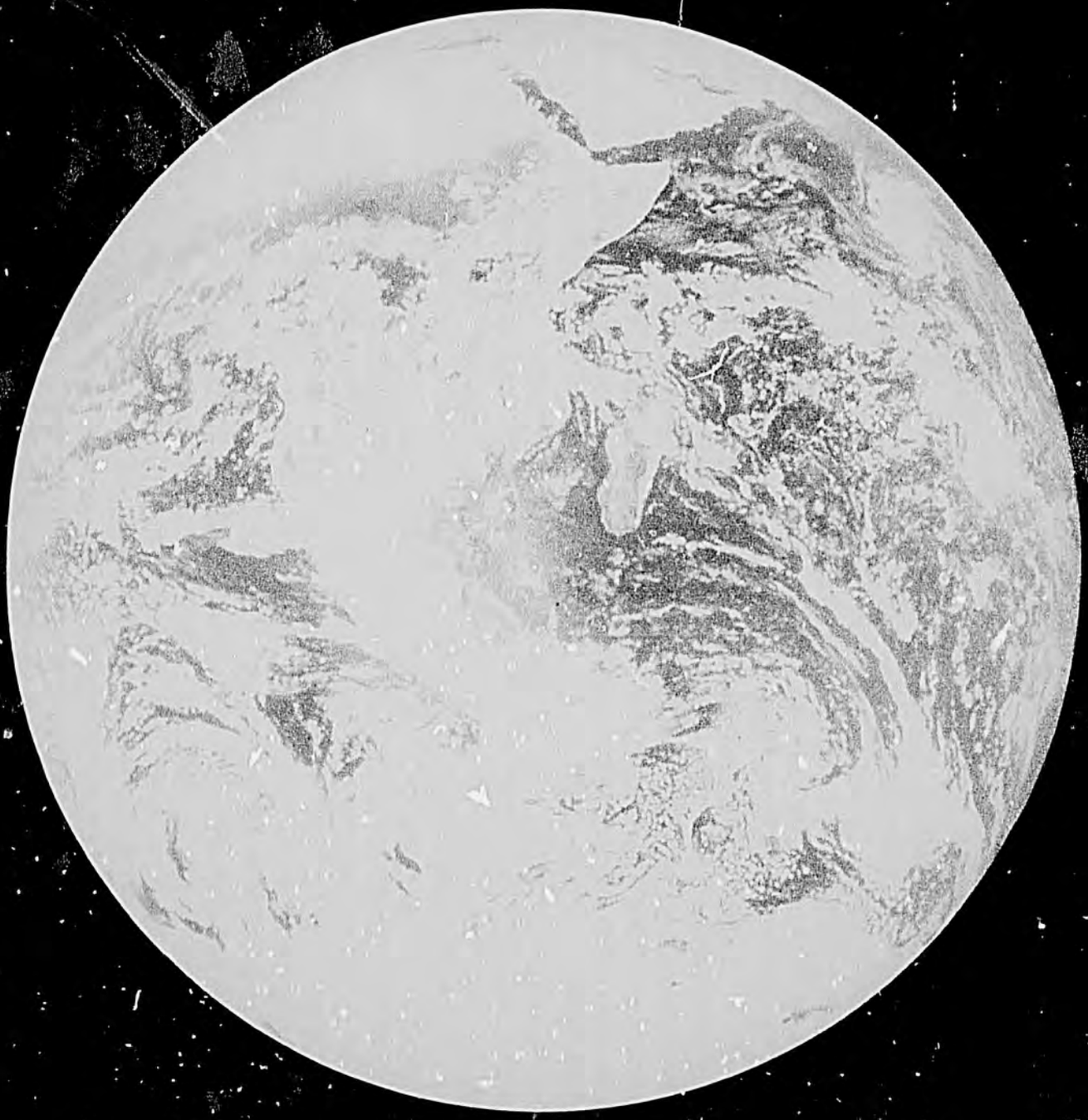
Energy and Development

A Preliminary Analysis of Less Developed Countries



The MITRE Corporation

Energy and Development

A Preliminary Analysis for Less Developed Countries

Ranvir K. Trehan
John G. Leigh
Wayne R. Park

Contract Sponsor: USAID Office of Energy
Contract No.: AID SOD PCD-C-0146
Project No.: 1693A
Dept.: W-51

July 1979

The MITRE Corporation
1820 Dolley Madison Boulevard
McLean, Virginia 22102

MTR-79W00216

ABSTRACT

This report describes the results of quantitative analyses of the relationships between energy production and consumption and economic and social development in Less-Developed Countries (LDC's). The work was performed by the Metrek Division of The MITRE Corporation for the Office of Energy in the United States Agency for International Development (USAID). This work is a continuing part of a broader effort to provide analytical support for policy development in the energy assistance programs of USAID.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude for the helpful guidance and direction provided by Dr. Jerome Bosken of USAID. We would also like to express our appreciation to Mr. Edward G. Sharp and Dr. Hyder A. Lakhani for their valuable assistance and constructive criticism. Last but not least, we would like to thank Mrs. Margie J. Purkerson for looking after the typing and assembly of this report.

