reviewed in Chapter III use both supply and demand variables to determine housing activity.

Fair, for example, in his monthly Housing model defines demand for housing is a function of:

Population

Income

The number of houses already in existence

The purchase price of new houses

The cost of obtaining mortgage funds

His supply is a function of:

Price of houses

The cost of building houses (material, supplies, and labor cost)

The cost of short term credits[23]

In developing our model, we assume the demand for one-family houses to be a function of:

- size of population
- income
- availability and cost of alternate housing

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[22]Leo Grebler and Sherman Maisel, "Determinants of Residential Construction: A Review of Present Knowledge", Impacts on Housing Policy, Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1963.

[23]Ray C. Fair, Monthly Housing Starts, in National Housing Models, Lexington Books, Lexington, Massachussetts, 1973, p. 70.

- availability and cost of mortgage funds
- expectations of future supply

Supply of one-family houses is a function of:

- availability of resources
- alternate uses of resources
- availability of mortgage money
- expectations of future demand

While the demand and supply equations can be specified separately, it is impossible to obtain independent measurements on each; the only points that we are able to observe in reality are points at which supply and demand equal each other, since in the short run the market is always in equilibrium, and all of our observations are in the short run. Thus, in the short run, the observed values are a function of both demand and supply.

The variables were selected for inclusion in the analysis because they satisfied the following criteria:

- were defined as supply or demand determinants
- data for them was available on the state level
- the content of the series has not changed during the period for which data were collected.

The variables selected through application of these criteria are described below. (See Table 3.1)

X_2 - Value of Mortgage Loans made for New House Construction by members of the Federal Home Loan Bank Board (FHLB).

- Represents the mortgage funds available to home buyers.
- Effects the supply of one-family houses - if mortgage funds are not expected to be available, builders cannot expect to sell the houses they built.
- Lags permits at the time it is being reported, but expectations about its availability influence builders decisions about future construction.[24]

X_3 - Civilian Population - An estimate developed by the Population Division of the Bureau of the Census.

- Effects demand for housing - as population increases, with relation to the existing housing inventory, so does the demand for housing.

X_4 - Housing Inventory - Available only in decennial censi. Represents a measure of available housing stock.

- If inventory is greater than total demand, no supply of new housing is generated.
- If inventory is smaller than demand, no demand for new housing is generated.

X_5, X_6 - Interest return on FHLB Mortgage Loans.

- The price of mortgage money available .
- Available only on regional level.
- As the rate increases demand for mortgages, ergo housing, decreases.

X_7 - Number of households - Estimate made by the Population Division of the Bureau of the Census.

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[24] Huang, ibid.

- As the number increases the demand for housing increases.

X_8 - Personal Income by Place of Residence - Estimates made utilizing various data available.

- As income increases the demand for housing increases.

X_9 - Contract Construction Income

- A measure of construction industry activity.
- An increase may effect housing either way - if the return on other construction is higher than on housing - may decrease supply of housing; if profitability of housing construction is higher than in other construction - may increase supply of housing.

X_{10} - Number of FHA Insured Home Mortgages

X_{11} - Dollar Volume of FHA Insured Home Mortgages

- Measures of availability of mortgage funds; increase causes increase in housing.

X_{12} - Square Feet of New Non-Residential Construction Floor Area

- Measure of construction activity.
- Use of resources competes with housing.
- When there is a surplus of resources for non-residential construction, resources become available to housing construction.

X_{13} - Square Feet of New Residential Construction Floor Area

- Includes one-family and multi-family dwellings.

X_{14} - Number of FHA Insured Mortgages for New One-Family Houses

X_{15} - Dollar Volume of FHA Insured Mortgages for New One-Family Houses

- These two variables represent the availability of mortgage funds to purchasers of new one-family houses.

X_{16} - Number of Employees Employed by General Building Contractors

X_{17} - Taxable Payroll of General Building Contractors

- These variables measure construction activity, can effect housing either way.

X_{18} - Number of Employees Employed by Special Trade Contractors

X_{19} - Taxable Payroll of Special Trade Contractors

- Mostly a measure of housing construction activity - mostly but not exclusively used in housing.
- Change should effect housing in the same direction; i.e., increase will cause increase in housing, decrease will cause decrease in housing.

X_{20} - Number of New Housing Units Constructed in Apartment Buildings

- Represents supply of new housing units in apartment buildings. Both one-family houses and apartment buildings satisfy the total demand for housing.
- The extent to which they are substitutes is not clear. For some individuals, under given conditions, an apartment is not an alternative to a one-family house, for others it may represent a substitute.

- From the supply point of view, it does represent an alternative use of some resources used in construction of one-family houses.

If we identify the variables according to their predominant characteristics as demand or supply determinants, the following groupings emerge.

Demand Variables. Within the demand variables category included are socio-economic measures (X_3 - Civilian Population, X_7 - Number of Households, X_8 - Personal Income by Place of Residence), Measures of the existing housing inventory (X_4), measures of new construction of substitutes to one-family houses (X_{13} - Square Feet of New Residential Construction Floor Area X_{20} - Number of New Housing Units Constructed in Apartment Buildings).

The demographic variables (Civilian Population and Number of Households) are not measured directly between decennial censi, thus measures included in the analysis represent estimates developed by the Population Division of the Bureau of the Census. The income measure represents estimates obtained using different formulae in individual states depending on the availability of data.

The new construction measures were obtained from F. W. Dodge Division of McGraw-Hill Information Systems Company by special permission and represent direct observations.

Supply Variables. Among supply variables are included measures of availability of mortgage funds (X_2 - Mortgage Loans Made for New Construction by Federal Home Loan Banks, X_{10} - Number of FHA

Insured Home Mortgages, X_{11} - Dollar Volume of FHA Insured Mortgages, X_{14} - Number of FHA Insured Mortgages for New One-Family Houses, X_{15} - Dollar Volume of FHA Insured Mortgages for One-Family Houses), measures of current level of construction activity (X_{12} - Square Feet of New Non-Residential Construction Floor Area, X_9 - Contract Construction Income, X_{16} - Number of Employees Employed by General Building Contractors, X_{17} - Taxable Payroll of General Building Contractors, X_{18} - Number of Employees Employed by Special Trade Contractors, X_{19} - Taxable Payroll of Special Trade Contractors, measures of cost of mortgages (X_5 - Interest Return on Federal Home Loan Banks Mortgage Loans Held - June, X_6 - Interest Return on Federal Home Loan Banks Mortgage Loans Held - December).[26]

Unlike demand variables, all of the supply variables represent direct measurement of the phenomena.

Mortgage information is based on reports received from member banks. Employment in the construction industry is based on reports filed under the State Unemployment Insurance Program.

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[26]The designation of Interest Return on Mortgage Loans as a supply variable is arbitrary. The variable could have been as easily designated as a demand determinant since in it, more than in all other variables considered, the equality of demand and supply at the point at which transactions are conducted reveals itself. The decision to include it among supoly determinants was made mainly based on the fact that it measures the banks' return rather than the rate paid by the borrowers.

TABLE 3.1

VARIABLES USED IN FACTOR AND REGRESSION ANALYSIS

VARIABLE	NAME	SOURCE
X_1	Number of New Privately Owned One-Family House Units Authorized in Permit Issuing Places	Construction Reports, C 40, Housing Authorized by Building Permits and Public Contracts.
X_2	Mortgage Loans Made for New Home Construction, FHLB, ($000)	Federal Home Loan Bank Board, Savings and Home Financing, Source Book.
X_3	Civilian Population, (000)	Current Population Reports, P-25, Population Estimates.
X_4	Housing Inventory	1970 Census of Housing
X_5	Interest Return on FHLB Mortgage Loans Held, June, (%)	Federal Home Loan Bankboard, Savings and Home Home Financing, Source Book.
X_6	Interest Return on FHLB Mortgage Loans Held, December, (%)	Federal Home Loan Bank Board, Savings and Home Financing, Source Book.
X_7	Number of Households, (000)	Current Population Reports, p-25, Population Estimates
X_8	Personal Income by Place of Residence, ($000,000)	Survey of Current Business, Vol. 54, No. 8, August 1974.
X_9	Contract Construction Income, ($000,000)	Survey of Current Business, Vol. 54, No. 8, August 1974
X_{10}	Number of FHA Insured Home Mortgages	HUD Statistical Yearbook

TABLE 3.1 -- Continued

VARIABLES USED IN FACTOR AND REGRESSION ANALYSIS

VARIABLE	NAME	SOURCE
X_{11}	Dollar Volume of FHA Insured Home Mortgages, ($000)	HUD Statistical Yearbook
X_{12}	Square Feet of New Non-Residential Construction Floor Area, (000)	McGraw-Hill Information Systems Company, F. W. Dodge Division; Proprietory Data Provided by Special Permission.
X_{13}	Square Feet of New Residential Construction Floor Area, (000)	McGraw-Hill Information Systems Company, F. W. Dodge Division; Proprietory Data Provided by Special Permission.
X_{14}	Number of FHA Insured Mortgages for New One-Family Houses	HUD Statistical Yearbook
X_{15}	Dollar Volume of FHA Insured Mortgages for New One-Family Houses	HUD Statistical Yearbook
X_{16}	Number of Employees Employed by General Building Contractors	County Business Patterns
X_{17}	Taxable Payroll of General Building Contractors, ($000)	County Business Patterns
X_{18}	Number of Employees Employed by Special Trade Contractors	County Business Patterns
X_{19}	Taxable Payroll of Special Trade Contractors, ($000)	County Business Patterns
X_{20}	Number of New Housing Units Constructed in Apartment Buildings.	McGraw-Hill Information Systems Company F. W. Dodge Division; Proprietory Data Provided by Special Permission.

Number of Observations

The stability of a model depends on the number of observations included in it; the larger the number of observations the more stable the model.

The very nature of time series creates a dependence among consecutive observations. But the movement over time also creates large differences among observations separated by long periods of time.

In other words, when selecting the number of observations from a time series one should consider the extent to which conditions over time influence the universe one wants to examine.

Ours is a time of rapid change and one almost intuitively excludes the possibility of drawing valid conclusions about an industry's or a company's future from an analysis performed on data remote from the present, and therefore, the future. How far can one go into the past in order to obtain stability of the model as well as stay within that universe which is the link between the past and future? This is an area in which judgment has to be exercised.

An attempt was made to obtain data for all the variables shown in Table 3.1, by state for the period 1968-1973. While monthly or quarterly data would have been desirable, none was available and even annual data was not available for all the years. Table 3.2 shows the years for which data was available for each one of the variables. Observations for the whole period 1968-1973 were available for X_1, X_2, X_3, X_5, X_6, X_7, X_8, X_9, X_{12}, X_{13}, X_{20}. In case of

TABLE 3.2

AVAILABILITY OF DATA BY VARIABLE, BY YEAR

VARIABLE	NAME	1973	1972	1971	1970	1969	1968
X_1	Number of New Privately Owned One-Family House Units Authorized in Permit Issuing Places	X	X	X	X	X	X
X_2	Mortgage Loans Made for New Home Construction, FHLB, ($000)	X	X	X	X	X	X
X_3	Civilian Population, (000)	X	X	X	X	X	X
X_4	Housing Inventory				X		
X_5	Interest Return on FHLB Mortgage Loans Held, June, (%)	X	X	X	X	X	X
X_6	Interest Return on FHLB Mortgage Loans Held, December, (%)	X	X	X	X	X	X
X_7	Number of Households, (000)	X	X		X		X
X_8	Personal Income by Place of Residence, ($000,000)	X	X	X	X	X	X
X_9	Contract Construction Income, ($000,000)	X	X	X			
X_{10}	Number of FHA Insured Home Mortgages		X	X	X	X	X

TABLE 3.2 -- Continued

AVAILABILITY OF DATA BY VARIABLE, BY YEAR

VARIABLE	NAME	1973	1972	1971	1970	1969	1968
X_{11}	Dollar Volume of FHA Insured Home Mortgages, ($000)		X	X	X	X	X
X_{12}	Square Feet of New Non-Residential Construction Floor Area, (000)	X	X	X	X	X	X
X_{13}	Square Feet of New Residential Construction Floor Area, (000)	X	X	X	X	X	X
X_{14}	Number of FHA Insured Mortgages for New One-Family Houses		X	X	X	X	X
X_{15}	Dollar Volume of FHA Insured Mortgages for New One-Family Houses		X	X	X	X	X
X_{16}	Number of Employees Employed by General Building Contractors		X	X	X	X	X
X_{17}	Taxable Payroll of General Building Contractors, ($000)		X	X	X	X	X
X_{18}	Number of Employees Employed by Special Trade Contractors		X	X	X	X	X
X_{19}	Taxable Payroll of Special Trade Contractors, ($000)		X	X	X	X	X
X_{20}	Number of New Housing Units Constructed in Apartment Buildings	X	X	X	X	X	X

the other variables, observations were available for some of the years but not for others. This points to a common problem in attempting to use data available from secondary sources in predictive models -- by the time the data is available it is useful only in ex-post-facto analysis.

The model developed is based on crossectional analysis of the data over a relatively short period of time. In a rapidly changing world the assumption that relationships among observed phenomena remain stable over time does not seem to be justified. Yet this is an implicit assumption made by the econometric models discussed earlier.

The data for this model was collected with the assumption that both geographic and temporal proximity are necessary to obtain a model that would express stable relationships.

Types of Analyses Performed

In order to obtain a state model of one-family house construction two types of multivariate analyses were performed:

- factor analyses
- regression analyses

Within each type serveral variations were used in order to develop a parsimonious model.

The purpose of factor analyses was to explore the structure underlying the system of variables selected for analyses and to determine which of the variables should be included in the estimating equation. The results of factor analyses are described in Chapter IV.

Utilizing the results of factor analyses, multiple stepwise regression analyses were performed in order to obtain estimating equations to test the hypotheses presented in Chapter I. A description of the results of regression analyses is given in Chapter V.

CHAPTER IV

STATE MODEL -- FACTOR ANALYSIS

In the previous chapter the approach used in building the state model was described. One of the methods of selecting variables to be included in estimating equations was factor analysis. In this chapter, the results of factor analysis will be described.

In the factor model each variable is represented as a linear function of a small number of unobservable common factor variables and a simple specific latent variate:

$$X_i = a_{i1} Y_1 + a_{i2} Y_2 + \ldots + a_{im} Y_m + e_i$$

where:

X_i -- the original variable

a_{ij} -- parameter reflecting the importance of the jth factor in composition of the ith variable

Y -- common factor j

e_i -- ith specific factor variate

In this model the number of factors (m) is always smaller than the number of variables (p) included in the analysis.

The model is useful in generating and testing hypothesis about the underlying structure of a data set.[1]

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[1]Donald F. Morrison, Multivariate Statistical Methods, New York: McGraw-Hill, Inc., 1967, pp. 259-300.

Several variations of factor analyses were performed in order to explore whether there exists an underlying structure among all the variables included in the model and to explore whether the various options provided by SPSS produce different results. While some researchers use factor analysis in order to obtain estimating equations, as a part of the analysis, here the sole purpose of the factor analysis was to obtain an explanatory model. Any row obtained in the factor matrix represents a variable in terms of the factors extracted - the problem in using this expression as an estimating equation is in obtaining the value of the factors for the period that one wants to predict.

Combinations of factor analyses and rotations were utilized. Below is a description of the types of factor analyses used, followed by description of rotations.

Types of Analysis Performed

The programs used to perform factor analysis provided options as to the types of analysis that could be performed. Options were also available with regard to rotations used in the analysis. Analysis was performed on combinations of factor analysis and rotations.

The types of factor analyses used are:

- Principal Factoring with Iterations (PA2)
- Rao's Canonical Factoring
- Alpha

PA2 - Principal Factoring with Iterations. This analysis is assumed to be performed on the universe of variables and cases. The purpose is to express the variables in terms of a small number of factors which account for most of the variance in the data set.

Unlike the Principal Component method, the Principal Factoring method produces inferred factors and uses iterations to improve the estimates of communalities.

In Rao's Canonical Factoring the purpose is to find a solution in which the correlation between the set of hypothesized factors and the set of data variables is maximized. Hypothesized factors are assumed to be determined by the linear combination of the common variance portion of the observed variables. Estimation of communality or unique variance becomes the central problem. This analysis assumes that the given correlation matrix is based on a sample of cases and attempts to estimate population parameters. (Variables are the entire universe of attributes.) Extracts the maximum number of factors to account for the correlation matrix.

Alpha follows the basic postulate in which variables are assumed to consist of two parts:

a) common factors

b) unique to each variable

Variables are considered to be a sample taken from a universe of variables. (In Rao's canonical - individuals are sampled but a total universe of observations is represented.)

Seeks to define factors that have maximum generalizability. (Measured by Kundu-Richardson's reliability coefficient or Cronback's alpha.) The number of factors retained is determined by the number of factors with positive generalizability.

We seek to make inferences about the universe of variables from a sample of variables; the population observed (states in our case) are a given population.

Variables are rescaled according to the communality (in Rao's - according to the variance estimate).[2]

Rotations Used

The purpose of rotation is to attain theoretically meaningful factors and a simple factor structure. Rotation of (usually) orthogonal axis are performed so as to bring them closer to clusters of variables. Oblique rotation is more flexible - the angle between the axis does not have to be 90°. Given the fixed number of factors and the fixed amount of variance accounted for by those factors - how do we go about simplifying the rows and, or, columns of the factor matrix? This is accomplished by making as many values as possible close to 0. Both simplifications ultimately lead to the same simple structure.

[2]Norman H. Nie, Dale H. Bent, C. Hadlai Hull, Statistical Package for the Social Sciences, New York: McGraw-Hill, Inc., 1970, passim.

The types of rotations used in combinations with types of analysis are:

- Varimax
- Quartimax
- Equimax
- Oblique

Varimax centers on simplifying the columns of the matrix. A simple factor in varimax will have only 1's and 0's in the column. This is equivalent to maximizing the variance of the squared loadings in each column, hence the name, varimax, maximum variance.

Quartimax's purpose is to obtain maximum complexity for the variable; i.e. rotate the axis in such a way that a variable will load high on one factor but almost 0 on all others. It is achieved by minimizing the cross-product of factor loadings for the variable.

Equimax is a compromise between Varimax and Quartimax -- tries to simplify both the rows (variables) and columns (factors) to some extent.

Oblique rotation uses the same simplification principles as orthogonal rotations but the orthogonality requirement is dropped. This allows having the axis dependent solely on the clustering of variables.[3]

Time Periods and Variables Analyzed in Factor Analysis

The lack of annual state data for all variables made it necessary to define variables in terms of the years for which observations were available. This brought the number of variables up to 102. (See note at Table 4.1.

[3]Op. cit., passim.

Because of the limitations of the SPSS program the whole system of variables, as shown in Table .1, could not be used in a single analyses.[4]

Therefore, the analysis was performed for the whole period 1968-1973 for only those variables for which observations were available for all the years. In order to use all the information represented by the variables and explore the importance of even those for which only a few observations were available, an additional analysis for the period 1968-1971 was performed. The variables included in the analyses of those two periods are shown in Table .1. The 1968-1971 analysis was also done by region, as defined in Table B1.

In addition, for the period of 1968-1973, an analysis was performed on the first differences between the annual observations.[5]

Results of Factor Analysis

The factors extracted and the percent of total variance of the system, for which they accounted, are shown in Table .2. The change of rotation does not effect the number of factors extracted. The portion of total variance explained, varies only slightly, by type of factor analysis.

A test of goodness of fit of the factor model to the system of variables, on national level, proved it to be a good fit with $\alpha \leq .001$ for all types of analysis in both periods. The test

[4] The program cannot accommodate more than 80 variables.

[5] Because of lack of observations for all variables, analysis of first differences could not be performed for the 1968-1971 period.

TABLE 4.1

VARIABLES INCLUDED IN FACTOR ANALYSIS

BY PERIOD

PERIOD	VARIABLE NUMBER			
1968-1971	X_{801}	X_{901}	X_{001}	X_{101}
	X_{802}	X_{902}	X_{002}	X_{102}
	X_{803}	X_{903}	X_{003}	X_{103}
			X_{004}	
	X_{805}	X_{905}	X_{005}	X_{105}
	X_{806}	X_{906}	X_{006}	X_{106}
	X_{807}		X_{007}	
	X_{808}	X_{908}	X_{008}	X_{108}
	X_{810}	X_{910}	X_{010}	X_{110}
	X_{811}	X_{911}	X_{011}	X_{111}
	X_{812}	X_{912}	X_{012}	X_{112}
	X_{813}	X_{913}	X_{013}	X_{113}
	X_{814}	X_{914}	X_{014}	X_{114}
	X_{815}	X_{915}	X_{015}	X_{115}
	X_{816}	X_{916}	X_{016}	X_{116}
	X_{817}	X_{917}	X_{017}	X_{117}
	X_{818}	X_{918}	X_{018}	X_{118}
	X_{819}	X_{919}	X_{019}	X_{119}
	X_{820}	X_{920}	X_{020}	X_{120}

TABLE 4.1 -- Continued

VARIABLES INCLUDED IN FACTOR ANALYSIS

BY PERIOD

PERIOD	VARIABLE NUMBER *					
1968-1973	X_{801}	X_{901}	X_{001}	X_{101}	X_{201}	X_{301}
	X_{802}	X_{902}	X_{002}	X_{102}	X_{202}	X_{302}
	X_{803}	X_{903}	X_{003}	X_{103}	X_{203}	X_{303}
	X_{806}	X_{906}	X_{006}	X_{106}	X_{206}	X_{306}
	X_{808}	X_{908}	X_{008}	X_{108}	X_{208}	X_{308}
	X_{812}	X_{912}	X_{012}	X_{112}	X_{212}	X_{312}
	X_{813}	X_{913}	X_{013}	X_{113}	X_{213}	X_{313}
	X_{820}	X_{920}	X_{020}	X_{120}	X_{220}	X_{320}

* The year of observation has been incorporated as the first digit of the variable number. Thus X_{801} or variable X_1 is 1968, X_{901} - X_1 in 1969, etc.

TABLE 4.2

PERCENT OF TOTAL VARIANCE ACCOUNTED FOR BY EACH FACTOR
BY TYPE OF FACTOR ANALYSIS

PERIOD	FACTOR	TYPE OF ANALYSIS		
1968-1971		PA2	RAO	ALPHA
	1	79.8%	80.6%	80.0%
	2	15.2	14.7	14.7
	3	3.4	3.4	3.4
	4	1.6	1.6	1.9
TOTAL		100.0	100.0	100.0
1968-1973				
	1	80.5	83.7	80.6
	2	14.5	11.9	14.4
	3	5.0	4.4	5.0
TOTAL		100.0	100.0	100.0

was performed using Lawley's formula [6]

$$\chi^2 = [N-1-1/2(2p+J)-2/3m]\sum_{i<}\sum_j \frac{(S_{ij}-\hat{\sigma}_{ij})^2}{\psi_i\psi_j}$$

$$\gamma = 1/2\ [1/2[(p-m)^2-p-m]$$

where:

N -- number of observations

p -- number of variables in the analysis

m -- number of factors extracted

S_{ij} -- original covariance value

$\hat{\sigma}_{ij} = \sum_{h=1}^{m} \hat{\lambda}_{ih}\hat{\lambda}_{ih}$ -- covariance after factor extractions

ψ_i -- residual variance for variable i unaccounted for by the factors

v -- degrees of freedom.

Because of the high number for degrees of freedom χ^2 was computed using the formula: [7]

$$\chi^2_\alpha = v(1-\frac{2}{9v}+Z_\alpha\sqrt{\frac{2}{9v}})^3$$

where:

v -- degrees of freedom

Z_α -- standard normal deviate for α level of significance

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[6] Donald F. Morrison, Multivariate Statistical Methods, New York: McGraw-Hill, Inc., 1967, 269.

[7] William M. Meredith, Basic Mathematical and Statistical Tables for Psychology and Education, New York: McGraw-Hill, Inc., 1967, p.247.

Results of 1968-1971 Analysis

As stated earlier, for the period 1968-1971 analysis was performed on different levels:

- National Level
- Regional Level

The results obtained for each level will be discussed below.

Table B2 shows for each combination of type of analysis and rotation the variables with the highest loadings on the four factors extracted in the national level analysis. While the variables selected as most important determinants of the factors remain the same regardless of type of analysis, their assignment to specific factors varies by rotation.

Based on the variables with the highest loadings on it (at least in six out of the twelve combinations analyzed) factor 1, can be said to represent the socio-economic conditions and the level of construction activity. In order of their importance, these variables are:

X_3 -- Civilian Population

X_7 -- Number of Households

X_{18})
X_{19}) -- Activity of Special Trade Contractors

X_8 -- Personal Income

X_{12} -- Square Feet of Floor Area of Non-Residential Construction

as can be seen in Table B3.

Table B4 illustrates the effect of rotation on assignment of variables to second, third, and fourth factors. While the same variables are involved, they are not uniquely assigned to a single factor. Thus, if one were to use only one type of rotation, the interpretation of results would depend on the type of rotation selected.

The secondary factors (all of which account for approximately 20% of the total variance), are defined in terms of the following variables:

X_5 -- Interest Return on FHLB Mortgage Loans, June.

X_6 -- Interest Return on FHLB Mortgage Loans, December

X_{14}, X_{15} -- FHA Insured Mortgages for New One Family Houses

X_{10}, X_{11} -- FHA Insured Home Mortgages

Thus, the whole system can be defined in terms of three dimensions:

- Socio-economic Measures
- Interest on Mortgages
- Availability of Mortgages Funds

The χ^2 test showed that the regional factor model did not constitute a good fit to the system of variables. Therefore, the results of regional analysis will not be discussed further.

Results of 1968-1973 Analysis

The Analysis for the period of 1968-1973 was performed only on those variables for which observations were available for every year of the period. Table 6.1 shows the variables included in the analysis. This analysis was performed on:

- Original Values of the Variables
- First Differences of the Observed Values

Tables B5 and B6 show the variables with highest loadings on the factors extracted by the analysis of the original values used. Variables X_1, X_2, and X_{13} had the highest loadings on the first factor, regardless of type of analysis and rotation. Different rotations determine the order of the secondary factors, as was observed in the 1968-1971 analysis. The variables with highest loading on the secondary factors are X_3 and X_8, and X_6.

The three dimensions emerging from this analysis can be defined as:

- One Family House Construction
- Socio-economic Conditions
- Interest rates

The availability of mortgages did not show up as an important determinant of the system 1968-1973 analysis, unlike the 1968-1971 analysis.

Table B7 shows the variables with highest loadings on the eleven factors extracted by the analysis of first differences. The first differences were defined in terms of the years, on whose bases they were computed, and the original variables. Thus, instead of the eight original variables, the analysis included forty-eight variables. The interpretation of the factors in terms of the original eight variables is not possible, since no factor loads on the same variables in all periods. The effect of time was eliminated by the first differences. But it obviously plays an important part in defining the system of variables. This supports the thesis that a meaningful analysis should be done on crossectional data over time, and not as a choice between the two.

This point is reinforced by inspection of the correlation matrices of the original data. Tables B8 and B9 show the highest off-diagonal correlation coefficients. In case of the analysis of original value series, 81% of these correlations were with another observation of the same time series in 1968-1971 analysis, and 91% in the 1968-1973 analysis. As is to be expected, the computation of first differences eliminated the time series characteristics, and only 10% of the correlations were within the same time series.

An additional point can be made based on the results shown in Table B8 and B9 -- and that is that the best predictors of future value in a time series are past and present values of the series itself.

Discussion

Certain observations on factor analysis are in order. As seen from the results of the analyses performed, both the type of factor analysis and rotation effect the results of the analysis. Since any single result is not unique, it justified only tentative interpretation. When using programs which provide options in factor analysis, it might be adviseable to exercise the various options to explore their effect on the particular set of data.

The underlying structure of the set of variables included in the analysis revealed by the factor analysis was not surprising; the three dimensions that emerged:

- socio-economic measures
- interest on mortgages
- availability of mortgages

are dimensions traditionally used by economists. The important result of the analysis is the selection of variables from among those available which best represent these dimensions.

This result was used in developing estimating equations via regression analysis. The results of regression analysis are presented in the next chapter.

CHAPTER V

STATE MODEL -- REGRESSION ANALYSES

In the previous chapter the results of factor analysis of the state data were described. These results constituted the starting point of regression analysis performed on the data. This chapter will be dedicated to the description of results of the regression analyses and their relationship to the hypotheses postulated earlier.

Types of Analyses

The variables with the highest loadings on the factors extracted were selected to be included in stepwise regression analyses. Seven lists of variables were used in the initial analyses.

- All variables for which observations were available for all years included in analysis: X_2, X_3, X_6, X_7, X_8, X_{12}, X_{20} (List 1).
- Combinations of variables with high loadings on factors extracted in factor analyses including one variable per each factor:
  - X_2, X_3, X_6 (List 2)
  - X_2, X_8, X_6 (List 3)
  - X_{12}, X_3, X_6 (List 4)
  - X_{12}, X_8, X_6 (List 5)

X_{20}, X_3, X_6 (List 6)

X_{20}, X_8, X_6 (List 7)

The first analyses performed were analyses for the periods 1968-1972 and 1968-1973 on observed values and their logarithms. The purpose of the logarithmic regressions was to explore whether a relationship among the rate of change in the variables would provide a better estimate than a linear relationship. The 1968-1972 analyses (both observed values and logarithmic) were performed on regional and national levels. The Durbin-Watson statistic for these analyses indicated that serial correlation existed in the original value series and in the logarithmic series. The coefficients of determination of the observed value series were higher than those obtained for the logarithmic analyses, thus indicating that linear relationships provided an adequate representation of the data. Because of this finding, all subsequent analyses were performed on the observed values only.

