ENERGY POLICY IN THE REPUBLIC OF CHINA AND JAPAN 1970-1985: A COMPARATIVE EXAMINATION OF ENERGY POLITICS AND POLICIES

DISSERTATION

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The impact of the energy crises in the 1970s hit all oil-importing countries much harder than it hit countries endowed with domestic supplies of energy. Energy politics and policies for the oil-importing countries have become vital issues that need to be examined. The purpose of this dissertation is to examine and compare the energy politics and policy processes in the Republic of China (ROC) and Japan during the period of 1970-1985. The study focuses on the politics of energy policies, using a policy analysis or systems framework for examining the policy processes in the two countries. A comparison is made of energy environments, the political actors, the institutions, and finally the substance of energy policy. An assessment is then made of the effects or consequences of energy policies on these two countries.

In attempting to study energy politics and policies in these two Asian countries, the researcher began with a policy model or conceptual schema of energy politics from which the researcher raised a number of research questions. These questions were used to guide the direction of the

study. A comparison was first made of energy systems, and then the major actors in the energy resources field were identified by comparing the political systems. Comparison of the political systems in energy politics helped to explain the differences in the political outcomes of energy policy. An assessment was made by using a series of multiple regression models to assess and compare the consequences of energy policies in these two countries.

The final purpose of this dissertation is to develop a conceptual model or framework for understanding the complexity, uncertainty, and interrelatedness of energy policies. The researcher concludes that comparative policy studies are useful and provide insights which otherwise would be missed.

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CHAPTER I

INTRODUCTION

The extraordinary increases in the price of oil that occurred in the wake of the 1973 Arab oil embargo, together with the disruption of international oil supplies caused by the Iranian revolution and the subsequent Iranian-Iraqi war, forced both developed and developing countries to seek effective energy policies to reduce their dependency on imported oil. Essentially, the world energy crises in the 1970's, in a very fundamental sense, were not merely energy crises; they were political, economical, and institutional crises as well. The energy crisis adversely affected both developing and developed countries, but acutely affected developed countries since "a continuous flow of energy is a vital necessity for every modern industrial society" (Krapel, 1980, p. ix). In attempting to meet the oil crises, nations often undertook a number of emergency actions to reduce the damage to their economies and national security.

The subject of energy policy and management became a major concern of national leaders and the subject of numerous political, economical, institutional and environmental studies. Also, an international organization was established in response to the rising demands for managing the scarce energy resources, namely the International Energy Agency (IEA). Also, an almost desperate search for new energy resources was stimulated around the world.

Statement of the Problem

This study compares the energy policies of two Asian countries, the Republic of China (ROC) and Japan during the period of 1970-1985. The study focuses on the politics of energy policies in each of the countries, considering how the physical characteristics, the market circumstances, and the general political environments affect policy outcomes. The energy policies of these countries, the political outcomes, then are examined to see how well they serve the national energy goals.

Specifically, this study of comparative energy policies of two Asian countries does the following: (1) It focuses on the character of the energy system in each of the countries. The systems of energy production, energy consumption, the total energy demand, as well as governmental policies and programs and cultural aspects such as public opinion regarding energy related matters are examined. Essentially, the study is macro rather than micro in nature. (2) The study develops both a historical and theoretical understanding of the politics of energy policies in these two countries. The historical aspects of the study elucidate specific energy problems and policies over time. A policy analysis framework or system approach provides a theoretical basis for examining the policy processes in the two countries. A comparison is made of the energy environments, the actors, the institutions, the policy processes in the two countries, and finally the substance of energy policies. (3) Since the nature of the study is a cross-national analysis in a broad systematic, historical, and theoretical context, its unit of analysis involves three different dimensions, that is, nation-state, regional, and international.

The main focus of the study is to compare the differences of policy outcomes in both nations, and this involves examination of the reltionships between policy outcomes and those social, economic, and political conditions which operate to shape them. It is important to note that the focus of this comparative study on energy politics and policy is not prediction; rather, it is to examine energy politics and policy processes for helping policy makers and social scientists to better conceptualize how energy policies are made and how they may be compared.

It may be questioned why one would undertake a comparative study involving a developing or a newly industrialized country like the ROC and a developed country like Japan. These two Asian countries were chosen for this study deliberately for a number of reasons. First, both the ROC and Japan are located in the same region and have relatively similar cultural backgrounds. Second, both countries' political, economic, and social systems are non-communist in nature. Third, both of these two countries lack enough domestic energy resources to serve their economic development, and, therefore, they are heavily dependent on imported energy resources, especially large amounts of oil from the Middle East. Finally, although Japan is now considered to be an advanced nation, it has since World War II experienced a period of rapid development, and in the earlier years of reconstruction it experienced many shortages and problems as a developing nation. Furthermore, as a developing country, the ROC has made great strides economically in recent decades. Development in both countries has been greatly influenced by the United States' aid and both are within the United States' sphere of influence. The fact that the researcher is a citizen of the ROC also gives him a special interest in this region.

Significance of the Study

Although there is an increasing energy interdependence of the nations and regions of the world today, nations still are forced to take actions attempting to protect themselves from change in the international energy environment. This is the subject of this dissertation research. The question considered here is whether the countries of the ROC and Japan, both who have limited energy resources, can manage and handle their energy problems in such a fashion as to protect themselves against future oil shocks.

Before the oil crises in the 1970s, most policymakers and analysts defined energy policy as having to do with government and industry activities relative to the several stages (prospecting, mining, refining, transforming, transporting, marketing, and research and development) of the supply of various forms of energy (Hatch, 1986, p. 3). In the past two decades, three political dimensions of energy policies have been stressed. The three political aspects of energy policies are as follows.

> (1) The major consideration is securing safe energy supplies in order to avoid threats to their military security and economic stability.
> (2) The cost of energy imports is seen as major factor affecting the balance of payments of a country, and should be limited by development of domestic energy sources when resources are available or by conservation of energy use.
> (3) Governments view energy as a vital component of the costs for the nation's goods and services which must be kept as low as possible in order for its goods to be com-

> petitive in the international market (Cowhey, 1985, pp. 36-8).

Contemporary scholars also stress that energy policies are not just technical or economic, they are political in nature (Bohi & Quandt, 1984, pp. 51-2; Ikenberry, 1986, pp. 105-37; Hatch, 1986, pp. 187-92). Energy policies, therefore, are highly controversial issues significantly affecting the character of the entire collective life of a nation-state. In this context, a national energy policy should relate to its political, economic, technological, and environmental factors if it is to be effective.

Purpose of the Study

The purpose of this dissertation is to examine the impact of the energy crises on national energy policies of two countries, the ROC and Japan. Since each has responded differently to the energy crises, a comparison will be made to identify the various factors affecting energy policies. Differences in the energy system, the political system and the policy outcomes will be examined, as well as the regional and international environmental challenges affecting policies in these two countries.

Another purpose is to compare the differences of policy outcomes in both nations. A comparison will be made of the policy outcomes or substance of the energy policies adopted by both countries. Policy outcomes express the value allocations of a society and those allocations are the chief output of society's political system. Policy outcomes thus must be assembled, described and explained for understanding the impact on socioeconomic conditions and political and economic system characteristics (Dye, 1966, pp. 1-5). Policy substance refers to what policy instruments say: Who is supposed to do what, to whom, when, why, and with what desired effects? The policy substance is found in laws (statutes and ordinances), guidelines (agency rules and regulations), and operational programs (Schneider & Ingram, 1978, pp. 1-2). How to compare the energy policy substance in these two countries presents a problem, since there is no agreed upon conceptual model for analyzing policy substance. In an attempt to operationalize the concept of policy substance in order that the researcher may compare common sets of categories in energy policies, this study defines policy substance as governmental goals, implementation strategies, organizational and administrative arrangements, and evaluation or assessment processes.

The final purpose is to help policy makers and social scientists to better conceptualize how energy policies are made and how politics shapes and influences policy outcomes. It is not the intention of the researcher to offer a new conceptual model or framework for analyzing energy policies.

Rather, the purpose is to highlight the existing body of research and adapt available models to clarify central aspects of energy politics, to analyze various policy alternatives, and to assess the consequences of energy policies in this study.

Methodology for Comparative Policy Analysis

The study of public policy continues to be thwarted by the absence of conceptual frameworks for describing the public policies. Public policy, as it is usually defined, is a pattern of actions (or inaction) composed of multiple decision points, and many different participants (Schneider, 1978, p. 1). Public policy also contains notions of inputs, forces, systems, and characteristics, and there are number of problems between the language of explanation and the language of research operations (Dye, 1966, p. 23). George D. Greenberg et al., (1977) noted a decade ago that tests of major hypotheses in the public policy literature have been impossible to conduct because it has been impossible to operationalize the policy variables (Greenberg, et al., 1977, pp. 1532-1543). To understand the dynamics of public policy, one must look closely and carefully at what governments do in response to a variety of problems that confront them (Rose, 1976, p. 8).

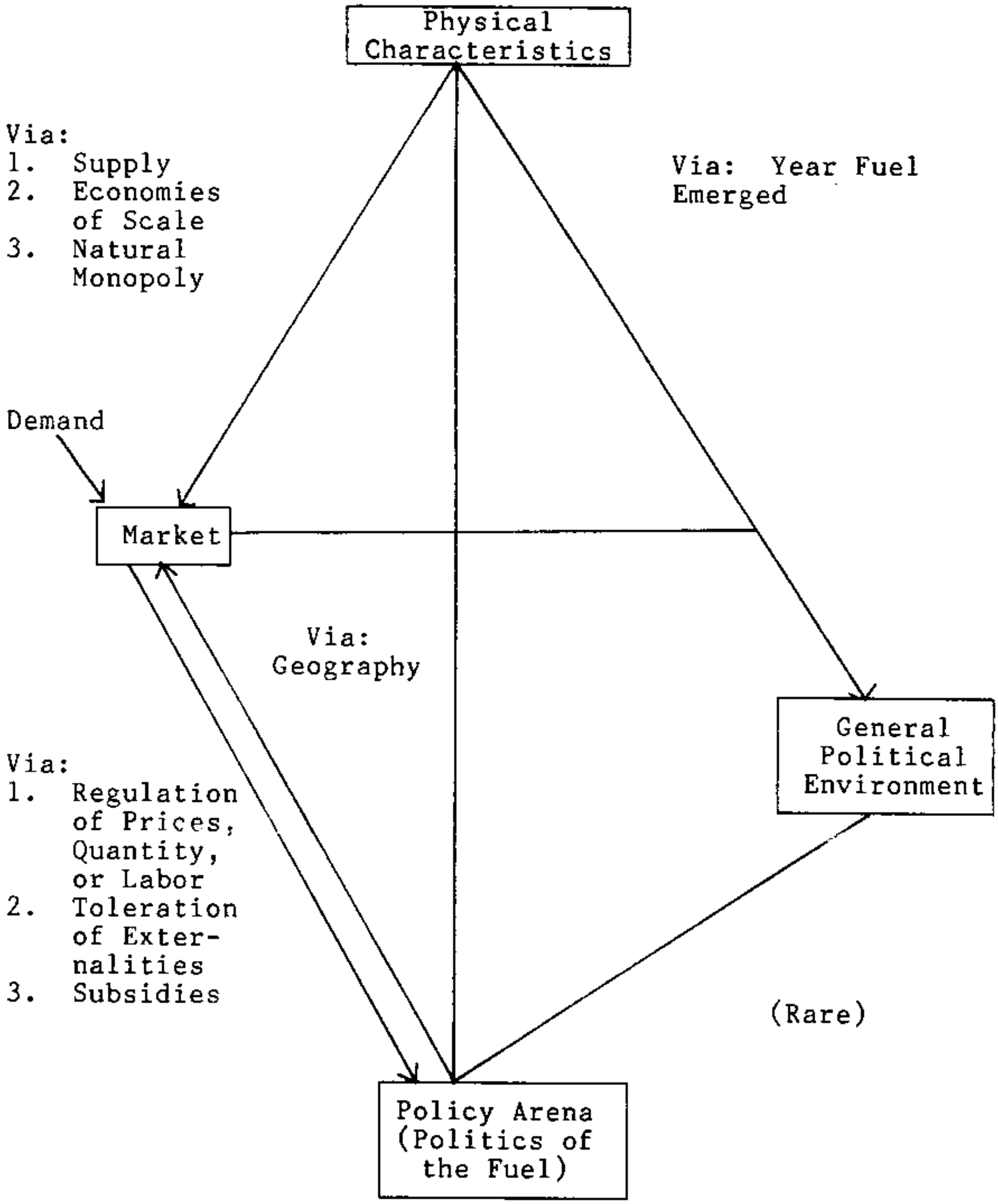
Policy analysis often is considered to be an applied social science discipline which uses multiple methods of inquiry and argument to produce and transform policy--relevant information that may be utilized in political settings to resolve policy problems (Dunn, 1981, p. 35). Policy analysis efforts of this nature seek to solve human problems with general analytical procedures, either before or after action. But policy analysis also may be conceived as a social science effort to better understand the working of the social and political environments. In this context, the audience that the policy analysis is aimed at is not solely the public officials attempting to deal with complex, real-world problem, but also at members of an academic discipline (Mead, 1985, pp. 419-21). This dissertation hopes to offer insights helpful to governmental practitioners, but mainly it is an effort to understand the politics of energy policies and to assess their impact in these two countries. In this sense, this research is an academic undertaking.

Even fewer efforts have been made to create comparative policy models. The comparative analysis "can create apparent alternatives in conceptualizing public problems by analyzing the standards that different nations or jurisdictions apply in policy analysis" (Anderson, 1978, p. 30). Also, recognizing the need for comparison is much easier than coping with some of the problems posed by efforts to compare on a systematic basis. This study mainly focuses on what the policy systems in these two countries did, regarding energy policy in the period of energy crises.

Multiple methods of inquiry are used in attempting to study energy politics and policies in these two Asian countries. First, an effort is made to systematically compare all the factors (e.g., sociodemographic, economic, and political) affecting the energy policy arena. Basically this dissertation rests upon systems theory.

The conceptual schema of energy politics adapted from David H. Davis, shown as Figure 1, provides a guide for the researcher as he attempts to ask pertinent questions pertaining to energy politics. For instance, the physical characteristics of the two countries are major factors affecting energy politics. The researcher, therefore, will describe the energy systems in the two countries. What percentages of energy come from various resources, such as coal, oil, gas, hydroelectric, nuclear, etc, and, what percentage of these are domestic and foreign energy resources. Another systems model adapted from C. M. Siddayao's Sociodemographic and Economic Variables Affecting a National Energy System also helped in the examination of the energy system in these two countries.

Figure 1
The Conceptual Schema of Energy Politics



Source: David H. Davis, Energy Politics, (New York: St. Martin's Press, 1982), p. 15.

The conceptual schema also shows the market to be a major aspect of energy politics. The researcher, therefore, will compare the structures of national economies of the two countries since the types of economic activities in the nation determine the total demand for energy, and also the price of energy affects the types of economic activities. Also, the energy consumption in these two countries will be compared. How is energy used? What percentage is used for industry, for commerce, for various modes of transportation, and for households, etc.

The energy politics schema also indicates that the general political environment is a factor in energy politics. For instance, questions pertaining to the use of nuclear power are affected by popular attitudes on nuclear issues. Similarly, attitudes pertaining to environmental matters affect the types of energy policies that can be undertaken. Other aspects of the political environment such as the degree of pluralism or corporatism (Schmitter, 1979, p. 13), or statism within the state also affects the nature of the policy process.

Finally, the energy politics schema shows that the policy arena should be considered. Questions pertaining to the nature and degree of conflict among various sources of energy and the groups affected by energy policies are compared. And the governmental policies and activities during the crises period are studied. With the use of this model, the researcher systematically compares energy politics in the two societies.

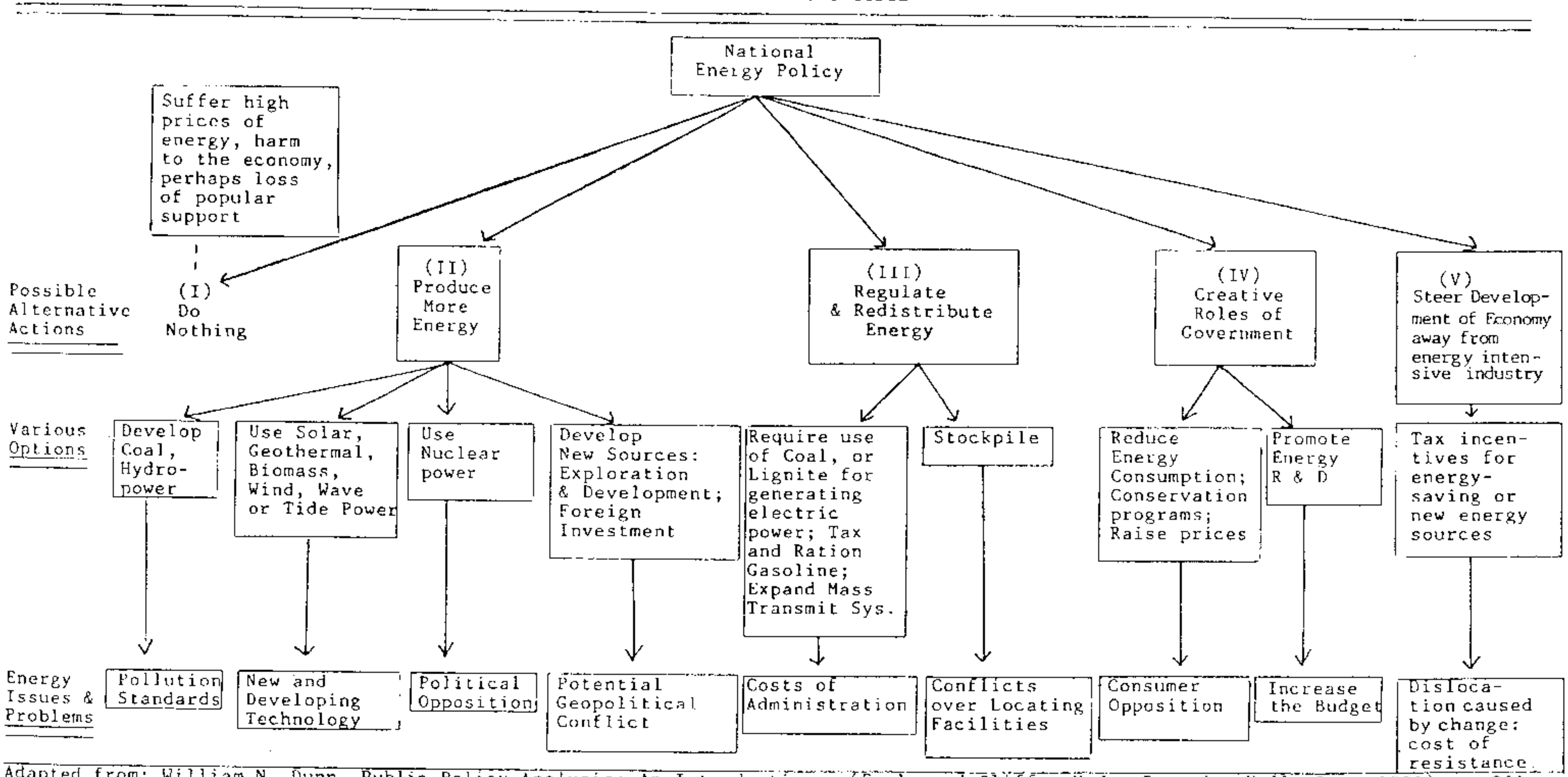
The question facing these countries as a result of the energy crises was what should be done? What should be the substance of energy policy? And what policy alternatives are to be considered in the decision process? Various energy policy alternatives considered for the two countries next are examined with the help of William N. Dunn's decision-making model on Designing a National Energy Policy, shown as Figure 2.

This model guides the researcher in his efforts to understand the actions considered and taken by the two countries. It also shows the various options that need to be considered and the political consequences which need to be weighed. With this model, the researcher systematically studies the politics of energy policy as a result of policy responses to the energy crises for both nations.

Because of the severe consequences of doing nothing, the first alternative shown in the schema (Figure 2), neither of the countries could follow this path. The economies of both countries were staggered by the rapidly escalating prices for imported fuel, and to do nothing could have threatened the stability of the economic and political system.

Figure 2

Designing a National Energy Policy: Alternatives that Need to be Considered



Adapted from: William N. Dunn, Public Policy Analysis: An Introduction. (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1981), p. 261.

The second alternative shown in the schema, to produce more energy from alternative fuel sources, became a major goal of each of the countries. But because of the differences in the resource bases and the technological levels of the two countries, they reacted differently. Also seeking to develop alternative energy sources affects other policy arena. For instance, expansion of coal or hydroelectric power industries affects environmental conditions raising issues of pollution standards. Development of new sources of energy such as solar, geothermal, wind, wave or tide power, etc, is limited because of a lack of developed technology in these fields. Governments may choose to finance this techology in universities and research agencies, or to subsidize the building of facilities using whatever technology is available with the hope of a breakthrough in new technology. Such policies, however, are expensive and may be ineffective. Producing more energy by any source, but especially with nuclear power creates political opposition.

The third alternative shown in the schema, to regulate and redistribute energy, also demonstrates the significant aspect of energy politics and policy. Regulation and redistribution policies, conservation, and subsidization of programs all serve an allocative purpose. For instance, a government policy requiring all electrical power to be generated from lignite or coal rather than from gas or oil obviously requires a major shift which may benefit some and injure others. Similarly, placing large taxes on gasoline in order to discourage the use of private automobiles affects different groups differently, while a rationing system of gasoline to ensure equity will in turn increase the scope of public administration. Public construction of mass transportation systems also affects groups differently. Any change in governmental energy policies, in fact, has an economic impact which must be considered if one is to understand the conflict which generates the politics of energy.

Governments may also promote conservation or promotion of research and development as is shown in Figure 2. Furthermore, governments attempt to steer economic development away from high-energy-intensive to low-energy-intensive industry such as high tech industry in a number of ways. Subsidies may be given to encourage more energy efficient buildings, homes, and machinery. Development of public transit systems to reduce the need for private vehicles may be enacted concomitantly with increases in taxes on gasoline. Pollution standards may be lowered to permit the use of "dirty" coal or lignite sources that could not otherwise compete. All conservation measures have economic, political, or environmental impacts which must be considered by policy makers. With aid of this conceptual framework of policy alternatives, the researcher examines the energy policy alternatives, the energy politics, and the policy responses to the energy crises in both nations.

Since policy evaluation or assessment is essential and inevitable in comparative policy research (Anderson, 1978, p. 41), the researcher will assess the consequences of energy policies, and compare the differences resulting from the energy crises and the energy policies. In doing so, five regression models are developed to help answer research questions raised about the different outcomes evident in these two countries. Energy demand, supply, productivity, domestic oil prices, and economic growth are the dependent variables in these regression models. An attempt is made to find out how three categories of independent variables, namely, sociodemographic and energy-economic, policy, and political variables, affect these dependent variables. Results from these statistics helped to answer the research questions as to how the energy crises, energy policies, and other factors affected the nations.

Research Questions

Using the three fore mentioned conceptual frameworks, the researcher raised a number of research questions to guide the study. These questions are as follows.

1. What are the characteristics of the energy systems, regarding energy supply and demand in these two nations? What percent of energy is produced domestically as compared with energy imported from other countries?

2. Who are the decision-makers in energy politics in both of these countries? What were the respective roles of government and private enterprises before and after the energy crises in these two countries? What were the major political conflicts over the energy policies in each of these countries during the period of 1970-1985? How were the political conflicts over energy policies resolved?

3. What are the contents of the policies taken in response to energy crises at different stages in these two countries? What possible policy alternative actions were considered as ways of alleviating the energy shocks?

4. How can the consequences of energy policy be assessed? Can the difference in energy demand be attributed to the energy crises and policies? How did the oil crises and resulting energy policies effect the national energy supply? How is energy productivity different in the various economic sectors of these two countries? What explains differences in domestic oil price changes? And why did the world's energy environmental changes effect economic growth differently?

Data Collection

Since this study proposes to examine energy politics and policies in the two countries, data regarding socio-demographic, economic, and political aspects of the environment have to be collected. Government documents, statistical abstracts, public laws, administrative regulations, plus scholarly literature on energy policies provided much of the information pertaining to demographic and economic matters. Other data also have to be collected pertaining to energy sources within each of the countries, such as percentage of domestic and foreign energy, price and demand for energy, requirement and use by various sectors, governmental activities such as taxation, regulation, redistributing, and promoting energy research and development, distribution, and use.

Information pertaining to the politics of energy policy, in part, was obtained from interviews with key actors in the energy field, and, in part, from the historical and scholarly literature on the subject of energy. The researcher discussed with key administrative officials in major energy agencies of the Republic of China, energy policies for the two countries. The researcher also gathered information from the Economic Energy Conference of the Asian Area which held in Taipei in December, 1986. From papers delivered at the conference and discussions with representatives in attendance from both countries, insights were gained about the politics of energy, interests of energy-related groups, and the strategies of the various groups seeking to affect energy policy. From these general discussions with energy administrators and other scholars, plus information gleamed from a review of the literature on energy policies in the two countries, the researcher was able to identify key actors in the policy arena.

Finally, the policies enacted were studied through examining statutes and administrative regulations in the two countries, and an assessment of the consequences of these energy policies was made using the economic, social, and political data previously described. Data on regional and international development affecting these countries were obtained from various sources, including the Asia Bank, the World Bank, the International Energy Agency (IEA), the Organization for Economic Cooperation and Development (OECD), and International Petroleum Encyclopedia, etc.

Basically, the primary data are used to help compare and assess the effect of the energy policies on conditions within these countries. Data in this study are analyzed with simple methods such as percentages and ratios. Also, multiple regression analysis is used to assess the consequences of the energy crises and the energy policies. In this dissertation, multiple regression analysis permits the reseacher to explore the impact of governmental energy policies and energy crises on total energy demand, total energy supply, energy productivity, domestic oil prices, and economic growth. In short, the focus is on explaining differences across time through the use of multiple regression analysis (Chandler and Vogler, 1974, pp. 107-118).

Specifically, the researcher compares such factor as the percentage of domestic and foreign energy used from 1970 to 1985 in the two countries. Did the policies make the countries more independent from exterior energy sources? The cost of energy on a constant dollar basis also is considered for this period. Did the policies help keep prices stable? The growth of GDP in the period before the oil crisis and since the crisis is examined to see if the energy policies help to protect the economy from exterior shock. The growth of various economic sectors was analyzed to see if major changes in growth patterns occurred as a result of the energy policies. Also, possible economic and energy structure changes that might be caused by energy policies are examined.

Limitations of the Study

A number of research problems emerge in the process of gathering data for this study. First, there is no single source which contains the full range of the needed statistical data. Consequently, the data have to come from many different sources, which sometimes provide conflicting figures. An effort to solve this problem is made by choosing that the most primary sources.

Second, the data for energy supply and demand are presented in different units of measure in the various publications. For this study, a conversion factor is used when possible for providing comparability in the production and consumption figures for each energy source. Since oil is still the most important fuel source, a better perspective on the energy situation can be gained by examining each fuel source in terms of oil. To do this, does not imply any deficiencies in the other possible units of measurement. Much of the energy data is converted to the unit of oil equivalent such as the kilogram of oil equivalent (KLOE) or million tons of oil equivalent (MTOE), etc.

The comparability of economic data from these two countries also presents problems. The fluctuations in market exchange rates produce distortions in the translation of economic data from one currency into another. In order to make up this deficiency the Gross Domestic Product (GDP) rather than the Gross National Product (GNP) is used as the measure of economic productivity. The GDP is used because it contains only a nation's domestic economic activity, while GNP includes net overseas income. The point is that "since domestic energy consumption is being analyzed, the GDP appears to be the more appropriate measure to employ." (Darmstadter et al., 1977, p. 5).

Another research problem involves the sensitivity of the energy issues in the politics of the nations being examined. Energy plays an important role in a broad range of strategic interests in these two countries, in the region, and in international affairs. Some data about such an issue is not available to the researcher. Data about the political conflict involved in the process of energy policymaking also is difficult to collect because these countries are not as open as the Western democracies. Accordingly, the general methodology in the social sciences such as sampling, interviewing, and popular attitudes testing was not used. In short, survey research material on energy issues is more difficult to obtain because of the nature of political systems in these two countries (Burch & DeLuca, 1984, pp. 177-81).

Organization of Dissertation

This dissertation includes seven chapters. The content of each of the chapters is summarized below:

Chapter I, "Introduction," describes the purposes, the methodology for comparative policy analysis, and the sources and methods of data collection about the energy policies in the Republic of China and Japan. Three conceptual frameworks on energy politics are used to raise the key research questions guiding this study.

Chapter II, "Energy Politics and Policy: A Literature Review," reviews the contemporary policy literature and then reviews the literature pertaining to energy policy on the ROC and Japan.

Chapter III, "Comparison of Energy Systems in the ROC and Japan," focuses on the sociodemographic and economic differences of the energy systems in the two countries. A comparison is made of similarities and differences in the energy systems in these two countries.

Chapter IV, "Comparison of Energy Politics in the ROC and Japan," examines the political actors and policy processes in the two countries. How the politics of each country affects policymakers in designing a national energy policy is also considered.

Chapter V, "Policy Responses to the Energy Crises in the ROC and Japan," examines the approaches adopted by these two countries in response to the energy shocks over the past two decades. Government documents and administrative regulations of the two countries are examined.

Chapter VI, "Assessing the Consequences of Energy Policies in the Republic of China and Japan," presents five statistical models in order to assess the impact of the energy policies, energy crises and other factors on the total energy demand, total energy supply, energy productivity, domestic oil prices, and economic growth in the two countries. Multiple regression analysis is the major quantitative technique for this assessment work.

Finally, in chapter VII, "Summary and Conclusion," summarizes the findings about these two countries and attempts to answer the research questions. It also provides a view on the significance of comparative study of energy policies.

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CHAPTER II

ENERGY POLITICS AND POLICY: A LITERATURE REVIEW

After the second World War, low prices for oil seemed to promise a never ending source of cheap energy. Discoveries of huge oil resources were found in the United States, Mexico, and the Middle East, particularly in the Persian Gulf area. The abundance of oil caused prices to be low, and the cheap and abundant energy source rapidly replaced the use of coal throughout the world. As a result of the cheap energy, energy cousumption grew rapidly as economic development spread. Between 1948 and 1972 oil consumption in non-U.S. and non-Communist countries rose from 2.4 million barrels per day (b/d) to 26.2 million b/d, an elevenfold increase. Similar the United States energy growth rate has averaged 3.4 per cent from 1954 to 1973 (Rotty, 1979, pp. 883-5; Ghadar, 1983, p. 4). This growth in oil consumption was accompanied by a declining reliance on domestic coal, and in a sense, this economic situation weakened oil-importing countries control over their own energy systems, since coal was a national industry and the oil-industry was organized internationally.

Until the late 1960s and early 1970s, energy policy was seldom a major concern of governments. Much of the literature dealing with energy issues in this time focused on such issues as utility regulation, rate-making, technical engineering reports, reports on energy reserves or production, or the composition of the oil industry (Leeman, 1962; Mikdashi, 1966; Frank, 1966; Penrose, 1968; Odell, 1970). Energy was not an area of critical government concern. The major concerns of nations at this time focused on economic growth, industry recovery and national defense policy, although the studies on national defense seldom considered the vulnerability resulting from the heavy reliance on international oil sources. As a result, there were no elaborate national energy policies at this time. Paul Kemezis and Ernest J. Wilson writing about this period state that there were two main reasons why energy was not considered as a major issue. First, oil was cheap, convenient and seemingly plentiful from secure sources. Second, oil was dominanted by the multinational companies. Under such a system there was little incentive for a single government to try to make itself independent of the system (Kemezis & Wilson, 1984, pp. 10-11).

During the 1960s as the new powerful international regimes, the Organization of Petroleum Exporting Countries (OPEC) and the Organization of Arab Petroleum Exporting

Countries (OAPEC) were emerging, the oil market and political environment changed radically (Pachauri, 1985, pp. 53-75). The old era of cheap and plentiful oil supply was ending. The sudden increase in the cost of oil created a new era in which oil was to be a more costly and uncertain energy source. The role of the major actor in the old era, the multinational companies, was reduced, and the dominant actor in the new era became the oil rich exporting nations in OPEC.

Review of Energy Politics and Policy Literature

High prices, impending shortages, and continued international vulnerability now demonstrated that energy policy is inseparable from economic development and national defense policy (Lindberg, 1977, p. 9). As a result of this new recognition of the importance of energy policy, a host of new literature began to be written on the subject of energy (Fried & Schultze, 1975; Jacoby, 1975; Commoner, 1976; Kelley, 1977; Griffin & Steele, 1980). Most of the early studies were not politically oriented, they focused mainly on economics, including such subjects as oil prices and the impact of oil price on the world economy, nuclear power and nuclear reactor safety, energy-related environmental concerns, and so forth. The main reason why the earlier policy studies were dominated by economists, according to Phillip O. Foss, is that very few political scientists qualify as "expert witnesses" in any of the substantive policy areas, while economists, on the other hand, have for years had experts in most of the major policy areas (Foss, 1973, p. 69).

Furthermore, economists have dominated the policy science not only because they have actively involved themselves in policy studies, but also because political science have abdicated in the policy field (Foss, 1973, p. 69). Many of the earlier studies also discussed the significance of oil supply on national security. Kemezis and Wilson, for example, pointed out that by the end of 1970s energy was treated as an almost precious commodity, necessary to a nation's well-being and national security (Kemezis & Wilson, 1984, p. 4). Other literature considering the importance of energy supply to national defense included such works as David A. Deese and Joseph S. Nye's Energy and Security (1981), and Alvin L. Alm's Energy Supply Interruptions and National Security (1981).

There were few studies on energy politics, or studies considering energy policy systems and the policy processes. Partly, this was due to the fact that policy-oriented studies generally have been slow to develop in the discipline of political science. Since the 1950s such writers as Harold D. Lasswell have urged that policy research should become a vital part of the study of political science. In his essay "The Policy Orientation" included in Lerner and Lasswell's, The Policy Sciences: Recent Developments in Scope and Method, Lasswell provided invaluable advice to those who would engage in the analysis of public policy or, conversely, engage in the development or advocacy of public policy (Lasswell, 1960, pp. 3-15). Policy studies can be broadly defined as focusing on the nature, causes, and effects of alternative public policies that address specific social problems (Nagel, 1984, p. 1).

In the 1960s, political scientists began to use systems theory to study the actors and processes in the policy process. Systems theory explains the political process in terms of a wide variety of sources of power. The systems theorists state that public policy is determined on the basis of a wide range of political forces, and that particular policies are the result of different combinations of factors (Woll, 1974, pp. 50-1). In other words, systematic analysis of public policy requires methods and concepts that are different from those employed in micropolitical approaches. Only since the 1970s have policy studies on energy issues received major attention (Davis, 1974; Cook & Surrey, 1977; Eden, 1980, pp. 127-139; Hooker et al., 1981). One recent writer, William N. Dunn in his book, Public Policy Analysis: An Introduction (1981), provided a system framework for studying domestic energy policy process. His conceptual framework was modified and used as a guide by the researcher (Dunn, 1981, p. 261).

By the start of the 1980s, energy policy became a vital issue and the study of the energy policy processes flourished, although still dominated by economists. National energy policy and management had become a priority concern of virtually all oil-importing countries, because the promise of cheap, boundless energy supplies had been broken. Now the oil-importing countries were forced to take systematic policy steps at home and worldwide to insure they could obtain enough fuel to maintain their economies and to protect their national security (Kemezis & Wilson, 1984, pp. 12-3).

One of the earlier studies by C. A. Hooker et al., entitled Energy and the Quality of Life: Understanding Energy Policy (1981), pointed out the importance of national energy policies. The authors of this work said:

> Our discussion has emphasized that energy policy is fundamental to all social policy-making and that many of the most important areas of government policy responsibility are directly affected by the choice of energy policy.... The choice of an energy policy is a matter of great social and political moment. It amounts to the choice of the most basic structural principle in society, and every facet of the society feels the effects of that choice... It is clear that there are as many potential components to public energy policy as there are ways open to government to influence socioeconomic development... Choosing an energy policy is a fundamental part of choosing our future (Hooker et al., 1981, pp. 13-4).

Studies on Energy Policy and Politics within Nations

There were an increasing number of works dealing with the energy policy processes within single nations. David Howard Davis' Energy Politics was one of important earlier works on energy politics written in the 1970s. He provided an analytical model in which five political arenas of energy, coal, oil, natural gas, electricity and nuclear power in the United States are examined (Davis, 1982, pp. 13-4). He described his conceptual scheme or analytical model as follows:

> Energy politics depends on three sets of independent variables: physical characteristics, market forces, and the general political environment. Of the first set of independent variables, geography affects the fuel's politics directly. Specific physical proporties, such as its energy value per ton or its ease of production, influence market forces via supply, economies of scale, and natural monopoly.... The second set of independent variables focuses on the market forces that structure an industry. Certain branches of energy production have experienced instability that has led to profound political impacts. The third set of independent variables shapes the policy process. At any given time certain issues so dominant American politics that they penetrate the particular politics of each arena. These three variables interact to produce a particular process, here labeled 'the policy arena' or 'the politics of the fuel (Davis, 1982, pp. 14-7).

One of the contributions of this book is that it provides an analytic model for studying energy politics and policy processes.

More recently, Russell Mills et al., published a book entitled Energy, Economics, and the Environment (1985) with the stated intention of providing principles of energy analysis. A set of analytical techniques for energy analysis, the authors state, include physical, economic, environmental, social and political variables. It is important to note that, as the authors suggest, energy policymaking can be broken down into such five stages as energy forecasting, assessing energy supplies, limits on energy production, ownership, control, and accountability, and research, information, and promotion. They also point out that energy policymakers need to be concerned with the specifics of implementation (Mills et al., 1985, p. 375). The difference the variables stressed in this work and Davis' book reflect the different emphasis of economist and political scientist.

Historical Accounts of Energy Policy in the ROC

Many of the studies on energy policies in the ROC are historical accounts of the government's role in the energy fields. One such article in 1974, entitled "The Energy Situation in Taiwan, Republic of China: Past, Present and Future", written by K. S. Chang, a former Ministry of Economic Affairs, was one of the earlier studies on energy in Taiwan. This article reviewed the history of energy development from 1954 to 1973, and discussed plans and policies to assure an adequate supply of energy for the future. The author proposed reducing dependence on Middle East oil and diversification of energy sources from various foreign countries. This article shows that diversification was considered by governmental officials even before the first energy crisis (Chang, 1974, pp. 1-12).

Another study by John F. Copper, in Gerard J. Mangone's Energy Policies of the World: India, Japan, Taiwan (1979), provided a historical review of the energy situation in Taiwan from 1895 to 1978. He pointed out that until the late 1970s the key problem of energy policy for the ROC remained the heavy dependence upon petroleum imports from only two Arab states, Kuwait and Saudi Arabia. He proposed that nuclear power generation be developed as an energy substitute for oil. Problems of pollution caused by energy use was another issue discussed. Finally, he considered the territorial disputes over potential rich oil and gas fields offshore in the Taiwan areas.

Still, another group of basically historical studies described energy policies in specific countries and often made recommendation as to what needed to be done. One such article by David S. L. Chu, entitled "National Energy Policy and Program of Taiwan, Republic of China" (1979) traced why Taiwan needed a national energy policy. The author stated that a national energy policy "is to guide the management and development of the energy industries to be compatible with and supportive to the overall economic objectives" (Chu, 1979, pp. 2-3). In general, this article was a statement of why the current energy policies needed revision.

Another more recent article describing energy policies in Taiwan is Chi-yuan Liang's article, entitled "Energy Supply and the Viability of the Economy of Taiwan, the Republic of China." This article provided a comprehensive study on various energy policy issues in 1986. Indeed, this study not only reviewed the energy situation in Taiwan from 1965 to 1983, but also examined the impact of the energy crises on the economy, and made suggestions regarding policy options for the future (Liang, 1986, pp. 109-37). As can be seen from these writings, there has not yet been a study that deals fully with energy politics and policies in Taiwan.

Historical Accounts of Energy Policy in Japan

There also have been a number of energy policy studies on Japan. Rocco M. Paone's chapter in Energy Policies of the World: Indian, Japan, Taiwan (Mangone, 1979) traced the historical development of energy policy in Japan since 1973. He described the current national energy conservation plans of Japan and their likely effect upon petroleum, coal, and nuclear power. He also looked at long-range energy planning and forecasts, and concluded that there is a number of obstacles that Japan must overcome to achieve its energy goals and maintain its phenomenal economic growth (Paone, 1979).

Another historical study of Japan's responses to the energy crises is Hirofumi Shibata's article "The Energy Crises and Japanese Responses" (1983). In this article, the author discussed the Japanese government's responses to the energy crises. Although basically a historical-economic study, the article examined the important factors contributing to the Japanese success in coping with the energy shocks. Governmental energy policies responses are evaluated by the author. The key finding is that governmental microeconomic guidance and policies have apparently contributed little toward alleviating the energy crises in Japan. Rather, the author says the major reasons why Japan has been able to cope with the energy crises are:

> Japan's economic success... stems not so much from specific governmental energy policies but from the initiatives and dynamism of management; from restrained labor movement; from continued high private saving rates; from high adaptability of business and government to the international environment; and from the swiftness of adjustment of industrial structure and production process to the changing world energy conditions (Shibata, 1983, p. 153).

The historical economic study entitled "The Remarkable Adaptation of Japan's Economy" by Teruyasu Murakami (Yergin and Hillenbrand, 1982) provided a historical review of how the Japanese government adapted its economy and society to the energy crises. Since the Japanese economy is so dependent on imported oil, three policy responses were considered to minimize the damages caused by the 1973 and 1979 oil shocks. The three policy responses were: (1) crisis management to minimize the initial damage to the economy; (2) lessening dependency upon OPEC oil by reducing the use of oil and developing alternative sources of energy; and (3) international cooperation between consumer countries and OPEC attempting to provide a stable supply of oil and at a reasonable price (Murakami, 1982, pp. 146-52). The author suggested that changes in energy demand and supply structure are the essential strategies which Japan needed to follow in order to cope with energy shortages and to maintain its economic growth.

Joji Watanuki's article "Japanese Society and the Limits of Growth" (Yergin and Hillenbrand, 1982) provided a different viewpoint on how the Japanese government and bureaucracy responded to the energy crises. One of the significant questions raised in this work is why did the 1979 shock not set off the same crisis reactions as seen in 1973? The author explained it as follows:

> First of all, unlike the conditions in 1973, the Japanese economy was healthy and stable before the crisis... Second, consumers had learned that panic buying was harmful to their own interests. Third, corporations refrained from speculation. Finally, the mass media, taking care not to influence the inflation consciousness of the public, refrained from sensational reporting and pessimistic forecasts of price rises (Watanuki, 1982, p. 183).

In attempting to solve its energy problems, the Japanese bureaucracy played an important role during the era of energy crises in managing energy regulations, energy conservation, and energy R & D. The author concluded that although the Japanese political system is not suited to producing strong political leadership, it is capable of cautious guidance and steady policy implementation through its bureaucracy (Watanuki, 1982, pp. 197-8).

Other literature focused on the goals of energy policies in Japan, and the politics involved in making and implementing energy policies. Yujiro Eguchi's article (1980) on Japanese Energy Policy considered the main goals of Japan's energy policies. It concludes that these goals are securing enough oil to ensure steady growth for the economy, diversification of energy away from petroleum and into coal, nuclear and LNG, as well as diversification to other oil producing countries other than those in the Middle East. Basically this article is an economic evaluation of the potential of the various possible energy sources. The author makes the argument that Japan lacks a comprehensive energy policy because of the variety of disparate actors in the policy system (Eguchi, 1980, pp. 263-79).

One of the more significant recent books related to energy politics in Japan is Ronald A. Morse's The Politics of Japan's Energy Strategy: Resources, Diplomacy, Security (1981). This book included articles written by a number of specialists on Japanese energy politics. In attempting to link the domestic Japanese policy process to the broader international energy context, the authors examine the complexities of the domestic public policy process in Japan and how it affects international relations. They generally agree that Japan has been somewhat less successful in the energy area than is generally perceived (Morse, 1981, p. ix). Despite the number of studies on Japan's responses to the energy crises, there has been a few study on energy politics and policy processes, and even Morse's book does not provide a complete overview of energy politics and processes in Japan.

Studies on Energy Policy: International Politics

Paul Kemezis and Ernest J. Wilson's The Decade of Energy Policy: Policy Analysis in Oil-Importing Countries (1984) examined how the oil-importing countries reacted to the energy crises on a worldwide basis. Since the most significant change in the 1970s was the universal shift by governments away from passive energy policies to active ones, the authors called this phenomenon, the Energy Policy Explosion. The energy policy explosion was much more than simply finding a new way to solve old problems; it involved new policy instruments and governmental entities needed for energy matters, and the very activitism of the governments created new public awareness and interest groups (Kemezis & Wilson, 1984, p. 27). The consequence of the energy policy explosion was more government involvement in both domestic and international energy markets. Two main purposes of this book are to demonstrate the full range of governmental responses and organizational adjustments to the energy crises, and to document, compare, and explain how oil-importing countries have tried to adapt to the new oil regime. The authors believed that to study other countries' energy policies is necessary for minimizing international tensions and conflicts. Similarly, to encourage or enlarge international cooperation, as the International Energy Agency (IEA) did in the past decade, also improves the international energy environment (Kemezis & Wilson, 1984, pp. 24-5).

Peter F. Cowhey's The Problems of Plenty: Energy Policy and International Politics (1985) is another important recent study on energy policy at the international level.

It examines the interplay of technology, economics, and politics in the world energy market. It particularly emphasizes how shifting international coalitions of governments and businesses have altered the world market since 1914. First, the author traced the evolution of energy policy from 1918 to the present time. The primary purpose of this study is to develop a typology of management strategies to describe the actions of various actors in the international energy market. The author stated that each strategy is a product of a combinations of economic, technical, and political factors pertaining to how actors understand their interests and perceive the distribution of risks and rewards in the world market. Thus, the management strategies are for coping with international tensions and for reducing conflicts among actors. Finally, the author suggested that a sound energy policy must enhance the ability of political institutions to learn about energy problems and to manage conflicts arising over energy policy, as well as improving the technical and economic performance of the energy sector (Cowhey, 1985, p. 25).

For studying Japan's resource diplomacy at the international level, F. Quei Quo's work in Ronald C. Keith's _Energy, Security, and Economic Development_ (1986) presented a picture of how the Japanese government sought to diversify energy resources away from the Middle East. To carry out resource diplomacy on a worldwide base, three main strategies have been adopted by the Japanese government since the late 1960s. These strategies are as follows. First, the government played the key role by providing loans, grants, loan guarantees, and tax advantages to both Japanese businesses or joint ventures with resource rich countries. Second, Japan joined IEA to ensure sufficient energy imports should supplies be limited. Finally, Japan established its essential energy-intensive industries, such as petrochemical and steel, in the energy-rich countries as Japanese firms or as joint ventures. Despite these efforts, resource diplomacy can only be regarded as a palliative rather than as comprehensive solution to continuing dependence on the Middle East oil according to the author (Quo, 1986, pp. 179-83).

Comparative Studies on Energy Politics and Policy

There has been an increasing recognition of the value of comparative energy policy studies as pointed out by Richard Rose in 1976. Rose said:

> The comparative approach is valuable, because it enables one to see to what extent problems that face one country are the same as those that face its neighbors. When a government's policy stipulates nationwide uniformity, it is only by cross-national comparison that the causes and consequences of differences can be examined... Policies that seem 'obvious' in one national context may be 'unthinkable' in another, because of differences in political culture and political ideology, not because there is anything intrin-

> sically impossible or compelling about them (Rose, 1976, p. 28).

Despite this recognition of the value of comparative policy studies, there are still relatively few using a comparative approach with more than one nation. All oil-importing countries have been forced to adapt their policies and actions since the 1970s, but the domestic differences in the energy, economic, and political systems result in different policies and ways of adapting to the energy crises. Each country has a different environmental mix which results in different policies to achieve their national purposes. Comparative policy studies thus need to consider the environmental differences in national economic, energy, and political differences, as well as the differences in political processes in the various countries.

Many of the comparative policy studies on the energy field were done by economists and the focus is mainly on economics or history of economic development rather than politics or policy processes. One such comparative study of energy policy was edited by Leon N. Lindberg. His book entitled The Energy Syndrome (1977), compared the energy policies within seven nations and suggested that national energy policies share three common characteristics in the postwar period. These three characteristics are as follows: (1) all nations have continued increases in energy consumption; (2) public policies focus almost exclusively on the supply side; and (3) there are institutional and structural obstacles to the adoption of alternative policies (Lindberg, 1977, p. 325). The author describes the process of energy policy making as follows:

> The energy policies in all nations involve a bargaining and exchange process among a multitude of actors that is orchestrated in some fashion by complex governmental bureaucracies that are themselves the congeries of more or less loosely articulated agencies with a variety of tasks and definitions of the situation. Government acts simultaneously (or different agencies do) as consumer, producer, broker, regulator, and promoter. In so doing, the various national agencies are from more or less stable alliances with 'outside' industrial, professional, or special interest groups that lead them to different policy position (Lindberg, 1977, p. 11).

Another comparative study on three Asian countries, the ROC, the ROK, and Japan, was made by Chen Sun and Chi-yuan Liang in 1980. With a comparative examination, these authors examined the energy supply and demand for various kinds of energy in the three countries, and considered the plans by these countries for meeting energy supply needs. Basically, it is an economic study which contends that the long run solution to the energy problems lies in technological progress and cooperation between oil-exporting and oil-importing countries. It does not consider energy politics or the policy process.

Still another comparative study of energy policies written by Joy Dunkerley et al., is entitled Energy Strategies for Developing Nations (1981). The authors focused on developing countries and the world energy crises. They stated that "doing something about the energy problems of the developing world involves, first of all, understanding what the situation really is" (Dunkerley, 1981, p. xiv). And in the foreword they stated their intent is to offer a way of thinking about energy policy. They develop a number of energy strategies for developing nations, and most of the book discusses the economics of energy. Again, this work does not deal with the politics of energy or with the policy processes.

