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Analysis of a long-range environmental forecasting model

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ANALYSIS OF A LONG-RANGE ENVIRONMENTAL FORECASTING MODEL

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Monterey, California

THESIS

ANALYSIS OF A LONG-RANGE
ENVIRONMENTAL FORECASTING MODEL

by

Everett Alvarez, Jr.

December 1976

Thesis Advisor: M.G. Sovereign

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On the basis of imperfect data that is available for these regions, this study examines the innovations

(20. ABSTRACT Continued)

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Utilizing new estimated regression coefficients, a forecast simulation for several Middle East countries follows along with concluding analyses and a discussion of inherent problems present in the model.

Analysis of a Long-Range Environmental Forecasting Model

by

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Submitted in partial fulfillment of the
requirements for the degree of

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TABLE OF CONTENTS

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I. INTRODUCTION

A. TECHNICAL FORECASTING

The art of technical forecasting is still considered to be in the development stage. In defining technical forecasting in his thesis presented at the Naval Postgraduate School, Rooney [Reference 1] classifies technical forecasting into three commonly accepted areas. These are:

a. Exploratory – starts from a present empirical or theoretical basis of knowledge and is oriented toward the future.

b. Normative – first assesses future goals and missions, then works backwards toward the present.

c. Intuitive – that type of forecasting which is based on the informal use of Exploratory and Normative techniques, including the forecasters biases and hunches.

Falling within these separate classifications are a myriad of methods and techniques ranging from those widely used and well accepted in practice – such as the Delphi technique, or Least Squares Linear Regression; to some techniques which have limited use, or are more recently developed, and thus are still subject to a considerable degree of doubt and skepticism.

In keeping with this trend of thought, the scope of this thesis lies almost entirely within the area described as exploratory. The purpose is to analyze a developed model

based on the relationships of current measures of the state of national and international relations, and to forecast these relations to the mid to long-range future.

B. BACKGROUND

> During the past decade, scholars of international affairs have begun to direct more attention towards developing and utilizing techniques that could help systematize the explanation and prediction of international political concepts such as hostility, escalation, and alignment, as well as various techniques to express relationships among such measures. Their goal is to produce accurate descriptions of the state of international relations or some subset thereof, and to employ descriptions of some elements as explanations of predictors of others.
>
> [Reference 16, pg. 1]

The U.S. Government, particularly the Department of Defense, has been instrumental in recent developments in this field, and has supported various agencies in the use of newer methods and techniques in the area of international relations. The U.S. Government has likewise been instrumental in supporting efforts to bridge the gap between recent academic developments and the practicing foreign affairs community. One such effort is the work that has been done by Consolidated Analysis Center, Incorporated, (CACI), on a project sponsored by the Defense Advanced Research Project Agency (DARPA). As CACI reports in their publication [Ref. 16, pg. 2]:

The goals of the effort are:

1. To communicate to the foreign affairs establishment the variety of newly acquired capabilities for foreign affairs planning and analysis.
2. To suggest means of integrating recent quantitative developments with more traditional "judgemental" approaches; and to allow members of this community to evaluate experimental applications of the newer techniques.

CACI reports on an effort to accomplish these goals with respect to one general subject area – long-range environmental forecasting. Specifically, forecasting the political, military, and economic environment for specific regions of the world in the projected future.

The foreign affairs community, and military planners in particular, is well aware of the need to anticipate significant changes in the world situation in order to formulate policy in time to prepare for these changes. It is vital to be able to forecast in a planning context because time lags are required for reactions to become operative.

C. STATEMENT OF THE PROBLEM

The intent of this thesis is to present a general introduction of the model employed by CACI in their effort to suitably forecast the political-economic-military environment in a future time period. The model for the Lesser Developed Countries takes in a broad spectrum of concepts and the model itself is fairly general. The scope of this thesis is limited to the Middle East area. Within this area, this study

concentrates primarily on those countries having the best data available. Concurrently, the intention is to investigate only that portion of the model having more theoretically sound relationships among the variables representing the descriptors.

The model examines the relationships among the areas' central environmental descriptors. This thesis is concerned primarily with only one central environmental descriptor — national economic power base. A descriptor, as used in this study, refers to a variable which is a component used to describe a country's economic power base, such as DOM (Domestic Government Expenditures). A descriptor in turn may also act as a predictor in a relation describing another descriptor, such as in the case of GDP (Gross Domestic Product).

The analysis here includes a determination if the model in fact suitably and effectively utilizes newly acquired capabilities in the prediction. If so, the results may be in fact useful to the foreign affairs establishment.

Upon review of the methods employed, this thesis focuses on particular areas in which the author has a higher degree of familiarity; delves into the particular utility, and pitfalls, of the various techniques; and follows through with some recommendations which may improve the outcome. The author introduces his ideas for improvement into the model, runs a simulation with upgraded data, and then analyzes the results.

II. THE MODEL

The Lesser Developed Countries (LDC) model is a development of CACI's initial forecasting model for projection of the European situation. In the original effort, a considerable amount of study went into the selection of the European central environmental descriptors, development of empirical measures of the descriptors, generation of hypotheses relating the descriptors to endogenous and exogenous predictors, and the collection of data for measures of these descriptor and predictor variables.

The data collected and the techniques adopted by CACI were used to evaluate the hypotheses and to mathematically describe the relationships between central environmental descriptor and predictor variables. The results forecast by simulation experimentation on the dynamic model were compared to actual data.

There were several considerations involved in the selection of concepts which can be credibly forecast. First, the concept should be general enough to be amenable to a long-range forecast. As an example, a user might desire to forecast future alliances. However, alliance is probably too specific to allow a useful and credible forecast. On the other hand, a concept such as alignment is felt to probably be general enough to permit credible forecasts. At the same time, alignment would probably tend to reflect most

of the policy-relevant characteristics of alliance. Selection of the appropriate concepts, then, often involves determining the overlap between the user's needs and research capabilities.

A second consideration concerning forecasting credibility is the reasonable availability of data. A research of literature in this field led the author to the conclusion that, generally, the greater the amount of quality data available, the greater the likelihood that a given relevant concept will be included in the analysis. A related concern is the state of development of substantive social science theory which is relevant to the concept. The usual trend is the less the development, the more unlikely the concept is apt to be employed.

Once CACI selected the central environmental descriptors, the goal was to generate empirical measures of the concepts and to extract potentially useful hypotheses relating the concepts to one another, and to exogenous predictor variables. Suffice it to say here that the selection of measures is guided by previous research and the availability of data, and the generation of hypotheses according to their credibility within the context of the particular geographical region under study.

In the process of the survey, it is necessary to divide many of the central environmental descriptors into components. This is done because usually the descriptor as it is initially conceptualized is too broad for operationalization. Separating

the descriptors analytically allows them to be explicitly examined rather than hidden within the broad concept.

Once CACI collected the data for each of the indicators of the central environmental descriptors and for each of the predictor variables, the various relationships were empirically analyzed by econometric techniques. These techniques allowed both statistical tests of the various hypothesized relationships and of the mathematical descriptors of those found significant. The forecasting models for each descriptor, or descriptor component, take the form of regression equations relating that descriptor or component to its various predictor variables.

Once CACI completed their basic work on the European model consisting of five central environmental descriptors, as a follow-on, CACI personnel developed an LDC Model for the Middle East, Latin America, and Africa. It attempted to provide the defense community with models to be used in support of the Joint Long-Range Strategic Study. These models are basically derivatives of the European Model. They are designed to account for the highly volatile situations that are found in these areas and to produce usable forecasts from the poor data which is available for these regions.

The single theoretical model serving as the starting point for these regional models is shown in Table 1, Appendix I. Table 2 lists the variables included within the theoretical model. Thirteen of the 28 equations included in the model — numbers 7, 8, 10, 13, 14, 16, 17, 18, 19, 22, 23, 26, and

28 — are identities. These only transform variables for intermediate calculations, or transform calculated values to forecast variables and contain none of the estimated parameters. The equations follow standard Fortran IV priorities in the compilation and computation: exponentiation is performed first, followed by multiplication and division, and then addition and subtraction.

The Middle East study includes 15 nations.[1] After an intensive survey of the data available for these countries, it was decided to limit the study to ten countries in this region. The reason for the close scrutinization of the data provided was because of the questionable documentation available with the model. The ten final countries selected for study are listed in Table 3, Appendix I.

While investigating the above, and studying the logic used in the hypotheses involved in the model, it was decided to narrow the scope of study further and limit the analysis to 12 of the equations of Table 1. The twelve equations are listed in Table 4, Appendix I. These latter equations were selected because it was felt the variables involved offered a better opportunity to use reliable data, and at the same time comprising descriptive relations with a higher degree of accepted theoretical validity.

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[1]These 15 countries are listed in Reference 2.

Of the 12 equations selected, Bloc 1 — consisting of POP(1), INV(3), DOM(4), DEFX(9 and 10) — is completely recursive. That is, these variables are functions of previous values of forecast variables and exogenous predictors only. In the original study, CACI estimated these by Ordinary Least Square (OLS) techniques.

Bloc 2 — consisting of CONS(2), TIM(5), TEX(6), and GDP(7) — is nonrecursive and over-identified; that is, these variables are functions not only of lagged values of forecast variables and exogenous predictors, but also present values of forecast variables in both Blocs 1 and 2. The use of present values of forecast variables as predictors means that one of the assumptions of classical linear regression is violated. That is, ... that there be no error in the independent variables. Two-Stage Least Square (2SLS) techniques were used by CACI to evaluate the coefficients for Bloc 2.

Equation 27 contains lagged values of the forecast variables, exogenous variables, and present values of forecast variables found in Blocs 1 and 2. It is solved in sequence because no direct feedback exists from it to Blocs 1 or 2.

III. THE ECONOMIC DATA

One of the primary difficulties with the Middle East model was the relative difficulty obtaining sufficient, accurate data. In comparison to the European or North American regions where the bureaucracies that collect and maintain data have existed longer, are better developed, and have established and accepted data collection procedures; it is much more difficult. It is even more difficult in the lesser developed regions where many new nations recently emerged. Although the countries selected in this thesis have better data available, in many cases the data sought does not exist.

This factor is particularly true in the economic sector with measures of Gross Domestic Product (GDP), Private Consumption Expenditures (CONS), Private Investment Expenditures (INV), and Domestic Government Expenditures (DOM) in some instances severely lacking. Also, many of the published listings of Military Aid (Military grants and credit sales) and Defense Expenditures are basically unreliable because of the different accounting procedures adopted by each of the nations concerned. Overall, however, the countries selected in this study proved to have sufficiently standardized data accumulation procedures whereby one is able to consistently select the required information from conventional sources.

After considerable thought, investigation, and discussion with the users of the model from the Joint Chiefs of Staff Computer System Support Center in Washington, D.C.; an appraisal by all those associated with this effort disclosed a basic need for a complete reconstruction of the data base.

With this as the initial step in the overall effort proposed by the author, the actual work commences with a breakdown of that portion of the overall model under study to each descriptor variable in the part-by-part analysis and discussion that follows.

The principle purpose of this thesis is not to question the validity of the model in its basic structure. Rather, it will accept the model as presented and assume the endogenous and exogenous variables given do accurately describe the state of relationships. The intent, however, is to evaluate the data, analyze the regression techniques utilized, and to compare statistical tests of significance to determine which method produces more reliable forecasting values.

A. POPULATION

Population is a basic variable to the model under study. Regardless of a nation's level of economic development, some minimum population is required if the nation is to exploit its natural resources effectively and employ high-energy production techniques [Ref. 1, pg. 229]. A large population also provides the necessary domestic market for industry [Ref. 10, p. 141]. No nation can become or remain a significant world or regional power without the population necessary to

establish and maintain an industrial base, field combat units, and feed and equip the soldiers and citizens [Ref. 8, pg. 119]. Forecasts of population provide a means of meaningfully comparing forecasts of the other variables for nations of greatly differing sizes or per capita measures.

Forecasts of GDP, for example, cannot be used to infer relative levels of economic development for countries that are very different in population. Per capita forecasts, which require an estimate of future population, reduce much of this comparability problem [Ref. 2, pg. 15].

The approach used in this study was to apply estimated population growth rates from the International Monetary Fund Statistical publication of May 1976. The reason this source was selected was because of completeness and also because the source presents consistent population figures. The compiled population data for twelve of the Middle East countries is listed in Appendix II, Table 1. All population figures are in millions of people.

The forecast population figures appear to be too high. Experts agree that present population growth rates are too high to be maintained indefinately [Ref. 3]. Yet it is very difficult to know when the population growth rates will level off. Since this study is concerned mainly with comparative economic measures, and since population is a predictor variable in most economic descriptors, utilizing Equation 1 as given should maintain a comparative trend in the following

economic descriptor equations. Further research into a new population growth model should prove to be valuable in providing more realistic population growth rates.

B. ECONOMIC VARIABLES

The economic variables are those described with Equations 2 through 7. These are: Private Consumption Expenditures (CONS), Private Investment Expenditures (INV), Domestic Government Expenditures (DOM), Total Imports (TIM), Total Exports (TEX), and Gross Domestic Product (GDP).

In this model, these 6 variables, along with Defense Expenditures, are of major importance in describing a country's economic power base. The basic variable is GDP, but together they are used to represent the economic sector of each country. The economic model is developed from Keynesian income-expenditure analysis. The major problem in specifying this economic model was to identify the components of spending and to develop equations for forecasting each of these components so that forecasts of GDP could be generated. By definition, income equals production in each period and spending, appropriately defined, also equals production. Total production, or total expenditures, is equal to gross domestic product [Ref. 2, pg. 16].

This model identifies three basic types of expenditures: (1) Private Spending, (2) Government Spending, (3) Foreign Sector Spending.

1. Private Spending

Private spending is divided into Private Consumption Expenditures and Private Investment Expenditures, the latter including spending on plants and equipment (capital goods) as well as spending on inventory accumulation.

The basic influence on Consumption (Eq. 2) is disposable income. In this equation, GDP is used as a proxy measure for the "true" value of disposable income. This is a normal practice when direct data on disposable income is generally unavailable [Ref. 2, pg. 16]. Previous values of consumption are included in order to obtain an adjustment effect since large increases or decreases in disposable income are often not translated immediately into proportional changes in consumption expenditures.

The investment equation (Eq. 3) is based upon the assumption that plants are constructed, and equipment purchased against expectations that additional production can be sold. However, the model must forecast investment spending before the value of total sales is known. In order to settle the problem, it is assumed that the pattern of expected future sales is based on past patterns, so that investment is predicted as a function of changes in the proxy variable for disposable income — GDP.

2. Government Spending

Government spending is divided into two components: (1) Domestic non-defense government spending (DOM) and defense expenditures (DEFX). Non-defense government spending

(Eq. 4) is predicted by previous values of non-defense government spending and GDP, and the present value of population. The previous value of DOM is intended to capture the inertia that typically characterizes government economic policy and behavior. The lagged value of GDP includes the influence of total wealth of the nation on the government activities.

Simultaneously, in a country with a rapidly growing population, the larger a population, the larger the increase on such services such as education, public facilities, social services, etc.; and the tendency for per capita wealth to grow more slowly. The degree this influence has varies from one country to another [Ref. 1].

3. Foreign Sector Spending

Foreign sector spending is represented by two equations; one for export sales, or income from other countries (Eq. 6), and the other for imports, or spending going to other countries (Eq. 5). The two equations take an identical form. However, in the import equation, GDP influences imports as a proxy measure of disposable income and the country's capacity of resources.

In the export equation (Eq. 6), GDP serves as a measure of the total available production for export, while population serves as a surrogate for the size of the domestic market [Ref. 2, pg. 18].