TABLE OF CONTENTS

		Page
	LIST OF ILLUSTRATIONS	vii
	LIST OF TABLES	viii
	EXECUTIVE SUMMARY	xi
1.0	INTRODUCTION	1
2.0	SETTING FOR THE ANALYSIS	3
2.1	Energy Economic Relationships and Development Policy	3
2.2	Characteristics of Statistical Analysis	4
2.3	Data Limitations and Accuracy	5
2.4	Related Work	7
3.0	STRUCTURE OF THE ANALYSIS	11
3.1	Country List and Stratification	11
3.2	Regression Methodology	15
4.0	ENERGY AND ECONOMIC DEVELOPMENT	17
4.1	The Relationship Between Energy Consumption and Economic Growth	17
4.1.1	Conclusions	17
4.1.2	Approach	18
4.1.3	Models Tested	19
4.1.4	Results	22
4.1.5	Discussion	32
4.2	The Effects of Petroleum Prices on Economic Growth Rates and Inflation Rates	34
4.2.1	Conclusions	34
4.2.2	Approach	34
4.2.3	Data Sources and Limitations	36
4.2.4	Results	37
4.2.5	Discussion	47
4.3	Balance of Payments Analysis	49
4.3.1	Conclusions	49
4.3.2	Approach and Data	49
4.3.3	Results and Discussion	50

TABLE OF CONTENTS (Continued)

		Page
5.0	ENERGY AND SOCIAL DEVELOPMENT	55
5.1	Conclusions	55
5.2	Approach	55
5.3	Data Limitations	58
5.4	Results	59
	5.4.1 Unstratified Runs	59
	5.4.2 Stratified Runs	64
	5.4.3 Analysis of PQLI Components	74
5.5	Discussion of Results and Implications	74
	APPENDIX A - LISTINGS OF DATA BASES	79
	REFERENCES	103

LIST OF ILLUSTRATIONS

Figure Number		Page
1	Country Stratification	14
2	GNP/Capita vs. Energy/Capita	27
3	Petroleum Dependence Chart	31
4	Mean Balance of Payments for Non-Oil-Exporting LDC's (U.S. $ X 10^6, 1970)	52
5	Mean Balance of Payments for Oil-Exporting LDC's (U.S. $ X 10^6, 1970)	53
6	PQLI vs. Natural Logarithm of GDP Per Capita, Ln (GDPPC)	60
7	Regression Analyses for PQLI Stratified by Type of Economy	67
8	Regression Analysis for PQLI Stratified by Geographical Region (Non-Oil-Exporting LDC's)	70
9	Regression Analysis for PQLI Stratified by Religion (Non-Oil-Exporting LDC's)	73
10	Regression Analysis for PQLI Against Energy Consumption Stratified by Religion (Non-Oil-Exporting LDC's)	75

LIST OF TABLES

Table Number		Page
I	Basic LDC List	12
II	Economic-Energy Models Tested	20
III	GNP/Capita Regressions	23
IV	GNP/Capita Regressions (Additive Model on Energy)	24
V	GNP/Capita Regressions (Multiplicative on Energy)	26
VI	GDP Growth Rate Regression (All Countries)	28
VII	GDP Growth Rate Regression (Country Groups)	29
VIII	Mean Economic Growth Rates and Inflation Rates for LDC's	38
IX	Regressions for Change in GDP/Capita Growth Rate	41
X	Regressions for Change in Inflation Rate	45
XI	Mean Balance of Payments for LDC's (1979 U.S. $)	51
XII	PQLI Regression Analyses (Unstratified)	61
XIII	Defined Tolerances for PQLI Data	63
XIV	PQLI Regression Analysis Stratified by Type of Economy	66
XV	PQLI Regression Analysis Stratified by Geographical Region (Non-Oil-Exporting LDC's)	69
XVI	PQLI Regression Analysis Stratified by Religion (Non-Oil-Exporting LDC's)	72
XVII	Correlation Matrices for PQLI, Life Expectancy (e), Infant Mortality (m), and Adult Literacy (a)	76

LIST OF TABLES (Continued)

Table Number		Page
A-1	GNP-Energy Data Base	80
A-2	GNP-Energy Growth Rate Data Base	83
A-3	Economic Growth Rate Data Base	86
A-4	Inflation Data Base	89
A-5	Balance of Payments Data	92
A-6	PQLI Data Base	97
A-7	PQLI Data	100

BLANK PAGE

EXECUTIVE SUMMARY

This report describes the results of quantitative analyses of the relationships between commercial energy production and consumption and economic and social development in Less-Developed Countries (LDC's). The questions examined include the relationship between energy consumption and economic growth; the impacts of energy cost increases on economic growth, balance of payments, and inflation; and the relationship between energy and social progress. The work was performed by the Metrek Division of The MITRE Corporation for the Office of Energy in the United States Agency for International Development (USAID). This work is a continuing part of a broader effort to provide analytical support for policy development in the energy assistance programs of USAID.

The analyses described in this report indicate strongly that energy is an important contributor to the economic and social development process in LDC's:

- GNP per capita is strongly related to commercial energy consumption.
- Growth rates in GDP per capita are strongly related to growth rates in investment, employment and energy.*
- The Physical Quality of Life Index (PQLI, based on infant mortality, life expectancy and literacy) is strongly related to commercial energy consumption, and to GDP per capita.

*Both Gross National Product (GNP) and Gross Domestic Product (GDP) were used in this analysis, depending upon data availability. GDP excludes certain foreign transactions which are included in GNP. The differences are very minor for most LDC's.

It appears that the relationship of energy to GNP changes with the level of development of the country. A unit change in commercial energy consumption relates to approximately three times the change in GNP for advanced non-agricultural LDC's as for low income agricultural countries.

The significance of energy to economic development in LDC's is emphasized by the deleterious effects which have resulted from the oil price rises of 1973-1974. Developing countries which depend on imported oil suffered severe repercussions:

- Real GNP per capita growth rate dropped by more than half (from 3.1% to 1.5%) after 1973. Those contries which were growing most rapidly suffered the largest declines.
- Inflation rates more than tripled (from 7.7% to 24.5%) after 1973.
- Real balance of payments deficits nearly tripled after 1973.