The serial correlation indicated by the Durbin-Watson statistic could be due either to relationship over time or to geographic proximity as defined by Dodge Regions. But, since the regional regression Durbin-Watson also indicated the existence of serial correlation, it was assumed that the cause of serial correlation was relationship over time. In order to test this assumption regression analysis was performed on data grouped by year for all the years for which data was available: 1968, 1969, 1970, 1971, 1972, 1973. The Durbin-Watson statistic obtained in these analyses did not indicated an existence of serial correlation, thus confirming the assumption.

Estimating equations to be used in testing the formulated hypotheses were obtained by performing regression analyses on the average values for the period 1968-1972; 1973 estimates were tested against actual measurements for the period.

In addition, analysis of lagged independent variables was performed to test the hypotheses that for one-family house -- itself a leading series -- estimates based on lagged independent variables will be inferior to estimates obtained using concurrent measures on all variables.

The SPP multiple stepwise regression analysis program was used in obtaining the equations. This program, unlike other stepwise regression programs, uses only forward inclusion. Since backward elimination is not being used, there is a danger of multicolinarity among the variables selected. Table .1 shows the results of regression analyses performed on observed values and their logarithmic transformation for the periods 1968-1973 and 1968-1972. The results are shown by list. The purpose of the analyses was to determine whether a linear or a logarithmic relationship fitted the data better.

Analyses of the Period 1968-1973

For all the lists used in analyses, the coefficient of determination obtained using observed values were higher than those obtained using logarithmic relationships. Thus, the results indicate that a linear relationship provides an adequate description of the variables under consideration.

All of the Durbin-Watson statistics computed indicated the

Table 5.1

RESULTS OF REGRESSION ANALYSIS OF OBSERVED VALUES AND THE LOGARITHMIC TRANSFORMATION 1968-1973 AND 1968-1972, BY LIST*

	CONSTANT	X_2	X_3	X_6	X_8	X_{12}	X_{20}	R^2	F	D.W.
LIST 1										
1968-1973										
Observed	-20,322.69	+0.03085 (0.00528)		3256.34 (903.72)		+0.33492 (0.02573)	+0.11844 (0.02247)	0.86717	491.25	0.91174
Lg.	-1.01110	-0.11976 (0.04971)	+0.57101 (0.07324)	+1.88837 (0.55718)			+0.52532 (0.04746)	0.82854	363.64	0.68952
1968-1972										
Observed	-30,412.27	+0.04378 (0.00576)		+4,810.40 (1,073.13)		+0.29761 (0.02839)	+0.10721 (0.02265	0.87888	453.50	0.88548
Lg.	-1.23591	-0.11706 (0.05439)	+0.59855 (0.08140)	+2.10083 (0.67848)			+0.51158 (0.05209)	0.83066	306.57	0.69082
LIST 2										
1968-1973										
Observed	-18,145.83	+0.06416 (0.00434)	+1.64150 (0.15800)	+2,911.90 (1,026.65)				0.82959	490.08	0.51983
Lg.	+0.66152				+0.16766 (0.04377)		+0.67949 (0.03523)	0.80185	613.06	0.81040

TABLE 5.1 -- CONTINUED

RESULTS OF REGRESSION ANALYSIS OF OBSERVED

VALUES AND THE LOGARITHMIC TRANSFORMATION

1968-1973 AND 1968-1972, BY LIST*

	CONSTANT	X_2	X_3	X_6	X_8	X_{12}	X_{20}	R^2	F	D. W.
1968-1972										
Observed	-25,819.90	+0.07407 (0.00511)	+1.42912 (0.17291)	+4,113.02 (1.190.90)				0.84391	452.36	0.60206
Lg.	+0.65600				+0.15879 (0.04629)		+0.68965 (0.04629)	0.80103	507.26	0.86379
LIST 3										
1968-1973										
Observed	-2,356.88	+0.07081 (0.00417)			+0.29019 (0.03198)			0.81794	680.63	0.49560
Lg.	-0.99454			+1.85266 (0.70479)	+0.53021 (0.05362)	+0.31163 (0.04106)		0.63407	174.43	0.87493
1968-1972										
Observed	-17,472.26	+0.07901 (0.00500)		+2,969.91 (1,181.21)	+0.27278			0.83720	430.00	0.61359
Lg.	-1.85703			+2.97401 (0.86953)	+0.51838 (0.05673)	+0.31355 (0.04244)		0.62782	141.13	0.97133

TABLE 5.1 -- CONTINUED

RESULTS OF REGRESSION ANALYSIS OF OBSERVED

VALUES AND THE LOGARITHMIC TRANSFORMATION

1968-1973 AND 1968-1972, BY LIST*

	CONSTANT	X_2	X_3	X_6	X_8	X_{12}	X_{20}	R^2	F	D. W.
LIST 4										
1968-1973										
Observed	-41,460.38			+6,383.64 (999.93)		+0.56439 (0.01563)		0.81407	663.31	0.92879
Lg.	-2.61346		+1.09292 (0.03564)	+3.42900 (0.57516)				0.63407	174.43	0.87493
1968-1972										
Observed	-60,751.71		-0.74921 (0.35854)	+9,434.34 (1,194.48)		+0.67938 (0.05530)		0.82103	383.82	1.01831
Lg.	-3.19368		+1.11077 (0.03895)	+4.07776 (0.69156)				0.76433	408.64	0.47956
LIST 5										
1968-1973										
Observed	-41,460.38			+6,383.64 (999.93)		+0.56439 (0.01563)		0.81407	663.31	0.92879
Lg.	+0.12040	+0.46422 (0.04945)			+0.40333 (0.05730)			0.65856	292.21	0.47825

TABLE 5.1 -- CONTINUED

RESULTS OF REGRESSION ANALYSIS OF OBSERVED

VALUES AND THE LOGARITHMIC TRANSFORMATION

1968-1973 AND 1968-1972, BY LIST*

	CONSTANT	X_2	X_3	X_6	X_8	X_{12}	X_{20}	R^2	F	D. W.
1968-1972										
Observed	-62,470.61			+9,649.42 (1,971.95)		0.56941 (0.01711)		0.81791	565.98	0.96516
Lg.	+0.10546	+0.4985 (0.05329)			+0.36917 (0.06073)			0.65623	240.53	0.59250
LIST 6										
1968-1973										
Observed	-33,356.06		+2.32953 (0.13743)	+5,226.42 (1,045.74)				0.80888	426.05	0.93849
Lg.	-2.61346		+1.09292 (0.03564)	3.42900 (0.57516)				0.75741	473.01	0.45899
1968-1972										
Observed	-42,273.52		+2.37892 (0.15425)	+6,629,07 (1,304.13)			0.25845	0.80075	336.25	0.99310
Lg.	-3.19368		+1.11077 (0.03895)	+4.07776 (0.69156)				0.76433	408.64	0.47956

TABLE 5.1 -- CONTINUED

RESULTS OF REGRESSION ANALYSIS OF OBSERVED

VALUES AND THE LOGARITHMIC TRANSFORMATION

1968-1973 AND 1968-1972, BY LIST*

	CONSTANT	X_2	X_3	X_6	X_8	X_{12}	X_{20}	R^2	F	D. W.
1968-1972										
Observed	-62,470.61			+9,649.42 (1,971.95)		0.56941 (0.01711)		0.81791	565.98	0.96516
Lg.	+0.10546	+0.4985 (0.05329)			+0.36917 (0.06073)			0.65623	240.53	0.59250
LIST 6										
1968-1973										
Observed	-33,356.06		+2.32953 (0.13743)	+5,226.42 (1,045.74)				0.80888	426.05	0.93849
Lg.	-2.61346		+1.09292 (0.03564)	3.42900 (0.57516)				0.75741	473.01	0.45899
1968-1972										
Observed	-42,273.52		+2.37892 (0.15425)	+6,629,07 (1,304.13)			0.25845	0.80075	336.25	0.99310
Lg.	-3.19368		+1.11077 (0.03895)	+4.07776 (0.69156)				0.76433	408.64	0.47956

TABLE 5.1 -- CONTINUED

RESULTS OF REGRESSION ANALYSIS OF OBSERVED

VALUES AND THE LOGARITHMIC TRANSFORMATION

1968-1973 AND 1968-1972, BY LIST*

	CONSTANT	X_2	X_3	X_6	X_8	X_{12}	X_{20}	R^2	F	D. W.
LIST 7										
1968-1973										
Observed	-18,875.00			+3,275,98 (1,074.83)	+0.45034 (0.02930)	+0.29446	0.79076 (0.02174)	380.45	0.98389	
Lg.	-0.72712		+0.48294 (0.06397)	+1.40289 (0.52375)			0.48552 (0.04485)	0.82524	475.36	0.63207
1968-1972										
Observed	-30,209.01			+5,012,465 (1,337.85)	+0.48300 (0.03425)		+0.28200 (0.02514)	0.78346	302.72	1.03326
Lg.	- 0.95438		+0.51068 (0.07093)	+1.62279 (0.64572)			+0.47392 (0.04942)	0.82752	401.41	0.64168

* The standard error of regression coefficient shown in parenthesis

Note: All regression coefficients are significant at $\alpha = 0.01$
Variables with regression coefficient at lower level of significance were rejected by the program from inclusion in equations.

existence of serial correlation.

Analyses of the Period 1968-1972

Data on all variables were collected for the period 1968-1973. In order to test performance of estimating equations obtained in the analyses these equations were obtained using the period 1968-1972 and estimates obtained utilizing them compared to actual observations made in 1973. The analyses for this period were performed on national and regional levels on observed values and on their logarithms. Table C1 shows the assignment of states to the regions. This assignment follows the definition of regions used by the F. W. Dodge Division of McGraw-Hill Information Systems Company and FHLB.

The results of national analysis of observed values and the results of national analyses on the logarithmic transformation are shown in Table 5.1. The coefficients of determination are higher for the observed data. Durbin-Watson statistic indicate serial correlation on all levels of analyses for both forms of the data.

The values of Durbin-Watson statistic obtained in the regional analyses are shown in Tables C1 and C2.

Since most of the Durbin-Watson statistic values indicated serial correlation, the results of this analyses could not be used in estimating.

Annual Analyses

If the serial correlation observed in the analyses of 1968-1972 and 1968-1973 was caused by relationship over time, then no serial correlation should be observed in an analysis of the data within a single time period. Thus annual analyses were performed using variables for which observations were available for all the years. The results of these analyses are shown in Table 5.2. For all the years the Durbin-Watson statistic indicates that there is no serial correlation within the years. As can be seen in the table, the variable that appeared in the equations of all the years and was the first to be selected was X_{12} -- Square Feet of Non-Residential Floor Area. Equations using only this variable are shown in Table 5.3. As can be seen in the table, the coefficient of determination computed using only non-residential floor area is only slightly lower then the coefficient of determination using other variables as well.

Box-Jenkins' principle of parsimony would indicate that it is more desirable to use equations utilizing only one variable than euqations with more variables. In addition, unlike other variables in the equations (X_2, X_3, and X_6) data for X_{12} are available monthly from F. W. Dodge only four weeks after the closing of the period.

Annual regressions using only X_2 and X_{20}, which were also highly correlated with one-family house permits are shown in Tables 5.4 and 5.5. For every year the coefficients of determination are lower than those obtained using X_{12}. Thus, if a single predictor variable was desired, X_{12} was the best candidate. From the point of view of availability of measurement, X_{20} -- Apartment Building Dwelling Units started -- is equivalent to X_{12} since a measure of its activity is available monthly.

Average Value Regressions

In order to obtain estimating equations free of serial correlation, national regressions were performed on average observed

TABLE 5.2

ANNUAL REGRESSIONS USING VARIABLES

COMMON TO ALL YEARS

X_2, X_3, X_6, X_8, X_{12}, X_{20}

1968

$$-27{,}390.6 + 0.31205\,X_{12} + 0.41648\,X_{20} + 4{,}636.4\,X_6$$
$$(0.04184) \quad (0.07127) \quad (2{,}448.5)$$

$R^2 = .94$ D.W. = 1.78818

1969

$$2.358.2 + 0.54553\,X_{12} + 0.03978\,X_2 - 2.12456\,X_3$$
$$(0.09658) \quad (0.01060) \quad (0.59416)$$

$R^2 = .93$ D.W. = 1.77130

1970

$$-34{,}778.4 + 0.60514\,X_{12} - 0.32738\,X_8 + 5{,}475.5\,X_6 + 0.03159\,X_2$$
$$(0.11111) \quad (0.11738) \quad (2{,}676.8)$$

$R^2 = .89$ D.W. = 1.94326

1971

$$-117{,}584.1 + 0.59187\,X_{12} + 17{,}187.0\,X_6 + 0.02814\,X_2$$
$$(0.08263) \quad (5{,}259.3) \quad (0.01343)$$

$R^2 = .90$ D.W. = 1.71089

1972

$$-87{,}852.5 + 0.44869\,X_{12} + 0.32992\,X_{20} + 12{,}795.4\,X_6$$
$$(0.06984) \quad (0.06157) \quad (5{,}793.6)$$

$R^2 = .92$ D.W. 1.75412

1973

$$1{,}653.6 + 0.44345\,X_{12} + 0.16076\,X_{20}$$
$$(0.04544) \quad (0.04322)$$

$R^2 = .90$ D.W. = 1.76756

TABLE 5.3

ANNUAL REGRESSIONS USING ONLY X_{12}

1968	$907.8 + .51745\ X_{12}$	
	$R^2 = .87$	$F = 339.6709$
1969	$1.384.3 + .40541\ X_{12}$	
	$R^2 = .87$	$F = 314.5958$
1970	$2,117.2 + .46423\ X_{12}$	
	$R^2 = .83$	$F = 246.82445$
1971	$1,346.5 + .72623\ X_{12}$	
	$R^2 = .86$	$F = 303.07582$
1972	$1,644.0 + .75357\ X_{12}$	
	$R^2 = .85$	$F = 275.06226$
1973	$891 + .57467\ X_{12}$	
	$R^2 = .87$	$F = 318.88422$

TABLE 5.4

ANNUAL REGRESSIONS USING ONLY X_2

1968	$2,866.17 + .11543\ X_2$	$R^2 = .84$
1969	$2,765.40 + .10511\ X_2$	$R^2 = .85$
1970	$2,483.58 + .12946\ X_2$	$R^2 = .80$
1971	$1,775.14 + .11384\ X_2$	$R^2 = .78$
1972	$3,920.99 + .10036\ X_2$	$R^2 = .77$
1973	$4,680.40 + .07859\ X_2$	$R^2 = .72$

TABLE 5.5

ANNUAL REGRESSIONS USING ONLY X_{20}

1968	$3,438.32 + .88063 X_{20}$	$R^2 = .86$
1969	$5,791.92 + .45395 X_{20}$	$R^2 = .59$
1970	$6,326.43 + .45835 X_{20}$	$R^2 = .64$
1971	$10,025.31 + .35146 X_{20}$	$R^2 = .39$
1972	$6,603.14 + .67172 X_{20}$	$R^2 = .84$
1973	$8,236.85 + .4816 X_{20}$	$R^2 = .69$

values of observations for the period 1968-1972. Estimating equations were obtained for simple and weighted averages. The weighted average weights were obtained by solving:

$$W_i = \frac{1}{p^i}$$

$$\sum W_i = 1$$

Where:

W_i -- weight assigned to period i

i -- 1.....n; 1 for the most recent year (1972 for our analyses). n -- number of years included in the analysis

Table .6 shows results of the simple average regression analyses performed on four lists. The first list included all variables for which observations were available for each year included in the period. The other equations were obtained using only one independent variable: X_2, X_{12}, and X_{20}.

All the Durbin-Watson statistics obtained indicate no serial correlation at $\alpha = 0.01$. The coefficient of determination obtained for X_{12} was the highest among single variable equations and only a few points lower than the best equation selected which includes variables for which concurrent measurements are not available.

Since single variable equations seem to have high enough coefficients of determination, the weighted average regression analyses included only X_2, X_{12}, and X_{20} as single independent variables. The results of this analysis are shown in Table C3. The results are similar to those obtained in simple average analysis -- no evidence

TABLE 5.6

AVERAGE REGRESSION EQUATIONS

(1968-1972)

1 $(X_2, X_3, X_6, X_7, X_8, X_{12}, X_{20})$

$$X_1 = 2{,}107.27 + \underset{(0.13438)}{0.74855}\,X_{12} + \underset{(0.06405)}{0.21488}\,X_{20} - \underset{(0.68724)}{2.14588}\,X_3$$

R^2 = .92937 F = 206.16205 D. W. = 1.92361

$$X_1 = 1{,}572.26007 + \underset{(0.04930)}{0.35355}\,X_{12} + \underset{(0.06034)}{0.31436}\,X_{20}$$

R^2 = .91472 F = 257.44053

2 (X_2)

$$X_1 = 2{,}912.59 + \underset{(0.00753)}{0.11177}\,X_2$$

R^2 = .81822 F = 220.55417 D. W. = 1.78105

3 (X_{12})

$$X_1 = 1{,}420.17 + \underset{(0.03208)}{0.57211}\,X_{12}$$

R^2 = .86650 F = 228.40634 D.W. = 1.74770

4 (X_{20})

$$X_1 = 4{,}121.07 + \underset{(0.04516)}{0.68251}\,X_{20}$$

R^2 = .82336 F = 228.40634 D. W. = 1.74770

All Durbin Watson indicate no autocorrelation at $\alpha = 0.01$

R^2 of estimates is actual.

of serial correlation and equation with X_{12} has the highest coefficient of determination.

The similarity of the results is seen even more clearly in Table C4 where the standardized equations for the three independent variables are shown. No significant difference exists among the regression coefficients obtained by the two methods of averaging. Thus, the simple average equations with X_{12} as the single independent variable will be used in estimating 1973.

Lagged Regression

The results of the lagged regression analyses are shown in Table C5. In some cases the Durbin-Watson statistic indicated existence of serial correlation.

The lagged analysis was performed on X_1 vs prior year X_1, X_2, X_{12}, and X_{20}. Not surprisingly, X_1 turned out to be the best predictor of itself. A one year lag was enough to produce coefficients of determination of .97 and higher (Table C6). The highest coefficients of determination using other variables was .85.

Test of Hypotheses

The hypotheses postulated in Chapter I were respresented by the inequalities:

$$R_1^2 > R_2^2 > R_3^2 \qquad R_2^2 > R_4^2$$

$$R_5^2 > R_2^2, R_3^2, R_4^2$$

Thus

$$R_2^2 = .87 > R_3^2 = .83$$

$$R_2^2 = .87 > R_4^2 = .85$$

$$R_5^2 = .998 > R_2^2, R_3^2, R_4^2$$

as postulated.

All the coefficients of determination considered are significant at least at the $\alpha = 0.01$ level, as can be seen from the values of the F statistic obtained in the regression analysis ANOVA (Analysis of Variance).

The known tests of significance applicable to multiple correlation coefficients test whether the coefficient differs significantly from zero.

I know of no test which tests the significance of the difference between two coefficients of determination. However, since all of the coefficients are significant, the direction of the difference between them may be considered as supporting the postulated hypotheses.

The results of the state analysis support the hypotheses made with regard to the goodness of fit of various estimating equations. The comparison with results obtained using the county model will be discussed in Chapter VII.

Discussion

An important result obtained in the analysis of state data was that a single variable -- X_{12} -- square feet of non-residential floor area -- provided a high enough coefficient of determination to be considered a single best estimator of one-family house permits. Use of X_{12} enables forecasting for longer periods of time, since the data for it is available promptly. It also provides an opportunity to use the equations for periods shorter than a year, since data are available monthly. It is also possible that estimates for subdivisions of states could be made using X_{12}, since data for it is available on a county level. The feasibility and goodness of monthly county estimates using X_{12} will not be explored here, but is recommended as further research.

Non-residential construction competes with one-family house construction for resources available. The fact that in the model obtained in our analysis both move in same direction indicates that for the period of analysis both were determined by common factors, rather than by the competition among them. This may not hold for other periods. It is, therefore, recommended that the estimating equation be recomputed utilizing the most recent data available.

CHAPTER VI

COUNTY MODEL

In previous chapters the theoretical foundations of the study and the existing housing models were discussed. This chapter is dedicated to the county model. In particular it will deal with the need for monthly county data for one-family house permits, the conceptual foundations of the model, data collection methodology employed, and analysis of the model's performance versus actual measurement by the Bureau of the Census.

Need for Monthly County Information

Ours is a time of rapid change in business conditions. Businessmen find it more and more difficult to perform the main functions of management: planning and control, without timely data. Planning is done on different levels of management and the level of geographic detail is directly related to the level of management which will receive the data. Top management is likely to be satisfied with national or regional data, since this is its level of decision making. Middle level management, however, needs finer geographic breakdowns both in planning and control of the operations for which they are responsible. They have to translate top management's decisions to the sales territory level and for this purpose data by county is most appropriate. Not because decisions are being made for individual counties, but because counties provide a convenient building block for sales territories. Every company defines sales territories based on different criteria and tends to change their definition periodically, as economic conditions, or company organization, or both, change. In order to be able to evaluate performance from one period to the next, when the territory definitions were not the same, the manager needs data for smaller units which together define the territories. Counties are a very convenient unit for this purpose.

While top management seldom needs data for periods shorter than a quarter, middle management is likely to need timely data for shorter periods of time since it has to be able to evaluate quickly the performance of the sales force in comparison to plans so that corrective action can be taken.

Housing Permit data is available from the Bureau of the Census on the county level, however, only annual reports can be obtained. This cannot serve adequately a decision maker who needs monthly data.

Thus, the model described below is meant to provide the decision maker with monthly data by county that would prove useful to the middle level manager in his decison making process.

It should be pointed out that not all of the counties are completely permit covered, i.e., there are areas where no building permit is required by the local jurisdiction. Ideally, the decision maker would want data that measures the total construction activity. In order to satisfy this need an estimate of activity in non-permit issuing areas has to be made. This study, however, will not deal with the problem of estimating non-permit area activity, but will concentrate on the permit covered areas.

Conceptual Framework

There are 14,000 Permit Issuing Places known to the Bureau of the Census. The Bureau collects data from all of them annually and from the largest -- monthly. Thus there is no monthly data on the activity taking place in all of the permit issuing jurisdictions. Yet this data is needed by decision makers.

To collect monthly data from all 14,000 permit issuing places is expensive and inefficient since many of the places have little or no activity during the month. Thus, a method has been deviced by which data will be collected monthly from the largest Permit Issuing Places and an estimate will be made of the activity taking place in the smaller permit places.

Large Permit Places (LPP) are defined as places which issue 50 or more one-family house permits a year. These places account for about 20% of the permit places but represent more than 80% of the permits issued in all of the United States.

Small Permit Places (SPP) are defined as permit issuing places which issue less than 50 one-family house permits a year.

These places account for 80% of the permit place universe but for only 20% of the permits issued for the United States as a whole.

The proposed model is based on the identity:

$$CP_{ij} = LPP_{ij} + SPP_{ij}$$

where:

CP_{ij} -- Total number of permits issued in a county in month i, year j

LPP_{ij} -- Permits issued by Large Permit Places within the county in month i, year j

SPP_{ij} -- Permits issued in Small Permit Places within the county in month i, year j.

SPP_{ij} is a random variable whose distribution is dependent on the annual activity of all such places in base year j_o - (SPP_{j_o}) the seasonal index for month i, year j - (I_{ij}) and the rate of change between year (j) and (j_o) - (SPP_j/SPP_{j_o}).

$$SPP_{ij} = (SPP_{j_o})\ (I_{ij})\ (SPP_{ij}/SPP_{ij_o})$$

Since no direct observations are made on the Small Permit Places during month (i) in year (j), the rate of change from the base year (j_o) to current year (j) cannot be obtained directly. In the model it is assumed that

$$\frac{SPP_j}{SPP_{j_o i}} = \frac{LPP_j}{LPP_{j_o i}}$$

which can be measured from the reports received from Large Permit Places.

Thus: $SPP_{ij} = (SPP_{j_o})\ (I_{ij})\ (LPP_j/LPP_{j_o}) + e_s$

$$CP_{ij} = LPP_{ij} + SPP_{ij} + e_c$$

where:

> e_s and e_c are error terms assumed to be normally distributed with mean equal to zcro and known variance
>
> $$e \sim N(0, \sigma^2)$$

The county error -- e_c -- is composed of LPP measurement error, e_1, and SPP measurement and estimating error, e_s.

The LPP and SPP designation is not constant but changes as annual data becomes available from the Bureau of the Census. At this point the permit places are reclassified, if their annual activity changed -- to an extent justifying reclassification.

At the same time, the values of e_c, e_1, and e_s are empirically obtained by comparing county estimates to reports received by the Bureau of the Census.

$$e_c = (C_{j_a} - C_{j_b}) / 2$$

$$e_1 = (LPP_{j_a} - LPP_{j_b}) / 2$$

$$e_s = (SPP_{j_a} - SPP_{j_b}) / 2$$

where:

> The subscript "a" indicates the Bureau of the Census and "b" indicates study

since

$$e = X - E(X)$$

$$e_c = C_j - E(C_j)$$

$$E(C_j) = (C_{j_a} + C_{j_b}) / 2$$

substituting

$$e_c = C_{j_a} - (C_{j_a} + C_{j_b}) / 2$$
$$2e_c = 2C_{j_a} - C_{j_a} - C_{j_b}$$
$$2e_c = C_{j_a} - C_{j_b}$$
$$e_c = (C_{j_a} - C_{j_b}) / 2$$

by the same reasoning

$$e_1 = (LPP_{j_a} - LPP_{j_b}) / 2$$
$$e_s = (SPP_{j_a} - SPP_{j_b}) / 2$$

The distribution of e_c, e_1, and e_s for the United States as a whole and SMSA and Non-SMSA was analyzed for basic characteristics using the Codebook program in Statistical Packages for Social Sciences. This program provides measures for the mean, median, mode, variance, kurtosis, skewness, range, minimum and maximum values in the distribution.

Theoretically, all those distributions, but especially e_1 should be normal with mean 0.

The formula used as a basis for the county model is a form of a regression equation in which the coefficients are not based on regression analysis of the data, but on assumptions about behavior of the phenomena.

Design

For the purpose of the study the universe of all Permit Issuing Places was partitioned into LPP and SPP according to the definitions given above.

All places identified as LPP were contacted to assure that monthly data would be obtained from them by the tenth working day in the month following the month of interest. After the initial contact has been established a form is sent out to the place every month so that it could be received by the tenth working day with the data filled in. If the place issues 250 or more permits a year, every effort is made to obtain the data from it by phone or via a telegram, if not received by the fifth working day. If the place issues less than 250 permits a year and a report has not been received by the tenth working day of the following month, an estimate of the activity of the place is made based on the last six months for which reports were received and the seasonal indices for these months:

$$\widehat{LPP}_{ij} = \left(\sum \frac{LPP_{i-k,\ j-1}}{I_{i-k,\ j-1}} \Big/ k \right) I_{ij}$$

$$k = 1, 2....6, \quad 1 = 0, 1$$

The annual activity of Small Permit Places is summarized by county and the result stored in a computer. Each month an estimate of the SPP county activity is obtained by multiplying the annual figure for the base year by the seasonal index for the month and the rate of change from the base year.

TABLE 6.1

CENSUS REGIONS

NORTHEAST	Connecticut Maine Massachusetts New Hampshire New Jersey New York Pennsylvania Rhode Island Vermont
NORTH CENTRAL	Illinois Indiana Iowa Kansas Michigan Minnesota Missouri Ohio Nebraska North Dakota South Dakota Wisconsin
SOUTH	Alabama Arkansas Delaware District of Columbia Florida Georgia Kentucky Louisiana Maryland Mississippi North Carolina Oklahoma South Carolina Tennessee Texas Virginia West Virginia
WEST	Alaska Arizona California Colorado Hawaii Idaho Montana New Mexico Nevada Oregon Utah Washington Wyoming

$$\widehat{SPP}_{ij} = (SPP_{j_o})\ (I_{ij})\ (LPP_{ij}/LPP_{ij_o})$$

The I_{ij} and LPP_{ij}/LPP_{ij_o} are computed by SMSA and Non-SMSA within four Census Regions, (Table 6.1). Counties are uniquely designated as SMSA or Non-SMSA within the regions following the definition of the Office of Management and Budgets.

As soon as the Bureau of the Census data becomes available it is used to revise the classification of the permit places and to evaluate the estimating errors, as described in the previous section.

Analysis of Deviations

The annual comparisons with Census data were performed for 1971, 1972, and 1973 and the results are shown in Table 6.2. Table .2 shows the characteristics of the distribution of e_c, e_1, and e_s as defined above. As can be seen from this table, the assumption that errors are normally distributed with mean "0" and known variance is not supported by the data. All the means are significantly different from 0 and measures of skewness and kurtosis are not those characteristic of a normal curve.[1] However, all modes are equal to zero, and most medians are not significantly different from zero.

Since no monthly permit data are available, no comparison is possible on a monthly level. It is assumed, however, that performance on an annual level can be used as an indicatior of performance month by month. Indeed, if the annual estimates obtained using the county model are superior to those obtained using the state model, than the

[1]The measurement of skewness for the normal curve equals zero, and kurtosis equals three.