4. Defense Expenditures

The theoretical forecasting equations for defense expenditures are equations 9 and 10. These attempt to predict

changes in expenditure levels in order to capture the linkage between the domestic and international political conditions a nation faces, and its response in terms of enhancing or reducing its military capabilities. Annual changes of a nation's defense spending are predicted by annual changes in its rivals'defense expenditures, that portion of the previous year's GDP that is devoted to military expenditures, the country's previous level of conflict, the previous annual change in per capita wealth, the average level of military aid received from the superpowers — the U.S. and the U.S.S.R. — over the previous five years, and the previous level of cooperation between the country under study and the two superpowers.

The relation between conflict and defense spending seems obvious. There are numerous references to conflict events leading to increased rates of defense spending, conscription, mobilization, etc. In a similar manner, the notions of rivalries (arms races) influencing defense spending tends to be widely supported. "Rival" nations, for the purpose of this study, were selected on the basis of historic rivalries, border and territorial disputes, and the like. In the samples selected for statistical analysis later, the three countries chosen were Egypt, Israel, and Syria; Israel being the chief rival of Egypt and Syria during the past decade.

C. CONSTRUCTING THE DATA BASE

Construction of the data base proved to be a long, tedious, and somewhat frustrating process. The final sources selected for each of the above variables are listed in Table 5, Appendix I. The tabulated data is compiled in Appendix II.

The sources selected list each country's statistics in local currency figures. In some cases a country will provide data in constant year values, while other nations do not. Furthermore, those listing constant year values did not always select the same base year for the different variables. This led the author to select for the most part the IMF published statistics, supplemented by the United Nations Yearbook of National Accounts Statistical publications, for consistent data. In each case, the values extracted from these tables were current year local values.

Widespread inflation and sharp price swings in primary commodities over the past decade introduce significant distortions into the data when it is expressed in current prices. The goods that were bought for a million U.S. dollars at the current prices in 1965 cost considerably more dollars at the current prices in 1976. Thus, the reporting of annual purchases in equivalent current value of local currency for each year presents an impression of growth in expenditures which seriously misrepresents actual acquisition.

No simple adjustment for prices is entirely valid. Inflation rates vary among nations; in particular, they often

differ between two countries exchanging goods. Furthermore, the inflation rate for a nation's economy as a whole is not necessarily representative of the different sectors within the same economy [Ref. 15, pg. 9]. No general basis exists for separating out the special impact of inflation on the differing sectors of a nation's or different nation's, economies. Inflation is a very significant factor in analyzing the trends of expenditure.

The next step was to standardize all values to a common base year.

An approximate compensation for the effects of inflation were made by "deflating" the current local currency values for the data of each country to constant 1970 local currency values before conversion to U.S. dollar equivalents. The price indices used were local Consumer Price Indices (CPI), Wholesale Price Indices (WPI), and in the case of the oil producing nations whose major export is oil — the local Oil Price Index, when it was available, for the variable TEX. If it was not available, the author utilized the WPI if it appeared permissible to do so.

An example may help to understand the process. Consider the variable CONS for Egypt for the year 1965. The number of Egyptian pounds spent on private consumption expenditures was 1,463 million pounds. The local CPI, with 1970 as the base year, was 81.7. This given-year-weighted price index, i.e., Paasche's index, adjusts current year expenditures made up of current-year prices for current-year quantities,

i.e., P_nQ_n, to base-year prices for current year quantities P_0Q_n. The adjustment is accomplished by dividing the current year expenditure by the Paasche's index:

$$\frac{\Sigma P_nQ_n}{\Sigma P_nQ_n/P_0Q_n} = \Sigma P_0Q_n$$

which represents the purchases of given-year quantities at base year prices. Hence, in this example, the current amount of

$$\frac{1,463 \times 100}{81.7} = 1,790.7$$

millions of constant year 1970 Egyptian pounds. Using the exchange rates as listed in the May 1976 issue of International Financial Statistics, of $2.30 U.S./Egyptian pound gave a private consumption expenditure of $4.119 billion U.S. (in constant 1970 U.S. dollars). Figure 1 on the following page completes the example for the years 1969-1974. The complete tabulated results are listed in Appendix II.

It should be added here that the CPI and WPI were used where the author deemed it more appropriate. One reason so much data is missing for so many countries in the early 1960's is due to a price index not being available for that period for many of the countries.

FIGURE 1

EXAMPLE

Country = EGYPT

Year	Private Consumption Expenditures			
	Egyptian lbs. (Millions)	Egyptian CPI	1970 Egypt lbs. (Millions)	1970 U.S. $ (Billions)
1960	972	69.7	1394.55	3.207
1961	993	70.2	1414.53	3.253
1962	1101	68.1	1616.74	3.718
1963	1171	68.6	1707.00	3.926
1964	1247	71.1	1753.87	4.034
1965	1463	81.7	1790.70	4.119
1966	1583	89.0	1778.65	4.091
1967	1633	89.7	1820.51	4.187
1968	1762	93.2	1890.56	4.348
1969	1807	96.3	1876.42	4.316
1970	1940	100.0	1940.00	4.462
1971	2066	103.1	2003.88	4.609
1972	2208	105.3	2096.87	4.823
1973	2237	109.8	2037.34	4.686
1974	2339	121.7	1921.94	4.420

IV. INTERNATIONAL CONFLICT

One measure of international conflict in the model for the Middle East is CONF. This represents a wide continuum of conflict behavior, from verbal conflict to actual military engagements. In reality, this measure is basically a difficult concept to define, and particularly, to operationalize. It is assessed as a unidimensional phenomena with small-scale disruptions and negative verbal behavior of a limited scope falling at one end of a scale, and military or other violent conflict falling at the other end. A monadic measure, it can be interpreted as reflecting not only the absolute quantity of negative behavior in which a country engages, but also the intensity of its negative behavior.

Equation 27 is used to forecast conflict. It attempts to capture the impact of both domestic and international forces on a nation's conflict level. DEFX, as a proportion of GDP, attempts to indicate the degree to which a nation's budgetary outcomes indicate a preoccupation with military affairs, while changes in defense spending over the short term are used to represent fluctuations in military preparedness, which itself may be an indication of possible conflict [Ref. 2, pg. 30]. Previous conflict levels are used as a surrogate for the historical conflict-proneness of nations.

COOP (the total U.S. and Soviet cooperative behavior directed toward a nation — Equation 26) is used to capture

the extent of bi-polar interest in a particular conflict. It is a dyadic measure of the extent to which superpower competition is likely to intensify conflict among the client nations.

A. WEIS FILES

After a thorough search of references on the operationalization of this type of data used for CONF and COOP, it appeared a more logical procedure would be to determine if a more substantive basis could be found for the weighting and scaling of the events that comprise this data.

Of the various methods used by personnel working in events research, a method proposed by Charles McClelland[1] involves a nominal scaling method which classifies, or sorts, events into homogeneous categories. There are no assumptions about relationships between the categories. Numbers are arbitrarily associated with each category; yet, there is no way that justifies the use of arithmetic operations. The function of numbers in this scheme is merely that of naming. The McClelland scale is a classification of 22 major categories that have a nominal relationship. These categories are verbal and non-verbal cooperative/conflictive. He assumes an underlying conflict/cooperation continuum.

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[1] Havener, T., and Peterson, A., pgs. 27-29.

These 22 major categories are the same as those that constitute the WEIS data files (World Events Interaction Survey), an event-data collection and filing procedure that has become widely employed in international relations research.[1]

In an attempt to clarify and systematize the underlying dimension of the conflict/cooperation continuum, considerable extended effort was carried on in the WEIS area by Herbert Calhoun.[2] He proceeded on the premise that friendliness and hostility in international relations were functions of the investigator's interpretations of events. Integrating a Semantic Differential technique to discover the perceived underlying dimensions, and by using n-dimensional geometric techniques Calhoun produced scales for each of the dimensions which underlie international reaction.[3] The WEIS Event Codes with their respective category definitions are listed in Figure 2. The number preceding each category name are McClelland's numbers. Calhoun re-prioritized the event categories and his numbers are in parenthesis following the category name. Figure 3 contains Calhouns Friendly/Hostile scale.

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[1]For an excellent summary, refer to R. Sherwins "WEIS Project Final Report."

[2]*Ibid*.

[3]For a detailed explanation of these techniques, refer to Sherwins report (referenced above) and further references on work performed by Charles Osgood and his associates.

FIGURE 2

WEIS EVENT CODES

01 YIELD (09) CALHOUN'S SCALE

011 Surrender, yield to order, submit to arrest, etc.
012 Yield position; retreat; evacuate
013 Admit wrongdoing; retract statement

02 COMMENT (10)

021 Explicit decline to comment
022 Comment on situation-pessimistic
023 Comment on situation-neutral
024 Comment on situation-optimistic
025 Explain policy or future position

03 CONSULT (02)

031 Meet with; at neutral site; or send note
032 Visit; go to
033 Receive visit; host

04 APPROVE (06)

041 Praise, hail, applaud, condolences
042 Endorse others policy or position, tive verbal support

05 PROMISE (08)

051 Promise own policy support
052 Promise material support
053 Promise other future support action
054 Assure; reassure

06 GRANT (05)

061 Express regret; apologize
062 Give state invitation
063 Grant asylum
064 Grant privilege, diplomatic recognition; de facto relations, etc.
065 Suspend negative sanctions; truce
066 Release and/or return persons or property

07 REWARD (01)

071 Extend economic aid (for gift and/or loan)
072 Extend military assistance
073 Give other assistance

08 AGREE (03)

081 Make substantive agreement
082 Agree to future action or procedure; agree to meet, to negotiate

09 REQUEST (07)

091 Ask for information
092 Ask for policy assistance
093 Ask for material assistance
094 Request action; call for
095 Entreat; plead; appeal to; help me

10 PROPOSE (04)

101 Offer proposal
102 Urge or suggest action or policy

11 REJECT (17)

111 Turn down proposal; reject protest demand, threat, etc.
112 Refuse; oppose; refuse to allow

12 ACCUSE (16)

121 Charge; criticize; blame; disapprove
122 Denounce; denigrate; abuse

13 PROTEST (15)

131 Make complaint (not formal)
132 Make formal complaint or protest

14 DENY (14)

141 Deny an accusation
142 Deny an attributed policy, action, role, or position

15 DEMAND (19)

151 Issue order or command, insist; demand compliance, etc.

16 <u>WARN</u>

160 Give warning

17 <u>THREATEN</u>

171 Threat without specific negative sanctions
172 Threat with specific non-military negative sanctions
173 Threat with force specified
174 Ultimatum; threat with negative sanctions and time limit specified

18 <u>DEMONSTRATE</u>

181 Non-military demonstration; walk-out on
182 Armed force mobilization, exercise and/or display

19 <u>REDUCE RELATIONSHIP</u> (as Neg. Sanction)

191 Cancel or postpone planned event
192 Reduce routine international activity, recall officials, etc.
194 Halt negotiations
195 Break diplomatic relations

20 <u>EXPEL</u>

201 Order personnel out of country
202 Expel organization or group

21 <u>SEIZE</u>

211 Seize position or possessions
212 Detain or arrest person(s)

22 <u>FORCE</u>

221 Non-injury destructive act
222 Non-military injury-destruction
223 Military engagement

FIGURE 3

CALHOUN'S FRIENDLY/HOSTILE SCALE

RANK (2 Dimension)	CONCEPT (Descriptors)	SCALE	
1.	Reward	3.387	
2.	Consult	2.942	
3.	Agree	2.780	
4.	Propose	2.568	
5.	Grant	2.518	
6.	Approve	2.514	cooperation
7.	Request	1.241	
8.	Promise	1.018	
9.	Yield	0.720	
10.	Comment	0.108	
	ORIGIN	0.000	
11.	Reduce Relations	-1.070	
12.	Warn	-1.668	
13.	Demonstrate	-1.807	
14.	Deny	-1.866	
15.	Protest	-1.982	
16.	Accuse	-2.653	conflict
17.	Reject	-2.884	
18.	Expel	-3.062	
19.	Demand	-3.181	
20.	Threat	-3.342	
21.	Seize	-3.503	
22.	Force	-4.044	

The arrangement of events, and the distance between them on the scale conforms basically to the arrangements that might have been had the events been scaled using intuitive techniques only. However, here is a systematically derived scale which may be more justifiably incorporated in the computerized procedures.

B. COMPUTATION OF CONFLICT/COOPERATION

The next step in the study involved obtaining the raw data desired from the WEIS data files. The data for both CONF and COOP are obtained in a similar manner, the only difference requiring a slight rearrangement of the calling program initiating the event-scanning process.[1]

Since the author was basically interested in the monadic absolute quantities of cooperative or conflictive behavior, the Calhoun Scale values were used independently. That is, in evaluating the conflict data, each event was weighted by its corresponding absolute value of the scale, then summed for each category. The sum total of the weighted values of the combined categories then represented the values assigned to CONF for the year concerned.

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[1]This procedure involved use of the WEISUM5 computerized program, set up at the Naval Postgraduate School Computer Center. An example of the calling program for the variable CONF data is illustrated in Appendix II, Table 3, and is aptly described in Reference 13.

As an example, Table 3 in Appendix II lists the raw data as taken from the WEIS data files for the year 1972. The country file number for Egypt is 651. Since the author was concerned with those events relating to a monadic measure of conflict, only categories 11 through 22 (Calhoun's scale) were used. As one can observe, there were 10 events recorded in category 17, 45 in category 16, one event in category 15, 5 in 14, and so forth. Multiplying the number of events by its appropriate absolute scale factor produced the desired weighted value. Hence:

$$(10 \times 2.884) + (45 \times 2.653) + (1 \times 1.982) + (5 \times 1.866) + \ldots$$
$$= 216.860$$

The remainder of the computational results for the variable CONF for Egypt and Lebanon from 1966 through 1975 are given in Figure 4. An examination of the resulting values showed a large variation in scale, particularly when one compared results among the different countries under review. This is readily noticable in comparing the results shown in Figure 4 for Egypt and Lebanon. This effect was accredited partially to a bias in reporting by the news media where daily events are more likely to be fully reported in countries where significant events are happening on a more frequent basis, as compared to a country where the news services do not always have personnel present. As a

FIGURE 4

EXAMPLE - $CONF_t$

EGYPT			LEBANON	
Year	$CONF_t$	$Log_{10}(CONF_t+1)$	$CONF_t$	$Log_{10}(CONF_t+1)$
1966	168.18	2.229	11.934	1.111
1967	340.365	2.533	23.905	1.396
1968	200.728	2.305	33.185	1.534
1969	694.265	2.842	158.342	2.202
1970	968.308	2.986	154.591	2.192
1971	248.617	2.397	21.993	1.362
1972	216.860	2.338	108.465	2.039
1973	528.973	2.724	138.287	2.144
1974	121.634	2.089	72.413	1.866
1975	99.071	2.000	97.980	1.996

MONADIC Transformation for compensation of bias and large variation in scale

compensation for this bias and variance in scale, the computed values were subjected to a logarithmic (base 10) transformation.[1]

The computation for COOP was done in a similar manner. These calculations also resulted in a noticable variance in scale and in skewness toward the more significant nations, however the effect was not as large as for CONF. A transformation of the computed values here was done by taking the square-root of the values for cooperation between the country concerned and either the U.S. or the U.S.S.R. This transformation is not as severe as taking the logarithm, so that not as much information is lost in the technique used to make the data more manageable. Figure 5 lists the final values obtained for Egypt for the period 1966-1975.

The complete final transformed results for each of the countries is given in Appendix I. It should be pointed out here that data for years previous to 1966 is not available, since the WEIS system did not commence until that year.

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[1]Weil, Greenberg, et. at., "Quantitative Methods for Long-Range Environmental Forecasting", pgs. 361-363.

NOTE: Data for Soviet Union Military Aid has not been included in the data tables. Inclusion of this information would have involved a re-classification of this Thesis to CLASSIFIED. The information for both SUM and USM can be obtained from the sources listed in Table 5, Appendix I.