These effects were reversed or much reduced for oil-exporting LDC's.

The relationship between the PQLI and energy consumption appears to be relatively independent of the economic structure of the country or its geographical location, but appears to be affected by the culture of the country as expressed by its dominant religion. Generally, for a given PQLI, Islamic countries have higher energy consumptions and GDP's than Christian countries, and Christian countries are higher than Buddhist or Hindu countries. Thus, the way in which resources are used may be as important in affecting the PQLI as the absolute level of the resources. It is, of course, possible that

there is some cultural bias which affects the basis on which the components of PQLI are measured. The whole question of non-economic measures of development urgently requires more study.

This initial study was based upon readily-available published data. These data are limited in coverage and are highly aggregated. In particular, no data are available for noncommercial energy in LDC's, which may account for the major part of consumption in some countries. Further, no data are readily available on investment or energy consumption by economic sector (i.e., industrial, agricultural, service).

The methodology used in the study was primarily linear regression analysis. This technique is limited in its ability to prove causality of relationships which are detected, and caution should be exercised in deducing necessary cause-and-effect relationships from our results.

However, for energy-poor LDC's these results strongly suggest that energy development must be regarded as an integal part of development in general. They indicate that development of indigenous energy sources will be beneficial to GNP growth and the physical quality of life, and will contribute to price stability and balance of payments improvement.

BLANK PAGE

1.0 INTRODUCTION

The report describes the results of a quantitative analysis of the relationships between energy and development indicators for developing countries (LDC's). The work was performed by the Metrek Division of The MITRE Corporation for the Office of Energy in the United States Agency for International Development (USAID). This work is part of a broader effort to provide analytical support for policy development in the energy assistance programs of USAID.

Through the joint efforts of USAID and MITRE, the following five questions were defined for analysis in this task:

- What is the relationship between energy consumption and economic growth for LDC's?
- What has been the impact of increases in the cost of imported energy upon the growth rates of LDC's?
- What has been the impact of increases in the cost of imported energy upon the inflation rates of LDC's?
- What has been the impact of increases in the cost of imported energy upon the balance of payments of LDC's?
- What is the relationship between energy consumption and production and indicators of social and economic progress in LDC's?

This document describes initial results obtained in the analysis of these questions. Further work in this area is projected. The results presented here should be treated as preliminary and possibly subject to revision and refinement.

BLANK PAGE

2.0 SETTING FOR THE ANALYSIS

The work described in this report represents a broad preliminary analysis. Because of this breadth, it is essential to establish a firm foundation for the perspective of the analysis. This foundation is needed to enable results and conclusions to be interpreted relative to the structure of the assumptions and analysis, and the limitations of the data. This section therefore provides a setting for the work described in the report.

2.1 Energy Economic Relationships and Development Policy

The five questions examined in this study in themselves postulate the existence of important relationships between energy and economic, financial, and social development. The expressed purpose of this research was to define and examine these relationships. From a wider perspective, the identification of relationships between energy and other economic and noneconomic factors indicates that actions in energy development may have significant influence on other development needs in developing countries, and *vice versa*.

The broader purpose of this paper therefore is to provide insight on energy-economic-social relationships that will be useful in the formulation of both energy-specific and overall development assistance policy. However, relative to detailed energy development planning, there is an important need to look at energy-economic relationships in developing countries in detail. The need is to discover specific areas in the economy of a developing country where energy

development can have a major impact on economic and social growth. Analyses of broad indicators such as performed in this study are limited in their contribution to these specific desired results. Rather, they may form a foundation on which energy planning may take place, and to indicate fruitful areas for more detailed work.

2.2 Characteristics of Statistical Analysis

The assessments performed in this study are based on statistical analysis. It is important to note that this statistical analysis does not determine causality. That is to say, the analysis does not determine if changes in one or more variables will cause the changes in other variables suggested by the relationships. The expected or desired causality relationships important to the success of policy decision making must be based on the judgment of the policy maker and not on the statistical definition of relationships.

The statistical analysis should provide the policy maker with insight and depth of understanding to which good judgment can be applied. The results of this study, still preliminary and ongoing, are directed to providing this kind of understanding.

The statistical analysis performed in this study is primarily regression based upon cross-sectional data. A discussion of regression analysis and pertinent statistics is presented in Section 3.0. Cross-sectional analysis means that results are obtained by comparing data between countries for a given stratification of countries.

Cross-sectional analysis attempts to measure what is common between countries.

Cross-sectional analysis by itsel. does not permit analysis of interactions within a given country. For instance, we have found a strong positive correlation between per capita energy consumption and per capita GNP. What this really means is that in moving from a country with a lower per capita energy consumption to a country with a higher per capita energy consumption, there is a strong tendency for per capita GNP to increase. This is a "between country" relationship. It would be useful to assert that that relationship holds within any given country and it is very likely that it does so*. The point is, the cross-sectional analysis cannot confirm this. In future research, the cross-sectional analysis may be expanded to include pooled time series data in which intra-country energy relationships can be assessed.

2.3 Data Limitations and Accuracy

Gross economic and energy indicators from published sources have been used to identify relationships in this study. The level of aggregation of these indicators can and does cover up details which may be important to development policy making. We have tried to identify these potential hazards in the appropriate places in the text. The use of more recently available disaggregated data from unpublished

*Historically, increases in GDP and energy consumption have gone hand-in-hand for the (industrialized) countries for which data is available.

sources in future analyses should clarify many of these relationships.