TABLE 6.2

CHARACTERISTICS OF THE DISTRIBUTION OF ERROR TERMS IN 1971, 1972, 1973

e = (CENSUS-STUDY) / 2

		MEAN	MEDIAN	MODE	σ_X^2	KURTOSIS	SKEWNESS	RANGE	MINIMUM	MAXIMUM	#
1971											
e_1	LPP-U.S.	28.466	0.089	0.0	164,570.000	530.466	21.370	12,904.500	-1,888.000	+11,016.000	1,161
	SMSA	27.103	0.516	0.0	19,351.387	18.159	1.600	1,807.000	-770.500	+ 1,036.500	493
	NON-SMSA	3.188	0.013	0.0	6,737.734	418.578	-18.337	2,194.000	-1,888.000	+ 306.000	663
e_s	SPP-U.S.	31.097	0.338	0.0	426,199.000	1929.116	41.442	32,246.500	-112.500	+32,134.000	3,100
	SMSA	32,313	5.450	0.0	6,011.734	24.818	3.972	843.500	-112.500	+ 731.000	444
	NON-SMSA	6.710	0.215	0.0	821.517	357.443	13.565	969.000	- 77.500	+ 891.500	2,651
e_c	CTY-U.S.	13.943	0.918	0.0	5,586.066	171.967	-1.735	2,909.000	-1,888.000	+ 1,021.000	3,097
1972											
e_1	LPP-U.S.	41.657	0.644	0.0	389,262.063	439.745	17.537	22,365.000	-6,077.000	+16,288.000	1,173
	SMSA	17.528	3.964	0.0	101,070.813	272.792	-14.263	7,203.000	-6,077.000	+ 1,126.000	494
	NON-SMSA	11.319	0.200	0.0	3,098.714	49.953	4.694	942.500	-220.000	+ 722.500	674

TABLE 6.2 -- Continued

CHARACTERISTICS OF THE DISTRIBUTION OF ERROR TERMS IN 1971, 1972, 1973

e = (CENSUS-STUDY) / 2

		MEAN	MEDIAN	MODE	σ_X^2	KURTOSIS	SKEWNESS	RANGE	MINIMUM	MAXIMUM	#
1972											
e_s	SPP-U.S.	35.769	0.511	0.0	574,756.688	1,914.795	41.280	37,703.000	-395.500	+37,307.500	3,129
	SMSA	41.416	6.250	0.0	12,707.340	37.334	4.717	1,657.500	-395.500	+1,262.000	444
	NON-SMSA	7.059	0.247	0.0	1,141.236	206.081	9.680	1,066.000	-165.500	+900.500	2,680
e_c	CTY-U.S.	17.156	1.724	0.0	19,353.324	1,250.261	-26.906	7,659.500	-6,157.500	+1,502.000	3,126
1973											
e_1	LPP-U.S.	3.073	-0.079	0.0	20,524.219	61.829	2.078	3,174.500	-1,578.500	+1,596.000	1,172
	SMSA	7.898	-0.086	0.0	24,683.793	27.463	2.542	2,266.000	- 954.500	+1,311.500	498
	NON-SMSA	-4.084	-0.077	0.0	5,367.922	319.775	-14.779	1,985.500	-1,578.500	+ 407.000	669
e_s	SPP-U.S.	33.059	0.202	0.0	520,465.563	1,752.490	39.683	34,829.000	- 348.000	+34,481.000	3,129
	SMSA	39.435	4.583	0.0	16,820.996	70.371	6.534	2,080.500	- 348.000	+ 1,732.500	444
	NON-SMSA	6.333	0.165	0.0	1,203.281	64.228	5.368	918.500	- 322.500	+ 596.000	2,680
e_c	CTY-U.S.	11.426	0.235	0.0	9,026.852	362.111	10.365	4,583.000	-1,578.500	+3,004.500	3,126

use of the county model is recommended since it also provides estimates of county by month. While the analysis of deviations described provided us with a measure of performance of the county model on county level, no test is available to test the quality of monthly estimates that it provides.

As the state model, the county model described above does not provide estimates of activity in non-permit issuing areas, since no measure of this activity exists. It is possible, however, to make estimates utilizing results of the Bureau of the Census sample of non-permit areas and the population residing within these areas. But because of lack of direct measurement of activity in non-permit issuing areas, there is no way of evaluating the performance of such estimates.

The performance of the county model as an estimating method is evaluated in Chapter VII via a comparison of the estimates obtained by state to the actual number of building permits reported and to the estimates obtained using the state model.

CHAPTER VII

COMPARISON OF ESTIMATES OBTAINED BY THE STATE AND COUNTY MODELS TO CENSUS REPORTS

The previous two chapters presented the estimating equations used in the two models proposed: Chapter VII -- the state model; Chapter VIII -- the county model. In this chapter the estimates for 1973 obtained utilizing these two models are compared to the figures reported by the Bureau of the Census.

The state model equations used in estimating are those selected as most desirable, i.e. those utilizing only X_{12} as an explanatory variable. While this selection is not arbitrary it should not be taken for granted that for other periods X_{12} will also be the best predictor. In order to provide meaningful estimates equations should be revised as new data become available.

The regional and national equations used in obtaining the state model estimates are shown in Table 7.1. The actual comparison of the three estimates

- county
- regional
- national

are shown in Table 7.2.

The coefficient of determination -- R^2 -- is used as a measure of deviation of estimates from actual. As postulated, the county model provides the best estimate with an R^2 = .96. No significant difference

TABLE 7.1

REGIONAL EQUATIONS USED IN

OBTAINING 1973 ESTIMATES

REGION I	$X_1 = 1,185.9978 + 0.43621\ X_{12}$
REGION II	$X_1 = 8,304.7821 + 0.30516\ X_{12}$
REGION III	$X_1 = -10,206.7564 + 1.02047\ X_{12}$
REGION IV	$X_1 = -335.4999 + .48979\ X_{12}$
REGION V	$X_1 = 1,419.1526 + 0.53803\ X_{12}$
REGION VI	$X_1 = 2,496.7241 + 0.52741\ X_{12}$
REGION VII	$X_1 = 875.8619 + 0.50877\ X_{12}$
REGION VIII	$X_1 = 3,112.8412 + 0.65530\ X_{12}$

NATIONAL EQUATION USED IN OBTAINING

1973 ESTIMATES

$$X_1 = 1,420.17 + 0.57211\ X_{12}$$

exists between the regional and national estimates at $R^2 = .865$ and $R^2 = .867$ respectively. The performance of the state model can be improved by using as the final estimate the average of national and regional estimates.

$$Y_S = (Y_{SR} + Y_{SN}) / 2$$

where:

Y_S -- estimate for the state

Y_{SR} -- estimate for the state using the regional equation

Y_{SN} -- estimate for the state using national equation

When this estimate is used, the coefficient of determination for 1973 estimates goes up to $R^2 = .891$.

The regional alignment used in our analysis was that used by F. W. Dodge and FHLB. It is conceivable that a different alignment might have produced a better fit for the regional equations. An attempt was made to group states by regression coefficients on various variables (X_2, X_3, X_8, X_{12}, X_{20}) but the results were not encouraging. Other criteria for alignment may be more efficient and may provide a significantly better estimate when utilizing regional equations.

In terms of the hypotheses postulated --

- $R_1^2 > R_2^2$ holds -- the coefficient of determination obtained by using the county model is higher than the coefficient of determination obtained using the

TABLE 7.2

COMPARISON OF THE NUMBER OF ONE-FAMILY HOUSE PERMIT ISSUED BY STATE TO ESTIMATES

1973

STATE	CENSUS REPORT (C 40)	COUNTY MODEL	REGIONAL REGRESSION	NATIONAL REGRESSION
ALABAMA	10,610	10,594	9,585	15,341
ALASKA	942	1,152	6,230	3,625
ARIZONA	28,740	28,032	18,465	14,354
ARKANSAS	5,619	5,198	8,263	7,174
CALIFORNIA	102,974	118,259	105,697	90,853
COLORADO	20,309	20,839	21,852	17,324
CONNECTICUT	11,766	10,177	8,044	9,926
DELAWARE	4,240	3,964	9,038	4,285
DISTRICT OF COLUMBIA	144	127	11,128	6,207
FLORIDA	69,419	57,551	79,148	51,210
GEORGIA	29,009	25,226	45,770	32,414
HAWAII	5,584	8,508	7,793	4,995
IDAHO	4,829	3,308	6,169	3,571
ILLINOIS	33,372	28,989	41,661	43,873
INDIANA	19,746	19,241	23,467	24,440
IOWA	6,817	7,402	9,957	11,526
KANSAS	6,886	6,384	8,316	9,295
KENTUCKY	9,411	8,250	8,872	11,694
LOUISIANA	10,162	9,977	12,425	13,936
MAINE	3,812	2,949	3,216	3,565

TABLE 7.2-- Continued

COMPARISON OF THE NUMBER OF ONE-FAMILY HOUSE PERMIT ISSUED BY STATE TO ESTIMATES 1973 - CONTINUED

STATE	CENSUS REPORT (C 40)	COUNTY MODEL	REGIONAL REGRESSION	NATIONAL REGRESSION
MARYLAND	25,054	22,997	17,333	17,892
MASSACHUSETTS	18,817	17,208	14,064	17,857
MICHIGAN	37,622	36,048	28,216	29,512
MINNESOTA	15,808	15,178	16,116	16,589
MISSISSIPPI	8,184	6,557	7,701	8,600
MISSOURI	14,988	15,419	16,340	15,975
MONTANA	1,192	1,777	5,541	3,021
NEBRASKA	6,139	5,553	6,630	7,390
NEVADA	8,263	7,000	8,371	5,502
NEW HAMPSHIRE	4,554	3,863	3,335	3,721
NEW JERSEY	28,352	22,917	21,227	25,226
NEW MEXICO	5,775	3,418	7,299	4,562
NEW YORK	33,022	30,258	27,503	37,044
NORTH CAROLINA	24,837	23,342	33,348	25,418
NORTH DAKOTA	1,586	1,763	3,272	2,870
OHIO	33,799	32,515	35,439	42,865
OKLAHOMA	8,515	8,648	11,393	12,770
OREGON	13,175	13,458	13,761	10,229
PENNSYLVANIA	35,905	21,909	25,346	32,982
RHODE ISLAND	3,470	3,027	3,029	3,320
SOUTH CAROLINA	16,659	18,411	11,393	13,054

TABLE 7.2 -- Continued

COMPARISON OF THE NUMBER OF ONE-FAMILY

HOUSE PERMIT ISSUED BY STATE TO ESTIMATES

1973 - CONTINUED

STATE	CENSUS REPORT (C 40)	COUNTY MODEL	REGIONAL REGRESSION	NATIONAL REGRESSION
SOUTH DAKOTA	1,779	1,497	3,159	2,750
TENNESSEE	14,829	14,494	31,841	24,570
TEXAS	41,611	39,594	58,349	65,808
UTAH	7,750	8,984	10,652	7,503
VERMONT	1,926	1,165	1,855	1,772
VIRGINIA	43,736	39,611	20,699	24,231
WASHINGTON	18,032	19,803	18,382	14,282
WEST VIRGINIA	1,855	963	3,268	5,119
WISCONSIN	18,963	17,728	19,768	20,489
WYOMING	1,470	1,480	3,853	1,540
$R^2 = \frac{\sum (Y_c - \overline{Y})^2}{\sum (Y - \overline{Y})^2}$		.960	.865	.867
$\frac{\sum \text{(Estimate/Actual)}}{51}$		.943	1.445	1.345
Number of Times that (Estimate-Actual) is Minimum		30	8	13

state model with concurrent measurement of the explanatory variables.

$R_5^2 > R_2^2$ is not supported by the study -- there does not seem to be a significant difference between estimates obtained using regional equations and estimates obtained using a single national equation.

CHAPTER VIII

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of the study was to develop models for new one-family house construction at the state and county level. Construction in general, and one-family houses in particular, have long been recognized as important leading indicators of economic activity. They are used in almost all econometric models concerned with predicting the state of the economy on a national level. However, many decision makers need data for smaller geographic units in order to be able to make and evaluate marketing decisions such as: forecasting future sales of their product, determining sales quotas, designing sales territories, and evaluating the sales organization's performance. It is the needs of middle management, involved with this kind of decisions, that the models developed are aimed to satisfy.

The procedure employed in developing the models was to proceed from establishing the theoretical foundations for the model building effort, evaluation of the state of the art in housing models and methods of small area estimating, to building of the models themselves.

In Chapter I the importance of one-family house construction activity data was discussed. Governments at differnet levels -- federal, state, and local need the information for planning services and estimating receipts. The business community needs the data mainly for marketing decisions in estimating the demand for its products, setting sales goals, evaluating the sales force's performance, etc. The available measures of one-family house construction were presented. Of the three:

- building permits
- starts
- value put in place

building permits were selected since they provide direct measurement of one-family house construction for small areas. The other two measures represent estimates made by the Bureau of the Census on the basis of permit information.

The current state of the art in housing models and the methods used in obtaining small area estimates were discussed in Chapter II. In modelling the greatest methodological sophistication evolved in econometric models for the nation as a whole. Despite their sophisticated methodology many of the models use series that are not based on direct measurement of the variable, but rather represent estimates which reflect more the assumptions made by the estimator than the actual development of the phenomena. Newcomb, in his judgmental approach pays greater attention to the quality of data he uses and keeps his model flexible so that it would allow him to use the best data series available at the time.

Not much is known on the state of the art used in regional modelling, what has been found is that they are usually extensions of national models assuming that relationships found on the national level are applicable to smaller areas.

The methods used by the Population Division of the Bureau of the Census and the Bureau of Economic Analysis in obtaining small area estimates are not based on an established body of theory but rather use ad hoc formulations that vary from case to case. Ericksen's method of combining sampling with methods used by the Population Division promised to improve the quality of the estimates but does not provide a new theoretical approach.

The conceptual foundations of the state model are presented in Chapter III. Box-Jenkins' iterative approach was utilized in building the models. First the types of models applicable to the problem were discussed. These fall into two major categories:

- time series analysis
- multivariate techniques.

Within time series analysis two main approaches were identified:

- components analysis, and
- stochastic process analysis.

Components analysis assumes the series to be composed of trend, cycle, seasonal, and random movements. The analysis attempts to extract these components from the series.

The stochastic process approach regards a time series as an observed sample function representing an underlying stochastic process. The underlying stochastic process may be either stationary or nonstationary. By employing a more elaborate probability framework than the components approach, the stochastic process approach utilizes statistical estimation. In general, time series analysis is useful when the following conditions hold:

- the period for which observations exist is similar to the period to be estimated
- the large number of obse⁻⁻at..ons meeded to develop parameters of the model has not introduced artificial stability into the model, which is not likely to exist in the future.

The multivariate techniques presented were:

- factor analysis
- regression analysis
- analysis of variance.

Problems which arise when the basic assumptions underlying the models are violated were discussed and tests available to detect violations were presented.

The hypotheses set forth in terms of coefficients of determination postulated that estimates based on a concurrent sample of permits are superior to estimates based on concurrent measures of explanatory variables, these in turn are superior to estimates utilizing lagged measurements of the explanatory variables.

To test these hypotheses, two types of models were presented: the county model, in which estimates are based on direct measurement of activity in the largest permit issuing jurisdictions; and the state model, which utilized explanatory variables in obtaining estimates.

The procedure employed in building the state model was described in Chapter III. Two basic principles underlie the building of the model:

- in selecting variables to be included in the model, those for which direct measurement is available are to be preferred to those which represent estimates made by other researchers
- the principle of parsimony -- use the smallest possible number of parameters for adequate presentation.

Nineteen variables were selected for consideration in the model. They were assumed to represent the demand and supply of one-family houses. In general, they represented the socio-economic conditions, availability and cost of mortgage funds, and measures of construction activity.

The number of observations used for the variables selected depended on availability of data on a state level. An attempt was made to balance stability over time with crossectional analysis.

Observations made in the period 1968-1973 were used in the analysis. Factor analysis and regression analysis were performed on the data. The results of these analysis were described in Chapters IV and V respectively.

The results of factor analysis were used in deriving estimating equations via regression analysis. The analyses confirmed that a linear relationship provided a good fit to the data. The hypotheses postulated were supported by the analysis.

During the analysis, it became apparent that a single variable -- X_{12} -- square feet of non-residential floor area -- explained 86% of the variance of one-family house construction. Since X_{12} is a variable on which timely measurements are available by county, it is a most desirable estimator of one-family house construction activity. Thus, all the final equations were computed using this variable alone.

The county model is described in Chapter VI. The purpose of this model is to provide a measure of one-family house construction activity by month, by county. The model utilizes the "cut-off" method of sampling which combines stratified sampling, in which some strata are not sampled at all, with a ratio estimate of the parameters of interest. The permit issuing jurisdictions are partitioned by size and a complete census of the largest is taken monthly. The county monthly activity is obtained by estimating the activity of the smaller places utilizing:

- the rate of change in large permit places from base period to current period
- the number of permits issued by the small permit issuing jurisdictions during the base year
- seasonal index for the current month and year.

The results obtained from the model are compared annually to reports received from all permit places. The purpose of the comparison is to reclassify permit places, whenever their activity warrants. A by-product of the comparison is an evaluation of the distribution of deviations. The data does not support the often made assumption that measurement errors are normally distributed with mean "0" and known variance.

In Chapter VII, the performance of the proposed models was tested by comparing estimates for 1973 obtained utilizing them, to reports received by the Bureau of the Census. The best estimate with $R^2 = .96$ was obtained by using the county model. Both the regional and national equations of the state model produced estimates with $R^2 = .87$. The hypotheses that the county model will provide better estimates than the state model was supported by the comparison. In addition to providing better annual estimates by state, the county model provides monthly estimates by county. While it may be considered an ad hoc model, its performance is beyond question and it is able to satisfy a need for monthly small area statistics for one-family house construction, not satisfied in any other way.

Conclusions

Both the state and the county model provided adequate state estimates of one-family house construction activity. Both models, in their final form,utilized direct measurement in the period to be estimated in order to obtain the estimates. The county model, however, has means of providing monthly estimates by county, while the state model was developed using annual state data.

Recommendations

It seems that most serious research is being directed towards development of sophisticated methodologies with little regard to the data to which the methodologies are to be applied. There is a need to improve the quality of data by concentrating more effort on developing methods of data collection.

Further work on the state model presented here is recommended to determine whether different criteria for regional alignment would not improve the quality of estimates.

In the state regression analysis, it was found that X_{12} -- square feet of non-residential floor area -- provided good estimates of one-family house permits. Since X_{12} is measured monthly, and since information on it is available on a county level, it would be worthwhile to explore the goodness of county estimates using equations with this variable versus county estimates obtained using the county model.

APPENDIX A

CORRELATION TABLES

TABLE A1

OBSERVED VALUES -- 1968-1971

CORRELATION COEFFICIENTS..

	VAR801	VAR802	VAR803	VAR805	VAR806	VAR807	VAR808	VAR810	VAR811	VAR812
VAR801	1.00000	0.91625	0.88377	0.05198	0.02970	0.89151	0.86739	0.94655	0.95076	0.93484
VAR802	0.91625	1.00000	0.84318	0.06880	0.05528	0.85269	0.82557	0.84556	0.84531	0.89162
VAR803	0.88377	0.84318	1.00000	-0.11740	-0.14961	0.99837	0.98420	0.85157	0.84319	0.97745
VAR805	0.05198	0.06880	-0.11740	1.00000	0.98873	-0.10350	-0.12428	0.14036	0.15601	-0.08586
VAR806	0.02970	0.05528	-0.14961	0.98873	1.00000	-0.13547	-0.15334	0.11229	0.12951	-0.11165
VAR807	0.89151	0.85269	0.99837	-0.10350	-0.13547	1.00000	0.98676	0.86176	0.85848	0.97836
VAR808	0.86739	0.82557	0.98420	-0.12428	-0.15334	0.98676	1.00000	0.83733	0.84579	0.95941
VAR810	0.94655	0.84556	0.85157	0.14036	0.11229	0.86176	0.83733	1.00000	0.98545	0.88767
VAR811	0.95076	0.84531	0.84319	0.15601	0.12951	0.85848	0.84579	0.98545	1.00000	0.88582
VAR812	0.93484	0.89162	0.97745	-0.08586	-0.11165	0.97836	0.95941	0.88767	0.88582	1.00000
VAR813	0.97126	0.93079	0.87753	0.04630	0.02378	0.88280	0.84227	0.92073	0.90744	0.92597
VAR814	0.86790	0.78635	0.83796	0.33306	0.31254	0.65565	0.61224	0.89753	0.89733	0.71847
VAR815	0.87081	0.79266	0.83872	0.34521	0.32552	0.66033	0.62718	0.88827	0.91039	0.72058
VAR816	0.90578	0.87144	0.95406	-0.03711	-0.08830	0.94789	0.90710	0.86616	0.83180	0.95577
VAR817	0.69229	0.63726	0.72808	-0.20421	-0.20627	0.72753	0.73175	0.61942	0.61911	0.73954
VAR818	0.89483	0.86463	0.99702	-0.11969	-0.15249	0.98394	0.96464	0.85384	0.83447	0.96681
VAR819	0.88104	0.85923	0.98415	-0.12474	-0.15042	0.98575	0.98553	0.84361	0.84516	0.95963
VAR820	0.73669	0.70588	0.60884	0.05578	0.04742	0.62121	0.59014	0.70767	0.69181	0.65769
VAR901	0.99183	0.90359	0.85766	0.09081	0.06282	0.86687	0.84320	0.93867	0.94577	0.91410
VAR902	0.92413	0.93680	0.83605	0.07839	0.05616	0.84787	0.81817	0.86885	0.86383	0.88838
VAR903	0.88618	0.84532	0.99798	-0.11502	-0.14722	0.99845	0.98405	0.85414	0.84575	0.97831
VAR905	0.02040	0.04069	-0.16267	0.98909	0.99132	-0.14773	-0.16339	0.09990	0.11982	-0.12880
VAR906	-0.00527	0.01174	-0.18542	0.96645	0.99163	-0.17005	-0.18824	0.08234	0.10139	-0.15217
VAR908	0.88052	0.83716	0.99035	-0.13446	-0.16339	0.99300	0.99329	0.84735	0.85450	0.96935
VAR910	0.93312	0.83065	0.85916	0.12639	0.09927	0.86579	0.84623	0.99140	0.97301	0.88478
VAR911	0.94005	0.83192	0.85327	0.13940	0.11395	0.86461	0.85630	0.98361	0.99164	0.88475
VAR912	0.94386	0.88937	0.97246	-0.04508	-0.07307	0.97816	0.96118	0.90096	0.90936	0.98925
VAR913	0.95976	0.92256	0.85163	0.07301	0.04540	0.86085	0.82122	0.90997	0.90201	0.90249
VAR914	0.83934	0.75668	0.60767	0.38068	0.35765	0.62249	0.57748	0.87822	0.87233	0.68402
VAR915	0.56351	0.53119	0.48478	0.04170	0.06346	0.47773	0.48981	0.57732	0.55467	0.46119
VAR916	0.99540	0.97084	0.94124	-0.06502	-0.09673	0.93539	0.89185	0.85305	0.81369	0.94392
VAR917	0.90949	0.89592	0.97907	-0.09760	-0.12294	0.97706	0.95532	0.86895	0.84828	0.97353
VAR918	0.89855	0.87152	0.96147	-0.11649	-0.14858	0.97845	0.95600	0.85663	0.83307	0.96517
VAR919	0.87560	0.86586	0.98250	-0.13879	-0.16284	0.98213	0.97822	0.83661	0.82368	0.95931
VAR920	0.75575	0.72774	0.61449	0.06834	0.07504	0.63173	0.59876	0.72528	0.71741	0.65495
VARC01	0.97314	0.87561	0.82179	0.13309	0.10365	0.82716	0.79251	0.93222	0.92334	0.88341
VARC02	0.90272	0.96993	0.83687	0.06901	0.04484	0.84222	0.80377	0.84920	0.82460	0.83683
VARC03	0.89372	0.85132	0.99959	-0.11266	-0.14416	0.99383	0.98462	0.86104	0.85333	0.93059
VARC04	0.93255	0.88186	0.95504	0.00062	-0.03066	0.95418	0.91712	0.90858	0.88340	0.96208
VARC05	-0.01023	0.00640	-0.21199	0.97238	0.98560	-0.19702	-0.21536	0.06755	0.08714	-0.16610
VARC06	-0.04660	-0.03214	-0.25559	0.93845	0.96473	-0.24014	-0.25622	0.02934	0.05008	-0.20409
VARC07	0.90025	0.85959	0.99767	-0.10169	-0.13379	0.99962	0.98603	0.86819	0.86498	0.98112
VARC08	0.88306	0.83951	0.99112	-0.13060	-0.16046	0.99387	0.99298	0.84846	0.85542	0.97029

TABLE A1

OBSERVED VALUES -- 1968-1971

	VAR801	VAR802	VAR803	VAR805	VAR806	VAR807	VAR808	VAR810	VAR811	VAR812
VAR010	0.93809	0.85383	0.85933	0.16504	0.13311	0.86603	0.84074	0.98168	0.96367	0.88539
VAR011	0.94673	0.85499	0.85138	0.17692	0.14693	0.86270	0.84867	0.97488	0.98215	0.88398
VAR012	0.95486	0.89782	0.96239	-0.03883	-0.06497	0.96470	0.94015	0.91137	0.90578	0.98376
VAR013	0.94757	0.89048	0.82874	0.12065	0.08841	0.83678	0.79268	0.91149	0.90196	0.88347
VAR014	0.80570	0.73684	0.59910	0.39085	0.36920	0.60878	0.55378	0.83375	0.81695	0.67012
VAR015	0.83983	0.76418	0.62435	0.40130	0.38011	0.63778	0.59248	0.85953	0.85975	0.69687
VAR016	0.91541	0.87004	0.94380	-0.04776	-0.08229	0.94049	0.90084	0.87184	0.84045	0.94978
VAR017	0.92961	0.89382	0.97382	-0.07997	-0.10730	0.97527	0.95584	0.88697	0.87384	0.97390
VAR018	0.91185	0.87998	0.97775	-0.10468	-0.13858	0.97697	0.95556	0.86712	0.84847	0.96581
VAR019	0.89210	0.87661	0.97987	-0.12258	-0.14846	0.98209	0.97856	0.84906	0.84717	0.96221
VAR020	0.67001	0.67083	0.57546	0.04398	0.03221	0.57933	0.53793	0.58007	0.58575	0.63653
VAR101	0.97169	0.87790	0.91301	0.14992	0.12080	0.82127	0.79034	0.93134	0.92975	0.87602
VAR102	0.88529	0.95393	0.79827	0.03282	0.06270	0.80247	0.75847	0.83995	0.80500	0.85181
VAR103	0.89713	0.85365	0.99933	-0.10940	-0.14117	0.99873	0.98406	0.86461	0.85677	0.99153
VAR105	-0.09121	-0.08144	-0.29089	0.93166	0.95150	-0.27292	-0.28574	0.01310	0.03343	-0.24427
VAR106	-0.07725	-0.08042	-0.30676	0.90110	0.92584	-0.29189	-0.31411	0.01076	0.02433	-0.24571
VAR108	0.88561	0.84191	0.99135	-0.13016	-0.16028	0.99395	0.99271	0.85054	0.85691	0.97090
VAR109	0.89680	0.85941	0.98633	-0.12423	-0.15409	0.98719	0.97846	0.85396	0.84769	0.96675
VAR110	0.93697	0.95093	0.82085	0.21153	0.18433	0.83268	0.80467	0.96975	0.96298	0.85767
VAR111	0.93953	0.86045	0.81421	0.21073	0.16407	0.82956	0.81182	0.95786	0.97147	0.85746
VAR112	0.95099	0.89832	0.93743	0.00036	-0.03133	0.93937	0.90349	0.91174	0.89505	0.96732
VAR113	0.94785	0.88592	0.82221	0.13203	0.10314	0.83000	0.78526	0.90169	0.89523	0.88085
VAR114	0.92180	0.77169	0.83019	0.33030	0.31082	0.63929	0.58169	0.84000	0.81554	0.69586
VAR115	0.85939	0.80433	0.86102	0.33185	0.31278	0.67287	0.62313	0.86829	0.85750	0.72720
VAR116	0.90623	0.85080	0.93742	-0.03589	-0.07497	0.93361	0.89052	0.86458	0.83485	0.94330
VAR117	0.92248	0.87193	0.97869	-0.07699	-0.10953	0.97990	0.95945	0.88516	0.87504	0.97649
VAR118	0.89999	0.86237	0.97366	-0.10075	-0.13809	0.97267	0.94971	0.86196	0.84183	0.95645
VAR119	0.67740	0.85553	0.97968	-0.13278	-0.16360	0.98237	0.97918	0.83971	0.83825	0.95468
VAR120	0.59899	0.58348	0.52920	0.25316	0.22882	0.53650	0.49445	0.57435	0.58216	0.54142

	VAR813	VAR814	VAR815	VAR816	VAR817	VAR818	VAR819	VAR820	VAR901	VAR902
VAR801	0.97126	0.96790	0.87081	0.92578	0.69229	0.89483	0.88104	0.73689	0.99183	0.92413
VAR802	0.93079	0.73635	0.78265	0.57144	0.63726	0.86463	0.85923	0.70588	0.90359	0.96080
VAR803	0.67753	0.63795	0.63872	0.95406	0.72808	0.98702	0.98415	0.60834	0.85766	0.83805
VAR805	0.04630	0.33306	0.34521	-0.05711	-0.20421	-0.11969	-0.12474	0.05578	0.09081	0.07639
VAR806	0.02378	0.31254	0.32552	-0.08830	-0.20627	-0.15249	-0.15042	0.04742	0.06282	0.05616
VAR807	0.58280	0.65565	0.66033	0.94789	0.72753	0.98394	0.98575	0.62121	0.86687	0.84787
VAR808	0.84227	0.61224	0.62718	0.90710	0.73175	0.96464	0.98553	0.59014	0.84320	0.81817
VAR810	0.92073	0.89753	0.88827	0.80616	0.61942	0.85384	0.84361	0.70767	0.93867	0.86885
VAR811	0.90744	0.89733	0.91039	0.83180	0.61911	0.83447	0.84516	0.69181	0.94577	0.86383
VAR812	0.92597	0.71847	0.72058	0.95577	0.73954	0.95681	0.95963	0.65769	0.91410	0.88668
VAR813	1.00000	0.87492	0.85549	0.93578	0.67816	0.90082	0.85723	0.74248	0.96070	0.94679