FIGURE 5

EXAMPLE — $COOP_t$

COUNTRY = EGYPT

Year	SUC_t	$\sqrt{SUC_t + 1.0}$	USC_t	$\sqrt{USC_t + 1.0}$
1966	37.839	6.232	14.462	3.932
1967	54.331	7.439	19.922	4.574
1968	33.061	5.836	12.959	3.736
1969	25.477	5.146	13.464	3.803
1970	75.860	8.767	65.967	8.183
1971	67.607	8.283	58.349	7.704
1972	44.249	6.727	8.776	3.127
1973	57.439	7.645	87.916	9.430
1974	38.249	6.265	173.094	13.194
1975	29.042	5.481	91.179	9.601

DYADIC Transformation is for compensation for skewness resulting from bias in reporting.

V. LINEAR REGRESSION ANALYSIS

With the accumulation of the data for the ten Middle East countries completed, the author elected to take a sample of the nations involved for an analysis of the LDC model with the data now available. Three countries were selected — Egypt, Israel, and Syria. A glance at the data tables will indicate that these three countries offer a substantial quantity of data which should enable one to perform a fairly decent regression analysis.

Concurrently, these three nations offer a scenario which is significant in the Middle East political arena. Israel has definitely been a chief rival of both Syria and Egypt. Although none of the three are explicitly significant nations in the current oil question, they do present many economic, political, and military facets pertinent to the region.

The author strongly felt that incorporating these three countries into the study lent an excellent opportunity to assess this model's validity and reliability.

A. DISCUSSION

It is not clear if the Ordinary Least Square and the Two-Stage Least Square analysis CACI performed on Blocs one and two were simultaneous multi-equation OLS and 2SLS operations, or if the equations in the respective Blocs were examined independently. The author does not have the facilities available, nor the knowledge, to attempt a simultaneous multi-equation analysis for the structural coefficients.

This study undertakes an independent analysis of each descriptor variable by linear regression techniques. The data for each variable is first examined by ordinary least-squares regression analysis, then followed by the Durbin two-stage least square correction for serial correlation. The estimators obtained by both methods were tested for statistical significance, and a comparative analysis was used to determine which of the resulting parameters should be incorporated in the forecasting program.

The original intention was to use data from the time-period 1961-1970 throughout the regression portion, obtain regression estimators by the techniques described above, then forecast the descriptor variables for the time period 1971-1985. However, because of the unavailability of data for portions of the time period 1961-1970 for some countries, the author was confronted with the problem of having too few observations to effectively pursue a valid regression. This was particularly true for the latter equations 9 and 27, where the information for the variables COOP and CONF was not available prior to 1966. In cases such as these, the only choice was to use whatever information was available.

Since each equation involves different variables, the number of years of available data (hence the number of observations) for each equation will differ. Figure 6 lists the time period of observations used for each regression equation for each of the countries. Naturally, it was desired to

FIGURE 6

OBSERVATION PERIODS USED IN THE REGRESSIONS

Equation	Descriptive Variable	Country	No. of Observations	Period
Eq. 1	POP	all	10	1961-1970
Eq. 2	CONS	Egypt	10	1961-1970
		Israel	10	1961-1970
		Syria	8	1961-1970
Eq. 3	INV	Egypt	9	1962-1970
		Israel	data unavailable	
		Syria	9	1962-1970
Eq. 4	DOM	Egypt	10	1961-1970
		Israel	7	1964-1970
		Syria	11	1960-1970
Eqns. 5,6	TIM, TEX	Egypt	10	1961-1970
		Israel	8	1963-1970
		Syria	10	1961-1970
Eq. 9	ΔDEFX	Egypt	8	1966-1973
		Israel	7	1966-1972
		Syria	7	1966-1972
Eq. 27	CONF	Egypt	8	1966-1973
		Israel	7	1966-1972
		Syria	7	1966-1972

obtain as many observation points as possible, especially for the later equations involving four (Eq. 9) or six (Eq. 27) independent predictor variables.

The more observations one could utilize meant the greater the degrees of freedom available in the statistical tests for significance. On the other hand, the economic equations with one or two independent variables tended to react well to the analysis with not more than 9 or ten observations. One effect that enters here with this type of an economic model is that using too long an observation period tends to incorporate early economic or political effects into the estimators which are no longer valid in descriptively representing a country's actual state.

B. THE REGRESSION

The Ordinary Least-Squares and Two-Stage Least-Square techniques were done using the computerized SNAP/IEDA Computing Package set up on the IBM 360 at the Naval Postgraduate School Computer Center.[1] An example of a SNAP/IEDA regression program used in this analysis is illustrated in Appendix II.

With the utilization of this package, it was fairly simple to perform both regression techniques in the same computer run. The OLS method was called first. The package is set up

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[1]Ref. 9. This package was originally developed by the Department of Statistics, Princeton University, July 1972.

to do a step-wise linear fit for the variables specified. By specifying a particular command, it was also possible to save the serial correlation coefficient (ρ). The printed output provides statistical information on the data which includes a correlation matrix for the dependent and independent variables, a table of coefficients for each independent variable, the square of the multiple correlation (R^2) between the dependent variable and those independent variables included in the regression at each step, the standard error of each coefficient, an F-ratio of the variance of the residual of the dependent variable before the present step and the variance of the residual of that variable after the present step.

With the desired statistical information obtained through the OLS procedure completed, the two-stage iteration followed. This estimation procedure is appropriately described by Kmenta[1] for estimating regression equations with autoregressive disturbances. He shows that the procedure is convergent with the values of the maximum likelihood estimators, and that these two-stage estimators have the same asymptotic properties as the MLE's.

One major factor which prevented the author from continuing beyond the two iterations was the relatively small sample size. At each iteration, there is a loss of one

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[1]Kmenta, Jan, pgs. 287-ff.

observation, and a corresponding loss of a degree of freedom. In experimentation described by Kmenta, in most cases concerning autoregressive disturbances where the sample size is in the order of ten, the OLS estimator is inefficient relative to the two-stage estimators. However, an observation noted by the author later in this analysis concerned the relative ineffectiveness of utilizing the two-stage procedure where four or five variables are involved in the regression equations resulting in less than 3-4 degrees of freedom.

The second iteration involved use of the arithmetic options of the SNAP/IEDA package. Once this was accomplished, the second regression was called in the same manner as before and similar statistical information for this regression was provided.[1] Possession of the results of both techniques enabled a comparative analysis to determine which estimator should be used in the forecasting program. The tables in Figure 7 list the results for both iterations. In each case, a close analytical examination of each estimator was performed.

The process involved following the regression at each step; examining the t-statistic and the F-ratio which determined which variable would enter the regression next, ... until the point was reached where entering any additional variable would be of no significance.

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[1]The sample SNAP/IEDA program in Appendix II summarizes the process very well.

FIGURE 7

EGYPT

	OLS		2SLS		
	t	R^2		t	R^2
Eq. 1:					
B_1 = 1.025	———	———	———	———	———
Eq. 2:					
B_2 = 1.249	———		B_2 = 2.003	———	
B_3 = 0.217	.89	.896	B_3 = 0.140	.98	.952
B_4 = 0.397	.83		B_4 = 0.421	1.5	
Eq. 3:					
B_5 = 0.839	———	.542	B_5 = 0.641	———	.540
B_6 = 0.384	2.9		B_6 = 0.324	2.7	
Eq. 4:					
B_7 = 5.381	———		B_7 = 8.859	———	
B_8 ———	———		———	———	
B_9 = 1.108	3.64	.839	B_9 = 1.160	1.88	.804
B_{10} = -0.353	3.68		B_{10} = -0.355	2.19	
Eq. 5:					
B_{11} = 3.199	———		B_{11} = 4.235	———	
B_{12} = 0.560	4.09	.713	B_{12} = 0.536	4.32	.760
B_{13} = -0.175	3.65		B_{13} = -0.179	4.26	
Eq. 6:					
B_{14} = 2.398	———		B_{14} = 3.687	———	
B_{15} = 0.403	3.63	.661	B_{15} = 0.455	5.69	.845
B_{16} = -0.126	3.23		B_{16} = -0.142	5.26	

ISRAEL

	OLS t	OLS R^2		2SLS t	2SLS R^2
<u>Eq. 1</u>:					
$B_1 = 1.029$	——	——	——	——	——
<u>Eq. 2</u>:					
$B_2 = 0.205$	——		$B_2 = .303$	——	
$B_3 = 0.093$	3.0	.989	$B_3 = .104$	3.7	.991
$B_4 = 0.843$	13.0		$B_4 = .809$	12.8	
<u>Eq. 3</u>:					
B_5	——	——		——	——
B_6	——	——		——	——
<u>Eq. 4</u>:					
$B_7 = -5.670$	——		$B_7 = -6.806$	——	
$B_8 = 0.0$	1.67	.968	$B_8 = 0.292$	4.86	1.00
$B_9 = 0.0$	1.88		$B_9 = -0.126$	15.75	
$B_{10} = 2.296$	——		$B_{10} = 2.402$	14.9	
<u>Eq. 5</u>:					
$B_{11} = -3.583$	——		$B_{11} = -4.397$	——	
$B_{12} = 0.316$	2.61	.925	$B_{12} = 0.343$	6.125	.977
$B_{13} = 1.566$	2.03		$B_{13} = 2.257$	5.35	
<u>Eq. 6</u>:					
$B_{14} = -3.279$	——		$B_{14} = -3.134$	——	
$B_{15} = 0.090$	1.3	.926	$B_{15} = 0.118$	3.03	.963
$B_{16} = 1.485$	3.35		$B_{16} = 1.741$	5.88	

SYRIA

	OLS			2SLS		
		t	R^2		t	R^2
<u>Eq. 1:</u>						
$B_1 = 1.034$		——	——	——	——	——
<u>Eq. 2:</u>						
$B_2 = 0.392$		——		$B_2 = 0.705$	——	
$B_3 = 0.231$		1.3	.614	$B_3 = 0.148$	1.0	.584
$B_4 = 0.348$		1.2		$B_4 = 0.323$	1.2	
<u>Eq. 3:</u>						
$B_5 = 0.196$		——	.043	$B_5 = 0.117$	——	.004
$B_6 = 0.109$		0.56		$B_6 = -0.023$	.15	
<u>Eq. 4:</u>						
$B_7 = -0.338$		——		$B_7 = -1.246$	——	
B_8		——	.554	——	——	.515
$B_9 = 0.449$		3.35		$B_9 = -0.654$	1.09	
B_{10}		——		$B_{10} = 0.467$	1.89	
<u>Eq. 5:</u>						
$B_{11} = -0.029$		——		$B_{11} = -0.057$	——	
$B_{12} = 0.267$		5.4	.791	$B_{12} = 0.274$	7.02	.874
B_{13}		——		——	——	
<u>Eq. 6:</u>						
$B_{14} = 0.356$		——		$B_{14} = 0.526$		
$B_{15} = 0.541$		3.98	.788	$B_{15} = 0.568$	3.8	.771
$B_{16} = -0.146$		2.7		$B_{16} = -0.162$	2.94	

EGYPT

	OLS				2SLS	
		t	R^2		t	R^2
<u>Eq. 9</u>:						
A_1	= -0.173	———		A_1 = -0.069	———	
A_2	———	———		———	———	
A_3	———	———		A_3 = -1.651	1.5	
A_4	= 0.079	1.29	0.619	A_4 = 0.060	1.9	.933
A_5	= -0.080	1.17		———	———	
A_6		———		———	———	
A_7	= 0.003	0.75		A_7 = 0.006	2.0	
<u>Eq. 27</u>:						
A_{47}	= 2.008	———		A_{47} = 4.352	———	
A_{48}		———		———	———	
A_{49}	= -2.669	.944	.339	———	———	.611
A_{50}		———		A_{50} = -26.425	1.5	
A_{51}	= 0.050	1.56		A_{51} = 0.049	1.63	

ISRAEL

	OLS			2SLS	
		t	R^2		t	R^2
Eq. 9:					
A_1 = -0.414	——		A_1 = -2.554	——	
A_2 = 0.333	1.74		A_2 = 5.770	2.57	
A_3	——		——	——	
A_4 = 0.109	4.04	0.933	A_4 = 0.480	3.22	.99
A_5	——		A_5 = -0.02	2.5	
A_6	——		——	——	
A_7 = 0.022	3.67		A_7 = .028	7	
Eq. 27:					
A_{47} = 0.985	——		A_{47} = 3.061	——	
A_{48} = 0.779	1.4		A_{48} = 0.527	2.01	
A_{49} = -3.012	0.878	.342	——	——	.642
A_{50}	——		A_{50} = -7.326	1.79	
A_{51}	——		——	——	

SYRIA

	OLS t	OLS R^2	2SLS	2SLS t	2SLS R^2
<u>Eq. 9</u>:					
A_1 = -0.136	——		A_1 = - .297	——	
A_2	——		——	——	
A_3	——		——	——	
A_4 = -0.035	2.33	0.982	——	5.8	.996
A_5	——		——	——	
A_6 = 0.908	4.96		A_6 = 1.105	7.17	
A_7 = 0.042	10.5		A_7 = 0.038	21.5	
<u>Eq. 27</u>:					
A_{47} = 2.724	——		A_{47}= 3.867	——	
A_{48}	0.89		A_{48}= -0.259	.5	
A_{49}	——	.436	——	——	.360
A_{50} = -8.098	1.62		A_{50}= -8.169	1.25	
A_{51}	——		——	——	

The appropriate t-statistic here was $t = \frac{\hat{B}}{S.E._{\hat{B}}}$, which has a t-distribution with (n-k) degrees of freedom; k = number of independent variables + 1, since k+1 degrees of freedom got "used up" for calculating the coefficients.[1] The t-statistic generally held up to be around 2.0. Anything below 1.7 or 1.8 was considered to mean the variable was of no significance, and the variable was not brought into the equation. In each regression, the estimator showing the greatest statistical bases was used, regardless of the method employed to obtain the coefficient. The final selected estimators are listed in the table in Figure 8. The coefficients for Equation 27 (A_{47} through A_{51}) have been renumbered A_8 through A_{12} for convenience.

In the sample illustration for Equation 4 shown in Appendix II, the OLS method statistically should terminate with step 1. The F-ratio on step 2 drops below 4.0, which is equivalent to a t-statistic of 2.0, which were used as minimum acceptable levels. At step 1, $t = \frac{\hat{B}}{S.E._{\hat{B}}} = 3.35$. At step 2, the t-statistics dropped well below 2, meaning only variable X_3 (GDP_{t-1} in this case) is of significance, while the remaining independent variables should not be included.

The two-stage method entered variable X_4 (POP_t) in step 1, then GDP_{t-1} was brought in on step 2. However, the F-ratio

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[1]Kmenta, Jan, pgs. 225-236.

on step 1 was 6.2 as compared to 11.2 in the previous iteration, giving significantly lower t-statistics for the estimator of GDP (B_{10}).

Aside from the above, it somehow does not make sense that the annual Domestic Government Expenditure (DOM) should depend on population (which increased only slightly in comparison to the change in the GDP) before it is affected by the previous years GDP. This is a problem that possibly becomes greater as the number of independent variables increase, and the observations decrease.

The third step of the second iteration showed that including the third variable threw everything out of skelter, aside from the fact that the F-ratios were well below the minimum acceptable.

The argument brought forth in discussing the nonsensical results of the two-stage iteration for DOM above point out the acceptance of common sense in determining the correct estimators to be used. Because of the limited sample sizes, and because of the peculiar characteristics the data tended to display, one often needed to ask the question if the results were reasonable. However, there is the possibility one can carry this too far, lest he revert to a wholly intuitive scheme. For basic soundness in utilizing the model, one must work with the statistics as much as possible.