The Energy Balance in Northeast Asia (Yager & Matsuba, 1984) compared the energy responses of South Korea, Taiwan and Japan with those of three other industrialized countries, Australia, Canada and the United States. Special attention is paid to how the nations adjusted to the oil crises and to the relations between energy security and foreign policy. The authors found that the most significant energy development in these three Asian countries is the continuing shift from primary dependence on Middle Eastern oil to a dependence on a variety of energy sources mainly from Pacific countries. The authors in this work also projected possible future energy requirements in Northeast

Asia, and estimated the quantities of fuels--oil, coal, natural gas, and uranium--that would be needed to meet these requirements. As can be seen from the contents of this work, it is basically a study of the economic responses to the oil crises and economic projections. It is not a study of energy politics or the policy processes.

Studies on Assessing Energy Policies

The importance of evaluating energy policies was pointed out by the Executive Director of the IEA, Ulf Lantzke, in his article "Energy Policies in Industralized Countries: An Evaluation of the Past Decade" (1984). He stated that despite much progress in the matters of energy conservation, international pricing of crude oil, fuel-efficiency standards, and energy R & D in the decade of 1973 to 1983, industrial countries need to continue assessment of energy policies, and to continue improving energy efficiency. He did not provide, however, a methodology for evaluating energy policies (Lantzke, 1984, pp. 11-7).

With the evolution of energy policies over the past few decades, it naturally has become important to measure the performance of energy policies and to determine which policies are more effective. As a result, the emphasis on assessing or measuring performance in energy policy, the field of evaluation developed. Evaluation, Michael Scriven states, is itself a methodological activity, which consists simply in the gathering and combining of performance data with a weighted set of goal scales to yield either comparative or numerical ratings (Scriven, 1972, pp. 123-4). The purpose of evaluation research, in short, is to measure the effects of a policy or program against the goals its sets out to accomplish as a means of contributing to subsequent decision-making about policies or programs (Weiss, 1972, p. 4).

One serious problem of evaluation research, especially in the energy field, which has both national and international dimensions, is that there is no agreed-upon conceptual framework to guide this research. Much of the evaluation research thus measures goals on the basis of the evaluators' own perceptions and value, not on the basis of some kind of objective measure of national or international goals (Doctors & Workutch, 1980, pp. 34-5). As a result, the findings of such evaluations are biased despite use of data gathered objectively and dispassionately. The problem of weighing goals in the international arena is even more difficult.

Another problem in evaluation research is lack of appropriate data. Policy assessment or program evaluation is highly dependent on the use of appropriate data and analytical methods. Without appropriate and accurate data attempts at evaluation are worthless. Pessimism grows regarding the ability to obtain data or to select appropriate methods to full assess the impact of complicated policies which intertwine with almost every aspect of society as energy policies do. In developing countries, such pessimism regarding data is especially prevalent. The problem of gathering appropriate data for assessing national energy policies was spelled out by C. M. Siddayao (1986). He stated that in most countries, only sample data of questionable general applicability are available, and thus reported usage for some countries may be over- or underestimated (Siddayao, 1986, p. 14). An analyst from an Asian country reported, for example, that estimates of consumption were based on data deduced from aerial observations showing the degree of denudation of forests at two points in time (Siddayao, 1986, p. 14).

Other writers contend, however, that lack of data is often an excuse for not undertaking rigorous assessment research. For example, Shinichi Ichimura and Mitsuo Ezaki state that many economists believe that statistical data in most under-developed countries are still poor in quality and insufficient in quantity. But these authors claim that this is not necessarily true in many countries, and often the question is a matter of degree (Ichimura & Ezaki, 1985, p. v).

An even more serious problem of evaluating energy policies grows out of the inability to accurately model how the complex, interdependent energy system works domestically and internationally. This inability mainly grows out of the lack of understanding. Model-building the energy field involves many variables both domestic and international which interrelated with all aspects of society, economic, social, demographic, legal-political, and technological. Most energy models, therefore, are extremely deficient (Greenberger & Richels, 1979, p. 145). The U.S. Congress, for instance, in attempting to deal with the complex issues of energy policy in 1974 found that there was no agreement as to various models upon which forecasts or evaluations were being made. The assumptions, data, and theoretical bases of energy models, therefore, were suspect. As a result, a program entitled the Project Independence Evaluation System, (PIES) was created to help validate energy models used for forecasting and assessing policies (Gass, 1981, p. 422). The importance of validation in model assessment is discussed by Saul I. Gass:

> The process of model evaluation is one by which interested parties can assess the model and its results in terms of its structure and data inputs to determine, with some level of confidence, whether the results can be used. Thus, the outcome of an evaluation can be interpreted as a recommendation to policymakers to use or not to use the outputs of a model (Gass, 1981, p. 422).

Other concerns of how conceptual difficulties complicated analytical studies in an area such as energy demand are presented by C. M. Siddayao in his book entitled Energy Demand and Economic Growth: Measurement and Conceptual Issues in Policy Analysis (1986). He listed a number of problems regarding systematic studies of energy demand, such as boundary issues, indexing problems, aggregating energy data, and accounting for energy variables (Siddayao, 1986, p. 17).

Sunwoong Kim' article, "Models of Energy-Economy Interactions for Developing Countries: A Survey" (1985), attempts to review models of energy-economy interaction in developing countries or newly industrialized countries. He critically reviews a number of energy-economy models for estimating total energy demand functions of the energy policies in developing countries. The author provided two major observations. First, the environment of a country is a prime determinant in formulating policy questions and the choice of modeling approaches. Certain types of models are sometimes more useful to certain types of policy questions. Second, models for analyzing the energy-economy interactions for developing countries are far from satisfactory. It is true that one major barrier to improved methods is the unavailability or unreliability of data sources in most of the developing countries. The author suggests that more research efforts should be devoted to data collection and model-building to meet the environmental condition of specific countries (Kim, 1985, pp. 141-64).

Summary

As can be seen from this literature review, much of the literature on energy issues has been written since the crises of 1973 and 1979. Economists have led the field in producing works on energy policy. Many of these present a historical account of economic aspect of energy policies. Relatively few political scientists have yet written about the politics or policy processes of energy. Fewers still have attempted to undertake comparative studies of energy policies of nations or have considered international politics of energy. There are few models of domestic energy policy, and none that adequately links domestic and international politics. Neither is there an established body of research on evaluation of energy policies. Many recognize the need for such understanding, but as of yet no works adequately provides a conceptual framework for studying the complexities of energy politics and policies.

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CHAPTER III

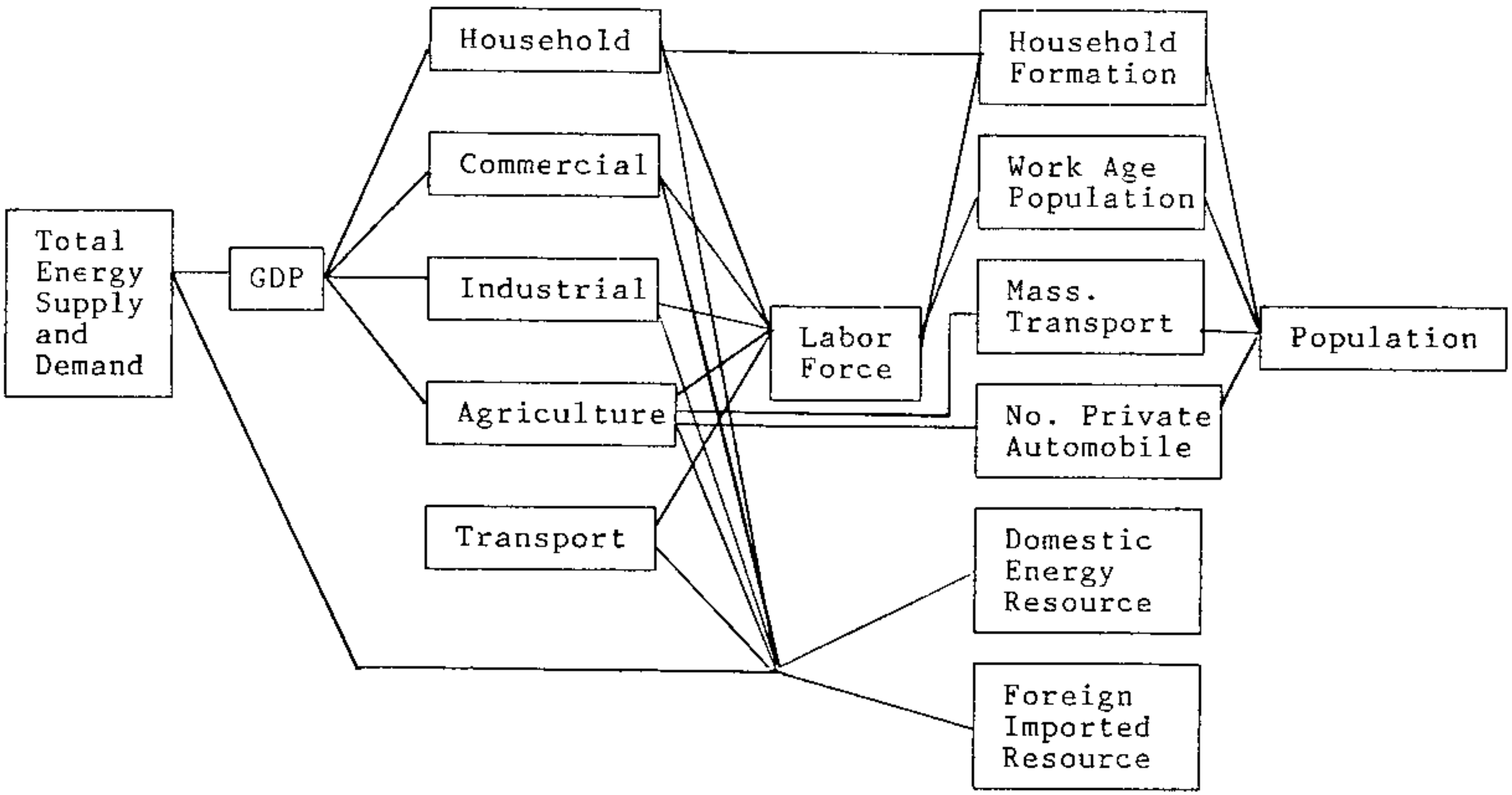
ENERGY SYSTEMS IN THE REPUBLIC OF CHINA AND JAPAN: A COMPARISON

In the Fall of 1973, the Organization of Petroleum Exporting Countries (OPEC) countries increased their export prices for crude oil from $4 to $12 per barrel. The shock of a three hundred percent increase in the price of oil seriously damaged the economies in both developed and developing countries, creating stagnation and inflation in the world economy (El Serafy, 1979, pp. 273-90). The economies of the Republic of China (ROC) and Japan were no exception, and indeed, the damage incurred by these countries was more severe than in most other countries because their economies depended more heavily on imported energy resources. Similarly, the second oil crisis in the Spring of 1979 caused the price of oil to jump to $25.26 per barrel, another one hundred percent increase. This also had a serious impact on the global economy including the economies of the ROC and Japan. The seriousness of these energy crises forced governments throughout the world to enact energy policies which would make them less dependent on the international oil market. The governments of the ROC and Japan were among those enacting policies seeking to promote energy conservation and to substitute coal, nuclear power, and other energy sources for oil in order to make themselves less susceptible to the international market.

The energy crises found both of these nations without an overall energy policy and unprepared to face effectively the new situation in terms of organization or management and technical skills. This chapter examines the characteristics of the energy resource systems in the two countries, the ROC and Japan. Understanding the nature of a country's energy system calls for an examination of the various sociodemographic and economic factors which influence energy demand and sources of energy. Figure 3 which shows the sociodemographic and economic variables affecting a national energy system was used as a guide in making the comparison of the energy systems in the two countries.

Two questions are examined in the chapter: (1) What are the characteristics of the energy systems, regarding energy supply and demand? and (2) What percent of energy is produced domestically as compared with energy imported from other countries? In order to answer these two questions, the chapter is divided into three sections dealing with the following: (1) the energy system in the ROC; (2) the energy system in Japan; and finally (3) a comparison of energy systems between these two countries.

Figure 3
Sociodemographic and Economic Variables Affecting
A National Energy System



Adapted from: Corazon M. Siddayao, Energy Demand and Economic Growth: Measurement and Conceptual Issues in Policy Analysis, (Boulder, Colorado: Westview Press, 1986), p. 28.

Energy System in the Republic of China

Taiwan, the island province of the Republic of China, occupies an area of 36,000 square kilometers, roughly equal to the size of the Netherlands. Its population of over 19.1 million in 1985 was approximately the same as Australia (15.8 million) and New Zealand (3.3 million) combined. About 59 percent of the total population in 1985 was in the labor force leaving 41 per cent in the dependent category. In 1985, Taiwan had 39.5 per cent of its population under 19 years of age, a relative large percentage of young people who are coming on to the labor market in the next few years. Taiwan, therefore, must continue to increase its rapid development in order to absorb this large influx of young workers into this labor market.

Taiwan's economy in the post World War II era grew rapidly as a result of assistance from the United States and an annual investment rate of more than 10 per cent of its National Net Profit. United States aid during the period of 1951-1965 was used mainly to expand the infrastructure, including electricity, transportation, and communication and was indispensable to the economic development of Taiwan (Kuo, pp. 18-9). More recently, the government constructed industrial districts and developed export processing zones. An export-oriented industrial sector was stimulated through the attraction of foreign direct investment and the implantation of technology by the multinationals (Ting, 1985, p. 9). Many important American companies established plants in Taiwan as a result. The great economic strides made by Taiwan since 1960 are reflected in Table I which shows indicators of consumption in the country.

Table I
Selected Indicators of Consumption in Taiwan
(1960, 1970, 1985)

	1960	1970	1985
Per Capita Income Index (1952=100)	272.3	753.6	5,976.5
Labor Force (1,000 persons)	3,617	4,654	7,651
GNP (1952=100)	362.1	1,312.7	13,954.3
Employment by Industry (1,000 persons)	3,473	4,576	7,428
Imports (US$ million)	296	1,524	20,102
(1981=100)	20.1	24.6	110.8
Exports (US$ million)	164	1,481	30,722
(1981=100)	25.2	38.6	98.8
Railway & Highway Traffic			
Passengers (million)			
Railway	121	138	131
Highway	261	573	1,028
Vehicles			
Sedans	6,395	28,849	830,315
Trucks & Wagons	3,994	26,850	366,335
Motocycle	26,468	701,421	6,588,854

Source: Taiwan Statistical Data Book, (Taipei: Council for Economic Planning and Development, ROC, 1986).

The performance of Taiwan's economy in the 1960s was characterized by rapid growth and relatively stable consumer prices. During 1961-1971, the real GNP grew at an annual average rate of 10.2 per cent in each year. As Table II shows, the index of GNP growth, with 1952 equaling 100, grew to 506.6 in 1971 and since then has increased to 1,539.1 in 1985. Consumer prices were relatively stable in this period. From 1961 to 1971 consumer prices increased at an annual rate of 2.9 per cent. With the coming of the energy crisis, however, problems of inflation began to plague the ROC. The 1973 increase of OPEC oil prices had a serious effect on Taiwan's economy. The inflation rate jumped to 40.6 per cent in 1974, and the growth rate of GNP dropped to only 1.1 per cent. As a result of a number of corrective governmental actions to deal with this economic crisis, inflation in 1975 was slowed, and the economy recovered to register a 4.2 per cent growth. The rise of oil prices in the second oil crisis of 1979 and 1980, again created problems for Taiwan's economy. Wholesale prices rose at annual rates of 13.8 per cent in 1979 and 21.5 per cent in 1980, while the GNP growth rate declined to 8.1 per cent in 1979 and 6.6 per cent in 1980. Thus, the inflation rate during the second oil shock was about half that of the first shock (Kuo, 1983, pp. 199-201). Table II shows also the rate of inflation in Taiwan from 1970 to 1985.

Table II
Fluctuations of Growth and Inflation Rates in Taiwan

	GNP (Index 1952=100)		Consumer Prices (Index 1981=100)		Wholesale Prices (Index 1952=100)	
	GNP	% of Change		% of Change		% of Change
1970	448.7	11.3	31.90	3.5	237.96	0.02
1971	506.6	12.9	32.80	2.8	238.02	4.50
1972	574.0	13.3	33.78	2.9	248.57	22.90
1973	647.6	12.8	36.54	8.1	305.44	40.60
1974	654.8	1.1	53.89	47.5	429.40	-5.10
1975	682.8	4.3	56.71	5.2	407.63	2.80
1976	774.9	13.5	58.13	2.5	418.85	2.80
1977	852.8	10.1	62.22	7.0	430.46	3.50
1978	971.4	13.9	65.81	5.8	445.65	13.80
1979	1,053.6	8.5	72.23	9.8	507.28	21.50
1980	1,128.7	7.1	85.96	19.0	616.55	7.60
1981	1,193.1	5.7	100.00	16.3	663.53	-0.30
1982	1,232.4	3.3	102.96	2.9	662.34	n.a.
1983	1,329.6	7.9	104.36	1.3	654.52	n.a.
1984	1,469.5	10.5	104.33	-0.2	657.66	n.a.
1985	1,539.1	4.7	104.16	-0.1	640.63	n.a.

n.a. = not available

Source: Taiwan Statistical Data Book, (Taipei: Council for Economic Planning and Development, ROC, 1986), pp. 24, 175, 182, and 190.

Historically, ROC's government around the 1960s began shifting the strategy of industrialization for the country from one of import substitution to one of the production and promotion of export goods. After about 1970, it changed the strategy again to emphasize capital-intensive heavy industrialization and enlargement of the industrial infrastructure. More recently, the strategy has been aimed at building "knowledge-intensive" high-technology industries (Johnson, 1981, p. 15).

The underlying reason for changing its strategy in the 1960s from the inward-looking, import-substitution to the outward-looking industrialization and export-oriented economy was the scarcity of natural resources, especially energy resources, combined with the relatively large population needing to be productively employed. This strategy coupled with the scarcity of domestic energy supply, led to an increasing dependence on foreign energy sources. An increasing volume of energy imports were necessitated by economic growth. But payment for this imported energy could be made only if there was an uninterrupted expansion of foreign exchange earnings from exports and investments in foreign countries (Wu, 1985, p. 5). Under this circumstance, therefore, the government sought to reduce dependence on imported energy, particularly oil, by encouraging the use of alternative sources, primarily gas, coal and nuclear power. Because of the scarcity of domestic energy sources, it also promoted exploration and investment in alternative energy sources abroad and attempted to diversify its sources of energy. Also, the government undertook a number of programs to encourage the development of industries that were not big consumers of energy (Tanzer, 1982, pp. 28-9; Gold, 1986, p. 106).

Domestic Energy Sources in the ROC

Taiwan is not blessed with a large supply of domestic energy sources. Although it relies most heavily upon oil as a source of energy, "it has limited indigenous resources and is almost completely dependent on overseas sources for crude oil, the main source of energy for the economy" (World Directory of Energy Information, 1982, p. 150). The small oil production in Taiwan is operated by the Chinese Petroleum Company (CPC), a state operated agency, which began operation in 1946. Its total annual production since 1970, shown in Table III, amounts to a very small fraction of the country's total oil use; amounting to no more than 2 per cent in the past two decades.

Before the second energy crisis in 1979 and the oil discoveries in the South China Sea and the Taiwan Strait CPC began to extend offshore exploration in conjunction with the United States and other business partners (World Sourcing Sites in Asia, 1979, pp. 342-3; Cooper and Segal, 1981, p. 3). Although some oil was discovered, it was in quantities far short of domestic demands. During the period, since the second oil crisis, CPC has entered into agreements and made investments with such countries as Panama, Indonesia, and the Philippines for overseas oil drilling exploration in the

Table III
Domestic Energy Resources in Taiwan
Unit: 10^3 KLOE

	Oil	Coal	Natural Gas	Hydro Power
1971	125.9	2,822.1	1,121.4	806.4
1972	144.6	2,695.8	1,304.4	938.5
1973	168.1	2,292.0	1,505.4	861.6
1974	210.0	2,021.5	1,586.7	1,211.9
1975	214.8	2,163.6	1,574.5	1,324.2
1976	247.2	2,229.1	1,886.6	1,079.5
1977	253.9	2,076.3	1,991.1	999.7
1978	246.8	1,986.7	1,961.3	1,239.0
1979	230.6	1,873.7	1,893.3	1,140.4
1980	211.4	1,772.9	1,958.5	728.8
1981	182.8	1,684.9	1,668.9	1,189.6
1982	139.0	1,642.1	1,418.1	1,187.7
1983	134.6	1,540.4	1,470.8	1,239.0
1984	136.0	1,385.2	1,480.0	1,100.2
1985	118.1	1,279.9	1,326.8	1,720.5

Source: _Taiwan Energy Statistics_, (Taipei: Energy Committee, Ministry of Economic Affairs, ROC, 1985), pp. 76-105.

hope that oil discoveries will contribute to future supplies (Cooper and Segal, 1981, p. 3).

Domestic Coal Sources. Taiwan also has a scarcity of coal resources as is shown in Table III. According to the World Energy Conference in 1979, it is estimated that Taiwan's recoverable coal reserves were 680 million metric tons. But by 1981, the total estimated coal reserves was reduced to only 200 million metric tons. The reserves are located mainly in the North Taiwan area, and can be mined only through deep mines. As the reserves have declined so has the number of producing mines. In 1974 there were 189 coal mines in the country, compared with 171 in 1981. Most of these are small producers; only 8 are capable of producing over 5,000 metric tons of coal per month. Accordingly, the total coal production of these mines amounted to only 2.34 MTCE in 1983, as compared with the maximum production of 5.14 million m.t. in 1961 (Yih, 1982, p. 149; Campbell, 1985, pp. 128-9).

The coal industry is at present the largest individual energy producing sector in Taiwan. But the industry faces difficulties in trying to reverse past trends. The industry consists of a number of private mining companies, which are experiencing difficulties common to deep-mining operations in many parts of the world (World Directory of Energy Information, 1982, p. 152). Despite the lack of domestic coal resources, after the oil crises there has been a major effort by the government to shift consumption from oil to coal, particularly for the generation of electricity. Coal imports, therefore, increased dramastically.

Domestic Natural Gas Sources. The utilization of natural gas in the ROC also has become economically far more attractive as crude oil prices increased. Fortunately, in contrast to oil and coal resources, the ROC's natural gas production has increased over the last twenty years.

Estimated proven reserves of natural gas in Taiwan amount to 21.5 billion cubic metres (Cooper and Segal, 1981, p. 15). As a result of the relative abundance of natural gas reserves, gas has become one of the most important energy alternative under the oil-deficit situation. Natural gas consumption in 1981 was 1.53 billion cubic meters of which 32 per cent was for industrial use, 45 per cent for fertilizer production and agriculture, and 23 per cent for residential, commercial, and other uses (Yih, 1982, p. 151).

In recent years, the escalating demand for natural gas in the Taiwan area has caused the ROC's government and its business leaders to import liquid natural gas (LNG) from Australia and Malaysia. There are two fundamental reasons for importing LNG. First, domestic natural gas production is not adequate for satisfying future domestic needs. Searches for additional indigenous natural gas have not kept pace with demand and it is forecast that shortages will appear in the near future. Unless new reserves are found, there is sufficient gas for only ten years of production. Second, demand for natural gas is expected to increase as pollution problems from the use of oil and coal become more acute since natural gas is a much cleaner fuel.

The increase in demand coupled with a declining supply has forced the ROC government to consider several alternatives for meeting the demands for gas resources.

First, it has considered increasing supply through onshore and offshore exploration. Exploration and development are continuing and the country's long-term energy plans forecasts that output will double by the end of the 1980s. In any event, the scale of the gas industry's operation will expand substantially since importation of LNG will increase to complement domestic production.

Electric Sources. The sole electrical system in Taiwan, the Taiwan Power Company (Taipower), a state undertaking, is responsible for generation and distribution of electrical power. Taipower developed the various electric generating systems with hydro, oil-fired and coal-fired thermal, and nuclear power at different stages since 1962. Before the first energy crisis occurred in 1973, hydro power and oil-fired thermal power generation were the main sources in the electric power supply system. The rising demand for electricity after 1979 coupled with the uncertainty of the oil supply, led Taipower to begin converting oil-fired to coal-burning generators, and later to nuclear generating plants.

During the 1970s and the early 1980s, approximately three-quarters of all electricity was generated by thermal power stations, fueled largely on oil (World Directory of Energy Information, 1982, p. 152). Since the late 1970s, however, a number of Taipower's oil-fired units have been converted into coal burning ones. Coal-fired units have increased their output from 980 MW or 10.82 per cent in 1980 to 3,055 MW or 19.13 per cent of the total electrical power in 1985. By contrast, oil-fired units in total electric power capacity have been reduced from 5,418 MW or 59.83 per cent in 1980 to 5,282 MW or 33.07 per cent in 1985 (Taipower Statistic Yearbook, 1986). As a consequence, a large increase in the use of coal is for electrical generation with approximately 6.51 million tons being used annually for this purpose. The cost of oil-fired and coal-fired thermal power is more expensive than that of nuclear power.

Hydro-electric Resources. Taiwan's mountainous topography coupled with an average annual rainfall between 70 and 283 inches, plus periodical typhoons gives it a potential for generating hydroelectric power. At present the hydro power system consists of five dams, plus eight pondage plants and 17 small run-of-river plants. Like many other countries, hydro power was one of the earliest forms of primary energy in Taiwan, and it provided in 1971, 32.48 per cent of the country's total energy supply. Since the late 1970s, there has been a renewed interest in small hydro plants for supplying electric generation as a result of the escalation of oil prices (Foster et al., 1981, p. 229). In respect to the hydro power potential in Taiwan, it is estimated that a total of 12,000 million watt (MW) is possible but only about 5,100 MW are considered economically and technically feasible (Chang, 1974, pp. 6-7; Yih, 1982, p. 152). The percentage of energy supply by hydro power has been reduced from 32.48 per cent in 1971 to 15.59 per cent in 1985. But the actual amount of hydro generated power has increased from 901 MW in 1971 to 2,489 MW in 1985 (Taipower Statistic Yearbook, 1986). Recently, Taipower has planned two new hydro power developments scheduled for completion in 1991 (Yih, 1982, p. 153).

Renewable Energy Sources. Since the first energy crisis in the 1970s, the ROC's government has encouraged the development of alternative energy sources from renewable energy sources such as geothermal, solar, wind, biomass, and small-low yield hydro projects (Energy Policy for the Taiwan Area, 1973; Energy Management Law, 1980). Since Taiwan is located in the subtropics on the Western rim of the Pacific Ring of Fire, geothermal energy is considered to be a promising potential source of energy. It is forecast that geothermal energy will supply 169.3 thousand kilogram of oil equivalent (KLOE) by the year 2000. Solar energy is considered even a better potential source of energy. Solar energy is expected to produce an estimated total of 1,250 thousand KLOE by the turn of the century.

Wind power is also expected to be another potential energy resource in Taiwan. In fact, since 1965 there have been approximately 25 wind energy projects established to test, evaluate, or demonstrate the potential of generating power with wind mills. It is expected that wind power will produce 117 thousand KLOE, which may ultimately expand to a total production over 500 MW by the turn of century since wind energy is abundant in Taiwan (Chiu, 1985, pp. 158-66).

Biomass energy results from the chemical breakdown of plants and other organic materials such as agricultural cellulasic waste and animal manure. Since Taiwan has a subtropical climate the growth of plants makes this a promising source of continuing energy. It is forecast that by the turn of the century, 1270 thousand KLOE will be produced from this process. In addition, research is considering the use of small low-yield hydro generation and energy generated by the rise and fall of tides. Small hydro power facilities are expected to provide another 146.9 thousand KLOE units of energy. All of these renewable sources are expected to produce only 2,976.6 thousand KLOE or 3.33 per cent of the total energy supply by the year 2000 (Kang, 1984, p. 129).

Imported Energy Sources in the ROC

As a result of the rapid economic growth in Taiwan in the post World War II period, energy consumption has continuously increased. Before the first oil crisis in

1971, Taiwan produced 37 per cent of its total energy resources. Since that time the percentage of domestically produced energy has decreased to a low of only 12.15 per cent in 1985. Foreign imports of energy, on the other hand, have increased from 61.05 per cent in 1971 to 87.85 per cent in 1985.

Imported Oil Source. Oil is by far the largest form of energy used in Taiwan, even though the percentage of oil to total energy consumed has decreased from 64.28 per cent in 1971 to 53.81 per cent in 1985 (Taiwan Energy Statistics, 1985, p. 14). The energy situation pertaining to all imported oil over the last 15 years is shown in Table IV. Imported oil, however, amounted to 99.35 per cent of the total oil supply in 1985. Most of the oil imported by the ROC comes from Saudi Arabia and Kuwait; however, the percentage of total oil imports from Middle Eastern countries has continued to decline.

Despite the fact that oil makes up a decreasing percentage of total fuel imported, the total amount of oil imported continues to climb. During the past 15 years (1971-1985) the imported oil supply more than doubled, from 8,562.5 to 20,737.3 thousand KLOE. The continuing growth in oil imports has occurred despite government attempts to

Table IV
Imported Energy Indicators in Taiwan
(1970-1985)

Year	Energy Dependency on Imports %	Imported Oil on Total Energy %	Imported Oil of Total Energy Supply %	Imported Oil from Middle East %
1970	55.15	n.a.	98.31	n.a.
1971	61.05	64.28	98.38	96.57
1972	61.68	66.71	98.27	96.18
1973	68.50	72.15	98.41	93.98
1974	68.75	68.78	98.06	94.23
1975	67.69	69.93	98.08	89.38
1976	74.47	76.45	98.45	89.50
1977	77.25	76.87	98.55	91.66
1978	79.81	76.22	98.68	87.91
1979	82.18	71.91	98.87	87.17
1980	86.02	71.00	99.10	87.43
1981	85.11	67.65	99.14	86.28
1982	85.64	63.72	99.27	85.07
1983	86.95	61.65	99.33	79.06
1984	88.48	59.37	99.33	83.26
1985	87.85	52.81	99.35	75.43

n.a. = not available.
Source: Energy Indicators Quarterly, (Taipei: Energy Committee, Ministry of Economic Affairs, ROC, 1986), pp. 6-7.

reduce oil dependency by switching to other energy sources, such as coal, LNG and nuclear power.

Imported Coal. Coal is the second largest energy resource used in Taiwan, accounting for 21 per cent in 1971 and 22 per cent of the total energy in 1985 (Energy Indicators Quarterly, 1986, p. 18). As noted, Taiwan has few indigenous coal resources. Despite the shortage of domestic coal, until 1979 more than one half of the coal consumed in the country was domestically produced. Since 1979 imports of coal have increased dramatically, growing from 1,900 to 7,066.3 thousand KLOE in 1985 (see Table V). As a result of the growing demand during the last few years, Taiwan has entered the international coal trade. The main sources of imported coal come from the United States, Australia, South Africa, and Canada.

Table V
Coal Supply and Consumption in Taiwan
Unit: 10^3 KLOE

Year	Total	Domestic Production	Foreign Imports	Final Consumption
1971	2,830.2	2,822.1	8.1	2,521.9
1972	2,695.8	2,695.8	n.a.	2,527.0
1973	2,409.1	2,292.0	117.1	2,333.4
1974	2,446.7	2,021.5	425.2	2,051.0
1975	2,242.1	2,163.6	78.5	1,898.8
1976	2,370.6	2,229.1	141.5	2,004.4
1977	2,713.0	2,036.3	676.7	1,897.8
1978	2,988.2	1,986.7	1,001.5	2,391.2
1979	3,773.7	1,873.7	1,900.0	2,252.6
1980	5,216.2	1,772.9	3,443.3	2,505.4
1981	5,156.6	1,684.9	3,471.7	2,558.3
1982	5,644.7	1,642.1	4,002.6	3,427.9
1983	6,181.7	1,540.4	4,641.3	4,122.7
1984	6,749.7	1,385.2	5,364.5	4,086.3
1985	8,346.2	1,279.9	7,066.3	4,245.2

n.a. = not available
Source: Energy Indicators Quarterly, (Taipei: Energy Committee, Ministry of Economic Affairs, ROC, 1986), p. 19; 21.

The government's energy policy in recent years has encouraged coal imports as it has attempted to use coal as a substitute for oil in power generation and such industries as the cement and steel industries. In doing so, the government, through the Bureau of Mines, not only has projected coal demand for the future, but also has designed or constructed a number of projects for inland transportation system, storage yards, and a fleet for shipping coal.

Imported Nuclear Fuel. Since Taiwan does not have uranium resources, its imports fuel for nuclear power facilities. Nuclear power is of growing importance in the ROC's energy plans. Nuclear power is seen to have a number of advantages over hydro or oil-fired thermal power in addition to being less expensive. First, nuclear fuel comes from South Africa, Australia, the United States and Canada, a different fuel source from its major supply of petroleum. These are states with which Taiwan has traditionally had good relations. Trade with such stable countries as the United States, Canada, and Australia helps to reduce the potential for damage from supply shortages caused by future political disturbances. Second, nuclear fuel is easier to ship and can be transported by air. Finally, it lasts for a much longer period of use and, therefore, Taiwan can store a much longer supply of nuclear fuel than petroleum (Copper, 1979, p. 278). Based upon these considerations, Taiwan has a nuclear policy that encourages the development of nuclear generated electricity. At the same time, Taipower is looking for new suppliers of nuclear fuel and has joined a uranium exploration venture in Paraguay together with partners from the U.S., South Korea, and Paraguay.

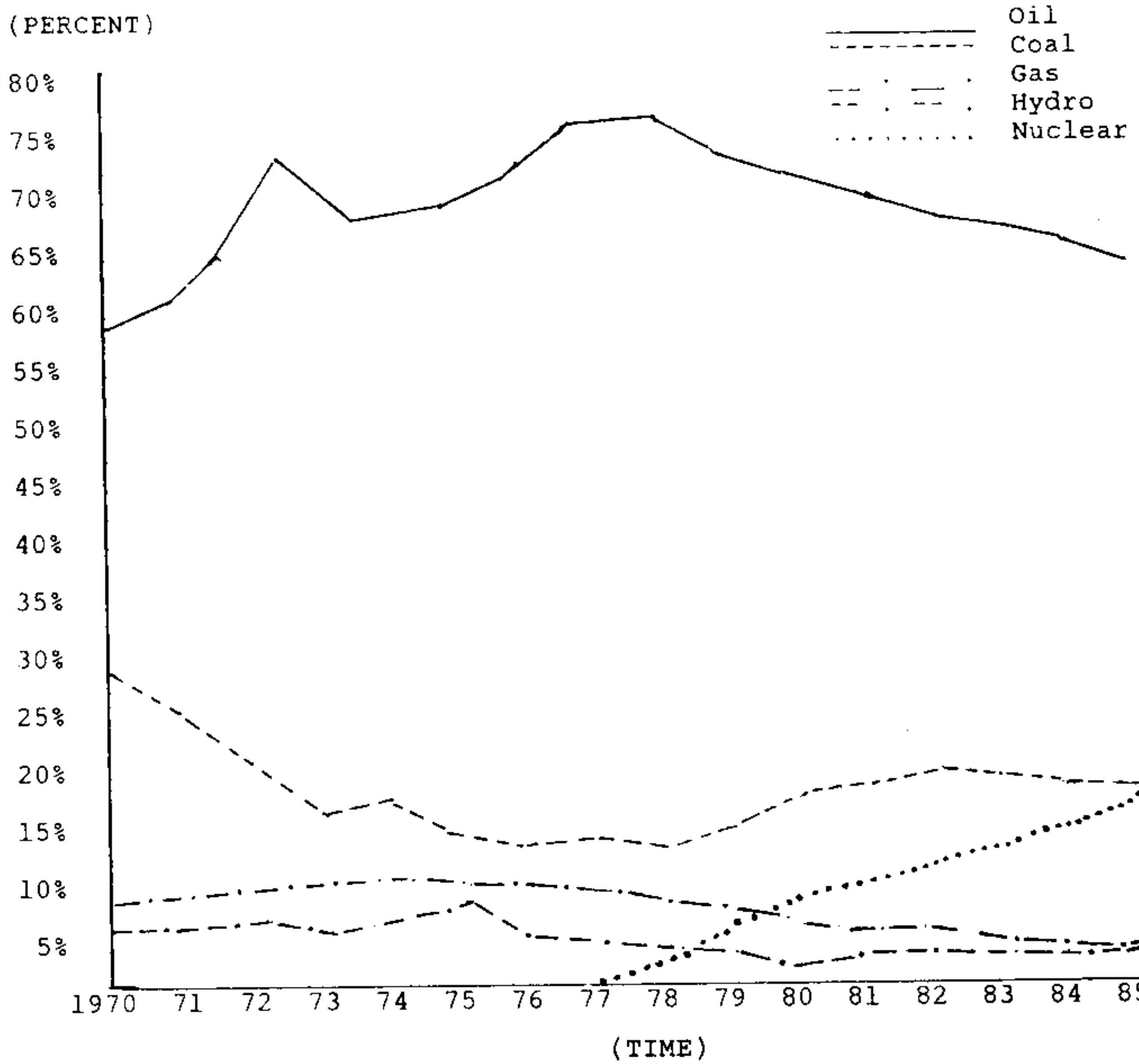
Taiwan as of 1985 had three nuclear power plants. The first nuclear station went on line in 1979 with a capacity of 1,270 MW. The second nuclear units with a capacity of 2,000 MW was commissioned in 1982. The third facilities has a capacity of 2,500 MW. Nuclear power contributed 18 per cent of the country's energy supply in 1985 (Sathaye, 1984, p. 63) as compared with only 9,06 per cent in 1977. Nuclear power in 1985 supplied 32.21 per cent of the total electrical power and it is the goal for 1991 to produce about one-half of its total electricity with nuclear power. To reach its goals of 50 per cent of electrical energy from nuclear power, Taipower plans to build about one reactor per year (Taipower, 1980, p. 12).

Energy Consumption in the ROC

Figure 4 shows the composition of the primary energy supply in the ROC by percentages. The changing pattern of energy supply from 1970 to 1985 can be clearly seen. Oil supply until the mid 1970's continued to grow and to represent the largest percentage of total energy each year, while the coal supply percentage continued to decline each year before the second energy crisis in 1978. Since 1978 coal has increased from 12 per cent to 19 per cent in 1985. The percentage of natural gas supply remained nearly constant and the percentage of energy from hydro power gradually declined in the 16 year period. Nuclear power, which was introduced only in 1977, shows a rapid rise in its percentage of the total supply.

As can be seen in Table VI, the largest user of energy in Taiwan is the industrial sector, which used 44.39 per cent of the total energy consumed in 1985. Energy used by the industrial sector tripled in the period 1970 to 1985 from 5,434.4 thousand KLOE to 15,289.2 thousand KLOE. Consumption of energy for transportation amounted to 12.86 per cent of the total energy consumed in 1985. Energy used for transportation increased more than six-fold in the 16 year period, growing from 701.3 thousand KLOE in 1970 to 4,433.6 thousand KLOE in 1985. The commercial sector in 1985 used 2.5 per cent of the total energy. Commercial energy use in the 16 year period increased four-fold from 251.7 thousand KLOE to 876.4 thousand KLOE. Residential use of energy accounted for 11.73 per cent of total energy consumption, increasing almost five times from 895 thousand KLOE in 1970 to 4,042.7 thousand KLOE in 1985.

Figure 4
Composition of Primary Energy Supply
in the ROC



Adopted from: Chi-Yuan Liang, "Energy Supply and the Viability of the Economy of Taiwan, Republic of China," In Ronald C. Keith, editor. Energy, Security and Economic Development in East Asia, (Beckenham, Kent.: Croom Helm Ltd., 1986), p. 115.

Table VI
Internal Final Consumption of Energy in Taiwan
Unit: 10^3 KLOE

Year	Industry	%	Transport	%	Commerce	%	Residential	%
1970	5,434.4	53.72	701.3	6.88	251.7	2.48	895.0	8.83
1971	5,954.8	52.86	898.2	7.62	250.9	2.22	1,027.0	9.11
1972	7,012.3	54.35	1,083.4	8.35	258.5	2.02	1,207.3	9.34
1973	7,538.9	52.20	1,374.0	9.47	297.8	2.06	1,412.5	9.78
1974	7,497.2	51.62	1,487.0	10.22	298.8	2.05	1,554.8	10.70
1975	7,984.3	49.55	1,732.8	10.72	347.4	2.15	1,785.2	11.07
1976	9,299.4	48.26	2,052.3	10.59	418.0	2.16	2,077.5	10.78
1977	10,260.3	49.00	2,291.1	10.91	458.8	2.19	2,261.5	10.80
1978	12,088.9	48.90	2,715.2	10.98	536.3	2.16	2,608.1	10.55
1979	13,257.1	49.43	3,052.7	11.37	594.0	2.21	2,810.4	10.47
1980	13,957.8	48.85	3,288.4	11.49	626.5	2.19	2,976.0	10.41
1981	13,040.5	47.55	3,323.9	12.09	649.3	2.36	3,065.1	11.17
1982	13,191.2	47.18	3,478.4	12.40	678.1	2.42	3,146.2	11.25
1983	14,413.8	46.52	3,836.1	12.35	761.9	2.45	3,514.5	11.34
1984	15,075.7	45.58	4,241.7	12.80	820.6	2.48	3,765.3	11.38
1985	15,289.2	44.39	4,433.6	12.86	876.4	2.54	4,042.7	11.73

% = Percentage of total energy consumption.
Source: <u>Taiwan Energy Statistics</u>, (Taipei: Energy Committee, Ministry of Economic Affairs, ROC, 1986), pp. 38-45.

If a comparison is made of the percentage of energy used by each sector for each year over the past 16 years, it can be seen that the greatest change in the pattern of energy consumption was in the transportation sector. In part, this reflects the continuing growth in the level of industrialization and growth of commerce, but it also in part reflects the increase in the number of automobiles and trucks on the national highways, which in part reflects the rising standard of living in the nation.

The Energy System in Japan

Japan is an island country stretching along the northeastern coast of the Asian Continent. It consists of four main islands--Hokkaido, Honshu, Shikoku, and Kyushu from north to south--and more than 3,900 smaller islands. The total land area is 377,682 square kilometers, an area about ten times larger than the ROC. In Japan, only a small proportion of total land is easily usable. About 74 per cent of the land area is mountainous, and mostly of this is forest or wilderness (Kahn & Pepper, 1978, pp. 59-60). It has a population over 120 million in 1984; but the rate of population growth has declined remarkably since 1973. The population density of Japan in 1985 was 324 persons per square kilometer, as compared with 535 in the ROC. Japan and the ROC are among the most densely populated countries in the world (Statistical Handbook of Japan, 1981, pp. 15-23; World Population Data Sheet, 1985).

From the end of World War II until 1960, Japan, like the ROC, had to rebuild its economy and reinstitute its governmental system. Japan was remarkably adaptative in rebuilding its economy in this period. Economic development after the mid-1960s increased demand for labor in manufacturing and service industries. However, while the proportion of employed persons in the primary industries declined from 30.2 per cent of total employed persons in

1960 to 10.4 per cent in 1980, the proportion of the persons engaged in both secondary and tertiary industries increased from 28 per cent and 41.9 per cent in 1960 to 34.8 per cent and 54.6 per cent in 1980, respectively (Statistical Handbook of Japan, 1981, pp. 15-23).

Like the ROC, the economic performance of Japan increased dramatically at over 10 percent per year throughout the 1960s and the early 1970s. In part, this was caused by strong private investment in plant and equipment centered on technological innovation. The first oil crisis imposed an internal shock to the economic system, severly disordering it and causing inflation followed by depression. Although Japan's economy began to recover by 1975, the economy grew at a very slow rate. Annual growth rates of over 5 per cent were recorded in the years 1976 to 1979 before the second oil crisis. The second oil crisis which began in 1979 found the Japanese in far better shape than it had been in 1973, partly because of the experience of the first oil crisis. Governmental policies such as a tight monetary policy and price control on large manufactures pursued since the first oil crisis helped restrain prices, and as a result there was no serious price explosion such as there had been in 1974 (Murakami, 1982, p. 254; Shibata, 1983, pp. 129-154). Table VII shows the rate of inflation in Japan from 1970 to 1985.

Table VII
Fluctuations of Growth and Inflation Rates in Japan

Year	GNP (Constant 1975 Prices Billion)	Consumer Prices Index 1980=100	%	WholesalePrices Index 1980=100	%
1970	117,593.1	42.3	9.0	48.4	5.0
1971	123,105.4	42.0	6.5	51.3	-0.1
1972	134,148.7	42.3	4.0	53.3	-0.1
1973	145,972.3	49.0	12.8	60.2	17.2
1974	144,164.1	65.2	24.8	73.7	34.0
1975	147,874.0	72.9	8.0	75.9	2.0
1976	155,506.6	79.7	9.0	79.7	6.0
1977	163,754.3	86.1	10.5	81.2	-0.2
1978	172,135.4	89.4	6.0	79.1	-0.4
1979	181,136.9	92.6	2.6	84.9	-0.8
1980	188,735.1	100.0	8.6	100.0	2.1
1981	194,661.4	104.9	4.9	101.4	1.5
1982	n.a.	107.7	2.6	103.2	2.6
1983	n.a.	109.7	1.8	n.a.	n.a.
1984	n.a.	n.a.	2.3	n.a.	n.a.
1985	n.a.	n.a.	4.4	n.a.	n.a.

n.a. = not available

Source: World Tables, Vol.1, Economic Data, (Baltimore: The Johns Hopkins University Press, 1983), pp. 238-9; Economic Statistics: 1900-1983, (New York: Facts on File Publications, 1985), pp. 111-123; International Energy Statistical Review, (Washington, D.C.: Directorate of Intelligence, 1985), p. 1.

Domestic Energy Sources in Japan

Japan has very few indigenous energy resources, but its per capita rate of energy consumption is twice the world's average. According to the 1979 Japanese official survey, the composition of total primary energy supplies by type of source, indigenous energy resources provided only 13 per cent of the total domestic needs (Statistical Handbook of Japan, 1981, pp. 15-23). Most of Japan's energy comes from distant places such as the Middle East, North America, South America, and the USSR. In attempting to develop its overseas sources of supply, Japan must cope with the geopolitical uncertainties of transportation and sea-lane security (Conant and Gold, 1978, pp. 4-6; Quo, 1986, pp. 168-9). Japan is undoubtedly one of the most vulnerable nations in the world. Table VIII shows Japan's total energy requirements for the period 1970 to 1985.

Domestic Oil Resources. Japan's demand for oil has increased steadily since the 1960s and most of this has been met with imported oil. Domestic production of oil has decreased continually in this period, and domestic production now supplies less than 800,000 tons of petroleum per year. Stated in another way only 6 thousand barrels per day as compared with needs for 4,241 thousand of barrels per day were producted domestically in 1984 (Fesharaki and Schultz, 1984, pp. 42-3).

Japanese dependence on imported oil for its economic survival and growth are readily apparent from Table IX which shows the increasing gap between domestic production and foreign imports of petroleum over the past 15 years.

Table VIII
Energy Requirements by Energy Types in Japan
Unit: Mtoe

Year	Oil	Natural Gas	Hydro Power	Nuclear Power	Total
1970	196.74	3.43	19.63	1.13	282.56
1971	219.70	n.a.	n.a.	n.a.	301.40
1972	234.20	n.a.	n.a.	n.a.	310.80
1973	260.03	5.36	17.63	2.38	343.27
1974	258.90	n.a.	n.a.	n.a.	346.50
1975	244.00	7.70	19.10	5.30	330.50
1976	250.32	10.12	21.71	8.35	347.03
1977	260.40	10.90	17.40	6.90	348.10
1978	260.42	16.06	18.44	14.53	356.05
1979	265.10	20.30	19.20	14.90	369.90
1980	241.25	21.88	22.78	20.24	365.76
1981	222.77	22.42	22.41	21.52	354.26
1982	212.56	23.16	20.90	25.10	346.13
1983	214.17	24.74	21.91	28.00	350.70
1984	222.42	33.15	19.13	32.90	377.23
1985	201.30	36.00	21.80	33.30	365.30

n.a. = not available
Source: Energy Balances of OECD Countries-Japan, (Paris: IEA/OECD, 1986), p. 75; For the years of 1971, 1972, 1974-5, 1977, 1979, and 1985, see BP Statistical Review of World Energy, (London: The British Petroleum Company, 1986), pp. 7-8, p. 24, pp. 27-8, and p. 30.

The problem of foreign oil dependence is further complicated by the fact that such a large percentage of Japan's energy comes from the Middle East. The president of the Institute of Energy Economics in Japan, Toyoaki Ikuta pointed out in 1984 that 70 per cent of Japan's oil imports and 40 per cent of the total energy supply was from the Middle East, making Japan one of the most vulnerable countries to the instability in the Middle East (Ikuta, 1986, p. 22).

Table IX
Oil Supply and Demand in Japan
Unit: Mtoe

Year	Domestic Production	Foreign Imports	Internal Consumption
1970	.82	182.83	167.72
1971	.82	200.17	172.78
1972	.72	219.67	183.74
1973	.72	251.57	203.19
1974	.69	246.04	197.44
1975	.62	230.54	181.01
1976	.60	239.75	199.50
1977	.61	248.05	198.74
1978	.57	245.50	205.51
1979	.51	249.82	227.64
1980	.55	229.55	196.14
1981	.51	204.64	185.51
1982	.52	187.13	178.41
1983	.55	219.71	180.08
1984	.53	230.28	190.76

* Mtoe = Million tons oil equivalent
** Includes solid fuels, crude oil, NGL, and petroleum products.
Source: Energy Balances of OECD Countries, 1970/1982; 1983/1984, (Paris: IEA/OECD, 1984, pp. 93-105; 1986, pp. 76-77).