The value of statistical analysis is heavily dependent on the accuracy of the data used. There is a tendency to lose sight of this fact in the details of the statistical results. In this study there was generally insufficient time to assess the impact of potential data errors. We did observe some substantial differences in data as reported from different sources. In some cases, countries were dropped from portions of our analysis simply because the data were unrealistic. We do believe, however, that the conclusions of the study are valid independent of potential data errors.

Besides the questions on accuracy of data, there are also some important limitations on the type of data available. Non-commercial energy (dung, wood, etc.) is an extremely important resource for the people of developing countries. Data on the extent of this noncommercial energy consumption are at best limited and preliminary and were not included in this assessment. Although commercial energy consumption data by fuel type are available for most countries, there are little data on the sectoral utilization of this energy. Also subsistence activities (e.g. crops consumed mainly by the farmer and his family) are likely to be unreported or underreported in GNP statistics.

Finally, in dealing with dollar value data, international assessments such as this must always contend with the question of the

proper conversion of foreign currency values into U.S. dollars. In this analysis this conversion has always been at the official exchange rate of the country. There is bias in comparing values between countries in this manner since official exchange rates are often unrealistic. Moreover, official exchange rates reflect only the values of those goods which are traded internationally. However, alternatives to official exchange rates are not complete enough to be used effectively.

2.4 Related Work

Interest in and information on energy-economic relationships in developing countries are rapidly growing today. It is not the purpose of this section to survey the entire range of literature. Rather, we want to identify work which has been important for the background and orientation of this task.

Resources for the Future (RFF) has had a continuing involvement in assessment of world energy-economic relationships. An extensive treatise on this subject was developed by J. Darmstadter and others at RFF in the early seventies.[1] This extensive work is recommended reading for background to this report. More current RFF assessments of international energy use have been prepared by J. Darmstadter and J. Dunkerley.[2,3]

Staff members of the World Bank have conducted many investigations of economic relationships for developing countries. Of particular importance are the reports on energy-economic relationships for

developing countries by Lambertini[4] and more recently by Choe.[5] The World Bank has also been an excellent resource for uniform data for developing countries. The most recent of these reports formed the most prominent data source for this study.[6]

Brookhaven National Laboratory (BNL) has supported USAID in the assessment of energy needs, uses, and resources in developing countries. The work of Palmedo, Nathans and others from BNL[7] influenced the definition of country stratifications used in this study.

The International Monetery Fund (IMF) develops and maintains extensive time series financial data on countries throughout the world. Although somewhat sparse on energy information, the economic data given are most useful.[8] Financial data were also obtained from the United Nations.[9,10]

Energy data used in this report were also developed by the United Nations. They have developed one substantial 25 year time series[11] and two more current 5 year time series[12,13] on both production and supply of commercial energy for each country in the world.

International labor statistics were obtained from the International Labor Organization (ILO).[14,15]

Data on statistics on agricultural production and Land use were obtained from both UN Statistics[9] and the Food and Agriculture Organization (FAO).[16] The FAO is soon to release a

book by Michigan State University describing energy needs and use in agriculture for developing countries.[17] Some of the discussion in this report is based on a preprint of sections of that work.[18] In particular, a paper by LeVern Faidley describes energy-agriculture production relationships for the world. He states that developing countries apply only 4 percent of total commercial energy consumption to agricultural production. He also reports that there is a close relation in all regions of the world between commercial energy input and output per agricultural worker.

BLANK PAGE

3.0 STRUCTURE OF THE ANALYSIS

This section describes the basic list of LDC's used in the analyses, the way in which they were stratified by type of economy, and the statistical methodology used in the analyses.

3.1 Country List and Stratification

Table 1 lists 112 developing countries. Although particular elements of data are unavailable for many of these countries, this has formed the basic list for all analyses in this study. The list includes both oil-exporting and non-oil-exporting countries. It includes all countries designated as LDC's by the World Bank.[6]

These countries have been grouped on the basis of type of economy. The categories used are based on those introduced by Brookhaven National Laboratory [7] and the World Bank [6]. BNL uses six categories: Industrialized, Oil Exporters, Balanced Growth Economics, Primary Exporters, Agricultural Exporters and Other Agricultural. The World Bank divides countries purely on the basis of Gross National Product per capita; they chose $250 per year as the dividing line. We have defined five economy-type categories for the analyses conducted here. They are Advanced Non-Agricultural, Oil Exporters, Primary Exporters, Low-Income Agricultural and Advanced Agricultural.* Figure 1 illustrates the way in which these categories relate to those used by BNL and the World Bank.

*The Low-Income Non-Agricultural category contained only India and Pakistan. Because of the small number of countries, analysis was not applied to this category. Thus, although India and Pakistan are included in the all-countries analyses, they do not appear in the analyses which are stratified by type of economy.