FIGURE 8

	Egypt	Israel	Syria
B_1	1.025	1.029	1.034
B_2	2.003	0.303	0.392
B_3	0.140	0.104	0.231
B_4	0.421	0.809	0.348
B_5	0.839	-----	0.196
B_6	0.384	-----	-----
B_7	5.381	-6.806	-0.338
B_8	0.0	0.292	0.0
B_9	1.108	0.126	0.449
B_{10}	-0.353	2.402	0.0
B_{11}	4.235	-4.397	-0.057
B_{12}	0.536	0.343	0.274
B_{13}	-0.179	2.257	-----
B_{14}	3.687	-3.134	0.526
B_{15}	0.455	0.118	0.568
B_{16}	-0.142	1.741	-0.162
A_1	-0.069	-0.414	-0.297
A_2	-----	0.333	0.0
A_3	-1.651	-----	0.0
A_4	0.060	0.109	0.0
A_5	-----	-----	0.0
A_6	-----	-----	1.105
A_7	0.006	0.022	0.038
A_8	4.352	3.061	2.724
A_9	-----	0.527	0.0
A_{10}	-----	-----	0.0
A_{11}	-26.425	-7.326	-8.098
A_{12}	0.049	-----	0.0

VI. THE FORECASTING SIMULATION

A. THE MAIN FORECASTING PROGRAM

The main forecasting program is included in Appendix II. It is basically the same as CACI's forecasting model with some modifications made for simplification. Much of the same terminology and documentation has been retained in order to ease the familiarization for those who may have worked with the original program.

The estimated coefficients are read in first, followed by the required data. In most cases only the 1970 data is required, except for descriptors such as GDP and POP where the previous two or three years information is also needed.

The iterations are then run for each year commencing with 1971 and in this case ending in 1984. One noteworthy point in the solution of the current year descriptors is the simultaneous solution of the equations comprising Bloc 2. These descriptors — $CONS_t$, TIM_t, and TEX_t — depend on the current value of GDP_t; and GDP_t in turn depends on them. A simultaneous solution of Equations 2, 5, 6, 7, 9, and 10 is effected using local variables. Basically, this arithmetic operation is carried out as follows:

Eq. 2 $$CONS_t = B_2 + B_3*GDP_t + B_4*CONS_{t-1}$$

$$\text{let } B_2 + B_4*CONS_{t-1} = CX$$

Eq. 5 $TIM_t = B_{11} + B_{12}*GDP_t + B_{13}*POP_t$

let $B_{11} + B_{13}*POP_t = TI$

Eq. 6 $TEX_t = B_{14} + B_{15}*GDP_t + B_{16}*POP_t$

let $B_{14} + B_{16}*POP_t = TX$

Eq. 7 $GDP_t = CONS_t + INV_t + DOM_t + DEFX_t + TEX_t - TIM_t$

The following descriptor variables are not dependent on the current value of GDP_t, hence they can be found and

let $DOM_t = DX$

let $\Delta DEFX_t = CFX$

let $DEFX_t = DEFX_{t-1} + CFX$

Substitution in Eq. 7 results in:

$$GDP_t = CX + B_3*GDP_t + INV_t + DX + FX + TX + B_{15}*GDP_t - TI - B_{12}*GDP_t$$

thus,

$$GDP_t - B_3*GDP_t - B_{15}*GDP_t + B_{12}*GDP_t = CX + INV_t + DX + FX + TX - TI$$

or,

$$GDP_t(1.0 - B_3 - B_{15} + B_{12}) = CONST$$

$$\text{let } B_3 + B_{15} + B_{12} = ALPHA$$

hence, the solution,

$$GDP_t = CONST/(1.0 - ALPHA)$$

This value for GDP_t is then used to determine the current values for CONS, TIM, and TEX. All values are updated for each year, and the forecast values are obtained for the period 1971 - 1984.

Several of the forecasted descriptors have been graphed on the following pages. Since GDP is basic to the other variables, i.e., each variables behavior depends heavily on these, it can be seen that most of the economic variables will follow the pattern set by GDP.

There is not much conclusive evidence that the model will be effective in all, or even in most, cases. Israel tends to exhibit reasonable forecast information, however the predictions for Egypt and Syria exhibit questionable predictive capabilities for the model.

The actual observations shown do not exhibit such radical downward trends as is forecast for both Egypt and Syria GDP. This leads the author to suspect the presence of

unstable parameters involved in the computational process which may cause such unlikely, or meaningless results.

One possibility for this radical behavior of the model may lie in the relationship predicting GDP_t. If one considers ALPHA in the term CONST/(1.0 - ALPHA), and run a comparison for the three countries, the following arises:

Country	ALPHA	1.0 - ALPHA
Egypt	0.059	0.941
Israel	- 0.121	1.121
Syria	0.524	0.476

Israel is the only country with a negative ALPHA term, thus producing a denominator value greater than one.

However, if this was the critical point in the arithmetic operation, a denominator greater than one would tend to drive GDP down, not up as is forecast. By the same argument, the GDP for Egypt and Syria would be driven higher instead of falling off as they do.

This led the author to consider that the problem must lie in CONST. This term is composed of previous year values, values found outside the simultaneous operation, and estimated coefficients. Again one is led back to the question of accuracy in the estimators derived from the data.

When the author explored the regression results to determine the correct coefficients to be used, in several instances he questioned the validity and logic of some estimators that

exhibited negative values. Structurally, there is no way to disprove these with the manner in which the statistical tests were imposed on the data analyzed. One has to surmise that this is an effect due to multicollinearity, which in essence can cause invalid estimators. This difficulty is discussed in the Summary which follows.

Perhaps it is possible to overcome this problem with a simultaneous multi-equation 2SLS type of solution mentioned earlier. However, at this time there is no method know to the author to solve this difficulty with the techniques used in this thesis.

B. SUMMARY

The concluding analysis causes one to have some skepticism with regard to this model. It is apparent from the correlation tables obtained with the SNAP/IEDA package that there is a very high degree of multicollinearity between the independent variables. As shown in the example program in Appendix II, GDP and POP have a correlation of .95, meaning that in the (X'X) matrix one column is close to being a linear combination of another remaining column.[1] This means that the variances and covariances of the estimated regression coefficients are large. A higher degree of multicollinearity is harmful in the sense that the estimates of the regression coefficients are highly imprecise.

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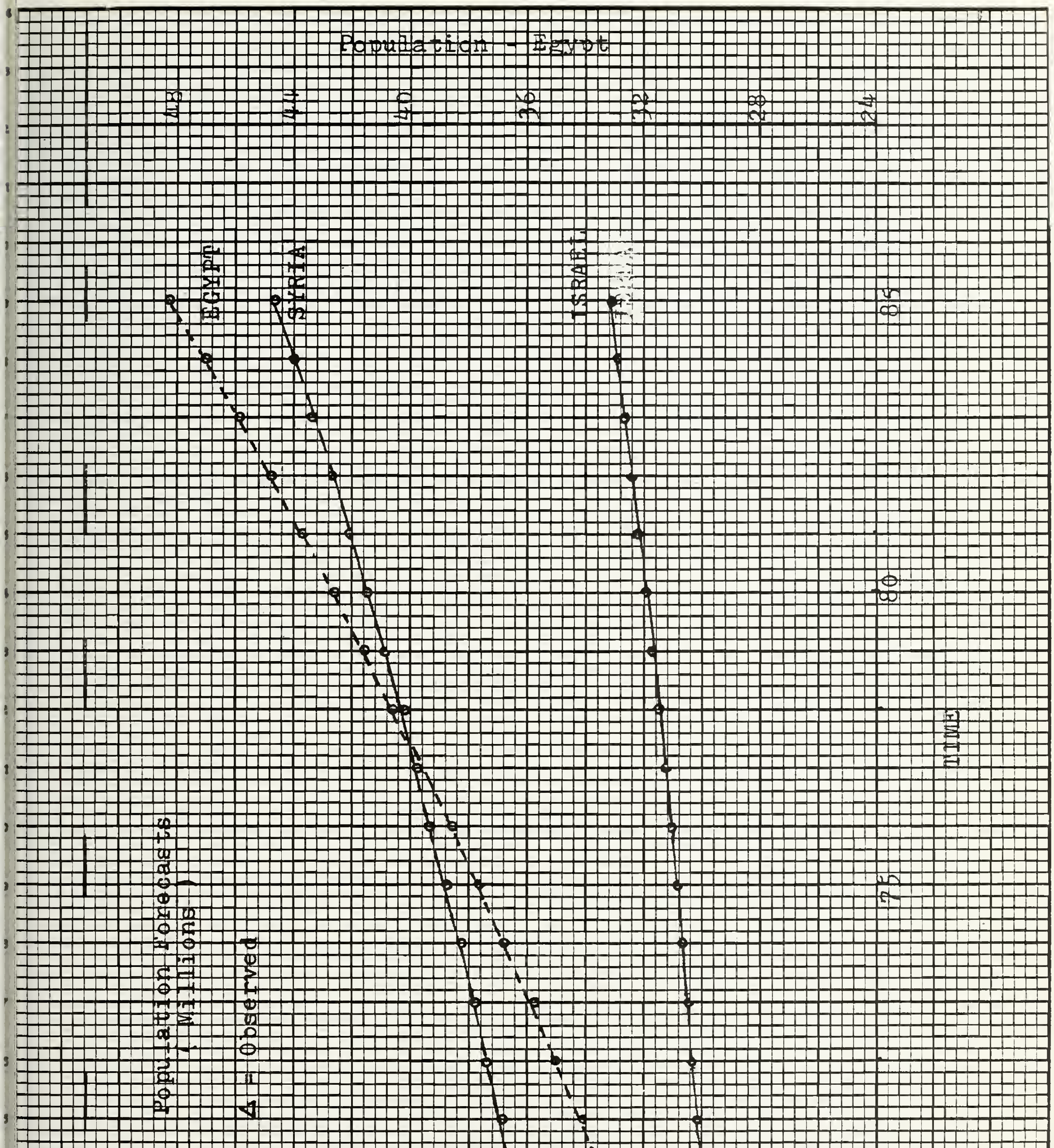
[1] Kmenta, Jan, pp. 388-389.

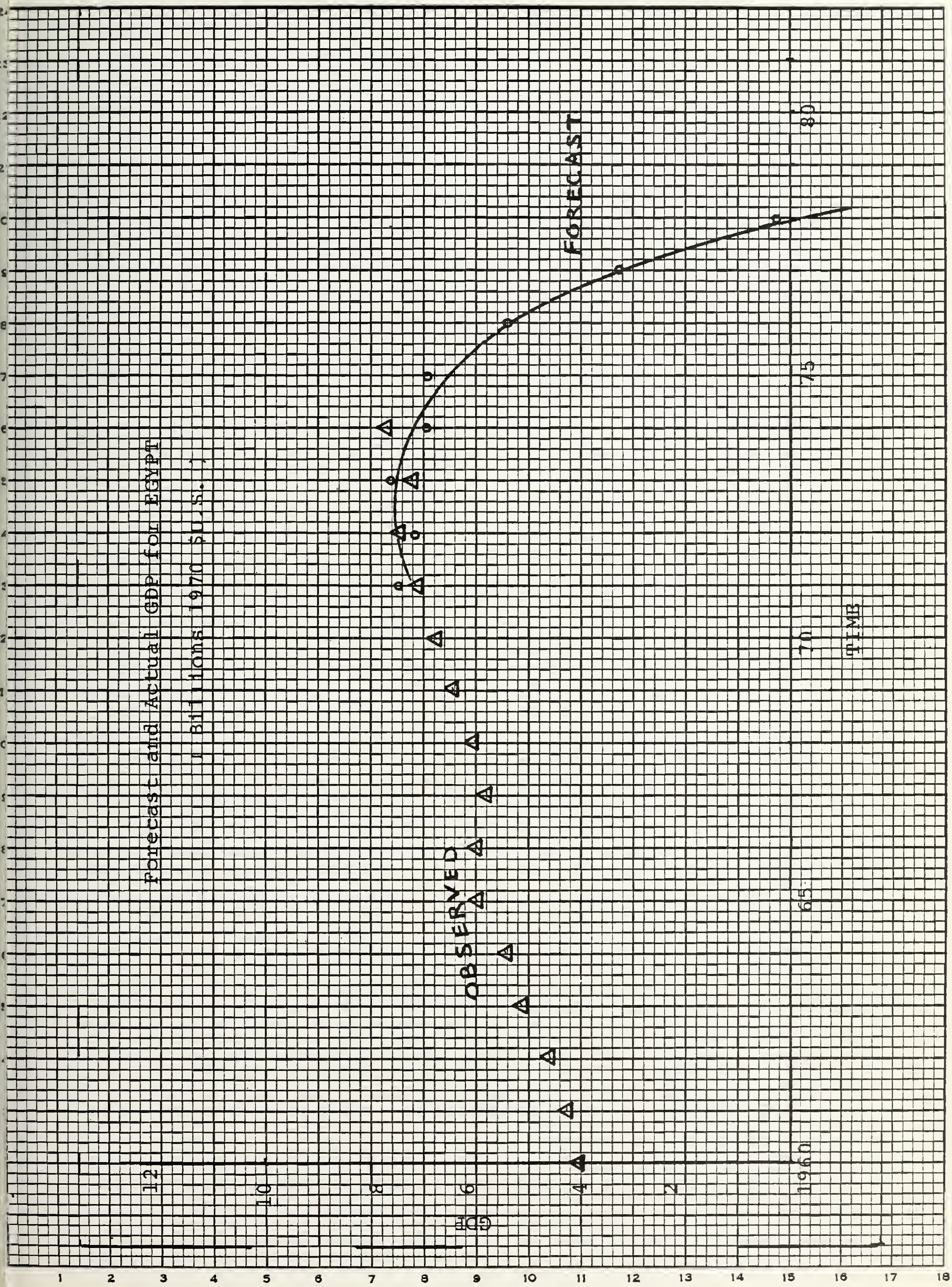
In regard to this example, this means that DOM_t can be a function of GDP_t or POP_t, but when both are included in the equation, in reality the descriptive relationship no longer holds, even though statistically one may be able to show both variables belong. The author feels this is the major difficulty with this model.