How to reduce its dependence on the Middle Eastern oil became one of the major issues in Japan after the first oil crisis. Given the very limited availability of indigenous energy sources, this has meant the promotion of energy saving and use of alternative sources of energy. Exploration for onshore and offshore oil also was increased. Public loans were made to encourage exploration and development for both domestic and overseas oil production

(Mikdashi, 1986, p. 90). In spite of these efforts, however, Japan's dependence on imported oil continues since it does not have adequate domestic sources of petroleum, and it does not have alternative commercially feasible sources of energy to take the place of oil.

Domestic Coal Sources. Japan's most abundant energy source is coal, which served as the primary source of energy until the 1950s. Japan's coal reserves are estimated to be 22 billion tons; however, no more than 3 billion can profitably be mined because of the difficulties in mining caused by geological faults and folds and water in the coal field basins. Japanese coal resources are mainly found in Hokkaido and Kyushu, which possess 45 per cent and 40 per cent of total domestic coal production, respectively (Blum, 1978, pp. 144-5). Table X shows domestic coal production in Japan from 1973 to 1985. It shows a continuous decrease in domestic coal production.

Coal was not given a high priority in the alternative-energy mix before 1973 because of the political differences among coal producers, environmental groups and resource planners (Holloman & Grenon, 1975, p. 207). During this period, the Coal Mining Industry Rationalization Corporation was founded for improving the coal industry and for

Table X
Coal Supply and Demand in Japan
Unit: Mtce

Year	Domestic Production	Foreign Imports	Final Consumption
1973	25.1	59.0	82.7
1977	17.0	41.2	79.0
1978	18.7	52.7	66.6
1983	17.0	74.9	88.5
1984	16.6	86.7	99.5
1985	14.4	91.9	104.5

Source: Coal Information, (Paris: IEA/OECD, 1986), p. 233.

increasing coal production. Despite these efforts, coal production did not increase sufficiently to meet the growing demands for energy. Domestic coal production peaked at 55 million tons in 1961, and in recent years (1983-85) has averaged only 14.7 million tons (Siddiqi & James, 1982, p. 296; Energy Balance and IEA Country Submission, 1985, p. 233).

In the middle and late 1970s, greater efforts were made by government to increase coal production. A new agency, the Coal Mining Council, composed of the Mitsubishi and Sumitomo Groups, Hokkaido Colliery, and Steamship Company, was created and given authority to subsidize and support measures for increasing coal production. In 1980 the government provided subsidies and low interest loans, totalling 59.9 billion yen, to encourage the development of local supplies and to assist with the technological improvement and the modernization of Japanese coal mines (Energy Policies and Programmes of IEA Countries, 1980, p. 183). Also, under the government's "Sunshine Project" started in 1974, these three new technological processes, coal hydrogenation, solvent-treated liquefaction, and solvolysis liquefaction were developed (Tagawa, 1986, pp. 168-71). In addition to these projects, Japan is also involved in two international joint projects for coal liquefaction.

Domestic Natural Gas Source. Natural gas, like coal, is an energy source expected to help reduce Japan's dependence on oil imports. Japan's domestic gas production, however, has never equalled the amount consumed in the past 15 years. Estimated proven reserves of natural gas are not extensive, amounting to only 1.1 trillion cubic feet at the end of 1985 (BP Statistical Review of World Energy, 1986, p. 22), and the amount of gas produced domestically has continuously declined in the period, as shown in Table XI. Increased exploration onshore and offshore are encouraged as a part Japan's energy policy along with efforts to promote overseas exploration and development and the use of LNG.

Table XI
Natural Gas Supply and Demand in Japan
(Mtoe)

Year	Domestic Production	Foreign Imports	Final Consumption
1970	2.45	.98	5.75
1971	2.49	1.19	6.32
1972	2.52	1.29	6.57
1973	2.58	2.84	7.16
1974	2.46	4.58	7.65
1975	2.44	5.96	7.93
1976	2.24	7.88	8.44
1977	2.52	9.00	9.00
1978	2.37	13.69	8.91
1979	2.17	16.98	9.58
1980	1.97	19.91	9.92
1981	1.89	20.53	10.31
1982	1.84	21.36	10.35
1983	1.87	22.87	10.74
1984	1.92	31.23	11.84

Source: Energy Balances of OECD Countries (1970/1982, 1983/1984), (Paris: OECD/OCDE, 1984, 1986), pp. 93-105, 129, 148.

The Far East Oil and Energy Survey published in 1981 writing on gas exploration on the continental shelf reported that "the money and effort expended on Japan's own continental shelf over many years has so far been rather a disappointment as only one producing field has been established" (Cooper & Segal, 1981, Japan, p. 6). Since there are not extensive reserves of natural gas in Japan, the distribution systems via pipes have not been developed as extensively as in the US and Europe. In Japan, gas is supplied by 255 companies, of which 75 are public corporations. The three largest are Osaka, Toho and Tokyo gas companies which supply the major metropolitan areas and serve 10 million (about 71 per cent) consumers out of 13.8 million. All other gas companies are small, averaging about 10,000 customers.

Electric Sources. Japan, with a total generating capacity of about 130.4 thousand magawatts in 1985 is the third largest producer of electricity in the world, following the US and the USSR, but leading such Western countries as Great British, Canada, and West Germany. A large part of this generating capacity has been developed since the early 1950s when nine private companies were established to produce and transmit Japanese electricity. The country was divided into nine districts and each of the nine private companies was given exclusive control over generation and distribution within its area (Gale, 1981, pp. 85-97).

In addition to these nine companies, there is also a number of other semi-governmental agencies involved in electrical development, regulation, and generation, such as the Electric Power Development Company and the Japan Atomic Power Company. Indeed, the Japanese government plays an important role in managing elect.ic affairs. For instance, the Electric Power Development Co-ordination Council is responsible for authorizing the construction of new power stations. The Ministry of International Trade and Industry (MITI) and the Science and Technology Agency are both involved in research and development work and the administration and control of hydro and nuclear facilities. It is also important to note that the government has created the "Wide Area Coordinative System Operation" in 1978 that normally provides a valuable channel for intercompany cooperation in electric power transfers and the joint development of electric power sources (Paone, 1979, pp. 161-2).

The Japanese electrical system has developed the various electrical generating systems, hydro, oil-fired and coal-fired thermal power, and nuclear power, at different stages. Before the first energy crisis occurred in 1973, 72.47 per cent of electricity was generated from oil-fired generating facilities. Hydro power and coal-fired thermal power produced 8.15 MTOE in 1970, oil-fired thermal 11.47 MTOE, and nuclear power which had just begun to use produced 1.13 MTOE (Energy Balances of OECD Countries, 1983, p. 223). The first energy crisis caused electrical power to increase in price 56.8 per cent in 1974 and an additional 30 per cent in the Summer of 1976. Demand for electricity dropped sharply as a result of these huge price increases and an effort began to convert oil-fired to nuclear power. In

1976, as a result of the completion of several new nuclear power facilities nuclear output reached 7,999 MW, making Japan the fourth largest nuclear generating country in the world. The percentage produced by nuclear generation increased to 9.6 per cent, an increase of 3.1 per cent at the expense of oil-fired thermal power generation. Since 1976 the percentage of oil-fired generated electrical power has decreased to 34.22 per cent in 1984, while the percentage of nuclear power has increased to 10 per cent. The generating capacities of hydro power and coal- and oil-fired thermal units has remained almost constant producing 19.13 MTOE in 1984 as compared with 17.63 in 1973.

In 1985, Japan had 33 nuclear power stations in operation. The total capacity for nuclear generation was 24.7 GW in 1985. By 1985, nuclear power generation accounted for 26 per cent in total capacity, as compared to 25 per cent of oil-fired, 21 per cent of LNG, 14 per cent of hydro power, 10 per cent of coal-fired power respectively (Smith, 1982, p. 142).

Hydro Electric Sources. The meager coal production and the scarcity of domestic petroleum and gas resources in Japan led very early to the development of hydro-electric facilities wherever there were available sites. Although Japan is a land of mountains and relatively heavy rainfall, it has few good hydro sites as it is divided into small drainage basins that provide only for modest hydro installations rather than the more profitable large or medium-sized power plants. Also, the frequency of earthquakes is a menace to large dams. Japan's hydro-electric power stations provides nearly 24 per cent of the domestic hydro-electricity (Smith, 1982, p. 151).

Renewable Energy Sources. Japan, like many oil-importing countries, sought to develop renewable energy sources after the oil crisis. In fact, renewable energy resources are considered by Japan as "the energy frontier". (Tagawa, 1986, pp. 168-82). With the creation of the New Energy Development Organization (NEDO) in 1980, a number of efforts have been made to promote renewable energy sources. Japan has established eight geothermal electrical power generating facilities with a total capacity of 215 MW, making Japan fourth in geothermal power generation (Gregory, 1983, pp. 489-90). Plans call for geothermal power to provide 50 million KW or about 15 per cent of the total electric energy power requirement in the 1990.

Although Japan has spotlighted nuclear energy development in its long-term plans, solar energy is also one of the more promising renewable energy sources. Research on solar energy at the Electrotechnical Laboratory and Government Industrial Research Institute has demonstrated the feasibility of solar energy. Development of biomass energy from the chemical breakdown of plants and other organic materials has also been given high priority as a renewable energy source in the 1980s. By 1981, there were six seperate projects producing energy from various biomass technologies (Gregory, 1983, p. 489).

Wind power is another of the renewable resource alternatives being considered by Japan. Several wind operated electrical generating facilities are already in place. The Tokyo Electric Power Company has a 100 KW plant in operation and NEDO has constructed a 100 KW class wind power generator on Miyake island and others are in the planning stage (World Directory of Energy Information, 1982, p. 137; Tagawa, 1986, p. 172).

Imported Energy Sources in Japan

Japanese domestic energy production has never been able in recent decades to keep pace with the rapid growth in energy consumption. Total consumption of energy in Japan has grown yearly at an average rate of 10.1 per cent since 1965. The yearly growth rates for the various types of energy were as follows: oil 14.0; natural gas 17.6; coal 2.3; nuclear 50.2; and hydropower -1.4 (Taher, 1982, p. 148). To meet the increasing demand Japan has imported even increasing amount of energy resources from foreign countries. For instance, in 1973, nine-tenths of Japan's total energy was imported, of which 77.4 per cent was crude oil from the Middle East. By 1984, the percentage of energy imported had increased to 95 per cent, but the percentage of oil imports had decreased, amounting to only 54 per cent of total energy supply.

Imported Oil Resource. During the 1970s, Japan become the second largest oil-importer in the world after the United States, importing nearly 5 million barrels of crude oil daily (MBD) (Cooper & Segal, 1981, p. 1). Following the oil crisis of 1973, Japanese oil demand, however, contracted sharply, from 5 MBD to 4.2 MBD, but then in the easier market climate of 1975 to 1978, expanded once again. The 1979 and 1980 oil crisis, however, galvanized public opinion to recognize that the security of Japanese energy supplies must be assured. The government, building on this national consensus, developed a wide-ranging programme to reduce oil dependency and to secure stable oil supplies. Japan's imported oil ranged from 182.83 MTOE in 1970 to 251.57 MTOE in 1973, but declined to 230.28 MTOE in 1984, as was shown in Table IX.

As price increased as a result of the oil crisis, efficiency of oil use and diversification to other energy sources become major policy emphases in Japan. Japan's success with this policy can be seen in the fact that imports of oil declined percentage wise from the peak year of 1973 every succeeding year. Also, there was a major shift from oil to coal or LNG, especially in industries such as cement and steel manufacturing (Murakami, 1982, p. 143). There also was a major shift from oil to nuclear power for electric generating since the oil crisis occurred.

The government has increased efforts to encourage a shift away from using Middle Eastern oil. Both government-to-government (GG) transactions and direct-deal (DD) by private companies have been directed away from the Middle East, and this has had the effect of shifting the geographic distribution of oil imports. In 1973, 85.2 per cent of imported oil to Japan came from the Middle East, 13.2 per cent from Asia and 1.6 per cent from other areas. By 1982, the geographic source had changed and the Middle East countries supplied 69.3 per cent, Asia 24.6 per cent and others 6.1 per cent, mainly from Canada, Algeria, Mexico and Venezuela (Energy Policies and Programmes of IEA Countries, 1982, p. 49).

Imported Coal Resource. Coal imports for Japan increased significantly over the past two decades. While total domestic coal production decreased from 25.6 Mtce in 1973 to 14.43 Mtce in 1985, coal imports increased from 51.0 Mtce in 1973 to 91.9 Mtce in 1985 (see Table X). According to International Energy Agency (IEA), Australia, Canada, and the United States were the largest, second largest, and third largest exporters of coal to Japan in 1985. It should be noted that agreements have been recently entered into with the USSR and the People's Republic of China (PRC) to increase the amount of coal to be sold to Japan. Japan's co-production ventures with the PRC, according to a Japanese expert, Yujiro Eguchi, are very significance as the PRC is estimated to have 99 billion TCE (ton of coal equivalent) or 15.5 per cent of the world's recoverable reserves (Eguchi, 1980, p. 267).

Imported Natural Gas Sources. Natural gas, like coal and nuclear, is the energy source expected to reduce Japan's dependence on oil imports. Japan imports a large proportion of natural gas in liquefied form from overseas, as Table XI shows. Since 1973 imports of LNG have increased more than six fold, and total imports in 1984 was about 30 time greater than the amount of gas produced indigenously. With a very limited domestic production of natural gas, the Japanese government's natural gas policy is to accelerate development of domestic natural gas resources, to promote overseas exploration and development, and to increase use of imported LNG (Energy Policies and Programmes of IEA Countries: 1985 Review, 1986, p. 129). The imports of LNG began in 1969 when gas supplies from Alaska began to be shipped to the Tokyo Gas and Tokyo Electric Company. Later in 1973, purchase of LNG were made from Brunei; and by calender year 1979 Japan's total imports of LNG had risen to 16.98 million tons/year, which came from Indonesia and the United Arab Emirates as well as Brunei and Alaska (Energy Policies and Programmes of IEA Countries, 1979 Review, 1980, p. 11).

Japan since 1983 has also diversified its gas supply source through purchases from Malaysia, and it plans by 1990 to import gas from Australia and Canada (Energy Policies and Programmes of IEA Countries, 1982 Review, 1983, p. 214). In 1985, Japan accounted for approximately 50 per cent of the world's LNG, and more than three-quarters of the LNG imports are used in power plants (Quo, 1986, pp. 167-184).

The underlying reason for the huge increase in the use of natural gas is that it is regarded as a "clean energy" source. Public resistance to development of coal-fired thermal generation or additional nuclear plants in urban areas forced Japan to the alternative of natural gas. It is forecast that LNG will reach 40 million tons and account for 12 per cent of Japan's total energy needs in 1995 (Sakisaka, 1985, pp. 1-11).

Imported Nuclear Fuels. Nuclear power has become an important fuel source for the generation of electricity in Japan since 1978. Imported nuclear fuel has increased from 1.13 MTOE in 1970 to 36.50 MTOE in 1985. Most of Japan's uranium resources come from Australia, Canada, the United

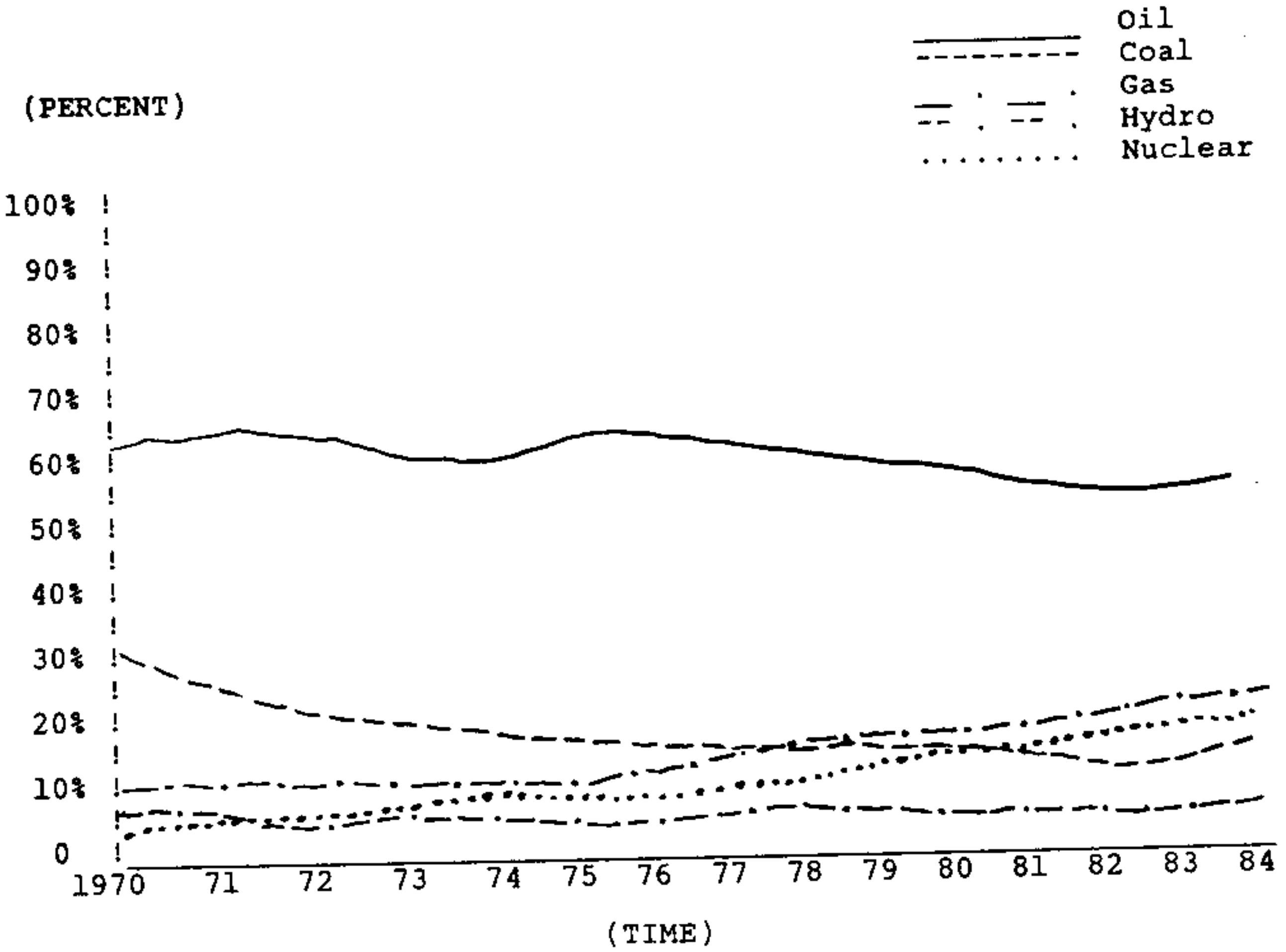
States, and South Africa. Japan has acquired uranium oxide for power generation since the late 1960s.

Nuclear power capacity in Japan has grown much faster than that of hydro and coal-fired thermal power capacities over the past 16 years. It is forecast that nuclear power will account for about 25 per cent of electricity in 1990 and 30 per cent in 2000 (Gale, 1981, p. 121). Demands for nuclear fuel are estimated to grow from 9,000 tons in 1980 to 21,000 tons in 1990, and, by the year 2000, to 420,000 tons of uranium oxide (Blum, 1978, pp. 154-7).

Energy Consumption in Japan

The changing pattern of total energy supply from 1970 to 1984 is shown in Figure 5. It shows the composition of the primary energy supply in Japan by percentage. Oil supply until 1977 continued to grow and the represent the largest percentage of total energy supply each year, while the coal supply percentage continued to decline each until 1983. The percentage of natural gas supply increased from 10 per cent in 1970 to 20 per cent in 1984, and the percentage of energy supply from hydro power gradually declined over the past 15 years. Nuclear power in the percentage of total supply increased dramatically from 5 per cent in 1970 to 15 per cent in 1984.

Figure 5
Composition of Primary Energy Supply
In Japan



Source: Hirofumi Shibata, The Energy Crises and Japanese Response <u>Resources and Energy</u>, (1983), 5:132; <u>Japan's Aggregate Energy Statistics</u>, (Tokyo: Statistics Bureau, Prime Minister's Office, 1985).

Oil was by far the largest fuel source, accounting for 54 per cent of total energy supply in 1984 as compared with 62 per cent in 1970. Coal consumption decreased somewhat from 53.9 Mtce in 1973 to 51.9 Mtce in 1984. Natural gas consumption, however, increased yearly from 5.75 MTOE in

1970 to 11.84 MTOE in 1984. Japan's use of electricity as part of the total energy consumption is the highest among the major industrial countries, using 24 per cent between 1975 and 1979, 39 per cent in 1980. In 1982, two thirds of Japan's electricity was used by industry (Murakami, 1982, p. 190).

Table XII also shows the total energy consumption by various sectors in the past 15 years. While the total energy use by the industrial sector declined from 57.68 per cent in 1970 to 47.92 per cent in 1984, energy consumption for both the transport and commercial sectors increased from 16.35 per cent and 0.54 per cent in 1970 to 22.44 per cent and 8.50 per cent in 1984, respectively. The more than eight fold growth in energy use by the commercial sector may partially be explained by the new direction that the economy has taken in recent years. The share used by the residential sector remained relatively stable during this period.

Summary: Comparison of Energy Systems

The model of sociodemographic and economic variables affecting a national energy system shown in Figure 3, provides a useful guide for comparing various aspects of the energy systems in the ROC and Japan over the past 16 years.

Table XII
Final Consumption of Energy by Sectors in Japan
Unit: Mtoe

Year	Industry	%	Transport	%	Commerce	%	Residential	%
1970	119.75	57.68	33.95	16.35	1.13	0.54	33.63	16.20
1971	122.86	52.00	35.43	14.99	3.01	1.27	33.72	14.27
1972	129.10	51.69	39.02	15.62	3.50	1.40	37.09	14.85
1973	142.46	55.71	44.27	17.31	3.89	1.52	39.63	15.49
1974	137.14	57.09	43.83	18.24	4.31	1.79	39.24	16.33
1975	117.64	50.38	42.33	18.12	4.84	2.07	44.62	19.10
1976	138.94	54.53	42.58	16.71	4.84	1.89	45.50	17.85
1977	136.18	52.21	44.24	16.96	5.30	2.03	46.67	17.89
1978	137.61	52.13	51.57	19.53	5.80	2.19	48.67	18.43
1979	141.82	52.05	53.32	19.57	6.24	2.29	49.68	18.23
1980	129.42	50.27	46.90	18.21	6.35	2.46	53.93	20.95
1981	119.79	47.80	46.86	18.70	6.45	2.57	54.69	21.82
1982	114.69	49.10	46.61	19.95	6.76	2.89	52.80	22.60
1983	113.40	47.68	54.54	22.93	19.88	8.35	28.40	11.94
1984	120.75	47.92	56.56	22.44	21.44	8.50	29.76	11.81

% = Percentage of total energy consumption.
Source: Energy Balances of OECD Countries--Japan, (Paris: IEA/OECD, 1986).

One can find by using this model that the two countries differ in many aspects but are similar in others. The major difference between these two countries is their national land area and population density. While Japan's land area is ten time greater than the ROC, and its total population is about six time larger, its population density is almost 50 per cent less than the ROC. Both have very dense and relatively young populations with many youth coming into the labor force yearly, thus requiring a growing economy to employ these new workers. This economic development patterns since the post World War II period are similar in that both have emphasized the replacement of import substitution with export promotion. They also are similar in that both have relatively few natural resources, especially energy resources, and therefore, are dependent on international trade.

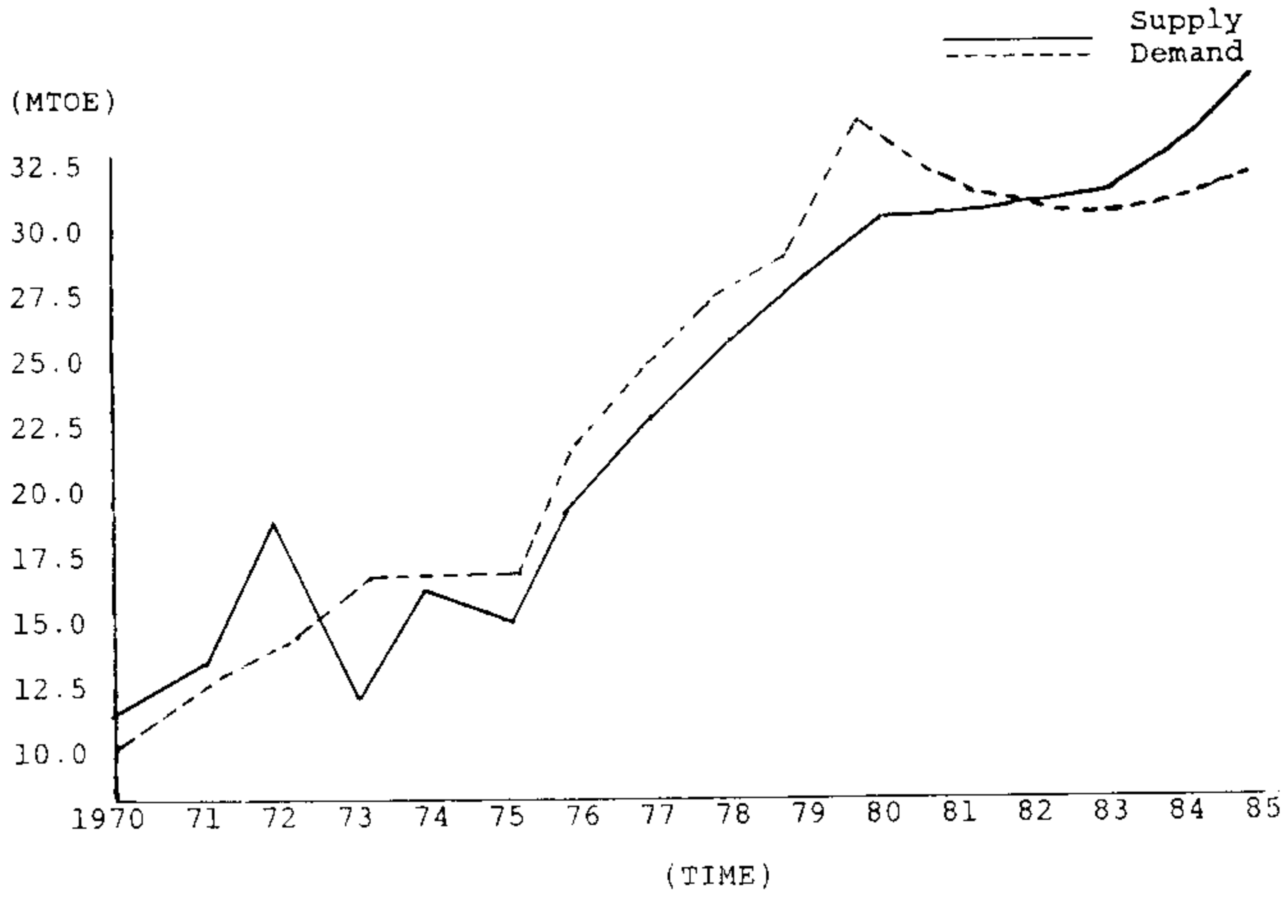
During the 1970s, the sharp increase in oil prices seriously affected both country's economies, causing inflation, deficits in the balance of payments, very slow economic growth, and high unemployment. Both governments reacted similarly. While the ROC government "tightened credit and reduced consumer purchasing power by increasing the prices of goods and services", the Japanese government "applied restrictive monetary and fiscal policies" (Yager & Matsuba, 1984, pp. 120). in order to control prices and to maintain their economic growth.

Also, as a result of oil crises, both governments undertook programs to reduce dependence on imported oil resource, to develop alternative sources (primarily coal, natural gas and nuclear), to engage in the development of onshore and offshore oil exploration, and to strength relations with their main suppliers. Although the governmental programs differed, the strategies were same, with the intent of reducing vulnerability and securing stable energy supplies. Again, both countries increased the proportion of total energy supplies from nuclear power. Both have given high priority to nuclear power as an important component of their ambitious economic development plans. Both also received nuclear technology from U.S. manufacturers through license arrangements and loans from the U.S. Export-Import Bank in the past decade (Smith, 1982, pp. 125-6).

The changing pattern in various energy sectors after the energy crises is also similar in these two countries. The share of energy use by the industrial sector in each country decreased yearly, while the share of the transportation sector increased. The change in the pattern of energy use indicates that the industrial structure in these two countries is moving from high energy intensity industries to a high-technology- and knowledge-intensive structure. Furthermore, the high energy-consuming industries such as steel, cement, and sheet glass have made considerable economies in energy use. Energy use in the commercial sector presents different tendencies. While the commercial use of energy has remained relatively stable in the ROC, in Japan there has been a dramatic increase in this sector. Residential use in both countries has remained at a relative stable level despite the population changes.

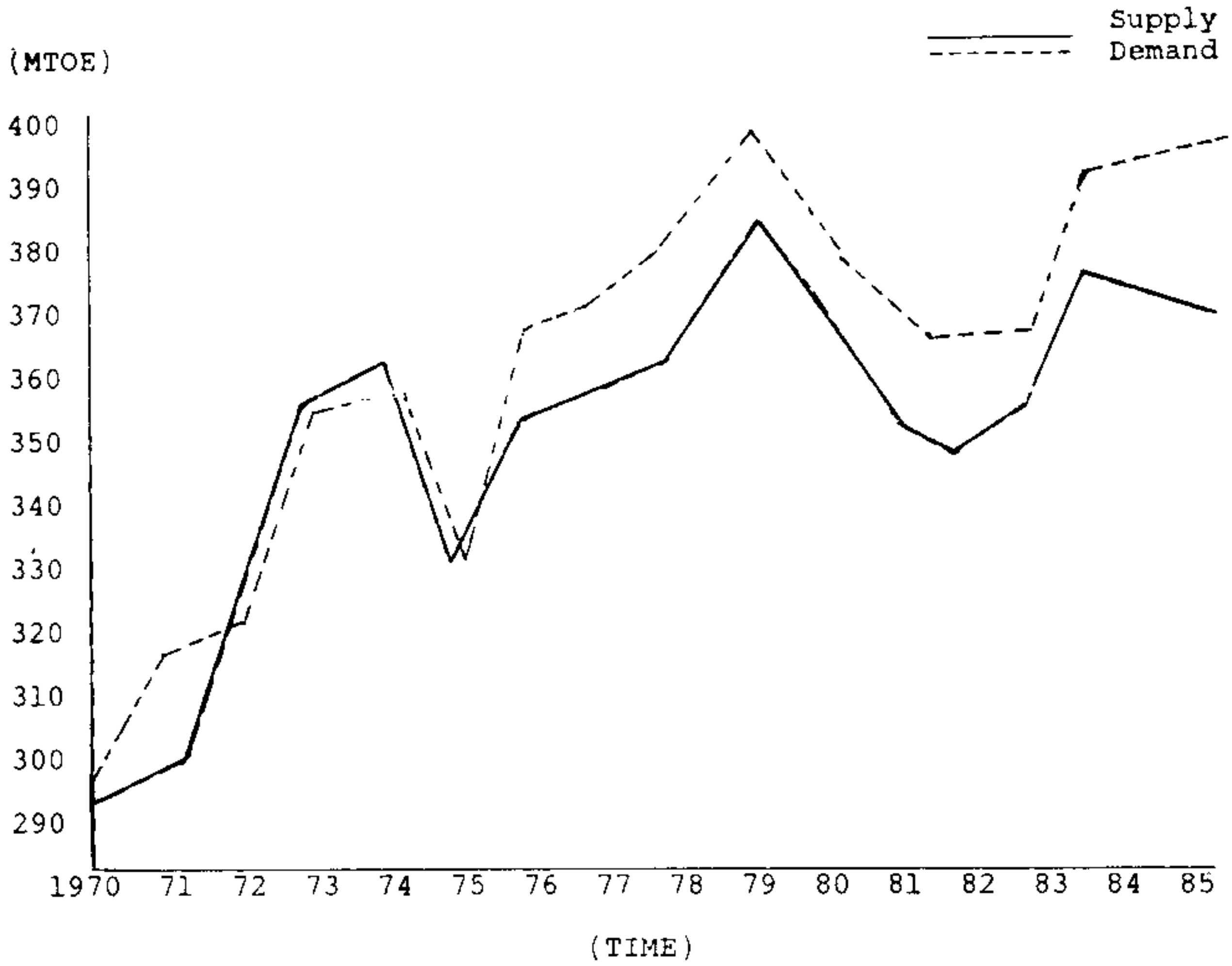
A final comparison of the energy systems of the countries needs to compare economic growth with energy supply and demand, and how the energy crises impacted energy consumption. Figure 6 and Figure 7 show the total energy supply and demand in the two countries over the past 16 years.

Figure 6
Total Energy Supply and Demand in the ROC



Source: Taiwan Energy Statistics, (Taipei: Energy Committee, Ministry of Economic Affairs, ROC, 1985).

Figure 7
Total Energy Supply and Demand in Japan



Source: Energy Balances of OECD Countries, 1970-1982 Review, (Paris: OCDE/OECD, 1983); Japan's Aggregate Energy Statistics, (Tokyo: Statistics Bureau, Prime Minister's Office, 1985).

The charts are remarkably similar for both energy supply and demand in the two countries. The crisis in 1973 slowed supply and demand in both countries temporarily, but by 1975 there was a rapid increase in supply and demand.

The 1979-80 crisis seemingly had a more lasting impact on energy supply and demand in both countries. Demand in the both of the countries has only in 1984 and 1985 reached the 1979 level. The gap between supply and demand since 1982-83 differs in the two countries, with supply of energy exceeding demand in the ROC. The policies and programs of government are still other important variables in affecting the energy systems in these two countries. In the next chapter, the study will deal with energy politics in these two countries.

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CHAPTER IV

ENERGY POLITICS IN THE REPUBLIC OF CHINA AND JAPAN

Energy politics has become one of the most significant controversies in all nations as they have attempted to develop energy policies. The energy crises caused changes that affected groups differently and thus led to conflict over energy policy. All energy policies create major benefits and costs for social groups and individuals. New policies produce winners and losers, richer and poorer, contented and aggrieved. As government assumes greater responsibility for national energy policy, controversies over the benefits and costs involved in energy management increase (Rosenbaum, 1981, p. 5). Energy policy outcomes are affected by the degree of internal and external conflict and consensus that can be reached among the political actors.

The fates of governments, politicians, and political parties are intimately dependent upon what happens to energy. The preferences of numerous nongovernmental groups also are allocated in the politics of energy. To deal with the complexity of the politics of energy, this chapter focuses on the major political actors in the two countries;

it looks at both the cooperation and conflict between these actors. Broadly speaking, the political actors in the conflict over energy policies include (1) the political party in power and the opposition party (2) the Prime Ministerial and Cabinet elites; (3) the bureaucracy; (4) the private businesses effected by energy issues; and (5) a host of interest groups affected by different aspects of the proposed changes in energy policy. The major premise of the chapter is that modern energy politics must be understood in terms of the relative influence of numerous political actors contending for protection or promotion by government (Kemezis & Ernest, 1984, pp. 217-8). The roles of both the formal institutional decision makers, as well as the political parties and interest groups such as producers, consumers, and corporate interest groups involved in domestic and foreign policies are examined.

Energy politics in both the Republic of China (ROC) and Japan is shaped by their internal and external environments. Both countries have few domestic sources of energy, and therefore, there is not the intensive conflict between energy sectors such as oil, coal, and gas that one finds in countries richer in energy sources such as the United States (Kash & Rycroft, 1984, pp. 102-7). The long tradition of governmental intervention in the energy field also dampens conflicts between public and private interests. Also since sources of energy are so vital to the economies of both countries, there is little conflict over whether to import energy or not. Since the economies of both countries have been intimately connected with that of U.S., there also is relatively little ideological conflict over contracts with multinational companies. Much of the conflict which does arise over imports usually focuses on the price and allocation of energy, and whether to control prices through governmental actions and subsidies or not (Cisler et al., 1982, pp. 175-86; Okimoto, 1982, p. 35).

Questions regarding energy policy such as the following are dealt with in this chapter: Who are the decision-makers in energy politics in both of these countries? What were the respective roles of government and private enterprise before and after the energy crises? And how was political conflict over energy policies resolved?

The Politics of Energy in the ROC

Ideologically, the Republic of China's politics is based upon Dr. Sun Yat-sen's San Min Chu Yi (Three Principles of the People), which have remained virtually unrevised since the 1920s. Sun's principles of "nationalism, democracy, and people's livelihood" are not just the underlying ideas of a political party's platform; they are the leitmotif of the ROC s Constitution. The principle of people's livelihood is the guiding theme for the national economic development. It stresses two objectives, increasing national wealth and assuring an equitable distribution of wealth. Also, because of the continuous competition of the Chinese Communist ideology, Sun's principles continue to be an important factor in the lives and politics of the people of the ROC.

The national government of the ROC was established in accordance with a constitution adopted on the mainland in 1946. The constitution provides for a National Assembly to elect the president and vice-president and amend the constitution, a Legislative Yuan (assembly) to pass laws, an Executive Yuan (premier and cabinet) to carry out laws, a Judicial Yuan (branch) to interpret the constitution and serve as a court of last resort, a Control Yuan (audit and supervision board) to audit accounts and to supervise officials, and an Examination Yuan (merit board) to conduct civil service examinations. In 1949 the government was moved to Taiwan when the Chinese Communists gained power on the mainland. The constitution and governmental structure have remained essentially unchanged in Taiwan and the ROC claims to be the legitimate government of all China (Clough, 1978, pp. 33-52).

In order to improve the economic well-being of the people, to create a national political consensus, and to minimize social conflict, the ROC has continuously adopted a number of measures to achieve economic equality over the past four decades. A successful land reform was undertaken in the early 1950s, and an anti-poverty program aimed at the urban and rural poor was instituted in the late 1960s and early 1970s (Wu, 1985, pp. 6-7). The government during this period also sought to promote economic development and to maintain a stable price structure. As a result of the policies emphasizing economic equality, when the price of crude oil rose sharply during the crises in the 1970s, Taiwan's utility rates were controlled and not allowed to increase sufficiently to cover the full cost of fuel. The government subsidized the cost of energy and as a result of the low energy pricing policy demand did not decrease as much as it would have declined otherwise (Kuo, 1983, p. 218). The same consideration underlies the ROC's consistent policy to maintain a viable agricultural sector and a high level of domestic food production in spite of the apparently greater comparative advantage of manufacturing (Wu, 1985, p. 20). These policies reflect the ideology of Sun's "principle of people's livelihood", which plays a very important role in policy making on the ROC (Sheng, 1980, pp. 5-18).

Political Party in the ROC

Political parties in modern society, both in democratic and non-democratic political systems, undertake a wide variety of political responsibilities. They articulate interests, aggregate demands, recruit leaders, make government policy, transmit policy decisions to the people, adjudicate disputes, and educate or coerce people (Lawson, 1980, pp. 3-5; Huntington, 1969; LaPalombara & Weiner, 1966).

In the ROC, the ruling Kuomintang (KMT) party, which was established by Dr. Sun Yet-sen in 1919 is one of the major actors in the political system. The KMT has been in power continuously since 1949 when it moved to Taiwan along with the government. The organizational structure of KMT is centralized and hierarchical. Professional, full-time party members at each level carry out party policies which are made by the Central Committee (Copper, 1981, p. 365). The Central Committee of 130 members is elected by a Party Congress composed of senior party members who have served previously in key party positions. The KMT is headed by Mr. Ching-kuo Chiang, the chairman of the party and the president of the country who has veto power over the Central Committee actions. The executive body between plenary sessions of the Central Committee is a 25-member Central Standing Committee composed of the chairman and the chief military, party, and economic officials (Clough, 1981, p. 359).

The KMT has primary responsibility for assuring that the needs of various groups are considered and for broadening political participation so as to link the governmental leadership and the people. Professional party members work closely with and have significant influence on leaders of various associations, labor unions, cooperatives, and business interest groups (Lu, 1985, p. 1089). The importance of the KMT in Taiwan has been noted by John F. Copper;

> Paralleling or shadowing governmental organization at all levels is the KMT. Thus understanding the Nationalist Party's structure and its influence on politics at all levels is a *sine qua non* for understanding the political processes in Taiwan (Copper, 1981, p. 365).

Pluralism has increased as Taiwan has economically developed and KMT's legitimacy depends more and more on "its ability to sustain economic growth and improve the business environment" (Gold, 1986, p. 129). In order to maintain political stability and economic growth, KMT has been forced to become more open to the demands of the increasing number of interests in society. Unlike a more advanced nation such as Japan, however, the private corporate sector is not strong. Much of the industrial growth of the nation represents international firms doing business in the country, local private business dependent to a large degree upon governmental support, or public enterprises operated by government, such as the Chinese Petroleum Corporation (CPC), the Taiwan Power Company (Taipower), and the China Petrochemical Development Corporation (CPDC). As a result, demands from the corporate sector are not as influential as they are in Japan, which is sometimes called 'Japan Incorporated.'

The party alone in the ROC is the central most important actor in policy making and neither the corporate interest nor the bureaucracy are as influential as they are in Japan. As the KMT party structure has become more open in recent years, popular acceptance has increased (Werner, 1985, pp. 1110-1111).

Little organized opposition to the ruling KMT party exists in Taiwan. There are two other political parties, the Chinese Youth Party and the Democratic Socialist Party, which have representatives in the National Assembly, the Legislative Yuan, and the Control Yuan. These opposition parties are small and generally insignificant in terms of their prospects of winning control of the government or influencing policies since they normally receive less than one per cent of the total votes (Lu, 1985, p. 1089). Furthermore, since their ideologies do not differ significantly from the KMT's, they have little hope of attracting favorable public opinion (World Sourcing Sites in Asia, 1979, p. 348).

Another political opposition in Taiwan is the Dangwei (literally "out-of-the-Party"). This group generally challenges the legitimacy of the ruling party, but it is not unified (Domes, 1981, pp. 1011-28). Some of the groups of the Dangwei even advocate violent overthrow of the government. Others advocate nonviolent changes proposing their own policy agendas which for some consist of leftist, liberal proposals and for others more rightist, conservative proposals (Lu, 1985, p. 1092). As a result of the wide differences in this group, it is unable to unite under a coherent ideology, program or opposition coalition (Werner, 1985, p. 1111).

Bureaucracy in the ROC

ROC's three branches of the government, the Executive, Legislative, and Judicial are similar in form to their counterparts in Western political systems. The Examination and Control Yuan, however, are basically carryovers from the Chinese tradition. Their functions of selection of personnel and of auditing expenditures of funds and supervising actions of personnel are different from Western institutions.

The Executive Yuan or the Cabinet is the executive branch of government and is responsible for implementation of policy. The head of the Executive Yuan is the premier, who is appointed by the president with the consent of the Legislative Yuan. In addition to the premier, the Executive Yuan consists of a number of ministers, chairman of commissions and ministers without portfolio, who are chosen by the premier and formally appointed by the president. Responsibility for energy policies is divided among several ministries and commissions, including the Ministry of Economic Affairs (MOEA), the Council for Economic Planning and Development (CEPD), the National Science Council (NSC), the Research, Development, and Evaluation Commission (RDEC), and the Atomic Energy Council (AEC). Table XIII shows the energy establishment in the ROC.

The governmental bureaucracy in the ROC is a significant actor in the implementation of energy policy because of the complexity of the field, but it is not as powerful in influencing the making of public policy as the bureaucracy is in Japan. Partly, this is due to the fact that the ruling party is so dominant and that the corporate sector is not as powerful in the policy process. Furthermore, bureaucrats do not have the high status that they do in Japan and they normally do not become key

Table XIII
The Energy Establishment in the ROC

Party Structure	President	Executive Yuan
Central Standing Committee Central Committee	Senior Advisor National Policy Advisory Committee	Premier, Ministers Ministers without Portfolio

Vested Interest	Key Cabinet Actors
International Economic Cooperation & Development (Working Groups for Planning and Development of the Electronics Industry)	Premier
China External Trade Development Council	Ministry of Economic Affairs (Energy Committee & Industrial Development Bureau)
Central Bank of China	Economic Planning & Development Council
Central Investment Holding Co.	National Science Council (Hsin-chu Science-based Industrial Park)
Chinese Petroleum Corporation	Atomic Energy Council
China Petrochemical Development Corporation	Research, Development, & Evaluation Commission
Taiwan Power Company	Ministry of Foreign Affairs
Industrial Technology Transfer Corporation	Ministry of Finance
Taiwan Fertiliser Company	Ministry of the Interior
United Asia Electric Company	Ministry of Communications

Lobbyists	Research Groups
Tatung Electronics Company	Industrial Technology & Research Institute (Electronics Research Service Organization)
Taiwan Electronics Appliance Manufacturers Association	Energy Research Laboratories
Taiwan Cement Corporation	National Taiwan University
Formosa Plastics Companies	Tsinghua & Chiaotung University

Source: Annual Review of Government Administration, ROC, 1981-1982, (Taipei: Research, Development, and Evaluation Commission, the Executive Yuan, 1983); James C. Hsiung et al., Contemporary Republic of China: The Taiwan Experience, 1950-1980, (New York: Praeger Publishers, 1981).

political or business leaders upon retirement. The Central Standing Committee of the KMT is the main policy actor, and the bureaucracy can only influence policy as result of its specialized knowledge.

The Ministry of Economic Affairs is the most significant administrative agency in the energy field. It is involved in economic development and is responsible for promoting and supervising agricultural, mining, industrial, commercial, trade and water conservancy programs. Since energy is essential in each of the economic area, MOEA is vitally involved in energy policy matters. Energy planning in the ROC began in 1968 with the establishment of the Energy Planning and Development Committee. The Committee initially was under the guidance of the Council for International Co-operation and Development, but two years later it was renamed the Energy Policy Committee and transfered to the Ministry of Economic Affairs. In 1979 the Energy Policy Committee was renamed and reorganized again into the Energy Committee in MOEA, and made responsible for the implementation of energy policy (Liang, 1986, p. 131). MOEA's Energy Committee focuses much of its attention on changes to the industrial structure as a means for achieving maximum utilization of energy. MOEA also is authorized to participate in joint ventures with energy-producing countries for the manufacture of energy-intensive products.

The national energy policy in the ROC was enunciated in the Energy Policy for the Taiwan Area, (1974, 1979, 1984), and the Energy Management Law (1981). Under these laws, MOEA or other governmental administrative agencies are to implement energy policies pertaining to stabilization of energy supply, regulation of energy prices, promotion of efficient energy use, prevention of energy-related pollutions, and advancement of energy research and development. A number of public enterprises such as the Chinese Petroleum Corporation (CPC), the Taiwan Power Company (Taipower), and the China Petrochemical Development Corporation (CPDC), which are directly involved in energy matters, are also under the aegis of MOEA. Although these public enterprises are part of the organizational structure of MOEA, they operate much like municipal public utility companies or governmental corporations in the United States (Copper, 1979, p. 312).

According to the Energy Management Law, MOEA has the authority to regulate the rates of the Chinese Petroleum Corporation and Taipower. Both public enterprises are required to provide finances for establishing an energy research and development fund and most of this fund is to support Energy Research Laboratories (ERL). These laboratories were established in 1981 to plan and coordinate energy research and development (Yih, 1982, p. 155).

The Council for Economic Planning and Development (CEPD), another agency within the Executive Yuan is responsible for formulating long-term economic plans, conducting economic research and supervising the execution of major economic construction programs. In 1981 the chairman of the CEPD, Kuo-hwa Yu, called for changes in the industrial structure to develop strategic industries such as electronics, information, precision equipment, and automobile production as a means of lessening the demand for energy (China News, 1981, p. 4). Since then CEPD has emphasized restructuring of the industrial sector of the economy, stressing technology-intensive, nonpolluting, nonenergy-guzzling industries instead of heavy or capital-intensive ones. Its Ten-Year Plan for 1980-1989 and Four-Year Plan for 1982-1986 reflect this priority (Gold, 1986, p. 102). Mass transportation and rapid transit systems, as well as use of energy-saving devices on personal vehicles also are view as important aspects of the national energy plan. Three large transportation systems were completed in the 1970s as part of the "Ten Great Projects." Other projects underway include a second North-South Expressway and a subway system in Taipei.

The National Science Council (NSC), still another agency within the Executive Yuan, is responsible for executing government policy and allocating funds for scientific development. Another agency, the Research, Development, and Evaluation Commission (RDEC) is responsible for promoting research and development (R & D) activities among government agencies and exercising the functions of administrative control and evaluation. Finally, the Atomic Energy Council (AEC), a separate organ under the Executive Yuan, has responsibility for research, planning, and use of atomic energy. It acts as a regulatory body for nuclear activities as well as having responsibilities concerning international cooperation (i.e., International Atomic Energy Agency) in the use of atomic energy.

A number of other governmental agencies have responsibilities which influence the energy field. For example, the Ministry of Foreign Affairs is vitally involved in diplomatic negotiation pertaining to foreign energy sources. The Ministry of the Interior's responsibilities for environmental problems also involves it in energy matters. Similarly, the Ministry of Finance and Communications affect energy policies since the activities of their departments affect all governmental policies.

Corporate Groups in the ROC

Three distinctive features characterize corporate groups in Taiwan. They rely heavily upon foreign technology, are dependent upon government planning and investment, and act in close cooperation with government or government-sponsored organizations. The role of corporate groups in Taiwan has become more significant since the first oil crisis. In order to cope with the nation's political and economic challenges caused by the energy crises, government was forced to devise a multifaceted strategy to reduce its vulnerability to the instability of the global economy. In doing so, the government and the corporate sector had to work closely on economic strategies to promote economic development and stability in face of the uncertainty in the energy field. In order to reduce conflicts and improve channels of communications between the corporate sector and government, the government began in mid-1982 a series of public forums between corporate leaders, bureaucrats, and party leaders to discuss what needed to be done to stimulate economic growth in face of changes in the energy field.

Results of these corporate inputs may be seen from the fact that of the eight R & D policy priorities announced by the ROC government in 1983, energy and energy related technologies for industry were at the very top of the list (The Commercial Times, 1983, p. 2). Transfers of new technologies to assist industries also were emphasized in these policies priorities since "many of Taiwan's largest business groups have either a capital or technology relationship with a foreign firm" (Simon, 1981, p. 210).