TABLE I

BASIC LDC LIST

1. Afghanistan
2. Algeria
3. Argentina
4. Angola
5. Bahamas
6. Bahrain
7. Bangladesh
8. Barbados
9. Belize
10. Benin
11. Bolivia
12. Botswana
13. Brazil
14. Br. Solomon I.
15. Burma
16. Burundi
17. Cambodia
18. Cameroon
19. Central Af. Emp.
20. Chad
21. Chile
22. China, Rep. of
23. Colombia
24. Congo. P.R. of
25. Costa Rica
26. Cyprus
27. Dominican Rep.
28. Ecuador
29. Egypt, Arab Rep. of
30. El Salvador
31. Eq. Guinea
32. Ethopia
33. Fiji
34. Gabon
35. Ganbia
36. Ghana
37. Greece
38. Guatemala
39. Guinea
40. Guyana
41. Haiti
42. Honduras
43. Hong Kong
44. India
45. Indonesia
46. Iran
47. Iraq
48. Israel
49. Ivory Coast
50. Jamaica
51. Jordan
52. Kenya
53. Korea, Rep. of
54. Kuwait

TABLE I (Continued)

55. Lao P.D.R.
56. Lesotho
57. Lebanon
58. Liberia
59. Libyan A.R.
60. Madagascar
61. Malawi
62. Malysia
63. Mali
64. Malta
65. Mauritania
66. Maurtius
67. Mexico
68. Morocco
69. Mozambique
70. Nepal
71. Netherlands Awt.
72. Nicaragua
73. Niger
74. Nigeria
75. Oman
76. Pakistan
77. Panama
78. Papua New Guinea
79. Paraquay
80. Peru
81. Philippines
82. Portugal
83. Qatar
84. Rhodesia
85. Rwanda
86. Saudi Arabia
87. Senegal
88. Sierra Leone
89. Singapore
90. Somalia
91. Spain
92. Sri Lanka
93. Sudan
94. Surinam
95. Swaziland
96. Syrian Arab Rep.
97. Tanzania
98. Thailand
99. Togo
100. Trinidad and Tobago
101. Tunisia
102. Turkey
103. Uganda
104. Un. Arab Em.
105. Upper Volta
106. Uruguay
103. Venezuela
108. Yemen A.R.
109. Yemen P.D.R
110. Yugoslavia
111. Zaire
112. Zambia

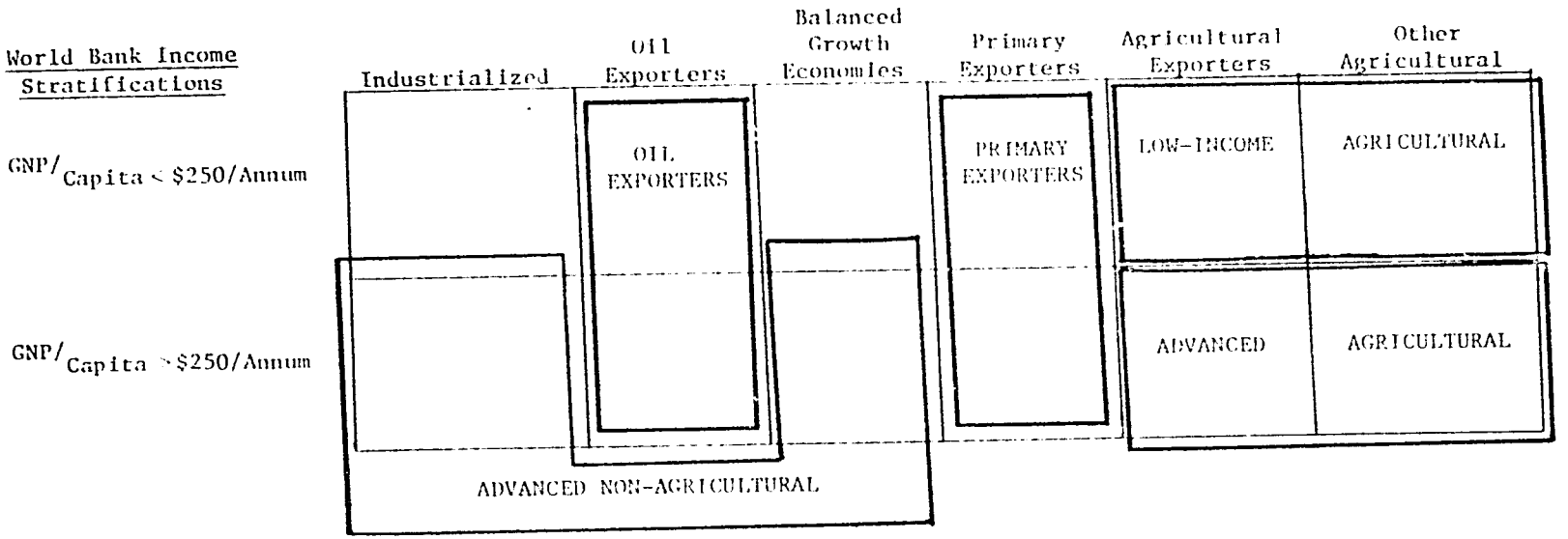


FIGURE 1
COUNTRY STRATIFICATION

3.2 Regression Methodology

The basic technique which has been used to search for significant relationships between energy and economic and social development is multiple linear regression. This is a well-known technique for estimating the coefficients, B_i, of an equation of the type:

$$y = B_o + B_1x_1 + B_2x_2 + \ldots + B_nx_n$$

where y is the dependent variable and x_1 through x_n are the independent or explanatory variables. For instance, y may represent the PQLI, and x_1 the energy consumption per capita (variables x_2 through x_n not being present in this instance).

It is not the purpose of this section to describe the mathematical methods which are used in estimating the coefficients. The interested reader can find a good description in Plackett.[19] However, the main parameters which describe the significance and importance of the relationship obtained will be briefly described. These are called the coefficient of determination (r^2), the F statistic, and the standard error of the coefficient.

The coefficient of determination, r^2, shows how much of the variability of the dependent variable is explained by the relationship. More precisely, r^2 is the fraction of the total variance of the dependent variable which is explained by the regression. It is an indicator of the closeness of fit of the data to the regression surface. If r^2 is near 0, the fit is poor; if r^2 is near 1, the fit is good.