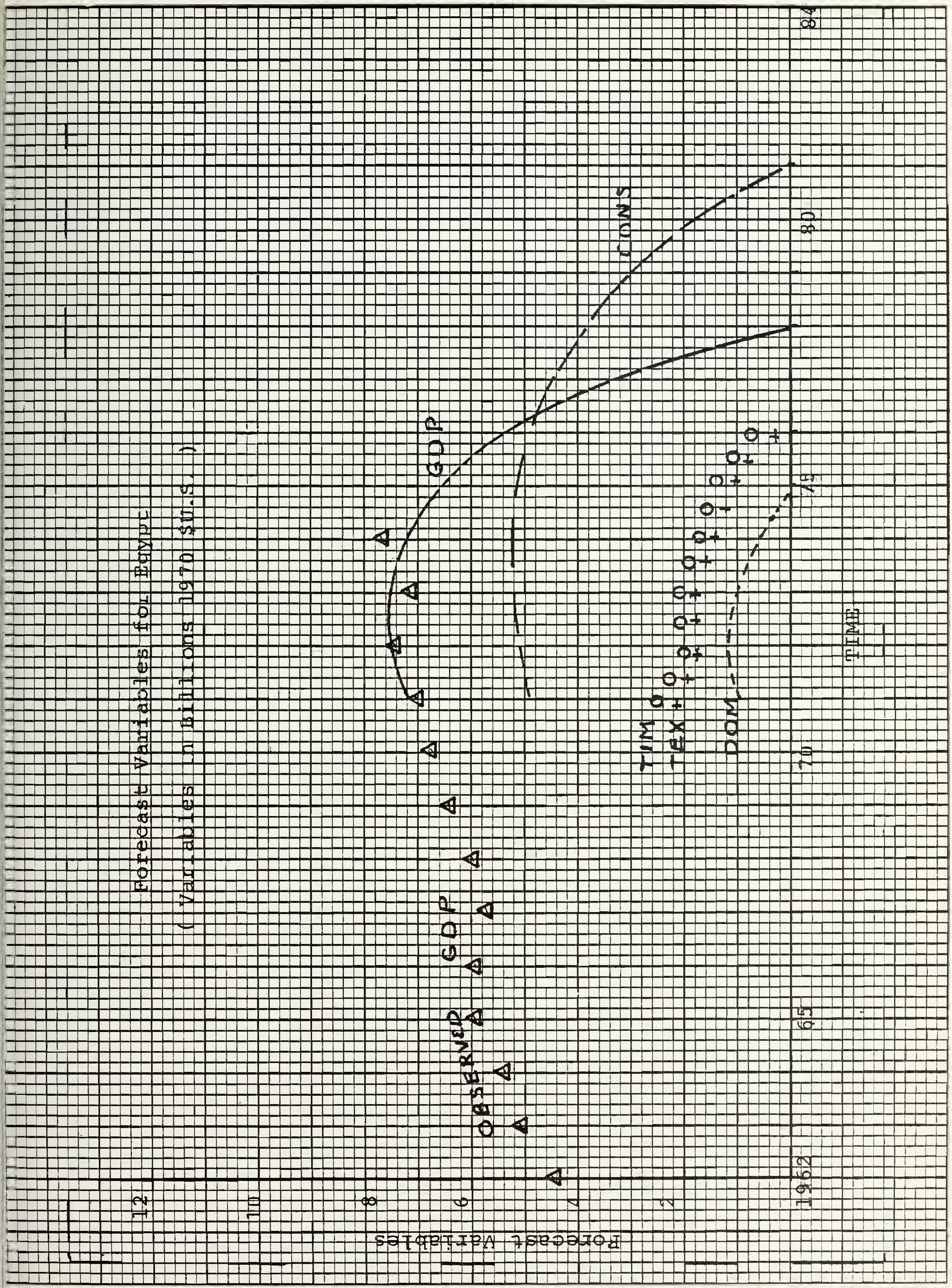
Many of the peculiarities encountered can be traced to the data itself. It is very important to have accurate data. It may be worthwhile to retrace the work done here and restructure the data base for a 1962-1975 time period. With many recent standardized accounting procedures imposed on the various nations by the United Nations, the International Monetary Fund, SIPRI, and other organizations, more reliable data is now available and the above mentioned time frame would provide an adequate number of observations.

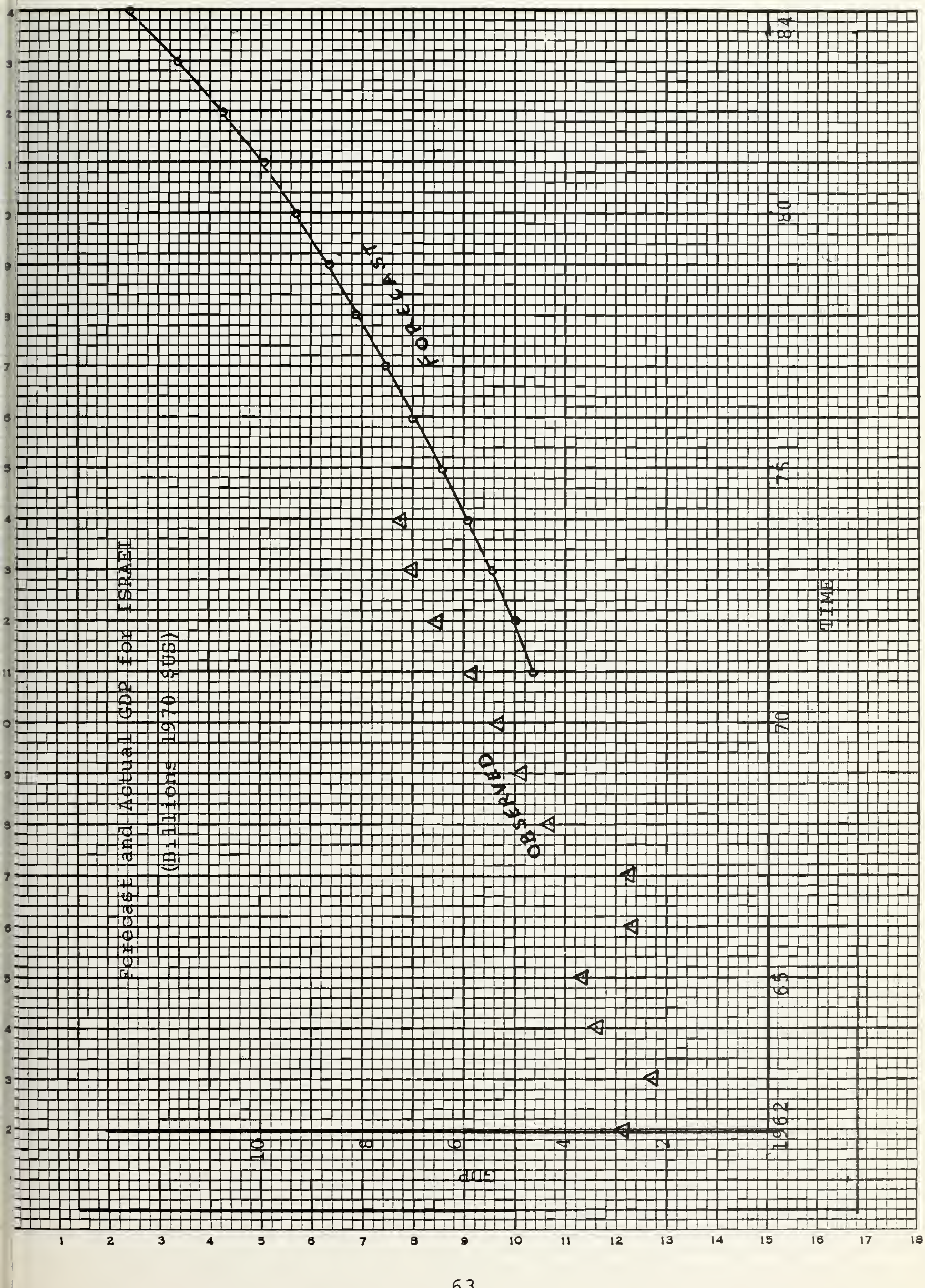
With new data, one may find differences in the coefficients, thus also incorporating the effects of recent policy changes in the various countries and possibly providing more reliable forecasts. One can also run simulations for other nations previously lacking sufficient data.

It is strongly felt that one has to be very careful in employing a model of this type. For the reasons discussed with regard to multicollinearity, data reliability, and a possible unstable arithmetic operator, it would be wise to proceed with caution.


Population - Egypt
48
44
40
36
32
28
24
EGYPT
SYRIA
ISRAEL
85
80
75
70
1968
TIME
Population Forecasts
(Millions)
Δ = Observed
12
10
8
6
4
2
Population - Israel, Syria


Forecast and Actual GDP for EGYPT
(Billions 1970 $U.S.)
OBSERVED
FORECAST
GDP
TIME
12
10
8
6
4
2
1960
65
70
75
80


Forecast Variables for Egypt
(Variables in Billions 1970 $U.S.)
GDP
CONS
OBSERVED GDP
TIM
TEX
DOM
TIME
Forecast Variables
1962
65
70
75
80
84
2
4
6
8
10
12


Forecast and Actual GDP for ISRAEL
(Billions 1970 $US)
FORECAST
OBSERVED
TIME
GDP
1962
65
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84
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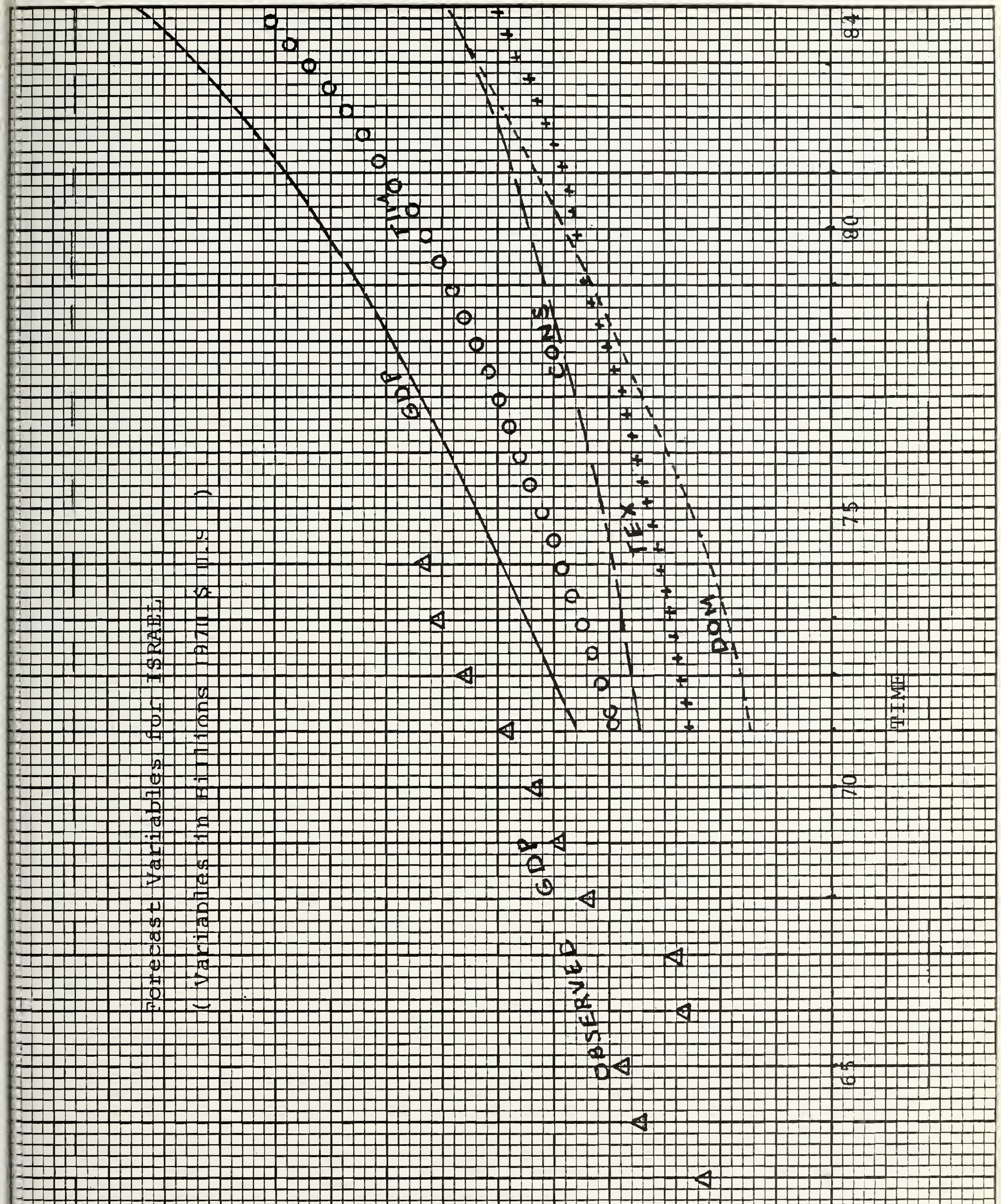
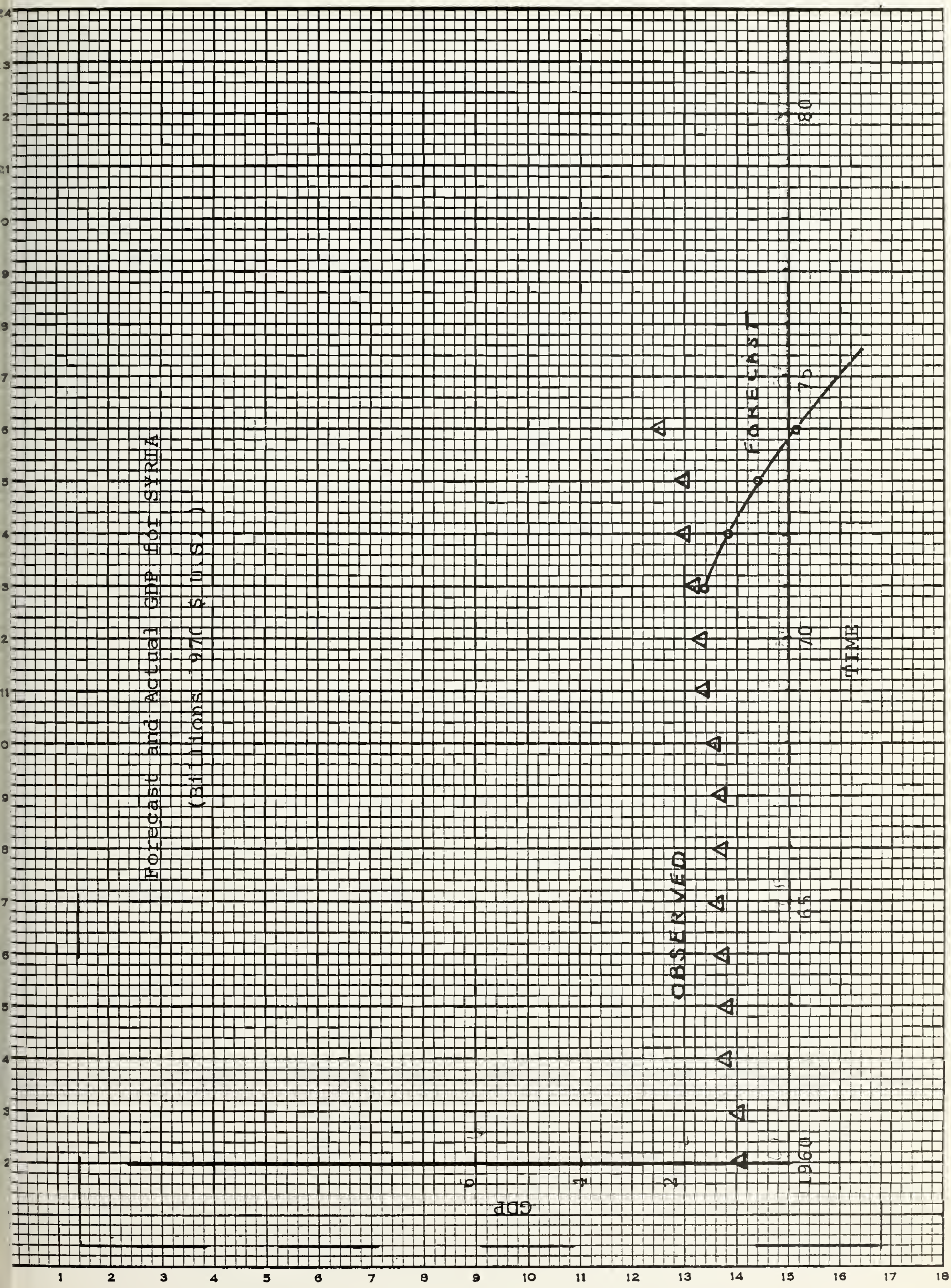
6
4
2


Forecast Variables for ISRAEL
(Variables in Billions 1970 $ U.S.)
Forecast Variables
TIME
GDP
CONS
TEX
DOM
OBSERVED
GDP
1962
65
70
75
80
84
12
10
8
6
4
2


Forecast and Actual GDP for SYRIA
(Billions 1970 $ U.S.)
OBSERVED
FORECAST
TIME
1960
65
70
75
80
GDP
2
4
6