Corporate groups in Taiwan differ from those in other advanced industrialized countries in that they are greatly influenced by government either through direct or indirect control. The mixed economic system enables the government to influence the direction of corporate groups' activities, but at the same time to preserve these groups and individual initiative (Cheng, 1985, p. 12).

Corporate interest groups in the ROC are not the major actors in the energy policy process despite the recent openings of the new communications with the government. The number of representatives of corporate interest groups in the powerful Central Standing Committee of the KMT is quite small. Of the 25 members on the Central Standing Committee only 4 at present directly come from the corporate sector. As a result, the main influence of the business community comes from the national consensus regarding the need for economic development rather than from their position or influence in the party. Although corporate groups may place their demands on government, the party ultimately remains the dominant influence in making policies, and the party's ideology emphasizes social welfare and equality which tends to inhibit the influence of strong dominant businesses.

Other Energy-Related Issues

Taiwan's environmental problems in recent years have become so serious as to affect the quality of life in the country. Taiwan experiences a number of types of environmental pollutants that are closely connected to energy policy: gaseous pollutants mainly from factories, particulate matter such as ash from coal-burning firms, radioactive waste, and water pollution, either as chemical or heat pollution resulting from energy conversion and use (Copper, 1979, pp. 300-6). Each may threaten the environmental quality, especially during periods of temperature inversions when there is little wind.

Although Taiwan has no strong environmental groups lobbying against pollution as is found in some more pluralistic countries, there is strong public opinion opposed to pollution which the party is forced to recognize. Recognition of this issue by the party can be seen from the fact that the government in 1973 enacted the executive regulation called the Energy Policy for the Taiwan Area, ROC, which requires both public and private enterprises to "improve and apply technology for the prevention of environmental pollution" (Energy Policy for the Tawian Area, 1973). The following year the Legislative Yuan enacted the Air Pollution Control Act applying strict air quality standards. More recently controls over all kinds of pollution have been strengthened.

The government faced some difficult issues in setting priorities for protecting the environment from pollution by utilities and industries. The government had proposed a policy of reducing dependence on imported oil by changing over to coal-fired generating plants. The use of coal for electrical generation, however, may create environmental problems in air quality, disposal of fly-ash and storage and handling of coal resource. To control these problems, electrical generating plants must be equipped with sophisticated anti-pollution technology and must use a high quality coal (Cisler et al., 1982, p. 150). Utilities and industries burning coal were manadated to install anti-pollution devices and to burn a quality of high grade coal that is less polluting or to switch to LNG or nuclear power.

Nuclear power is preferable as a means of dealing with the "greenhouse effect" caused by temperature inversions because it emits no carbon dioxide (Yager & Matsuba, 1984, p. 219). However, utilization of nuclear energy has been at the center of public debate in Taiwan. Public opposition to nuclear power stems largely from fear, which was magnified by the Three Mile Incident in the United States and the Chernobye Incident in the Soviet Union.

Another difficult environmental issue facing government involves control of pollutants from vehicles using internal ccmbustion engines. The number of private automobiles continues to increase in Taiwan, and pollutants from these cars present a growing challenge. The government has tried two tactics to solve this problem. It has increased mass transit facilities, electric operated trains as well as buses to reduce the need for private transportation, and it requires anti-pollution devices on all automobiles. an alternative to the internal combustion engines.

A number of governmental bodies are involved in controlling pollution of the environment. At the central government level, the Environmental Protection Bureau in the Ministry of the Interior is responsible for establishing and examining the standards of environmental pollutions. The responsibility for implementing these standards is shared with provincial and local governments.

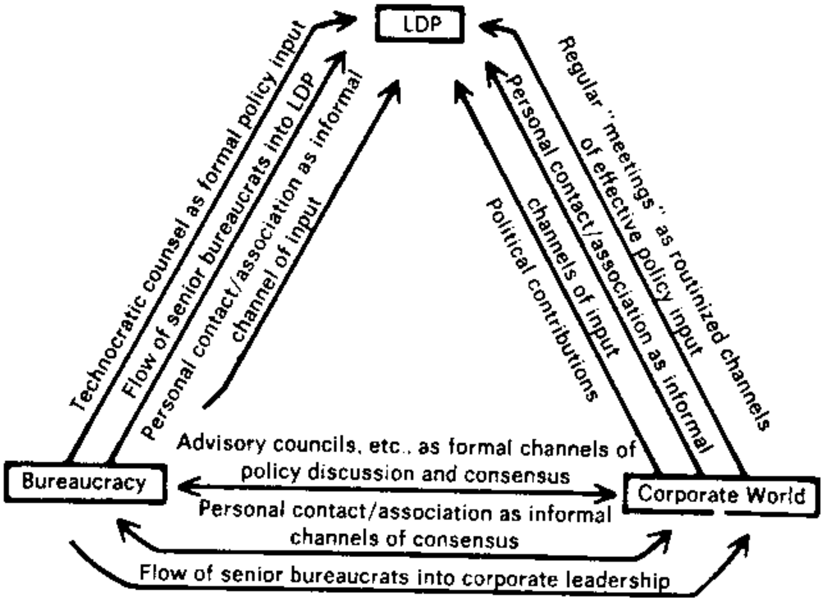
The Politics of Energy in Japan

Japanese politics is often characterized as lacking major schisms and resolving its lesser conflicts with relative ease, thanks to a consensual decision-making process. This view of Japanese politics states that politics is not confrontational because there is no strong ideological differences dividing groups or factions. A contrasting view of Japanese politics, however, stresses the extreme militancy of opposition parties and labor unions, pointing to their dogmatic and inflexible pronouncements. According to some scholars both of these views are correct, only their emphasis is different (Ishida, 1984, pp 16-38).

One can not reconcile these seemingly contradictory views of Japanese society without an appreciation of Japanese culture. The Japanese culture with its valuation of group over individual and group linkage to higher authority have produced a decisional context that gives priority to harmony over conflict and nuance over the general principle. A group cooperative spirit is promoted at the national level through the idea of one-family nation (Kazoku Kokka) (Michio, 1973, pp. 46-54). The myths of the Emperor are the center of a national entity in which all Japanese are seen to be his children (Brown, 1955, p. 16). The Emperor within this culture remains the symbol of national unity. Traditional values still are strong and influence modern society. Many of the sharp cleavages found in other more heterogenous societies are not present in the more homogeneous Japan. The ideology of economic growth and energy development is widely held and is represented in the dominant party, the Liberal Democratic Party (LDP, Jiyuminshuto) which heads the unitary governmental system. The decision-making process in the governmental system follows the traditional pattern of consultation, consensus, and harmony. Confrontational tactics in politics under these conditions rarely occur except when minority interests feel strongly about an issue which it can not resolve in the normal decision process.

In Japan, the formal institutions of government most directly involved in the process of allocating values are the ruling political party, the Prime Minister and Cabinet, the bureaucracy, and corporate interest. There is in Japan a conservative policy establishment that comprises an interlocking network between political parties, governmental bureaucracy, and industry (Kohl, 1984, pp. 15-6). Figure 8 shows the relationships among political party, bureaucracy and corporate groups within the ruling triumvirate in Japan.

Figure 8
The Ruling Triumvirate in Japan



Adopted from: Taketsugu Tsurutani, Political Change in Japan: Response to Postindustrial Challenge, (New York: David McKay Company, Inc., 1977), p. 94.

Although the last five prime ministers have come from the conservative LDP, the LDP is not a party with political autonomy but rather it is the political branch of an institutional triumvirate. The other two member in the triumvirate are the governmental bureaucracy and the corporate leadership (Tsurutani, 1977, p. 71). Policies are made by the institutional triumvirate not by the party alone. The ruling party has to cooperate with the powerful institutions of the bureaucracy and the corporate leadership. In fact, Taketsugu Tsurtani states that:

> The LDP's policy making, especially as the volume and technical complexity of issues and problems expand, is based on a more or less uncritical acceptance of the preference and recommenaation of the bureaucracy directly expressed to the party and indirectly transmitted and reinforced through corporate leadership, which is dominated by former senior bureaucrats (Tsurutani, 1977, p. 91).

As a result of this form of policy making, the LDP has been called "a party without policies" (Daiichi, 1968, pp. 446-7).

Political Party in Japan

In Japan, the Liberal Democratic Party (LDP) which has held power continuously since 1955, has ruled Japan from a virtually unbeatable posture, while the party opposition has been severely fragmented. As Scott C. Flanagan pointed out (1980), "LDP has managed to hold itself together for twenty-five years because of the realization that so long as the party commanded a majority, each faction's power aspirations could best be served by remaining within the party" (Flanagan, 1980, p. 48). This phenomenon continues even to the 1980s; and as of the 1980 elections no other party has ever succeeded in gaining more than 11 percent of the popular vote. The current situation of the LDP, as Steven R. Reed states, is that "even if the LDP were to lose its majority, the probable outcome would be an LDP-dominated coalition" (Reed, 1986, p. 452). This coalition would allow the LDP to retain preponderant control over the nation's political institutions and its public policies.

Japan is characterized by close, informal links between government and industry, often labeled as the phenomenon of "Japan Incorporated". The bureaucracy, the majority party, and big business have so many interests in common, and dominate the governmental system to such an extent, that policymaking is basically cooperative rather than conflictual Burks, 1981, pp. 136-7; Campbell, 1984, p. 294). By the time a policy paper reaches the cabinet-ministerial level, a government- and industry-wide deliberative and consultative process has already taken place that virtually ensures the recommendation of the policy proposals (Morse, 1982, p. 258). The prime minister is the main actor involved in energy policymaking, however, the LDP's Political Affairs Research Committee makes its policies on energy research and development matters, and reviews government energy-legislative bills and programs before they go to the prime minister.

The four major opposition parties, the Japanese Socialist Party (JSP, Nihon Shakaito), the Japanese Communist Party (JCP, Nihon Kyosanto), the Democratic Socialist Party (DSP, Mishato), and the Clean Government Party (CGP, Komeito), have little opportunity to overturn policies of the LDP, and can effectively influence policy only by cooperating with the LDP. Factional dispute and the accompanying inability to compromise has been a major factor contributing to the lack of success of the opposition parties. Such factional disputes have centered around ideology as well as leadership personalities. Cooperating with LDP, however, blurs their image in the eyes of the electorate, keeping them largely politically impotent (Pempel, 1975, pp. 63-79).

It is important to note that the opposition parties may gain supporters through recruitment of those in the "citizen protest movements". Various movements have been formed in recent years that are comprised of citizens who have common complaints, especially concerning environmental pollution (Bradley, 1984, pp. 216-7). In this regard, the opposition strategy of focusing on local political contests to increase their representative strength should not be ignored as environmental problems still remain unresolved.

Bureaucracy in Japan

In Japan, bureaucracy has a long tradition of taking the leadership in developing the country. As Nobutaka Ike pointed out in 1978, "if there is one institution that looks upon itself as the guardian of the general interest, it is the bureaucracy" (Ike, 1978, p. 61). Also, Chalmers Johnson made the observation that "elite bureaucracy in Japan makes most major decisions, drafts virtually all legislation, controls the national budget, and is the source of all major policy innovations in the system" (Johnson, 1982, pp. 20-1).

Two fundamental reasons explain why the dominant relationship between the bureaucracy and party leadership is one of "accommodation". First, many bureaucrats retire and run for political office or become corporate leaders and rise to positions of power in either the government or the corporate world. Second, the vertical and horizontal relationships between bureaucrats and business leaders is so strong, and business has a major impact on the party since it furnishes the party funds to operate (Ike, 1978, pp.

62-3). Based upon the above analysis, it can be said that the role of the bureaucracy is crucial in the nation's political affairs and conduct of the modern industrial economy (Tsurutani, 1977, pp. 70-116).

The role and influence of bureaucrats in energy-policy process can be described in two ways. First, bureaucrats usually look to the LDP politicians for actions favorable to them in budget appropriations and jurisdictional aggrandizement. In effect, the budget authorized by the LDP is very limited. Bureaucrats control the power of budgetary decisions over energy production, utilization, and energy research and development. According to Tsutomu Toichi, bureaucrats can influence the power of fiscal budget so as to determine priorities in implementing energy policies (Toichi, 1983, pp. 97-106).

Bureaucrats are also deeply involved in making energy policy in part because of the volume and technical complexities of energy policy matters. Bureaucrats in Japan are sophisticated "technocrats" and highly skilled in the intricacies of their field. In order to deal with the complexities of energy policy, an increasing number of bureaus and programs have been established within existing energy-oriented ministries. Table XIX shows the energy establishment in Japan.

Table XIX
The Energy Establishment in Japan

Prime Minister	Key Cabinet Actors
Science and Technology Council Atomic Energy Commission Nuclear Safety Commission Electric Power Development Coordination Council Atomic Power Policy Discussion	Comprehensive Security Council Ministerial Council on Overall Energy Policy Ministry of International Trade and Industry (Agency for Natural Resources and Energy) Science and Technology Agency (Power Reactor and Nuclear Fuel Development Corp.) Economic Planning Agency Ministry of Finance Ministry of Foreign Affairs Ministry of Transportation

Parliament	Environmental/Consumer
(Lower House) Energy and Minerals Resources Subcommittee (Upper House) Energy Measures Committee Liberal Democratic Party and Other Party Energy Policy Committees	Environmental Agency Industrial Pollution Control Association of Japan Consumer's Union of Japan Council of Environmental Groups

Lobbyists	Vested Interests	Research Groups
Japan Federation of Economic Organizations Energy Policy Promotion Committee Petroleum Asso. of Japan	Oil Companies Trading Companies Japan Development Bank Atomic Power Commission Japan Atomic Industrial Forum, Inc. Electric Industries Association	National Institute for Research Advancement Nomura Research Institute Mitsubishi Research Institute Committee for Energy Policy Promotion

Source: Ronald A. Morse, editor. The Politics of Japan's Energy Strategy: Resources-Diplomacy-Security, (Berkeley, Ca.: University of California Press, 1981).

The key governmental agency in the bureaucracy responsible for energy-policy process is the Ministry of International Trade and Industry (MITI) which has central responsibility for most areas of energy policy. Within MITI, the Agency for Natural Resources and Energy, which was created just before the 1973 oil crisis, has direct jurisdiction over natural resources and energy. It implements the country's overall energy program, supervises power stations, and carries out energy planning, including reviews of foreign investment applications (Japan, 1977, p. 325).

There are a number of other agencies that are tangentially involved in energy policy. The Science and Technology Agency is responsible for nuclear research and development, and the Atomic Energy Commission decides on matters relating to licensing and building nuclear facilities. In the consultative process the Ministry of Education (university and research funding), the Environment Agency (pollution policy and regulation), the Ministry of Finance (budget support for national energy policies), and several other economic planning bodies have a voice or input, as well as some responsibilities for implementing various aspects of energy policy (Morse, 1982, p. 258). The government also consults with a number of major advisory groups on energy matters such as General Energy Council, Petroleum Deliberation Council, Institute of Energy Economics, Petroleum Association of Japan, and Nuclear Fuel Cycle Problem Council. Other agencies such as the Economic Planning Agency and the Environment Agency develop and manage still other technical programs pertaining to energy.

Bureaucracies also have significant influence on the economy. Since the 1930's the bureaucracy has been given increased authority "in the laws establishing the various ministries, to issue directives (shiji), requests (yobo), warnings (keikoku), suggestions (kankoku), and encouragements (kansho) to the enterprises or clients within a particular ministry's jurisdiction" (Johnson, 1982, p. 265). Administrative power to guide or direct the economy also comes from the close government-business relationships. Governmental policies provide that agencies may direct or guide various energy-oriented business and industrial activities both in domestic and foreign spheres. Energy policy is often determined through the "administrative guidance". The government determines what is best for Japan and passes "guidance" on as a comment at a meeting with industry representatives.

MITI is one of the important and powerful bureaucracies in the energy and other economic fields. MITI's authority over oil affairs derives from the Basic Petroleum Law of 1962, which gives MITI the right to grant licenses for the construction of new refineries, recommend modifications in refinery production plans, and establish a "standard price" for oil products during crises (Krapels, 1980, p. 63). MITI officials presented the Long Term Energy Plan in 1976 which provides the framework for guiding total energy activities in the nation. Use of alternative energy such as coal, nuclear power, and liquid natural gas (LNG), and promotion of conservation are all a part of this plan.

Two provisions of the energy plan give MITI additional powers over the economy. First, it was given authority to guide or force private enterprises to follow its advice in achieving the objectives of the energy policy as a whole. Under this plan, "MITI has on occasionally retaliated with force against enterprises that rejected its advice" (Morse, 1982, p. 266). MITI also can use its authority to encourage Japanese firms to engage in oil exploration, production, and refining, or it may discourage the domination of an industry by a major oil or general trading company. MITI's aim is not to reduce competition among Japanese companies, but to create the strongest possible companies with the greatest competitive potential (Vogel, 1979, p. 72). Second, MITI is given broad authority in order that it may respond to new energy situations, requiring flexibility and adaptation.

Since the bureaucracy is so influentual in energy politics, much of the political conflict over energy becomes bureaucratic politics. The conflicts between MITI and other parts of the bureaucracy clearly shows the dynamics of energy politics. John C. Campbell describes this bureaucratic politics as follows:

> MITI has had persisting arguments with the Finance Ministry over macroeconomic policy, with the Foreign ministry over export promotion and foreign aid, with the Welfare ministry over pollution, and with the Agriculture ministry over protectionism--every ministry provides several such examples. Negotiations among ministry representatives--the weekly cabinet or vice-ministrys' conference meetings, or lower-level liaison committees--often resemble the United Nations Security Council at a tense moment (Campbell, 1984, p. 299).

As can be seen the differing preferences of various groups are to a large degree fought out in inter-departmental struggles. In order to cope with bureaucratic conflicts, a number of organizational mechanisms combining bureaucratic and political agencies have been created, such as the Cabinet's Legislation Bureau, the Vice-Minister's Conference, and the LDP's Executive Council. It is within these inter-departmental and political agencies, that the give and take of politics and the bargaining and compromising essential to policy making occurs.

Corporate Groups in Japan

The third major political actor involved in policy-making is the business and corporate leaderships. The massive financial backing by business to the LDP, which amounted to some seventy five per cent of the party's funds is a major link between the LDP and the business sector (Soukup, 1963, pp. 748-9). Another linkage between the businessmen and the LDP and the bureaucracy grows out of the similarity in views and attitudes toward economic and political matters. In part, this is based upon a common professional and educational background, strenghtened by frequent interactions through regular meeting, personal contacts, and political contributions. Through these interactions, the corporate leaders have a major role in policy making. Also, private business and industry make inputs to national energy policy, through their participation in government advisory bodies and through industrial federations or specific industrial lobbying groups (Morse, 1982, p. 258).

The corporate leaderships, generally, consists of the top executives of three big business organizations. The Federation of Economic Organizations (Keidanren) with its membership of 100 major trade or industrial associations and some 750 major firms is considered the political capstone of Japanese business. Its president is frequently referred to as the prime minister of the financial world. The Japanese Committee for Economic Development (Keizai Doyukai), with fifteen hundred individual members is also a major voice in the articulation of business interests. Some 30,000 employers are organized into the Japanese Federation of Employers' Associations (Nikkeiren) through which they attempt to speak with a unified voice on matters such as energy and labor-management conflicts (Pempel, 1982, pp. 29-30). Two other important business oriented groups are the Japanese Chamber of Commerce and Industry, plus top officials of the Industrial Club (Yanaga, 1968, p. 32). Other energy related industries such as the Coal Association and the Electric Power Industrial Association are also important groups influencing governmental energy policy. At times these business organizations have different preferences and differ sharply in their approaches to policies. They range from the staid Federation of Economic Organization to the more liberal Committee for Economic Development to the even more conservative Federation of Employer's Association.

Corporate leadership articulates and aggregates their own interests regarding energy policy. In this sense, the term "corporatism", meaning a union of political and economic sectors, may be applied to describe the pattern of Japanese politics (Schmitter, 1974, pp. 85-131). The business community has enormous potential influence on politics, but it can not be assumed that business controls all policy decision taken by government. Corporate interests generally do not have the decisive influence on political rather than economic policies and on international rather than domestic policies, according to Donald C. Hellmann. Hellmann states:

> In domestic economic policy, business influence is formidable if not decisive, through a close working relationship with the bureaucracy. This intimate cooperation is not a recent phenomenon. Consequently, Japanese business has acquired effective access to policy-making, it is the bureaucracy, not the conservative party, that rules... However, when a policy matter is international, not domestic, essentially political rather than economic, and the party not the bureaucracy is the dominant force, the established channels of business contacts are comparatively limited in value (Hellmann, 1977, pp. 125-6).

Despite this observation, corporate interests actually controls 60 percent of Japan's total energy imports and exports, and nearly one-third of Japan's oil-market purchases (Morse, 1982, p. 258). These business and industrial companies working with MITI have helped to restructure Japan's over-all energy system by substituting alternative energy sources such as coal, LNG, and nuclear power for oil. Also, private industrial groups helped to implement the Japanese overseas energy policy of investment in foreign energy development.

Other Groups Demands

In addition to the ruling triumvirate, other groups affected by energy policies also place demands on government. Environmental groups and local citizen associations are two such groups attempting to influence governmental energy policies. Concern for air, water, and land environmental quality has been widespread since the 1970s in Japan. Environmental problems have a severe impact due to the very small land area involved for concentrating industrial activity and the large urban population. Thus, environmental pollution has become a major public concern.

In 1971, the Diet created a new Environment Agency (Kankyocho) which has broad jurisdiction over environmental problems, and is responsible for coordinating environmental administration and supervising standards (McKean, 1977, p. 230). The Environment Agency faces a number of internal and external problems. As a new organization in Japan's pantheon of ministries, it stands at the low end of the bureaucratic pecking order with respect to prestige, influence, and the power (Kelley, Stunkel, and Wescott, 1974, pp. 765-6). While other ministries such as MITI, the Ministry of Finance, and the Ministry of Construction are political powerful, adequately funded and are squarely on the side of business and continued growth, the Environment Agency does not have the power or resources to fully implement the environmental laws. For instance, the Agency has no control over the storage, and disposal of nuclear wastes because the Science and Technology Agency has the responsibility for encouraging development in this field.

Another weakness of the Environment Agency is that it is composed of many bureaucrats transferred from other agencies whose attachments are frequently to the agencies from which they came. Problems of personal loyalties to other agencies and groups whose goals conflicted with stringent regulation of pollution laws weakens the Environment Agency's ability to operate effectively, and at times makes it appears to be working at cross-purposes. As a result of the ineffectiveness of the Environment Agency, environmental lobbies have found it difficult to launch effective action against polluters at the national level (Kelley, Stunkel, and Wescott, 1974, p. 764). All four of the opposition parties have criticized the government and have given various aid to antipollution movements in which a large number of organized labor associations have participated in order to increase their influence on environmental issues.

Other local citizen associations, such as hamlet (buraku-kai) and neighborhood (chyonaikai) organizations, also play a role in promoting citizens' protest movement in local politics. Under the revisions of the Basic Law for

Environmental Pollution Control in 1970, local governmental bodies were given greater authority over environmental problems, thus permitting local citizen associations to participate more directly in environmental matters. Increasing citizens' participation makes the conflicts over environmental matters more visible. According to Margaret A. McKean, a consequence of the citizens' movement activities was an increase in the number of pollution-prevention contracts (kyotei) between local government bodies and industrial firms (McKean, 1981, pp. 249-51).

Pollution has also become acute in several coastal ocean districts, such as Tokyo Bay, Ise Bay, and the Inland Sea, as well as in some rich fishing areas. The shrinkage of near-shore fisheries and seaweed plantations due to pollution and land reclamation has already caused a decline in ocean products and loss to a major industry (Patrick & Meissner, 1976, pp. 458-60). In order to protect fishing grounds, the Japanese government has strengthened enforcement of the Water Quality Preservation Law, the Factory Effluents Control Law, and the Sewerage Regulation Law. Environmental issues arising from oil and gas exploration in offshore fishing grounds, another source of environmental pollution, increasingly pits fishermen against the oil and gas industry.

Citizen and group demands, such as those reflected in these environmental issues, often are consumed in the politics of bureaucracy or in other parts of the ruling triumvirate. The cultural propensities for harmony provide an incentive for consensus. In some instances, however, consensus is not obtainable and protest are made in the form of marches and civil disobedience as a means of presenting unresolved demands on the government. Protest over nuclear and environmental issues pertaining to oil exploration and offshore drilling in fishing grounds are two examples of such unresolved issues.

Summary: Comparison of Energy Politics

The politics of energy in these two countries are in many ways very similar, and yet are also very different. The fact that both have relatively few energy resources limits the conflicts between different energy sectors, and there is little conflict over energy importation since both are dependent on foreign energy sources to fuel their export trade which is vital to economic development. Also both have long histories of government involvement in the energy policy arena, which lessens the potential of conflicts between private and public interest, and both have had close ties to the United States so there is relatively little debate over negotiation with multinational corporations.

Government involvement in economic planning generally also is widely accepted in both countries even though both are capitalist countries. Furthermore, the more confrontational style of politics often found in more pluralistic countries is absent in these two countries. Politics in both countries reflects a more consensual form. Environmental pollution is a crucial problem in both countries, and the fear of nuclear power affects the kinds of energy decisions which can be made. Public opinion against nuclear power continues to act as a major factor affecting energy policy.

The differences in politics in the two countries reflect the differences in their histories and cultures. In Japan, the cultural emphasis upon the group over the individual and group linkage to higher authority has produced a decisional context that encourage harmony and consensual politics. The way that decisions are made by the ruling triumvirate reflects the importance of consultation and consensus. The strong corporate sector is able to influence the party and the bureaucracy so that decisions involve all three members of the triumvirate.

In the ROC, on the other hand, the historical and cultural forces shaping politics are radically different. The war with the Chinese Communists remains a major influence in the life and politics of the ROC. A strong charismatic leader and a party based upon the ideology of

Dr. Sun Yat-sen dominates all politics. Corporate groups have only recently emerged and are still relatively weak in influencing government. The party because of its ideological committment to social welfare and economic equality is not as receptive to demands of corporate interests as the government in Japan. ROC's bureaucracy also does not have the influence and status of the Japanese bureaucracy. Their main influence is derived from their technological competencies rather than from their status or interactions with corporate or party influentials. As a result of the relative weakness of the corporate sector and the bureaucracy, policy making is dominated by the political party, and most of the bargaining and compromising vital to policy making occurs in the Central Standing Committee.

How these different political systems dealt with the energy crises is the next question which need to be examined. Chapter V will study the energy policies of the two countries.

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CHAPTER V

POLICY RESPONSES TO THE ENERGY CRISES IN THE REPUBLIC OF CHINA AND JAPAN

The drastic increase in the prices of oil in 1973 and 1979 forced all the industrial economies into a dilemma involving both stagnation and inflation, and the Republic of China (ROC) and Japan were no exception (Pachauri, 1985, pp. 94-114). Use of traditional economic policies designed to solve specific maladies such as monetary and fiscal controls were ill designed to deal with this new crisis. The problems created by the sudden quadrupling of oil prices required more drastic actions. A deficit of accounts in the international balance of payments was created and neither the ROC nor Japan could immediately reduce oil consumption. Inflation accelerated because of the increase in the price of such a basic production input as oil. The higher price of oil not only increased fuel costs but also the cost of all other commodities and services (Morgenthau, 1975, p. 45). The higher oil prices caused huge shifts of income from the oil-importing to the oil-exporting countries, and as income was drained from the ROC and Japan there was a reduction of demand followed by recession. Profits of most businesses, except oil-importing concerns, were reduced because skyrocketing energy costs caused both the raw materials and labor costs to rise (Kuo, 1983, pp. 209-221; Shibata, 1983, pp. 135-8). This economic shock in turn aggravated the recession. In this crisis environment, government was forced to react.

This chapter compares the policy responses in the ROC and Japan to the energy crises of 1973-1974 and 1979-1980. The possible responses to the energy crises differ from country to country, because of the differences in their energy systems and political and economic environments. The purpose of this chapter is to compare how these two nations responded to the energy crises.

The responses to the energy crises may be categorized into three stages. First, crisis management occupies the initial period where government attempts to deal with short run rapidly escalating prices. Second, a period of structural adaptation to the energy problem follows the immediate crisis period. In this stage, energy policies set forth national goals pertaining to energy, and administrative agencies are created to implement the new policies. Third, policy implementation of energy goals follows simultaneously as policy alternatives are considered and strategies are made for the implementation of energy policy. Since there is a host of possible alternatives a nation may adopt, this chapter is guided by the schema of alternatives shown in Figure 2, (page 14, chapter one) entitled "Designing a National Energy Policy: Alternatives that Need to be Considered". Among the possible policy alternatives are the production of more energy, the regulation and redistribution of energy, the creation of new patterns of consumption and production, and the development of the economy away from energy intensive industry. This chapter examines two questions: (1) What are the contents of the policies taken in response to energy crises at different stages in these two countries? and, (2) What possible policy alternative actions were considered as ways of alleviating the energy shocks?

Policy Responses in the Republic of China: Crisis Management

The ROC has relatively few domestic energy resources and imported 61.05 per cent of its total energy resources in 1971; 98 per cent of its imported oil came from the Middle East. As a result, the oil crises drastically increased the nation's oil bill and set off seemingly uncontrollable price inflation in its home market. The inflation rate, the wholesale and consumer prices, jumped from 4.5 per cent and 3.0 per cent in 1972 to 40.6 per cent and 47.5 per cent in 1974, respectively. The rate of economic growth dropped from 13.3 per cent in 1972 to 1.1 per cent in 1974 (DGBAS, ROC, 1982). The oil shock also affected adversely the trade balance and the balance of payments in Taiwan.

In face of this dire economic emergency the government undertook a number of programs to minimize the damage of the oil shock. In the second half of 1973 the government decided to maintain existing prices and rates for oil products and public utilities, and thus shielded the public from the full blow of the crisis. This act in effect subsidized the cost of energy and kept individuals from personally adjusting to higher priced fuel as fast as they would have otherwise. In addition, agricultural subsidies on foodstuffs were extended to support artifically low food prices. Exports in 1973 as a result grew, and the economy as a whole ended the year with a trade surplus. This surplus added fuel to money supply expansion and combined with the vigorous growth in the export sector, caused substantial wage increases, further overheating the economy. Another governmental response was raising the interest rate on one-year savings deposits from 8.75 to 15 per cent between July 1973 and January 1974 (Myers, 1986, p. 52). Because this delayed action to limit the money supply, inflation soared in 1974, as prices ended the year at 40.6 per cent higher.

An Economic Stabilization Program was announced by the government in 1974. The highlights of this program included a substantial increase in interest rates causing a tightening of credit, an upward adjustment in prices for petroleum, electricity, and transportation services, and the adoption of price controls on many essential industrial commodities. Under this program, the government raised interest rates an average of 33.4 per cent, oil prices 88.4 per cent, and electricity rates 78.7 per cent (Kuo, 1983, pp. 211-4). It also increased taxes, but stimulated employment by continuing to develop the ambitious infrastructural and industrial modernization scheme called the Ten Big Projects. As a result of these actions, inflation was finally checked and the inflationary expectations of the public were dampened. In turn, this drastic stabilization program caused a reduction in the rate of growth and a recession occurred.

The government which had been working on an energy policy before the 1973 crisis, promulgated a comprehensive energy policy just as the economic crisis hit. The Energy Policy for the Taiwan Area, ROC (1973), among other things called for conservation, diversification, and development of energy sources as a means of reducing dependence on imported oil from the Middle East (Chu, 1979, p. 3). Efforts were proposed to increase the expansion of indigenous energy sources and offshore exploration. Also proposals were made to encourage the use of nonconventional sources of energy such as geothermal, wind, and solar energy. Since diversification of energy sources was stressed as a means of reducing dependency on imported oil, the government proposed a program of diversification from oil to coal or to nuclear power for the generation of electrical power. By the end of 1974, the economy was on the path to recovery and the government turned from actions that were mainly crisis management to programs for adapting institutional structures to the new energy environment.

By the time the second energy crisis occurred in 1979-1980, the ROC had modified its governmental institutions and had adopted a national energy policy which is considered in the next section on structural adaptation. The doubling of OPEC oil prices again in 1979 caused another shock to Taiwan. The wholesale and consumer prices reflecting the inflation rate rose from 13.8 per cent and 9.8 per cent in 1979 to 21.5 per cent and 19.0 per cent in 1980, respectively. Economic growth declined from 8.1 per cent to 6.6 per cent in 1980 (Kuo, 1983, pp. 200-1). The trade balance as a result of the second crisis fell from US $1,761 million in 1978 to US $291 million in 1979, and to a deficit of US $547 million in 1980. Similarly, the balance of payments deteriorated from a surplus of US $1,951 million in 1978 to US $96 million in 1979 and then to a deficit in 1980 of US $127 million (Liang, 1986, pp. 122-3). It can be seen that impact of the second crisis although serious was not as severe as the earlier crisis. The inflation rates during the second oil crisis rose only about half that of the first shock, and the damage to the economic growth rate was also less.

Although no fundamental macroeconomic policy changes had been made since the first energy crisis in 1973, the government in the second crisis had obviously learned the importance of cost-reflecting pricing in energy policy. Energy prices were adjusted upwardly immediately after OPEC's price increase. During 1979-1981, prices of both oil and electricity were raised every year (Kuo, 1983, p. 218). Macroeconomic policies were activated to contain domestic inflation caused by the huge increase in oil prices. Taxes were reduced, public expenditures, especially for capital expenditures were decreased, and the money supply closely controlled. Although the impact of the second oil shock was great, prolonged and widespread, by 1982 the Taiwan economy seemed to be recovering. Again, the ROC had weathered the storms of the international oil market.

The second energy crisis caused the ROC's government again to review and revise its energy policy in accordance with the new energy situation. Several amendments were made to the Energy Policy for the Taiwan Area, ROC. Greater emphasis was place on accelerating the development of indigenous energy and conservation measures were strengthened aimed at actively promoting energy conservation and raising efficiency by assisting industries to automate and replace energy-intensive equipment with energy-saving equipment. Also, plans were initiated to construct mass transporation systems as a means of reducing energy consumption.

Policy Responses in the Republic of China: Structural Adaptation

Once the urgency of the immediate economic crisis lessened, it became obvious that the ROC needed an energy policy. A policy that would help to protect national security and well-being from similar external threats and to prepare the economy to face the future when the world's effective supply of fossil fuels is expected to be exhausted. Despite a wide spread consensus on the need for such a policy, it is difficult to enact a national energy policy since it affects the allocation and distribution of resources. It is highly political in nature.

The crux of the energy problem lies in the high price of petroleum, which not only increases costs of production but also results in a huge loss of real national income through adverse changes in the terms of trade (Kuo, 1983, p. 310). The key goals of an energy policy are to achieve economic growth with a minimum consumption of energy.

Energy policies, therefore, stress both energy conservation and economic growth (Munasinghe, 1980, pp. 359-73; Kuo, 1983, pp. 310-3). Several approaches may promote the reduction of the use of oil without affecting economic growth. Energy conservation and improved efficiency in the use of energy can be the most effective ways to cope with the continuing oil crisis. They contribute to national security and to an adequate supply of capital for further economic growth by reducing the need for energy imports (Chu, 1979, p. 16). Energy efficiency may be improved through the use of more energy-efficient machinery and equipment. The industrial structure may be modified to expand those sectors that can generate more value added with less energy. Also, diversification of energy sources away from the high-priced oil can provide more energy at less cost. Furthermore, by importing more kinds of energy from different countries throughout the world, the threat of a single nation or area having the power to cripple the economy is lessened.

The Energy Policy for the Taiwan Area, originally enacted by the ROC in 1973, stressed both energy conservation and economic growth. The policy set forth the following energy objectives:

1. To assure adequate and reliable supplies of of the various forms of energy needed to sustain economic growth;

2. To enforce energy-saving measures to enhance the effects of energy conservation;

3. To strength the exploration and exploitation of indigenous energy and to diversify the types and resources of energy imports to reduce the reliance on oil and to alleviate the impact of the unavoidable shortage of oil supply on economic growth;

4. To assure reasonable energy prices and to encourage the reduction of the cost of energy.

5. To encourage the use of the nonconventional sources of energy such as geothermal energy, wind energy and solar energy (Energy Policy for the Taiwan Area, ROC, 1973; Feng, 1975, pp. 4-5).

The energy policies in 1973 stressed mainly short-run aspects of energy. They did not emphasize specific long-term projects such as encouraging and fostering research and development of new energy sources, which often require large investments and a long lead time before they become technically and commercially feasible.

Responsibility for these new energy policies fell upon a bureaucracy which had had little experience in planning or managing energy resources. In 1968, the first energy planning in the ROC began with the establishment of the Energy Planning Committee (EPC), which was located in the Council for International Co-operation and Development. In 1970, this organization was placed under the Ministry of Economic Affairs (MOEA). The programs of this new agency were hardly established when the energy crisis occurred in 1973.

Ministry of Economic Affairs, the agency with the major responsibility in the energy field, is responsible for the promotion and supervision of most economic activities in the country. Also, the public enterprises directly involved in energy matters, such as the Chinese Petroleum Corporation (CPC) and Taiwan Power Company (Taipower), are a part of the organizational structure of MOEA, operating autonomously as governmental corporations. MOEA, however, has ultimate authority over the regulation of rates and the expenditures necessary for capital improvements of these public enterprises.

Another agency in the Executive Yuan, the Council for Economic Planning and Development (CEPD), also is responsible for formulating long term economic plans. Although it is not involved as directly in the immediate short-run energy programs, its emphasis on restructuring the industrial sector away from the energy-intensive industries to technology-intensive, non polluting industries is a long-run factor in energy managment.

To implement the new energy policy in 1973, the Executive Yuan promulgated the "Temporary Measures on Energy Conservation" in 1973, and the "Measures on Energy Conservation" in 1979. To meet the goals of these policies, MOEA had to institute a number of new programs pertaining to conservation and diversification. The new conservation programs attempted to reduce the demand for energy. A number of programs were developed seeking to reduce the use of energy. Public relations programs attempted to increase citizen awareness of the need to conserve energy. Manufacturers of appliances such as refrigerators, air conditions, etc., were required to attach to each of their products a label indicating the energy efficiency. Large scale energy consumers such as public facilities, universities, and industries were required to designate energy administrators. Businesses were encouraged to use electrical power during off-peak periods where possible. Individuals were encouraged to use mass transportation or to use car-pooling. Building codes began to stress the use of energy efficient materials in construction and the use of solar energy. Factories were encouraged through tax credits and low interest loans to convert to energy efficient machinery and equipment, and the economy generally was directed to less-energy-intensive industries through favorable fiscal measures.

The government also adopted programs for energy diversification after the first oil crisis aimed at promoting coal and nuclear power as alternatives to the use of oil. The diversification of sources, as Arthur E. Bush states, is expensive but a changeover to a less vulnerable energy source provides some insurance that the total supply will not be cut off in future interruptions (Bush, 1973, p. 10). To implement these programs, MOEA and Taipower began planning coal-fired or nuclear-fired electric generating plants to replace oil-fired facilities. Since the ROC has relatively little coal and no uranium resources, these resources had to be imported. In the case of coal, capital outlays had to be made to purchase equipment for the transportation and the utilization of coal in the generation of electric power. The success of the diversification program was assessed in 1982 by the Council for Economic Planning and Development (CEPD) as follows:

> The share of coal in total energy supply consequently increased from 12.8 per cent in 1975 to 14.7 per cent in 1981; the share of crude oil and related products first rose from 70 per cent in 1975 to a peak of 78 per cent in 1977; and then declined to 66.8 per cent in 1981; hydropower's share declined yearly due to limited water sources; while nuclear power increased in share from 0.1 per cent in 1977 to 8.6 per cent in 1981. The success of the energy diversification policy can be witnessed from these changes in the energy supply structure following the first oil crisis (Industry of Free China, 1982, p. 14).

MOEA also has initiated programs to promote development of domestic energy sources, and research and development. Domestic oil and gas exploration was intensified after the first oil crisis. CEPD reported that during the Six-Year Economic Plan which was initiated in 1974, a total of 109 oil wells--66 onshore and 43 offshore--were drilled. Thirty of the onshore wells found oil or gas and nine of offshore wells were producers (Yen, 1978, pp. 3-13). Domestic coal resources are extremely limited, and it is doubtful whether any great increase in local production can be achieved despite attractive prices (Chang, 1974, p. 134).

Research and development programs also were initiated by the government following the first energy crisis. Originally, the R & D programs were aimed at "encouraging the use of nonconventional sources of energy such as geothermal, wind, and solar energy" (Energy Policy for the Taiwan Area, ROC, 1973). The National Science Council instituted several geothermal pilot plants for the purpose of developing geothermal power generation in this period. After the second energy crisis, the government gave R & D an even more important role by establishing an energy research and development fund and creating the Energy Research Laboratory of the Industrial Technology and Research Institute (ITRI). Also, a number of the major universities became to be involved in energy research.

During the second energy crisis in 1979, the Energy Policy was amended to include two additional objectives not found in the 1973 Energy Policy. The new policy objective were: (1) to plan and develop harbors, inland transportation systems, and storage facilities to handle imported energy resources; and (2) to give first priority to the use of coal for industrial production and to restrict the improper use of natural gas as an industrial fuel (Energy Policy for the Taiwan Area, ROC, 1979).

The amendment of the Energy Policy in 1979 also emphasized diversification of imported energy sources in order to lessen the dependency of the country on the Middle Eastern oil. The amendment called for a speed up in coal and oil exploration in foreign countries on a joint-venture basis. By the time the amendment was made to the Energy Policy, environmental pollution had become a major public concern. As a result, the new amendment to the Energy Policy called for the prevention of energy-related environmental pollution, and in 1981 the Air Pollution Control Act was enacted applying strict air quality standards.

In order to strengthen energy management, the Energy Management Law was enacted in 1980. This Law spelled out in more detail the responsibilities of the energy agencies. The Law made the Central Government responsible for overseeing the production, distribution and conservation of energy; it required consumers to provide data about the use of energy; it required industrial energy users to build storage facilities to store reserves of fuel; it provided for stockpiling of energy to meet national security needs; it provided for energy efficiency standards; and it authorized energy rationing in case of shortages (Energy Management Law, 1980).

Policy Implementation in the ROC: Strategies to Supply More Energy

One of the policy goals of oil-importing countries is to attempt to increase the supply of energy resources through a number of alternative means (Foster et al., 1981, p. xxii). The development of indigenous energy sources and the use of increasing amounts of non-oil resources are major policy goals in the ROC to increase the supply. The policy to increase the use of indigenous energy sources has led to increased exploration for oil and gas resources onshore and offshore.

Exploration for oil and gas resources were underway before the first energy crisis. Chinese Petroleum Corporation (CPC), which is responsible for the operation of oil and gas exploration, production, refinement and sales, has adopted two approaches for stimulating oil and gas exploration. In the first place, CPC, with the help of capital and technology from foreign companies, has drilled a number of oil and gas fields onshore in the Taiwan area. As of mid-1978 Taiwan had sixty-eight operational wells producing petroleum at a rate of around 4.3 thousand barrels per day (b/d) (Copper, 1979, p. 248). The domestic oil production, however, has decreased in recent years from

4,170 b/d in 1979 to an average domestic production of 3,850 b/d in 1980 (Cooper & Segal, 1981, p. 1).

Exploration offshore increased as it became increasingly clear that domestic onshore production was declining. The fundamental political obstacle for the ROC in offshore operations, however, is the persistent territorical conflicts with the PRC, Japan, and the Philippines. Another obstacle is lack of adequate technology. The lack of technology and experience in offshore drilling led the government to open up offshore tracts for leasing to private companies. Nine U.S.-based companies soon became involved in Taiwan's offshore drilling. As of 1976, the government envisioned a private/public drilling program which would have in operation 60 wells in 1980 and 70 to 80 wells by 1982 (Cooper & Segal, 1981, p. 1). Recognition of the PRC by the U.S. in 1978 to a large degree scuttled this program. Washington did not want U.S. companies to enter into any agreements which might endanger the normalization of ties between the U.S. and the PRC. During the late 1970s and early 1980s, Clinton International Oil company alone continued to participate in exploratory drilling (Cooper & Segal, 1981, p. 65). Today CPC is continuing exploration alone and is operating only four wells with a potential of producing 3,300 b/d of oil.

The natural gas exploration onshore in Taiwan increased markedly from a small annual production of around sixty million cubic meters before 1962 to around one billion cubic meters in 1970, and two billion cubic meters in 1977 (Copper, 1979, p. 149). As a result of the increasing consumption of natural gas, it is estimated that unless new reserves are found, there is sufficient gas for only another ten years of production. Since natural gas accounts for about 5.6 per cent of the country's energy requirement, government and business leaders are proceeding with plans for importing liquid natural gas (LNG) as a replacement for the decreasing natural gas production. The ROC is purchasing LNG from Australia and Malaysia. Under an agreement with Australia, the ROC has been able to importing 2.0 to 2.5 million tons of LNG per year since 1980.

A second approach for increasing the energy supply required looking for new sources of energy overseas in areas other than the Middle East. The Energy Policy for the Taiwan Area, ROC (1984) called for diversification of energy from oil to coal, gas, or nuclear power, and also diversification of the countries from which energy resources are imported. This has led to resource diplomacy which seeks to build economic relationships with countries rich in energy resources other than the Middle East. There are limitations, however, on ROC's ability to conduct resource diplomacy. The strong anti-communist ideology of the country prevents it from negotiating with any communist countries (Chiang, 1986, pp. 37-52). Furthermore, its history of war with the Chinese communist prevents it from any contacts with the PRC, today a potentially energy-rich country seeking to sell oil, gas, coal and uranium.

The fact that political ideology is such important aspect of Chinese politics makes it difficult to assert, as Japan frequently does, that economics should be separated from politics in order to permit contacts and cooperation with communist countries or past enemies who may have energy resources. Furthermore, the ROC, unlike the more developed Japan, does not have the great wealth to provide aid or loans to other energy-rich developing countries so as to enhance its ability in resource diplomacy. Neither does it have the great influence nor clout in international organizations by which it can favor those energy-rich developing countries which enter into agreements with it. As a result, ROC has more difficult in resource diplomacy than Japan.

Despite these limitations on its resource diplomacy, the ROC sees cooperative actions with energy-rich countries as a major alternative for becoming more energy sufficient. Also, the ROC has attempted to participate in joint ventures with energy-rich countries for those energy-intensive industries essential to its economy, such as fertilizer, petrochemical, etc. One example of this type of diversification is the ethylene plant built as a joint venture in Saudi Arabia. The Taiwan Fertilizer Corporation is also cooperating with Saudi Arabia's National Petroleum Corporation in producing urea fertilizer (Sun & Liang, 1980, p. 14). Likewise, the Formosa Plastic Companies, a private enterprise, has received government approval to invest in the United States for the production of petrochemicals (Sun & Liang, 1980, p. 15). By creating firms in which the Chinese have an ownership equity, supply of essential goods are guaranteed while at the same time reducing demands for energy in the ROC.

Nuclear power seemed to be somewhat of a panacea to energy planners in the ROC after the first energy crisis. Unlike other energy sources, it could be stored for longer periods thus providing protection to national security in the case of future cut-offs of energy supplies. As a result, Taipower aggressively planned to develop nuclear generating plants capable of furnishing ultimately one-half of the island's electrical needs (Smith, 1982, p. 149; Rose and Wakabayashi, 1984, pp. 713-6). As of 1985 three nuclear plants were in operation furnishing 32.21 per cent of the country's electrical supply. Recently, however, fears of nuclear accidents have delayed the construction of further nuclear facilities.

Since Taiwan has no commercial uranium resources, it must import the uranium for these programs. The main sources of uranium are South Africa, Australia, the United States, and Canada. The government also has actively been participating in exploration and exploitation programs overseas to ensure its long term uranium supply (Chu, 1979, p. 14). It has joined in uranium exploration ventures in Paraguay together with partners from the U.S., South Korea, and Paraguay.

Policy Responses in Japan: Crisis Management

When OPEC shocked the world in October, 1973 by quadrupling the price of oil, Japan was ill-prepared to deal with the challenge since it was accustomed to having a stable supply of cheap oil from the Middle East. Japan is extremely poor in oil and other energy sources. It is the most thoroughly dependent industrial country in the world on imported energy. When the first oil shock occurre in 1973, Japan depended for 90 per cent of its energy needs on imported energy of which 77.4 per cent was crude oil from the Middle East (Shibata, 1983, p. 129).

The impact of the sudden increase in the oil price hit Japan harder then it hit other countries blessed with more ample energy resources. The drastic increase in oil prices created a number of difficult problems. The price of oil jumped $8.20 per barrel, increasing the nation's annual expense for energy by $15 billion dollars, which in turn caused a deficit in the balance of payments. Inflation followed since the price of oil affected almost every economic factor (Tomitate, 1981, pp. 751-2). The wholesale and consumer prices went up from minus 0.1 per cent and 4.0 per cent in 1972 to 34.0 per cent and 24.8 per cent in 1974, respectively. The economic growth rate dropped from 10.0 per cent in 1972 to 3.6 per cent in 1974 (World Tables, 1983, pp. 238-9). The effect of higher oil prices on Japan's balance of trade was thrown into deficit from US $1.5 billion in 1973 to minus US $1.1 billion in the first quarter of 1974 (OECD, 1975, p. 31). Labor demanded and won wage increases averaging 30 per cent to compensate for inflation. The increased outflow of capital to the oil-exporting nations drained capital from Japan, reducing effective demand. The Japanese government sought to fight inflation by tightening monetary and fiscal policies which in turn reduced effective demand further (Yager & Matsuba, 1984, pp. 223-4). Recovery was slowed by the fact that businesses faced not only higher prices for materials caused by the cost-push inflation and increased labor cost, but also by the tight monetary policies instituted by government to fight inflation.

Immediately after the shock, the only existing policy was to pass the high oil price on to the final consumers. No subsidy, tax relief, or special loans of any kind, according to Hirofumi Shibata, were introduced to help the users of energy who had to pay for suddenly increased energy costs (Shibata, 1983, p. 139). Demand for oil dropped precipitously from 5 million barrels daily (Mbd) in 1973 to 4.2 Mbd in 1975 (Copper, 1979, p. 248). As a result of the shifting of high energy cost to consumers, inflation became rampant, increasing 25 to 35 per cent per year. The Japanese economy which had grown at an average real GNP growth rate of 10 per cent or more in the post World War II period fell into a severe recession.