The F statistic for an independent variable is an indicator of the significance of that variable in the relationship. For 1/10 degrees of freedom,* any value of F greater than 4.96 shows significance at the 5% level. For 1/30 degrees of freedom, the value decreases to 4.17. For specific cases, the reader should refer to a standard F statistic table.

The F statistic for the regression is an indicator for the strength of the linear relationship as a whole. Again, the meaning of the value of the statistic is dependent on the degrees of freedom given. As an example, for 2/40 degrees of freedom, any value of F greater than 3.23 shows there is a significant linear relationship at the 5% level. Again, for specific cases, the reader should refer to an F statistics table.

The Standard Error (S.E.) of a coefficient B represents the accuracy with which the coefficient is estimated. It is the standard deviation of the sampling variability of B.

---

*The numerator of the degrees of freedom is the number of independent variables in the regression equation. The denominator is the difference between the number of data points and the number of independent variables, minus 1. Thus 1/10 degrees of freedom refers to an equation with 1 independent variable and 12 data points.

4.0 ENERGY AND ECONOMIC DEVELOPMENT

This chapter describes the analyses of the following questions:

- What is the relationship between commercial energy consumption and economic growth for LDC's?
- What has been the impact of increases in the cost of imported energy upon the growth rates of LDC's?
- What has been the impact of increases in the cost of imported energy upon the inflation rates of LDC's?
- What has been the impact of increases in the cost of imported energy on the balance of payments of LDC's?

Section 4.1 deals with the first of these questions, Section 4.2 deals with the next two, and Section 4.3 deals with the last question.

4.1 The Relationship Between Energy Consumption and Economic Growth

4.1.1 Conclusions

The following statements summarize the major conclusions of the analysis performed for this question.

- Per capita commercial energy consumption is positively and significantly related to GNP* per capita for developing countries.
- Per capita commercial energy consumption is positively and significantly related to the industrial portion of GNP per capita for developing countries.
- Per capita commercial energy consumption is not significantly related to the agricultural portion of GNP per capita for developing countries.**

---

*Gross National Product.

**Probably because commercial energy use for agriculture accounts for only 4% of total energy consumption in developing countries. Recent analysis has shown that commercial energy inputs, though small, may be a critical factor in agricultural development in developing countries.(18)

- For all developing countries as a whole, growth rates in GDP* are positively and significantly related to growth rates in investment, labor, and energy.

- Country income (GNP/capita) is not related to the country dependence on oil for commercial energy.

- The greatest petroleum dependence among developing countries is in central and eastern Africa and in Central America.

4.1.2 Approach

The level of economic activity of any country is a result of a level of production of goods and services. This production requires inputs of capital, labor and energy.

To determine a relationship between energy consumption and economic performance of developing countries, our approach was first to postulate functional relationships for the production of goods and services. Then using multiple regression techniques, we estimated numerical values for the coefficients of these functional forms. As described in the previous section, regression analysis was applied to data for countries stratified by economic type.** The coefficients for the energy variable then indicated a relationship between energy consumption and the level of the economy for each country stratification. This methodology attempts to discover if the relationships obtained for countries of a particular economic type appear different from those obtained for all countries together.

---

*Gross Domestic Product.

**A listing of the data base is given in Appendix A, Tables A-1 and A-2.

A number of functional forms were tested and restructured when necessary. Data limitations were an important factor in the need for restructuring.

Partly because of data limitations and also to gain more insight, functional forms of economic growth rates were tested relative to growth rates in factors of production. Finally, we attempted to refine the analyses by comparing economic activity of a country with its dependence on imported petroleum. Although the results were not definitive, the exercise generated an interesting presentation of the LDC dependence on petroleum for energy.

Data limitations restricted the number of countries available for the analysis to about 60.

4.1.3 Models Tested

Table II shows the economic-energy models tested in this analysis. Two indicators of economic activity were used. The first was Gross National Product per capita. The second was the (geometric) mean annual percentage growth rate in Gross Domestic Product per capita. Agricultural and industrial portions of these two variables were also used in parallel with the primary indicators.

In the first analysis, each of Gross National Product per capita, and agricultural and industrial portions of Gross National Product per capita were regressed individually against Gross Domestic Investment per capita and commercial energy consumption per capita. Our original

TABLE II

ECONOMIC-ENERGY MODELS TESTED

Analysis		Regressions Made		Tested on What Data?	
		Dependent Variable	Independent Variables	All Countries Pooled	Stratifications of Countries
First Analysis	Additive $\left(\text{Dependent Variable}\right) = a_0 + \sum a_i \left(\text{Independent Variable}\right)$	GNP/CAP	GDI/CAP ENER/CAP	X	
		AG/CAP	GDI/CAP ENER/CAP		
		IND/CAP	GDI/CAP ENER/CAP		
	Multiplicative $\left(\text{Dependent Variable}\right) = a_0 \left(\text{Independent Variable}\right)^{a_i}$ or $\log \left(\text{Dependent Variable}\right) = \log a_0 \sum a_i \log \left(\text{Independent Variable}\right)$	LGNP/CAP	LGDI/CAP* LENER/CAP	X	
		LAG/CAP	LGDI/CAP LENER/CAP		
		LIND/CAP	LGDI/CAP LENER/CAP		
	Additive (Same notation as above)	GNP/CAP	ENER/CAP	X	X
		AG/CAP	ENER/CAP		
		IND/CAP	ENER/CAP		
	Multiplicative (Same notation as above)	LGNP/CAP	LENER/CAP*		X
		LAG/CAP	LENER/CAP		
		LIND/CAP	LENER/CAP		
Second Analysis	Additive (Same notation as above)	RGDP	RGDI RENER RLABOR	X	X
		RAG	RGDI RENER RLABOR		
		RIND	RGDI RENER RLABOR		