APPENDIX I

TABLE 1: MODEL STRUCTURE

1. $POP_t = B_1 * POP_{t-1}$

2. $CONS_t = B_2 + B_3 * GDP_t + B_4 * CONS_{t-1}$

3. $INV_t = B_5 + B_6 * (GDP_{t-1} - GDP_{t-2})$

4. $DOM_t = B_7 + B_8 * DOM_{t-1} + B_9 * GDP_{t-1} + B_{10} * POP_t$

5. $TIM_t = B_{11} + B_{12} * GDP_t + B_{13} * POP_t$

6. $TEX_t = B_{14} + B_{15} * GDP_t + B_{16} * POP_t$

7. $GDP_t = CONS_t + INV_t + DOM_t + DEFX_t + TEX_t - TIM_t$

8. $MILA_t = USM_t + SUM_t$

9. $\Delta DEFX_t = A_1 + A_2 * \Delta RIVDEX_{t-1} + A_3 * (DEFX_{t-1}/GDP_{t-2})$

$$+ A_4 * CONF_{t-1} + A_5 * (GDP_{t-1} - GDP_{t-2})/(POP_{t-1} - POP_{t-2})$$

$$+ A_6 * \frac{\sum_{i=1}^{5} MILA_{t-i}}{5} + A_7 * COOP_{t-1}$$

10. $DEFX_t = DEFX_{t-1} + \Delta DEFX_t$

11. $TRADEUS_t = (A_7 + A_{12}) + (A_8 + A_{13}) * GDP_t$

$+ (A_9 + A_{14}) * POP_t + (A_{10} + A_{15}) * USGDP_t$

$+ (A_{11} + A_{16}) * VOT\theta_{t-1}$

12. $TRADESU_t = (A_{17} + A_{55}) + (A_{18} + A_{56}) * GDP_t$

$+ (A_{52} + A_{57}) * POP_t + (A_{53} + A_{58}) * SUGDP_t$

$+ (A_{52} + A_{59}) * VOT\theta_{t-1}$

13. $$TRADR_t = \sqrt{\left(\frac{TRADESU_t}{TRADESU_t + TRADEUS_t}\right)^2 + \left(\frac{TRADEUS_t}{TRADESU_t + TRADEUS_t}\right)^2}$$

14. $$TRAD\theta_t = \left(\frac{TRADESU_t}{TRADESU_t + TRADEUS_t}\right) \Big/ TRADR_t$$

15. $\Delta MILM_t = A_{19} + A_{20} * CONF_{t-1} + A_{21} * DEFX_t$

$$+ A_{22} * \left(\frac{\sum_{i=1}^{5} MILA_{t-i}}{5}\right)$$

16. $MILM_t = MILM_{t-1} + \Delta MILM_t$

17. $$ARMR_t = \sqrt{\left(\frac{SUT_t}{SUT_t + UST_t}\right)^2 \left(\frac{UST_t}{SUT_t + UST_t}\right)^2}$$

18. $$ARM\theta_t = \left(\frac{SUT_t}{SUT_t + UST_t}\right) \Big/ ARMR_t$$

19. $RELAID_t = (USA_t + USM_t) / (SUA_t + SUM_t + 1.0)$

20. $$VOT\theta_t = A_{23} + A_{24} * ARM\theta_t + A_{25} * GOVT_t + A_{26} * TRAD\theta_t + A_{27} * RELAID_t$$

21. $$VOTR_t = A_{28} + A_{29} * TRADR_t + A_{30} * GOVT_t + A_{31} * [(GDP_t - GDP_{t-1}) / (POP_t - POP_{t-1})] + A_{34} * \left(\frac{\sum_{i=1}^{5} MILA_{t-i}}{5}\right)$$

22. $ALIGNR_t = (TRADR_t + VOTR_t) / 2.0$

23. $ALINS_t = |TRAD\theta_t - VOT\theta_t|$

24. $$TML_t = A_{35} + A_{36} * TML_{t-1} + A_{37} * \left(\frac{\sum_{i=1}^{5} COUP_{t-i}}{5} \right)$$

$$+ A_{38} * STRAIN_t + A_{39} * MILM_t + A_{40} * (DEFX_t / GDP_t)$$

$$+ A_{41} * \left(\frac{\sum_{i=1}^{5} MILA_{t-i}}{5} \right)$$

25. $$COUP_t = A_{42} + A_{43} * \left(\frac{\sum_{i=1}^{5} COUP_{t-i}}{5} \right) + A_{44} * TML_t$$

$$+ A_{45} * \left(\frac{\sum_{i=1}^{5} MILA_{t-i}}{5} \right) + A_{46} * \left(\frac{GDP_t - GDP_{t-4}}{POP_t - POP_{t-4}} \right)$$

26. $$COOP_t = USC_t + SUC_t$$

27. $$CONF_t = A_{47} + A_{48} * CONF_{t-1} + A_{49} * \Delta DEFX_t$$

$$+ A_{50} * (DEFX_t / GDP_t) + A_{51} * COOP_t$$

28. $$TR_t = (DEFX_t / \overline{DEFX}_t) * 100.0$$

TABLE 2

MODEL VARIABLES

Variable Name	Variable
ALINS	Alignment Instability
ALIGNR	Average Alignment Intensity
ARMΘ	Arms Alignment Direction
ARMR	Arms Alignment Intensity
CONF	International Conflict
CONS	Consumption Expenditures
COOP	Cooperative Behavior from U.S. and USSR
COUP	Propensity for Coups
DEFX	Defense Expenditures
DOM	Domestic Government Expenditures
ΔDEFX	Yearly Change in Defense Expenditures
ΔMILM	Yearly Change in Military Manpower Levels
ΔRIVDEX	Yearly Change in Rival's Defense Expenditures
GDP	Gross Domestic Product
GOVT	Government Type
INV	Investment Expenditures
MILA	Military Aid from U.S. and USSR
MILM	Military Manpower Levels
POP	Population
RELAID	Aid from U.S. Relative to Aid from USSR
RIVDEX	Rival's Defense Expenditures
STRAIN	Domestic Strain
SUA	Economic Aid from USSR
SUT	Arms Purchases from USSR
SUM	Military Aid from USSR
SUC	Cooperative Behavior from USSR
SUGDP	USSR Gross Domestic Product
TML	Turmoil Behavior
TR	Tension Ratio
TEX	Total Exports
TIM	Total Imports
TRADEΘ	Trade Alignment Direction
TRADR	Trade Alignment Intensity
TRADEUS	Trade with U.S.
TRADESU	Trade with USSR
USA	Economic Aid from U.S.
UST	Arms Purchases from U.S.
USM	Military Aid from U.S.
USC	Cooperative Behavior from U.S.
USGDP	U.S. Gross Domestic Product
VOTΘ	Voting Alignment Direction
VOTR	Voting Alignment Intensity

TABLE 3

LESSER DEVELOPED COUNTRIES

MIDDLE EAST

Data Selection Restricted to:

	Country	WEIS File Number
1.	EGYPT (UAR)	651
2.	IRAN	630
3.	IRAQ	645
4.	ISRAEL	666
5.	JORDAN	663
6.	LEBANON	660
7.	LIBYA	620
8.	MOROCCO	600
9.	SAUDI ARABIA	670
10.	SYRIA	652

TABLE 4

FINAL MODEL STRUCTURE

1. $POP_t = B_1 * POP_{t-1}$

2. $CONS_t = B_2 + B_3 * GDP_t + B_4 * CONS_{t-1}$

3. $INV_t = B_5 + B_6 * (GDP_{t-1} - GDP_{t-2})$

4. $DOM_t = B_7 + B_8 * DOM_{t-1} + B_9 * GDP_{t-1} + B_{10} * POP_t$

5. $TIM_t = B_{11} + B_{12} * GDP_t + B_{13} * POP_t$

6. $TEX_t = B_{14} + B_{15} * GDP_t + B_{16} * POP_t$

7. $GDP_t = CONS_t + INV_t + DOM_t + DEFX_t + TEX_t - TIM_t$

8. $MILA_t = USM_t + SUM_t$

9. $\Delta DEFX_t = A_1 + A_2 * \Delta RIVDEX_{t-1} + A_3 * (DEFX_{t-1}/GDP_{t-2})$

$$+ A_4 * CONF_{t-1} + A_5 * (GDP_{t-1} - GDP_{t-2})/(POP_{t-1} - POP_{t-2})$$

$$+ A_6 * \left(\frac{\sum_{i=1}^{5} MILA_{t-i}}{5} \right) + A_7 * COOP_{t-1}$$

10. $DEFX_t = DEFX_{t-1} + \Delta DEFX_t$

26. $COOP_t = USC_t + SUC_t$

27. $CONF_t = A_{47} + A_{48} * CONF_{t-1} + A_{49} * \Delta DEFX_t$

$$+ A_{50} * (DEFX_t/GDP_t) + A_{51} * COOP_t$$

TABLE 5

DATA SOURCES

Variable	Years	Sources
1. Population	1960-1975	International Monetary Fund Statistical Publication, May, 1976
2. Consumption Expend. (CONS)	1960-1974	"
3. Investment Expend. (INV)	1960-1974	"
4. Domestic Govt. Expend. (DOM)	1960-1974	DOM = Total Govt. Expend. - Defense Expend.
a. Total Govt. Expend.	1960-1973	UN Yearbook of National Accounts Statistics
b. Defense Expend. (DEFX)	1960-1973	"
5. Total Imports (TIM)	1960-1974	IMF Statistical Pubs (Data unavailable for Iran, incomplete for others)
6. Total Exports (TEX)	1960-1974	"
7. Gross Domestic Prod. (GDP)	1960-1974	IMF Statistical Pub.

*Note: INV_t = Gross Fixed Capital Formation + Increase in Inventory Stockpiles.
Both values found in IMF Publication.

9. Military Aid From US. (USM)	1966-1975	U.S. Overseas Loans and Grants AID Publication
10. Mil. Aid from USSR (SUM)	1971-1975	Foreign Mil. Assistance, DIA Classified Pub. April 1976
11. Cooperative Behaviour from U.S. & USSR (COOP)	1966-1975	WEIS Files
12. International Conflict (CONF)	1966-1975	"

APPENDIX II

TABLE I

CCUNTRIES = :

ALGERIA, EGYPT, IRAN, IRAQ, ISRAEL , JORDAN, KUWAIT, LEBANON, LIBYA, MOROCCO, SAUDI ARABIA, SYRIA

POPULATION IS FOR YEARS 1951 – 1970, IN MILLIONS

8.93	20.94	16.67	5.34	1.52	1.32	0.16	1.67	1.04	9.11	4.97	3.58
9.13	21.44	17.13	5.48	1.61	1.34	0.17	1.71	1.05	9.34	5.07	3.67
9.37	21.94	17.65	5.64	1.65	1.36	0.18	1.76	1.07	9.57	5.17	3.76
9.44	22.56	18.22	5.79	1.69	1.39	0.19	1.80	1.09	9.84	5.27	3.86
9.68	22.99	18.72	5.96	1.75	1.44	0.20	1.85	1.13	10.11	5.38	3.97
9.90	23.53	19.26	6.13	1.83	1.48	0.21	1.90	1.17	10.40	5.49	4.08
10.13	24.09	19.80	6.30	1.94	1.53	0.22	1.95	1.21	10.69	5.60	4.19
10.35	24.66	20.35	6.49	2.00	1.58	0.24	2.00	1.26	10.99	5.72	4.31
10.58	25.24	20.93	6.68	2.06	1.63	0.25	2.01	1.30	11.35	5.85	4.43
10.80	25.92	21.52	6.89	2.11	1.67	0.28	2.03	1.35	11.64	5.98	4.56
11.03	26.58	22.13	7.10	2.18	1.70	0.32	2.05	1.40	11.97	6.12	4.69
10.92	27.26	22.77	7.32	2.29	1.76	0.35	2.07	1.45	12.25	6.26	4.84
11.21	27.95	23.43	7.55	2.38	1.82	0.39	2.10	1.50	12.50	6.42	4.99
11.68	28.66	24.08	7.80	2.48	1.87	0.43	2.13	1.56	12.73	6.58	5.12
11.92	29.39	24.81	8.05	2.56	1.91	0.48	2.15	1.62	13.02	6.75	5.33
12.66	30.14	25.54	8.31	2.63	1.97	0.52	2.21	1.69	13.37	6.93	5.50
13.08	30.91	26.30	8.58	2.67	2.04	0.57	2.27	1.76	13.70	7.12	5.68
13.50	31.69	27.08	8.86	2.74	2.10	0.63	2.34	1.84	14.07	7.32	5.87
13.91	32.50	27.89	9.15	2.82	2.19	0.69	2.40	1.91	14.46	7.52	6.05
14.33	33.33	28.66	9.44	2.91	2.30	0.75	2.47	1.99	14.86	7.74	6.26

BETA FOR COUNTRIES ARE:

1.035	1.025	1.029	1.033	1.029	1.034	1.098	1.030	1.037	1.029	1.028	1.034

FORECAST POPULATIONS 1971 – 1995

14.83	34.16	29.49	9.75	2.99	2.38	0.82	2.54	2.06	15.29	7.96	6.47
15.35	35.02	30.35	10.07	3.08	2.46	0.90	2.62	2.14	15.73	8.18	6.69
15.89	35.89	31.23	10.41	3.17	2.54	0.99	2.70	2.22	16.19	8.41	6.92
16.44	36.79	32.13	10.75	3.26	2.63	1.09	2.78	2.30	16.66	8.64	7.16
17.02	37.71	33.06	11.10	3.36	2.72	1.20	2.86	2.39	17.14	8.89	7.40
17.62	38.65	34.02	11.47	3.45	2.81	1.31	2.95	2.47	17.64	9.13	7.65
18.23	39.62	35.01	11.85	3.55	2.91	1.44	3.04	2.57	18.15	9.39	7.91
18.87	40.61	36.02	12.24	3.66	3.01	1.58	3.13	2.66	18.68	9.65	8.18
19.53	41.62	37.07	12.64	3.76	3.11	1.74	3.22	2.76	19.22	9.92	8.46
20.21	42.67	38.14	13.06	3.87	3.21	1.91	3.32	2.86	19.78	10.20	8.75
20.92	43.73	39.25	13.49	3.99	3.32	2.10	3.42	2.97	20.35	10.49	9.04
21.65	44.83	40.39	13.94	4.10	3.44	2.30	3.52	3.08	20.94	10.78	9.35
22.41	45.95	41.56	14.40	4.22	3.55	2.53	3.63	3.19	21.55	11.08	9.67
23.20	47.09	42.77	14.87	4.34	3.67	2.78	3.74	3.31	22.17	11.39	10.00
24.01	48.27	44.01	15.36	4.47	3.80	3.05	3.85	3.43	22.82	11.71	10.34
24.85	49.48	45.28	15.87	4.60	3.93	3.35	3.96	3.56	23.48	12.04	10.69
25.72	50.72	46.59	16.39	4.73	4.06	3.68	4.08	3.69	24.16	12.38	11.05
26.62	51.98	47.95	16.93	4.87	4.20	4.04	4.21	3.83	24.86	12.72	11.43
27.55	53.28	49.34	17.49	5.01	4.34	4.43	4.33	3.97	25.58	13.08	11.82
28.51	54.62	50.77	18.07	5.15	4.49	4.87	4.46	4.12	26.32	13.45	12.22
29.51	55.98	52.24	18.67	5.30	4.64	5.34	4.59	4.27	27.09	13.82	12.63
30.54	57.38	53.75	19.28	5.46	4.80	5.87	4.73	4.43	27.87	14.21	13.06
31.61	58.81	55.31	19.92	5.62	4.96	6.44	4.87	4.59	28.68	14.61	13.51
32.72	60.28	56.92	20.58	5.78	5.13	7.07	5.02	4.76	29.51	15.02	13.97
33.87	61.79	58.57	21.26	5.95	5.31	7.76	5.17	4.94	30.37	15.44	14.44

TABLE 2

Gross Domestic Product - 1970 U.S. $ (Billions)

(GDP_t)

Year	Algeria	Egypt	Iran	Iraq	Israel	Jordan
1959	WPI or CPI not available		4.544	1.848	2.207	
1960		4.215	4.833	1.876	1.700	
1961		4.340	4.987	2.056	2.610	
1962		4.614	5.304	2.353	2.867	
1963		5.159	5.655	2.240	2.291	
1964		5.560	6.139	2.597	3.481	
1965		6.040	6.892	2.934	3.797	
1966		6.058	7.584	3.193	2.735	
1967		5.840	8.469	2.999	2.806	.626
1968		6.118	9.486	3.573	4.398	.603
1969		6.540	10.445	3.641	4.965	.657
1970		6.833	11.671	3.605	5.409	.588
1971		7.220	13.093	3.905	5.956	.560
1972		7.562	19.437		6.673	.619
1973		7.250	22.190		7.104	.593
1974		6.799	17.847		7.452	.628

Gross Domestic Product (Cont.)