By late 1973 the government decided to counter the inflationary effects of higher oil prices and direct controls were imposed on the prices of major commodities and on the consumption of oil and electricity. The Bank of Japan raised the rediscount rate and used informal administrative controls on bank lending to reduce the money supply. Plans for government spending were cut back significantly (Yager & Matsuba, 1984, p. 49). By 1974, however, the government began to plan the phased removal of the emergency price controls since the crisis atmosphere was lessening. Public investment projects continued to be held at a minimum level until 1976 and the size of money supply

(M2) was progressively reduced. Also Japan introduced policies directly aimed at dealing with energy problems such as those designed to conserve energy and to substitute other fuels for oil. These policies constituted Japan's first attempts at an energy policy.

The second energy shock was no less serious, although the Japanese government was in a better position to deal with it, and it did not create the same sense of panic as the first. Crude oil rose by almost $20 per barrel, which was more than double the amount of the first oil shock. The increase in the oil bill of Japan was larger this second time than in the first oil crisis, it endangered both Japan's international balance of payments and its entire domestic price system (Matsukawa, 1982, p. 5). There was no panic as in 1973 partly because of the step-by-step nature of the price increase and partly because of the experience of the first oil crisis. During the second oil crisis, energy prices to final consumers in Japan rose 13.3 per cent in 1979 and 59.2 per cent in 1980 (OECD Observer, 1981, p. 17). As a result, wholesale prices rose 7.3 per cent in 1979 and 17.8 per cent in 1980, and declined thereafter. In 1981 they increased only 1.7 per cent. Consumer prices were even less affected by the oil crisis; they rose 3.6 per cent in 1979, 8.0 per cent in 1980, and 4.9 per cent in 1981, respectively (OECD Economic Survey, 1981, p.16; Japan

Statistical Yearbook, 1982, pp. 398-404). This time inflationary expectations fueled by the second oil crisis were better contained and Japan did not see a price explosion as it had in 1974.

Japan's successful adjustment to the second oil crisis was the combined result of fortunate circumstances and wise government policies (Mahler, 1981, pp. 26-9). Structural changes in the manufacturing sector encouraged by the government after the first oil crisis reduced the vulnerability of the economy. Technological/knowledge-intensive industries such as chemical, electrical machinery, transport equipment, and precision machinery had been promoted, while oil/energy-intensive industries such as pulp, paper, nonmetallic mineral products, and basic metals had been discouraged. The structural changes that occurred reduced energy consumption per unit of output and increased labor productivity. The strong increase in labor productivity and the moderate rise in labor costs made it easier for the government to contain the inflationary effects of the increase in oil prices (Yoshitomi, 1980, pp. 688-91; Yager & Matsuba, 1984, pp. 53-4).

Policy Responses In Japan: Structural Adaptation

Energy management became an issue of great public concern in Japan following the drastic price increases in

1973. In the years 1974 and 1975 many energy organizations or advisory groups were created, and many laws and regulations were passed. The need to protect national security and economic well-being from similar threats led to the enactment of the Petroleum Supply and Demand Adjustment Law. The Law includes a number of measures pertaining to petroleum supply targets, submission of marketing and import plans by refiners and importers, administrative authority to modify such plans, and to promulgate restrictions on the use of petroleum, provisions for mediation in disputes concerning oil allocation, and administrative authority to impose allocation and rationing schemes (Morse, 1981, p. 43). Meanwhile, two other documents were being considered in the Advisory Committee for Energy and the Ministerial Council. These documents set forth the basic goals and objectives of the Japanese energy policy. The new policy provided for greater government involvement in oil and other energy markets (Watanuki, 1982, pp. 175-6). The specific objectives of the energy policy were as follows:

1. The promotion of overseas oil development and better use of domestic energy sources.
2. The development of alternatives to oil energy: coal, nuclear power, liquefield natural gas (LNG), and geothermal power.
3. The diversification of oil supply sources and the encouragement of direct and government-to-government oil deals with the producing nations.

4. The encouragement of conservation and the commercialization of new energy techniques.

5. The preparation of energy emergency-management procedures and the buildup of petroleum stockpiles to insulate Japan in the event of a major oil disruption (e.g., a 90-day oil stockpile) (Morse, 1981, pp. 1-2).

The basic philosophy underlying Japan's energy policy stresses joint efforts by the government and business to conserve energy, to expand domestic energy resources, to promote overseas energy development and to prepare for minimizing damages to the economy during energy shortages. The powerful Ministry of International Trade and Industry (MITI), which spearheaded the Japanese government's energy program and which traditionally was involved in domestic policy, now found it necessary under this new policy to take on a larger international role in world energy markets (Morse, 1981, p. 5).

The underlying motif of Japan's structural adaptation after the first energy crisis was diversification. This meant diversifying the sources of its oil imports geographically, as well as diversifying the types of energy from oil to some other source (Hassanain, 1985, p. 234). In order to enhance its ability to diversify energy resource, the Japanese government followed a policy of resource diplomacy which included increasing government-to-government (GG) and direct-deals (DD) between private businesses (Wu, 1977, pp. 60-2; Murakami, 1982, pp. 150-1).

Japan's Advisory Committee on Energy was heavily engaged in promoting government-to-government deals in oil and diversifying away from the Middle East. At home, the Committee worked on suggestions to reorganize the energy industry and to reconstruct industry to order to reduce the rate of energy consumption (Evans, 1976, p. 131). MITI's Industrial Structure Council also recommended a restructuring of the economy away from resource-hungry industries like steel and petrochemical.

Conservation programs were among the first actions taken by the government after the oil crisis of 1974. These programs were mainly educational or public relations in nature and attempted to reduce demand for energy. There were also a number of regulatory measures such as the requirements that manufacturers list the energy efficiency of appliances and automobiles, and the requirement that large-scale users of energy appoint energy conservation administrators.

In 1975, research efforts on alternative fuels were stressed and a new Energy Technology Development Institute was established to coordinate research such as the Sunshine Project. The Sunshine Project sought to develop on a broad scale the utilization of clean, alternative energy sources, such as solar, wind and geothermal energy (Holloman & Grenon, 1975, p. 218). A revised version of the Sunshine

Project in 1979 also stressed research on coal liquefaction and coal gasification. Still another important research program to improve conservation enacted during the second crisis was called the Moonlight Project. This project was designed to undertake large-scale research and development projects which could not be carried out by the private sector.

After the second energy crisis in 1979-1980, the Japan became even more active in attempting to lessen vulnerability from imported oil. It enacted a Petroleum Stockpiling Law as a national defense measure. In 1978, the overseas oil development responsibilities of the Japan Petroleum Development Corporation (established in 1967) were combined with the national stockpile effort, and the new JNOC absorbed both responsibilities (Morse, 1981, p. 46).

International cooperation in the International Energy Agency (IEA) became a second method Japan used to reduce its vulnerability. IEA was established in 1974 by the major industrial countries to assure the security of energy supplies to its members by setting up an emergency oil-sharing program, establishing stockpiles, and encouraging research on alternative energy sources. In a major supply interruption, the major members could turn to IEA which was to see that all members shared in available supplies (Japan, 1977, p. 388).

Efforts to improve energy efficiency were increase after the second oil crisis and the Japanese government enacted the Law for Rationalization of Energy Consumption in 1979. The Law provided for financial and tax incentives to encourage change to energy efficient equipment and machinery. The Law applied not only to the industrial sector, but also to other energy consuming sectors, such as commercial enterprises, transportation, and households.

In 1980, the government passed the Petroleum-Substitute Energy Promotion and Development Law which set goals for the development of new energy sources, and established the New Energy Development Organization (NEDO). NEDO began operation on Oct 1, 1980 as Japan's equivalent of a synfuel corporation (Morse, 1981, p. 11).

Policy Implementation in Japan: Strategies to Supply More Energy

Simultaneously as the nation was attempting to adjust to the new energy challenges by enacting statutes, creating administrative agencies, and setting forth various programs, it had to consider a number of possible strategies to implement national energy policies. To meet the goal of producing more energy so as to ensure an adequate supply, Japan first attempted to increase domestic output of energy through exploration for oil and gas onshore and offshore. Two means were considered to increase energy exploration and development. First, exploration for oil onshore and offshore was made a major priority of the newly constituted Japanese National Oil Corporation (JNOC). JNOC increased each year the number of exploratory wells drilled. Beginning in April 1980, the Japanese government provided for drilling some 15 exploratory wells per year on the continential shelf, with estimated capital expenditures reaching US $750 million over the five-year period (Japan Petroleum and Energy Weekly, 1979, p. 2).

Second, under the Petroleum Supply-Demand Adjustment Law, the government provides financial and tax incentives for Japanese firms to engage in oil exploration and development both in the area of Japan and in foreign countries. This law provided tax incentives, protection from possible losses because of war or expropriation, as well as governmental loans to private oil ventures (Yager and Matsuba, 1984, p. 68). The purpose of these actions is to increase the percentage of energy from indigenous sources or from companies controlled by Japanese firms (Wu, 1977. pp. 5-8). This search for fuel sources throughout the world caused the Japanese Foreign Ministry and MITI to spend increasing efforts in resource or fuel diplomacy (Klein, 1980, p. 43). The Japanese government had set a goal of having at least 30 per cent of its oil supplies come from Japanese-owned ventures overseas. As of 1985, however, it still had not succeeded in this goal and the goal has been scaled down to 20 per cent of the total supply by 1990 (Quo, 1986, pp. 175-9).

Another aspect of the diversification stragety adopted by Japan provides that essential energy-intensive industries, such as petrochemicals, plastics, fertilizer, and steel, be established either as Japanese firms or as joint ventures with the energy-rich countries. These firms in which it has an ownership equity can ensure a supply of these essential materials to Japan. Examples of this types of diversification can be seen in the Aluminum projects developed in Indonesia and Brazil, and in the Japanese copper smelting industries located in Canada, Zaire, and Gambia (Quo, 1986, p. 173).

Japan's third strategy to supply more energy was to undertake resource diplomacy. Japan's resource diplomacy is mainly based upon three approaches. First, Japan sought to increase the oil supply under its control by dealing directly with producers in order to reduce dependence on major oil companies, which were feared since they could in times of shortage divert oil away from Japan. Second, Japan sought to implement national programs by cultivating bilateral relations with individual energy-producing countries. This often caused Japan to provide aid or investments to developing nations. Third, through international cooperation in the IEA Japan attempted through collective measures to protect itself from future oil supply shortages. Although Japan is a member of IEA, most Japanese politican, bureaucrats and industrialists have little faith in IEA's ability to cope with a prolonged energy crisis (Quo, 1986, p. 171).

Japan's Resource Diplomacy: Countries of the Asian-Pacific Region

Japan's vulnerability goes beyond price. Because of the long distances between the Middle East and Japan, the sea lanes are vulnerable. Any international confrontation may threaten Japan's entire supply of vital oil resources. As a result, Japan's efforts to diversify sources looked first at energy resources nearer home, namely those countries in the Asian-Pacific region which would shorten the sea lanes, thus reducing the strategic danger, as well as transportation costs. The Asian-Pacific region is vitally important economically and strategically to Japan.

Economically, the Asian-Pacific countries represent important trading partners for Japan, providing necessary raw materials and a large and growing export market. Likewise, most of these countries are also strategically in the international waterways connecting the Middle East and Japan. For these reasons, Japan naturally has great interest in its relationship with Asian-Pacific countries, such as Indonesia, Australia, Malaysia, Brunei, the People's Republic of China (PRC), and the Soviet Union (Kosaka, 1975, pp. 793-808).

Japan's Resource Diplomacy: Indonesia

Indonesia, the major oil producer in the region, has become the largest energy exporter to Japan in the past two decades. Indonesia exported 40 to 50 per cent of its total exports to Japan in the period 1980 to 1985, the bulk of which consisted of crude oil, LNG, and other petroleum products. Japan, in turn, exported to Indonesia an average between 23 to 30 per cent of Indonesia's foreign trade in the same period (Kinoshita, 1986, p. 36). This represents a classical case of international trade in terms of energy relationships between Japan a developed but resource-poor country, and Indonesia a developing but resource rich country (Hsiao & Matsushima, 1979, pp. 73-98).

The Japanese energy policy in dealing with Indonesia presents its basic orientation of resource diplomacy. One fundamental purpose of Japan's resource diplomacy is to cultivate bilateral relations between Japan and individual oil-producing countries (Soetowo, 1973, pp. 72-79). Japan has given considerable aid and has made numerous investments in Indonesian developments as a means of promoting good relations between these two countries. The Japanese government also provides financial aid and low interest loans to Indonesian-owned oil companies. Often Japanese firms rely on third parties to negotiate energy contracts as a means of avoiding possible hostilities that local individuals or governments may harbor against Japan (Wu, 1977, p. 77).

The Japanese also have been able to use their position in international bodies to support friendly developing countries, and thus to promote its resource diplomacy. Japan is a member of most international organizations dealing with development issues, such as the International Monetary Fund (IMF), the International Development Association (IDA), the Asian Development Bank (ADB), and others. Japan thus can more easily than most Asian countries use these international organizations as a mechanism to influence those developing countries with energy resources essential to Japan (Morse & Chapman, 1984, p. 15). For example, in the ADB all four its most recent presidents have been Japanese, and during 1980 Japan provided $60.7 million in loans to Indonesia for promoting industrialization and development in outlying islands.

Japan's Resource Diplomacy: Other Countries in the Asian-Pacific Region

Japan's energy relationships with Australia indicate another aspect of resource diplomacy. In order to meet

MITI's goal in the Long Term Energy Plan (1975), the Japanese government has participated in overseas coal development in a number of countries. Australia, which is rich in coal resources, has become the largest supplier to Japan over the past decade. By 1981, for instance, over 70 per cent of Australia's hard coal (34.4 million tons), 63 per cent of its steam coal (4.5 million tons), and 41 per cent of its coking-coal (26.5 million tons) exports went to Japan (McMahon & Harris, 1983, p. 79). In addition, Japan imports today sizable quantities of LNG from Australia.

Malaysia and Brunei are two other oil and gas producting nations in Asian-Pacific region relatively near to Japan. Malaysia since 1974 has increased its crude oil production and exports to 7.6 million tons. Japan is the largest crude oil importer receiving 43 per cent of the total. Malaysia also has developed major gas fields and facilities for processing LNG with aid from Japan. It is under contract to provide 6 million tons of LNG annually by the end of the 1980s (Stern, 1983, p. 103).

Brunei was the first Asian country to deliver LNG to Japan in 1972. The Brunei-Japan LNG export venture, with more than a decade of successful operation, provides between 3.65 to 5.16 million tons of LNG yearly to Tokyo Electric, Tokyo Gas, and Osaka Gas companies (Cooper & Segal, 1981, p. 71). The twenty year contract which Japan has with Brunei ensures Japan of receiving LNG for this period. Table XV shows the LNG exports to Japan from Brunei and six other Asian-Pacific countries.

Table XV
Japan's LNG Import Contracts

Exporting Country	Approximate Plateau Volumes (MT/Yr)	Number of Contracts	Start-up date
Brunei	5.1	1	1973
Indonesia	29.9	11	1977
Malaysia	6.0	1	1983
Australia	6.0	1	1986
New Zealand	2.7-3.2	1	n.a.
Thailand	0.4	1	n.a.
Bangladesh	1.0	1	n.a.

Source: Bryan Cooper and Jeffrey Segal, editors. Far East Oil and Energy Survey, (Geneva-Dubin: Petroleum Economist and Petroconsultants, Press, 1981), pp. 85-6.

Japan's Resource Diplomacy: the People's Republic of China

Throughout the post World War II era, the People's Republic of China (PRC) was largely closed to international trade with Japan and the Western bloc. Before 1971, Japan's trade with the PRC never rose higher than a mere 2.5 per cent of its total trade (Mendl, 1983, p. 221). Japan's principal attraction to the PRC since the 1970s is its potential as a source of oil, coal, and other raw materials as well as a market for Japanese machinery and manufactured goods. Shuichi Matsune, chairman of the energy-policy committee of the Federation of Economic Organization (Keidanren), expressed the commonly held hope that Chinese oil will make Japan less dependent on the Middle East. He states:

> Japan has no choice but to gear to using Chinese oil, and once this process is in motion, we will be able to meet one-third of our oil needs with oil from Asia! There will be no need to go the Straits of Malacca. This would mean security for Japan both economically and politically (Harrison, 1977, p. 161).

Since the visit of Prime Minister Tanaka to Peking in September 1972, the PRC has been open to trade with Japan. Between 1972 and the signing of the Treaty of Peace and Friendship in August 1978, trade between these two countries increased five fold, and since 1978 not only has trade continued to grow but the economic partnership between the countries has expanded (Mendl, 1983, pp. 221-8). The Long-Term Trade Agreement between Japan and the PRC in 1978 outlined the schedules for the PRC's export of crude oil and coal in exchange for Japanese technology, equipment and machinery. Japan agreed to provide technological and financial aid in the development of offshore oil and gas resources in the Bohai Gulf and Pearl River Estuary (Keith, 1986, p. 29).

As a result of these agreements, Japan's Import-Export Bank lent approximately $2 billion to develop China's oil and coal resources, and a consortium of private Japanese banks agreed to another loan of $8 billion to develop natural resources (Klein, 1980, p. 47). Since 1979 Tokyo has designated Peking as a priority aid recipient and has allocated $3.5 billion in yen credits mainly for railroad and port construction projects. Loans were also made for a petrochemical projects at Daqing and an iron mill at Baoshan (Brooks & Orr, 1985, p. 331). The PRC is the top recipient of Japan's bilateral overseas development aid.

Japan's Resource Diplomacy: the Soviet Union

The possibility of cooperative relations on energy projects between Japan and the Soviet Union before the 1960s seemed impossible because of the ties between Japan and the U.S. In 1961, Soviet Deputy Premier Mikoyan, the first Soviet leader since the end of World War II visited Japan and proposed a joint venture for the development of iron-ore fields in the Soviet Far East. As a result of these economic overtures, Japan subsequently developed a strong interest in economic cooperation and development in Russia.

In the mid-1960s, the Soviet Union invited Japan to participate in the development of natural resources in Siberia over the period 1965-1979. Despite the consternation this caused in the U.S., Japan proceeded. The Soviet-Japanese Economic Committee was formed to plan economic cooperation in the Soviet Far East. Seven major projects were undertaken between 1968 and 1978 which included development of coal, oil, and gas resources (Falkenheim, 1979, pp. 1215-6).

By 1975 four major energy-related projects were underway to exploit Siberian natural resources. Under the agreement for these projects, Japan was to provide the Soviet Union with credits or bank loans from the Export-Import Bank of Japan to purchase machinery and equipment, and the Soviet Union was to export to Japan a negotiated quantity of oil, coal, natural gas and other products (Akao, 1983, p. 199). Japan by 1979 had provided nearly $4 billion in loans and credits on these projects.

When the Soviet Union invaded Afghanistan, the project was delayed and has not to this date been revived. As this incident shows, Japan's resource diplomacy is constrained by the fact that it is within the U.S. sphere of influence (Akao, 1983, p. 203). The Japanese government is reluctant to undertake a large capital commitments without the U.S. blessings in view of the political risk thought to be inherent in investing in the Soviet Union (Goodman, 1982, p. 58). Despite the fact that for Japan, the USSR remains an attractive possible bilateral energy source, the ultimate factor determining if this source can be pursued is the relationship between the two superpowers.

Japan's Resource Diplomacy: Countries on the Outer Pacific Rim

While Japan's resource diversification plans first called for developing energy relationships with those countries nearest to the homeland, they also sought to develop energy relationships with those countries on the outer rim of the Pacific area, such as the United States, Canada, Mexico, and the South America countries.

Japan's Resource Diplomacy: the United States

Japan's search for fuel throughout the world obviously brings it into direct contact with the United States, one of the richest energy sources in the world. While Japan, a regional power, sees resource diplomacy as a means to expedite bilateral relationships essential for its energy goals, the U.S., a world power, perceives the world and the nature of the energy crisis entire differently. The U.S. perception is global and interdependent, involving the struggle with the Soviet threat. It is committed to the use of multinational institutions to mold broad international consensus, to enlarge relations with Western allies, and to legitimize its global interests (Imai, 1980, p. 48).

The differences between their priorities and perspectives poses a serious problem for Japan. This latent conflict between resource diplomacy and its dependency upon the U.S. for military security has been called Japan's ultimate vulnerability (Quo, 1986, p. 168). It is difficult for Japan to pursue resource diplomacy without giving proper consideration to the American global strategy. Japan's purchase of oil from Iran in 1979 and the criticisms it caused in the U.S. illustrates this point. Similarly, Japan's involvement in joint resource development projects with the USSR is another illustration. Likewise, Japanese-South African relations at times have strained relations between Japan and the U.S., although the Japanese government has been reluctant to jeopardise the South African supply of energy resources, particularly uranium, to appease American opinion (Quo, 1986, pp. 169-70).

The bilateral trade in energy between Japan and the U.S. does not follow the pattern one would expect. It would seem that Japan, which has vigorously pursued resource diplomacy throughout the world seeking to build bilateral relations with energy rich countries, would import huge amount of energy resources from the U.S. The fact is, however, that Japan does not import a large amount of oil or

LNG from the U.S. In 1983, for instance, Japan imported only about 1 million tons of LNG from Alaska and no crude oil. Although Japan imported 25 per cent of its crude oil from major U.S. oil companies, it was not produced in the U.S. (Sakisaka, 1985, pp. 8-9). The U.S. is the third largest exporter of coal to Japan, but it could supply a great deal more since the U.S. has huge coal reserves. Furthermore, the Carter and Reagan administrations have aggressively pushed U.S. coal exports as a means to boost the domestic coal industry and provide export earnings (Kemezis & Wilson, 1984, p. 77).

There are a number of reasons why trade in energy resources between Japan and the U.S. is not larger. In part it is due to the cultural differences between these two countries. Even though both countries assert a committment to a free market economy, the government in Japan, as has been seen, often intervenes in the energy trade of private businesses. Government frequently serves as "coach" and uses "administrative guidance" to direct private business activities which has worked to the disadvantage of U.S. interest (Bohi & Quandt, 1984, p. 21). There are a number of Japanese laws which provide for governmental regulations in energy matters. The Basic Petroleum Law of 1962, for instance, seeks to curtail the role of the foreign petroleum industry and to expand Japanese supply development activities.

The U.S. also has enacted a number of laws and regulations which have restricted directly or indirectly trade with Japan in energy resources. Most important of these is the Export Administration Act of 1979 which imposes such severe restrictions that in effect it bans exportation to Japan of any oil transported through the Trans-Alaskan pipeline (Kohl, 1984, p. 16). Other laws also directly or indirectly restrict trade of crude oil, natural gas, and coal with Japan. As a result of such regulations, U.S. trade in energy resources with Japan has stagnated.

Both nations, as is evident by their actions, have latent fears of each other. Japan appears to fear American's size and wealth and particularly its control of the oil resources through the major American oil companies. The fact that the major oil companies during the second oil crisis unilaterally cut off oil supplies to Japan makes it fearful of being dependent on American companies. Furthermore, the U.S. refusal to sell Alaskan oil strengthens the Japanese belief that nations are self-centered in the energy game. On the other hand, the U.S. looks at the growing imports into America from Japan, while U.S. exports to Japan are limited by governmental actions, as a threat to its economic well-being. As previously stated, perhaps the ultimate vulnerability of Japan, and perhaps of the U.S. as well, lies in this complex relationships between these two countries (Quo, 1986, p. 172).

Despite the relative smallness of the energy trade between Japan and the U.S., Japan has heavily relied upon U.S. research and technology in the energy field, especially in nuclear technology. U.S. nuclear policy has greatly influenced Japan's nuclear development and energy outlook (Imai, 1980, pp. 35-47; Scheinman, 1980, pp. 76-96; Suttmeier, 1981, pp. 106-130). The planning and implementation of Japan's nuclear energy policy has been linked very closely to the U.S. Japan has followed the American lead in developing light-water reactors, and in adopting a fuel-cycle strategy in which reprocessing, recycling, plutonium, and fast-breeder reactors were assigned prominent roles (Scheinman, 1980, p. 86). The US' "Atoms for Peace Plan" was widely accepted by the Japanese in the 1970s since it provided for a large-scale worldwide transfer of peaceful nuclear technology (Khan, 1982, p. 53).

Since the energy crises of the 1970s, Japan and the U.S. have undertaken a number of cooperative transactions on new alternative energy resources. The agreements cover research projects and activities not only on nuclear fusion and coal conversion technologies, but also on solar, geothermal, and high-energy physics research (Samuels, 1981, p. 149).

Japan's Resource Diplomacy: Other Countries on the Outer Pacific Rim

Canada, like the United States, is among the richest countries in energy resources in the world. Before 1980, Canada, in response to concerns about the availability of oil and gas resources to satisfy domestic demands, virtually eliminated international oil trade by the imposition of an oil export tax, aimed particularly at the U.S. By 1979, a huge gap had developed between the administered Canadian price and the much higher international oil price, creating a host of problems. A revised energy policy in 1980 provided for a new pricing arrangement, bringing it more in line with the international market (McRae, 1985, p. 50). International trade in Canadian energy resources as a result has increased. Canada is expected to supply Japan 185,000 barrels per day (b/d) from the Beaufort Sea beginning in 1987 (Cooper & Segal, 1981, p. 7).

Since the passage of the new energy policy in Canada, Japan has found a promising opportunity for importing LNG. Canada and Japan also are considering several joint ventures for developing Canadian natural gas resources. As of 1983, Canada exported 37 per cent of its total uranium to Japan.

Mexico has become a supplier of oil to Japan in recent years, and the trade is anticipated to grow to 100,000 barrel per day annually. Two other Latin America countries, Venezuela and Ecuador, also have become oil exporters to Japan.

Japan has not limited its resource diplomacy just to the Pacific area. It has sought energy resources around the world. Six Africa nations, namely South Africa, Algeria, Libya, Angola, Nigeria and Egypt trade energy resources to Japan. South Africa particularly is a major exporter of uranium to Japan.

Summary: Comparison of Energy Policies

Despite the differences in the two countries, they responded in a very similar manner to the energy crises. In the crisis period immediately after the OPEC's dramatic price increases, both countries relied on monetary and fiscal policies to deal with inflationary pressures. Both also enacted price control measures and formulated procedures for allocating and rationing energy in case of shortages. In adjusting to the huge oil price increases, both governments were faced with a dilemma of either maintaining price stability or economic growth and full employment (Yager & Matsuba, 1984, p. 2). China's actions of continuing expenditures on public projects differed from Japan's actions, perhaps reflecting the more serious unemployment problems in the ROC. Economic measures also were found to be ineffective in dealing with the new energy situation. New energy policies were thought to be necessary and both countries enacted policies emphasizing energy conservation, diversification, and R & D. Table XVI shows the names of the various energy laws enacted in the two countries.

Table XVI
Energy Legislation in the ROC and Japan
(1973-1985)

ROC	Japan
Major Energy Agency The Energy Committee, MOEA	Major Energy Agency The Energy Advisory Committee, MITI
1. Energy Policy for the Taiwan Area, ROC (1973)	1. Petroleum Supply and Demand Adjustment Law (1974)
2. Temporary Measures on Energy Conservation (1973)	2. Sunshine Project (1974)
3. Economic Stabilization Program (1974)	3. Energy Stabilization Policy for the Coming Decade (1975)
4. Reorganized the Energy Committee, MOEA (1976)	4. Basic Direction of General Energy Policy (1975, 1977)
5. Measures on Energy Conservation (1979)	5. Moonlight Project (1978)
6. Revised Energy Policy (1979, 1984)	6. Petroleum Stockpiling Law (1979)
7. Energy Management Law (1980)	7. Rationalization of Energy Consumption Law (1979)
	8. Petroleum-Substitute Energy Promotion and Development Law (1980)

Although the new energy policies involved the governments in new activities, both governments have long played a major role in the energy fields. Governmental enterprises in the ROC perform many of the activities such as exploration, production, and refinement of oil and gas, and generation and distribution of electricity, which private firms do in some other countries. The only private sector involvement in the energy field in the ROC is the small coal industry. Agencies like the Chinese Petroleum Corporation and Taipower have direct operating responsibilities in producing and distributing energy, and such agencies as Ministry of Economic Affairs (MOEA), Council for Economic Planning and Development, and the Energy Committee of MOEA are major policy actors and have played an increasing role in making policies, influencing energy prices, energy imports and exports, and the distribution of energy resources.

The Japanese government relies much more on the private sector for energy development. Private electrical companies generate and distribute electrical power, private oil and gas companies compete with governmental oil companies such as Japan National Oil Corporation and Japan Petroleum Development Company, and private coal companies also compete in the energy market. Governmental involvement in the energy field, however, is pervasive. The tradition of bureaucratic involvement in private businesses through administrative guidance gives such governmental agencies as MITI, the Ministry of Finance, and the Fair Trade Commission, the power to make and direct energy policy. Also a number of state-owned companies, such as JNOC, JPDC, and the Japan Coal Development Company (JCDC), and the others, engage in a wide range of energy activities. The Energy Advisory Committee within MITI is a mechanism for providing a channel of formal policy interaction between the bureaucracy and the corporate interests. Energy policy in Japan is made, for the most part, by the institutional triumvirate led by the powerful bureaucracy.

As the full impact of the oil crises hit, the governments in both countries began a series of activities stressing conservation to reduce energy consumption, coupled an almost desperate attempt to increase domestic production of energy. The initial conservation measures were similar in both countries. Public relations program attempted to increase citizen awareness to conserve; tax incentives were provided to businesses to introduce energy efficient machinery; and regulatory measures were taken to audit larger users of energy. Mass transit and car pooling also were promoted. In the long-range conservation plans, the governments of both countries proposed to change the direction of the economy stressing technological-intensive industries instead of energy-intensive industries. Both countries also proposed to establish essential energy-intensive industries, such as steel, petrochemical, and fertilizers, near energy sources in other countries through joint ventures so as to provide a supply of these essential products.

After the first energy crisis, both countries had strong incentives to reduce their dependence on Middle Eastern oil. But finding oil supplies outside the Middle East proved to be difficult; substituting other sources of energy for oil seemed more feasible. Both governments attempted to switch from oil to other energy sources. The ROC stressed a change from oil to coal and nuclear for electrical generation, while Japan sought to change to LNG and nuclear power. Both countries forecast increasing dependence on nuclear power. The ROC expects to provide approximately 50 per cent of its electrical demand from nuclear power and Japan expects to produce 25 to 30 per cent of its total electricity from nuclear power by 1990.

In addition to the attempts to switch from oil to other sources of energy, both governments also sought to pursue resource diplomacy so as to diversify the source of energy away from the Middle East. The ROC had more difficulty pursuing resource diplomacy than Japan because of its political ideology and its lack of economic wealth and power. The ROC could not seek out energy contracts with communist countries such as the PRC or the Soviet Union nor could it influence oil-rich developing countries as Japan with aid and loans. Japan, on the other hand, has had great success in its resource diplomacy, although it has not significantly reduced its dependency on Middle Eastern oil. The major limitations on Japan's resource diplomacy are the necessity to keep its policies from offending the U.S., the main source of international security for Japan. How well these policies worked is the next subject that needs to be addressed. Chapter VI will deal with this subject.

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CHAPTER VI

ASSESSING CONSEQUENCES OF ENERGY POLICIES IN THE REPUBLIC OF CHINA AND JAPAN

Policy assessment is a continuing social process.

Walter A. Rosenbaum, 1981.

The Republic of China (ROC) and Japan adopted and adjusted their energy policies in reaction to the oil shocks of 1973 and 1979. The goals of these policies were to meet the external challenges caused by the jump in energy prices, to ensure an adequate energy supply to meet domestic economic needs, and to provide for the national security. Energy policies, therefore, have both national and international aspects. They attempt to respond to external events as well as to affect internal use and distribution of energy resources (Gordon, 1980, pp. 45-52). The major focus of this chapter is to assess and compare the consequences of energy policies in these two countries.

Since both nations are poorly endowed with energy resources, and both nations depend on foreign trade for their economic well-being, such factors as energy demand, supply, productivity, domestic oil prices and economic growth not only reflect economic conditions in the countries, but also how well the energy policies are working. All of these factors are measurable. This permits comparisons to be made. These factors serve as indicators of changes in the energy system, and therefore, are the dependent variables in this study. Energy productivity, for instance, computed by dividing gross domestic product by the total energy consumption, is an indicator of how efficiently a nation is using energy resources.

In attempting to assess the different consequences resulting from energy policies in these two countries, five research questions are raised.

1. Can the difference in total energy demand be attributed to the energy crises and policies?

2. How did the oil crises and the resulting energy policies effect the national energy supply? Why is there such a different mix in domestic and foreign supply of energy in these two countries?

3. How is energy productivity different in the various economic sectors of these two countries? Can this difference in energy productivity be attributed to the energy crises and the energy policies?

4. What explains differences in domestic oil price changes? Are the energy policies major factors affecting prices?

5. Why did the world energy environmental changes effect economic growth differently? Can the manner of this change be attributed to the energy policies adopted in these countries?

Methods of Assessment

The unit of analysis in this study is time; data are gathered on by-year-basis. There are two data sets, one for the ROC and the other for Japan. Each data set includes 16 observations, each for the years 1970-1985.

Sources of Data

The data necessary for this study come from the following sources. For the ROC, the data were mainly obtained from Taiwan Statistical Data Book (1986), Statistical Yearbook of the Republic of China (1985), Taiwan Energy Statistics (1985), Energy Indicators Quarterly in Taiwan, ROC (1986), and Energy Balance in Taiwan, ROC (1985). In addition, some specific public records, such as the Far East Oil and Energy Survey (1981), the International Energy Strategies: Proceedings of the 1979 IAEE/RFF Conference (1980), the Proceedings of the International Workshop on Energy Economics and Policies (1982), and the Proceedings of the Conference on Energy Economics (1986) provide relevant data.

For Japan, the energy data were obtained from international energy publications published by the International Energy Agency (IEA), the Organization for Economic Co-operation and Development (OECD), the Asia Bank, and the World Bank. At the same time, data were gained from the following materials: Energy Balances of OECD Countries (1986), Energy Statistics and Main Historical Series (1985), The Energy Decade 1970-1980: A Statistical and Graphic Chronicle (1982), OPEC Annual Statistical Bulletin (1984), Energy Policies and Programmes of IEA Countries: 1973-1984 Review (1985), International Petroleum Encyclopedia (1985), Oil Economists' Handbook (1986), British Petroleum Statistical Review of World Energy (1986), Japan's Aggregate Energy Statistics (1985), Monthly Bulletin of Statistics, UN (1986), and Worldwide Economic Indicators, (1985).

The data collected show energy demand, population, OPEC oil prices, energy/GDP ratio, and energy using sectors, etc., of these two countries for each year. An attempt was made to convert all factors into comparable units. For instance, energy demand was converted into million ton oil equivalent (Mtoe). GDP for the countries was converted to a common numerator as 1975 billion US$. Since OPEC oil prices differ depending upon the country making the sale, data from the official OPEC price lists were used. Similarly, both countries' population were recorded in thousands by mid-year caculation.

Variables Specification

To answer these research questions, a series of five multiple regression models was used to assess how significantly energy policy among others factors affected the dependent variables. Multiple regression analysis is a statistical technique for estimating the relationship between a continuous dependent variable and two or more continuous or discrete independent variable (Bohrnstedt and Knoke, 1982, pp. 357-60; Kvanli et al., 1986, pp. 495-548). Three categories of independent variables are used in the models discussed here: (1) sociodemographic and energy-economic variables; (2) energy policy variables; and (3) political variables. The types of variables under each of these categories are shown in Table XVII.

Twenty sociodemographic and energy-economic variables are included; each has been operationalized and will be used to assess results of energy policies. Two policy variables, such as energy policy and energy diversification, are also included and will be treated either as dependent or as independent variable in this study. One of these policy variable, energy policy (EP), is dummy coded. It is defined, EP=0, before energy policy was enacted; and EP=1, after energy policy was enacted. One political variable, energy crisis, also is specified as an independent variable. This variable is also dummy coded by assigning zero to the time periods before the intervention and one to the time periods after the intervention. For instance, during the

Table XVII
List of Variables

Variables	Abbreviations	Operationalization
I. Sociodemographic & Energy-Economic Variables		
Population	POP	(In thousands)
Labor Force	LOF	(In thousands)
Gross Domestic Product	GDP	(US$)
Consumer Price Index	CPI	(1980=100, ROC) (1980=100, Japan)
Industrial Production Index	IPI	(1980=100, ROC) (1980=100, Japan)
Exports/Imports Ratio	EIR	(Percent)
Economic Growth	EG	(GDP)
OPEC Oil Price	OPECP	(US$/bbl)
Energy Supply	ES	(Mtoe)
Energy Demand	ED	(Mtoe)
Industrial Use	IDU	(Mtoe)
Transport Use	TPU	(Mtoe)
Commercial Use	CMU	(Mtoe)
Residential Use	RDU	(Mtoe)
Domestic/Foreign Energy Ratio	DFR	(Percent)
Change in Stock	CIS	(Mtoe)
Energy Productivity	EPP	(GDP/Mtoe)

Table XVII (Continued)

Domestic Oil Price	DOP	(US$)
Population Growth Rate	PGR	(Percent)
Labor Growth Rate	LGR	(Percent)
II. Policy Variables		
Energy Diversification	EDF	(Percentage dependency on Oil)
Energy Policy	EP	(0, 1)
III. Political Variable		
Energy Crises	EC	(0, 1)

crisis period of 1974 to 1976 and 1979 to 1980, this variable is assigned the value of 1; otherwise, it is assigned the value of 0. Energy policy and energy crises are qualitative variables, and as such, are dummy coded.

Interpretation of Variance

The analysis of variance for the following models includes the R-SQUARE and ADJ R-SQ, F-Value, the P-Value and the P-Value of F, and the Beta coefficient. In the first place, the coefficient of determination (R-SQUARE) indicates the amount of variation in the dependent variable explained or accounted for by the independent variables in a regression equation. In other words, it describes the percentage of the total variation in the dependent variable values explained by this set of predictor variables (Kvanli, Guynes, and Pavur, 1986, p. 517). Since R-SQUARE always increases when new variables are added, the researcher reports the value of ADJ R-SQ, indicating whether there is a significant increase or not.

Second, the statistical significance of the F-Value is commonly used as a criterion to evaluate the overall usefulness of the regression model. When all other assumptions of regression analysis are met, a statistically significant F-Value (i.e., the P-Value of the F smaller than .05 is significantally specified by this study) implies that the overall regression model is useful in analysis and prediction.

Third, one assumption of regression analysis is that the residual terms are independent. When using Ordinary Least Square (OLS) estimates on time series data, as this study does, this assumption is sometimes violated, that is, autocorrelation might exist. The Durbin-Watson d-statistic, a statistic tool frequently used to test for significant autocorrelation, is reported in this study. If the value of the Durbin-Watson D is near zero, it indicates a strong positive autocorrelation, while a value close to four means that there is a significant negative autocorrelation. A value near two indicates that there is no or very little autocorrelation, if so, the use of regression analysis on the time series data is valid. (Kvanli, Guynes, and Pavur, 1986, pp. 539-40, pp. 681-684).

Fourth, the P-Value focuses on demonstrating statistical significance (Bohrnstedt and Knoke, 1982, p. 189). If the P-Value of an independent variable is less than .05, it implies that the independent variable has a significant relationship with a given dependent variable, while all other independent variables included in this model are held constant.

Finally, each Beta coefficient is important in regression analysis because it provides a useful interpretation of the relationship between a specific independent variable and dependent variable in a given regression equation. The Beta coefficient can be either statistically significant or not. The P-Values corresponding to the Beta coefficients represent the level of statistical significance. The value of the Beta coefficient, which can be either positive or negative, indicates the relative ability to explain the contribution of each independent variable to change in the dependent variable (Bohrnstedt and Knoke, 1982, pp. 366-8).

Regression Models for Assessing Policy Consequences

Five multiple regression models are presented for the purpose of assessing policy consequences, and to determine the variate association of each models' independent variables and dependent variables. The Pearson correlation coefficients (r) is employed as a preliminary estimation of the relationship among all variables. The programs for these models are attached as Appendix A for the ROC and as Appendix B for the Japan.

Regression Model I: Total Energy Demand

Model I is designed to assess the impact of such independent variables as population, OPEC oil prices, GDP, and energy policy on the total energy demand in these two countries. The dependent variable in the equation for Model I is total energy demand. The demand for energy in a given nation is affected by a whole series of factors, stemming from the differences in institutional arrangements, in the physical and geographical nature of individual countries, and in the pattern of energy consumption (Dunkerley, 1980, pp. 105-115). Increased energy demand brings about an increase in prices of energy, and this in turn influences production decisions of major energy producers. According to C. M. Siddayao, the demand for energy may be influenced at the aggregate level by the following variables:

> (1) population growth and age distribution; (2) the level and distribution of income; (3) consumer tastes and preferences (sometimes referred to as "life-styles"; (4) technical change affecting the intensiveness of energy use; (5) changes in the stock of energy-consuming goods; (6) consumer price and income expectations; (7) the price of energy relative to other goods and services; and (8) public policy changes that would affect spending and savings patterns (Siddayao, 1986, pp. 23-4).

The importance of each of the factors that effect energy demand, however, is not easily sorted out or quantified in empirical work. Before the model was finalized all of the variable discussed by C. M. Siddayao were considered. However, some of this data was not available. After using a Stepwise procedure to test several variables, it was found that there was a high degree of multicollinearity between these independent variables and total energy demand. Therefore, the final model was modified to include the following four independent variables, such as population, GDP, OPEC oil prices, and energy policy.

The complete model I is shown as follows:

$$TED = A + B(1)*POP + B(2)*OPECP + B(3)*GDP + B(4)*EP + e$$

Where

TED = Total Energy Demand
POP = Population
OPECP = OPEC Oil Prices
GDP = Gross Domestic Product
EP = Energy Policy

The results of this analysis are summarized in Table XVIII for the two countries.

Table XVIII
Regression Results of the First Model with Total Energy Demand as the Dependent Variable

	ROC		Japan	
Independent Variables	Parameter Estimate (B)	P Value	Parameter Estimate (B)	P Value
Constant	-100.1269	0.0006	-162.1738	0.6732
POP	0.0079	0.0003	0.0044	0.3361
OPECP	0.2618	0.0064	-0.7697	0.3488
GDP	-0.4458	0.0049	0.0068	0.9772
EP	-3.7698	0.0616	19.8892	0.1838

R-SQUARE = 0.9720 (ROC); 0.8397 (Japan)
ADJ R-SQ = 0.9619 (ROC); 0.7814 (Japan)
F VALUE = 95.602 (ROC); 14.407 (Japan)
PROB>F = 0.0001 (ROC); 0.0002 (Japan)
STANDARD ERROR = 1.4405 (ROC); 11.6845 (Japan)
DW = 2.217 (ROC); 1.320 (Japan)
SAMPLE SIZE = 16

<u>Findings and Implications</u>. The first model shows different results between these two countries. The R-SQUARE of 0.9720 and ADJ R-SQ of 0.9619 in the ROC show a high degree of correlation between energy demand and the independent variables in this model. In Japan, the R-SQUARE

of 0.8397 and ADJ R-SQ of 0.7814 also show a large degree of correlation. The model for these two nations implies that it is useful in analyzing the variation between energy demand and energy policy, as well as other independent variables. But it is obvious that the higher correlation between these variables in the ROC makes it more accurate for prediction than in Japan.

The F-Value of 95.602 in the ROC and 14.407 in Japan implies that the overall model is less likely to be due to chance in the ROC than that of Japan. The P-Value of F for both nations in this model is smaller than .05 which indicates the model is useful. The value of the Durbin-Watson D, 2.217 in the ROC and 1.320 in Japan, indicates that there is very little autocorrelation. P-Value in this model shows that the independent variables such as population, OPEC oil prices, and Gross Domestic Product significantly affected the national energy demand only in the ROC. Energy policy, however, had an insignificant effect on energy demand in both countries (i.e., based on the A = .05 level).

The results from this model for the ROC seems to support Boum Jong Choe's statement (1979) that developing countries maintained relatively higher growth rates of energy consumption than industrialized countries in the post-1973 period (Choe, 1980, pp. 224-8). In fact, during the era of the energy crises, the ROC government continued to promote the so-called Ten Big Projects and other changes in the economy which caused greater use of energy. Japan, on the other hand, was able to move its economy more rapidly toward high technology and low energy consuming industries.

Regression Model II: Total Energy Supply

Changes in the quantity of oil affect the economies of both countries tremendously since both import more than 95 per cent of their oil, much of it from the Middle East. Maintaining a stable supply of cheap energy for the critical sectors of their economies is, therefore, a main concern of their energy policies. Energy supply plays a key role in the nations' economic health, as well as its national security. Both nations have attempted to expand their domestic energy sources as the world's oil market has become more dynamic and uncertain (Kim, 1984, pp. 717-25). Despite the efforts to increase domestic supply, the problem of energy supply in both countries is essentially one of imported oil. Although there are efforts to diversify to other energy resources and to import energy from sources other than the Middle East, oil is projected to be the major fuel source until the next century.

As a result, the model to assess the impact of energy policies on total energy supply for the nations included such variables as OPEC oil prices, domestic and foreign energy ratio, exports/imports ratio, and energy policy. Another independent variable, the percentage of dependency on oil also was considered in this model.

The complete Model II is shown as follows.

```
TES = A + B(1)*OPECP + B(2)*DFR + B(3)*EIR + B(4)*EP
        + B(5)*EDF + e
```

Where

```
TES   = Total Energy Supply
OPECP = OPEC Oil Prices
DFR   = Domestic/Foreign Energy Ratio
EIR   = Exports/Imports Ratio
EP    = Energy Policy
EDF   = Percentage Dependency on Oil
```

The results of this regression model are summarized in Table XIX for these two countries.

Findings and Implication. Model II for energy supply, as shown in Table XIX, presents relatively different results between the two countries. The R-SQUARE of 0.9850 and ADJ R-SQ of 0.9774 in the ROC show a high degree of correlation of energy supply and the independent variables in this model. In Japan, the R-SQUARE of 0.8657 and ADJ R-SQ of 0.7986 also show a relative high degree of correlation which implies that the variation between energy supply and energy policy along with other independent variables is useful.

Table XIX
Regression Results of the Second Model with
Total Energy Supply as the Dependent Variable

	ROC		Japan	
Independent Variables	Parameter Estimate (B)	P Value	Parameter Estimate (B)	P Value
Constant	17.8722	0.0371	143.4377	0.2697
OPECP	0.3150	0.0001	2.0433	0.0220
DFR	-22.5730	0.0007	-255.1468	0.3094
EIR	9.9815	0.0287	41.7938	0.1760
EDF	-3.3375	0.3307	273.6405	0.1127
EP	1.6078	0.3677	6.7091	0.7548

R-SQUARE = 0.9850 (ROC); 0.8657 (Japan)
ADJ R-SQ = 0.9774 (ROC); 0.7986 (Japan)
F Value = 130.912 (ROC); 12.894 (Japan)
PROB>F = 0.0001 (ROC); 0.0004 (Japan)
STANDARD ERROR = 1.39484 (ROC); 11.8366 (Japan)
DW = 1.666 (ROC); 2.024 (Japan)
SAMPLE SIZE = 16

But it is still a higher correlation in the ROC than in Japan.

The F-Value of 130.912 in the ROC and 12.894 in Japan indicates that the overall model is more useful in analysis and prediction in the ROC than that of Japan. Also, the P-Value of F is smaller than .05 in both nations implies that this regression model is useful. The value of the

Durbin-Watson D, such as 1.666 in the ROC and 2.024 in Japan, indicates that there is very little autocorrelation in the model.

The P-Values of independent variables in this model, such as OPEC oil prices and domestic and foreign energy ratio, significantly effected total energy supply only in the ROC. But OPEC oil prices variable is also significantly effecting total energy supply in Japan. Another independent variable exports/imports ratio was a significant effect only in the ROC. Energy policy had an insignificant effect on energy supply in both of these countries. The reason energy policy had an insignificant impact on energy supply in both nations perhap lies in the fact that both must import energy for their national economies and security. The rapid growth of the foreign trade in both nations during the last two decades, has been a key element promoting their economic growth. As a result, they have become highly export-oriented countries requiring more energy supply (Hasan, 1983, pp. 31-59). The Beta coefficient shows that energy policy for both nations had a positive relationship with total energy supply.

Regression Model III: Energy Productivity

Energy productivity refers to how efficiently a nation uses its energy resources. Since the 1970s, both the ROC and Japan, as most nations, have developed energy policies to influence the use of energy. Such action, as Julio R. Gamba et al., stated (1986), is based on the premise that government needs to strengthen and supplement market forces to improve energy efficiency or energy productivity (Gamba et al., 1986, p. 49). All major economic sectors such as industrial, transportation, commercial, and residential, etc., impact on energy productivity and need to be examined in order to understand energy productivity. The dependent variable in this equation for Model III is energy productivity.

The industrial sector especially is very importance in these two countries, since it uses between 45 to 57 per cent of total energy consumption (Energy Balance in Taiwan, ROC, 1985; Japan's Aggregrate Energy Statistics, 1985). The transportation sector is also critical to these two countries for two reasons. First, it provides the basic infrastructure for mass mobility; second, it is a mechanism for national integration and a necessary prerequisite for integrating market structures and commercial networks. Comparatively, while the ROC's transportation sector accounted for 6.88 per cent of total energy consumption in 1970, and 12.86 per cent in 1985, transportation in Japan accounted for 14.99 per cent of total energy consumption in 1970, and 22.93 per cent in 1984 (Energy Balance in Taiwan, ROC, 1985; Japan's Aggregate Energy Statistics, 1985).