TABLE A1

OBSERVED VALUES -- 1968-1971

	VAR813	VAR814	VAR815	VAR816	VAR817	VAR818	VAR819	VAR820	VAR901	VAR902
VAR814	0.87492	1.00000	0.98776	0.73000	0.47404	0.65625	0.61432	0.68932	0.87329	0.81677
VAR815	0.85549	0.98776	1.00000	0.70318	0.48095	0.64396	0.62361	0.65935	0.87765	0.89424
VAR816	0.93578	0.73000	0.70318	1.00000	0.70582	0.97355	0.92067	0.66164	0.88199	0.87090
VAR817	0.67816	0.47404	0.43095	0.70582	1.00000	0.72916	0.73643	0.46658	0.66535	0.63277
VAR818	0.90082	0.65625	0.64396	0.97355	0.72916	1.00000	0.97913	0.64815	0.87192	0.86487
VAR819	0.85723	0.61432	0.62361	0.92067	0.73643	0.97913	1.00000	0.62136	0.85491	0.94763
VAR820	0.74248	0.68932	0.65935	0.65164	0.46658	0.64815	0.62136	1.00000	0.74020	0.73555
VAR901	0.96070	0.87329	0.87766	0.56189	0.66535	0.87192	0.85481	0.74020	1.00000	0.92256
VAR902	0.94679	0.81677	0.89424	0.87090	0.63277	0.86487	0.84763	0.73555	0.92256	1.00000
VAR903	0.87993	0.64185	0.64242	0.95502	0.72879	0.98740	0.98421	0.61151	0.86023	0.83850
VAR905	0.00888	0.29970	0.31462	-0.10073	-0.21580	-0.16006	-0.15965	0.03222	0.05641	0.04510
VAR906	-0.01395	0.28543	0.30088	-0.12417	-0.23340	-0.18696	-0.18716	0.01208	0.02852	0.01804
VAR908	0.85418	0.61890	0.63296	0.91779	0.74154	0.97402	0.99297	0.60399	0.85646	0.83031
VAR910	0.39562	0.85725	0.95025	0.86160	0.62119	0.85707	0.85697	0.68500	0.92161	0.84384
VAR911	0.88863	0.86234	0.87364	0.85290	0.62241	0.84317	0.86118	0.67525	0.93165	0.84334
VAR912	0.93095	0.75261	0.76273	0.94618	0.73239	0.96365	0.95887	0.67142	0.93018	0.89422
VAR913	0.98922	0.87984	0.86369	0.90913	0.66063	0.67879	0.83458	0.75095	0.96254	0.95371
VAR914	0.84748	0.98787	0.96863	0.71361	0.44871	0.63410	0.58544	0.67272	0.85354	0.78817
VAR915	0.53193	0.47630	0.46269	0.49513	0.37924	0.51516	0.55207	0.39054	0.52603	0.49023
VAR916	0.93726	0.72677	0.69542	0.99392	0.69714	0.96786	0.90743	0.67524	0.87632	0.87872
VAR917	0.91707	0.68607	0.67615	0.97461	0.74120	0.98875	0.97310	0.66992	0.88556	0.89103
VAR918	0.90931	0.66621	0.64850	0.97569	0.72661	0.99855	0.97240	0.65860	0.87533	0.87615
VAR919	0.86189	0.60543	0.60572	0.92855	0.73585	0.98336	0.99708	0.62650	0.84895	0.85599
VAR920	0.76723	0.72806	0.71426	0.66601	0.47064	0.65297	0.62691	0.38618	0.76847	0.76950
VARC01	0.95681	0.88790	0.67523	0.87600	0.61567	0.84428	0.80739	0.76260	0.98533	0.90179
VARC02	0.93367	0.79191	0.75350	0.91194	0.62217	0.87531	0.83747	0.72566	0.90224	0.98247
VARC03	0.88605	0.65035	0.65209	0.95528	0.73044	0.98785	0.98548	0.62154	0.86904	0.84605
VARC04	0.93778	0.77173	0.76384	0.95565	0.69585	0.94831	0.92033	0.66482	0.90967	0.87533
VARC05	-0.01303	0.28829	0.39049	-0.13462	-0.22981	-0.20720	-0.21499	0.01991	0.02816	0.01425
VARC06	-0.05425	0.24471	0.23650	-0.19134	-0.25554	-0.25090	-0.25498	0.00166	-0.01240	-0.02383
VARC07	0.59141	0.66559	0.65985	0.95017	0.72913	0.96533	0.98583	0.63122	0.87752	0.85025
VARC08	0.85833	0.62391	0.63734	0.92161	0.74130	0.97621	0.99261	0.60898	0.86009	0.83415
VARC10	0.91416	0.88289	0.67592	0.87676	0.61742	0.86133	0.85067	0.70380	0.93350	0.83504
VARC11	0.90938	0.88819	0.89832	0.84630	0.61739	0.84661	0.95365	0.70021	0.94676	0.86775
VARC12	0.95191	0.78311	0.78026	0.96664	0.73031	0.96699	0.94511	0.70345	0.93983	0.90192
VARC13	0.97934	0.99752	0.97981	0.89725	0.62665	0.65282	0.80006	0.74442	0.95515	0.92339
VARC14	0.84255	0.95358	0.92249	0.72517	0.42475	0.62728	0.56135	0.68664	0.81775	0.75745
VARC15	0.85473	0.96861	0.95733	0.72603	0.45087	0.64534	0.59908	0.69732	0.85369	0.73971
VARC16	0.94703	0.74864	0.72372	0.93993	0.70171	0.96709	0.90917	0.68899	0.90114	0.83375
VARC17	0.92634	0.71414	0.71153	0.96602	0.74426	0.98069	0.96685	0.68772	0.91175	0.87594
VARC18	0.92187	0.68483	0.67048	0.96937	0.72569	0.99415	0.96963	0.67654	0.89698	0.89135
VARC19	0.87719	0.62929	0.63299	0.92468	0.73638	0.98011	0.99437	0.64748	0.87213	0.87390
VARC20	0.71467	0.59549	0.59988	0.64250	0.42447	0.59520	0.54520	0.50773	0.67492	0.69019
VAR101	0.95282	0.89447	0.89027	0.85887	0.61389	0.83325	0.80382	0.76552	0.98749	0.90454
VAR102	0.92896	0.79102	0.75146	0.87635	0.59264	0.84587	0.79770	0.73352	0.88524	0.97324
VAR103	0.88973	0.65693	0.65778	0.95665	0.73049	0.98820	0.98494	0.62583	0.87318	0.84930

TABLE A1

OBSERVED VALUES -- 1968-1971

	VAR813	VAR814	VAR815	VAR816	VAR817	VAR818	VAR819	VAR820	VAR901	VAR902
VAR105	-0.09629	0.22543	0.24310	-0.22272	-0.26522	-0.29101	-0.28959	-0.01462	-0.04455	-0.07000
VAR106	-0.07541	0.24608	0.25661	-0.21177	-0.25189	-0.30310	-0.31618	-0.02039	-0.03774	-0.06932
VAR108	0.85134	0.62619	0.63879	0.92302	0.73950	0.97737	0.99315	0.61311	0.86308	0.83720
VAR109	0.88561	0.64295	0.64403	0.94495	0.74133	0.98913	0.99136	0.65392	0.87709	0.86708
VAR110	0.92722	0.92498	0.92039	0.85344	0.59630	0.83027	0.81540	0.71547	0.94096	0.88338
VAR111	0.91569	0.91550	0.92630	0.82496	0.59584	0.81715	0.81861	0.70795	0.94754	0.88220
VAR112	0.96058	0.80836	0.79856	0.96965	0.69471	0.94835	0.90935	0.71472	0.94197	0.90761
VAR113	0.97833	0.89910	0.88387	0.89242	0.61247	0.84771	0.79527	0.74800	0.95818	0.92039
VAR114	0.87424	0.93767	0.89970	0.75927	0.45498	0.66839	0.59948	0.70635	0.83361	0.80934
VAR115	0.89234	0.95272	0.93059	0.76857	0.48367	0.69340	0.64191	0.72099	0.87206	0.83668
VAR116	0.93832	0.75176	0.72702	0.93849	0.69129	0.96092	0.89627	0.67247	0.89550	0.86598
VAR117	0.91922	0.71310	0.71026	0.97080	0.74496	0.98484	0.96562	0.67134	0.90738	0.87738
VAR118	0.91322	0.68454	0.68812	0.97079	0.72264	0.99360	0.96239	0.67700	0.88703	0.87697
VAR119	0.86443	0.61348	0.62123	0.92386	0.73842	0.98300	0.99253	0.64343	0.85992	0.85918
VAR120	0.64045	0.60938	0.60510	0.58207	0.39234	0.53409	0.50479	0.48226	0.60401	0.59815

	VAR903	VAR905	VAR906	VAR908	VAR910	VAR911	VAR912	VAR913	VAR914	VAR915
VAR801	0.88618	0.02040	-0.00527	0.88052	0.93312	0.94005	0.94386	0.95978	0.83934	0.56351
VAR802	0.84532	0.04069	0.01174	0.83716	0.83068	0.83182	0.88937	0.92256	0.75668	0.53118
VAR803	0.99998	-0.16267	-0.18542	0.99035	0.85916	0.85327	0.97246	0.85163	0.60787	0.49478
VAR805	-0.11502	0.99909	0.99645	-0.13446	0.12639	0.13940	-0.04508	0.07301	0.38068	0.04170
VAR806	-0.14722	0.97132	0.99163	-0.16339	0.09927	0.11395	-0.07307	0.04540	0.35765	0.06346
VAR807	0.99845	-0.14773	-0.17005	0.99300	0.86579	0.86461	0.97815	0.86085	0.62249	0.47773
VAR808	0.98405	-0.16339	-0.18824	0.99329	0.84623	0.85630	0.96118	0.82122	0.57748	0.49981
VAR810	0.85414	0.09990	0.08234	0.84735	0.99140	0.98361	0.90096	0.90997	0.87822	0.57732
VAR811	0.84575	0.11982	0.10139	0.85450	0.97301	0.99164	0.90986	0.90201	0.87233	0.55457
VAR812	0.97931	-0.12880	-0.15217	0.96935	0.88478	0.88475	0.98925	0.90248	0.68402	0.46119
VAR813	0.87993	0.00885	-0.01395	0.85418	0.89562	0.88863	0.93095	0.98922	0.84748	0.53193
VAR814	0.64185	0.29970	0.28643	0.61890	0.85725	0.86234	0.75261	0.87984	0.98787	0.47630
VAR815	0.64242	0.31462	0.30083	0.63296	0.85025	0.87364	0.76273	0.86369	0.96863	0.45269
VAR816	0.95502	-0.10073	-0.12417	0.91779	0.86160	0.83290	0.94618	0.90913	0.71361	0.49513
VAR817	0.72879	-0.21580	-0.23340	0.74154	0.62119	0.62241	0.73239	0.66063	0.44871	0.37924
VAR818	0.95740	-0.16006	-0.18696	0.97402	0.85707	0.84317	0.96365	0.87879	0.63410	0.51516
VAR819	0.98421	-0.15965	-0.18716	0.99297	0.85697	0.86113	0.95887	0.83458	0.58544	0.55207
VAR820	0.61151	0.03222	0.01208	0.60399	0.66500	0.67525	0.67142	0.75095	0.67272	0.39054
VAR901	0.86023	0.05641	0.02652	0.85646	0.92161	0.93168	0.93018	0.96254	0.85354	0.52603
VAR902	0.83850	0.04610	0.01804	0.83031	0.84384	0.84334	0.89422	0.95371	0.78817	0.49023
VAR903	1.00000	-0.16026	-0.18300	0.99034	0.86136	0.85552	0.97346	0.85417	0.61184	0.48555
VAR905	-0.16026	1.00000	0.99249	-0.17226	0.08432	0.10198	-0.08583	0.03655	0.34583	0.04992
VAR906	-0.18300	0.99249	1.00000	-0.19743	0.06550	0.08189	-0.10929	0.01204	0.32892	0.01695
VAR908	0.99034	-0.17226	-0.19743	1.00000	0.85601	0.86506	0.97115	0.83326	0.58509	0.49558
VAR910	0.86136	0.08432	0.06550	0.85601	1.00000	0.98747	0.89313	0.87673	0.84264	0.64034

TABLE A1

OBSERVED VALUES -- 1968-1971

	VAR903	VAR905	VAR906	VAR908	VAR910	VAR911	VAR912	VAR913	VAR914	VAR915
VAR911	0.85552	0.10198	0.08189	0.86506	0.98747	1.00000	0.90384	0.87524	0.84388	0.62695
VAR912	0.97346	-0.08583	-0.10929	0.97115	0.89313	0.90384	1.00000	0.92073	0.71854	0.46365
VAR913	0.85417	0.03655	0.01204	0.83326	0.87673	0.87524	0.92073	1.00000	0.85225	0.47793
VAR914	0.61184	0.34583	0.32892	0.58509	0.84264	0.84388	0.71864	0.85225	1.00000	0.49312
VAR915	0.40558	0.04992	0.01695	0.49558	0.64034	0.62695	0.46365	0.47798	0.49312	1.00000
VAR916	0.94223	-0.10963	-0.13161	0.90293	0.84468	0.91197	0.93801	0.91765	0.70916	0.48011
VAR917	0.97967	-0.13704	-0.16120	0.96532	0.87284	0.85629	0.96780	0.89653	0.66050	0.53405
VAR918	0.98200	-0.15653	-0.18374	0.95657	0.85665	0.83957	0.96119	0.88933	0.64447	0.51034
VAR919	0.90769	-0.17390	-0.20200	0.93715	0.84945	0.94658	0.95343	0.83860	0.57805	0.55357
VAR920	0.61721	0.06439	0.04400	0.61234	0.69470	0.69230	0.69292	0.79340	0.70697	0.36970
VARC01	0.82455	0.09452	0.06579	0.60596	0.91634	0.91327	0.89476	0.95805	0.87948	0.53960
VARC02	0.93929	0.03420	0.00565	0.81792	0.82856	0.81027	0.88113	0.93357	0.76416	0.45991
VARC03	0.99967	-0.15698	-0.17997	0.93136	0.86734	0.86220	0.97694	0.86198	0.62022	0.48949
VARC04	0.95598	-0.05123	-0.06911	0.92484	0.91173	0.88728	0.95716	0.91048	0.74053	0.52255
VARC05	-0.20932	0.98839	0.98553	-0.22409	0.04552	0.06319	-0.12514	0.01658	0.33276	0.00318
VARC06	-0.25285	0.96659	0.96944	-0.26298	0.00721	0.02641	-0.16549	-0.02637	0.28154	-0.01711
VARC07	0.99785	-0.14546	-0.16846	0.99285	0.87032	0.86992	0.98169	0.87146	0.63226	0.47950
VARC08	0.99115	-0.16365	-0.19396	0.99975	0.85548	0.86445	0.97331	0.83909	0.59054	0.48855
VARC10	0.56146	0.11973	0.09716	0.84889	0.98718	0.97417	0.89929	0.90109	0.87521	0.63746
VARC11	0.95360	0.13328	0.11246	0.85621	0.97568	0.98689	0.90914	0.90226	0.87735	0.62636
VARC12	0.96367	-0.07819	-0.10405	0.95170	0.90215	0.90016	0.98859	0.93483	0.75654	0.50305
VARC13	0.93141	0.07984	0.05755	0.90402	0.87910	0.87649	0.90378	0.99077	0.87776	0.46964
VARC14	0.88271	0.35253	0.33535	0.55353	0.79961	0.79166	0.69736	0.84484	0.97046	0.48482
VARC15	0.92793	0.36570	0.34682	0.59775	0.82857	0.83481	0.73259	0.86137	0.97828	0.50771
VARC16	0.94501	-0.09076	-0.11286	0.91064	0.85826	0.83282	0.95107	0.93419	0.72882	0.45297
VARC17	0.97466	-0.11719	-0.14002	0.96497	0.88431	0.87410	0.97728	0.91507	0.68457	0.50066
VARC18	0.97643	-0.14455	-0.17191	0.96614	0.86293	0.85061	0.96829	0.91006	0.66112	0.49871
VARC19	0.94714	-0.15745	-0.18539	0.98739	0.85587	0.85786	0.96250	0.86296	0.59988	0.53436
VARC20	0.57720	0.03614	-0.07094	0.55012	0.55638	0.56486	0.65637	0.72263	0.57869	0.29428
VAR101	0.91580	0.11081	0.03352	0.50282	0.91424	0.91724	0.89339	0.95850	0.88384	0.53038
VAR102	0.90091	0.05114	0.02274	0.77278	0.81840	0.79185	0.84470	0.92978	0.77746	0.48505
VAR103	0.99946	-0.15391	-0.17701	0.99092	0.87034	0.86516	0.97841	0.86631	0.62641	0.49013
VAR105	-0.28817	0.95928	0.96125	-0.29418	-0.00806	0.00959	-0.20105	-0.06306	0.26187	-0.04293
VAR106	-0.30350	0.92403	0.92750	-0.32096	-0.01305	-0.00196	-0.20948	-0.04333	0.28425	-0.05073
VAR108	0.99139	-0.16849	-0.17409	0.93964	0.85786	0.86632	0.97378	0.84234	0.59322	0.49406
VAR109	0.96661	-0.16176	-0.13918	0.93780	0.85923	0.85663	0.96805	0.86887	0.61716	0.52120
VAR110	0.82340	0.16983	0.14877	0.81330	0.96078	0.95986	0.88754	0.92640	0.91869	0.61422
VAR111	0.91573	0.17253	0.14974	0.81988	0.94663	0.96490	0.89302	0.92128	0.90564	0.59994
VAR112	0.93889	-0.04454	-0.06659	0.91551	0.99925	0.88570	0.96839	0.94559	0.78513	0.47529
VAR113	0.92493	0.09956	0.06578	0.79710	0.87000	0.86977	0.89909	0.98485	0.88341	0.47823
VAR114	0.83363	0.29149	0.27507	0.58946	0.60506	0.79107	0.72192	0.88194	0.94962	0.50586
VAR115	0.56441	0.29577	0.27660	0.63218	0.83707	0.83471	0.75951	0.90292	0.95888	0.54035
VAR116	0.93859	-0.08154	-0.10520	0.90161	0.84993	0.82608	0.94699	0.92603	0.73656	0.43094
VAR117	0.97948	-0.11649	-0.14075	0.96978	0.88075	0.87401	0.98243	0.90688	0.68875	0.47024
VAR118	0.97430	-0.14183	-0.16921	0.95038	0.85619	0.84304	0.96336	0.90213	0.66559	0.48281
VAR119	0.97983	-0.16852	-0.19667	0.93798	0.84419	0.84734	0.96002	0.85299	0.59259	0.50778

TABLE A1

OBSERVED VALUES -- 1968-1971

	VAR903	VAR905	VAR906	VAR908	VAR910	VAR911	VAR912	VAR913	VAR914	VAR915
VAR120	0.52998	0.21243	0.21122	0.50020	0.54904	0.55872	0.56632	0.65140	0.60509	0.28472

	VAR916	VAR917	VAR918	VAR919	VAR920	VAR001	VAR002	VAR003	VAR004	VAR005
VAR801	0.99540	0.90349	0.89655	0.87560	0.75575	0.97314	0.90272	0.89372	0.93255	-0.01023
VAR802	0.87084	0.89592	0.87152	0.86586	0.72774	0.87561	0.96993	0.85132	0.88186	0.00640
VAR803	0.94124	0.97907	0.98147	0.98260	0.61449	0.82179	0.83687	0.99959	0.95504	-0.21199
VAR805	-0.06502	-0.09760	-0.11649	-0.13879	0.08834	0.13309	0.06801	-0.11266	0.00062	0.97238
VAR806	-0.09673	-0.12294	-0.14858	-0.16284	0.07504	0.10366	0.04484	-0.14416	-0.03066	0.98560
VAR807	0.93539	0.97706	0.97845	0.98213	0.63173	0.82716	0.84222	0.99883	0.95418	-0.19702
VAR809	0.99195	0.95532	0.95600	0.97822	0.59376	0.79251	0.80377	0.98462	0.91712	-0.21536
VAR810	0.85305	0.86895	0.85663	0.83661	0.72528	0.93222	0.84920	0.86104	0.90858	0.06755
VAR811	0.91369	0.84828	0.83307	0.82968	0.71741	0.92334	0.82460	0.85333	0.88340	0.08714
VAR812	0.94392	0.97353	0.96517	0.93931	0.66495	0.88341	0.88683	0.98059	0.96208	-0.16610
VAR813	0.93726	0.91707	0.90931	0.86189	0.76723	0.95681	0.93367	0.88605	0.93778	-0.01303
VAR814	0.72677	0.68607	0.66621	0.60543	0.72806	0.88790	0.78191	0.65085	0.77173	0.28829
VAR815	0.69542	0.67615	0.64350	0.60572	0.71426	0.87523	0.75350	0.65209	0.76384	0.30049
VAR816	0.99392	0.97451	0.97569	0.92855	0.66601	0.87600	0.69194	0.95528	0.96565	-0.13482
VAR817	0.69714	0.74120	0.72661	0.73585	0.47064	0.61567	0.62217	0.73044	0.69595	-0.22931
VAR818	0.96786	0.98875	0.99855	0.98336	0.65297	0.84428	0.87531	0.98785	0.94831	-0.20720
VAR819	0.90743	0.97310	0.97240	0.99708	0.62691	0.80739	0.83747	0.98548	0.92033	-0.21499
VAR820	0.57324	0.65992	0.65360	0.62650	0.99619	0.76260	0.72566	0.62154	0.66482	0.01991
VAR901	0.37632	0.88566	0.87533	0.84895	0.76847	0.98533	0.90224	0.86904	0.90967	0.02616
VAR902	0.87372	0.89103	0.87519	0.85599	0.70950	0.90179	0.98247	0.84606	0.87598	0.01425
VAR903	0.94223	0.97957	0.98200	0.93269	0.61721	0.82455	0.83929	0.99967	0.95598	-0.20732
VAR905	-0.10963	-0.13704	-0.15653	-0.17390	0.06439	0.09452	0.03420	-0.15698	-0.05123	0.98889
VAR906	-0.13161	-0.16120	-0.19374	-0.20200	0.04400	0.06579	0.00565	-0.17997	-0.06911	0.98553
VAR908	0.90293	0.96532	0.96657	0.96715	0.61234	0.80596	0.81792	0.99136	0.92484	-0.22409
VAR910	0.94468	0.97294	0.89565	0.84945	0.69470	0.91634	0.82866	0.86734	0.91173	0.04552
VAR911	0.81197	0.95629	0.83957	0.64058	0.69230	0.91327	0.81027	0.86220	0.88728	0.06319
VAR912	0.73801	0.95780	0.95119	0.95343	0.59292	0.89475	0.88113	0.97694	0.95716	-0.12514
VAR913	0.91763	0.99653	0.88933	0.83860	0.79340	0.95805	0.93357	0.86198	0.91048	0.01658
VAR914	0.70316	0.86050	0.64447	0.57805	0.70697	0.87948	0.76416	0.62022	0.74053	0.33276
VAR915	0.48011	0.93405	0.51034	0.55357	0.36970	0.53960	0.45991	0.48949	0.52255	0.00318
VAR916	1.00000	0.97319	0.97300	0.91878	0.68485	0.87330	0.90247	0.94331	0.95904	-0.14273
VAR917	0.97419	1.00000	0.98819	0.97866	0.67693	0.85781	0.89639	0.98163	0.96137	-0.18216
VAR918	0.97300	0.98819	1.00000	0.97975	0.66457	0.95113	0.88917	0.98280	0.94672	-0.20160
VAR919	0.91978	0.97966	0.97975	1.00000	0.62890	0.80647	0.85347	0.98368	0.91917	-0.22740
VAR920	0.66485	0.67693	0.66457	0.62890	1.00000	0.78708	0.74583	0.62882	0.67607	0.05255
VAR001	0.87330	0.85781	0.95113	0.80647	0.78708	1.00000	0.89615	0.83301	0.89420	0.07149
VAR002	0.90247	0.94639	0.88917	0.85347	0.74583	0.89615	1.00000	0.84487	0.87745	0.00364
VAR003	0.94331	0.98163	0.98280	0.98368	0.62882	0.83301	0.84487	1.00000	0.95798	-0.20593
VAR004	0.95904	0.96187	0.94672	0.91917	0.67607	0.89420	0.87745	0.95798	1.00000	-0.09236

TABLE A1

OBSERVED VALUES -- 1968-1971

	VAR916	VAR917	VAR918	VAR919	VAR920	VAR001	VAR002	VAR003	VAR004	VAR005
VAR005	-0.14273	-0.18216	-0.20160	-0.22740	0.05255	0.07149	0.00364	-0.20593	-0.09236	1.00000
VAR006	-0.19023	-0.22677	-0.24409	-0.26551	0.02968	0.02907	-0.03382	-0.24919	-0.14005	0.98692
VAR007	0.93982	0.97919	0.98057	0.98253	0.64323	0.83851	0.85070	0.99880	0.95631	-0.19400
VAR008	0.90774	0.96763	0.96891	0.96683	0.61846	0.81033	0.82219	0.99226	0.92669	-0.23036
VAR010	0.86604	0.88052	0.86125	0.84269	0.72178	0.93607	0.85099	0.86750	0.92576	0.07873
VAR011	0.83313	0.86402	0.84394	0.83944	0.72571	0.93715	0.83533	0.86067	0.90022	0.09503
VAR012	0.96137	0.97448	0.96736	0.94453	0.71503	0.91482	0.89814	0.96743	0.96746	-0.11823
VAR013	0.90546	0.97110	0.86261	0.90215	0.78807	0.96446	0.91032	0.83872	0.90159	0.06486
VAR014	0.72369	0.65257	0.63834	0.55778	0.72143	0.87094	0.75449	0.60959	0.73770	0.34487
VAR015	0.72301	0.67416	0.65278	0.53922	0.73734	0.89021	0.76312	0.63605	0.75637	0.35312
VAR016	0.99271	0.96905	0.97136	0.91657	0.70312	0.89294	0.90059	0.94706	0.96076	-0.12304
VAR017	0.96314	0.99159	0.97769	0.96802	0.70227	0.87788	0.89215	0.97828	0.96256	-0.15976
VAR018	0.96896	0.99562	0.99633	0.97571	0.68954	0.87224	0.89752	0.98058	0.94657	-0.18838
VAR019	0.91747	0.97760	0.97747	0.99593	0.65776	0.82843	0.86401	0.98253	0.92063	-0.20900
VAR020	0.65682	0.61173	0.60084	0.54236	0.54545	0.67771	0.68303	0.58411	0.64270	0.01111
VAR101	0.86001	0.85149	0.83917	0.80011	0.79703	0.99514	0.89137	0.82517	0.88899	0.08698
VAR102	0.89026	0.87137	0.86239	0.81706	0.75384	0.89306	0.99348	0.80714	0.85479	0.02481
VAR103	0.94508	0.98233	0.98335	0.98313	0.63366	0.83780	0.84798	0.99995	0.95962	-0.20254
VAR105	-0.23151	-0.26299	-0.28565	-0.30392	0.01750	-0.00675	-0.08608	-0.28392	-0.16971	0.98092
VAR106	-0.21872	-0.26923	-0.29504	-0.32682	0.01515	0.01055	-0.08244	-0.29960	-0.16541	0.96660
VAR108	0.90947	0.96869	0.97037	0.98780	0.62269	0.81454	0.82550	0.99258	0.92785	-0.22026
VAR109	0.93817	0.98594	0.98574	0.99191	0.66169	0.83527	0.86236	0.98871	0.93568	-0.21361
VAR110	0.85107	0.85576	0.83292	0.80654	0.75020	0.94379	0.85625	0.83143	0.89660	0.13498
VAR111	0.82046	0.84143	0.81738	0.80485	0.74849	0.93919	0.84139	0.82557	0.87335	0.13684
VAR112	0.97076	0.96212	0.95175	0.91092	0.73337	0.92942	0.91300	0.94307	0.97091	-0.07758
VAR113	0.90100	0.86408	0.85749	0.79673	0.78999	0.96918	0.90753	0.83236	0.89321	0.07482
VAR114	0.76657	0.69811	0.68197	0.60162	0.74925	0.88488	0.79606	0.64166	0.75954	0.28189
VAR115	0.77423	0.72596	0.70376	0.63913	0.76656	0.90973	0.81171	0.67345	0.78373	0.26092
VAR116	0.99966	0.95623	0.96461	0.90209	0.68794	0.89145	0.88681	0.93991	0.95390	-0.11170
VAR117	0.96463	0.98614	0.98290	0.96489	0.66546	0.87481	0.87853	0.98210	0.95645	-0.15814
VAR118	0.97146	0.98051	0.99542	0.96743	0.68944	0.86470	0.88743	0.97604	0.93993	-0.18526
VAR119	0.91781	0.97319	0.97973	0.99246	0.65475	0.81569	0.85095	0.98183	0.91007	-0.22091
VAR120	0.57852	0.55492	0.53130	0.49649	0.53031	0.61025	0.56874	0.53359	0.58333	0.20117