Variable Symbols:

GNP/CAP = Total Gross National Product Per Capita
AG/CAP = Agricultural Portion of Gross National Product Per Capita
IND/CAP = Industrial Portion of Gross National Product Per Capita
GDI/CAP = Gross Domestic Investment Per Capita
ENER/CAP = Commercial Energy Consumption Per Capita (kilograms coal equivalent)
RGDP = Growth Rate in Gross Domestic Product 1970-1976
RAG = Growth Rate in Agricultural Portion of Gross Domestic Product 1970-1976
RIND = Growth Rate in Industrial Portion of Gross Domestic Product 1970-1976
RGDI = Growth Rate in Gross Domestic Investment 1970-1976
RENER = Growth Rate in Commercial Energy Consumption 1970-1974
RLABOR = Growth Rate in Labor Force 1970-1975

* The "L" prefix signifies logarithm of the variable.

formulations included labor force per capita as an additional explanatory variable. However, the ILO labor force figures available to us at the time of the analysis were collected on markedly different bases in different countries. We therefore could not use these labor figures directly in the regression analysis.

Four models were tested in the first analysis: additive and multiplicative* forms using investment and energy and additive and multiplicative forms using only energy. The high correlation in the investment and energy variables in the first two models led us to drop the investment variable for the remaining tests.

In the second analysis, growth rates in Gross Domestic Product, and growth rates in agricultural and industrial portions of Gross Domestic Product were regressed against growth rates in Gross Domestic Investment, commercial energy consumption and labor force. We included growth rates in labor in this functional form, since the discrepancies in labor force data were not nearly as restrictive when using growth rates. As noted, we used an additive model for the regression on growth rates.

All data used in the regressions just described were obtained from World Bank figures;[6] growth in energy use was obtained from U.N. publications.[11]

---

*Multiplicative forms are tested by taking natural logarithms to convert them to additive forms which can be handled by the regression analysis.

4.1.4 Results

Table III shows the results of testing the first three models in the first analysis as applied to all countries. The results may be summarized as follows:

- The additive model of GNP/Capita of all countries (and agricultural and industrial components of GNP - AG/CAP and IND/CAP respectively) shows strong linear relationships of both GNP/CAP and IND/CAP (as dependent variables) to GDI/CAP and ENER/CAP (as independent variables). However, the correlation of GDI/CAP and ENER/CAP is high at .70.

- The multiplicative model shows similar results. However, the correlation of the logarithms of investment and energy per capita (LGDI/CAP) is very high at .83. The high correlation of energy and investment led to the deletion of investment variable.

- The additive model on all countries using just ENER/CAP as an explanatory variable shows strong linear relationships of both GNP/CAP and IND/CAP (as dependent variables) to ENER/CAP (as the independent variable).

- The relationship of AG/CAP to either ENER/CAP or GDI/CAP is not as strong as for the other relationships given above. This implies that the agricultural sector output in developing countries has not, in the past, been strongly related to commercial energy nor capital investment.

Table IV shows the results of applying the additive model on energy alone to stratifications of countries. The principal results are as follows:

- In all country groups the linear relationship of both GNP/CAP and IND/CAP to ENER/CAP is strong. The relationship appears to be less pronounced in the low income agricultural country group.

- In all country groups there is virtually no relationship between the agricultural component of GNP per capita and energy per capita. (Again, it is important to note this is historical information, and energy consumption is limited to commercial energy).

TABLE III

GNP/CAPITA REGRESSIONS

Run No.	Country Group	Number of Data Values	Dependent Variable (1)	Independent Variable (2)	Coef. B	Standard Error of B	F Statistic Coef.	F Statistic Reg.	r^2	Degrees of Freedom	P Significance Level of Regression
Additive on Investment and Energy	All Countries	65	GNP/CAP	ENER/CAP(3)	.61	.075	67.38	178.27	.85	2/62	P<.01
				GDI/CAP	1.57	.247	40.32				
			AG/CAP	GDI/CAP	.25	.069	12.87	12.87	.17	1/63	P<.01
			IND/CAP	GDI/CAP	.77	.078	97.99	299.06	.91	2/62	P<.01
				ENER/CAP	.21	.024	80.64				
Multiplicative on Investment and Energy	All Countries	65	LGNP/CAP	LGDI/CAP(4)	.42	.059	50.94	233.83	.88	2/62	P<.01
				LENER/CAP	.26	.050	27.37				
			LAG/CAP	LGDI/CAP	.16	.090	3.14	15.34	.33	2/62	P<.01
				LENER/CAP	.11	.077	2.16				
			LIND/CAP	LGDI/CAP	.67	.077	75.13	286.41	.90	2/62	P<.01
				LENER/CAP	.35	.065	28.10				
Additive on Energy	All Countries	65	GNP/CAP	ENER/CAP	.95	.068	194.70	194.70	.76	1/63	P<.01
			AG/CAP	ENER/CAP	.067	.021	9.83	9.83	.13	1/63	P<.01
			IND/CAP	ENER/CAP	.38	.027	196.94	196.94	.76	1/63	P<.01

(1) U. S./Capita.

(2) ENER/CAP measured in kilograms coal equivalent/capita.
CDI/CAP measured in U. S. $/Capita.

(3) Correlation between ENER/CAP and GDI/CAP - .70.

(4) Correlation between LENER/CAP and LGDI/CAP - .83.
"L" prefix stands for logarithm of its variable.