The home market is still too small to support the rapidly expanding productive capacities of these two countries, and much of the commerce for both countries is in international trade. Although Japan is much less dependent upon imported intermediate goods and capital equipment than is the ROC, both are heavily dependent upon imported raw materials and fuels (Wu, 1985, p. 11, 20). Finally, the residential sector also must be considered in computing the total energy consumption in these two countries. The increasing or decreasing percentage of energy use by the residential sector may be caused by the standard of living and/or the per capita use of energy which reflects in part energy conservation policies.

The complete model III for assessing energy productivity is shown as follows.

$$EPP = A + B(1)*IDU + B(2)*TPU + B(3)*RDU + B(4)*CMU + B(5)*EC + B(6)*EP + e$$

Where

EPP = Energy Productivity
IDU = Industry Use
TPU = Transport Use
RDU = Residential Use
CMU = Commercial Use
EC = Energy Crises
EP = Energy Policy

The results of this regression model are summarized in Table XX for the two countries.

Table XX
Regression Results of the Third Model with
Energy Productivity as the Dependent Variable

	ROC		Japan	
Independent Variables	Parameter Estimate (B)	P Value	Parameter Estimate (B)	P Value
Constant	0.7905	0.0073	1.5009	0.0019
IDU	-0.0701	0.0180	-0.0056	0.0581
TPU	-0.4287	0.3373	-0.0066	0.1914
CMU	1.3677	0.3908	0.0446	0.0034
RDU	0.5345	0.2645	0.0202	0.0004
EC	0.1124	0.0346	-0.0666	0.1414
EP	-0.0570	0.5861	-0.0001	0.9983

R-SQUARE = 0.7504 (ROC); 0.9548 (Japan)
ADJ R-SQ = 0.5840 (ROC); 0.9247 (Japan)
F VALUE = 4.510 (ROC); 31.706 (Japan)
PROB>F = 0.0220 (ROC); 0.0001 (Japan)
STANDRAD ERROR = 0.0614 (ROC); 0.0641 (Japan)
DW = 1.550 (ROC); 1.673 (Japan)
SAMPLE SIZE = 16

Findings and Implications. Model III for energy productivity are shown in Table XX, which indicates a number of findings. In the first place, both nations differ in the R-SQUARE and the ADJ R-SQ. The figures for the ROC are 0.7504 and 0.5840, and the figures for Japan are 0.9548 and 0.9247. Japan has a higher correlation between energy productivity and the independent variables in the model; the model is more successful in predicting for Japan than for the ROC.

Second, the results of F-Value as 4.510 in the ROC and 31.706 in Japan imply that the overall model is more useful in analysis and prediction in Japan than in the ROC. The P-Values of F for both nations demonstrate that the overall model is also useful in prediction. But it is more useful in Japan than in the ROC. The value of the Durbin-Watson D, such as 1.550 in the ROC and 1.673 in Japan, indicates that the model has very little autocorrelation.

Third, the P-Values of F shows that energy productivity was affected differently by the energy crises in these two countries. While the energy crises significantly effected energy productivity in the ROC, they did not have a significant effect in Japan. Japan has a higher efficiency productivity ratio than the ROC, and therefore, the energy crises did not affect it as much as it did the ROC. This finding seems to be consistent with statements by Sueo Sekiguchi and Hirofumi Shibata. They point out that despite its higher vulnerability to energy shortages, Japan was able to turn the situation to its advantage through intensive energy-saving efforts (Sekiguchi, 1983, p. 336; Shibata, 1983, p. 153). The energy policy variable was insignificant in effecting energy productivity in both countries.

The various economic sectors also show different results in the model pertaining to energy productivity in both countries. Japan's energy productivity was significantly affected by three sectors of the economy, namely, industrial, commercial, and residential, while the ROC's energy productivity was affected significantly only by one of the economic sectors, the industrial sector. Energy productivity seemed not to have been effected by the transportation, commercial, and residential economic sectors in the ROC. This finding pertaining to the ROC is consistent with Frank C. C. Chang's statment (1985), that since transportation and utilities for the residential sector are two of the five major energy intensity uses in Taiwan, there is need for more active energy conservation and rational utilization in these sectors (Chang, 1985, pp. 41-2).

Finally, the Beta coefficient in this model also shows that energy policy variable in both nations had a negative relationship between energy productivity. The energy crises, as an independent variable, was insignificant in Japan, but significant in the ROC which suggests that the energy crises forced the ROC to improve on its energy productivity. The fact that the energy crises variable was significant in the ROC but the energy policy variable was insignificant in both countries, perhaps implies that the increase in prices of energy causes changes faster than governmental policies. Also, the fact that the Japanese bureaucracy is intimately involved in guiding industry may in part indicate why energy productivity increased faster in that country.

Regression Model IV: Domestic Oil Prices

The sharp rise in the OPEC price of crude oil and the consequent balance of payments difficulties, as mentioned earlier, forced both nations to adjust their domestic oil prices to more closely reflect the actual costs in the international oil markets. Because oil is an important factor used in the production of other goods and services, changes in the price of oil can alter potential output by changing the efficient combination of inputs in production. An increase in the price of oil will encourage domestic exploration for oil and the substitution of other energy sources, as well as encouraging greater efficiency in the use of energy (Bohi and Montgomery, 1982, p. 53).

Oil prices serve as an important signal in the oil-importing countries' economic systems. They can provide the incentives to change the levels of production, the patterns of consumption and industrial development, and the levels of investment in various economic activities (Cisler et al., 1982, p. 176). The adjustment of domestic energy prices in developing countries, however, is generally slower than in developed countries (Gamba et al., pp. 53-54). It is important to assess how domestic oil prices in these two countries were influenced by the changes in OPEC oil prices and energy diversification (i.e., the percentage dependency on oil). Before this model was finalized, a number of energy-economic and policy variables were considered which could effect domestic oil prices. For instance, consumer price index, change in stock, and energy policy were considered as possible independent variables. After testing the model with these variables, it was found that there was a high degree of multicollinearity between these variables and domestic oil prices. The final model was modified to include one energy-economic and one policy variable. The policy variable most directly impacting on domestic oil prices is the energy diversification variable, which shows the percentage of dependency on oil. This policy variable was used rather than the energy policy variable which is dummy coded.

The complete model IV for assessing how domestic oil prices were affected is shown as follows.

$$DOP = A + B(1)*OPECP + B(2)*EDF + e$$

Where

DOP = Domestic Oil Prices
OPECP = OPEC Oil Prices
EDF = Energy Diversification

The results of this regression model are summerized in Table XXI for the two countries.

Table XXI
Regression Results of the Fourth Model with Domestic Oil Prices as the Dependent Variable

	ROC		Japan	
Independent Variables	Parameter Estimate (B)	P Value	Parameter Estimate (B)	P Value
Constant	0.0467	0.0001	0.0644	0.4161
OPECP	0.0012	0.0001	0.0010	0.0359
EDF	0.0009	0.9137	-0.0200	0.8599

R-SQUARE = 0.9360 (ROC); 0.5227 (Japan)
ADJ R-SQ = 0.9261 (ROC); 0.4493 (Japan)
F VALUE = 94.992 (ROC); 7.119 (Japan)
PROB>F = 0.0001 (ROC); 0.0082 (Japan)
STANDARD_ERROR = 0.0042 (ROC); 0.0136 (Japan)
DW = 1.185 (ROC); 0.561 (Japan)
SAMPLE SIZE = 16

Findings and Implications. The value of model IV as a predictor in the ROC is indicated by the R-SQUARE of 0.9360 and the ADJ R-SQ of 0.9261. In Japan, however, the R-SQUARE and the ADJ R-SQ are only 0.5227 and 0.4493 indicating the model is less successful in predicting for Japan than for the ROC.

The F-Value shows that the overall model is more applicable for the ROC (94.992) than for Japan (7.119).

Since P-Value of F is less than .05 for both nations, it demonstrates that the model is useful in analysis and prediction. The value of the Durbin-Watson D, such as 1.185 in the ROC and 0.561 in Japan indicates that Japan had a relative stong positive autocorrelation in this model. Thus, this model for Japan violates one assumption of regression analysis and is useless.

The P-Value shows that OPEC oil prices variable was significant in effecting domestic oil prices in both countries, as would be expected. The other independent variable, energy diversification, was insignificant in both countries which suggest that the energy policies of diversification had little effect on domestic oil prices. Oil is still the major energy resource for both of these countries. Furthermore, since the time frame in this model includes only 16 years, the full impact of energy diversification may not be fully demonstrated. The negative coefficient between domestic oil prices and diversification away from oil in Japan indicate that the greater the diversification, the lower are domestic oil prices. This is not true for the ROC.

Regression Model V: Economic Growth

One primary objective of national energy policies is to maintain or enhance the growth of the nation's economy. As

Klause P. Heiss et al., noted in 1973, the needs for energy is closely correlated to the level of economic and social development of a society and its per capita energy consumption (Heiss et al., 1973, p. 103). More recently, Nazli Choucri pointed out that the relationship between total energy demand and economic growth is clearly evident; that is, it is an almost perfect positive correlation which appears across time and in crossnational comparisons (Choucri, 1982, pp. 9-14). It is important, therefore, to assess how the energy crises among other factors affected economic growth in these two countries.

The complete model V for assessing the impact of the energy crises and policies on economic growth is shown as follows.

$$EG = A + B(1)*IPI + B(2)*EIR + B(3)*CPI + B(4)*EC + B(5)*LGR + e$$

Where

EG = Economic Growth
IPI = Industrial Production Index
EIR = Export/Import Ratio
CPI = Consumer Price Index
LGR = Labor Growth Rate
EC = Energy Crises
EP = Energy Policy

The results of this regression model are summarized in Table XXII for these two countries.

Table XXII
Regression Results of the Fifth Model with Economic Growth as the Dependent Variable

	ROC		Japan	
Independent Variables	Parameter Estimate (B)	P Value	Parameter Estimate (B)	P Value
Constant	-13.9403	0.0748	210.8570	0.0001
IPI	0.0720	0.5371	2.2109	0.0172
EIR	17.2383	0.0783	-104.1373	0.0296
CPI	0.3373	0.0001	3.2544	0.0010
LGR	-0.6581	0.0551	1.9367	0.8024
EC	3.7148	0.0150	-25.7195	0.0162
EP	-5.0104	0.1825	3.2038	0.7714

R-SQUARE = 0.9950 (ROC); 0.9962 (Japan)
ADJ R-SQ = 0.9916 (ROC); 0.9937 (Japan)
F VALUE = 296.844 (ROC); 395.617 (Japan)
PROB>F = 0.0001 (ROC); 0.0001 (Japan)
STANDARD ERROR = 1.3760 (ROC); 8.7101 (Japan)
DW = 1.738 (ROC); 2.166 (Japan)
SAMPLE SIZE = 16

Findings and Implications. The Model V regarding economic growth, shown in Table XXII helps to answer the research question, why did the changes in the oil market affect economic growth differently in these two countries? The R-SQUARE of 0.9950 and 0.9962 and the ADJ R-SQ of 0.9916 and 0.9937 in the ROC and Japan, respectively, indicates the value of this model.

The F-Value in this model of 296.844 in the ROC and 395.617 in Japan implies that the overall model is useful in analysis and prediction for both countries. The P-Value of F also demonstrates the value of the model. As can be seen in Table XXII, there is very little autocorrelation for both nations as the Durbin-Watson D shows 1.738 in the ROC and 2.166 in Japan.

The P-Values of the energy crises variable in this model significantly affected economic growth in both nations. Energy policy, however, as an independent variable was found to be insignificant and correlated negatively with economic growth in these two countries. This means that energy policies were not significant in effecting economic growth and, in fact, the negative correlation of the Beta coefficient suggests that energy policies had a negative impact on economic growth. In part, both nations' energy policies caused serious adjustments to be made by industry, and this in turn caused the energy policies to appear to injure the export-led economic growth.

Summary

In this chapter, five regression models have been presented for the purpose of assessing the consequences of energy policies and answering a series of research questions. The first model shows that the energy policies did not significantly effect total energy demand in these two countries. One important reason why energy policies were insignificant in effecting total energy demand is that these countries are poorly endowed in energy resources, and the increases in population and GDP directly effect total energy demand by requiring more housing, communications, transportation, and industrial products. The standard of living has more effect on energy demand than energy policies. The answer to question one, can the difference in energy demand in the two countries be attributed to energy policies, is unlikely.

The OPEC oil price increases referred to as the energy crises significantly effected total energy supply in these two countries. This answers the research question of how did OPEC oil prices effect the national total energy supply. Energy policies, however, did not significantly effect the total energy supply. The second part of the research question, why is there such a different mix in domestic and foreign supply of energy in the two countries, was not fully answered by the model since the policy variable on diversification showed to be insignificant in both nations. International oil prices still set domestic oil prices despite the diversification which has been made.

Energy productivity as, is seen in Model III, is significantly affected by changes in the economic sectors of industrial, commercial, and residential in Japan, but only changes in the industrial sector in the ROC. These results help answer the research question, how is energy productivity different in the various economic sectors of the two countries? The finding also shows that the energy crises stimulated energy productivity more in the ROC. Although energy policies were shown to be insignificant in explaining energy productivity in this model, some energy policies such as subsidies for changing to more energy efficient machinery or regulations on manufacturies to produce more efficient machineries may be difficult to measure because the shock of energy crises had such a strong impact.

The fourth model attempted to answer the research question, what explains the differences in domestic oil prices changes? The OPEC oil prices were found to significantly affect domestic oil prices in both countries. This result indicates that the domestic oil prices for the oil-importing countries, whether they are market guided or administrative guided, are significantly affected by the international oil market. The second part of this research question, are energy policies major factors effecting prices, was dealt with in model IV by the energy diversification policy variable. It was found that the energy diversification variable was insignificant in effecting domestic oil prices in both countries. Through energy diversification both nations sought to reduce damage from the oil shocks. The assessment, however, shows that to this point, energy diversification has not significantly effected domestic oil prices in either country.

The fifth Model attempted to answer the research question, why did the energy crises affect economic growth differently? And can the manner of these changes be attributed to energy policies adopted in these two countries? The energy crises did significantly effect economic growth in the ROC and Japan. The finding shows that energy policies did not have a significant effect on economic growth in either country.

It can be concluded, based upon the above analysis, that the five dependent variables (i.e., energy demand, supply, productivity, domestic oil prices, and economic growth) in both nations, were more significantly effected by the energy crises, that is upon economics, than by energy policies. The facts indicate that the high cost of energy presented a serious challenge to these two countries. As a result the improvement of energy productivity has become a national goal for economic growth in both nations. Increasing the efficiency of energy use is more attractive than increasing domestic supply, and reducing energy costs helps make domestic industry more competitive in the world market (Gamba et al., 1986, p. v).

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CHAPTER VII

SUMMARY AND CONCLUSIONS

The purpose of this dissertation is to compare the energy politics and policy processes in the Republic of China (ROC) and Japan during the period of 1970-1985. The study focuses on the politics of energy policies, using a policy analysis or systems framework for examining the policy processes in the two countries. A comparison is made of energy environments, the political actors, the institutions, and finally the substance of energy policy. An assessment is then made of the effects or consequences of energy policies on these two countries.

In the relevant literature on energy policies and politics, few studies compared energy policies of national states or considered the international politics of energy. Relatively few of the studies provided theoretical insights or conceptual frameworks on domestic energy policy, and none linked domestic and international politics. As a result, there is no agreed upon conceptual framework for guiding comparative policy research or for helping national policy makers in making energy policies. One purpose of this study is to advance theoretical knowledge and perhaps to provide a conceptual framework for understanding the complexity, uncertainty, and interrelatedness of energy policies.

A Comparison of the Energy Systems

In attempting to study these two Asian countries, the researcher began with a policy model or conceptual scheme of energy politics originated by David H. Davis from which the researcher raised a number of research questions (Davis, 1982, p. 15). These questions were used to guide the direction of the study. An attempt was made first to answer the research question pertaining to the characteristics of the energy resources systems in the two nations. Another model of the sociodemographic and economic variables affecting a national energy system by C. M. Siddayao guides the researcher in this effort (Siddayao, 1986, pp. 28). A number of significant conclusions can be drawn from this comparison of the energy systems. In the first place, both nations are poorly endowed in energy resources and heavily dependent upon foreign imports, especially upon oil from the Middle East. Neither has adequate domestic oil, gas, coal or uranium resources to meet national demands, and therefore, both are dependent on foreign resources. Both countries increased onshore and offshore exploration efforts after the oil crises, and, although some finds have been made offshore, especially by Japan, they have not been large enough to meet domestic needs.

A second characteristics of the energy systems in these two countries is that they are dominated to a large extent by government. Since there are few energy resources, there is not the pluralism of groups involved in energy as is to be found in an energy-rich and industrialized country such as the United States or Canada. Most of the energy resources are operated by the government, especially in the ROC. There the only private energy groups are the owners of the small coal mines. The gas and oil industries are entirely operated by state-owned enterprises. Similarly, the electrical system from generation to distribution is government operated, and obviously the same is true for nuclear power.

In Japan, although private enterprise in the energy field is more widespread and performs a more significant role, government plays a dominant role in the energy field. In addition to private coal operations, gas and oil production and distribution are also in private hands. Despite this private ownership, the government bureaucracy through its powers of administrative guidance to a large degree dominates the energy system.

Perhaps the most obvious characteristics of the energy systems in these two countries is their dependency on imported oil. Before the energy crisis in the 1970s, imported oil amounted to 60 per cent or more of the total energy supply in both countries. Little thought was given to the fact that they were dependent on the Middle East for such a large share of their energy supply. The cheap and plentiful oil supply was expected to last forever. It was only in the early 1970s that either of the countries began to consider plans for energy policies (Kemezis & Wilson, 1984, pp. 9-12).

Another aspect of the energy systems is that it is difficult or impossible to reduce demand for energy, since the economies of the countries are exported-oriented, and economic growth is closely related to energy consumption (Franssen, 1981, pp. 213-224). Both nations, therefore, must import oil or other energy, if the national well-being is to be maintained. Both nations are densely populated and have a large percentage of young workers coming into the labor force. Demand for more energy, therefore, continues to grow, despite the increases in the price of oil and other energy resources.

A Comparison of the Political Systems

The major actors in the energy resource field were identifed by comparing the political systems in the two countries. One of the major differences in the politics of the two countries is caused by the differences in political ideologies. The ROC because of its war with the Chinese

Communists is effected by political ideology much more than Japan. Sun Yat-sen's principles still have a major impact on the government's actions, and during the first energy crisis this ideology prevented the government from pricing oil at the real international market prices. Also, its anti-communist stance makes it impossible for the ROC to enter into agreements for energy with any communist country. Japan, on the other hand, has the ability to separate economics from politics and thus has been able to enter into energy agreements with such communist countries as the Soviet Union and the People's Republic of China (PRC).

One of the obvious differences in the political systems in the two countries is in the nature and roles of political parties. The ROC has basically a one-party-dominant system in which the major policy decisions are decided by the ruling Kuomintang party. The institutional offices in government, the Legislative Yuan and Executive Yuan and the bureaucracy are all subservient to the party (Gold, 1986, pp. 122-33). Industrial groups in China also are not a major force in making policies, since many of them are multinational corporations or, if local firms, are dependent on state aid or contracts. Japan, on the other hand, in theory has a competitive party system, although in reality the dominant Liberal Democratic Party has been in power since Japan emerged from military occupation after World War

II. The party by itself is not the major policy actor; in fact, policies are made in Japan by a ruling triumvirate compose of the ruling party, the bureaucracy, and the corporate leadership. Policies are made by the institutional triumvirate not by the party alone.

Another major difference in the political systems in the two countries is in the role of the bureaucracy. The bureaucracy in Japan is well established with a long history of enjoying the highest status and most powerful place in the formulation of public policy (Silberman, 1982, p. 230). The bureaucracy can influence industry through the process of administrative guidance. Japan as a result has been able to increase national energy productivity faster than the ROC. Also Japan's success in resource diplomacy is in part due to the more efficient bureaucracy. In the ROC, on the other hand, the bureaucracy enjoys no such special status and is not as well established to deal with complex energy matters. As a result, it has not had the same kind of successes in administering energy policies.

Corporate groups also are major political actors in energy politics in Japan. In fact, this is reflected in the characterization of Japan as "Japan Incorporated". Since industry in Japan is concerned mainly with keeping an adequate supply of energy, and since there are not the competing pluralistic groups found in oil-rich countries, energy supply, price and environmental controls are the main issues of concern to industry. Corporate groups in the ROC, however, are not nearly so strong politically. In part, this is due to the different stages of economic development in the ROC, and in part to the fact that much of the industry is multinational corporations, especially U.S. firms. The interest of local firms in the ROC must be advanced in the party, since the bureaucracy does not have the status or the power it does in Japan.

In the comparison of the political systems in energy politics, relatively little open political conflict was discovered between energy sectors such as oil, gas, coal, or nuclear, or between proponent of public or private operations of energy facilities. Neither was there the political conflict between consumers and producers as might be expected. This lack of open political conflict in both countries perhaps is explained by the fact that domestic energy sources are so scarce and that the government plays the dominant roles in the energy field. The conflicts over price and allocation of energy resources to a large degree are fought out in the bureaucracy in Japan where political compromise and bargaining occurs. These conflicts are resolved in the party in the ROC. One major political conflict over energy in both societies is the regulation of pollution. Open protest by groups for environmental protection, especially protest against nuclear facilities occurred in both countries. Also, the conflicts between fishermen and offshore drilling for oil and gas, and the conflicts over the location of coal-fired generating facilities often result in open political protests.

A Comparison of Energy Policies

In attempting to compare the policy responses to the energy crises, the researcher adapted William N. Dunn's conceptual framework for understanding the various energy policy alternatives (Dunn, 1981, p. 261). Since the oil crises so seriously affected both nations, both were forced to consider many of the same energy policy alternatives. How to control the rapidly increasing prices and inflation, and the concomitant forces of recession dominated policy makers in both nations in the initial period of the crises. How to reduce the growing demands and increase the supply of oil became other focuses of concern. Energy policy alternatives were considered to promote energy conservation, to increase domestic production, to encourage the use of alternative energy sources, to diversify energy resource use away from oil to other energy sources, and to diversify energy imports away from the Middle East. Both nations also had to consider how to prevent the energy shortage from threatening national security, and they had to make emergency plans for rationing and allocating energy in case oil supply was cutoff.

Both nations reacted initially by fostering conservation programs in an attempt to reduce the demand for energy. The conservation programs were similar in both countries. Both relied on public relation programs to encourage such matters as the use of mass transit or car-pooling, home insulation, use of electrical power during off-peak periods by business and industry, etc. Also, tax incentives and low interest rates were used as incentives to get industry to use more energy efficient machinery and equipment, and thus improve energy productivity. Regulatory measures were enacted to require machinery such as home appliances, automobiles, and industrial equipment to carry information pertaining to energy efficiency. Research and development programs were financed in both countries to promote renewable energy resources and the more efficient use of coal. As a result of these efforts, both nations were able to achieve an increase in their energy productivity and to produce a relative high economic growth with a lower consumption of energy (Sakakibara, 1984, pp. 41-8).

Ensuring an adequate supply of energy required the consideration of a number of policy alternatives. Both nations almost immediately after the beginning of the oil crisis, desperately began attempts to increase domestic production of energy. International politics, however, hindered the ROC's efforts at offshore exploration. Recognition of the PRC by the United States in 1979 coupled with the territorial disputes with the PRC, Japan, and the Philippines seriously hindered the ROC's efforts to expand its offshore resources. Japan's effort also produced far less energy than it needs. Similarly, efforts to promote new alternative energy resources, such as geothermal, wind, biomass, and solar produced only a fraction of the needed energy.

Diversification to other energy sources such as coal, gas, or nuclear power was another approach for reducing the dependence on oil. Efforts were made in the electrical systems of both countries to switch from oil-fired generating plants to coal, gas, or nuclear powered generation. Both nations successed in diversifying the generation of electrical energy. The most dramatic changes occurred in the growth of nuclear power. Nuclear power in 1985 produced 18 per cent of the ROC's total energy and it is projected to produce 50 per cent by 1990. Nuclear power in Japan, on the other hand, produced 10 per cent of its total energy supply in 1984 and is projected to produce 25 per cent in 1990 (Smith, 1982, p. 125; Kuo, 1984, pp. 143-57).

Diversification to other energy sources also changed the mix of the total supply of energy in each country. The ROC has reduced its reliance of oil imports from 64 per cent of total energy sources in 1971 to 53 per cent in 1985. Japan similarly decreased the percentage of imported oil on total energy sources from 62 per cent in 1970 to 54 per cent in 1984. Imports of other fuels such as coal, gas, and uranium increased percentage wise in this period (Taiwan Energy Statistics, 1985; Energy Balances of OECD Countries, 1970-1985).

Both countries attempted to reduce their vulnerability caused by the heavy reliance on the Middle East oil market by seeking new markets for energy elsewhere. As a result, both nations instituted resource diplomacy to help them diversify their sources of energy. Both nations have succeeded in decreasing the share of oil imported from the Middle East. Imported oil from the Middle East was decreased from 96.57 per cent of the total oil supply in the ROC in 1971 to 75.43 per cent in 1985. Similarly, Japan reduced its share of oil from the Middle East from 85.2 per cent of the total oil supply in 1973 to 69.3 per cent in 1982. This decrease in percentage occurred in face of continuing increases in total oil and energy demand (Energy Indicators Quarterly, 1986, pp. 6-7; Japan, OECD, 1982, p. 49).

Japan has been more successful in obtaining new energy sources through resource diplomacy than the ROC. Japan's success is due to a number of reasons. For one thing, its ability to separate economics from politics permits it to deal with former enemies and communist countries. Mainland China has become one of the major energy suppliers in recent years to Japan, and this energy cooperation is expected to increase in the future (Keith, 1986, pp. 29-32). Similarly, Japan was able throughout much of 1970's to obtain energy resources from the Soviet Union. Another reason why Japan has been more successful in its resource diplomacy is that it is a regional power with both economic and political resources which help it in dealing with oil-rich developing countries. Japan's membership in the major international organizations, such as the World Bank and Asian Bank, also help it in its resource diplomacy efforts. Japan's powerful and effective bureaucracy and its close ties with industry also plays an important role in resource diplomacy.

The ROC, on the other hand, has been hindered in its efforts to find new sources of energy by its great dependence upon the U.S. for political and economic support. Since the admission of the PRC to the United Nations in 1971 and the recognition of the PRC by the U.S. in 1979, many of the ROC's offshore exploration efforts were stymied. Since many countries followed the U.S. in recognizing the PRC, the resource diplomacy of the ROC was constrained. Neither does the ROC have the regional position or the strong bureaucracy or industry leadership that Japan has, and as a result it continues to relies more heavily on Middle East oil.

Despite Japan's success in resource diplomacy, there are limits on its ability to negotiate for energy with members of the communist bloc or other countries considered hostile to Western interest, such as Iran after its revolution. The limitation on Japan lies in the latent conflict between resource diplomacy and its dependency upon the U. S. for military security. It is impossible for Japan to pursue resource diplomacy without giving proper consideration to the American global strategy. Some writers have called this Japan's "ultimate vulnerability" (Quo, 1986, p. 168).

The Assessment of Energy Policies

After comparing energy policies in the two countries, an attempt was made to assess the impact of these policies. This required the creation of appropriate models for assessing the consequences of energy policies. A major problem that hindered the researcher in this assessment was that there is no agreed upon conceptual framework to guide research seeking to explain how the complex, interdependent energy system works domestically and internationally, and how it relates to other national and international systems, such as the economic, political, or policy systems.

Although in their work, Econometric Models of Asian Link (1985), Shinichi Ichimura and Mitsuo Ezaki presented a number of workable econometric models for East and Southeast Asian Countries. They are concerned primarily with national economies and do not include political and policy variables for these two countries which this assessment requires (Ichimura & Ezaki, 1985). Therefore, construction of a feasible model including economic variables as well as political and policy variables was a central concern for the researcher.

The second problem of assessing the consequences of energy policies is that energy policy is fundmental to all social policy making and that many of the most important areas of government policy are directly affected by the choice of energy policy (Hooker et al., 1981, p. 13). How to define or operationalize the wide variety of policy and political variables as well as the socio-economic variables was another major concern. This problem seems to bear out the earlier statement by George D. Greenberg et al., that "tests of major hypotheses in the public policy literature were impossible to conduct because it was impossible to operationalize the policy variables" (Greenberg et al., 1977, pp. 1532-43).

Despite these obstacles, the researcher presented five multiple regression models for assessing the consequences of energy policies in this dissertaion. Using energy demand, supply, productivity, domestic oil prices, and economic growth as dependent variables, an attempt was made to assess the significance of various independent variables on policy outcomes. Several significant findings were made. First, it was found that the energy crises, a political variable in these models, was much more significant than the energy policies enacted by the state on policy outcomes. Economics rather than governmental policy was shown to be the dominant factor controlling the major outcomes in both countries.

Secondly, although it was difficult to measure the success of governmental policies to improve energy efficiency in the nations, energy efficiency or productivity was improved in both countries. Japan was much more successful in this effort than the ROC. Improvement in energy efficiency of various economic sectors came about largely because of the economic pressure caused by increased prices. People began to find ways of conserving the high priced energy. But governmental programs, although the model was not sophisticated enough to show this, were influential in bringing about the use of more energy efficient machinery and in steering the economy away from energy-intensive industry toward high tech and low energy industries. Both nations also established high-energy types of industries essential to their economies such as steel, fertilizer, and petrochemical in other energy rich countries a national subsidaries or joint ventures. Thus ensuring that they would have the essential products without increasing national demands for energy. Again, Japan was more successful in these efforts than the ROC.

Thirdly, energy demand in both nations, as might be expected because of the export-oriented economy, continued to increase despite the increase in energy prices. Japan's total energy demand dropped dramatically after the 1973 and 1979 huge oil price increases, but increased after the crisis had passed. Demand in the ROC did not show the dramatic decrease as a result of oil price increases, but continued to grow throughout the entire period. In the years since the second oil crisis, the increase in total energy demand has not been as rapid as before the crisis. From the total energy demand model, it was found that the socio-economic factors, such population, GDP, and OPEC oil prices had a significant impact in effecting energy demand in the ROC alone. Energy policies, however, did not appear to be significant factors effecting energy demand in either country. Despite these findings, such energy policies as those in Japan steering the economy away from energy-intensive industries to technology-intensive industries seem to be major determinants which the researcher was not able to identify. ROC as a result of its need to continue development to employ its large labor force continued to encourage the building of energy-intensive industries such steel and cement industries long after the first oil crisis.

Fourthly, energy supply in both countries has been diversified since the first energy crisis. The components of Japan's energy sources has changed quite dramatically. In 1975, 73 per cent of energy was oil, whereas oil represented 62 per cent of total energy supply in 1983; nuclear power increased in this same period from 2 to 7 per cent; LNG from 2 to 8 per cent and coal from 16 to 18 per cent (Quo, 1986, p. 170). A somewhat similar picture is found in the ROC. Oil represented 67 per cent of total energy in 1975 and 62 per cent in 1983. Nuclear power, which not introduced until 1977, in 1983 produced 15 per cent of total energy. LNG decreased from 10 per cent in 1973 to 5 per cent in 1983, and coal increased from 15 per cent to 18 per cent in the same period (Liang, 1986, p. 115). The ratio of domestic and foreign energy has decreased in the ROC over the past 16 year period large because of continuing economic growth and the reduction in domestic natural gas supplies. In Japan, this ratio does not change largely over this period since increasing oil and gas production has occurred as total demand has grown.

Energy supply continued to increase to meet the demands of the growing economies. The ROC with the exception of a decrease in 1973 has experienced a steady growth in supply, from 12.5 million tons of oil equivalent (MTOE) in 1973 to 37.5 MTOE in 1985 (Taiwan Energy Statistics, 1986; Energy Balance in Taiwan, 1985). Japan's energy supply decreased dramatically from 1974 to 1975 and again from 1979 to 1982. In the peak years of 1979, Japan total energy supply was 390 MTOE. After decreasing to only 350 MTOE in 1982, the supply has increased to 382 MTOE in 1984 (Energy Balance of OECD Countries, 1983; IEA/OECD Energy Balance and IEA Country Submission, 1985). It is not clear why Japan's energy supply has fluctuated over the period. In part, it may reflect Japan's success in promoting energy conservation and its success in steering the economy toward less-energy intensive and high technological industries.

Finally, from the assessment models, it was found that domestic oil prices in both countries were significantly effected only by international oil prices. Energy policies did not have a significant effect on domestic oil prices. Similarly, economic growth was not significantly effected by energy policies in either country.

Significance of Comparative Study on Energy Policy

Despite the fact that there is no agreed upon conceptual framework for undertaking comparative policy studies among nations, the researcher believes that the study demonstrates the value of such studies (Schneider & Ingram, 1987). There are a number of insights which would not have been evident if the study had been a policy study only of a single nation. First, the importance of ideology on policy making would not have been as evident, and this obviously is a major difference. Also, the differences in the policy processes in these two countries, such as the role of the party, bureaucracy, and corporate interest was evident because of the comparative nature of the study.

The comparative nature of study also forced the researcher to search for reasons for policies being different in the two countries. Similar the comparative nature of the study helped to explain the differences in the energy policies made in these two countries. In turn, the researcher was able to consider the domestic and international environmental aspects which empowered the nation to undertake certain policies. Without a comparative approach, international forces and politics influencing the nation's domestic policy system might well be overlooked. Despite the problems of linking domestic and international politics in the policy studies, such a linkage is essential if one is to identifiy and assess the impact of the wide varity of socio-economic, political, and policy factors affecting the policy area.

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APPENDIX A:
REGRESSION MODELS FOR ASSESSING ENERGY POLICY CONSEQUENCES IN THE REPUBLIC OF CHINA

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1          SAS(R) LOG    OS SAS 5.16          VS2/MVS JOB IC55SAS   STEP SAS                         9:23 SUNDAY, AUGUST 2, 1987

NOTE: COPYRIGHT (C) 1984,1986 SAS INSTITUTE INC., CARY, N.C.  27511, U.S.A.
NOTE: THE JOB IC55SAS HAS BEEN RUN UNDER RELEASE 5.16 OF SAS AT NORTH TEXAS STATE UNIVERSITY (02152001).

NOTE: CPUID   VERSION = FF  SERIAL = 110003  MODEL = 3033 .

NOTE: SAS OPTIONS SPECIFIED ARE:
       SORT=5

 *** Welcome to SAS516 at North Texas State University ***

1           DATA ALL;
2             INPUT TED 1-8 TES 9-16 DOP 17-24 POP 25-32 LOF 33-40
3                   OPECP 41-48 GDP 49-56
4                   #2 IDU 1-8 TPU 9-16 RDU 17-24 CMU 25-32 CIS 33-40
5                   DFR 41-48
6                   #3 EPP 1-8 EGR 9-16 EDF 17-24 CPI 25-32 EC 33-40
7                   EP 41-48
8                   #4 EG 1-8 PGR 9-16 EIR 17-24 IPI 25-32 API 33-40
9                   LGR 41-48 T 49-56;
10          LABEL TED=TOTAL ENERGY DEMAND (Mtoe)
11                TES=TOTAL ENERGY SUPPLY (Mtoe)
12                DOP=DOMESTIC OIL PRICES (US$)
13                POP=POPULATION (In thousands)
14                LOF=LABOR FORCE (In thousands)
15                OPECP=OPEC OIL PRICES (US$/bbl)
16                GDP=GROSS DOMESTIC PRODUCT
17                IDU=INDUSTRY USE
18                TPU=TRANSPORT USE
19                RDU=RESIDENTIAL USE
20                CMU=COMMERCIAL USE
21                CIS=CHANGE IN STOCKS
22                DFR=DOMESTIC/FOREIGN RATIO
23                EPP=ENERGY PROD (GDP/Mtoe)
24                EGR=ENERGY/GDP RATIO
25                EDF=PERCENTAGE DEP ON OIL
26                CPI=CONSUMER PRICE INDEX
27                EC=ENERGY CRISES
28                EP=ENERGY POLICY
29                EG=ECONOMIC GROWTH (GDP/POP)
30                PGR=POPULATION GROWTH RATE
31                EIR=EXPORTS/IMPORTS RATIO
32                IPI=INDUSTRIAL PROD INDEX
33                API=AGRICULTURAL PROD INDEX
34                LGR=LABOR GROWTH RATE
35                T=TIME;
36          CARDS;

NOTE: DATA SET WORK.ALL HAS 16 OBSERVATIONS AND 26 VARIABLES. 220 OBS/TRK.
NOTE: THE DATA STATEMENT USED 0.68 SECONDS AND 100K.

101         PROC PRINT;
NOTE: THE PROCEDURE PRINT USED 0.98 SECONDS AND 224K AND PRINTED PAGE 1.

102         PROC CORR;
NOTE: THE PROCEDURE CORR USED 1.15 SECONDS AND 216K AND PRINTED PAGES 2 TO 7.
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103          PROC PLOT;
104             PLOT TED*T;
NOTE: THE PROCEDURE PLOT USED 1.02 SECONDS AND 208K AND PRINTED PAGE 8.

105          PROC PLOT;
106             PLOT TES*T;
NOTE: THE PROCEDURE PLOT USED 1.02 SECONDS AND 208K AND PRINTED PAGE 9.

107          PROC PLOT;
108             PLOT EPP*T;
NOTE: THE PROCEDURE PLOT USED 1.02 SECONDS AND 208K AND PRINTED PAGE 10.

109          PROC PLOT;
110             PLOT DOP*T;
NOTE: THE PROCEDURE PLOT USED 1.02 SECONDS AND 208K AND PRINTED PAGE 11.

111          PROC PLOT;
112             PLOT EG*T;
NOTE: THE PROCEDURE PLOT USED 1.02 SECONDS AND 208K AND PRINTED PAGE 12.

113          PROC REG;
114             MODEL TED=POP OPECP GDP EP/DW;
NOTE: ACOV AND SPEC OPTION ONLY VALID WITH RAWDATA
NOTE: THE PROCEDURE REG USED 1.09 SECONDS AND 436K AND PRINTED PAGE 13.

115          PROC REG;
116             MODEL TES=OPECP DFR EIR EDF EP/DW;
NOTE: ACOV AND SPEC OPTION ONLY VALID WITH RAWDATA
NOTE: THE PROCEDURE REG USED 1.08 SECONDS AND 436K AND PRINTED PAGE 14.

117          PROC REG;
118             MODEL EPP=IDU TPU CMU RDU EC EP/DW;
NOTE: ACOV AND SPEC OPTION ONLY VALID WITH RAWDATA
NOTE: THE PROCEDURE REG USED 1.08 SECONDS AND 436K AND PRINTED PAGE 15.

119          PROC REG;
120             MODEL DOP=OPECP EDF/DW;
NOTE: ACOV AND SPEC OPTION ONLY VALID WITH RAWDATA
NOTE: THE PROCEDURE REG USED 1.08 SECONDS AND 436K AND PRINTED PAGE 16.

121          PROC REG;
122             MODEL GDP=IPI EIR CPI LGR EC EP/DW;
NOTE: ACOV AND SPEC OPTION ONLY VALID WITH RAWDATA
NOTE: THE PROCEDURE REG USED 1.08 SECONDS AND 436K AND PRINTED PAGE 17.
NOTE: SAS USED 436K MEMORY.

NOTE: SAS INSTITUTE INC.
      SAS CIRCLE
      PO BOX 8000
      CARY, N.C. 27511-8000
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SAS

OBS	TED	TES	DOP	POP	LOF	OPECP	GDP	IDU	TPU	RDU	CMU	CIS
1	10.72	11.93	0.049	14676	4654	2.08	13.79	5.21	0.92	1.13	0.25	1.64
2	11.67	13.32	0.050	14995	4819	2.48	16.47	6.91	1.04	1.20	0.30	1.25
3	13.13	18.96	0.050	15289	5022	2.81	18.55	8.13	1.26	1.40	0.30	-3.78
4	15.18	12.83	0.050	15565	5395	6.43	21.78	8.75	1.59	1.64	0.35	2.80
5	14.87	16.10	0.055	15852	5571	10.08	20.93	8.70	1.72	1.80	0.35	-1.02
6	15.13	15.89	0.068	16150	5656	12.15	23.14	9.26	2.01	2.07	0.40	0.06
7	20.05	21.55	0.068	16508	5772	12.09	24.36	10.79	2.38	2.41	0.48	-0.61
8	21.91	23.53	0.068	16813	6087	13.27	21.52	11.90	2.66	2.62	0.53	-0.83
9	25.51	27.28	0.065	17136	6333	13.17	26.19	14.02	3.15	3.03	0.62	-1.72
10	26.45	28.74	0.070	17479	6507	25.26	32.29	15.38	3.54	3.26	0.69	-1.85
11	30.35	31.51	0.086	17805	6629	34.09	40.06	16.19	3.81	3.45	0.73	-1.35
12	29.17	31.55	0.091	18136	6764	36.44	46.24	15.13	3.86	3.56	0.75	-0.55
13	28.07	31.32	0.091	18458	6959	34.08	46.76	15.30	4.03	3.65	0.79	-1.47
14	28.66	35.42	0.086	18733	7266	30.96	49.80	16.72	4.44	4.08	0.88	-1.36
15	29.43	37.99	0.086	19012	7491	29.01	56.33	17.49	4.92	4.37	0.95	-1.29
16	30.12	39.27	0.084	19258	7651	27.72	59.12	17.74	5.14	4.69	1.02	-1.14

OBS	DFR	EPP	EGR	EDF	CPI	EC	EP	EG	PGR	EIR	IPI	API	LGR	T
1	0.69	0.8921	0.778	0.42	31.90	0	0	3.80	2.23	0.97	33.52	80.2	3.65	70
2	0.57	0.9177	0.709	0.48	32.80	0	0	4.10	2.17	1.12	40.33	80.6	3.55	71
3	0.44	0.9276	0.708	0.82	33.78	0	0	4.12	1.96	1.19	47.14	82.4	4.21	72
4	0.75	0.9513	0.697	0.68	36.54	1	0	4.41	1.81	1.18	53.95	84.6	7.43	73
5	0.55	0.9872	0.710	0.74	53.89	1	1	4.37	1.84	0.81	60.76	86.2	3.26	74
6	0.59	1.0165	0.654	0.74	56.71	1	1	4.53	1.88	0.89	67.57	85.2	1.53	75
7	0.37	0.8723	0.823	0.85	58.13	0	1	4.59	2.22	1.07	74.38	93.7	2.05	76
8	0.34	0.8786	1.018	0.86	62.22	0	1	4.78	1.85	1.10	81.19	97.5	5.46	77
9	0.32	0.8789	0.974	0.63	65.81	0	1	5.11	1.92	1.15	88.00	95.7	4.04	78
10	0.36	0.9369	0.819	0.80	72.23	1	1	5.36	2.00	1.09	93.00	100.7	2.75	79
11	0.34	0.8507	0.758	0.79	100.00	1	1	5.57	1.87	1.00	100.00	100.7	1.87	80
12	0.37	0.8834	0.631	0.74	116.30	0	1	5.79	1.86	1.18	103.40	100.0	2.04	81
13	0.27	0.9572	0.600	0.78	119.80	0	1	5.84	1.78	1.18	103.10	101.0	2.88	82
14	0.14	1.0245	0.576	0.66	121.40	0	1	5.89	1.49	1.24	117.20	102.6	4.41	83
15	0.12	1.1056	0.522	0.63	124.50	0	1	5.96	1.49	1.39	130.00	104.5	3.10	84
16	0.13	1.2055	0.509	0.56	130.00	0	1	6.03	1.30	1.53	134.00	106.6	2.14	85

VARIABLE	N	MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
TED	16	21.90125000	7.37752793	350.4200000	10.72000000	30.35000000
TES	16	24.82437500	9.28428850	397.1900000	11.93000000	39.27000000
DOP	16	0.06981250	0.01580809	1.1170000	0.04900000	0.09100000
POP	16	16991.56250000	1487.41977795	271865.0000000	14676.00000000	19258.00000000
LOF	16	6161.00000000	941.44477622	98576.0000000	4654.00000000	7651.00000000
OPECP	16	18.25750000	12.46138435	292.1200000	2.08000000	36.44000000
GDP	16	32.33312500	15.03180438	517.3300000	13.79000000	59.12000000
IDU	16	12.35125000	4.11957259	197.6200000	5.21000000	17.74000000
TPU	16	2.90437500	1.39681050	46.4700000	0.92000000	5.14000000
RDU	16	2.77250000	1.15534410	44.3600000	1.13000000	4.69000000
CMU	16	0.58687500	0.25104365	9.3900000	0.25000000	1.02000000
CIS	16	-0.70125000	1.55129140	-11.2200000	-3.78000000	2.80000000
DFR	16	0.39687500	0.19119689	6.3500000	0.12000000	0.75000000
EPP	16	0.95537500	0.09521723	15.2860000	0.85070000	1.20550000
EGR	16	0.71787500	0.14387442	11.4860000	0.50900000	1.01800000
EDF	16	0.69875000	0.12909299	11.1800000	0.42000000	0.86000000
CPI	16	76.00062500	36.59402546	1216.0100000	31.90000000	130.00000000
EC	16	0.31250000	0.47871355	5.0000000	0.00000000	1.00000000
EP	16	0.75000000	0.44721360	12.0000000	0.00000000	1.00000000
EG	16	5.01562500	0.76480036	80.2500000	3.80000000	6.03000000
PGR	16	1.85437500	0.25724097	29.6700000	1.30000000	2.23000000
EIR	16	1.13062500	0.17509878	18.0900000	0.81000000	1.53000000
IPI	16	82.97125000	31.00851622	1327.5400000	33.52000000	134.00000000
API	16	93.88750000	9.17960602	1502.2000000	80.20000000	106.60000000
LGR	16	3.39812500	1.51778882	54.3700000	1.53000000	7.43000000
T	16	77.50000000	4.76095229	1240.0000000	70.00000000	85.00000000

PEARSON CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 16

	TED	TES	DOP	POP	LOF	OPECP	GDP	IDU	TPU	RDU	CMU
TED TOTAL ENERGY DEMAND (Mtoe)	1.00000 0.0000	0.95715 0.0001	0.92317 0.0001	0.96007 0.0001	0.95206 0.0001	0.93482 0.0001	0.88396 0.0001	0.98570 0.0001	0.96471 0.0001	0.96204 0.0001	0.95207 0.0001
TES TOTAL ENERGY SUPPLY (Mtoe)	0.95715 0.0001	1.00000 0.0000	0.89515 0.0001	0.97475 0.0001	0.96602 0.0001	0.88382 0.0001	0.93739 0.0001	0.97445 0.0001	0.98079 0.0001	0.98012 0.0001	0.98192 0.0001
DOP DOMESTIC OIL PRICES (US$)	0.92317 0.0001	0.89515 0.0001	1.00000 0.0000	0.93644 0.0001	0.91043 0.0001	0.96742 0.0001	0.90007 0.0001	0.90203 0.0001	0.91878 0.0001	0.91587 0.0001	0.90581 0.0001
POP POPULATION (In thousands)	0.96007 0.0001	0.97475 0.0001	0.93644 0.0001	1.00000 0.0000	0.99608 0.0001	0.91834 0.0001	0.95924 0.0001	0.97777 0.0001	0.99572 0.0001	0.99552 0.0001	0.99088 0.0001
LOF LABOR FORCE (In thousands)	0.95206 0.0001	0.96602 0.0001	0.91043 0.0001	0.99608 0.0001	1.00000 0.0000	0.89711 0.0001	0.95094 0.0001	0.97701 0.0001	0.99435 0.0001	0.99469 0.0001	0.98777 0.0001
OPECP OPEC OIL PRICES (US$/bbl)	0.93482 0.0001	0.88382 0.0001	0.96742 0.0001	0.91834 0.0001	0.89711 0.0001	1.00000 0.0000	0.89270 0.0001	0.91192 0.0001	0.90820 0.0001	0.89916 0.0001	0.89411 0.0001
GDP GROSS DOMESTIC PRODUCT	0.88396 0.0001	0.93739 0.0001	0.90007 0.0001	0.95924 0.0001	0.95094 0.0001	0.89270 0.0001	1.00000 0.0000	0.91158 0.0001	0.95738 0.0001	0.95253 0.0001	0.96583 0.0001
IDU INDUSTRY USE	0.98570 0.0001	0.97445 0.0001	0.90203 0.0001	0.97777 0.0001	0.97701 0.0001	0.91192 0.0001	0.91158 0.0001	1.00000 0.0000	0.98371 0.0001	0.98122 0.0001	0.97439 0.0001
TPU TRANSPORT USE	0.96471 0.0001	0.98079 0.0001	0.91878 0.0001	0.99572 0.0001	0.99435 0.0001	0.90820 0.0001	0.95738 0.0001	0.98371 0.0001	1.00000 0.0000	0.99911 0.0001	0.99664 0.0001
RDU RESIDENTIAL USE	0.96204 0.0001	0.98012 0.0001	0.91587 0.0001	0.99552 0.0001	0.99469 0.0001	0.89916 0.0001	0.95253 0.0001	0.98122 0.0001	0.99911 0.0001	1.00000 0.0000	0.99568 0.0001
CMU COMMERCIAL USE	0.95207 0.0001	0.98192 0.0001	0.90581 0.0001	0.99088 0.0001	0.98777 0.0001	0.89411 0.0001	0.96583 0.0001	0.97439 0.0001	0.99664 0.0001	0.99568 0.0001	1.00000 0.0000
CIS CHANGE IN STOCKS	-0.44428 0.0847	-0.54209 0.0301	-0.37424 0.1533	-0.43017 0.0963	-0.41575 0.1092	-0.36512 0.1644	-0.33352 0.2068	-0.47994 0.0599	-0.41875 0.1064	-0.42226 0.1032	-0.40010 0.1246
DFR DOMESTIC/FOREIGN RATIO	-0.85325 0.0001	-0.94265 0.0001	-0.79603 0.0002	-0.89530 0.0001	-0.88395 0.0001	-0.73667 0.0011	-0.82682 0.0001	-0.88599 0.0001	-0.89293 0.0001	-0.89866 0.0001	-0.89830 0.0001
EPP ENERGY PROD (GDP/Mtoe)	0.26355 0.3240	0.44493 0.0842	0.29609 0.2655	0.49280 0.0524	0.52611 0.0363	0.25507 0.3404	0.60384 0.0132	0.38917 0.1363	0.49768 0.0498	0.50246 0.0473	0.52349 0.0374
EGR ENERGY/GDP RATIO	-0.24145 0.3676	-0.38002 0.1465	-0.41920 0.1060	-0.43183 0.0949	-0.42072 0.1046	-0.42438 0.1013	-0.64655 0.0068	-0.31390 0.2364	-0.41563 0.1094	-0.40399 0.1207	-0.44497 0.0842
EDF PERCENTAGE DEP ON OIL	0.24038 0.3698	0.13990 0.6053	0.24718 0.3560	0.16597 0.5390	0.15830 0.5582	0.24774 0.3549	0.00660 0.9807	0.22260 0.4073	0.12367 0.6482	0.12464 0.6456	0.06488 0.8113
CPI CONSUMER PRICE INDEX	0.91798 0.0001	0.94265 0.0001	0.95845 0.0001	0.97381 0.0001	0.95994 0.0001	0.94030 0.0001	0.97759 0.0001	0.92346 0.0001	0.96302 0.0001	0.96027 0.0001	0.96322 0.0001