Year	Kuwait	Lebanon	Libya	Morocco	Saudi Arabia	Syria
1957						.936
1958						.905
1959						.886
1960				1.620		.888
1961				1.858		.965
1962				1.917		1.194
1963				1.858		1.193
1964			1.497	1.878		1.304
1965	Kuwait has no price index available prior to 1972		1.900	1.917		1.334
1966		1.273	2.256	1.878	2.634	1.296
1967		1.213	2.554	1.996	2.869	1.364
1968		1.367	3.495	3.174	3.089	1.424
1969		1.396	3.692	3.174	3.379	1.645
1970		1.489	3.721	3.352	3.866	1.684
1971		1.624	4.359	3.510	4.460	1.855
1972		1.827	4.767	3.688	5.340	2.035
1973			5.405	3.747	6.132	2.080
						2.469

Private Consumption Expenditures - 1970 U.S. $ (Billions)

($CONS_t$)

Year	Algeria	Egypt	Iran	Iraq	Israel	Jordan
1959			3.604	.880	1.389	
1960		3.207	3.621	1.076	1.520	
1961		3.253	3.688	1.232	1.675	
1962		3.718	3.883	1.279	1.852	
1963		3.926	3.941	.997	2.070	
1964		4.034	4.261	1.317	2.282	
1965		4.119	4.426	1.513	2.483	
1966		4.091	4.954	1.619	2.550	
1967		4.187	5.197	1.565	2.573	.510
1968		4.348	5.899	1.691	2.808	.494
1969		4.316	6.227	1.669	3.118	.492
1970		4.462	6.899	1.722	3.267	.462
1971		4.609	7.030	1.839	3.455	.491
1972		4.823	7.720		3.781	.481
1973		4.686	8.409		4.127	.495
1974		4.420			4.371	

Private Consumption Expenditures (Cont.)

Year	Kuwait	Lebanon	Libya	Morocco	Saudi Arabia	Syria	
1959				1.646			
1960				1.689			
1961				1.728			
1962				1.916	.700	(.856)	est.
1963				1.926	.687	.913	
1964			.618	1.915	.691	1.036	
1965			.694	1.944	.706	1.057	
1966		1.117	.812	1.943	.723	1.073	
1967		1.048	.914	2.047	.937	1.182	
1968		1.173	1.007	2.166	1.056	1.056	
1969		1.203	1.096	2.293	1.193	1.114	
1970		1.284	1.106	2.421	1.302	1.184	
1971		1.400	1.257	2.510	1.364	1.306	
1972		1.590	1.440	2.604	1.410	1.515	
1973			1.602	2.700	1.382	1.168	
1974				2.694	1.465	1.677	

Total Exports - 1970 U.S. $ (Billions)

(TEX_t)

Year	Algeria	Egypt	Iran	Iraq	Israel	Jordan
1959				.797		
1960		.869		.834		
1961		.846		.838		
1962		.729		.892		
1963		.970		.930	.613	
1964		1.054		1.009	.657	
1965		1.121		1.106	.716	
1966		1.031		1.181	.809	
1967		1.010		1.106	.911	.089
1968		.749	confusing data	1.270	1.284	.091
1969		.921		1.266	1.422	.097
1970		.977		1.225	1.517	.090
1971		1.015		1.570	1.964	.056
1972		1.024			2.292	.129
1973		.970			2.289	.113
1974		.985			2.162	

Total Exports - (Cont.)

Year	Kuwait	Lebanon	Libya	Morocco	Saudi Arabia	Syria
1959				.484		
1960				.602		.211
1961				.543		.181
1962				.502	2.553	.291
1963				.547	2.353	.322
1964			.910	.610	2.452	.285
1965			1.099	.552	2.405	.280
1966		.239	1.257	.567	2.357	.267
1967		.248	1.407	.571	2.300	.230
1968		.323	2.139	.631	2.377	.284
1969		.316	2.296	.675	2.384	.381
1970		.351	2.436	.698	2.289	.339
1971		.418	2.612	.708	2.687	.357
1972		.481	2.646	.794	2.779	.464
1973			3.056	.938	3.334	.443
1974				1.379	8.704	.693

Total Imports - 1970 U.S. $ (Billions)

(TIM_t)

Year	Algeria	Egypt	Iran	Iraq	Israel	Jordan
1959				.466		
1960		.862		.546		
1961		.903		.584		
1962		.991		.535		
1963		1.286		.461	1.166	
1964		1.449		.584	1.350	
1965		1.274		.666	1.350	
1966		1.339		.713	1.311	
1967		1.066	confusing data	.550	1.440	.205
1968		1.070		.605	2.061	.294
1969		1.080		.630	2.481	.325
1970		1.258			2.824	.252
1971		1.377			3.358	.250
1972		1.416			3.652	.298
1973		1.377			4.848	.307
1974		1.353			4.714	

Total Imports (Cont.)

Year	Kuwait	Lebanon	Libya	Morocco	Saudi Arabia	Syria
1959				.503		
1960				.604		.274
1961				.617		.226
1962				.603	.374	.291
1963				.621	.342	.325
1964			.634	.588	.381	.314
1965			.672	.484	.473	.287
1966		.523	.758	.531	.539	.354
1967		.460	.830	.572	.828	.290
1968		.517	1.048	.662	1.011	.354
1969		.539	1.221	.686	1.080	.445
1970		.580	1.128	.757	1.109	.409
1971		.679	1.168	.730	1.107	.452
1972		.781	1.464	.729	1.296	.571
1973			2.036	.806	1.447	.478
1974				1.134	1.898	.817

Private Investment Expenditures (1970 U.S. $ - Billions)

(INV_t)

Year	Algeria	Egypt	Iran	Iraq	Israel	Jordan
1959			.798	.341		
1960		.525	.864	.292		
1961		.683	.831	.459		
1962		.766	.783	.408		
1963		.919	.784	.380		
1964		1.096	.915	.379		
1965		1.040	1.200	.417		
1966		1.125	1.230	.483		
1967		.909	1.684	.431		.085
1968		.826	1.919	.451		.121
1969		.808	2.140	.483		.193
1970		.957	2.209	.518		.113
1971		1.003	2.698	.512		.134
1972		.952	3.364			.127
1973		.991	4.178			.121
1974		.932				

Private Investment Expenditures (Cont.)

Year	Kuwait	Lebanon	Libya	Morocco	Saudi Arabia	Syria
1959				.168		
1960				.205		.130
1961				.221		.166
1962				.250	.300	.225
1963				.266	.295	.172
1964			.428	.249	.295	.178
1965			.559	.253	.415	.155
1966			.663	.271	.557	.172
1967		.307	.716	.343	.552	.169
1968		.245	.931	.479	.720	.220
1969		.252	.941	.377	.747	.294
1970		.270	.692	.445	.624	.259
1971		.287	.806	.422	.623	.297
1972		.322	1.196	.438	.713	.403
1973		.372	1.637	.559	.996	.356
1974					1.309	.527

DOM_t = Total Govt. $Exp._t$ - $DEFEX_t$ (U.S. $ - Billions)

Year	Egypt	Iran	Iraq	Israel	Jordan	Lebanon
1959			.345			
1960	.637	.569	.374			
1961	.629	.630	.387			
1962	.723	.604	.463			
1963	1.000	.624	.438	.577		
1964	1.066	.717	.440	.717		
1965	1.560	.817	.602	.760		
1966	1.703	1.173	.524	.844		.145
1967	1.724	1.422	.576	.991	.125	.149
1968	.978	1.700	.601	1.322	.129	.165
1969	1.068	1.742	.600	1.519	.128	.150
1970	.909	1.928	.890	1.541	.120	.169
1971	.802	2.061	.626		.121	.178
1972	.895	2.466	.936		.141	.220
1973	.874		.837		.162	
1974			1.334			

DOM_t (Cont.)

Year	Libya	Morocco	Saudi Arabia	Syria
1959				.071
1960				.076
1961				.075
1962				.083
1963				.154
1964				.092
1965	.419	.472		.123
1966	.547	.469		.138
1967	.731	.561		.135
1968	.838	.686	.852	.156
1969	.814	.721	.963	.172
1970	.814	.800	.974	.578
1971	1.337	.770	.990	.552
1972	1.936	.767	1.765	.620
1973		.732	1.751	

DEFEX - (From U.N. Statistical Yearbook) (U.S. $ Billions)

Year	Egypt	Iran	Iraq	Israel	Jordan	Lebanon
1959			.107			
1960	.246	.252	.124			
1961	.264	.202	.148			
1962	.292	.221	.154			
1963	.315	.214	.156	.146		
1964	.342	.211	.190	.192		
1965	.465	.241	.218	.254		
1966	.467	.346	.274	.273		.035
1967	.508	.470	.251	.313	.088	.039
1968	.533	.589	.264	.430	.124	.043
1969	.557	.640	.341	.581	.135	.043
1970	.569	.768	.398	.787	.105	.042
1971	.693	.816	.378	.850	.109	.043
1972	.694	1.078	.419		.109	.061
1973	.724		.401		.095	
1974			.573			

DEFEX (Cont'd)

Year	Libya	Morocco	Saudi Arabia	Syria
1959				.072
1960	.006	.052		.071
1961	.007	.059		.079
1962	.017	.063		.085
1963	.018	.083		.146
1964	.020	.075		.112
1965	.026	.065		.117
1966	.048	.068		.093
1967	.136	.074		.099
1968	.216	.086	.285	.164
1969	.330	.093	.269	.173
1970	.365	.088	.352	.161
1971	.390	.094	.367	.149
1972	.405	.104	.433	.182
1973	.400	.134	.558	
1974	.290			

$COOP_t = SUC_t + USC_t$

Year	Egypt	Iran	Iraq	Israel	Jordan
1966	10.164	6.685	4.135	8.624	3.348
1967	12.012	8.039	5.598	8.176	6.534
1968	9.572	6.016	2.000	9.071	7.145
1969	8.949	4.135	4.603	8.492	7.598
1970	16.950	4.440	3.490	12.635	8.148
1971	15.987	4.609	2.985	11.264	4.555
1972	9.854	4.568	8.253	8.169	4.368
1973	17.075	7.617	4.656	16.352	6.937
1974	19.459	7.430	3.624	16.179	8.452
1975	15.082	7.215	2.985	17.669	5.780

Year	Lebanon	Libya	Morocco	Saudi Arabia	Syria
1966	2.944	2.0	3.707	3.999	4.469
1967	2.889	3.70	4.775	2.628	5.899
1968	3.707	2.0	3.095	2.0	3.624
1969	3.251	3.298	2.985	2.0	3.536
1970	5.901	3.811	4.135	2.0	3.678
1971	5.772	3.455	5.721	4.516	3.995
1972	3.193	4.214	2.0	2.0	8.311
1973	5.174	4.820	4.487	6.585	7.465
1974	4.196	6.095	2.985	8.602	17.726
1975	4.283	4.109	2.0	6.311	9.842

$CONF_t$

Year	Egypt	Iran	Iraq	Israel	Jordan
1966	2.229	.899	1.136	2.203	1.925
1967	2.533	0.0	1.671	2.715	2.232
1968	2.305	.674	1.001	2.819	2.542
1969	2.842	1.205	1.826	3.183	2.393
1970	2.986	.563	1.653	3.221	2.663
1971	2.397	1.209	1.163	2.467	2.335
1972	2.338	1.517	1.674	2.741	1.695
1973	2.724	1.434	1.971	3.102	1.811
1974	2.089	1.830	1.999	2.911	1.326
1975	2.000	1.231	1.506	2.579	1.657

Year	Lebanon	Libya	Morocco	Saudi Arabia	Syria
1966	1.111	0	1.039	1.125	2.177
1967	1.396	.703	0	1.423	2.273
1968	1.534	.316	0	1.112	1.690
1969	2.202	1.469	.990	1.118	1.918
1970	2.192	1.500	1.227	.827	2.186
1971	1.362	1.225	.563	.984	1.707
1972	2.039	1.312	0	1.053	2.014
1973	2.144	2.279	1.460	1.859	2.573
1974	1.866	1.273	.563	1.302	2.576
1975	1.996	1.243	1.661	1.421	1.848

WEIS FILE OUTPUT

```
TIMES OF LCNDCN UPDATE:76C2C7 NYTTIMES-FROM-1/1/66-THRU-12/31/75
TITLE  :CCNFLICT CF CCUNTRIES
RCW ACTCR SELECT 12
615;651;630;645;666;663;69C;660;620;600;670;652;
CCLUMN CCMBEVENT ALL
CPTICNS 720101 721231 (INFORMATION IS FOR YEAR 1972)
MATRIX SIZE IS      528 BYTES
  5367C RECORDS PROCESSED.
 :CONFLICT OF CCUNTRIES
```

FREQUENCY TABLE — CATEGORY NUMBERS (MC CLELLAND'S)

	1	2	3	4	5	6	7	8	9	10	11
615	0	0	4	0	0	0	0	3	1	0	1
651	0	37	27	10	7	4	1	4	8	7	10
630	0	0	6	1	1	0	1	2	0	1	0
645	0	0	9	3	1	1	0	9	1	6	2
666	3	61	12	11	2	8	1	7	9	12	14
663	0	8	4	0	0	4	1	2	2	1	2
690	0	1	1	0	0	0	1	0	3	0	0
660	0	9	12	4	1	3	0	3	5	2	1
620	0	2	7	2	1	0	1	5	0	2	1
600	0	0	1	0	0	0	0	1	2	1	0
670	0	0	3	2	0	1	1	0	0	3	0
652	0	3	8	3	1	2	0	6	2	2	1
	(9)	(10)	(2)	(6)	(8)	(5)	(1)	(3)	(7)	(4)	(17)

CALHOUN'S CATEGORY NUMBERS

	12	13	14	15	16	17	18	19	20	21	22
615	0	1	0	0	0	0	0	0	0	0	0
651	45	1	5	2	6	5	1	4	1	2	2
630	3	0	0	0	4	0	0	1	0	0	4
645	7	0	1	0	0	1	0	1	0	1	3
666	58	4	16	4	28	3	2	3	0	2	55
663	12	0	5	0	1	0	0	0	0	0	0
690	0	0	0	0	0	0	0	0	0	0	0
660	18	1	7	0	1	1	3	0	0	0	8
620	5	0	0	0	0	1	0	0	0	0	0
600	0	0	0	0	0	0	0	0	0	0	0
670	2	0	0	0	3	0	0	0	0	0	0
652	4	0	0	0	1	1	0	0	0	2	19
	(16)	(15)	(14)	(19)	(12)	(20)	(13)	(11)	(18)	(21)	(22)

AN EXAMPLE OF THE RAW DATA FOR CONFLICT FOR THE 12 COUNTRIES WHOSE WEIS FILE NO. IS LISTED IN THE FAR LEFT COLUMN. RAW DATA IS FOR 1972. CALHOUN'S SCALE USES THE SAME DESCRIPTIVE CATEGORIES, BUT THE NUMBERING IS DIFFERENT (SEE FIG. 2).