TABLE A1

OBSERVED VALUES -- 1968-1971

	VAR006	VAR007	VAR008	VAR010	VAR011	VAR012	VAR013	VAR014	VAR015	VAR016
VAR801	-0.04660	0.90025	0.88306	0.93809	0.94673	0.95486	0.94757	0.80570	0.83983	0.91541
VAR802	-0.03214	0.85959	0.83951	0.85383	0.85499	0.89782	0.89048	0.73684	0.76418	0.87004
VAR803	-0.25559	0.99767	0.99112	0.85933	0.85139	0.96239	0.82874	0.59910	0.62435	0.94380
VAR805	0.93945	-0.10169	-0.13060	0.16504	0.17692	-0.03883	0.12065	0.39085	0.40130	-0.04776
VAR806	0.96473	-0.13379	-0.16046	0.13311	0.14693	-0.06497	0.08841	0.36920	0.38011	-0.08229
VAR807	-0.24014	0.99962	0.99387	0.85603	0.86270	0.96470	0.83678	0.60878	0.63778	0.94049
VAR808	-0.25622	0.98603	0.99298	0.84074	0.84867	0.94015	0.79268	0.55378	0.59248	0.90084
VAR810	0.02934	0.86819	0.84346	0.98168	0.97488	0.91137	0.91149	0.83375	0.85953	0.87184
VAR811	0.05008	0.85493	0.85542	0.96367	0.98215	0.90578	0.90196	0.81695	0.85975	0.84045
VAR812	-0.20409	0.98112	0.97029	0.88539	0.88393	0.98376	0.88347	0.67012	0.69687	0.94978
VAR813	-0.05425	0.89141	0.85833	0.91416	0.90838	0.95191	0.97934	0.84255	0.85473	0.94703
VAR814	0.24471	0.66359	0.62381	0.80289	0.88819	0.78311	0.89752	0.95358	0.96861	0.74664
VAR815	0.25650	0.66990	0.63734	0.87592	0.89832	0.78026	0.87981	0.92249	0.95733	0.72372
VAR816	-0.18134	0.95017	0.92161	0.87676	0.84630	0.96664	0.89725	0.72517	0.72603	0.98993
VAR817	-0.25554	0.72913	0.74130	0.61742	0.61739	0.73031	0.62665	0.42475	0.45087	0.70171
VAR818	-0.25090	0.98543	0.97521	0.86133	0.84661	0.96699	0.85282	0.62728	0.64534	0.96709
VAR819	-0.25496	0.98583	0.99261	0.85067	0.85365	0.94511	0.80006	0.56135	0.59908	0.90917
VAR820	0.00166	0.63122	0.60398	0.70380	0.70021	0.70345	0.74442	0.68664	0.69732	0.68899
VAR901	-0.01240	0.87752	0.86009	0.93350	0.94676	0.93883	0.95515	0.81775	0.85369	0.90114
VAR902	-0.02368	0.85705	0.83415	0.80604	0.86776	0.90192	0.92389	0.76746	0.78971	0.88375
VAR903	-0.25285	0.99785	0.99115	0.80146	0.85360	0.96367	0.83141	0.60271	0.62793	0.94501
VAR905	0.96659	-0.14546	-0.16666	0.11973	0.13628	-0.07619	0.07984	0.35253	0.36570	-0.09076
VAR906	0.96944	-0.16646	-0.19366	0.09716	0.11246	-0.10405	0.05755	0.33535	0.34682	-0.11286
VAR908	-0.26298	0.99285	0.99975	0.84989	0.85621	0.95170	0.80402	0.55853	0.59775	0.91064
VAR910	0.00721	0.87092	0.85543	0.98718	0.97568	0.90215	0.87910	0.79981	0.82857	0.85826
VAR911	0.02641	0.86992	0.86445	0.97417	0.98669	0.90016	0.87649	0.79166	0.83481	0.83282
VAR912	-0.16549	0.92169	0.97331	0.89929	0.90914	0.98859	0.90378	0.69736	0.73259	0.95107
VAR913	-0.02637	0.87146	0.83909	0.90109	0.90226	0.93483	0.99077	0.84484	0.86137	0.93419
VAR914	0.28154	0.68225	0.59054	0.87521	0.87735	0.75654	0.87776	0.97046	0.97828	0.72832
VAR915	-0.01711	0.47930	0.49855	0.63746	0.62636	0.50305	0.46964	0.48482	0.50771	0.45237
VAR916	-0.19023	0.93842	0.90774	0.85604	0.83313	0.96137	0.90546	0.72369	0.72301	0.99271
VAR917	-0.22677	0.97919	0.95763	0.86052	0.86402	0.97448	0.87110	0.65257	0.67416	0.96905
VAR918	-0.24405	0.98057	0.96691	0.86125	0.84394	0.96736	0.86261	0.63834	0.65278	0.97136
VAR919	-0.20551	0.96253	0.95683	0.84269	0.83944	0.94453	0.80215	0.55778	0.58922	0.91657
VAR920	0.02966	0.64323	0.61946	0.72178	0.72571	0.71503	0.78807	0.72143	0.73734	0.70312
VARC01	0.02907	0.83951	0.81633	0.93607	0.93715	0.91482	0.96446	0.87094	0.89021	0.89294
VARC02	-0.03382	0.85070	0.82219	0.85099	0.83533	0.89814	0.91032	0.75449	0.76312	0.90359
VARC03	-0.24919	0.99680	0.99226	0.85750	0.85067	0.96743	0.83872	0.60959	0.63605	0.94706
VARC04	-0.14005	0.95031	0.92663	0.92576	0.90022	0.96746	0.90159	0.73770	0.75637	0.96076
VARC05	0.99692	-0.19400	-0.22036	0.07873	0.09503	-0.11823	0.06486	0.34487	0.35312	-0.12304
VARC06	1.00000	-0.23707	-0.26026	0.02857	0.04690	-0.16264	0.01892	0.29148	0.30023	-0.16983
VARC07	-0.23707	1.00000	0.99392	0.87153	0.86889	0.96920	0.84723	0.61767	0.64707	0.94495
VARC08	-0.26026	0.99392	1.00000	0.85018	0.85752	0.95471	0.81035	0.56507	0.60368	0.91596
VARC10	0.02857	0.87153	0.85018	1.00000	0.98786	0.91563	0.90935	0.84997	0.87557	0.87675
VARC11	0.04690	0.86889	0.85752	0.98786	1.00000	0.91364	0.90919	0.84220	0.88229	0.85189
VARC12	-0.16264	0.96920	0.95471	0.91563	0.91364	1.00000	0.91839	0.74065	0.76574	0.96997

TABLE A1

OBSERVED VALUES -- 1968-1971

	VAR006	VAR007	VAR008	VAR010	VAR011	VAR012	VAR013	VAR014	VAR015	VAR016
VAR013	0.01092	0.84723	0.81035	0.90935	0.90919	0.91839	1.00000	0.88269	0.89509	0.92336
VAR014	0.29148	0.61767	0.56307	0.84997	0.84220	0.74065	0.88269	1.00000	0.98941	0.73396
VAR015	0.30023	0.64707	0.60368	0.87557	0.88229	0.76574	0.89509	0.98941	1.00000	0.73916
VAR016	-0.16988	0.94496	0.91596	0.87675	0.85189	0.96997	0.92336	0.73396	0.73916	1.00000
VAR017	-0.20286	0.97892	0.96800	0.86971	0.88040	0.97926	0.89086	0.66506	0.69362	0.97334
VAR018	-0.23121	0.98058	0.96908	0.86994	0.85877	0.97188	0.88419	0.65309	0.67149	0.97434
VAR019	-0.24793	0.98401	0.98787	0.85232	0.85520	0.95123	0.82742	0.57709	0.61234	0.92277
VAR020	-0.02879	0.58869	0.55557	0.56568	0.59288	0.65467	0.72039	0.59795	0.61552	0.66750
VAR101	0.04210	0.83259	0.80734	0.93727	0.94459	0.91040	0.96496	0.86882	0.89580	0.88056
VAR102	-0.01251	0.91199	0.77766	0.84325	0.82009	0.87055	0.91065	0.77927	0.77850	0.88464
VAR103	-0.24607	0.99891	0.99193	0.87100	0.86425	0.96940	0.84351	0.61560	0.64201	0.94916
VAR105	0.98841	-0.27017	-0.29165	0.01165	0.02854	-0.20066	-0.01424	0.26360	0.27690	-0.20570
VAR106	0.97068	-0.23786	-0.31845	0.00868	0.01845	-0.20566	0.01161	0.29682	0.30121	-0.19787
VAR108	-0.26010	0.99419	0.99991	0.85282	0.85983	0.95577	0.81367	0.56839	0.60653	0.91750
VAR109	-0.25707	0.98901	0.98943	0.86126	0.85382	0.96392	0.83737	0.59494	0.62632	0.94278
VAR110	0.06186	0.84019	0.81648	0.98369	0.98433	0.90475	0.93588	0.89554	0.92181	0.86365
VAR111	0.08569	0.83761	0.82295	0.95855	0.99825	0.89900	0.92845	0.87365	0.91292	0.83924
VAR112	-0.12701	0.94488	0.91952	0.92028	0.90624	0.98418	0.93925	0.77597	0.79377	0.97350
VAR113	0.02593	0.84064	0.80309	0.90424	0.90613	0.91784	0.99173	0.89156	0.90382	0.91409
VAR114	0.22740	0.64955	0.59697	0.85542	0.84342	0.76799	0.90924	0.98465	0.97111	0.77179
VAR115	0.22667	0.68345	0.63902	0.85494	0.88473	0.79726	0.92630	0.97962	0.98336	0.78381
VAR116	-0.16130	0.93782	0.90740	0.87300	0.84828	0.96600	0.92021	0.74476	0.74732	0.99493
VAR117	-0.20315	0.98294	0.97325	0.83727	0.87987	0.98289	0.88672	0.66839	0.69397	0.97484
VAR118	-0.23106	0.97598	0.96410	0.85683	0.85397	0.96936	0.87947	0.65905	0.67424	0.97534
VAR119	-0.26245	0.93399	0.98935	0.84365	0.84682	0.94844	0.81853	0.56905	0.60217	0.92315
VAR120	0.13129	0.54128	0.50857	0.58614	0.59440	0.57184	0.66391	0.64465	0.64213	0.58261

	VAR017	VAR018	VAR019	VAR020	VAR101	VAR102	VAR103	VAR105	VAR106	VAR108
VAR801	0.92961	0.91185	0.89210	0.57001	0.97169	0.88529	0.89713	-0.08121	-0.07725	0.88561
VAR802	0.89382	0.87998	0.87661	0.57083	0.87780	0.95593	0.95365	-0.08144	-0.08042	0.84191
VAR803	0.97322	0.97775	0.97987	0.57546	0.81301	0.79827	0.99933	-0.29089	-0.30676	0.99135
VAR805	-0.07997	-0.10468	-0.12258	0.04398	0.14992	0.08282	-0.10940	0.93166	0.90110	-0.13016
VAR806	-0.10730	-0.11858	-0.14846	0.03221	0.12080	0.06270	-0.14117	0.95150	0.92584	-0.16028
VAR807	0.97527	0.97697	0.95209	0.57933	0.82127	0.80247	0.99873	-0.27292	-0.29189	0.99395
VAR808	0.95584	0.95556	0.97856	0.53793	0.79034	0.75847	0.98406	-0.28574	-0.31411	0.99271
VAR810	0.98697	0.86712	0.84906	0.58007	0.93134	0.83995	0.86461	0.01310	0.01076	0.85054
VAR811	0.87384	0.84847	0.84717	0.58575	0.92975	0.80500	0.85677	0.03343	0.02433	0.85551
VAR812	0.97390	0.96681	0.96221	0.63653	0.67602	0.85181	0.98153	-0.24427	-0.24571	0.97090
VAR813	0.92634	0.92187	0.87719	0.71467	0.95282	0.92896	0.88973	-0.09629	-0.07541	0.86134
VAR814	0.71414	0.68483	0.62929	0.59949	0.89447	0.79102	0.65683	0.22543	0.24608	0.62619
VAR815	0.71153	0.67048	0.63299	0.59988	0.89027	0.75146	0.65778	0.24310	0.25661	0.63679
VAR816	0.96602	0.96937	0.92468	0.64250	0.85887	0.87635	0.95665	-0.22272	-0.21177	0.92302

TABLE A1

OBSERVED VALUES -- 1968-1971

	VAR017	VAR018	VAR019	VAR020	VAR101	VAR102	VAR103	VAR105	VAR106	VAR109
VAR817	0.74426	0.72369	0.73638	0.42447	0.61389	0.59264	0.73049	-0.26522	-0.25189	0.73950
VAR818	0.98069	0.99415	0.98011	0.59520	0.83325	0.84587	0.98820	-0.29101	-0.30310	0.77737
VAR819	0.96685	0.96963	0.97437	0.54520	0.80382	0.79770	0.93494	-0.28959	-0.31618	0.99315
VAR820	0.68772	0.67654	0.64748	0.50773	0.76552	0.73352	0.62583	-0.01462	-0.02039	0.61311
VAR901	0.91175	0.89698	0.87213	0.67492	0.98749	0.88524	0.87318	-0.04455	-0.03774	0.86309
VAR902	0.89594	0.99135	0.87390	0.69019	0.90464	0.97324	0.84930	-0.07000	-0.06932	0.23720
VAR903	0.97468	0.97843	0.98014	0.57720	0.81580	0.80091	0.99946	-0.28817	-0.30380	0.99139
VAR905	-0.11719	-0.14456	-0.15745	0.03614	0.11061	0.05114	-0.15391	0.95928	0.92403	-0.16849
VAR906	-0.14002	-0.17191	-0.18533	-0.00094	0.08352	0.02274	-0.17701	0.96125	0.92959	-0.19409
VAR908	0.96497	0.96614	0.98739	0.55012	0.80282	0.77278	0.99092	-0.29418	-0.32096	0.99954
VAR910	0.88431	0.86293	0.85537	0.55638	0.91424	0.81840	0.87034	-0.00806	-0.01305	0.85786
VAR911	0.87410	0.85061	0.85786	0.56486	0.91724	0.79185	0.86516	0.00959	-0.00196	0.86632
VAR912	0.97728	0.96829	0.96250	0.65637	0.89339	0.84470	0.97841	-0.20105	-0.20948	0.97373
VAR913	0.91507	0.91005	0.85295	0.72263	0.95850	0.92978	0.86631	-0.06306	-0.04333	0.84234
VAR914	0.68457	0.66112	0.59988	0.57969	0.88384	0.77746	0.62641	0.26187	0.28425	0.59322
VAR915	0.50066	0.49871	0.53436	0.29428	0.53638	0.48505	0.49013	-0.04293	-0.05073	0.49406
VAR916	0.96314	0.96595	0.91747	0.65682	0.86001	0.87026	0.94508	-0.23151	-0.21872	0.90947
VAR917	0.97159	0.98562	0.97760	0.51173	0.85149	0.87137	0.98233	-0.26299	-0.26923	0.96869
VAR918	0.97969	0.99633	0.97747	0.50084	0.83917	0.86239	0.98335	-0.28565	-0.29504	0.97037
VAR919	0.96802	0.97371	0.99593	0.54236	0.80011	0.81706	0.98313	-0.30392	-0.32682	0.98780
VAR920	0.70227	0.69554	0.65776	0.54545	0.79703	0.75384	0.63366	0.01750	0.01515	0.62269
VAR001	0.87788	0.87224	0.82643	0.57771	0.99514	0.89306	0.83780	-0.00675	0.01055	0.81454
VAR002	0.89215	0.87752	0.86401	0.68303	0.99137	0.99348	0.84798	-0.08608	-0.08244	0.82550
VAR003	0.77826	0.98058	0.98253	0.58411	0.82517	0.80714	0.99995	-0.28292	-0.29960	0.99258
VAR004	0.96256	0.94557	0.92063	0.54270	0.88899	0.85479	0.95962	-0.16971	-0.16541	0.92785
VAR005	-0.15975	-0.18838	-0.20300	0.01111	0.08698	0.02481	-0.20254	0.98092	0.95660	-0.22026
VAR006	-0.20286	-0.23121	-0.24793	-0.02879	0.04210	-0.01251	-0.24607	0.98841	0.97068	-0.26019
VAR007	0.97692	0.93058	0.98401	0.53869	0.83299	0.81198	0.99891	-0.27017	-0.28786	0.99419
VAR009	0.98600	0.95503	0.98787	0.55557	0.80734	0.77766	0.99193	-0.29165	-0.31845	0.99991
VAR010	0.88971	0.86994	0.85232	0.58568	0.93727	0.84328	0.87100	0.01165	0.00868	0.85282
VAR011	0.99040	0.65877	0.85520	0.59288	0.94459	0.82009	0.86425	0.02854	0.01245	0.85983
VAR012	0.97926	0.97186	0.95123	0.55467	0.91040	0.87055	0.96940	-0.20066	-0.20566	0.95577
VAR013	0.87006	0.88419	0.82742	0.72037	0.96496	0.91065	0.84351	-0.01424	0.01161	0.81367
VAR014	0.66506	0.65509	0.57709	0.59795	0.86382	0.77927	0.61560	0.26360	0.29682	0.56839
VAR015	0.69362	0.67149	0.61234	0.61552	0.89580	0.77850	0.64201	0.27690	0.30121	0.60653
VAR016	0.97334	0.97434	0.92277	0.55750	0.88056	0.68464	0.94916	-0.20570	-0.19787	0.91750
VAR017	1.00000	0.99503	0.97572	0.82529	0.87363	0.86422	0.97947	-0.23148	-0.24008	0.96880
VAR018	0.99503	1.00000	0.96097	0.61459	0.86241	0.87099	0.98160	-0.26990	-0.27994	0.97080
VAR019	0.97572	0.96097	1.00000	0.55672	0.82453	0.82763	0.98248	-0.28278	-0.30587	0.98897
VAR020	0.82529	0.61459	0.55672	1.00000	0.67112	0.68931	0.58788	-0.07257	-0.06094	0.55699
VAR101	0.87363	0.86241	0.82453	0.67112	1.00000	0.88569	0.83016	0.01128	0.02721	0.81137
VAR102	0.86422	0.87099	0.82763	0.68931	0.88569	1.00000	0.81075	-0.06553	-0.05464	0.78171
VAR103	0.97947	0.98160	0.98248	0.58788	0.83016	0.81075	1.00000	-0.28069	-0.29588	0.99231
VAR105	-0.23148	-0.26990	-0.28278	-0.07257	0.01128	-0.06553	-0.28069	1.00000	0.97953	-0.29205
VAR106	-0.24008	-0.27994	-0.30587	-0.06094	0.02721	-0.05464	-0.29588	0.97953	1.00000	-0.31844
VAR109	0.96880	0.97080	0.98897	0.55699	0.81137	0.78171	0.99231	-0.29205	-0.31844	1.00000

TABLE A1
OBSERVED VALUES -- 1968-1971

	VAR017	VAR018	VAR019	VAR020	VAR101	VAR102	VAR103	VAR105	VAR106	VAR108
VAR109	0.98426	0.97562	0.99398	0.56330	0.83132	0.82695	0.98894	-0.29061	-0.31252	0.99035
VAR110	0.86907	0.84769	0.82348	0.61619	0.95388	0.85361	0.83583	0.06360	0.06640	0.81922
VAR111	0.86029	0.83714	0.82659	0.61960	0.95405	0.83180	0.82992	0.06671	0.06313	0.82545
VAR112	0.96421	0.95523	0.91734	0.67505	0.92781	0.89308	0.94569	-0.16175	-0.15248	0.92104
VAR113	0.87870	0.87720	0.81974	0.71962	0.97303	0.90685	0.83721	-0.01157	0.01911	0.80659
VAR114	0.70575	0.69313	0.62204	0.61831	0.88589	0.82616	0.64774	0.19625	0.23261	0.60111
VAR115	0.73951	0.72325	0.66243	0.63794	0.91623	0.83408	0.67944	0.19843	0.22680	0.64288
VAR116	0.95863	0.96536	0.90618	0.67106	0.87796	0.87007	0.94216	-0.19946	-0.18791	0.90888
VAR117	0.99301	0.92544	0.96997	0.62400	0.86871	0.84780	0.98331	-0.23429	-0.24359	0.97392
VAR118	0.97849	0.99572	0.97074	0.61108	0.85505	0.86151	0.97717	-0.26959	-0.28007	0.96563
VAR119	0.97120	0.98173	0.99549	0.55003	0.81195	0.81346	0.98181	-0.29678	-0.32356	0.99022
VAR120	0.56126	0.54399	0.51383	0.42853	0.62836	0.57741	0.53671	0.11488	0.14738	0.51009

	VAR109	VAR110	VAR111	VAR112	VAR113	VAR114	VAR115	VAR116	VAR117	VAR118
VAR801	0.89680	0.93697	0.93953	0.95099	0.94785	0.82180	0.85939	0.90623	0.92248	0.89999
VAR802	0.86941	0.86093	0.86045	0.84832	0.88992	0.77169	0.80433	0.85080	0.87193	0.86237
VAR803	0.98633	0.82085	0.81421	0.93743	0.82221	0.63019	0.66102	0.93742	0.97869	0.97366
VAR805	-0.12423	0.21153	0.21073	0.00036	0.13203	0.33030	0.33185	-0.03539	-0.07699	-0.10075
VAR806	-0.15409	0.19433	0.19407	-0.03133	0.10314	0.31082	0.31278	-0.07497	-0.10953	-0.13809
VAR807	0.96719	0.83263	0.82956	0.93937	0.83000	0.63929	0.67287	0.93361	0.97990	0.97267
VAR808	0.97846	0.80497	0.81182	0.90349	0.78526	0.58069	0.62313	0.89052	0.95945	0.94971
VAR810	0.85336	0.95975	0.95786	0.91174	0.90169	0.84000	0.86829	0.86458	0.88516	0.86198
VAR811	0.84769	0.96298	0.97147	0.85505	0.89523	0.81554	0.85750	0.83485	0.87504	0.84183
VAR812	0.96675	0.85967	0.85746	0.96732	0.88086	0.69586	0.72720	0.94330	0.97649	0.95845
VAR813	0.88561	0.82722	0.91569	0.96058	0.97833	0.87424	0.89234	0.93832	0.91822	0.91322
VAR814	0.64295	0.92494	0.91590	0.80836	0.89910	0.93767	0.95272	0.75176	0.71310	0.68454
VAR815	0.64403	0.92637	0.92630	0.79856	0.88387	0.89970	0.93059	0.72702	0.71026	0.66912
VAR816	0.94495	0.85344	0.82493	0.95965	0.89242	0.75927	0.76857	0.96649	0.97080	0.97079
VAR817	0.74133	0.59830	0.59584	0.59471	0.61247	0.45498	0.48367	0.69129	0.74495	0.72264
VAR818	0.96913	0.53027	0.81715	0.94835	0.84771	0.66839	0.69340	0.96092	0.98464	0.97360
VAR819	0.97136	0.81540	0.81861	0.90935	0.79527	0.59948	0.64191	0.89627	0.96562	0.96239
VAR820	0.65392	0.71547	0.70795	0.71472	0.74800	0.70635	0.72099	0.67247	0.67134	0.67700
VAR901	0.87709	0.94096	0.94754	0.94197	0.95818	0.83361	0.87206	0.89550	0.90738	0.89703
VAR902	0.96708	0.55338	0.68220	0.90761	0.92039	0.80934	0.83668	0.86598	0.87738	0.87697
VAR903	0.98861	0.62340	0.81673	0.93889	0.82483	0.63363	0.66441	0.93859	0.97948	0.97430
VAR905	-0.16196	0.16983	0.17253	-0.04454	0.08956	0.29149	0.29577	-0.08154	-0.11643	-0.14183
VAR906	-0.18918	0.14377	0.14974	-0.06859	0.06578	0.27507	0.27660	-0.10520	-0.14075	-0.16921
VAR908	0.98780	0.81330	0.81988	0.91551	0.79710	0.58946	0.63218	0.90161	0.96978	0.96038
VAR910	0.85923	0.95078	0.94663	0.89925	0.87000	0.80506	0.83707	0.84993	0.88075	0.85619
VAR911	0.85663	0.95986	0.96480	0.88570	0.86977	0.79107	0.83471	0.82608	0.87401	0.84304
VAR912	0.96905	0.88754	0.89302	0.96839	0.89909	0.72192	0.75951	0.94699	0.98243	0.96336
VAR913	0.86887	0.92640	0.92128	0.94689	0.98485	0.88194	0.90292	0.92603	0.90688	0.90213

TABLE A1

OBSERVED VALUES -- 1968-1971

	VAR109	VAR110	VAR111	VAR112	VAR113	VAR114	VAR115	VAR116	VAR117	VAR118
VAR914	0.61716	0.91869	0.90564	0.78513	0.88341	0.94962	0.95888	0.73656	0.68875	0.66559
VAR915	0.52120	0.61422	0.59994	0.47529	0.47823	0.50586	0.54035	0.43094	0.47024	0.45281
VAR916	0.93817	0.85107	0.82046	0.97078	0.90100	0.76657	0.77423	0.98966	0.96463	0.97146
VAR917	0.98593	0.85576	0.84143	0.96212	0.86408	0.69811	0.72596	0.95629	0.98614	0.98051
VAR918	0.98574	0.83292	0.81738	0.95175	0.85749	0.68187	0.70376	0.96461	0.98290	0.99542
VAR919	0.99191	0.80654	0.80485	0.91092	0.79673	0.60162	0.63913	0.90209	0.96489	0.98743
VAR920	0.66189	0.75020	0.74849	0.73337	0.78999	0.74825	0.76656	0.68794	0.68546	0.68944
VAR001	0.83527	0.94379	0.93919	0.92942	0.96918	0.88488	0.90973	0.89145	0.87481	0.86470
VAR002	0.86236	0.85625	0.84139	0.91300	0.90753	0.79606	0.81171	0.88681	0.87853	0.98743
VAR003	0.98871	0.83143	0.82557	0.94307	0.83236	0.64166	0.67345	0.93991	0.98210	0.97604
VAR004	0.93568	0.89660	0.87335	0.97091	0.89821	0.75954	0.78373	0.95390	0.95645	0.93993
VAR005	-0.21361	0.13498	0.13684	-0.07758	0.07482	0.28189	0.28092	-0.11170	-0.15914	-0.19526
VAR006	-0.25707	0.08196	0.08569	-0.12701	0.02593	0.22740	0.22687	-0.16130	-0.20315	-0.23106
VAR007	0.98901	0.84019	0.83761	0.94488	0.84064	0.64955	0.68345	0.93782	0.98294	0.97598
VAR008	0.98943	0.81648	0.82295	0.91952	0.80309	0.59697	0.63902	0.90740	0.97325	0.96410
VAR010	0.86120	0.98369	0.96855	0.92028	0.90424	0.85542	0.88494	0.87300	0.88727	0.86683
VAR011	0.85832	0.93433	0.98825	0.90624	0.90613	0.84342	0.88473	0.84828	0.87987	0.85397
VAR012	0.96392	0.90475	0.89900	0.98418	0.91784	0.76799	0.79726	0.96600	0.98289	0.96936
VAR013	0.83737	0.93588	0.92845	0.93925	0.99173	0.90924	0.92630	0.92021	0.88672	0.87947
VAR014	0.59494	0.89554	0.87365	0.77597	0.89156	0.98465	0.97962	0.74476	0.66839	0.65905
VAR015	0.62632	0.92181	0.91292	0.79377	0.90382	0.97111	0.98336	0.74732	0.69397	0.67424
VAR016	0.94276	0.86365	0.83924	0.97350	0.91409	0.77179	0.78381	0.99493	0.97484	0.97534
VAR017	0.98425	0.85907	0.85029	0.96421	0.87870	0.70575	0.73861	0.95863	0.99301	0.97849
VAR018	0.96662	0.94769	0.83714	0.95523	0.87720	0.69813	0.72325	0.96536	0.98544	0.99672
VAR019	0.99392	0.82348	0.82659	0.91734	0.81974	0.62204	0.66243	0.90618	0.96997	0.97074
VAR020	0.56330	0.61619	0.61960	0.67505	0.71962	0.61831	0.63794	0.67106	0.62400	0.61108
VAR101	0.83132	0.95388	0.95405	0.92781	0.97303	0.88589	0.91623	0.87796	0.86871	0.85505
VAR102	0.82695	0.85361	0.83180	0.89308	0.90685	0.82616	0.83408	0.87007	0.84780	0.86151
VAR103	0.98894	0.83593	0.82992	0.94569	0.83721	0.64774	0.67944	0.94216	0.98331	0.97717
VAR105	-0.29061	0.06560	0.06671	-0.16175	-0.01157	0.19625	0.19843	-0.19946	-0.23429	-0.26959
VAR106	-0.31252	0.06540	0.06313	-0.15248	0.01911	0.23261	0.22680	-0.18791	-0.24359	-0.29007
VAR108	0.99035	0.81922	0.82545	0.92104	0.80659	0.60111	0.64288	0.90888	0.97382	0.96563
VAR109	1.00000	0.83252	0.83069	0.93680	0.83046	0.63853	0.67470	0.93106	0.98447	0.98231
VAR110	0.83252	1.00000	0.99196	0.91475	0.93764	0.90905	0.93770	0.86111	0.86675	0.84648
VAR111	0.83069	0.99196	1.00000	0.89973	0.93076	0.88459	0.92411	0.83667	0.85929	0.83395
VAR112	0.93620	0.91475	0.89973	1.00000	0.94290	0.80409	0.82631	0.97374	0.96917	0.95585
VAR113	0.83046	0.93764	0.93076	0.94290	1.00000	0.91860	0.93514	0.91481	0.87682	0.87383
VAR114	0.63853	0.90905	0.88459	0.80409	0.91860	1.00000	0.99250	0.77716	0.70402	0.70249
VAR115	0.67470	0.93770	0.92411	0.82631	0.93514	0.99250	1.00000	0.78639	0.73368	0.72420
VAR116	0.93106	0.86111	0.83667	0.97374	0.91481	0.77716	0.78639	1.00000	0.97039	0.97215
VAR117	0.93447	0.86675	0.85929	0.96917	0.87682	0.70402	0.73368	0.97039	1.00000	0.98594
VAR118	0.98231	0.84648	0.83395	0.95585	0.87383	0.70249	0.72420	0.97215	0.98594	1.00000
VAR119	0.99516	0.81630	0.81950	0.91525	0.81075	0.61429	0.65214	0.91246	0.97387	0.97852
VAR120	0.52668	0.63914	0.63600	0.59893	0.67492	0.68875	0.68627	0.58618	0.56078	0.54723

TABLE A1

OBSERVED VALUES -- 1968-1971

	VAR119	VAR120
VAR801	0.87740	0.53899
VAR802	0.85553	0.58348
VAR803	0.97968	0.52820
VAR805	-0.13279	0.25316
VAR806	-0.16360	0.22892
VAR807	0.93237	0.53650
VAR808	0.97918	0.47445
VAR810	0.83971	0.57435
VAR811	0.83825	0.58216
VAR812	0.95468	0.54142
VAR813	0.86443	0.64045
VAR814	0.61848	0.60338
VAR815	0.67123	0.63510
VAR816	0.92386	0.58207
VAR817	0.73842	0.39234
VAR818	0.98300	0.53409
VAR819	0.99253	0.50479
VAR820	0.64343	0.48225
VAR901	0.85992	0.60401
VAR902	0.83913	0.59815
VAR903	0.97983	0.52398
VAR905	-0.16852	0.21243
VAR906	-0.19657	0.21122
VAR908	0.95798	0.50020
VAR910	0.84419	0.54904
VAR911	0.84734	0.55872
VAR912	0.96002	0.56632
VAR913	0.85299	0.65140
VAR914	0.59259	0.60609
VAR915	0.50776	0.28472
VAR916	0.91781	0.57852
VAR917	0.97319	0.55492
VAR918	0.97973	0.53130
VAR919	0.99246	0.49649
VAR920	0.65475	0.53031
VARC01	0.81569	0.61025
VARC02	0.85095	0.56974
VARC03	0.98183	0.53359
VARC04	0.91007	0.58333
VARC05	-0.22091	0.20117
VARC06	-0.26249	0.13129
VARC07	0.98398	0.54128
VARC08	0.98935	0.50857
VARC10	0.84365	0.53614
VARC11	0.84682	0.59440
VARC12	0.94844	0.57184

TABLE A1

OBSERVED VALUES -- 1968-1971

	VAR119	VAR120
VAR013	0.91953	0.66391
VAR014	0.56905	0.64465
VAR015	0.60717	0.64213
VAR016	0.92315	0.59261
VAR017	0.97120	0.56126
VAR018	0.98173	0.54388
VAR019	0.99549	0.51393
VAR020	0.55003	0.42853
VAR101	0.81195	0.62836
VAR102	0.81346	0.57741
VAR103	0.98181	0.53671
VAR105	-0.29678	0.11483
VAR106	-0.32356	0.14738
VAR108	0.99022	0.51009
VAR109	0.99516	0.52668
VAR110	0.81630	0.63914
VAR111	0.81950	0.63500
VAR112	0.91525	0.59893
VAR113	0.81075	0.67492
VAR114	0.61429	0.68875
VAR115	0.65214	0.68627
VAR116	0.91246	0.58618
VAR117	0.97387	0.56078
VAR118	0.97852	0.54723
VAR119	1.00000	0.51188
VAR120	0.51188	1.00000

SQUARED MULTIPLE CORRELATIONS CANNOT BE FOUND.
INITIAL ESTIMATE OF COMMUNALITIES IS MAXIMUM OFF-DIAGONAL ELEMENT OF CORRELATION MATRIX.