PEARSON CORRELATION COEFFICIENTS / PROB > !R! UNDER H0:RHO=0 / N = 16

	TED	TES	DOP	POP	LOF	OPECP	GDP	IDU	TPU	RDU	CMU
EC ENERGY CRISES	-0.14207 0.5997	-0.28577 0.2833	-0.17674 0.5126	-0.19725 0.4640	-0.15488 0.5668	-0.03663 0.8929	-0.21740 0.4186	-0.11751 0.6647	-0.18463 0.4936	-0.19798 0.4623	-0.22987 0.3918
EP ENERGY POLICY	0.74571 0.0009	0.67850 0.0039	0.75676 0.0007	0.74577 0.0009	0.75276 0.0008	0.70855 0.0021	0.58255 0.0179	0.73838 0.0011	0.72651 0.0014	0.73804 0.0011	0.68139 0.0037
EG ECONOMIC GROWTH (GDP/POP)	0.97078 0.0001	0.96325 0.0001	0.94357 0.0001	0.98932 0.0001	0.98212 0.0001	0.95027 0.0001	0.95699 0.0001	0.97979 0.0001	0.98563 0.0001	0.98149 0.0001	0.98108 0.0001
PGR POPULATION GROWTH RATE	-0.63075 0.0088	-0.72946 0.0013	-0.60538 0.0130	-0.77261 0.0005	-0.80452 0.0002	-0.58999 0.0161	-0.81275 0.0001	-0.71253 0.0020	-0.76712 0.0005	-0.76890 0.0005	-0.77537 0.0004
EIR EXPORTS/IMPORTS RATIO	0.54018 0.0308	0.67456 0.0042	0.43984 0.0882	0.62703 0.0093	0.62508 0.0096	0.39928 0.1255	0.69896 0.0026	0.59639 0.0148	0.64253 0.0073	0.64349 0.0072	0.68647 0.0033
IPI INDUSTRIAL PROD INDEX	0.95002 0.0001	0.97278 0.0001	0.90940 0.0001	0.99363 0.0001	0.99622 0.0001	0.88587 0.0001	0.95030 0.0001	0.97608 0.0001	0.99487 0.0001	0.99618 0.0001	0.98894 0.0001
API AGRICULTURAL PROD INDEX	0.97662 0.0001	0.96090 0.0001	0.90016 0.0001	0.96931 0.0001	0.96650 0.0001	0.89316 0.0001	0.88275 0.0001	0.97744 0.0001	0.97281 0.0001	0.97393 0.0001	0.96248 0.0001
LGR LABOR GROWTH RATE	-0.32634 0.2174	-0.34787 0.1867	-0.48368 0.0577	-0.33898 0.1990	-0.29926 0.2602	-0.43452 0.0926	-0.34738 0.1874	-0.30994 0.2427	-0.33832 0.1999	-0.34170 0.1952	-0.32463 0.2199
T TIME	0.95634 0.0001	0.97269 0.0001	0.93142 0.0001	0.99965 0.0001	0.99742 0.0001	0.91110 0.0001	0.95806 0.0001	0.97635 0.0001	0.99562 0.0001	0.99602 0.0001	0.99034 0.0001

	CIS	DFR	EPP	EGR	EDF	CPI	EC	EP	EG	PGR	EIR
TED TOTAL ENERGY DEMAND (Mtoe)	-0.44428 0.0847	-0.85325 0.0001	0.26355 0.3240	-0.24145 0.3676	0.24038 0.3698	0.91798 0.0001	-0.14207 0.5997	0.74571 0.0009	0.97078 0.0001	-0.63075 0.0088	0.54018 0.0308
TES TOTAL ENERGY SUPPLY (Mtoe)	-0.54209 0.0301	-0.94265 0.0001	0.44493 0.0842	-0.38002 0.1465	0.13990 0.6053	0.94265 0.0001	-0.28577 0.2833	0.67850 0.0039	0.96325 0.0001	-0.72946 0.0013	0.67456 0.0042
DOP DOMESTIC OIL PRICES (US$)	-0.37424 0.1533	-0.79603 0.0002	0.29609 0.2655	-0.41920 0.1060	0.24718 0.3560	0.95845 0.0001	-0.17674 0.5126	0.75676 0.0007	0.94357 0.0001	-0.60538 0.0130	0.43984 0.0882
POP POPULATION (In thousands)	-0.43017 0.0963	-0.89530 0.0001	0.49280 0.0524	-0.43183 0.0949	0.16597 0.5390	0.97381 0.0001	-0.19725 0.4640	0.74577 0.0009	0.98932 0.0001	-0.77261 0.0005	0.62703 0.0093
LOF LABOR FORCE (In thousands)	-0.41575 0.1092	-0.88395 0.0001	0.52611 0.0363	-0.42072 0.1046	0.15830 0.5582	0.95994 0.0001	-0.15488 0.5668	0.75276 0.0008	0.98212 0.0001	-0.80452 0.0002	0.62508 0.0096
OPECP OPEC OIL PRICES (US$/bbl)	-0.36512 0.1644	-0.73667 0.0011	0.25507 0.3404	-0.42438 0.1013	0.24774 0.3549	0.94030 0.0001	-0.03663 0.8929	0.70855 0.0021	0.95027 0.0001	-0.58999 0.0161	0.39928 0.1255
GDP GROSS DOMESTIC PRODUCT	-0.33352 0.2068	-0.82682 0.0001	0.60384 0.0132	-0.64655 0.0068	0.00660 0.9807	0.97759 0.0001	-0.21740 0.4186	0.58255 0.0179	0.95699 0.0001	-0.81275 0.0001	0.69896 0.0026
IDU INDUSTRY USE	-0.47994 0.0599	-0.88599 0.0001	0.38917 0.1363	-0.31390 0.2364	0.22260 0.4073	0.92346 0.0001	-0.11751 0.6647	0.73838 0.0011	0.97979 0.0001	-0.71253 0.0020	0.59639 0.0148

PEARSON CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 16

	CIS	DFR	EPP	EGR	EDF	CPI	EC	EP	EG	PGR	EIR
TPU TRANSPORT USE	-0.41875 0.1064	-0.89293 0.0001	0.49768 0.0498	-0.41563 0.1094	0.12367 0.6482	0.96302 0.0001	-0.18463 0.4936	0.72651 0.0014	0.98563 0.0001	-0.76712 0.0005	0.64253 0.0073
RDU RESIDENTIAL USE	-0.42226 0.1032	-0.89866 0.0001	0.50246 0.0473	-0.40399 0.1207	0.12464 0.6456	0.96027 0.0001	-0.19798 0.4623	0.73804 0.0011	0.98149 0.0001	-0.76890 0.0005	0.64349 0.0072
CMU COMMERCIAL USE	-0.40010 0.1246	-0.89830 0.0001	0.52349 0.0374	-0.44497 0.0842	0.06488 0.8113	0.96322 0.0001	-0.22987 0.3918	0.68139 0.0037	0.98108 0.0001	-0.77537 0.0004	0.68647 0.0033
CIS CHANGE IN STOCKS	1.00000 0.0000	0.65883 0.0055	-0.09058 0.7387	-0.00586 0.9828	-0.51331 0.0420	-0.36852 0.1602	0.19267 0.4747	-0.45309 0.0780	-0.39970 0.1251	0.26467 0.3219	-0.19833 0.4615
DFR DOMESTIC/FOREIGN RATIO	0.65883 0.0055	1.00000 0.0000	-0.42594 0.1000	0.27353 0.3053	-0.18627 0.4897	-0.84414 0.0001	0.44112 0.0872	-0.67247 0.0043	-0.85201 0.0001	0.66041 0.0054	-0.65270 0.0061
EPP ENERGY PROD (GDP/Mtoe)	-0.09058 0.7387	-0.42594 0.1000	1.00000 0.0000	-0.73063 0.0013	-0.29949 0.2598	0.49475 0.0514	-0.05013 0.8537	0.20791 0.4397	0.43226 0.0945	-0.80514 0.0002	0.58814 0.0166
EGR ENERGY/GDP RATIO	-0.00586 0.9828	0.27353 0.3053	-0.73063 0.0013	1.00000 0.0000	0.27562 0.3015	-0.55142 0.0268	0.04707 0.8626	-0.02124 0.9378	-0.44043 0.0877	0.60266 0.0135	-0.45805 0.0744
EDF PERCENTAGE DEP ON OIL	-0.51331 0.0420	-0.18627 0.4897	-0.29949 0.2598	0.27562 0.3015	1.00000 0.0000	0.08291 0.7602	0.27644 0.3000	0.45613 0.0758	0.15612 0.5637	0.03390 0.9008	-0.21438 0.4253
CPI CONSUMER PRICE INDEX	-0.36852 0.1602	-0.84414 0.0001	0.49475 0.0514	-0.55142 0.0268	0.08291 0.7602	1.00000 0.0000	-0.23075 0.3899	0.68838 0.0032	0.97189 0.0001	-0.76191 0.0006	0.58689 0.0169
EC ENERGY CRISES	0.19267 0.4747	0.44112 0.0872	-0.05013 0.8537	0.04707 0.8626	0.27644 0.3000	-0.23075 0.3899	1.00000 0.0000	0.07785 0.7744	-0.15261 0.5726	0.06936 0.7985	-0.54331 0.0296
EP ENERGY POLICY	-0.45309 0.0780	-0.67247 0.0043	0.20791 0.4397	-0.02124 0.9378	0.45613 0.0758	0.68838 0.0032	0.07785 0.7744	1.00000 0.0000	0.70803 0.0021	-0.43607 0.0913	0.05321 0.8448
EG ECONOMIC GROWTH (GDP/POP)	-0.39970 0.1251	-0.85201 0.0001	0.43226 0.0945	-0.44043 0.0877	0.15612 0.5637	0.97189 0.0001	-0.15261 0.5726	0.70803 0.0021	1.00000 0.0000	-0.74146 0.0010	0.60677 0.0127
PGR POPULATION GROWTH RATE	0.26467 0.3219	0.66041 0.0054	-0.80514 0.0002	0.60266 0.0135	0.03390 0.9008	-0.76191 0.0006	0.06936 0.7985	-0.43607 0.0913	-0.74146 0.0010	1.00000 0.0000	-0.66462 0.0050
EIR EXPORTS/IMPORTS RATIO	-0.19833 0.4615	-0.65270 0.0061	0.58814 0.0166	-0.45805 0.0744	-0.21438 0.4253	0.58689 0.0169	-0.54331 0.0296	0.05321 0.8448	0.60677 0.0127	-0.66462 0.0050	1.00000 0.0000
IPI INDUSTRIAL PROD INDEX	-0.42710 0.0989	-0.89928 0.0001	0.52971 0.0348	-0.41546 0.1095	0.15381 0.5695	0.95542 0.0001	-0.17774 0.5102	0.75450 0.0007	0.97435 0.0001	-0.79367 0.0002	0.63883 0.0077
API AGRICULTURAL PROD INDEX	-0.44929 0.0808	-0.89478 0.0001	0.35527 0.1769	-0.23375 0.3836	0.25697 0.3367	0.91177 0.0001	-0.18262 0.4984	0.77543 0.0004	0.95486 0.0001	-0.66908 0.0046	0.57897 0.0188
LGR LABOR GROWTH RATE	0.34182 0.1950	0.32576 0.2182	-0.13627 0.6148	0.27884 0.2956	-0.07698 0.7769	-0.39722 0.1276	-0.01382 0.9595	-0.51539 0.0410	-0.32687 0.2166	-0.01815 0.9468	0.09889 0.7156
T TIME	-0.42831 0.0979	-0.89460 0.0001	0.50745 0.0448	-0.43213 0.0946	0.16596 0.5390	0.97117 0.0001	-0.19013 0.4806	0.75147 0.0008	0.98640 0.0001	-0.78195 0.0003	0.62817 0.0092

PEARSON CORRELATION COEFFICIENTS / PROB > !R! UNDER HO:RHO=0 / N = 16

	IPI	API	LGR	T
TED TOTAL ENERGY DEMAND (Mtoe)	0.95002 0.0001	0.97662 0.0001	-0.32634 0.2174	0.95634 0.0001
TES TOTAL ENERGY SUPPLY (Mtoe)	0.97278 0.0001	0.96090 0.0001	-0.34787 0.1867	0.97269 0.0001
DOP DOMESTIC OIL PRICES (US$)	0.90940 0.0001	0.90016 0.0001	-0.48368 0.0577	0.93142 0.0001
POP POPULATION (In thousands)	0.99363 0.0001	0.96931 0.0001	-0.33898 0.1990	0.99965 0.0001
LOF LABOR FORCE (In thousands)	0.99622 0.0001	0.96650 0.0001	-0.29926 0.2602	0.99742 0.0001
OPECP OPEC OIL PRICES (US$/bbl)	0.88587 0.0001	0.89316 0.0001	-0.43452 0.0926	0.91110 0.0001
GDP GROSS DOMESTIC PRODUCT	0.95030 0.0001	0.88275 0.0001	-0.34738 0.1874	0.95806 0.0001
IDU INDUSTRY USE	0.97608 0.0001	0.97744 0.0001	-0.30994 0.2427	0.97635 0.0001
TPU TRANSPORT USE	0.99487 0.0001	0.97281 0.0001	-0.33832 0.1999	0.99562 0.0001
RDU RESIDENTIAL USE	0.99618 0.0001	0.97393 0.0001	-0.34170 0.1952	0.99602 0.0001
CMU COMMERCIAL USE	0.98894 0.0001	0.96248 0.0001	-0.32463 0.2199	0.99034 0.0001
CIS CHANGE IN STOCKS	-0.42710 0.0989	-0.44929 0.0808	0.34182 0.1950	-0.42831 0.0979
DFR DOMESTIC/FOREIGN RATIO	-0.89928 0.0001	-0.89478 0.0001	0.32576 0.2182	-0.89460 0.0001
EPP ENERGY PROD (GDP/Mtoe)	0.52971 0.0348	0.35527 0.1769	-0.13627 0.6148	0.50745 0.0448
EGR ENERGY/GDP RATIO	-0.41546 0.1095	-0.23375 0.3836	0.27884 0.2956	-0.43213 0.0946
EDF PERCENTAGE DEP ON OIL	0.15381 0.5695	0.25697 0.3367	-0.07698 0.7769	0.16596 0.5390
CPI CONSUMER PRICE INDEX	0.95542 0.0001	0.91177 0.0001	-0.39722 0.1276	0.97117 0.0001

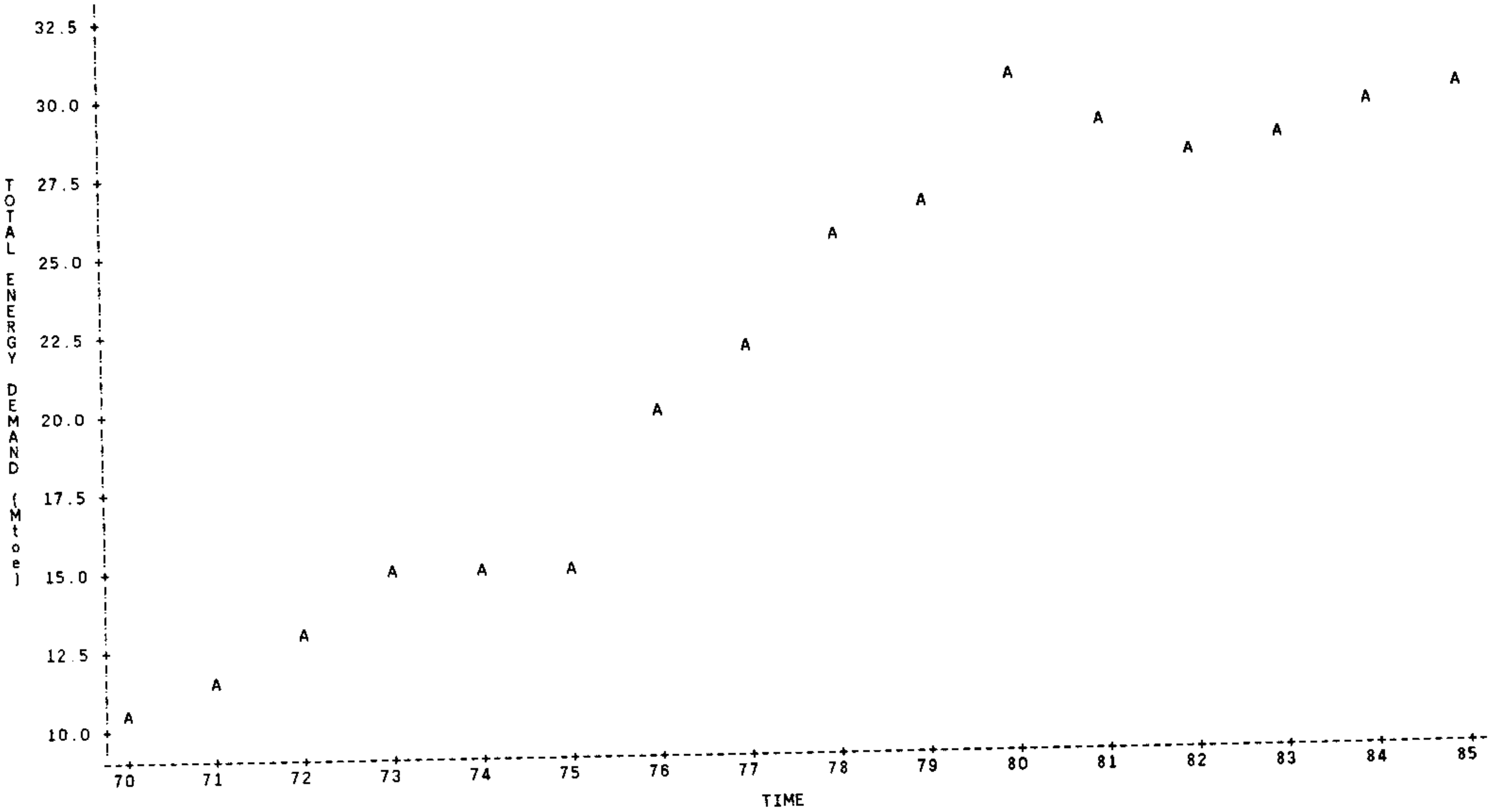
PEARSON CORRELATION COEFFICIENTS / PROB > !R! UNDER HO:RHO=0 / N = 16

	IPI	API	LGR	T
EC ENERGY CRISES	-0.17774 0.5102	-0.18262 0.4984	-0.01382 0.9595	-0.19013 0.4806
EP ENERGY POLICY	0.75450 0.0007	0.77543 0.0004	-0.51539 0.0410	0.75147 0.0008
EG ECONOMIC GROWTH (GDP/POP)	0.97435 0.0001	0.95486 0.0001	-0.32687 0.2166	0.98640 0.0001
PGR POPULATION GROWTH RATE	-0.79367 0.0002	-0.66908 0.0046	-0.01815 0.9468	-0.78195 0.0003
EIR EXPORTS/IMPORTS RATIO	0.63883 0.0077	0.57897 0.0188	0.09889 0.7156	0.62817 0.0092
IPI INDUSTRIAL PROD INDEX	1.00000 0.0000	0.96771 0.0001	-0.33477 0.2050	0.99556 0.0001
API AGRICULTURAL PROD INDEX	0.96771 0.0001	1.00000 0.0000	-0.30258 0.2547	0.96849 0.0001
LGR LABOR GROWTH RATE	-0.33477 0.2050	-0.30258 0.2547	1.00000 0.0000	-0.33863 0.1995
T TIME	0.99556 0.0001	0.96849 0.0001	-0.33863 0.1995	1.00000 0.0000

9:23 SUNDAY, AUGUST 2, 1987 8

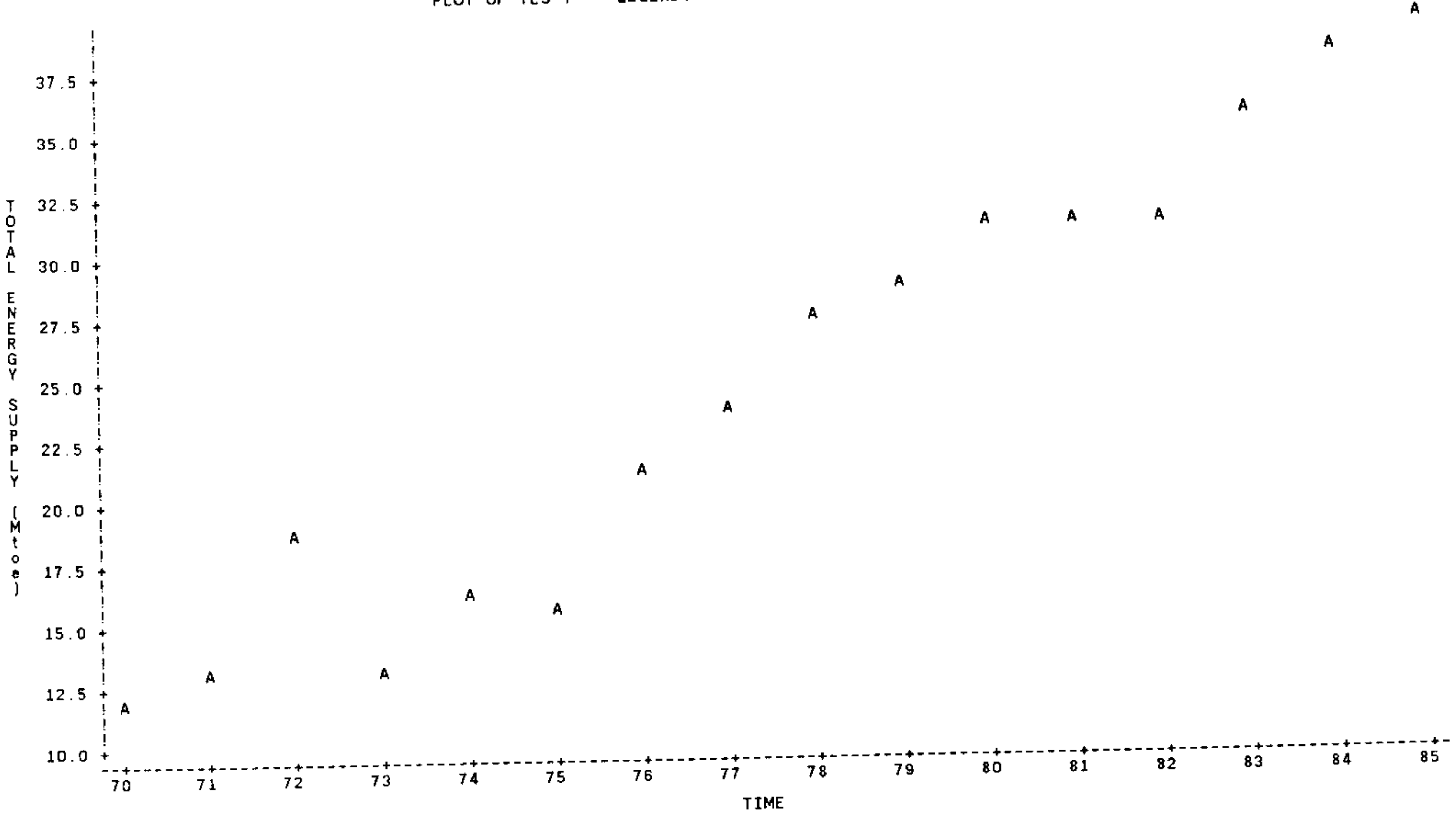
SAS

PLOT OF TED*T LEGEND: A = 1 OBS, B = 2 OBS, ETC.



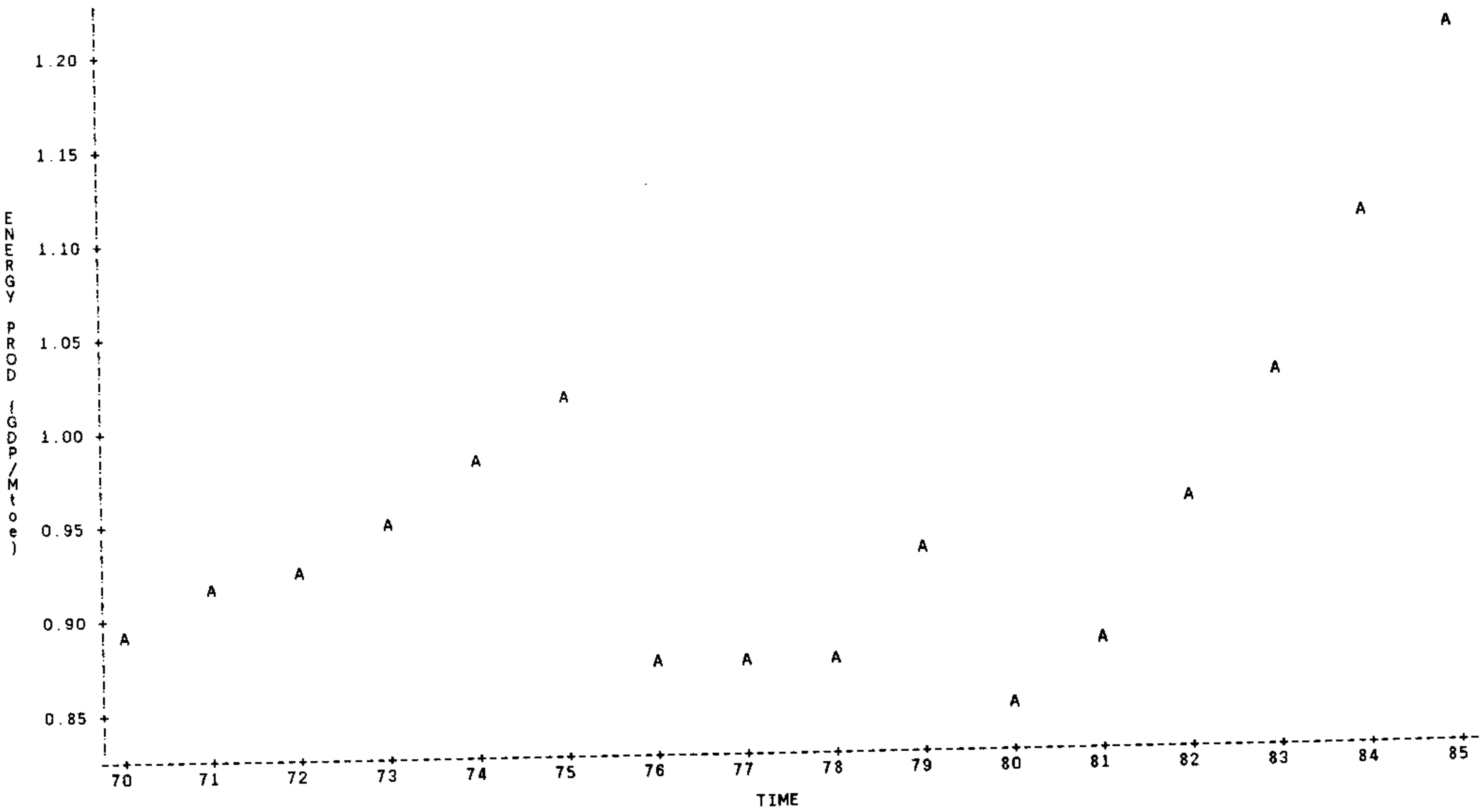
SAS

PLOT OF TES*T LEGEND: A = 1 OBS, B = 2 OBS, ETC.



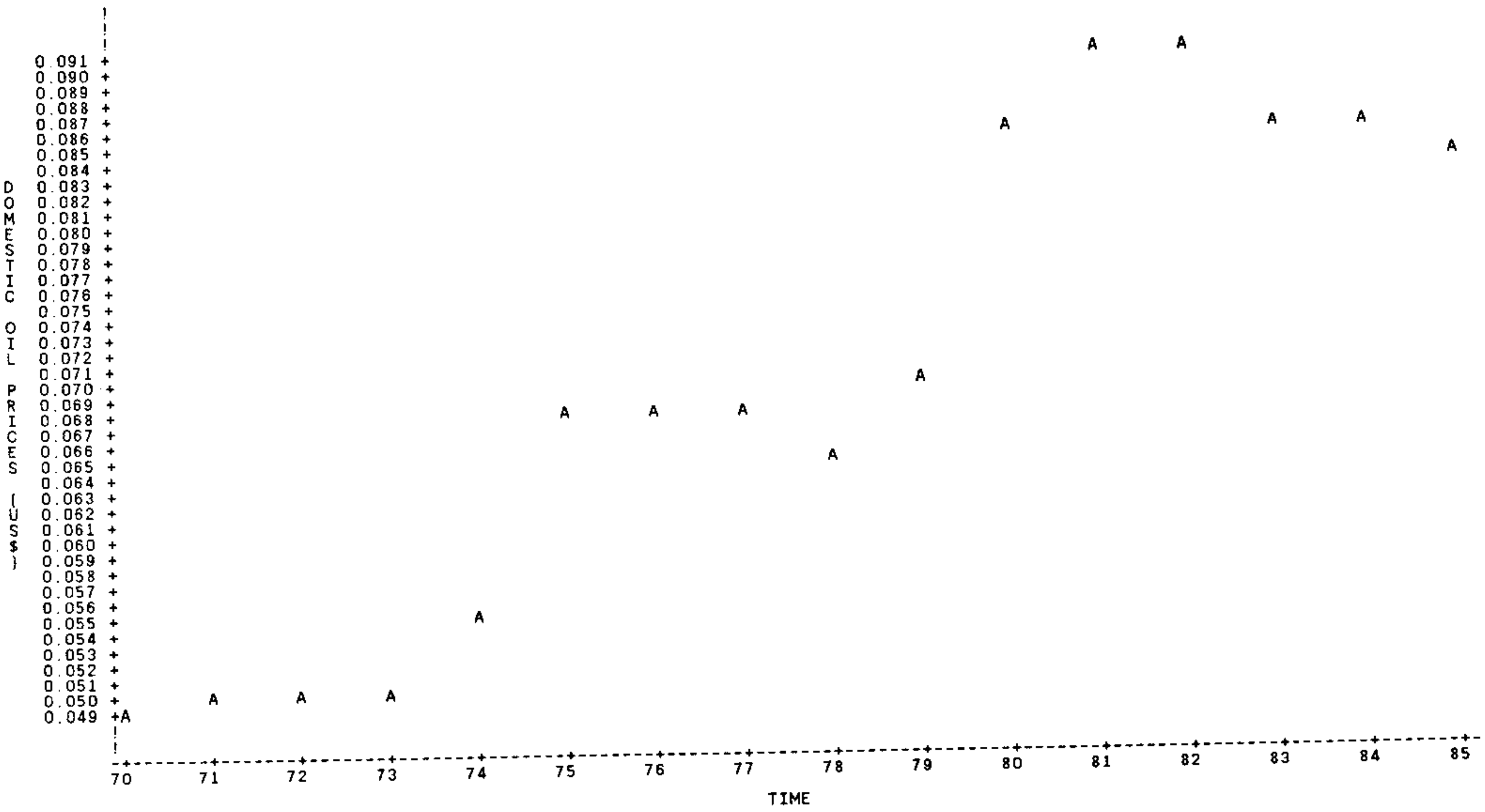
SAS

PLOT OF EPP*T LEGEND: A = 1 OBS, B = 2 OBS, ETC.

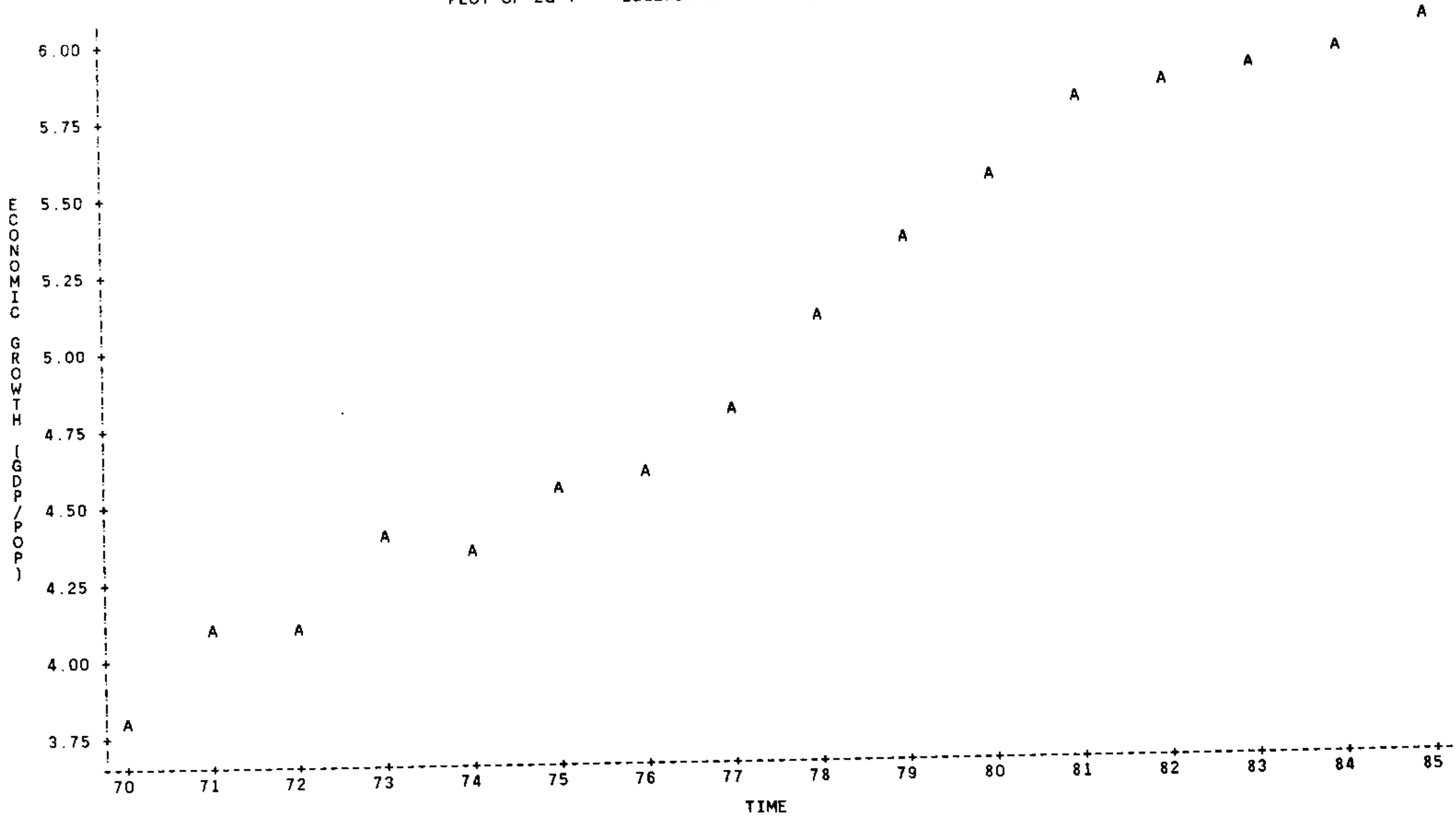


SAS

PLOT OF DOP*T LEGEND: A = 1 OBS, B = 2 OBS, ETC.



PLOT OF EG*T LEGEND: A = 1 OBS, B = 2 OBS, ETC.



DEP VARIABLE: TED TOTAL ENERGY DEMAND (Mtoe)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	4	793.59112	198.39778	95.602	0.0001
ERROR	11	22.82765343	2.07524122		
C TOTAL	15	816.41878			

ROOT MSE	1.44057	R-SQUARE	0.9720
DEP MEAN	21.90125	ADJ R-SQ	0.9619
C.V.	6.577569		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > !T!	VARIABLE LABEL
INTERCEP	1	-100.12697	21.23948503	-4.714	0.0006	INTERCEPT
POP	1	0.007915241	0.001537875	5.147	0.0003	POPULATION (In thousands)
OPECP	1	0.26182604	0.07798336	3.357	0.0064	OPEC OIL PRICES (US$/bbl)
GDP	1	-0.44588842	0.12725094	-3.504	0.0049	GROSS DOMESTIC PRODUCT
EP	1	-3.76988012	1.81148756	-2.081	0.0616	ENERGY POLICY

DURBIN-WATSON D 2.217
(FOR NUMBER OF OBS.) 16
1ST ORDER AUTOCORRELATION -0.121

DEP VARIABLE: TES TOTAL ENERGY SUPPLY (Mtoe)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	5	1273.51422	254.70284	130.912	0.0001
ERROR	10	19.45597303	1.94559730		
C TOTAL	15	1292.97019			

ROOT MSE	1.394847	R-SQUARE	0.9850
DEP MEAN	24.82437	ADJ R-SQ	0.9774
C.V.	5.618859		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > !T!	VARIABLE LABEL
INTERCEP	1	17.87223882	7.43402454	2.404	0.0371	INTERCEPT
OPECP	1	0.31502799	0.04824936	6.529	0.0001	OPEC OIL PRICES (US$/bbl)
DFR	1	-22.57300835	4.68629002	-4.817	0.0007	DOMESTIC/FOREIGN RATIO
EIR	1	9.98154298	3.90901842	2.553	0.0287	EXPORTS/IMPORTS RATIO
EDF	1	-3.33756365	3.26455829	-1.022	0.3307	PERCENTAGE DEP ON OIL
EP	1	1.60788792	1.70418184	0.943	0.3677	ENERGY POLICY

DURBIN-WATSON D	1.666
(FOR NUMBER OF OBS.)	16
1ST ORDER AUTOCORRELATION	0.145

DEP VARIABLE: EPP ENERGY PROD (GDP/Mtoe)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	6	0.10205059	0.01700843	4.510	0.0220
ERROR	9	0.03394422	0.003771580		
C TOTAL	15	0.13599481			

ROOT MSE	0.06141319	R-SQUARE	0.7504
DEP MEAN	0.955375	ADJ R-SQ	0.5840
C.V.	6.428176		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0	PROB > !T!	VARIABLE LABEL
INTERCEP	1	0.79058679	0.22926215	3.448	0.0073	INTERCEPT
IDU	1	-0.07019240	0.02432909	-2.885	0.0180	INDUSTRY USE
TPU	1	-0.42878324	0.42308857	-1.013	0.3373	TRANSPORT USE
CMU	1	1.36770880	1.51726313	0.901	0.3908	COMMERCIAL USE
RDU	1	0.53456823	0.44920349	1.190	0.2645	RESIDENTIAL USE
EC	1	0.11249801	0.04524671	2.486	0.0346	ENERGY CRISES
EP	1	-0.05709423	0.10112322	-0.565	0.5861	ENERGY POLICY

DURBIN-WATSON D	1.550
(FOR NUMBER OF OBS.)	16
1ST ORDER AUTOCORRELATION	0.115

DEP VARIABLE: DOP DOMESTIC OIL PRICES (US$)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	2	0.003508371	0.001754185	94.992	0.0001
ERROR	13	0.000240067	0.000018467		
C TOTAL	15	0.003748438			

ROOT MSE	0.004297285	R-SQUARE	0.9360
DEP MEAN	0.0698125	ADJ R-SQ	0.9261
C.V.	6.155466		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	0.04676752	0.006102745	7.663	0.0001	INTERCEPT
OPECP	1	0.001224718	0.000091904	13.326	0.0001	OPEC OIL PRICES (US$/bbl)
EDF	1	0.000979891	0.008871551	0.110	0.9137	PERCENTAGE DEP ON OIL

DURBIN-WATSON D	1.185
(FOR NUMBER OF OBS.)	16
1ST ORDER AUTOCORRELATION	0.391

DEP VARIABLE: GDP GROSS DOMESTIC PRODUCT

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	6	3372.28644	562.04774	296.844	0.0001
ERROR	9	17.04070324	1.89341147		
C TOTAL	15	3389.32714			

ROOT MSE	1.376013	R-SQUARE	0.9950
DEP MEAN	32.33312	ADJ R-SQ	0.9916
C.V.	4.255737		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > !T!	VARIABLE LABEL
INTERCEP	1	-13.94035193	6.91993481	-2.015	0.0748	INTERCEPT
IPI	1	0.07205692	0.11229354	0.642	0.5371	INDUSTRIAL PROD INDEX
EIR	1	17.23836351	8.67872921	1.986	0.0783	EXPORTS/IMPORTS RATIO
CPI	1	0.33734206	0.05052267	6.677	0.0001	CONSUMER PRICE INDEX
LGR	1	-0.65817734	0.29882465	-2.203	0.0551	LABOR GROWTH RATE
EC	1	3.71480584	1.23909065	2.998	0.0150	ENERGY CRISES
EP	1	-5.01042068	3.46908662	-1.444	0.1825	ENERGY POLICY

DURBIN-WATSON D	1.738
(FOR NUMBER OF OBS.)	16
1ST ORDER AUTOCORRELATION	0.125

APPENDIX B:
REGRESSION MODELS FOR ASSESSING ENERGY POLICY CONSEQUENCES IN JAPAN

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1         SAS(R) LOG   OS SAS 5.16         VS2/MVS JOB IC55SAS  STEP SAS                     9:24 SUNDAY, AUGUST 2, 1987

NOTE: COPYRIGHT (C) 1984,1986 SAS INSTITUTE INC., CARY, N.C.  27511, U.S.A.
NOTE: THE JOB IC55SAS HAS BEEN RUN UNDER RELEASE 5.16 OF SAS AT NORTH TEXAS STATE UNIVERSITY (02152001).

NOTE: CPUID   VERSION = FF  SERIAL = 110003  MODEL = 3033 .

NOTE: SAS OPTIONS SPECIFIED ARE:
       SORT=5

 *** Welcome to SAS516 at North Texas State University ***

1           DATA ALL;
2             INPUT TED 1-8 TES 9-16 DOP 17-24 POP 25-32 LOF 33-40
3                   OPECP 41-48 GDP 49-56
4                   #2 IDU 1-8 TPU 9-16
5                   RDU 17-24 CMU 25-32 CIS 33-40 DFR 41-48
6                   #3 EPP 1-8 EGR 9-16 EDF 17-24 CPI 25-32 EC 33-40
7                   EP 41-48
8                   #4 EG 1-8 PGR 9-16 EIR 17-24 IPI 25-32 API 33-40
9                   LGR 41-48 T 49-56;
10          LABEL TED=TOTAL ENERGY DEMAND (Mtoe)
11                TES=TOTAL ENERGY SUPPLY (Mtoe)
12                DOP=DOMESTIC OIL PRICES (US$)
13                POP=POPULATION (In thousands)
14                LOF=LABOR FORCE (In thousands)
15                OPECP=OPEC OIL PRICES (US$/bbl)
16                GDP=GROSS DOMESTIC PRODUCT
17                IDU=INDUSTRY USE
18                TPU=TRANSPORT USE
19                RDU=RESIDENTIAL USE
20                CMU=COMMERCIAL USE
21                CIS=CHANGE IN STOCKS
22                DFR=DOMESTIC/FOREIGN ENERGY RATIO
23                EPP=ENERGY PRODUCTIVITY (GDP/Mtoe)
24                EGR=ENERGY/GDP RATIO
25                EDF=PERCENTAGE DEPENDENCY ON OIL
26                CPI=CONSUMER PRICE INDEX
27                EC=ENERGY CRISES
28                EP=ENERGY POLICY
29                EG=ECONOMIC GROWTH (GDP/POP)
30                PGR=POPULATION GROWTH RATE
31                EIR=EXPORTS/IMPORTS RATIO
32                IPI=INDUSTRIAL PRODUCTION INDEX
33                API=AGRICULTURAL PRODUCTION INDEX
34                LGR=LABOR GROWTH RATE
35                T=TIME;
36          CARDS;

NOTE: DATA SET WORK.ALL HAS 16 OBSERVATIONS AND 26 VARIABLES. 220 OBS/TRK.
NOTE: THE DATA STATEMENT USED 0.69 SECONDS AND 100K.

101         PROC PRINT;
NOTE: THE PROCEDURE PRINT USED 0.97 SECONDS AND 224K AND PRINTED PAGE 1.

102         PROC CORR;
NOTE: THE PROCEDURE CORR USED 1.15 SECONDS AND 216K AND PRINTED PAGES 2 TO 7.
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103          PROC PLOT;
104            PLOT TED*T;
NOTE: THE PROCEDURE PLOT USED 1.02 SECONDS AND 208K AND PRINTED PAGE 8.

105          PROC PLOT;
106            PLOT TES*T;
NOTE: THE PROCEDURE PLOT USED 1.02 SECONDS AND 208K AND PRINTED PAGE 9.

107          PROC PLOT;
108            PLOT EPP*T;
NOTE: THE PROCEDURE PLOT USED 1.02 SECONDS AND 208K AND PRINTED PAGE 10.

109          PROC PLOT;
110            PLOT DOP*T;
NOTE: THE PROCEDURE PLOT USED 1.02 SECONDS AND 208K AND PRINTED PAGE 11.

111          PROC PLOT;
112            PLOT EG*T;
NOTE: THE PROCEDURE PLOT USED 1.02 SECONDS AND 208K AND PRINTED PAGE 12.

113          PROC REG;
114            MODEL TED=POP OPECP GDP EP/DW;
NOTE: ACOV AND SPEC OPTION ONLY VALID WITH RAWDATA
NOTE: THE PROCEDURE REG USED 1.04 SECONDS AND 436K AND PRINTED PAGE 13.

115          PROC REG;
116            MODEL TES=OPECP DFR EIR EDF EP/DW;
NOTE: ACOV AND SPEC OPTION ONLY VALID WITH RAWDATA
NOTE: THE PROCEDURE REG USED 1.03 SECONDS AND 436K AND PRINTED PAGE 14.

117          PROC REG;
118            MODEL EPP=IDU TPU CMU RDU EC EP/DW;
NOTE: ACOV AND SPEC OPTION ONLY VALID WITH RAWDATA
NOTE: THE PROCEDURE REG USED 1.03 SECONDS AND 436K AND PRINTED PAGE 15.

119          PROC REG;
120            MODEL DOP=OPECP EDF/DW;
NOTE: ACOV AND SPEC OPTION ONLY VALID WITH RAWDATA
NOTE: THE PROCEDURE REG USED 1.03 SECONDS AND 436K AND PRINTED PAGE 16.

121          PROC REG;
122            MODEL GDP=IPI EIR CPI LGR EC EP/DW;
NOTE: ACOV AND SPEC OPTION ONLY VALID WITH RAWDATA
NOTE: THE PROCEDURE REG USED 1.04 SECONDS AND 436K AND PRINTED PAGE 17.
NOTE: SAS USED 436K MEMORY.