EXAMPLE SNAP/IEDA PROGRAM
OLS/2SLS FOR EQUATION 4 WITH SYRIA DATA 1960 - 1970

STEPWISE REGRESSION NO. 1, 11 OBSERVATIONS, 4 VARIABLES.
10 DEGREES OF FREEDOM. F TO ENTER = 0.00, F TO REMOVE = 0.00

CORRELATION MATRIX

	X(2)	X(3)	X(4)	X(1)
X(2)	1.00	0.83	0.86	0.60
X(3)	0.83	1.00	0.95	0.74
X(4)	0.86	0.95	1.00	0.69
X(1)	0.60	0.74	0.69	1.00

THE FOLLOWING IS A TABLE OF COEFFICIENTS OF EACH INDEPENDENT VARIABLE AND RELATED CALCULATION FOR EACH STEP IN THE REGRESSION. ELEMENTS IN BOLD FACE ARE THE COEFFICIENTS OF VARIABLES IN THE REGRESSION AT THE END OF THAT STEP. THE OTHER COEFFICIENTS ARE THOSE WHICH WOULD HAVE RESULTED AT THAT STEP HAD THE CORRESPONDING VARIABLE ENTERED THE REGRESSION INSTEAD OF THE VARIABLE WHICH IN FACT ENTERED. M-R2 IS THE SQUARE OF THE MULTIPLE CORRELATION BETWEEN THE DEPENDENT VARIABLE AND THOSE INDEPENDENT VARIABLES WHICH WERE INCLUDED IN THE REGRESSION AT THAT STEP. F IS THE RATIO OF THE VARIANCE OF THE RESIDUALS OF THE DEPENDENT VARIABLE BEFORE THE PRESENT STEP & THE VARIANCE OF THE RESIDUALS OF THAT VARIABLE AFTER THE PRESENT STEP. SE-DPV IS THE STANDARD ERROR OF THE DEPENDENT VARIABLE AFTER REMOVING THE EFFECTS OF THE INDEPENDENT VARIABLE IN THE REGRESSION AT THAT STEP. SE IS THE STANDARD ERROR OF EACH COEFFICIENT IN THE REGRESSION. R2 IS THE SQUARE OF THE CORRELATION OF THE INDEPENDENT VARIABLE AND THE DEPENDENT VARIABLE AFTER REMOVING THE EFFECT OF THE OTHER INDEPENDENT VARIABLES IN THE REGRESSION.

				B_7	B_8	B_9	B_{10}
STEP	M-R2	F	SE-DPV	CONSTANT	X(2)	X(3)	X(4)
1	0.554	11.2	0.095	-0.388	2.275	**0.449**	0.172
STD.ER						0.134	
PAR.R2						0.554	
2	0.559	0.1	0.094	-0.256	-0.269	**0.568**	**-0.052**
STD.ER						0.457	0.190
PAR.R2						0.162	0.009
3	0.559	0.0	0.094	-0.274	**-0.106**	**0.570**	**-0.047**
STD.ER					1.894	0.490	0.223
PAR.R2					0.000	0.162	0.006

THERE ARE NO MORE VARIABLES WITH F-RATIO GREATER THAN 0.00.

RESIDUAL R(1) = 0.16980 00

STEPWISE REGRESSION NO. 2, 10 OBSERVATIONS, 4 VARIABLES.

9 DEGREES OF FREEDOM. F TO ENTER = 0.01, F TO REMOVE = 0.01

CORRELATION MATRIX

	X(2)	X(3)	X(4)	X(1)
X(2)	1.00	0.83	0.78	0.50
X(3)	0.83	1.00	0.93	0.52
X(4)	0.78	0.93	1.00	0.66
X(1)	0.50	0.52	0.66	1.00

THE FOLLOWING IS A TABLE OF COEFFICIENTS OF EACH INDEPENDENT VARIABLE AND RELATED CALCULATION FOR EACH STEP IN THE REGRESSION. ELEMENTS IN BOLD FACE ARE THE COEFFICIENTS OF VARIABLES IN THE REGRESSION AT THE END OF THAT STEP. THE OTHER COEFFICIENTS ARE THOSE WHICH WOULD HAVE RESULTED AT THAT STEP HAD THE CORRESPONDING VARIABLE ENTERED THE REGRESSION INSTEAD OF THE VARIABLE WHICH IN FACT ENTERED. M-R2 IS THE SQUARE OF THE MULTIPLE CORRELATION BETWEEN THE DEPENDENT VARIABLE AND THOSE INDEPENDENT VARIABLES WHICH WERE INCLUDED IN THE REGRESSION AT THAT STEP. F IS THE RATIO OF THE VARIANCE OF THE RESIDUALS OF THE DEPENDENT VARIABLE BEFORE THE PRESENT STEP & THE VARIANCE OF THE RESIDUALS OF THAT VARIABLE AFTER THE PRESENT STEP. SE-DPV IS THE STANDARD ERROR OF THE DEPENDENT VARIABLE AFTER REMOVING THE EFFECTS OF THE INDEPENDENT VARIABLE IN THE REGRESSION AT THAT STEP. SE IS THE STANDARD ERROR OF EACH COEFFICIENT IN THE REGRESSION. R2 IS THE SQUARE OF THE CORRELATION OF THE INDEPENDENT VARIABLE AND THE DEPENDENT VARIABLE AFTER REMOVING THE EFFECT OF THE OTHER INDEPENDENT VARIABLES IN THE REGRESSION.

STEP	M-R2	F	SE-DPV	CONSTANT	X(2)	X(3)	X(4)
1	0.438	6.2	0.107	-0.834	2.149	0.444	**0.225**
STD.ER							0.090
PAR.R2							0.438
2	0.515	1.1	0.100	-1.246	-0.190	**-0.654**	**0.467**
STD.ER						0.623	0.247
PAR.R2						0.136	0.338
3	0.527	0.2	0.099	-1.186	**0.867**	**-0.791**	**0.464**
STD.ER					2.176	0.748	0.263
PAR.R2					0.026	0.157	0.341

THERE ARE NO MORE VARIABLES WITH F-RATIO GREATER THAN 0.01.

RESIDUAL R(1) = -0.1310D 00

```
FORTRAN IV G LEVEL  21                MAIN                DATE = 76295          10/32/49

                C
                C
                C     THE MAIN PROGRAM FOR THE FORECASTING MODEL
                C     THE REGRESSION COEFFICIENTS ARE READ IN FIRST.
                C
 0001                 IMPLICIT REAL*8(A-H,O-Z)
 0002                 DIMENSION B(16,3), A(12,3), POP(4,3), GDP(4,3), CONS(2,3), INV(2,3
                     1), DCM(2,3), DEX(2,3), TIM(2,3), TEX(2,3), XMILA(2,3), CONF(2,3),
                     2 COOP(2,3), USM(6,3), SUM(6,3), EGDEX(2), XISRDX(2), SYRDEX(2)
                C
                C     READ IN THE COEFFICIENTS
                C
 0003                 WRITE (6,112)
 0004             112 FORMAT ('1','  THE BETA COEFFICIENTS IN ORDER ARE AS FOLLOWS;')
 0005                 WRITE (6,100)
 0006             100 FORMAT ('0',5X,'EGYPT',6X,'ISRAEL',6X,'SYRIA')
 0007                 READ (5,110) B
 0008             110 FORMAT (6F10.5)
 0009                 DO 10 I = 1,16
 0010                 WRITE (6,111) B(I,1), B(I,2), B(I,3)
 0011             111 FORMAT ('0',3(2X,F10.5))
 0012              10 CONTINUE
 0013                 WRITE (6,114)
 0014             114 FORMAT ('0','  THE ALPHA COEFFICIENTS IN ORDER ARE AS FOLLOWS:')
 0015                 WRITE (6,100)
 0016                 READ (5,110) A
 0017                 DO 12 I = 1,12
 0018                 WRITE (6,111) A(I,1), A(I,2), A(I,3)
 0019              12 CONTINUE
                C
                C     NOW TO READ IN DATA FOR 3 YEARS--- LATEST DATA POINT FIRST,
                C            1970, 1969, 1968
 0020                 ITIME = 1971
 0021                 DO 14 K = 1,3
 0022                 XMILA(1,K) = 0.0
 0023                 XMILA(2,K) = 0.0
 0024                 READ (5,116) (POP(I,K), I=1,3)
 0025             116 FORMAT (3F5.2)
 0026                 READ (5,117) (GDP(I,K), I=1,3), CONS(1,K), INV(1,K), DOM(1,K), (
                     1DEX(I,K), I=1,2), TIM(1,K), TEX(1,K), (CONF(I,K), I=1,2), (COOP(I,
                     2K), I=1,2)
 0027             117 FORMAT (7F8.3)
 0028                 READ (5,118)  (USM(I,K), I=1,6),  (SUM(I,K), I=1,6)
 0029             118 FORMAT (12F6.4)
 0030              14 CONTINUE
```

```
      DO 16 K = 1,3
      WRITE (6,121) (POP(I,K), I=1,3)
  121 FCRMAT ('0',2X,3F5.2)
      WRITE (6,119) (GDP(I,K), I=1,3), CONS(1,K), INV(1,K), DOM(1,K), (
     1DEX(I,K), I=1,2), TIM(1,K), TEX(1,K), (CONF(I,K), I=1,2), (COOP(I,
     2K), I=1,2)
  119 FCRMAT (' ',14F8.3)
   16 CCNTINUE
C
C    PRELIMINARY EQUATIONS
C
      DC 38 K = 1,3
      Q=0.0
      DO 20 J=2,6
   20 Q = Q + USM(J,K) + SUM(J,K)
      XMILA(2,K) = Q/5.0
      Q = 0.0
      DC 22  J = 1,5
   22 Q = Q  + USM(J,K) + SUM(J,K)
      XMILA(1,K) = Q/5.0
   38 CCNTINUE
C
C     COMPUTATION OF THE VARIABLES LISTED BELOW FOLLOWS.
C     POP IS COMPUTED FIRST AND FIGURES FOR THE PAST 4 YEARS UPDATED.
C     PCP, CCNS, INV, DOM, DEX, TIM, TEX
C
   30 DO 40 K = 1,3
      P = B(1.K)*POP(1.K)
      PCP(4,K) = POP(3,K)
      POP(3,K) = POP(2,K)
      PCP(2,K) = POP(1,K)
      PCP(1,K) = P
      DP = P - POP(2,K)
      DP2 = POP(2,K) - POP(3,K)
      IF (DP2.LE.0.0) DP2 = 0.001
C
C
```

```
C        CURRENT VALUES OF CONS, TIM, TEX DEPEND ON THE VALUE OF GDP FOR THE
C   CURRENT PERIOD, AND GDP IN TURN DEPENDS ON THEM.  A REDUCED FORM IS
C        USED TO EFFECT A 2-STEP DIRECT COMPUTATION.
C
C     STEP 1
C
C        THE LOCAL VARIABLES CX, VX, DX, FX, TI, AND TX ARE SET RESPECTIVELY
C        TO THOSE PARTS OF THE VARIABLES ABOVE NOT CONTAINING THE CURRENT GDP VALUE
         CX = B(2,K) + B(4,K)* CONS(1,K)
         DX = B(7,K) + B(8,K)*DOM(1,K) + B(9,K)*GDP(1,K) + B(10,K)*POP(1,K)
         IF (K.EQ.1) CRDEX = XISRDX(1) - XISRDX(2)
         IF (K.EQ.2) CRDEX=(EGDEX(1)+SYRDEX(1)) - (EGDEX(2)+SYRDEX(2))
         IF (K.EQ.3) CRDEX = XISRDX(1) - XISRDX(2)
         CFX = A(1,K) + A(2,K)*CRDEX  + A(3,K)*(DEX(2,K)/GDP(3,K)) + A(4,K)
        1*CONF(2,K) + A(5,K)*(( GDP(2,K)-GDP(3,K))/DP2) + A(6,K)*XMILA(1,K)
        2 + A(7,K)*CCOP(2,K)
C
         FX = DEX(1,K) + CFX
         DEX(2,K) = DEX(1,K)
         DEX(1,K) = DEX(2,K) + CFX
         IF (DEX(1,K).LT.0.00) DEX(1,K) = 0.00
         INV(2,K) = INV(1,K)
         INV(1,K) = B(5,K) + B(6,K)*(GDP(2,K)-GDP(3,K))
         IF (INV(1,K).LT.0.00)  INV(1,K) = 0.00
         TI = B(11,K) + B(13,K)*POP(1,K)
         TX = B(14,K) + B(16,K) *POP(1,K)
C
C
         CONST = CX + DX + FX + TX - TI + INV(1,K)
         ALPHA = B(3,K) + B(15,K) - B(12,K)
         IF (ALPHA.EQ.1.0) ALPHA = 0.999
         G = CONST/(1.0 - ALPHA)
         GDP(4,K) = GDP(3,K)
         GDP(3,K) = GDP(2,K)
         GDP(2,K) = GDP(1,K)
         GDP(1,K) = G
C
C
         CONS(2,K) = CONS(1,K)
         CONS(1,K) = CX + B(3,K)*G
         IF (CONS(1,K).LT.0.0) CONS(1,K) = 0.00
         DOM(2,K) = DOM(1,K)
         DOM(1,K) = DX
         IF (DOM(1,K).LT.0.0)  DOM(1,K) = 0.00
         TEX(2,K) = TEX(1,K)
         TEX(1,K) = TX + B(15,K)*G
         IF (TEX(1,K).LT.0.0)  TEX(1,K) = 0.00
         TIM(2,K) = TIM(1,K)
         TIM(1,K) = TI + B(12,K)*G
         IF (TIM(1,K).LT.0.00)  TIM(1,K) = 0.00
```

```
C
C
      CONF(2,K) = CONF(1,K)
      CONF(1,K) = A(8,K) + A(9,K)*CONF(2,K) + A(10,K)*(DEX(1,K)-DEX(2,K)
     1) + A(11,K)*(DEX(1,K)/GDP(1,K)) + A(12,K)*COOP(1,K)
      IF (CCNF(1,K).LT.0.0) CONF(1,K) = 0.00
C
C
      WRITE (6,124) ITIME
  124 FORMAT ('0','  YEAR = ',I4)
      IF (K.EQ.1) GO TO 33
      IF (K.EQ.2) GO TO 34
      IF (K.EQ.3) GO TO 35
   33 WRITE (6,130)
  130 FORMAT ('0',10X,'COUNTRY = EGYPT')
      GC TO 48
   34 WRITE (6,131)
  131 FORMAT ('0',10X,'COUNTRY = ISRAEL')
      GO TO 48
   35 WRITE (6,132)
  132 FORMAT ('0',10X,'COUNTRY = SYRIA')
   48 CONTINUE
      WRITE (6,120)
  120 FORMAT (' ','POP,     CONS,     INV      DOM      TIM      TEX
     1GCP      XMILA    ')
      WRITE (6,122) POP(1,K), CONS(1,K), INV(1,K), DOM(1,K), TIM(1,K),
     1TEX(1,K), GDP(1,K), XMILA(1,K), CONF(1,K)
  122 FCRMAT (2X,9F8.4)
      IF (K.EQ.1) GO TO 42
      IF (K.EQ.2) GO TO 44
      IF (K.EQ.3) GO TO 46
   42 EGDEX(2) = EGDEX(1)
      EGDEX(1) = DEX(1,K)
      GC TO 40
   44 XISRDX(2) = XISRDX(1)
      XISRDX(1) = DEX(1,K)
      GO TO 40
   46 SYRDEX(2) = SYRDEX(1)
      SYRDEX(1) = DEX(1,K)
   40 CONTINUE
      ITIME = ITIME + 1
      IF (ITIME.GT.1985) GO TO 50
      GO TO 30
   50 CONTINUE
      STCP
      END
```

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