TABLE A2

OBSERVED VALUES -- 1968-1973

CORRELATION COEFFICIENTS..

	VAR801	VAR802	VAR803	VAR806	VAR808	VAR812	VAR813	VAR820	VAR901
VAR801	1.00000	0.91625	0.88377	0.02970	0.86734	0.93484	0.97126	0.92924	0.99183
VAR802	0.91625	1.00000	0.84318	0.05528	0.82553	0.89162	0.93079	0.91985	0.90359
VAR803	0.88377	0.84318	1.00000	-0.14961	0.98419	0.97745	0.87753	0.80211	0.85766
VAR806	0.02970	0.05528	-0.14961	1.00000	-0.15373	-0.11165	0.02378	0.04620	0.06281
VAR808	0.86734	0.82553	0.98419	-0.15373	1.00000	0.95939	0.84223	0.77760	0.84316
VAR812	0.93484	0.89162	0.97745	-0.11165	0.95939	1.00000	0.92597	0.86281	0.91410
VAR813	0.97126	0.93079	0.87753	0.02378	0.84223	0.92597	1.00000	0.95821	0.96070
VAR820	0.92924	0.91985	0.80211	0.04620	0.77760	0.86281	0.95821	1.00000	0.92263
VAR901	0.99183	0.90359	0.85766	0.06281	0.84316	0.91410	0.96070	0.92263	1.00000
VAR902	0.92413	0.98680	0.83605	0.05616	0.81813	0.88688	0.94679	0.95049	0.92256
VAR903	0.88618	0.84532	0.99998	-0.14722	0.98404	0.97831	0.87993	0.80507	0.86023
VAR906	-0.00527	0.01174	-0.18542	0.99163	-0.18863	-0.15217	-0.01395	0.01336	0.02852
VAR908	0.87466	0.83337	0.98480	-0.15785	0.98855	0.96244	0.84869	0.78190	0.85194
VAR912	0.94386	0.88937	0.97246	-0.07307	0.96116	0.98925	0.93095	0.87135	0.93018
VAR913	0.95979	0.92256	0.85165	0.04544	0.82121	0.90249	0.98923	0.96409	0.96255
VAR920	0.75617	0.72549	0.61387	0.06552	0.59918	0.66552	0.76724	0.82149	0.76843
VAR001	0.97314	0.87561	0.82179	0.10365	0.79245	0.88341	0.95681	0.91695	0.98533
VAR002	0.90272	0.96993	0.83687	0.04484	0.80371	0.88683	0.93367	0.93192	0.90224
VAR003	0.89372	0.85132	0.99959	-0.14416	0.98462	0.98059	0.88605	0.81495	0.86904
VAR006	-0.04660	-0.03214	-0.25557	0.96473	-0.25654	-0.20409	-0.05425	-0.02015	-0.01240
VAR008	0.88306	0.83951	0.99112	-0.16046	0.99298	0.97029	0.85833	0.79623	0.86009
VAR012	0.95406	0.90133	0.96234	-0.06635	0.94051	0.98452	0.95141	0.90071	0.93799
VAR013	0.94755	0.89064	0.82873	0.08838	0.79265	0.88351	0.97934	0.94264	0.95513
VAR020	0.79840	0.76971	0.67551	0.06157	0.65559	0.74570	0.73941	0.80042	0.80037
VAR101	0.97169	0.87780	0.81301	0.12079	0.79029	0.87602	0.95282	0.91730	0.98749
VAR102	0.88529	0.95593	0.79827	0.06270	0.75840	0.85181	0.92896	0.93740	0.88524
VAR103	0.89713	0.85365	0.99933	-0.14117	0.98405	0.98153	0.88973	0.81927	0.87318
VAR106	-0.07714	-0.08030	-0.30640	0.92537	-0.31396	-0.24541	-0.07530	-0.03957	-0.03769
VAR108	0.88561	0.84191	0.99135	-0.16028	0.99271	0.97090	0.86134	0.79943	0.86308
VAR112	0.95099	0.89832	0.93743	-0.03133	0.90346	0.96732	0.96058	0.90856	0.94197
VAR113	0.94785	0.88992	0.82221	0.10314	0.78522	0.88086	0.97833	0.93176	0.95818
VAR120	0.59898	0.58352	0.52821	0.22899	0.49436	0.54141	0.64044	0.60362	0.60401
VAR201	0.96072	0.87499	0.79277	0.10813	0.76815	0.85942	0.94584	0.91663	0.98210
VAR202	0.85886	0.93241	0.75613	0.06113	0.71096	0.81527	0.91325	0.93129	0.86296
VAR203	0.90003	0.85654	0.99897	-0.13833	0.98302	0.98214	0.89374	0.82433	0.87675
VAR206	-0.13298	-0.13555	-0.34090	0.89976	-0.35023	-0.29579	-0.12681	-0.08537	-0.09772
VAR208	0.85788	0.83554	0.98405	-0.15128	0.98405	0.95879	0.84232	0.78655	0.83346
VAR212	0.95204	0.92342	0.90873	0.00591	0.87613	0.94714	0.97425	0.93432	0.94310
VAR213	0.89815	0.85458	0.75244	0.08098	0.70675	0.81196	0.95064	0.92931	0.91560
VAR220	0.85888	0.84810	0.70209	0.06247	0.67757	0.76449	0.89984	0.94454	0.88092
VAR301	0.95810	0.87228	0.80307	0.06420	0.78017	0.86423	0.93874	0.91028	0.97953
VAR302	0.79977	0.87227	0.68568	0.03294	0.63996	0.74433	0.86225	0.90412	0.80890
VAR303	0.90405	0.86033	0.99835	-0.13390	0.98171	0.98304	0.89875	0.83068	0.88158

TABLE A2

OBSERVED VALUES -- 1968-1973

	VAR801	VAR802	VAR803	VAR806	VAR808	VAR812	VAR813	VAR820	VAR901
VAR306	-0.14427	-0.15192	-0.36554	0.85307	-0.38025	-0.31352	-0.13326	-0.09617	-0.10909
VAR308	0.89875	0.85465	0.99276	-0.14952	0.99104	0.97540	0.87757	0.81772	0.87661
VAR312	0.95429	0.91939	0.88282	0.04605	0.84139	0.93088	0.97933	0.94127	0.94922
VAR313	0.86568	0.84398	0.70651	0.06419	0.66127	0.76760	0.92486	0.92866	0.88329
VAR320	0.75254	0.77163	0.58862	0.03288	0.56322	0.64473	0.81350	0.88824	0.77570

	VAR903	VAR906	VAR908	VAR912	VAR913	VAR920	VAR001	VAR002	VAR003
VAR801	0.88618	-0.00527	0.87466	0.94386	0.95979	0.75617	0.97314	0.90272	0.89372
VAR802	0.84532	0.01174	0.83337	0.89937	0.92256	0.72549	0.87561	0.96993	0.85132
VAR803	0.99998	-0.18542	0.98480	0.97246	0.85165	0.61387	0.82179	0.83687	0.99959
VAR806	-0.14722	0.99163	-0.15785	-0.07307	0.04544	0.06552	0.10365	0.04484	-0.14416
VAR808	0.98404	-0.18863	0.98855	0.96116	0.82121	0.59918	0.79245	0.80371	0.98462
VAR812	0.97831	-0.15217	0.96244	0.98925	0.90249	0.66552	0.88341	0.88683	0.98059
VAR813	0.87993	-0.01395	0.84869	0.93095	0.98923	0.76724	0.95681	0.93367	0.88605
VAR820	0.80507	0.01336	0.78190	0.87135	0.96409	0.82149	0.91695	0.93192	0.81496
VAR901	0.86023	0.02852	0.85194	0.93018	0.96255	0.76843	0.98533	0.90224	0.86904
VAR902	0.83850	0.01804	0.82711	0.89422	0.95370	0.76780	0.90179	0.98247	0.84606
VAR903	1.00000	-0.18300	0.98480	0.97346	0.85419	0.61661	0.82455	0.83929	0.99967
VAR906	-0.18300	1.00000	-0.19508	-0.10929	0.01205	0.03455	0.06579	0.00566	-0.17997
VAR908	0.98480	-0.19508	1.00000	0.96556	0.82999	0.61002	0.80362	0.81659	0.98555
VAR912	0.97346	-0.10929	0.96556	1.00000	0.92074	0.69322	0.89476	0.88113	0.97694
VAR913	0.85419	0.01205	0.82999	0.92074	1.00000	0.79353	0.95807	0.93357	0.86200
VAR920	0.61661	0.03455	0.61002	0.69322	0.79353	1.00000	0.78545	0.74354	0.62826
VAR001	0.82455	0.06579	0.80362	0.89476	0.95807	0.78545	1.00000	0.89615	0.83301
VAR002	0.83929	0.00566	0.81659	0.88113	0.93357	0.74354	0.89615	1.00000	0.84487
VAR003	0.99967	-0.17997	0.98555	0.97694	0.86200	0.62826	0.83301	0.84487	1.00000
VAR006	-0.25287	0.96944	-0.25747	-0.15549	-0.02634	0.02216	0.02907	-0.03382	-0.24919
VAR008	0.99115	-0.19386	0.99428	0.97331	0.83910	0.61907	0.81033	0.82219	0.99226
VAR012	0.96361	-0.10545	0.94698	0.98476	0.93439	0.71530	0.91343	0.90127	0.96734
VAR013	0.83140	0.05752	0.80216	0.90380	0.99078	0.78718	0.96442	0.91047	0.83872
VAR020	0.67746	0.01895	0.66369	0.75943	0.81087	0.68231	0.79868	0.77073	0.68936
VAR101	0.81580	0.08352	0.80013	0.89339	0.95951	0.79563	0.99514	0.89137	0.82517
VAR102	0.80091	0.02273	0.77313	0.84470	0.92978	0.75113	0.89306	0.99348	0.80714
VAR103	0.99946	-0.17701	0.98519	0.97841	0.86632	0.63308	0.83780	0.84798	0.99995
VAR106	-0.30346	0.92910	-0.31252	-0.20923	-0.04321	0.01044	0.01056	-0.08233	-0.29926
VAR108	0.99139	-0.19409	0.99433	0.97378	0.84235	0.62314	0.81454	0.82550	0.99258
VAR112	0.93889	-0.06859	0.91183	0.96839	0.94690	0.73212	0.92942	0.91300	0.94307
VAR113	0.82493	0.06578	0.79589	0.89909	0.98485	0.78838	0.96919	0.90753	0.83236
VAR120	0.52998	0.21140	0.50010	0.56631	0.65141	0.52876	0.61027	0.56878	0.53359
VAR201	0.79561	0.07432	0.77647	0.87656	0.95901	0.80699	0.98930	0.89577	0.80559
VAR202	0.75895	0.02361	0.72605	0.80824	0.92041	0.75202	0.87900	0.98205	0.76574
VAR203	0.99915	-0.17420	0.98442	0.97951	0.87110	0.63874	0.84241	0.85215	0.99979

TABLE A2

OBSERVED VALUES -- 1968-1973

	VAR903	VAR906	VAR908	VAR912	VAR913	VAR920	VAR001	VAR002	VAR003
VAR206	-0.33833	0.91229	-0.35815	-0.26163	-0.09642	0.01104	-0.04414	-0.13145	-0.33531
VAR208	0.98387	-0.18335	0.98484	0.95977	0.82516	0.61833	0.78717	0.82042	0.98453
VAR212	0.91061	-0.03633	0.88538	0.95365	0.96248	0.76304	0.93657	0.93436	0.91562
VAR213	0.75534	0.04756	0.72099	0.83024	0.97091	0.79393	0.94245	0.90206	0.76351
VAR220	0.70507	0.03164	0.69194	0.78762	0.93747	0.84739	0.89683	0.89020	0.71693
VAR301	0.80566	0.03048	0.79073	0.87867	0.95356	0.78427	0.98176	0.89546	0.81569
VAR302	0.68859	0.00023	0.65483	0.73485	0.87971	0.73262	0.83289	0.93878	0.69651
VAR303	0.99859	-0.16981	0.98333	0.98086	0.87695	0.64551	0.84838	0.85713	0.99943
VAR306	-0.36285	0.87017	-0.37638	-0.28256	-0.09860	-0.03110	-0.05388	-0.13959	-0.35992
VAR308	0.99294	-0.18366	0.99235	0.97797	0.85822	0.63901	0.83176	0.84062	0.99454
VAR312	0.88496	0.00447	0.84940	0.93499	0.96849	0.77840	0.95409	0.93856	0.89077
VAR313	0.70951	0.03359	0.67490	0.78260	0.94949	0.78890	0.91332	0.89525	0.71903
VAR320	0.59156	0.00952	0.57637	0.66530	0.86015	0.78525	0.79894	0.82338	0.60445

	VAR008	VAR012	VAR013	VAR020	VAR101	VAR102	VAR103	VAR106	VAR108
VAR801	0.88306	0.95406	0.94755	0.79840	0.97169	0.88529	0.89713	-0.07714	0.88561
VAR802	0.83951	0.90133	0.89064	0.76971	0.87780	0.95593	0.85365	-0.08030	0.84191
VAR803	0.99112	0.96234	0.82873	0.67551	0.81301	0.79827	0.99933	-0.30640	0.99135
VAR806	-0.16046	-0.06635	0.08838	0.06157	0.12079	0.06270	-0.14117	0.92537	-0.16028
VAR808	0.99298	0.94051	0.79265	0.65559	0.79029	0.75840	0.98405	-0.31396	0.99271
VAR812	0.97029	0.98452	0.88351	0.74570	0.87602	0.85181	0.98153	-0.24541	0.97090
VAR813	0.85833	0.95141	0.97934	0.79941	0.95282	0.92896	0.88973	-0.07530	0.86134
VAR820	0.79623	0.90071	0.94264	0.80042	0.91730	0.93740	0.81927	-0.03957	0.79943
VAR901	0.86009	0.93799	0.95513	0.80037	0.98749	0.88524	0.87318	-0.03769	0.86308
VAR902	0.83414	0.90470	0.92404	0.79337	0.90464	0.97324	0.84930	-0.06923	0.83720
VAR903	0.99115	0.96361	0.83140	0.67746	0.81580	0.80091	0.99946	-0.30346	0.99139
VAR906	-0.19386	-0.10545	0.05752	0.01895	0.08352	0.02273	-0.17701	0.92910	-0.19409
VAR908	0.99428	0.94698	0.80216	0.66369	0.80013	0.77313	0.98519	-0.31252	0.99433
VAR912	0.97331	0.98876	0.90380	0.75943	0.89339	0.84470	0.97841	-0.20923	0.97378
VAR913	0.83910	0.93439	0.99078	0.81082	0.95851	0.92978	0.86632	-0.04321	0.84235
VAR920	0.61907	0.71530	0.78718	0.68231	0.79563	0.75113	0.63308	0.01044	0.62314
VAR001	0.81033	0.91343	0.96442	0.79868	0.99514	0.89306	0.83780	0.01056	0.81454
VAR002	0.82219	0.90127	0.91047	0.77073	0.89137	0.99348	0.84798	-0.08233	0.82550
VAR003	0.99226	0.96734	0.83872	0.68938	0.82517	0.80714	0.99995	-0.29926	0.99258
VAR006	-0.26026	-0.16318	0.01892	-0.03850	0.04210	-0.01251	-0.24608	0.97013	-0.26010
VAR008	1.00000	0.95518	0.81036	0.67212	0.80734	0.77766	0.99193	-0.31807	0.99991
VAR012	0.95518	1.00000	0.91761	0.77667	0.90938	0.87387	0.96929	-0.20602	0.95624
VAR013	0.81036	0.91761	1.00000	0.79361	0.96494	0.91082	0.84350	0.01163	0.81368
VAR020	0.67212	0.77667	0.79361	1.00000	0.80050	0.77505	0.69339	-0.07785	0.67307
VAR101	0.80734	0.90938	0.96494	0.80050	1.00000	0.88570	0.83016	0.02721	0.81137
VAR102	0.77766	0.87387	0.91082	0.77505	0.88570	1.00000	0.81075	-0.05456	0.78171
VAR103	0.99193	0.96929	0.84350	0.69339	0.83016	0.81075	1.00000	-0.29558	0.99231

TABLE A2

OBSERVED VALUES -- 1968-1973

	VAR008	VAR012	VAR013	VAR020	VAR101	VAR102	VAR103	VAR106	VAR108
VAR106	-0.31807	-0.20602	0.01163	-0.07785	0.02721	-0.05456	-0.29558	1.00000	-0.31806
VAR109	0.99991	0.95624	0.81368	0.67307	0.81137	0.78171	0.99231	-0.31806	1.00000
VAR112	0.91952	0.98595	0.93933	0.78194	0.92781	0.89308	0.94569	-0.15229	0.92104
VAR113	0.80309	0.91738	0.99174	0.80494	0.97303	0.90685	0.83721	0.01912	0.80659
VAR120	0.50856	0.57111	0.66392	0.54099	0.62839	0.57746	0.53672	0.14731	0.51007
VAR201	0.78693	0.89111	0.96109	0.79618	0.99372	0.88940	0.81077	0.02454	0.79130
VAR202	0.73170	0.83835	0.90301	0.75839	0.86911	0.99432	0.76977	-0.04028	0.73637
VAR203	0.99128	0.97110	0.84853	0.69786	0.83475	0.81572	0.99993	-0.29238	0.99176
VAR206	-0.36032	-0.25860	-0.03826	-0.14533	-0.02765	-0.10287	-0.33192	0.96374	-0.36022
VAR208	0.99003	0.93792	0.79649	0.66413	0.78298	0.77915	0.98387	-0.30254	0.98976
VAR212	0.89189	0.97913	0.95521	0.79606	0.93542	0.92193	0.91878	-0.11901	0.89405
VAR213	0.72845	0.85667	0.97268	0.77585	0.93865	0.91521	0.76907	0.00857	0.73374
VAR220	0.70014	0.80988	0.92227	0.77762	0.90068	0.90613	0.72254	-0.01121	0.70573
VAR301	0.79936	0.89077	0.94887	0.78972	0.98345	0.88694	0.82061	-0.02057	0.80401
VAR302	0.66150	0.76352	0.85715	0.71959	0.81831	0.96049	0.70085	-0.05234	0.66727
VAR303	0.99030	0.97322	0.85478	0.70368	0.84083	0.82163	0.99970	-0.28720	0.99087
VAR306	-0.38377	-0.27420	-0.04188	-0.16001	-0.04520	-0.10623	-0.35645	0.96552	-0.38318
VAR308	0.99859	0.96386	0.83055	0.68659	0.82833	0.79984	0.99454	-0.30641	0.99908
VAR312	0.85886	0.96415	0.96510	0.81306	0.95209	0.93127	0.89444	-0.07061	0.86161
VAR313	0.68410	0.81094	0.94222	0.76413	0.90570	0.91690	0.72464	0.00098	0.69018
VAR320	0.58536	0.69153	0.83353	0.70753	0.79668	0.85377	0.60995	-0.01928	0.59215

	VAR113	VAR120	VAR201	VAR202	VAR203	VAR206	VAR208	VAR212	VAR213
VAR801	0.94785	0.59898	0.96072	0.85886	0.90003	-0.13298	0.85788	0.95204	0.89815
VAR802	0.88992	0.58352	0.87499	0.93241	0.85654	-0.13555	0.83554	0.92342	0.85458
VAR803	0.82221	0.52821	0.79277	0.75613	0.99897	-0.34090	0.98405	0.90873	0.75244
VAR806	0.10314	0.22899	0.10813	0.06113	-0.13833	0.89976	-0.15128	0.00591	0.08088
VAR808	0.78522	0.49436	0.76815	0.71096	0.98302	-0.35023	0.98405	0.87613	0.70675
VAR812	0.88086	0.54141	0.85942	0.81527	0.98214	-0.29579	0.95879	0.94714	0.81196
VAR813	0.97833	0.64044	0.94584	0.91325	0.89374	-0.12681	0.84232	0.97425	0.95064
VAR820	0.93176	0.60362	0.91663	0.93129	0.82433	-0.08537	0.78655	0.93432	0.92931
VAR901	0.95818	0.60401	0.98210	0.86296	0.87675	-0.09772	0.83346	0.94310	0.91560
VAR902	0.92039	0.59818	0.90844	0.95865	0.85338	-0.12296	0.82973	0.93174	0.90666
VAR903	0.82483	0.52998	0.79581	0.75895	0.99915	-0.33833	0.98387	0.91061	0.75534
VAR906	0.06578	0.21140	0.07432	0.02361	-0.17420	0.91229	-0.18335	-0.03633	0.04756
VAR908	0.79589	0.50010	0.77647	0.72605	0.98442	-0.35815	0.98484	0.88538	0.72099
VAR912	0.89909	0.56631	0.87656	0.80824	0.97951	-0.26163	0.95977	0.95365	0.83024
VAR913	0.98485	0.65141	0.95901	0.92041	0.87110	-0.09642	0.82516	0.96248	0.97091
VAR920	0.78838	0.52876	0.80699	0.75202	0.63874	0.01104	0.61833	0.76304	0.79393
VAR001	0.96919	0.61027	0.98930	0.87900	0.84241	-0.04414	0.78717	0.93657	0.94245
VAR002	0.90753	0.56878	0.89577	0.98205	0.85215	-0.13145	0.82042	0.93436	0.90206
VAR003	0.83236	0.53359	0.80559	0.76574	0.99979	-0.33531	0.98453	0.91562	0.76351

TABLE A2

OBSERVED VALUES -- 1968-1973

	VAR113	VAR120	VAR201	VAR202	VAR203	VAR206	VAR208	VAR212	VAR213
VAR006	0.02593	0.13143	0.03866	-0.00381	-0.24307	0.94097	-0.25002	-0.08725	0.02006
VAR008	0.80309	0.50856	0.78693	0.73170	0.99128	-0.36032	0.99003	0.89189	0.72845
VAR012	0.91738	0.57211	0.89111	0.83835	0.97110	-0.25860	0.93792	0.97913	0.85667
VAR013	0.99174	0.66392	0.96109	0.90301	0.84853	-0.03826	0.79649	0.95521	0.97268
VAR020	0.80494	0.54099	0.79618	0.75839	0.69786	-0.14533	0.66413	0.79606	0.77585
VAR101	0.97303	0.62839	0.99372	0.86911	0.83475	-0.02765	0.78298	0.93542	0.93865
VAR102	0.90685	0.57746	0.88940	0.99432	0.81572	-0.10287	0.77915	0.92193	0.91521
VAR103	0.83721	0.53672	0.81077	0.76977	0.99993	-0.33192	0.98387	0.91878	0.76907
VAR106	0.01912	0.14731	0.02454	-0.04028	-0.29238	0.96374	-0.30254	-0.11901	0.00857
VAR108	0.80659	0.51007	0.79130	0.73637	0.99176	-0.36022	0.98976	0.89405	0.73374
VAR112	0.94290	0.59895	0.91566	0.86248	0.94831	-0.19832	0.90720	0.98670	0.88870
VAR113	1.00000	0.67494	0.96922	0.89477	0.84236	-0.03585	0.78746	0.95678	0.97398
VAR120	0.67494	1.00000	0.61345	0.56369	0.54078	0.10215	0.50249	0.60491	0.64587
VAR201	0.96922	0.61345	1.00000	0.87980	0.81585	-0.02630	0.76272	0.92130	0.94976
VAR202	0.89477	0.56369	0.87980	1.00000	0.77547	-0.08374	0.73215	0.89654	0.92190
VAR203	0.84236	0.54078	0.81585	0.77547	1.00000	-0.32898	0.98313	0.92220	0.77580
VAR206	-0.03585	0.10215	-0.02630	-0.08374	-0.32898	1.00000	-0.33957	-0.17195	-0.03972
VAR208	0.78746	0.50249	0.76272	0.73215	0.98313	-0.33957	1.00000	0.87611	0.71339
VAR212	0.95678	0.60491	0.92130	0.89654	0.92220	-0.17195	0.87611	1.00000	0.91192
VAR213	0.97398	0.64587	0.94976	0.92190	0.77580	-0.03972	0.71339	0.91192	1.00000
VAR220	0.91847	0.59880	0.91887	0.91711	0.72969	-0.05887	0.69066	0.86270	0.96260
VAR301	0.95387	0.58099	0.99419	0.87906	0.82544	-0.07123	0.77458	0.91313	0.94267
VAR302	0.84141	0.52392	0.83985	0.98087	0.70733	-0.08790	0.66284	0.82515	0.90439
VAR303	0.84869	0.54533	0.82239	0.78217	0.99991	-0.32410	0.98203	0.92633	0.78359
VAR306	-0.04449	0.08924	-0.03821	-0.08312	-0.35313	0.96423	-0.36436	-0.18633	-0.03188
VAR308	0.82377	0.52104	0.80885	0.75637	0.99430	-0.34709	0.98794	0.90774	0.75407
VAR312	0.97140	0.61150	0.94172	0.91109	0.89850	-0.11585	0.84484	0.99158	0.93312
VAR313	0.93946	0.61318	0.92395	0.93298	0.73189	-0.04457	0.67384	0.87132	0.98828
VAR320	0.82342	0.54255	0.82571	0.88072	0.61798	-0.05857	0.58395	0.75316	0.90772