NOTE: SAS INSTITUTE INC.
      SAS CIRCLE
      PO BOX 8000
      CARY, N.C. 27511-8000
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OBS	TED	TES	DOP	POP	LOF	OPECP	GDP	IDU	TPU	RDU	CMU	CIS
1	294.12	299.47	0.053	103720	50940	2.08	398.24	119.75	33.95	33.63	1.13	-8.82
2	309.28	308.60	0.053	105687	51263	2.48	420.13	122.86	35.43	33.72	3.01	-3.73
3	312.20	328.99	0.054	107178	51379	2.81	440.26	129.10	39.02	37.09	3.50	-3.62
4	340.43	362.38	0.054	108660	51795	6.43	479.09	142.62	44.27	39.63	3.89	-6.43
5	341.92	366.85	0.060	110158	52067	10.08	479.14	137.14	43.83	39.24	4.31	-5.54
6	328.57	346.92	0.061	111520	52230	12.15	498.77	117.64	42.33	44.62	4.84	-0.59
7	348.72	363.33	0.063	112768	52398	12.09	510.35	138.94	42.58	45.50	4.84	-2.42
8	352.63	368.41	0.063	113880	52687	13.27	537.42	136.18	44.24	46.67	5.30	-5.55
9	362.34	373.03	0.065	114920	53179	13.17	580.64	137.61	51.57	48.68	5.80	-1.01
10	377.03	393.96	0.065	115880	53457	25.26	610.43	141.82	53.32	49.58	6.24	-6.38
11	362.78	381.74	0.072	116800	54329	34.09	640.62	129.42	46.90	53.93	6.35	-4.06
12	353.84	365.46	0.078	117704	55067	36.44	666.41	119.79	46.86	54.69	6.45	2.74
13	343.66	353.72	0.080	118690	56255	34.08	686.41	114.69	46.61	52.80	6.76	1.28
14	350.77	357.88	0.087	119259	56754	30.96	697.23	113.40	54.54	28.04	19.88	2.34
15	377.23	386.94	0.092	120240	57038	29.01	706.69	120.75	75.56	29.76	21.44	2.47
16	380.76	379.64	0.122	121095	57459	28.09	716.54	122.45	76.53	30.43	22.49	3.76

OBS	DFR	EPP	EGR	EDF	CPI	EC	EP	EG	PGR	EIR	IPI	API	LGR	T
1	0.22	1.3540	0.739	0.61	44.31	0	0	3.83	1.95	0.85	59.72	89.0	0.68	70
2	0.20	1.3584	0.736	0.65	49.88	0	0	3.97	1.90	0.91	63.38	89.0	0.63	71
3	0.17	1.4102	0.709	0.67	55.45	0	0	4.10	1.41	0.97	67.04	92.0	0.23	72
4	0.13	1.4073	0.711	0.70	61.02	0	1	4.40	1.38	0.93	70.70	95.0	0.81	73
5	0.14	1.4013	0.714	0.70	66.59	1	1	4.34	1.38	0.92	74.36	100.0	0.53	74
6	0.14	1.5180	0.659	0.67	72.16	1	1	4.47	1.24	0.96	78.02	100.0	0.31	75
7	0.15	1.4635	0.683	0.66	77.71	1	1	4.53	1.12	1.04	81.68	100.0	0.32	76
8	0.14	1.5240	0.656	0.67	83.30	0	1	4.72	0.99	1.14	85.34	99.2	0.55	77
9	0.15	1.6025	0.624	0.66	88.80	0	1	5.05	0.91	1.23	89.00	96.0	0.93	78
10	0.16	1.6190	0.618	0.64	94.40	1	1	5.27	0.84	0.93	96.00	95.0	0.52	79
11	0.18	1.7659	0.566	0.60	100.00	1	1	5.48	0.79	0.92	100.00	93.0	1.63	80
12	0.19	1.8834	0.531	0.56	104.90	0	1	5.66	0.77	1.06	101.00	94.0	1.63	81
13	0.20	1.9973	0.501	0.53	107.70	0	1	5.78	0.84	1.05	103.00	94.0	2.16	82
14	0.21	1.9877	0.503	0.62	109.70	0	1	5.85	0.48	1.16	105.00	95.0	0.89	83
15	0.20	1.8733	0.534	0.60	112.10	0	1	5.88	0.82	1.25	117.00	104.0	0.50	84
16	0.22	1.8818	0.532	0.60	114.40	0	1	5.92	0.71	1.36	122.00	106.0	0.74	85

VARIABLE	N	MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
TED	16	346.0175000	24.99313092	5536.280000	294.1200000	380.7600000
TES	16	358.5825000	26.48487631	5737.320000	299.4700000	393.9600000
DOP	16	0.0701250	0.01837344	1.122000	0.0530000	0.1220000
POP	16	113634.9375000	5385.29561515	1818159.000000	103720.0000000	121095.0000000
LOF	16	53643.5625000	2217.99789506	858297.000000	50940.0000000	57459.0000000
OPECP	16	18.2806250	12.48044362	292.490000	2.0800000	36.4400000
GDP	16	566.7731250	109.77813800	9068.370000	398.2400000	716.5400000
IDU	16	127.7600000	10.04133524	2044.160000	113.4000000	142.6200000
TPU	16	48.5962500	12.10812227	777.540000	33.9500000	76.5300000
RDU	16	41.7506250	9.00566523	668.010000	28.0400000	54.6900000
CMU	16	7.8893750	6.81297240	126.230000	1.1300000	22.4900000
CIS	16	-2.2225000	3.89777116	-35.560000	-8.8200000	3.7600000
DFR	16	0.1750000	0.03119829	2.800000	0.1300000	0.2200000
EPP	16	1.6279750	0.23389521	26.047600	1.3540000	1.9973000
EGR	16	0.6260000	0.08668410	10.016000	0.5010000	0.7390000
EDF	16	0.6337500	0.04814907	10.140000	0.5300000	0.7000000
CPI	16	83.9012500	23.55957721	1342.420000	44.3100000	114.4000000
EC	16	0.3125000	0.47871355	5.000000	0.0000000	1.0000000
EP	16	0.8125000	0.40311289	13.000000	0.0000000	1.0000000
EG	16	4.9531250	0.74267731	79.250000	3.8300000	5.9200000
PGR	16	1.0956250	0.41939589	17.530000	0.4800000	1.9500000
EIR	16	1.0425000	0.14712806	16.680000	0.8500000	1.3600000
IPI	16	88.3275000	18.91113658	1413.240000	59.7200000	122.0000000
API	16	96.3250000	4.86175551	1541.200000	89.0000000	106.0000000
LGR	16	0.8162500	0.54125625	13.060000	0.2300000	2.1600000
T	16	77.5000000	4.76095229	1240.000000	70.0000000	85.0000000

PEARSON CORRELATION COEFFICIENTS / PROB > !R! UNDER HO:RHO=0 / N = 16

	TED	TES	DOP	POP	LOF	OPECP	GDP	IDU	TPU	RDU	CMU
TED TOTAL ENERGY DEMAND (Mtoe)	1.00000 0.0000	0.95988 0.0001	0.67943 0.0038	0.87114 0.0001	0.71254 0.0020	0.71387 0.0019	0.81658 0.0001	0.21596 0.4218	0.80930 0.0001	0.20476 0.4468	0.63069 0.0088
TES TOTAL ENERGY SUPPLY (Mtoe)	0.95988 0.0001	1.00000 0.0000	0.50664 0.0452	0.77819 0.0004	0.56858 0.0216	0.64025 0.0075	0.70631 0.0022	0.36423 0.1655	0.67986 0.0038	0.32111 0.2252	0.47251 0.0646
DOP DOMESTIC OIL PRICES (US$)	0.67943 0.0038	0.50664 0.0452	1.00000 0.0000	0.83908 0.0001	0.92302 0.0001	0.72216 0.0016	0.85312 0.0001	-0.42090 0.1045	0.88195 0.0001	-0.24146 0.3676	0.89940 0.0001
POP POPULATION (In thousands)	0.87114 0.0001	0.77819 0.0004	0.83908 0.0001	1.00000 0.0000	0.93423 0.0001	0.91149 0.0001	0.98274 0.0001	-0.24503 0.3604	0.79651 0.0002	0.16272 0.5471	0.75948 0.0006
LOF LABOR FORCE (In thousands)	0.71254 0.0020	0.56858 0.0216	0.92302 0.0001	0.93423 0.0001	1.00000 0.0000	0.87845 0.0001	0.96607 0.0001	-0.47865 0.0607	0.82953 0.0001	-0.09855 0.7165	0.87210 0.0001
OPECP OPEC OIL PRICES (US$/bbl)	0.71387 0.0019	0.64025 0.0075	0.72216 0.0016	0.91149 0.0001	0.87845 0.0001	1.00000 0.0000	0.94403 0.0001	-0.37370 0.1539	0.59471 0.0151	0.30761 0.2465	0.59062 0.0160
GDP GROSS DOMESTIC PRODUCT	0.81658 0.0001	0.70631 0.0022	0.85312 0.0001	0.98274 0.0001	0.96607 0.0001	0.94403 0.0001	1.00000 0.0000	-0.33565 0.2037	0.78966 0.0003	0.11986 0.6584	0.77402 0.0004
IDU INDUSTRY USE	0.21596 0.4218	0.36423 0.1655	-0.42090 0.1045	-0.24503 0.3604	-0.47865 0.0607	-0.37370 0.1539	-0.33565 0.2037	1.00000 0.0000	-0.14834 0.5835	0.28711 0.2809	-0.40019 0.1245
TPU TRANSPORT USE	0.80930 0.0001	0.67986 0.0038	0.88195 0.0001	0.79651 0.0002	0.82953 0.0001	0.59471 0.0151	0.78966 0.0003	-0.14834 0.5835	1.00000 0.0000	-0.30572 0.2495	0.91016 0.0001
RDU RESIDENTIAL USE	0.20476 0.4468	0.32111 0.2252	-0.24146 0.3676	0.16272 0.5471	-0.09855 0.7165	0.30761 0.2465	0.11986 0.6584	0.28711 0.2809	-0.30572 0.2495	1.00000 0.0000	-0.51105 0.0431
CMU COMMERCIAL USE	0.63069 0.0088	0.47251 0.0646	0.89940 0.0001	0.75948 0.0006	0.87210 0.0001	0.59062 0.0160	0.77402 0.0004	-0.40019 0.1245	0.91016 0.0001	-0.51105 0.0431	1.00000 0.0000
CIS CHANGE IN STOCKS	0.47748 0.0614	0.33028 0.2115	0.78967 0.0003	0.76345 0.0006	0.82379 0.0001	0.66515 0.0049	0.76781 0.0005	-0.59122 0.0159	0.65205 0.0062	-0.10093 0.7100	0.73487 0.0012
DFR DOMESTIC/FOREIGN ENERGY RATIO	-0.05123 0.8505	-0.27746 0.2981	0.55360 0.0261	0.25998 0.3308	0.53230 0.0338	0.38374 0.1423	0.38678 0.1389	-0.74878 0.0008	0.32704 0.2163	-0.42104 0.1044	0.50483 0.0461
EPP ENERGY PRODUCTIVITY (GDP/Mtoe)	0.63141 0.0087	0.51012 0.0435	0.81114 0.0001	0.91711 0.0001	0.95826 0.0001	0.93999 0.0001	0.96229 0.0001	-0.54010 0.0308	0.66215 0.0052	0.09716 0.7204	0.72534 0.0015
EGR ENERGY/GDP RATIO	-0.68399 0.0035	-0.57066 0.0210	-0.80987 0.0001	-0.94267 0.0001	-0.95403 0.0001	-0.95208 0.0001	-0.97664 0.0001	0.48873 0.0547	-0.68167 0.0036	-0.14492 0.5923	-0.72000 0.0017
EDF PERCENTAGE DEPENDENCY ON OIL	-0.22829 0.3951	-0.07662 0.7779	-0.56726 0.0219	-0.56919 0.0214	-0.68705 0.0033	-0.75413 0.0007	-0.66567 0.0049	0.66799 0.0047	-0.31952 0.2277	-0.20575 0.4446	-0.35956 0.1714
CPI CONSUMER PRICE INDEX	0.84864 0.0001	0.75023 0.0008	0.83245 0.0001	0.99634 0.0001	0.94166 0.0001	0.93742 0.0001	0.99196 0.0001	-0.28126 0.2913	0.77448 0.0004	0.17886 0.5075	0.74576 0.0009

PEARSON CORRELATION COEFFICIENTS / PROB > !R! UNDER HO:RHO=0 / N = 16

	TED	TES	DOP	POP	LOF	OPECP	GDP	IDU	TPU	RDU	CMU
EC	0.16121	0.31490	-0.22454	-0.02712	-0.23462	0.02529	-0.11995	0.36281	-0.16127	0.37294	-0.26301
ENERGY CRISES	0.5509	0.2349	0.4031	0.9206	0.3818	0.9259	0.6581	0.1672	0.5507	0.1548	0.3250
EP	0.81027	0.86601	0.45343	0.74685	0.54794	0.62905	0.66540	0.19056	0.51068	0.38219	0.38907
ENERGY POLICY	0.0001	0.0001	0.0777	0.0009	0.0280	0.0090	0.0049	0.4796	0.0432	0.1440	0.1364
EG	0.80885	0.70025	0.84132	0.97698	0.96234	0.94946	0.99932	-0.33767	0.77710	0.13038	0.76222
ECONOMIC GROWTH (GDP/POP)	0.0001	0.0025	0.0001	0.0001	0.0001	0.0001	0.0001	0.2009	0.0004	0.6303	0.0006
PGR	-0.84830	-0.80719	-0.70511	-0.95065	-0.82937	-0.86339	-0.92039	0.11522	-0.67377	-0.24942	-0.65762
POPULATION GROWTH RATE	0.0001	0.0002	0.0023	0.0001	0.0001	0.0001	0.0001	0.6709	0.0042	0.3515	0.0056
EIR	0.65668	0.49751	0.80039	0.73419	0.73611	0.44625	0.69232	-0.18512	0.81533	-0.23712	0.79585
EXPORTS/IMPORTS RATIO	0.0057	0.0499	0.0002	0.0012	0.0011	0.0832	0.0030	0.4925	0.0001	0.3766	0.0002
IPI	0.85646	0.73507	0.90713	0.98033	0.96241	0.89700	0.98137	-0.29608	0.87107	0.04483	0.82878
INDUSTRIAL PRODUCTION INDEX	0.0001	0.0012	0.0001	0.0001	0.0001	0.0001	0.0001	0.2655	0.0001	0.8691	0.0001
API	0.66235	0.64426	0.62165	0.56685	0.48687	0.27308	0.45475	0.09160	0.73850	-0.18541	0.62365
AGRICULTURAL PRODUCTION INDEX	0.0052	0.0071	0.0101	0.0220	0.0558	0.3062	0.0768	0.7358	0.0011	0.4918	0.0098
LGR	0.18735	0.14741	0.27175	0.43448	0.45998	0.66289	0.52156	-0.34843	0.02064	0.53127	0.01797
LABOR GROWTH RATE	0.4872	0.5859	0.3086	0.0926	0.0730	0.0051	0.0383	0.1860	0.9395	0.0342	0.9473
T	0.83631	0.71949	0.88711	0.99142	0.97000	0.91283	0.99212	-0.32317	0.83023	0.06876	0.81517
TIME	0.0001	0.0017	0.0001	0.0001	0.0001	0.0001	0.0001	0.2221	0.0001	0.8002	0.0001

	CIS	DFR	EPP	EGR	EDF	CPI	EC	EP	EG	PGR	EIR
TED	0.47748	-0.05123	0.63141	-0.68399	-0.22829	0.84864	0.16121	0.81027	0.80885	-0.84830	0.65668
TOTAL ENERGY DEMAND (Mtoe)	0.0614	0.8505	0.0087	0.0035	0.3951	0.0001	0.5509	0.0001	0.0001	0.0001	0.0057
TES	0.33028	-0.27746	0.51012	-0.57066	-0.07662	0.75023	0.31490	0.86601	0.70025	-0.80719	0.49751
TOTAL ENERGY SUPPLY (Mtoe)	0.2115	0.2981	0.0435	0.0210	0.7779	0.0008	0.2349	0.0001	0.0025	0.0002	0.0499
DOP	0.78967	0.55360	0.81114	-0.80987	-0.56726	0.83245	-0.22454	0.45343	0.84132	-0.70511	0.80039
DOMESTIC OIL PRICES (US$)	0.0003	0.0261	0.0001	0.0001	0.0219	0.0001	0.4031	0.0777	0.0001	0.0023	0.0002
POP	0.76345	0.25998	0.91711	-0.94267	-0.56919	0.99634	-0.02712	0.74685	0.97698	-0.95065	0.73419
POPULATION (In thousands)	0.0006	0.3308	0.0001	0.0001	0.0214	0.0001	0.9206	0.0009	0.0001	0.0001	0.0012
LOF	0.82379	0.53230	0.95826	-0.95403	-0.68705	0.94166	-0.23462	0.54794	0.96234	-0.82937	0.73611
LABOR FORCE (In thousands)	0.0001	0.0338	0.0001	0.0001	0.0033	0.0001	0.3818	0.0280	0.0001	0.0001	0.0011
OPECP	0.66515	0.38374	0.93999	-0.95208	-0.75413	0.93742	0.02529	0.62905	0.94946	-0.86339	0.44625
OPEC OIL PRICES (US$/bbl)	0.0049	0.1423	0.0001	0.0001	0.0007	0.0001	0.9259	0.0090	0.0001	0.0001	0.0832
GDP	0.76781	0.38678	0.96229	-0.97664	-0.66567	0.99196	-0.11995	0.66540	0.99932	-0.92039	0.69232
GROSS DOMESTIC PRODUCT	0.0005	0.1389	0.0001	0.0001	0.0049	0.0001	0.6581	0.0049	0.0001	0.0001	0.0030
IDU	-0.59122	-0.74878	-0.54010	0.48873	0.66799	-0.28126	0.36281	0.19056	-0.33767	0.11522	-0.18512
INDUSTRY USE	0.0159	0.0008	0.0308	0.0547	0.0047	0.2913	0.1672	0.4796	0.2009	0.6709	0.4925

PEARSON CORRELATION COEFFICIENTS / PROB > !R! UNDER HO:RHO=0 / N = 16

	CIS	DFR	EPP	EGR	EDF	CPI	EC	EP	EG	PGR	EIR
TPU TRANSPORT USE	0.65205 0.0062	0.32704 0.2163	0.66215 0.0052	-0.68167 0.0036	-0.31952 0.2277	0.77448 0.0004	-0.16127 0.5507	0.51068 0.0432	0.77710 0.0004	-0.67377 0.0042	0.81533 0.0001
RDU RESIDENTIAL USE	-0.10093 0.7100	-0.42104 0.1044	0.09716 0.7204	-0.14492 0.5923	-0.20575 0.4446	0.17886 0.5075	0.37294 0.1548	0.38219 0.1440	0.13038 0.6303	-0.24942 0.3515	-0.23712 0.3766
CMU COMMERCIAL USE	0.73487 0.0012	0.50483 0.0461	0.72534 0.0015	-0.72000 0.0017	-0.35956 0.1714	0.74576 0.0009	-0.26301 0.3250	0.38907 0.1364	0.76222 0.0006	-0.65762 0.0056	0.79585 0.0002
CIS CHANGE IN STOCKS	1.00000 0.0000	0.42389 0.1018	0.80605 0.0002	-0.80060 0.0002	-0.55705 0.0250	0.75703 0.0007	-0.28145 0.2910	0.40318 0.1215	0.75947 0.0006	-0.66749 0.0047	0.74804 0.0009
DFR DOMESTIC/FOREIGN ENERGY RATIO	0.42389 0.1018	1.00000 0.0000	0.51304 0.0421	-0.45925 0.0735	-0.74559 0.0009	0.31050 0.2418	-0.46870 0.0671	-0.34456 0.1912	0.39116 0.1341	-0.09095 0.7376	0.25707 0.3365
EPP ENERGY PRODUCTIVITY (GDP/Mtoe)	0.80605 0.0002	0.51304 0.0421	1.00000 0.0000	-0.99556 0.0001	-0.78025 0.0004	0.93947 0.0001	-0.22159 0.4095	0.53831 0.0315	0.96532 0.0001	-0.85303 0.0001	0.61320 0.0115
EGR ENERGY/GDP RATIO	-0.80060 0.0002	-0.45925 0.0735	-0.99556 0.0001	1.00000 0.0000	0.75424 0.0007	-0.96195 0.0001	0.17672 0.5126	-0.58380 0.0176	-0.97882 0.0001	0.88804 0.0001	-0.63114 0.0087
EDF PERCENTAGE DEPENDENCY ON OIL	-0.55705 0.0250	-0.74559 0.0009	-0.78025 0.0004	0.75424 0.0007	1.00000 0.0000	-0.62409 0.0098	0.29285 0.2710	-0.09875 0.7160	-0.67486 0.0041	0.42609 0.0998	-0.26680 0.3179
CPI CONSUMER PRICE INDEX	0.75703 0.0007	0.31050 0.2418	0.93947 0.0001	-0.96195 0.0001	-0.62409 0.0098	1.00000 0.0000	-0.05111 0.8509	0.71645 0.0018	0.98857 0.0001	-0.94593 0.0001	0.70564 0.0023
EC ENERGY CRISES	-0.28145 0.2910	-0.46870 0.0671	-0.22159 0.4095	0.17672 0.5126	0.29285 0.2710	-0.05111 0.8509	1.00000 0.0000	0.32388 0.2211	-0.12669 0.6401	-0.03590 0.8950	-0.41884 0.1064
EP ENERGY POLICY	0.40318 0.1215	-0.34456 0.1912	0.53831 0.0315	-0.58380 0.0176	-0.09875 0.7160	0.71645 0.0018	0.32388 0.2211	1.00000 0.0000	0.65899 0.0055	-0.77806 0.0004	0.44681 0.0827
EG ECONOMIC GROWTH (GDP/POP)	0.75947 0.0006	0.39116 0.1341	0.96532 0.0001	-0.97882 0.0001	-0.67486 0.0041	0.98857 0.0001	-0.12669 0.6401	0.65899 0.0055	1.00000 0.0000	-0.91771 0.0001	0.67422 0.0042
PGR POPULATION GROWTH RATE	-0.66749 0.0047	-0.09095 0.7376	-0.85303 0.0001	0.88804 0.0001	0.42609 0.0998	-0.94593 0.0001	-0.03590 0.8950	-0.77806 0.0004	-0.91771 0.0001	1.00000 0.0000	-0.66027 0.0054
EIR EXPORTS/IMPORTS RATIO	0.74804 0.0009	0.25707 0.3365	0.61320 0.0115	-0.63114 0.0087	-0.26680 0.3179	0.70564 0.0023	-0.41884 0.1064	0.44681 0.0827	0.67422 0.0042	-0.66027 0.0054	1.00000 0.0000
IPI INDUSTRIAL PRODUCTION INDEX	0.76409 0.0006	0.38509 0.1408	0.91262 0.0001	-0.93271 0.0001	-0.61251 0.0117	0.97991 0.0001	-0.08526 0.7536	0.65450 0.0059	0.97517 0.0001	-0.89270 0.0001	0.75212 0.0008
API AGRICULTURAL PRODUCTION INDEX	0.47105 0.0655	-0.16790 0.5342	0.29584 0.2659	-0.33141 0.2099	0.09355 0.7304	0.50373 0.0467	0.18261 0.4985	0.64546 0.0069	0.42665 0.0993	-0.48355 0.0577	0.68102 0.0037
LGR LABOR GROWTH RATE	0.32067 0.2259	0.33400 0.2061	0.62780 0.0092	-0.60816 0.0124	-0.75458 0.0007	0.48599 0.0563	-0.19844 0.4613	0.27767 0.2978	0.54122 0.0304	-0.38830 0.1372	0.03713 0.8914
T TIME	0.78590 0.0003	0.37253 0.1553	0.94089 0.0001	-0.95792 0.0001	-0.62236 0.0100	0.99258 0.0001	-0.10238 0.7060	0.67737 0.0039	0.98694 0.0001	-0.92101 0.0001	0.75092 0.0008

PEARSON CORRELATION COEFFICIENTS / PROB > !R! UNDER HO:RHO=0 / N = 16

	IPI	API	LGR	T
TED TOTAL ENERGY DEMAND (Mtoe)	0.85646 0.0001	0.66235 0.0052	0.18735 0.4872	0.83631 0.0001
TES TOTAL ENERGY SUPPLY (Mtoe)	0.73507 0.0012	0.64426 0.0071	0.14741 0.5859	0.71949 0.0017
DOP DOMESTIC OIL PRICES (US$)	0.90713 0.0001	0.62165 0.0101	0.27175 0.3086	0.88711 0.0001
POP POPULATION (In thousands)	0.98033 0.0001	0.56685 0.0220	0.43448 0.0926	0.99142 0.0001
LOF LABOR FORCE (In thousands)	0.96241 0.0001	0.48687 0.0558	0.45998 0.0730	0.97000 0.0001
OPECP OPEC OIL PRICES (US$/bbl)	0.89700 0.0001	0.27308 0.3062	0.66289 0.0051	0.91283 0.0001
GDP GROSS DOMESTIC PRODUCT	0.98137 0.0001	0.45475 0.0768	0.52156 0.0383	0.99212 0.0001
IDU INDUSTRY USE	-0.29608 0.2655	0.09160 0.7358	-0.34843 0.1860	-0.32317 0.2221
TPU TRANSPORT USE	0.87107 0.0001	0.73850 0.0011	0.02064 0.9395	0.83023 0.0001
RDU RESIDENTIAL USE	0.04483 0.8691	-0.18541 0.4918	0.53127 0.0342	0.06876 0.8002
CMU COMMERCIAL USE	0.82878 0.0001	0.62365 0.0098	0.01797 0.9473	0.81517 0.0001
CIS CHANGE IN STOCKS	0.76409 0.0006	0.47105 0.0655	0.32067 0.2259	0.78590 0.0003
DFR DOMESTIO/FOREIGN ENERGY RATIO	0.38509 0.1408	-0.16790 0.5342	0.33400 0.2061	0.37253 0.1553
EPP ENERGY PRODUCTIVITY (GDP/Mtoe)	0.91262 0.0001	0.29584 0.2659	0.62780 0.0092	0.94089 0.0001
EGR ENERGY/GDP RATIO	-0.93271 0.0001	-0.33141 0.2099	-0.60816 0.0124	-0.95792 0.0001
EDF PERCENTAGE DEPENDENCY ON OIL	-0.61251 0.0117	0.09355 0.7304	-0.75458 0.0007	-0.62236 0.0100
CPI CONSUMER PRICE INDEX	0.97991 0.0001	0.50373 0.0467	0.48599 0.0563	0.99258 0.0001

PEARSON CORRELATION COEFFICIENTS / PROB > !R! UNDER HO:RHO=0 / N = 16

	IPI	API	LGR	T
EC ENERGY CRISES	-0.08526 0.7536	0.18261 0.4985	-0.19844 0.4613	-0.10238 0.7060
EP ENERGY POLICY	0.65450 0.0059	0.64546 0.0069	0.27767 0.2978	0.67737 0.0039
EG ECONOMIC GROWTH (GDP/POP)	0.97517 0.0001	0.42665 0.0993	0.54122 0.0304	0.98694 0.0001
PGR POPULATION GROWTH RATE	-0.89270 0.0001	-0.48355 0.0577	-0.38830 0.1372	-0.92101 0.0001
EIR EXPORTS/IMPORTS RATIO	0.75212 0.0008	0.68102 0.0037	0.03713 0.8914	0.75092 0.0008
IPI INDUSTRIAL PRODUCTION INDEX	1.00000 0.0000	0.57752 0.0191	0.39971 0.1251	0.99314 0.0001
API AGRICULTURAL PRODUCTION INDEX	0.57752 0.0191	1.00000 0.0000	-0.28437 0.2858	0.54551 0.0288
LGR LABOR GROWTH RATE	0.39971 0.1251	-0.28437 0.2858	1.00000 0.0000	0.43851 0.0893
T TIME	0.99314 0.0001	0.54551 0.0288	0.43851 0.0893	1.00000 0.0000

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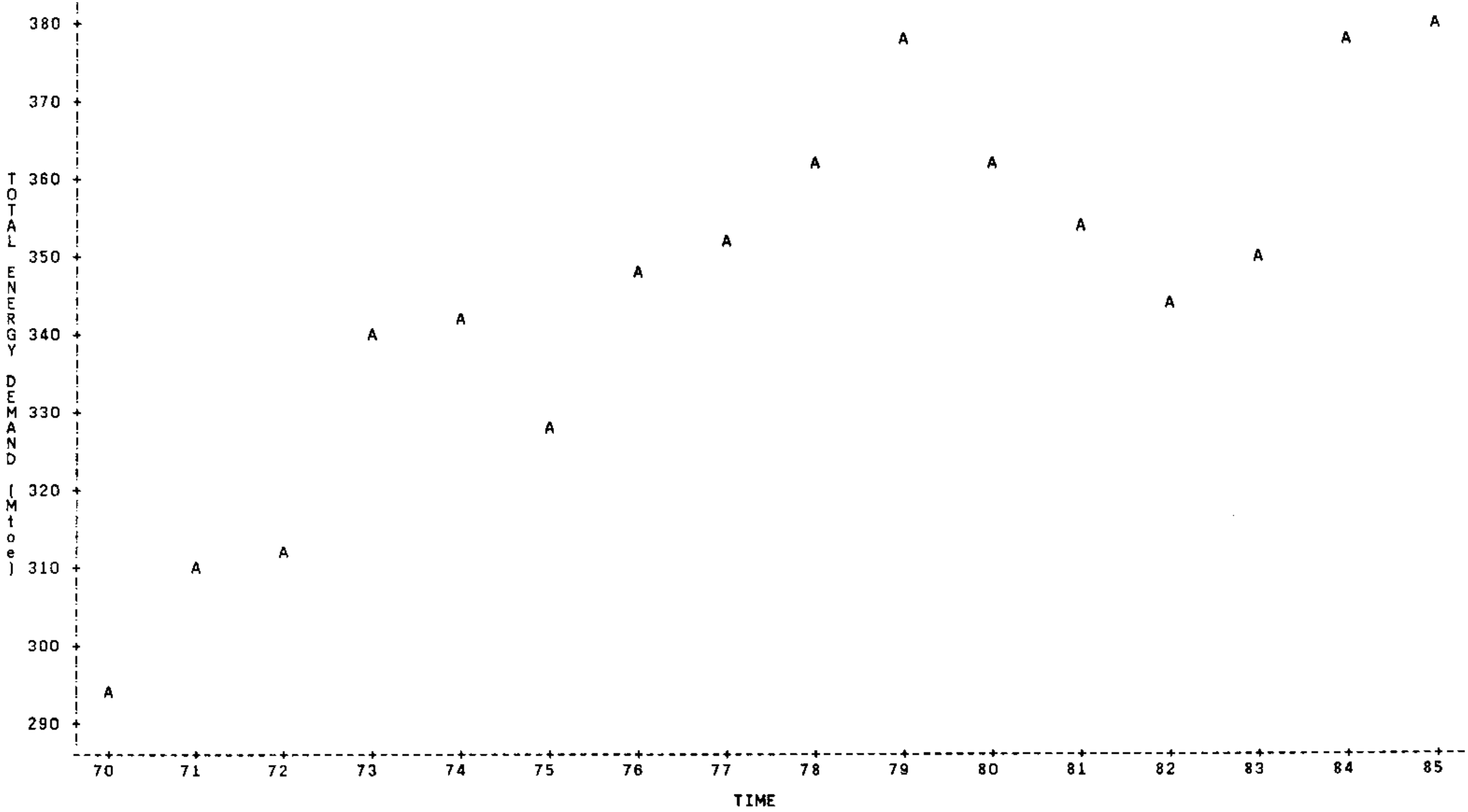
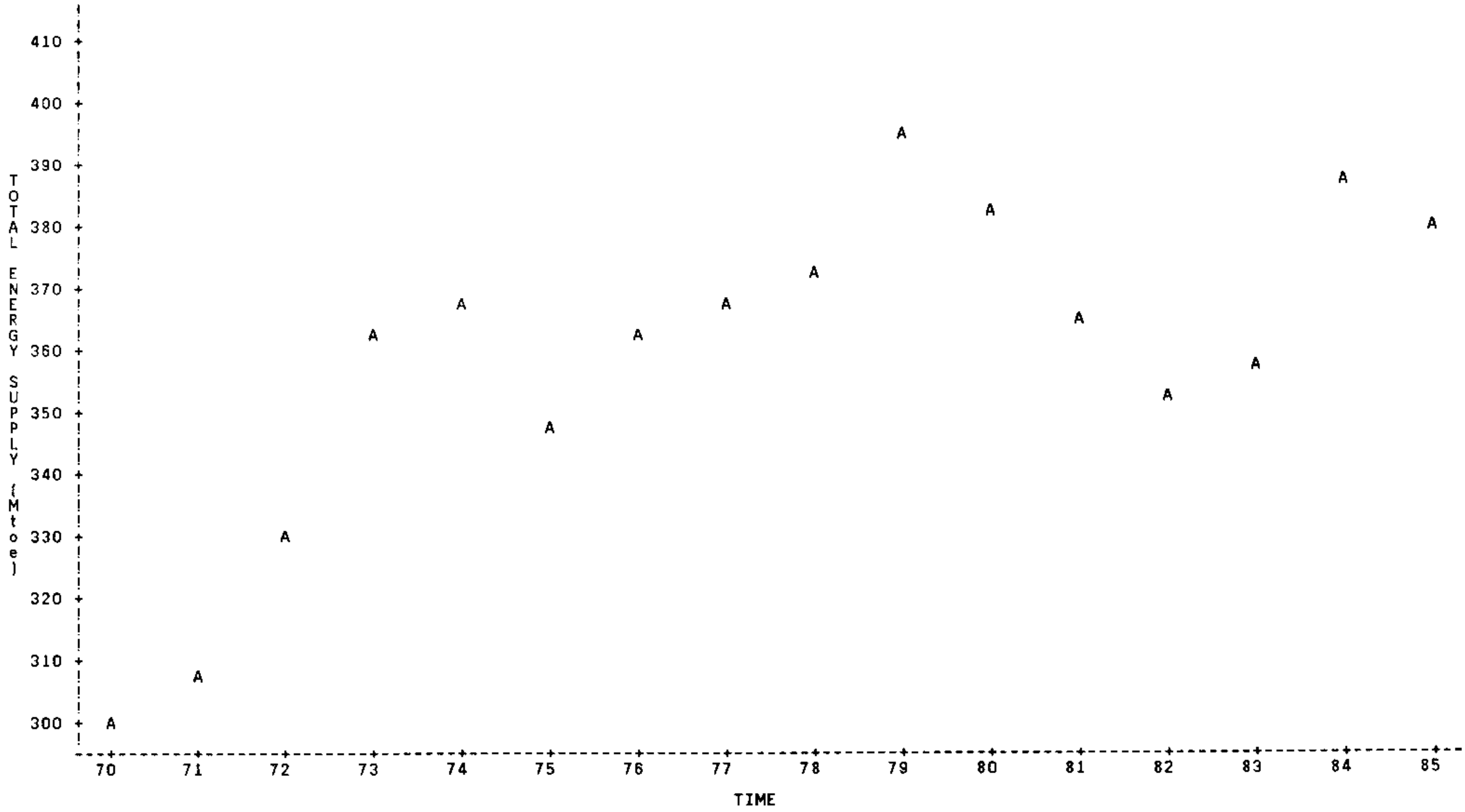
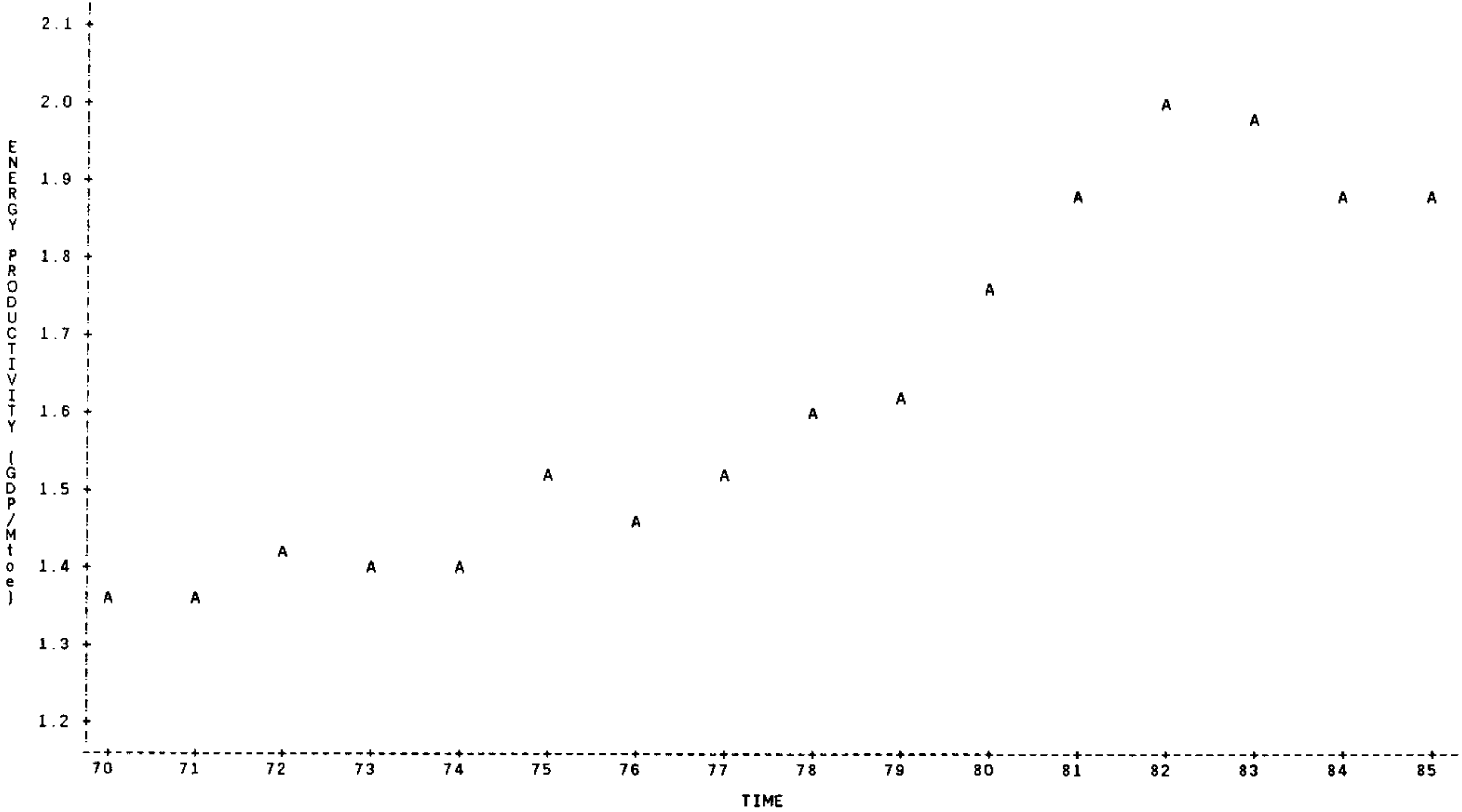
PLOT OF TED*T LEGEND: A = 1 OBS, B = 2 OBS, ETC.



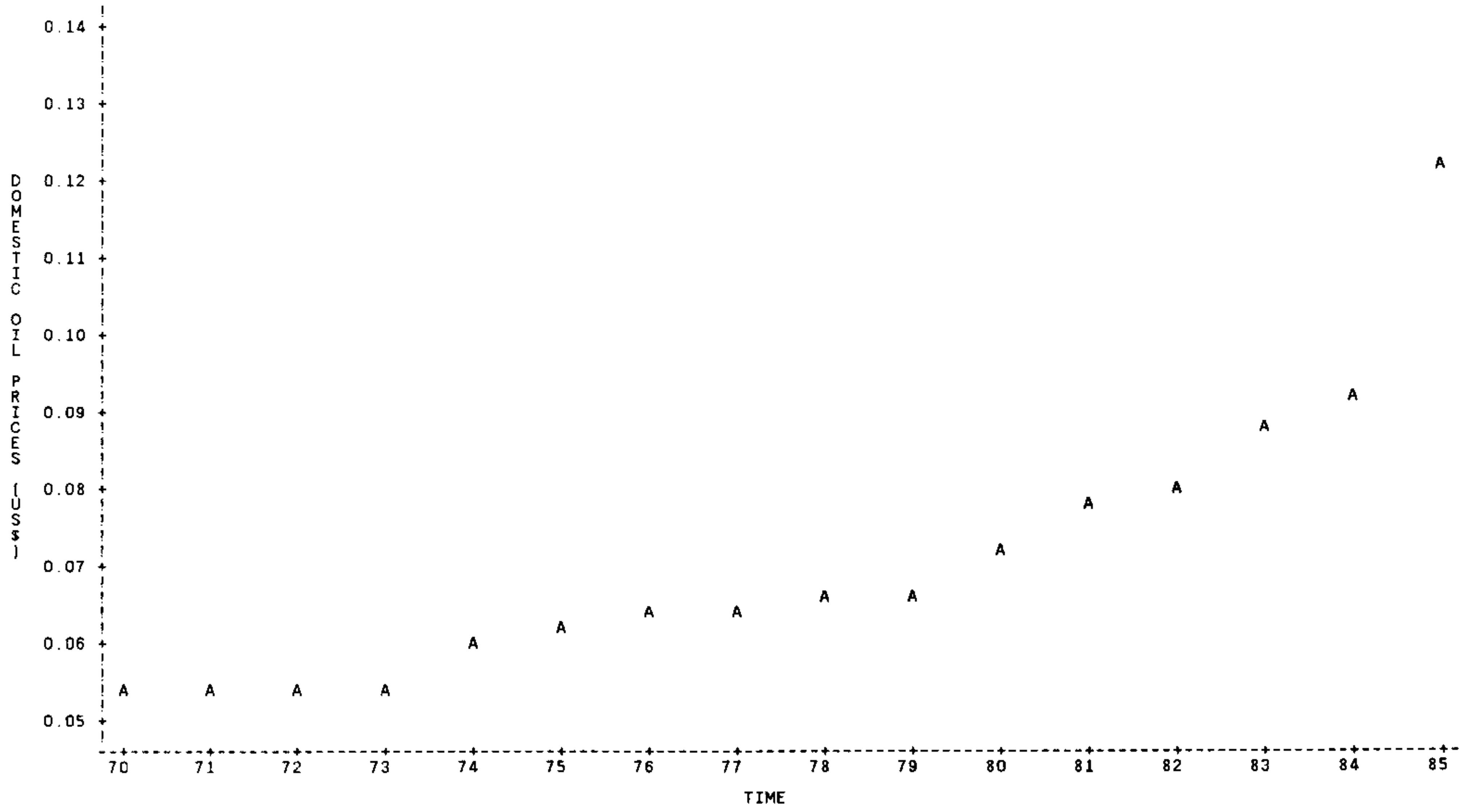
PLOT OF TES*T LEGEND: A = 1 OBS, B = 2 OBS, ETC.



PLOT OF EPP*T LEGEND: A = 1 OBS, B = 2 OBS, ETC.

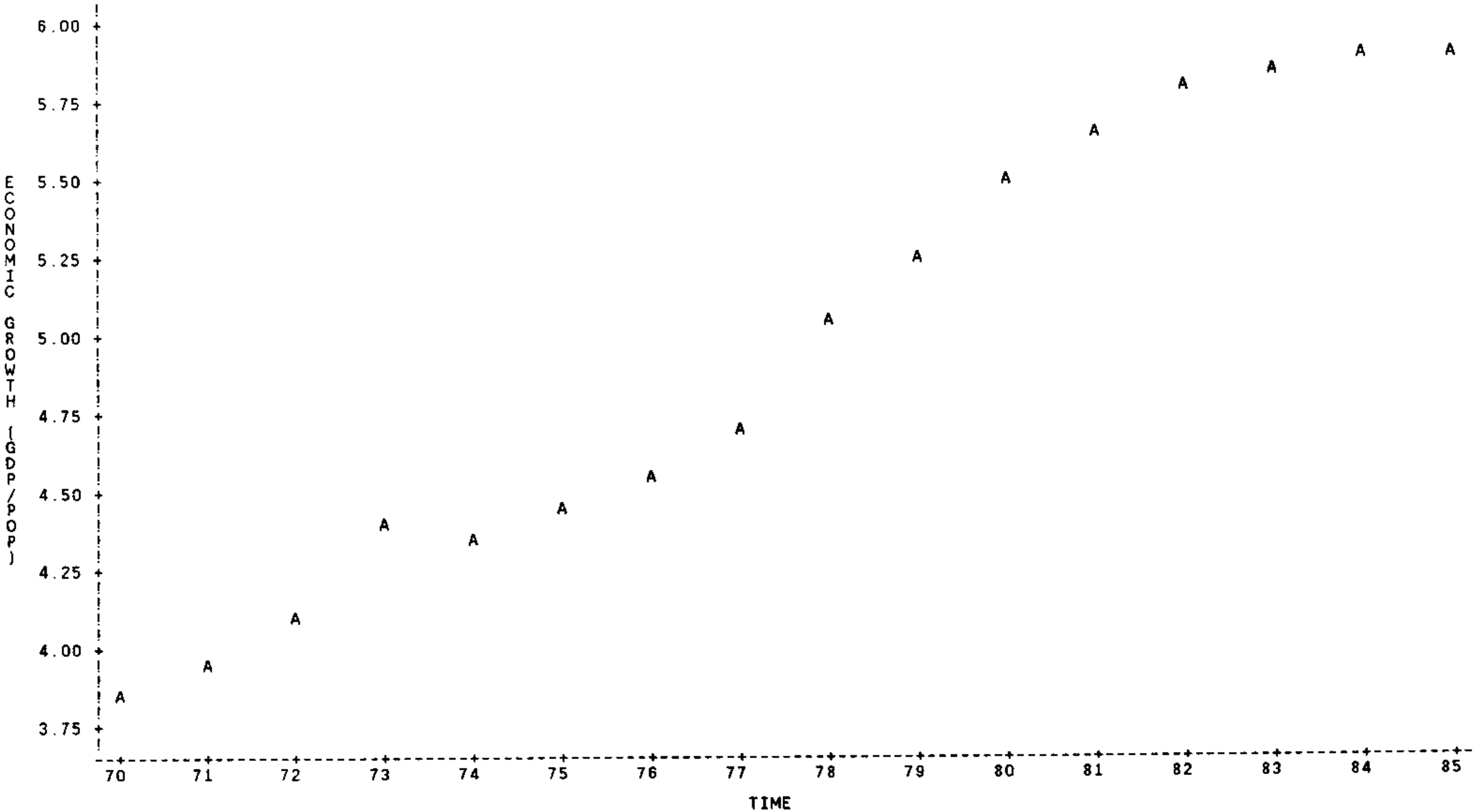


PLOT OF DOP*T LEGEND: A = 1 OBS, B = 2 OBS, ETC.



SAS 9:24 SUNDAY, AUGUST 2, 1987 12

PLOT OF EG*T LEGEND: A = 1 OBS, B = 2 OBS, ETC.



DEP VARIABLE: TED TOTAL ENERGY DEMAND (Mtoe)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	4	7868.02736	1967.00684	14.407	0.0002
ERROR	11	1501.82154	136.52923		
C TOTAL	15	9369.84890			

ROOT MSE	11.68457	R-SQUARE	0.8397
DEP MEAN	346.0175	ADJ R-SQ	0.7814
C.V.	3.376873		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > !T!	VARIABLE LABEL
INTERCEP	1	-162.17381	374.36994	-0.433	0.6732	INTERCEPT
POP	1	0.004419510	0.004393777	1.006	0.3361	POPULATION (In thousands)
OPECP	1	-0.76977284	0.78653614	-0.979	0.3488	OPEC OIL PRICES (US$/bbl)
GDP	1	0.006867914	0.23511595	0.029	0.9772	GROSS DOMESTIC PRODUCT
EP	1	19.88920091	14.02240474	1.418	0.1838	ENERGY POLICY

DURBIN-WATSON D	1.320
(FOR NUMBER OF OBS.)	16
1ST ORDER AUTOCORRELATION	0.330

DEP VARIABLE: TES TOTAL ENERGY SUPPLY (Mtoe)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	5	9108.81745	1821.76349	12.894	0.0004
ERROR	10	1412.91265	141.29127		
C TOTAL	15	10521.73010			

ROOT MSE	11.8866	R-SQUARE	0.8657
DEP MEAN	358.5825	ADJ R-SQ	0.7986
C.V.	3.314886		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > !T!	VARIABLE LABEL
INTERCEP	1	143.43776	122.74271	1.169	0.2697	INTERCEPT
OPECP	1	2.04339014	0.75450381	2.708	0.0220	OPEC OIL PRICES (US$/bbl)
DFR	1	-255.14686	238.28617	-1.071	0.3094	DOMESTIC/FOREIGN ENERGY RATIO
EIR	1	41.79385808	28.70007452	1.456	0.1760	EXPORTS/IMPORTS RATIO
EDF	1	273.64059	157.34928	1.739	0.1127	PERCENTAGE DEPENDENCY ON OIL
EP	1	6.70912857	20.90260823	0.321	0.7548	ENERGY POLICY

DURBIN-WATSON D	2.024
(FOR NUMBER OF OBS.)	16
1ST ORDER AUTOCORRELATION	-0.041

DEP VARIABLE: EPP ENERGY PRODUCTIVITY (GDP/Mtoe)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	6	0.78353562	0.13058927	31.706	0.0001
ERROR	9	0.03706893	0.004118770		
C TOTAL	15	0.82060455			

ROOT MSE	0.06417764	R-SQUARE	0.9548
DEP MEAN	1.627975	ADJ R-SQ	0.9247
C.V.	3.942176		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > !T!	VARIABLE LABEL
INTERCEP	1	1.50090543	0.34544662	4.345	0.0019	INTERCEPT
IDU	1	-0.005690971	0.002622250	-2.170	0.0581	INDUSTRY USE
TPU	1	-0.006611491	0.004679937	-1.413	0.1914	TRANSPORT USE
CMU	1	0.04465700	0.01130889	3.949	0.0034	COMMERCIAL USE
RDU	1	0.02021046	0.003763130	5.371	0.0004	RESIDENTIAL USE
EC	1	-0.06661320	0.04131747	-1.612	0.1414	ENERGY CRISES
EP	1	0.000176115	0.08162073	0.002	0.9983	ENERGY POLICY

DURBIN-WATSON D	1.673
(FOR NUMBER OF OBS.)	16
1ST ORDER AUTOCORRELATION	0.135

DEP VARIABLE: DOP DOMESTIC OIL PRICES (US$)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	2	0.002646878	0.001323439	7.119	0.0082
ERROR	13	0.002416872	0.000185913		
C TOTAL	15	0.005063750			

ROOT MSE	0.013635	R-SQUARE	0.5227
DEP MEAN	0.070125	ADJ R-SQ	0.4493
C.V.	19.44385		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	0.06445615	0.07673112	0.840	0.4161	INTERCEPT
OPECP	1	0.001004850	0.000429536	2.339	0.0359	OPEC OIL PRICES (US$/bbl)
EDF	1	-0.02004013	0.11133747	-0.180	0.8599	PERCENTAGE DEPENDENCY ON OIL

DURBIN-WATSON D	0.561
(FOR NUMBER OF OBS.)	16
1ST ORDER AUTOCORRELATION	0.366

DEP VARIABLE: GDP GROSS DOMESTIC PRODUCT

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	6	180085.79	30014.29838	395.617	0.0001
ERROR	9	682.80346	75.86705075		
C TOTAL	15	180768.59			

ROOT MSE	8.710169	R-SQUARE	0.9962
DEP MEAN	566.7731	ADJ R-SQ	0.9937
C.V.	1.5368		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > !T!	VARIABLE LABEL
INTERCEP	1	210.85708	32.15253323	6.558	0.0001	INTERCEPT
IPI	1	2.21090603	0.75881367	2.914	0.0172	INDUSTRIAL PRODUCTION INDEX
EIR	1	-104.13737	40.32996099	-2.582	0.0296	EXPORTS/IMPORTS RATIO
CPI	1	3.25440711	0.68088349	4.780	0.0010	CONSUMER PRICE INDEX
LGR	1	1.93676283	7.51314718	0.258	0.8024	LABOR GROWTH RATE
EC	1	-25.71959003	8.71816142	-2.950	0.0162	ENERGY CRISES
EP	1	3.20382913	10.69778066	0.299	0.7714	ENERGY POLICY

DURBIN-WATSON D	2.166
(FOR NUMBER OF OBS.)	16
1ST ORDER AUTOCORRELATION	-0.085

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