	VAR301	VAR302	VAR303	VAR306	VAR308	VAR312	VAR313	VAR320
VAR801	0.95810	0.79977	0.90405	-0.14427	0.89875	0.95429	0.86568	0.75254
VAR802	0.87228	0.87227	0.86033	-0.15192	0.85465	0.91939	0.84398	0.77163
VAR803	0.80307	0.68568	0.99835	-0.36554	0.99276	0.88282	0.70651	0.53862
VAR806	0.06420	0.03294	-0.13390	0.85307	-0.14952	0.04605	0.06419	0.03288
VAR808	0.78017	0.63996	0.98171	-0.38025	0.99104	0.84139	0.66127	0.56322
VAR812	0.86423	0.74433	0.98304	-0.31352	0.97540	0.93088	0.76760	0.64473
VAR813	0.93874	0.86225	0.89875	-0.13326	0.87757	0.97933	0.92486	0.81350
VAR820	0.91028	0.90412	0.83068	-0.09617	0.81772	0.94127	0.92866	0.88824
VAR901	0.97953	0.80890	0.88158	-0.10909	0.87661	0.94922	0.88329	0.77570
VAR902	0.90664	0.91782	0.85840	-0.13483	0.85135	0.93215	0.90114	0.84667
VAR903	0.80566	0.68859	0.99859	-0.36285	0.99294	0.88496	0.70951	0.59156

TABLE A2

OBSERVED VALUES -- 1968-1973

	VAR301	VAR302	VAR303	VAR306	VAR308	VAR312	VAR313	VAR320
VAR906	0.03048	0.00023	-0.16981	0.87017	-0.18366	0.00447	0.03359	0.00952
VAR908	0.79073	0.65483	0.98333	-0.37638	0.99235	0.84940	0.67490	0.57637
VAR912	0.87867	0.73485	0.98086	-0.28256	0.97797	0.93499	0.78260	0.66530
VAR913	0.95356	0.87971	0.87695	-0.09860	0.85822	0.96849	0.94949	0.86015
VAR920	0.78427	0.73262	0.64551	-0.03110	0.63901	0.77840	0.78890	0.78525
VAR001	0.98176	0.83289	0.84838	-0.05388	0.83176	0.95409	0.91332	0.79894
VAR002	0.89546	0.93878	0.85713	-0.13959	0.84062	0.93856	0.89525	0.82338
VAR003	0.81569	0.69651	0.99943	-0.35992	0.99454	0.89077	0.71903	0.60445
VAR006	-0.00382	-0.01806	-0.23846	0.93111	-0.24960	-0.04472	0.01449	-0.00140
VAR008	0.79936	0.66150	0.99030	-0.38377	0.99869	0.85886	0.68410	0.58536
VAR012	0.89077	0.76352	0.97322	-0.27420	0.96386	0.96415	0.81094	0.69153
VAR013	0.94887	0.85715	0.85478	-0.04188	0.83055	0.96510	0.94222	0.83353
VAR020	0.78972	0.71959	0.70368	-0.16001	0.68659	0.81306	0.76413	0.70753
VAR101	0.98345	0.81831	0.84083	-0.04520	0.82833	0.95209	0.90570	0.79668
VAR102	0.88694	0.96049	0.82163	-0.10623	0.79984	0.93127	0.91690	0.85377
VAR103	0.82061	0.70085	0.99970	-0.35645	0.99454	0.89444	0.72464	0.60995
VAR106	-0.02057	-0.05234	-0.28720	0.96552	-0.30641	-0.07061	0.00098	-0.01928
VAR108	0.80401	0.66727	0.99087	-0.38318	0.99908	0.86161	0.69018	0.59215
VAR112	0.91321	0.79143	0.95163	-0.21430	0.93224	0.97958	0.84151	0.71581
VAR113	0.95387	0.84141	0.84869	-0.04449	0.82377	0.97140	0.93946	0.82342
VAR120	0.58099	0.52392	0.54533	0.08924	0.52104	0.61150	0.61318	0.54255
VAR201	0.99419	0.83985	0.82239	-0.03821	0.80885	0.94172	0.92395	0.82571
VAR202	0.87906	0.98087	0.78217	-0.08312	0.75637	0.91109	0.93298	0.88072
VAR203	0.82544	0.70733	0.99991	-0.35313	0.99430	0.89850	0.73189	0.61798
VAR206	-0.07123	-0.08790	-0.32410	0.96423	-0.34709	-0.11585	-0.04457	-0.05857
VAR208	0.77458	0.66284	0.98203	-0.36436	0.98794	0.84484	0.67384	0.58395
VAR212	0.91313	0.82515	0.92633	-0.18633	0.90774	0.99158	0.87132	0.75316
VAR213	0.94267	0.90439	0.78359	-0.03188	0.75407	0.93312	0.98828	0.90772
VAR220	0.91639	0.92401	0.73798	-0.05932	0.72501	0.87973	0.97381	0.97014
VAR301	1.00000	0.84742	0.83166	-0.07605	0.82079	0.93103	0.92244	0.83156
VAR302	0.84742	1.00000	0.71487	-0.08035	0.68895	0.84442	0.93600	0.92224
VAR303	0.83166	0.71437	1.00000	-0.34810	0.99384	0.90349	0.74024	0.62691
VAR306	-0.07605	-0.08035	-0.34810	1.00000	-0.37162	-0.13525	-0.03135	-0.04258
VAR308	0.82079	0.68895	0.99384	-0.37162	1.00000	0.87836	0.71245	0.61329
VAR312	0.93103	0.84442	0.90349	-0.13525	0.87836	1.00000	0.89718	0.77627
VAR313	0.92244	0.93600	0.74024	-0.03135	0.71245	0.89718	1.00000	0.95192
VAR320	0.83156	0.92224	0.62691	-0.04258	0.61329	0.77627	0.95192	1.00000

SQUARED MULTIPLE CORRELATIONS CANNOT BE FOUND.
INITIAL ESTIMATE OF COMMUNALITIES IS MAXIMUM OFF-DIAGONAL ELEMENT OF CORRELATION MATRIX.

TABLE A3

FIRST DIFFERENCES -- 1968-1973

CORRELATION COEFFICIENTS..

	VARA01	VARA02	VARA03	VARA06	VARA08	VARA12	VARA13	VARA20	VARB01	VARB02
VARA01	1.00000	0.37217	-0.65946	0.22875	-0.33522	-0.29184	0.37802	0.04618	-0.37142	0.53361
VARA02	0.37217	1.00000	0.10450	0.25561	0.01259	0.28908	0.64736	0.22042	-0.20536	-0.06887
VARA03	-0.65946	0.10450	1.00000	-0.22564	0.51402	0.66302	0.19511	0.18289	0.38625	-0.76238
VARA06	0.22875	0.25561	-0.22564	1.00000	-0.26424	-0.00958	0.17098	-0.09551	0.02102	0.20079
VARA08	-0.33522	0.01259	0.51402	-0.26424	1.00000	0.40388	0.15170	0.13426	0.22570	-0.35502
VARA12	-0.29164	0.28908	0.66302	-0.00958	0.40388	1.00000	0.55029	0.27904	0.47582	-0.71499
VARA13	0.37602	0.64736	0.19511	0.17098	0.15170	0.55029	1.00000	0.30364	0.11671	-0.38946
VARA20	0.04618	0.22042	0.18289	-0.09551	0.13426	0.27904	0.30364	1.00000	-0.12121	-0.20676
VARB01	-0.37142	-0.20536	0.38625	0.02102	0.22570	0.47582	0.11671	-0.12121	1.00000	-0.56204
VARB02	0.53361	-0.06887	-0.76238	0.20079	-0.35502	-0.71499	-0.38946	-0.20676	-0.56204	1.00000
VARB03	-0.14964	0.33561	0.50093	-0.08195	0.23148	0.52206	0.50368	0.33908	0.33648	-0.66379
VARB06	0.13433	0.06050	-0.13303	-0.11490	-0.02611	-0.22519	0.02314	0.07909	-0.16354	0.15823
VARB08	-0.37565	0.02411	0.46694	0.09276	-0.21199	0.35794	0.04522	0.04292	0.33855	-0.41380
VARB12	0.47581	-0.04913	-0.70893	0.16617	-0.42874	-0.72974	-0.29480	-0.11571	-0.59233	0.65717
VARB13	0.50863	-0.00307	-0.52915	0.29212	-0.30537	-0.36659	-0.16239	-0.01790	-0.63445	0.67159
VARB20	-0.09304	-0.15095	-0.03683	-0.10272	0.00387	-0.04484	-0.12497	-0.66610	0.13183	0.00263
VARC01	-0.46084	0.15954	0.89640	-0.23735	0.44404	0.72335	0.34928	0.29986	0.33954	-0.79980
VARC02	-0.52035	0.13781	0.86007	-0.28651	0.45481	0.48458	0.26552	0.18085	0.11814	-0.70524
VARC03	-0.41749	0.30571	0.68818	-0.21637	0.46483	0.71858	0.39574	0.27863	0.24069	-0.73124
VARC06	-0.06231	-0.00850	-0.06676	-0.23075	0.07989	-0.13776	-0.09321	-0.04390	0.09171	0.06702
VARC08	-0.65051	0.02629	0.87129	-0.33135	0.54392	0.65552	0.14981	0.16741	0.43422	-0.72862
VARC12	0.30057	0.21459	-0.10236	0.14537	-0.08532	-0.21685	0.13733	0.10442	-0.40366	0.17653
VARC13	-0.43905	0.11144	0.81315	-0.36974	0.44035	0.59868	0.19417	0.26561	0.20181	-0.70366
VARC20	-0.03898	-0.00457	0.14609	0.13210	0.05023	0.15325	0.07130	0.05830	-0.01193	-0.13457
VARD01	-0.10850	0.38039	0.57450	-0.02572	0.20210	0.41055	0.53455	0.33035	0.20115	-0.56564
VARD02	-0.32629	0.32892	0.72959	-0.16470	0.34200	0.38783	0.40708	0.19793	-0.00428	-0.58553
VARD03	-0.08068	0.56550	0.54869	-0.05663	0.26182	0.46766	0.52378	0.33010	-0.19355	-0.46780
VARD06	-0.03636	0.01594	-0.18038	0.17271	-0.21405	-0.16312	-0.14037	0.17331	-0.09229	0.16890
VARD08	-0.32069	-0.06105	0.30612	-0.05933	0.22122	0.24261	0.10271	0.10654	0.14674	-0.30053
VARD12	-0.25722	-0.01703	0.41967	-0.29211	0.15451	0.35323	0.16673	0.20077	-0.04010	-0.44834
VARD13	-0.07782	0.60572	0.45937	-0.07226	0.23324	0.28028	0.51459	0.20471	-0.20319	-0.38856
VARD20	-0.00651	0.29110	0.15023	-0.12219	0.10036	0.06076	0.21290	0.11216	0.01057	-0.14530
VARE01	0.41157	-0.14107	-0.82423	0.16039	-0.29477	-0.62456	-0.25669	-0.39229	-0.11590	0.65436
VARE02	0.24656	0.63172	-0.11652	0.10739	-0.11414	-0.22138	0.33375	0.02797	-0.27304	0.01145
VARE03	-0.02073	0.54228	0.51829	-0.05631	0.17829	0.38332	0.53470	0.32585	-0.21086	-0.46732
VARE06	0.05813	0.11192	-0.02214	0.13545	0.17237	-0.11092	0.11918	-0.20680	-0.08242	0.08318
VARE08	-0.37900	0.07094	0.59197	-0.21481	0.27566	0.41615	0.02569	0.04820	0.26935	-0.44690
VARE12	-0.28819	0.19662	0.60127	-0.12458	0.17491	0.29290	0.17261	0.24133	-0.14949	-0.43026
VARE13	0.28112	0.08305	-0.49112	0.16043	-0.31727	-0.50488	-0.00295	-0.13352	-0.21430	0.26046
VARE20	0.22082	0.36099	-0.25122	0.16635	-0.19138	-0.26784	0.24552	-0.09890	-0.26263	0.04705

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	VARB03	VARB06	VARB08	VARB12	VARB13	VARB20	VARC01	VARC02	VARC03	VARC06
VARA01	-0.14984	0.13433	-0.37565	0.47581	0.50863	-0.09304	-0.46084	-0.52035	-0.41749	-0.08231
VARA02	0.33561	0.06050	0.02411	-0.04913	-0.00307	-0.15095	0.15954	0.13781	0.30571	-0.00850
VARA03	0.50093	-0.13303	0.46694	-0.70893	-0.52915	-0.03683	0.89640	0.86007	0.88818	-0.06676
VARA06	-0.08195	-0.11490	0.09276	0.16617	0.29212	-0.10272	-0.23735	-0.28651	-0.21637	-0.23075
VARA08	0.23148	-0.02611	-0.21199	-0.42874	-0.30537	0.00387	0.44404	0.45481	0.46483	0.07939
VARA12	0.52206	-0.22519	0.35794	-0.72974	-0.36659	-0.04484	0.72335	0.48458	0.71858	-0.13776
VARA13	0.50368	0.02314	0.04522	-0.29480	-0.16239	-0.12497	0.34928	0.26552	0.39574	-0.09321
VARA20	0.33908	0.07909	0.04292	-0.11571	-0.01790	-0.66610	0.29986	0.18085	0.27863	-0.04393
VARB01	0.33648	-0.16354	0.33855	-0.59233	-0.63445	0.13183	0.33954	0.11814	0.24069	0.09171
VARB02	-0.66379	0.15823	-0.41380	0.68717	0.67189	0.00283	-0.79980	-0.70524	-0.73124	0.06762
VARB03	1.00000	0.00328	0.30676	-0.36433	-0.45177	0.01704	0.67243	0.51409	0.63660	-0.03216
VARB06	0.00328	1.00000	-0.26582	0.17471	0.09896	-0.22658	-0.18828	-0.11024	-0.18844	-0.09595
VARB08	0.30676	-0.26582	1.00000	-0.44139	-0.35967	0.01252	0.43097	0.34903	0.41254	0.01622
VARB12	-0.36433	0.17471	-0.44139	1.00000	0.43786	-0.07110	-0.67157	-0.48494	-0.62145	-0.03598
VARB13	-0.45177	0.09896	-0.35967	0.43786	1.00000	-0.07868	-0.42364	-0.52358	-0.40364	-0.09740
VARB20	0.01704	-0.22658	0.01252	-0.07110	-0.07868	1.00000	-0.04013	-0.00215	-0.02922	-0.00814
VARC01	0.67243	-0.18828	0.43097	-0.67157	-0.42364	-0.04013	1.00000	0.81363	0.93716	-0.06852
VARC02	0.51409	-0.11024	0.34903	-0.48494	-0.52358	-0.00215	0.81363	1.00000	0.83428	-0.08018
VARC03	0.63660	-0.18844	0.41254	-0.62145	-0.40364	-0.02922	0.93716	0.83428	1.00000	-0.00460
VARC05	-0.03216	-0.09595	0.01622	-0.03598	-0.09740	-0.00814	-0.06852	-0.08018	-0.00480	1.00000
VARC08	0.43254	-0.25379	0.48377	-0.80758	-0.59727	-0.02381	0.82137	0.76123	0.80223	0.08124
VARC12	0.01427	0.02235	-0.15869	0.28035	0.33724	-0.09141	0.07313	0.12050	0.06906	0.03721
VARC13	0.53187	-0.15352	0.36319	-0.55455	-0.43715	0.02974	0.90742	0.78837	0.85841	-0.04490
VARC20	-0.13538	-0.18414	0.07247	-0.10286	0.09343	-0.28285	0.17071	0.10405	0.12609	-0.04927
VARD01	0.55552	0.03361	0.42160	-0.42375	-0.48968	-0.14558	0.65637	0.62899	0.65720	-0.01737
VARD02	0.45970	0.01019	0.31066	-0.39143	-0.46348	-0.09104	0.68158	0.90983	0.74911	-0.05016
VARD03	0.57688	-0.00828	0.23228	-0.16662	-0.26468	-0.11242	0.62631	0.73069	0.68337	-0.14076
VARD05	-0.20761	-0.27587	0.07471	0.09714	0.06643	-0.26147	-0.20061	-0.15571	-0.16478	0.23715
VARD08	0.06683	-0.16149	0.22274	-0.47204	-0.25989	-0.00914	0.22938	0.37533	0.21275	0.06665
VARD12	0.31282	0.09857	0.06492	-0.05914	-0.23897	-0.11261	0.40539	0.56226	0.42497	-0.24440
VARD13	0.36421	0.07688	0.16053	-0.12356	-0.37895	-0.16229	0.44237	0.67720	0.57372	-0.04072
VARD20	0.31948	0.26670	0.03787	-0.04721	-0.27676	-0.11387	0.13411	0.24050	0.19770	0.04045
VARE01	-0.52639	0.12235	-0.42448	0.51682	0.21456	0.12899	-0.89448	-0.75234	-0.83798	0.18196
VARE02	0.18153	0.15884	-0.35703	0.18116	-0.16066	-0.12269	-0.14908	0.07992	-0.03089	0.06397
VARE03	0.64541	0.01982	0.15651	-0.09537	-0.17465	-0.08890	0.64889	0.70653	0.71678	-0.14866
VARE05	-0.05940	0.50074	-0.21676	0.15857	0.01781	0.10929	-0.11691	0.00696	-0.06043	0.03061
VARE08	0.39408	-0.11228	0.30806	-0.31609	-0.32490	0.02512	0.61288	0.44087	0.61636	-0.01258
VARE12	0.45301	-0.06884	0.35614	-0.27344	-0.20861	0.01913	0.67983	0.67503	0.66238	-0.13461
VARE13	0.01038	0.23316	-0.17663	0.46927	-0.11168	-0.03211	-0.53937	-0.22197	-0.49995	0.01702
VARE20	0.12390	0.18470	-0.11952	0.35792	-0.23880	-0.05404	-0.29235	0.05255	-0.21511	0.03413

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FIRST DIFFERENCES -- 1968-1973

	VARC08	VARC12	VARC13	VARC20	VARD01	VARD02	VARD03	VARD06	VARD08	VARD12
VARA01	-0.65051	0.30057	-0.43905	-0.03898	-0.10850	-0.32629	-0.08068	-0.03636	-0.32069	-0.25722
VARA02	0.02629	0.21459	0.11144	-0.00457	0.38039	0.32892	0.56550	0.01594	-0.06105	-0.01703
VARA03	0.87129	-0.10236	0.81315	0.14809	0.57450	0.72959	0.54869	-0.18038	0.30812	0.41967
VARA06	-0.33135	0.14537	-0.36974	0.13210	-0.02572	-0.18470	-0.06663	0.17271	-0.05933	-0.29211
VARA08	0.54392	-0.08532	0.44035	0.05023	0.20210	0.34200	0.26182	-0.21405	0.22122	0.15451
VARA12	0.65552	-0.21665	0.59868	0.15325	0.41055	0.38783	0.46786	-0.16312	0.24261	0.35323
VARA13	0.14981	0.13733	0.19417	0.07130	0.53455	0.40708	0.52378	-0.14037	0.10271	0.16673
VARA20	0.16741	0.10442	0.26561	0.05830	0.33035	0.19793	0.33010	0.17331	0.10654	0.20077
VARB01	0.43422	-0.40366	0.20181	-0.01193	0.20115	-0.00428	-0.19355	-0.09229	0.14874	-0.04010
VARB02	-0.72862	0.17663	-0.70366	-0.13457	-0.56564	-0.58853	-0.48780	0.18890	-0.30053	-0.44634
VARB03	0.43254	0.01427	0.53187	-0.13538	0.55552	0.48970	0.57688	-0.20761	0.06683	0.31262
VARB06	-0.25379	0.02235	-0.15352	-0.16414	0.03361	0.01019	-0.00828	-0.27587	-0.16149	0.09857
VARB08	0.48377	-0.15869	0.36319	0.07247	0.42160	0.31066	0.23228	0.07471	0.22274	0.06492
VARB12	-0.80758	0.28035	-0.55455	-0.10286	-0.42375	-0.39143	-0.16662	0.09714	-0.47204	-0.05914
VARB13	-0.59727	0.33724	-0.43715	0.09343	-0.48968	-0.46348	-0.26468	0.06643	-0.25989	-0.23897
VARB20	-0.02361	-0.09141	0.02974	-0.28265	-0.14558	-0.09104	-0.11242	-0.26147	-0.00914	-0.11261
VARC01	0.82137	0.07313	0.90742	0.17071	0.65637	0.68158	0.62631	-0.20061	0.22938	0.40539
VARC02	0.76123	0.12050	0.78837	0.10405	0.62899	0.90983	0.73069	-0.15571	0.37533	0.56226
VARC03	0.50223	0.06906	0.85841	0.12609	0.65720	0.74911	0.68337	-0.16478	0.21275	0.42497
VARC06	0.08124	0.03721	-0.04490	-0.04927	-0.01737	-0.05016	-0.14076	0.23715	0.06685	-0.24440
VARC08	1.00000	-0.22372	0.75298	0.10816	0.51569	0.60197	0.40360	-0.05322	0.41618	0.26990
VARC12	-0.22372	1.00000	0.14363	0.16502	0.28127	0.18674	0.30227	0.05773	0.02819	-0.21469
VARC13	0.75298	0.14363	1.00000	0.18395	0.62589	0.63921	0.65244	-0.23218	0.23331	0.38446
VARC20	0.10816	0.16502	0.18395	1.00000	0.00286	0.07143	0.15004	-0.06978	0.03564	0.02490
VARD01	0.51569	0.26127	0.62589	0.00286	1.00000	0.74786	0.66424	-0.04473	0.10174	0.18662
VARD02	0.60197	0.18674	0.63921	0.07143	0.74786	1.00000	0.79860	-0.08115	0.21095	0.55517
VARD03	0.40360	0.30227	0.65244	0.15004	0.66424	0.79860	1.00000	-0.14758	0.04861	0.52007
VARD06	-0.05322	0.05773	-0.23218	-0.06978	-0.04473	-0.08115	-0.14758	1.00000	0.05224	-0.23664
VARD08	0.41618	0.02819	0.23331	0.03564	0.10174	0.21095	0.04861	0.05224	1.00000	-0.07290
VARD12	0.26990	-0.21469	0.38446	0.02490	0.18662	0.55517	0.52007	-0.23664	-0.07290	1.00000
VARD13	0.38784	0.21452	0.44385	0.07668	0.70627	0.82981	0.82333	-0.02991	0.02912	0.41543
VARD20	0.17215	-0.05909	0.07399	-0.79546	0.36221	0.33639	0.22812	0.06700	0.02018	0.18302
VARE01	-0.63458	-0.12801	-0.86808	-0.25539	-0.53601	-0.62571	-0.64717	0.21181	-0.19593	-0.49071
VARE02	-0.11269	0.15597	-0.21463	-0.07365	0.30592	0.33825	0.32600	0.13009	-0.12784	-0.05711
VARE03	0.26915	0.45092	0.62524	0.09863	0.66394	0.78626	0.91076	-0.17701	-0.00797	0.49960
VARE06	-0.09730	0.03946	-0.08510	0.01122	0.09020	0.05110	0.10352	-0.50941	-0.09410	0.01899
VARE08	0.54994	-0.15336	0.54641	0.07065	0.41666	0.43191	0.38585	-0.09016	-0.50051	0.36966
VARE12	0.44936	0.28058	0.73172	0.04155	0.60049	0.66572	0.64282	-0.01304	0.17192	0.23922
VARE13	-0.44727	-0.07743	-0.55483	-0.23727	-0.10806	-0.03461	-0.11181	0.12303	-0.07587	-0.04527
VARE20	-0.22663	0.04926	-0.26920	-0.03225	0.13668	0.25957	0.28447	0.09591	-0.01673	0.11515

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	VARD13	VARD20	VARE01	VARE02	VARE03	VARE06	VARE08	VARE12	VARE13	VARE20
VARA01	-0.07762	-0.00651	0.41157	0.24656	-0.02073	0.05813	-0.37900	-0.28819	0.28112	0.22082
VARA02	0.60572	0.29110	-0.14107	0.63172	0.54228	0.11192	0.07094	0.19562	0.08305	0.36099
VARA03	0.45937	0.15023	-0.82423	-0.11652	0.51829	-0.02214	0.59197	0.60127	-0.49112	-0.25122
VARA06	-0.07228	-0.12219	0.16039	0.10739	-0.05631	0.13545	-0.21481	-0.12458	0.18043	0.16635
VARA08	0.23324	0.10036	-0.29477	-0.11414	0.17829	0.17237	0.27566	0.17491	-0.31727	-0.19138
VARA12	0.28028	0.06076	-0.62456	-0.22138	0.38332	-0.11092	0.41615	0.29290	-0.50488	-0.26784
VARA13	0.51459	0.21290	-0.25669	0.33375	0.53470	0.11918	0.02589	0.17261	-0.00295	0.24552
VARA20	0.20471	0.11216	-0.39228	0.02797	0.32585	-0.20680	0.04820	0.24133	-0.13352	-0.09890
VARB01	-0.20319	0.01057	-0.11590	-0.27304	-0.21086	-0.08242	0.26935	-0.14949	-0.21430	-0.26263
VARB02	-0.38858	-0.14530	0.68436	0.01145	-0.46732	0.08318	-0.44690	-0.43026	0.26045	0.04705
VARB03	0.36421	0.31948	-0.52639	0.18153	0.64541	-0.05940	0.39408	0.45301	0.01038	0.12390
VARB05	0.07668	0.26670	0.12235	0.15884	0.01982	0.50074	-0.11228	-0.06884	0.23316	0.16470
VARB08	0.16053	0.03787	-0.42448	-0.05703	0.15851	-0.21676	0.30806	0.35614	-0.17663	-0.11952
VARB12	-0.12356	-0.04721	0.51682	0.18116	-0.09537	0.15857	-0.31609	-0.27344	0.46927	0.35792
VARB13	-0.37895	-0.27676	0.21456	-0.16066	-0.17465	0.01781	-0.32490	-0.20861	-0.11168	-0.23880
VARB20	-0.16229	-0.11387	0.12899	-0.12269	-0.08890	0.10929	0.02512	0.01913	-0.03211	-0.05404
VARC01	0.44237	0.13411	-0.89448	-0.14908	0.64889	-0.11691	0.61288	0.67983	-0.53937	-0.29235
VARC02	0.67720	0.24050	-0.75234	0.07992	0.70853	0.00696	0.44087	0.67503	-0.22197	0.05255
VARC03	0.57372	0.19770	-0.83798	-0.03089	0.71678	-0.06043	0.61636	0.66238	-0.49995	-0.21511
VARC05	-0.04072	0.04045	0.18196	0.06897	-0.14866	0.03061	-0.01258	-0.13461	0.01702	0.03413
VARC08	0.38784	0.17215	-0.63458	-0.11269	0.28915	-0.09730	0.54994	0.44936	-0.44727	-0.22653
VARC12	0.21452	-0.05909	-0.12801	0.15597	0.45092	0.03946	-0.15336	0.28058	-0.07743	0.04926
VARC13	0.44385	0.07399	-0.86808	-0.21463	0.62524	-0.00510	0.54641	0.73172	-0.55483	-0.26920
VARC20	0.07668	-0.79546	-0.25539	-0.07365	0.09863	0.01122	0.07065	0.04155	-0.23727	-0.03225
VARD01	0.70627	0.36221	-0.53601	0.30592	0.66394	0.09020	0.41666	0.60049	-0.10806	0.13668
VARD02	0.82961	0.33639	-0.62571	0.33825	0.78626	0.05110	0.43191	0.66572	-0.03481	0.25957
VARD03	0.82333	0.22812	-0.64717	0.32600	0.91076	0.10352	0.38585	0.64282	-0.11181	0.28447
VARD05	-0.02991	0.06700	0.21181	0.13009	-0.17701	-0.50941	-0.09016	-0.01304	0.12303	0.05591
VARD08	0.02912	0.02018	-0.19593	-0.12784	-0.00797	-0.09410	-0.50051	0.17192	-0.07587	-0.01673
VARD12	0.41543	0.16302	-0.49071	-0.05711	0.49960	0.01899	0.36966	0.23922	-0.04527	0.11515
VARD13	1.00000	0.37950	-0.37763	0.62097	0.76595	0.20007	0.34341	0.50330	0.12481	0.50124
VARD20	0.37950	1.00000	-0.01243	0.32559	0.24729	0.03418	0.12573	0.16320	0.22917	0.20917
VARE01	-0.37763	-0.01243	1.00000	0.23147	-0.67469	0.13601	-0.49843	-0.70779	0.56279	0.32699
VARE02	0.62097	0.32559	0.23147	1.00000	0.34727	0.12905	-0.01686	0.03398	0.61562	0.74082
VARE03	0.76595	0.24729	-0.67469	0.34727	1.00000	0.04360	0.36981	0.69686	-0.05301	0.22858
VARE05	0.20007	0.03418	0.13601	0.12905	0.04360	1.00000	-0.05890	-0.12513	0.10875	0.25045
VARE08	0.34341	0.12573	-0.49843	-0.01666	0.36981	-0.05890	1.00000	0.36119	-0.37037	-0.22100
VARE12	0.50330	0.16320	-0.70779	0.03398	0.69686	-0.12313	0.36119	1.00000	-0.22710	-0.00825
VARE13	0.12481	0.22917	0.56279	0.61562	-0.08301	0.10875	-0.37037	-0.22710	1.00000	0.83863
VARE20	0.50124	0.20917	0.32699	0.74082	0.22858	0.25045	-0.22100	-0.00825	0.83863	1.00000

SQUARED MULTIPLE CORRELATIONS CANNOT BE FOUND.
INITIAL ESTIMATE OF COMMUNALITIES IS MAXIMUM OFF-DIAGONAL ELEMENT OF CORRELATION MATRIX.

APPENDIX B

FACTOR ANALYSIS TABLES

TABLE B1

STATE ASSIGNMENT TO REGIONS

REGION 1	Connecticut Maine Massachusetts New Hampshire Rhode Island Vermont
REGION 2	Delaware District of Columbia (Washington D.C.) Maryland New Jersey New York Pennsylvania Virginia
REGION 3	Alabama Florida Georgia North Carolina South Carolina Tennessee
REGION 4	Kentucky Ohio West Virginia
REGION 5	Illinois Indiana Iowa Michigan Minnesota North Dakota South Dakota Wisconsin
REGION 6	Arkansas Louisiana Mississippi Missouri

TABLE B1 -- Continued

STATE ASSIGNMENT TO REGIONS

REGION 7	Kansas Nebraska Oklahoma Texas
REGION 8	Arizona Alaska California Colorado Hawaii Idaho Montana Nevada New Mexico Oregon Utah Washington Wyoming

TABLE B2

VARIABLES WITH HIGHEST FACTOR LOADINGS

BY TYPE OF ANALYSIS AND ROTATION

1968-1971

TYPE	ROTATION	FACTORS	VARIABLES WITH HIGHEST LOADINGS
PA2	VARIMAX	1	X_1, X_4, X_{12}, X_{13}, X_{16}, X_{17}
		2	X_5, X_6
		3	X_{14}, X_{15}
		4	X_{10}, X_{11}
PA2	QUARTIMAX	1	X_1, X_4, X_{12}, X_{13}, X_{16}, X_{17}, X_{18}
		2	X_5, X_6
		3	X_{14}, X_{15}
		4	X_{10}, X_{11}
PA2	EQUIMAX	1	X_2, X_3, X_4, X_7, X_8, X_{17}, X_{18}, X_{19}
		2	X_{14}, X_{15}
		3	X_{10}, X_{11}
		4	X_5, X_6
PA2	OBLIQUE	1	X_3, X_7, X_8, X_{19}
		2	X_5, X_6
		3	X_{14}, X_{15}
		4	X_{10}, X_{11}

TABLE B2 -- Continued

VARIABLES WITH HIGHEST FACTOR LOADINGS

BY TYPE OF ANALYSIS AND ROTATION

1968-1971

TYPE	ROTATION	FACTORS	VARIABLES WITH HIGHEST LOADINGS
RAO	VARIMAX	1	X_3, X_7, X_{12}, X_{17}, X_{18}, X_{19}
		2	X_{14}, X_{15}
		3	X_5, X_6
		4	X_{10}, X_{11}
RAO	QUARTIMAX	1	X_1, X_3, X_7, X_{12}, X_{13}, X_{16}, X_{17}, X_{18}
		2	X_5, X_6
		3	X_{14}, X_{15}
		4	X_{10}, X_{11}
RAO	EQUIMAX	1	X_3, X_7, X_8, X_{19}
		2	X_1, X_{10}, X_{11}
		3	X_{16}, X_{17}, X_{18}
		4	X_5, X_6
RAO	OBLIQUE	1	X_3, X_7, X_8, X_{18}, X_{19}
		2	X_5, X_6
		3	X_{14}, X_{15}
		4	X_{10}, X_{11}

TABLE B2 -- Continued

VARIABLES WITH HIGHEST FACTOR LOADINGS

BY TYPE OF ANALYSIS AND ROTATION

1968-1971

TYPE	ROTATION	FACTORS	VARIABLES WITH HIGHEST LOADINGS
ALPHA	VARIMAX	1	X_3, X_7, X_8, X_{12}, X_{17}, X_{18}, X_{19}
		2	X_{14}, X_{15}
		3	X_5, X_6
		4	X_{10}, X_{11}
ALPHA	QUARTIMAX	1	X_1, X_3, X_7, X_{12}, X_{13}, X_{16}, X_{17}, X_{18}
		2	X_5, X_6
		3	X_{14}, X_{15}
		4	X_{10}, X_{11}
ALPHA	EQUIMAX	1	X_3, X_7, X_8, X_{17}, X_{18}, X_{19}
		2	X_{14}, X_{15}
		3	X_{10}, X_{11}
		4	X_5, X_6
ALPHA	OBLIQUE	1	X_3, X_7, X_8, X_{18}, X_{19}
		2	X_5, X_6
		3	X_{14}, X_{20}
		4	X_{10}, X_{11}

TABLE B3

VARIABLES WITH HIGHEST LOADINGS ON FIRST FACTOR

BY TYPE OF ANALYSIS AND ROTATION

1968-1971

	PA2				RAO				ALPHA			
	VARIMAX	QUARTIMAX	EQUIMAX	OBLIQUE	VARIMAX	QUARTIMAX	EQUIMAX	OBLIQUE	VARIMAX	QUARTIMAX	EQUIMAX	OBLIQUE
X_1	v	v								v		
X_2			v			v						
X_3			v	v	v	v	v	v	v	v	v	v
X_4	v	v										
X_5												
X_6												
X_7			v	v	v	v	v	v	v	v	v	v
X_8			v	v			v	v	v		v	v
X_9												
X_{10}												
X_{11}												
X_{12}	v	v			v	v			v	v		

TABLE B3 -- Continued

VARIABLES WITH HIGHEST LOADINGS ON FIRST FACTOR

BY TYPE OF ANALYSIS AND ROTATION

1968-1971

	PA2				RAO				ALPHA			
	VARIMAX	QUARTIMAX	EQUIMAX	OBLIQUE	VARIMAX	QUARTIMAX	EQUIMAX	OBLIQUE	VARIMAX	QUARTIMAX	EQUIMAX	OBLIQUE
X_{13}	v	v				v				v		
X_{14}												
X_{15}												
X_{16}	v	v				v				v		
X_{17}	v	v	v		v	v			v	v	v	
X_{18}		v	v		v	v		v	v	v	v	v
X_{19}			v	v	v		v	v	v		v	v
X_{20}												

TABLE B4

VARIABLES WITH HIGHEST LOADINGS

ON SECOND, THIRD AND FOURTH FACTORS

BY TYPE OF ANALYSIS AND ROTATION

	PA2				RAO				ALPHA			
	VARIMAX	QUARTIMAX	EQUIMAX	OBLIQUE	VARIMAX	QUARTIMAX	EQUIMAX	OBLIQUE	VARIMAX	QUARTIMAX	EQUIMAX	OBLIQUE
X_1							v					
X_2												
X_3												
X_4												
X_5	v	v	0	v	x	v	0	v	x	v	0	v
X_6												
X_7												
X_8												
X_9												
X_{10}	0	0	x	0	0	0	v	0	0	0	x	0
X_{11}	0	0	x	0	0	0	v	0	0	0	x	0
X_{12}												

TABLE B4 -- Continued

VARIABLES WITH HIGHEST LOADINGS

ON SECOND, THIRD AND FOURTH FACTORS

BY TYPE OF ANALYSIS AND ROTATION

	PA2				RAO				ALPHA			
	VARIMAX	QUARTIMAX	EQUIMAX	OBLIQUE	VARIMAX	QUARTIMAX	EQUIMAX	OBLIQUE	VARIMAX	QUARTIMAX	EQUIMAX	OBLIQUE
X_{13}												
X_{14}	x	x	v	x	v	x		x	v	x	v	x
X_{15}	x	x	v	x	v	x		x	v	x	v	
X_{16}							x					
X_{17}							x					
X_{18}							x					
X_{19}												x
X_{20}												

v -- Second Factor

x -- Third Factor

0 -- Fourth Factor

TABLE B5

VARIABLES WITH HIGHEST FACTOR LOADINGS

BY TYPE OF ANALYSIS AND ROTATION

1968-1973

TYPE	ROTATION	FACTORS	VARIABLES WITH HIGHEST LOADINGS
PA2	VARIMAX	1	X_1, X_2, X_{13}, X_{20}
		2	X_3, X_8
		3	X_6
PA2	QUARTIMAX	1	X_1, X_2, X_3, X_{12}, X_{13}
		2	X_6
		3	X_3, X_8
PA2	EQUIMAX	1	X_1, X_2, X_{13}, X_{20}
		2	X_3, X_8
		3	X_6
RAO	VARIMAX	1	X_1, X_2, X_{13}, X_{20}
		2	X_3, X_8
		3	X_6
RAO	QUARTIMAX	1	X_1, X_2, X_{12}, X_{13}
		2	X_6
		3	X_3, X_8
RAO	EQUIMAX	1	X_1, X_2, X_{12}, X_{13}, X_{20}
		2	X_3, X_8
		3	X_6

TABLE B5 -- Continued

VARIABLES WITH HIGHEST FACTOR LOADINGS

BY TYPE OF ANALYSIS AND ROTATION

1968 - 1973

TYPE	ROTATION	FACTORS	VARIABLES WITH HIGHEST LOADINGS
ALPHA	VARIMAX	1	X_1, X_2, X_{13}, X_{20}
		2	X_3, X_8, X_{12}
		3	X_6
ALPHA	QUARTIMAX	1	X_1, X_2, X_{12}, X_{13}
		2	X_6
		3	X_3, X_8
ALPHA	EQUIMAX	1	X_1, X_2, X_{13}, X_{20}
		2	X_3, X_8
		3	X_6

TABLE B6

VARIABLES WITH HIGHEST FACTOR LOADINGS

BY TYPE OF ANALYSIS AND ROTATION

1968-1973

	PA2			RAO			ALPHA		
	VARIMAX	QUARTIMAX	EQUIMAX	VARIMAX	QUARTIMAX	EQUIMAX	VARIMAX	QUARTIMAX	EQUIMAX
X_1	v	v	v	v	v	v	v	v	v
X_2	v	v	v	v	v	v	v	v	v
X_3	x	v	x	x	0	x	x	0	x
X_6	0	x	0	0	x	0	0	x	0
X_8	x	0	x	x	0	x	x	0	x
X_{12}		v			v	v	x	v	
X_{13}	v	v	v	v	v	v	v	v	v
X_{20}			v	v		v	v		v

Factor 1 -- v
2 -- x
3 0

TABLE B7

VARIABLES WITH HIGHEST FACTOR LOADINGS

BY TYPE OF ANALYSIS AND ROTATION

1968-1973, FIRST DIFFERENCES*

TYPE	ROTATION	FACTOR	VARIABLES
PA2	VARIMAX	1	A03, C01, C02, C03, C13, D01, D02, D03, E01, E02, E03
		2	B01, B02, B12, B13, C12
		3	E02, E13, E20
		4	A02, A13
		5	C20, D20
		6	B06, D06, E06
		7	A20
		8	D08, E08
		9	D12
		10	A08
		11	B03

TABLE B7 -- Continued

VARIABLES WITH HIGHEST FACTOR LOADINGS

BY TYPE OF ANALYSIS AND ROTATION

1968-1973, FIRST DIFFERENCES*

TYPE	ROTATION	FACTOR	VARIABLES
PA2	QUARTIMAX	1	A03, A12, B12, C01, C02, C03, C08, C13, D01, D02, D03, E01, E03, E12
		2	E13, E20
		3	B01, C12
		4	A02, A13
		5	C20, D20
		6	B06, D06, E06
		7	A20, B20
		8	D08, E08
		9	D12
		10	A08, B08
		11	B03

TABLE B7 -- Continued

VARIABLES WITH HIGHEST FACTOR LOADINGS

BY TYPE OF ANALYSIS AND ROTATION

1968-1973, FIRST DIFFERENCES*

TYPE	ROTATION	FACTOR	VARIABLES
PA2	EQUIMAX	1	A01, A03, C08, D08
		2	B01, B02, B13
		3	E02, E13, E20
		4	A06, A08, C08
		5	C20, D20
		6	D08, E08
		7	A20, B20
		8	A02, A13
		9	C12, E03, E12
		10	D12
		11	B06, D06

TABLE B7 -- Continued

VARIABLES WITH HIGHEST FACTOR LOADINGS

BY TYPE OF ANALYSIS AND ROTATION

1968-1973, FIRST DIFFERENCES*

TYPE	ROTATION	FACTOR	VARIABLES
ROA	VARIMAX	1	A03, C01, C02, C03, C13, D02, D03, D13, E01, E03, E12
		2	E02, E13, E20
		3	C20
		4	B01, B13
		5	A02, A13
		6	A20, B20
		7	D08, E08
		8	C12
		9	D12
		10	B08
		11	B03

TABLE B7 -- Continued

VARIABLES WITH HIGHEST FACTOR LOADINGS

BY TYPE OF ANALYSIS AND ROTATION

1968-1973, FIRST DIFFERENCES*

TYPE	ROTATION	FACTOR	VARIABLES
ROA	QUARTIMAX	1	A03, B02, C01, C02, C03, C08, C13, D02, D03, E01, E03, E12
		2	E02, E13, E20
		3	C20
		4	C12
		5	A02, A13
		6	A20, B20
		7	D08, E08
		8	B01, B13 (8)
		9	D12
		10	A08, B08
		11	B03

TABLE B7 -- Continued

VARIABLES WITH HIGHEST FACTOR LOADINGS

BY TYPE OF ANALYSIS AND ROTATION

1968-1973, FIRST DIFFERENCES*

TYPE	ROTATION	FACTOR	VARIABLES
ROA	EQUIMAX	1	E02, E13, E20
		2	C12, D01, E03, E12
		3	D08, E08
		4	B01, B02, B13
		5	A02, A13
		6	D20
		7	D12
		8	A03, B08, C08
		9	B03
		10	A08
		11	A20, B20

TABLE B7 -- Continued

VARIABLES WITH HIGHEST FACTOR LOADINGS

BY TYPE OF ANALYSIS AND ROTATION

1968-1973, FIRST DIFFERENCES*

TYPE	ROTATION	FACTOR	VARIABLES
ALPHA	VARIMAX	1	A03, C01, C02, C03, C13, D01, D02, D03, E01, E03, E12
		2	B01, B12, B13, C12
		3	E02, E13, E20
		4	A02, A13
		5	A20
		6	B06, E06
		7	D20
		8	D08, E08
		9	A06
		10	D12
		11	A08, B03

TABLE B7 -- Continued

VARIABLES WITH HIGHEST FACTOR LOADINGS

BY TYPE OF ANALYSIS AND ROTATION

1968-1973, FIRST DIFFERENCES*

TYPE	ROTATION	FACTOR	VARIABLES
ALPHA	QUARTIMAX	1	A03, B02, C01, C02, C03, C08, C13, D01, D02, D03, E01, E03, E12
		2	E02, E13, E20
		3	B01, C12
		4	A02, A13
		5	A20, B20
		6	E06
		7	D20
		8	D08, E08
		9	D12
		10	B08
		11	B03

TABLE B7 -- Continued

VARIABLES WITH HIGHEST FACTOR LOADINGS

BY TYPE OF ANALYSIS AND ROTATION

1968-1973, FIRST DIFFERENCES*

TYPE	ROTATION	FACTOR	VARIABLES
ALPHA	EQUIMAX	1	C12, C13, D01, D03, E01, E03, E12
		2	B01, B02, B13
		3	E02, E13, E20
		4	E08
		5	B20
		6	D12
		7	C20
		8	D08
		9	D06
		10	A13
		11	B06, E06

* The variable number includes a letter classification defining the years for which the first difference was computed: A = 69-68, B = 70-69, C = 71-70, D = 72-71, E = 73-72

TABLE B8

HIGHEST OFF-DIAGONAL CORRELATION COEFFICIENTS

1968-1971

VARIABLE	CORRELATION WITH	VARIABLE	CORRELATION WITH
801	901	905	906
802	902	906	905
803	903	908	808
805	905	910	810
806	906	911	811
807	007	912	812
808	908	913	013
810	910	914	814
811	911	915	910
812	912	916	816
813	913	917	017
814	914	918	818
815	915	919	819
816	916	920	820
817	917	001	101
818	918	002	102
819	919	003	103
820	920	005	905
901	801	006	105
902	802	007	807
903	803	008	108

TABLE B8 -- Continued

HIGHEST OFF-DIAGONAL CORRELATION COEFFICIENTS

1968-1971

VARIABLE	CORRELATION WITH	VARIABLE	CORRELATION WITH
010	011	105	006
011	111	106	105
012	912	108	008
013	113	110	111
014	015	111	110
015	014	112	012
016	116	113	013
017	117	114	115
018	118	115	114
019	919	116	016
020	913	117	017
101	001	118	018
102	002	119	019
103	003	120	114

H_o: $p \leq .5$ H_1: $\geq .5$

p .19
Z -6.71
Pr(Z) .000001

Accept H_o

p -- Proportion of highest off-diagonal correlation coefficients of the form r_{ab} -- not belonging to the same time series.

TABLE B9

HIGHEST OFF-DIAGONAL CORRELATION COEFFICIENTS

1968-1973

VARIABLE	ORIGINAL VALUES	VARIABLE	FIRST DIFFERENCE
801	901	A01	A03
802	902	A02	D13
803	903	A03	C01
806	906	A06	C13
808	008	A08	C08
812	912	A12	C01
813	913	A13	A02
820	913	A20	B20
901	801	B01	B13
902	802	B02	A03
903	803	B03	C01
906	806	B06	E06
908	108	B08	A03
912	812	B12	C08
913	013	B13	B02
920	220	B20	A20
001	101	C01	D02
002	102	C02	D02
003	103	C03	C01
006	106	C06	D12
008	108	C08	A03

TABLE B9 -- Continued

HIGHEST OFF-DIAGONAL CORRELATION COEFFICIENTS

1968-1973

VARIABLE	ORIGINAL VALUES	VARIABLE	FIRST DIFFERENCE
012	912	C12	B13
013	113	C13	C01
020	312	C20	D20
101	001	D01	D02
102	202	D02	C02
103	003	D03	E03
106	006	D06	E06
108	008	D08	E08
112	212	D12	C02
113	013	D13	D02
120	113	D20	C20
201	301	E01	A03
202	102	E02	E20
203	103	E03	D13
206	306	E06	D06
208	008	E08	C03
212	312	E12	C13
213	313	E13	E02
220	313	E20	E13
301	201		

TABLE B9 -- Continued

HIGHEST OFF-DIAGONAL CORRELATION COEFFICIENTS

1968-1973

VARIABLE	ORIGINAL VALUES	VARIABLE	FIRST DIFFERENCE
302	202		
303	203		
306	106		
308	108		
312	212		
313	213		
320	220		

	H_o: $p \leq .5$	H_1: $p \geq .5$
p	.08	.9
Z	-11.17	+8.42
Pr(Z)	.000001	.99999

p -- Proportion of highest off-diagonal correlation coefficients of the form r_{ab} -- not belonging to to the same time series.

APPENDIX C

REGRESSION ANALYSIS TABLES

TABLE C1

DURBIN-WATSON STATISTIC FOR OBSERVED VALUES

REGIONAL REGRESSIONS -- 1968-1972

	LIST 1	LIST 2	LIST 3	LIST 4	LIST 5	LIST 6	LIST 7
	$X_2, X_3, X_6, X_7, X_8, X_{17}, X_{20}$	X_2, X_3, X_6	X_2, X_8, X_6	X_{12}, X_3, X_6	X_{12}, X_8, X_6	X_3, X_6, X_{20}	X_8, X_6, X_{20}
REGION 1 (n = 30)	1.41400 R^2 = .98	1.28012 R^2 = .97	1.25807 R^2 = .96	1.48303 * R^2 = .95	1.48296 * R^2 = .95	1.51892 * R^2 = .96	1.34960 R^2 = .96
REGION 2 (n = 35)	1.44059 R^2 = .81	0.27450 R^2 = .45	0.27451 R^2 = .45	0.71545 R^2 = .57	0.71545 R^2 = .57	0.52693 R^2 = .70	0.97072 R^2 = .74
REGION 3 (n = 30)	1.36593 R^2 = .97	1.42947 R^2 = .97	1.36593 R^2 = .97	1.29694 R^2 = .85	0.95272 R^2 = .83	1.30917 R^2 = .92	1.22972 R^2 = .92
REGION 4 (n = 15)	2.10537 * R^2 = .998	0.56947 R^2 = .99	0.64829 R^2 = .98	1.31622 R^2 = .95	1.33387 R^2 = .95	2.74732 * R^2 = .99	2.55222 * R^2 = .99
REGION 5 (n = 40)	1.08921 R^2 = .89	1.08921 R^2 = .89	1.02786 R^2 = .86	1.08921 R^2 = .89	1.02786 R^2 = 86	1.08921 R^2 = .89	1.02786 R^2 = .86

TABLE C1

DURBIN-WATSON STATISTIC FOR OBSERVED VALUES

REGIONAL REGRESSIONS -- 1968-1972

Continued

	LIST 1	LIST 2	LIST 3	LIST 4	LIST 5	LIST 6	LIST 7
	$X_2, X_3, X_6, X_7, X_8, X_{17}, X_{20}$	X_2, X_3, X_6	X_2, X_8, X_6	X_{12}, X_3, X_6	X_{12}, X_8, X_6	X_8, X_6, X_{20}	X_8, X_6, X_{20}
REGION 6 (n = 20)	0.57630 R^2 = .76	0.57630 R^2 = .76	0.57630 R^2 = .76	1.58541 * R^2 = .84	1.94014 * R^2 = .79	1.58541 * R^2 = .84	1.52345 * R^2 = .68
REGION 7 (n = 20)	1.29231 R^2 = .98	1.27161 R^2 = .98	1.27504 R^2 = .97	1.88938 * R^2 = .96	1.88938 * R^2 = .96	1.46603 * R^2 = .98	1.46603 * R^2 = .98
REGION 8 (n = 65)	1.16989 R^2 = .97	0.83997 R^2 = .96	0.80031 R^2 = .97	1.10918 R^2 = .92	1.02646 R^2 = .93	1.21399 R^2 = .93	1.02646 R^2 = .93

* No Serial Correlation $\alpha = 0.01$

TABLE C2

DURBIN-WATSON STATISTIC

REGIONAL LOGARITHMIC REGRESSIONS

1968-1972

	LIST 1	LIST 2	LIST 3	LIST 4	LIST 5	LIST 6	LIST 7
	$X_2, X_3, X_6, X_7, X_{12}, X_{20}$	X_2, X_3, X_6	X_2, X_6, X_8	X_{12}, X_3, X_6	X_{12}, X_6, X_8	X_{20}, X_8, X_6	X_{20}, X_6, X_8
REGION 1 (n = 30)	1.26395	0.91785	0.90523	0.94930	1.01235	0.97872	0.90418
REGION 2 (n = 35)	0.75100	0.58055	0.86469	0.46604	0.58035	0.78484	0.75484
REGION 3 (n = 30)	1.14194	0.81073	0.92379	1.05348	0.79117	0.66954	0.66954
REGION 4 (n = 15)	1.87460 *	0.91503	0.91503	2.03848 *	2.03848	2.53927 *	2.53927 *
REGION 5 (n = 40)	1.20579	1.05416	0.67369	1.34346	1.38832	1.28830	1.82020 *

TABLE C2

DURBIN-WATSON STATISTIC

REGIONAL LOGARITHMIC REGRESSIONS

1968-1972 -- Continued

	LIST 1	LIST 2	LIST 3	LIST 4	LIST 5	LIST 6	LIST 7
	$X_2, X_3, X_6, X_7, X_{12}, X_{20}$	X_2, X_3, X_6	X_2, X_6, X_8	X_{12}, X_3, X_6	X_{12}, X_6, X_8	X_{20}, X_8, X_6	X_{20}, X_6, X_8
REGION 6 (n = 20)	1.83902 *	1.41040 *	0.85791	1.83902 *	2.27895 *	1.41040 *	1.47915 *
REGION 7 (n = 20)	1.05998	1.16419	1.29966	1.16419	1.67768 *	1.05998	1.37789 *
REGION 8 (n = 65)	0.99078	0.47147	0.49916	0.49229	0.61902	0.91444	0.87615

* No Serial Correlation at $\alpha = 0.01$

TABLE C3

WEIGHTED AVERAGE* REGRESSION

(1968-1972)

1(X_2)

$$X_1 = 3,341.27 + 0.10673\ X_2$$

R^2 = .79019 F = 184.54949 D. W. = 1.62638

2(X_{12})

$$X_1 = 1,479.93 + 0.68114\ X_{12}$$

R^2 = .86106 F = 303.66334 D. W. = 1.50275

3(X_{20})

$$X_1 = 4.942.15 + 0.67226\ X_{20}$$

R^2 = .82319 F = 228.14010 D. W. = 1.68634

All Durbin Watson indicate no autocorrelation at α = 0.01

* Weights:

1972 -- 1/1.965	1971 -- 1/3.864
1970 -- 1/7.597	1969 -- 1/14.933
1968 -- 1/29.356	

TABLE C4

STANDARDIZED EQUATIONS

(1968-1972)

$$X_1 = \bar{X}_1 + B X_i$$

X_2	$X_1 = 15,315.4157 + 0.89510\ X_2$
Average	$X_1 = 15,315.4147 + 0.90455\ X_2$
Weighted Average	$X_1 = 17,860.6397 + 0.88893\ X_2$
X_{12}	$X_1 = 15,315.4157 + 0.87808\ X_{12}$
Average	$X_1 = 15,315.4147 + 0.93086\ X_{12}$
Weighted Average	$X_1 = 17,860.6397 + 0.92793\ X_{12}$
X_{20}	$X_1 = 15,315.4157 + 0.78158\ X_{20}$
Average	$X_1 = 15,315.4147 + 0.90789\ X_{20}$
Weighted Average	$X_1 = 17,860.6397 + 0.90780\ X_{20}$

$$\text{Average } X = (X_{68} + X_{69} + X_{70} + X_{71} + X_{72}) / 5$$

$$\text{Weighted Average } X = (X_{68} \cdot 1/29.356) + (X_{69} \cdot 1/14.933) + (X_{70} \cdot 1/7.597) + (X_{71} \cdot 1/3.864) + (X_{72} \cdot 1/1.965)$$

TABLE C5

LAGGED REGRESSIONS

1(X_{901}, X_{802})	$X_{901} = 2,673.26 + 0.10279\, X_{802}$	$R^2 = .816$	D.W. = 1.81825
2(X_{901}, X_{812})	$X_{901} = 1,025.65 + 0.45684\, X_{812}$	$R^2 = .836$	D.W. = 1.51698
3(X_{901}, X_{820})	$X_{901} = 3,121.12 + 0.78949\, X_{820}$	$R^2 = .851$	D.W. = 1.53423
4(X_{901}, X_{801})	$X_{901} = 51.70 + .89554\, X_{801}$	$R^2 = .984$	D.W. = 1.34099**
5$(X_{001}, X_{801}, X_{901})$	$X_{001} = 1,290.19 + 0.92990\, X_{901}$	$R^2 = .971$	D.W. = 1.30523**
6$(X_{101}, X_{801}, X_{901})$	$X_{101} = 485.31 + 2.09609\, X_{901} - 0.61644\, X_{801}$	$R^2 = .979$	D.W. = 1.53497
7$(X_{201}, X_{801}, X_{901}, X_{101})$	$X_{201} = 620.25 + 0.92903\, X_{101} - 0.62129\, X_{801} + .9465\, X_{901}$	$R^2 = .990$	D.W. = 2.11025
8$(X_{001}, X_{812}, X_{912})$	$X_{001} = 2,817.56 + + 0.36803\, X_{912}$	$R^2 = .801$	D.W. = 1.39811**
9$(X_{101}, X_{812}, X_{912}, X_{012})$	$X_{101} = 1,945.26 + 1.18212\, X_{012} - 0.45099\, X_{812}$*	$R^2 = .839$	D.W. = 1.52823
10$(X_{201}, X_{812}, X_{912}, X_{012}, X_{112})$	$X_{201} = 2,329.74 + 1.15102\, X_{112} - 0.32952\, X_{812}$*	$R^2 = .849$	D.W. = 1.54564

TABLE C5

LAGGED REGRESSIONS

CONTINUED

11 $(X_{001}, X_{820}, X_{920})$	$X_{001} = 4{,}119.18 + 0.74048\, X_{820}$	$R^2 = .841$ D.W. = 1.61917
12 $(X_{101}, X_{820}, X_{920}, X_{020})$	$X_{101} = 4{,}588.45 + 0.94634\, X_{820} + 0.16118\, X_{020}$ *	$R^2 = .854$ D.W. = 1.53919
13 $(X_{201}, X_{820}, X_{920}, X_{020}, X_{120})$	$X_{201} = 5{,}645.10 + 1.26366\, X_{820}$	$R^2 = .840$ D.W. = 1.48388
14 $(X_{001}, X_{802,}\ X_{902})$	$X_{001} = 3{,}931.96 + 0.09697\, X_{902}$	$R^2 = .813$ D.W. = 2.08596
15 $(X_{101}, X_{802}, X_{902}, X_{002})$	$X_{101} = 4{,}401.83 + 0.14811\, X_{902}$	$R^2 = .818$ D.W. = 1.92803
16 $(X_{201}, X_{802}, X_{902}, X_{002}, X_{102})$	$X_{201} = 5{,}807.56 + 0.31488\, X_{902} - 0.14985\, X_{802}$	$R^2 = .843$ D.W. = 1.79882

* Significant at $\alpha = 0.05$ not $\alpha = 0.01$

** Indicates autocorrelation

TABLE C6

CORRELATION COEFFICIENT OF $X_{...1}$

WITH PREVIOUS YEAR $X_{...1}$

	$R_{X_n, X_{n-1}}$	$R^2_{X_n, X_{n-1}}$
X_{901}, X_{801}	.99183	.98373
X_{001}, X_{901}	.98533	.970875
X_{101}, X_{001}	.99514	.99030
X_{201}, X_{101}	.99372	.98748
X_{301}, X_{201}	.99419	.98841

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