TABLE IV

GNP/CAPITA REGRESSIONS
(ADDITIVE MODEL ON ENERGY)

Model	Country Group	Number of Data Values	Dependent Variable (1)	Independent Variable (2)	Coef. B	Standard Error of B	F Statistic Coef.	F Statistic Rep.	r^2	Degrees of Freedom	P Significance Level of Regression
Additive on Energy	Advanced Non-Agricultural	7	GNP/CAP	ENER/CAP	1.53	.413	13.77	13.77	.73	1/5	.01<P<.05
			AG/CAP	ENER/CAP	------not significant-----				.05	1/5	P>.25
			IND/CAP	ENER/CAP	.52	.200	6.77	6.77	.58	1/5	.01<P<.05
	Oil Exporters	10	GNP/CAP	ENER/CAP	.78	.164	22.67	22.67	.72	1/9	P<.01
			AG/CAP	ENERGY/CAP	-----not significant-----			0.25	.03	1/9	P>.25
			IND/CAP	ENERGY/CAP	.32	.108	8.91	8.91	.50	1/9	.01<P<.05
	Primary Exporters	9	GNP/CAP	ENERGY/CAP	.63	.079	62.52	62.52	.90	1/7	P<.01
			AG/CAP	ENERGY/CAP	-----not significant-----			0.25	.03	1/7	P>.25
			IND/CAP	ENERGY/CAP	.27	.026	111.07	111.07	.94	1/7	P<.01
	Low-Income Agriculture	21	GNP/CAP	ENERGY/CAP	.52	.192	7.37	7.37	.28	1/19	.01<P<.05
			AG/CAP	ENERGY/CAP	-----not significant-----			0.50	.03	1/19	P>.25
			IND/CAP	ENERGY/CAP	.14	.057	6.03	6.03	.24	1/19	.01<P<.05
	Advanced Agriculture	15	GNP/CAP	ENERGY/CAP	.68	.269	6.29	6.29	.33	1/13	.01<P<.05
			AG/CAP	ENERGY/CAP	-----not significant-----			.12	.01	1/13	P>.25
			IND/CAP	ENERGY/CAP	.31	.072	18.18	18.18	.58	1/13	P<.01

(1) U.S. $/capita.
(2) Kilograms coal equivalent/capita.

- A unit change in energy consumption relates to approximately three times the change in GNP for advanced non-agricultural countries as for low income agricultural countries.

Table V shows the parallel results applying the multiplicative model on energy alone to stratifications of countries. Similar results occur except that the scaling effect of the logarithm function reduces the impact of the difference in regression coefficient between country groups. The regressions for LGNP/CAP as a function of LENER/CAP are plotted by country group in Figure 2 along with the scatter diagram. Again the steepness of the regression line for the Advanced Non-Agricultural country group is quite evident. It appears to show a more productive use of energy in this country group relative to the other countries and especially relative to the Low Income Agricultural group. This result needs to be examined in more depth as part of an ongoing study.

Tables VI and VII show the results of the second analysis in relating growth rates in Gross Domestic Product against growth rates in capital Gross Domestic Investment, labor and energy. Table VI shows the results for all countries pooled; Table VII shows the results for country stratifications. Table VI can be summarized:

- Growth rates in GDP and growth rates in the industrial portion of GDP are linearly related to all three growth rates: investment, labor, and energy. The strength of the relationship is strongest for the investment variable.

- Growth rates in the agricultural portion of GDP are not related significantly to growth rates in any of the independent variables.

TABLE V

GNP/CAPITA REGRESSIONS
(MULTIPLICATIVE ON ENERGY)

Model	Country Group	Number of Data Values	Dependent Variable	Independent Variable	Coef. B	Standard Error of B	F Statistic Coef.	F Statistic Reg.	r^2	Degrees of Freedom	P Significance Level of Regression
Multiplicative on Energy	Advanced Non-Agricultural	7	LGNP/CAP	LENER/CAP	1.10	.269	16.87	16.87	.77	1/5	P<.01
			LAG/CAP	LENER/CAP	.28	.541	.27	.27	.05	1/5	P>.25
			LIND/CAP	LENER/CAP	1.11	.370	8.94	8.94	.64	1/5	.01<P<.05
	Oil Exporters	11	LGNP/CAP	LENER/CAP	.54	.156	11.91	11.91	.57	1/9	P<.01
			LAG/CAP	LENER/CAP	.30	.132	.91	.91	.09	1/9	P>.25
			LIND/CAP	LENER/CAP	.52	.231	4.99	4.99	.35	1/9	.05<P<.10
	Primary Exporters	9	LGNP/CAP	LENER/CAP	.56	.109	26.22	26.22	.79	1/7	P<.01
			LAG/CAP	LENER/CAP	.21	.176	1.43	1.43	.17	1/7	P>.25
			LIND/CAP	LENER/CAP	.71	.112	40.31	40.31	.85	1/7	P<.01
	Low-Income Agriculture	21	LGNP/CAP	LENER/CAP	.24	.074	10.44	10.44	.35	1/19	P<.01
			LAG/CAP	LENER/CAP	.09	.099	.81	.81	.04	1/19	P>.25
			LIND/CAP	LENER/CAP	.38	.142	7.03	7.03	.27	1/19	.01<P<.05
	Advanced Agriculture	15	LGNP/CAP	LENER/CAP	.43	.155	7.64	7.64	.37	1/13	.01<P<.05
			LAG/CAP	LENER/CAP	-.05	.201	.06	.06	.00	1/13	P>.25
			LIND/CAP	LENER/CAP	.71	.205	12.04	12.04	.48	1/13	P<.01

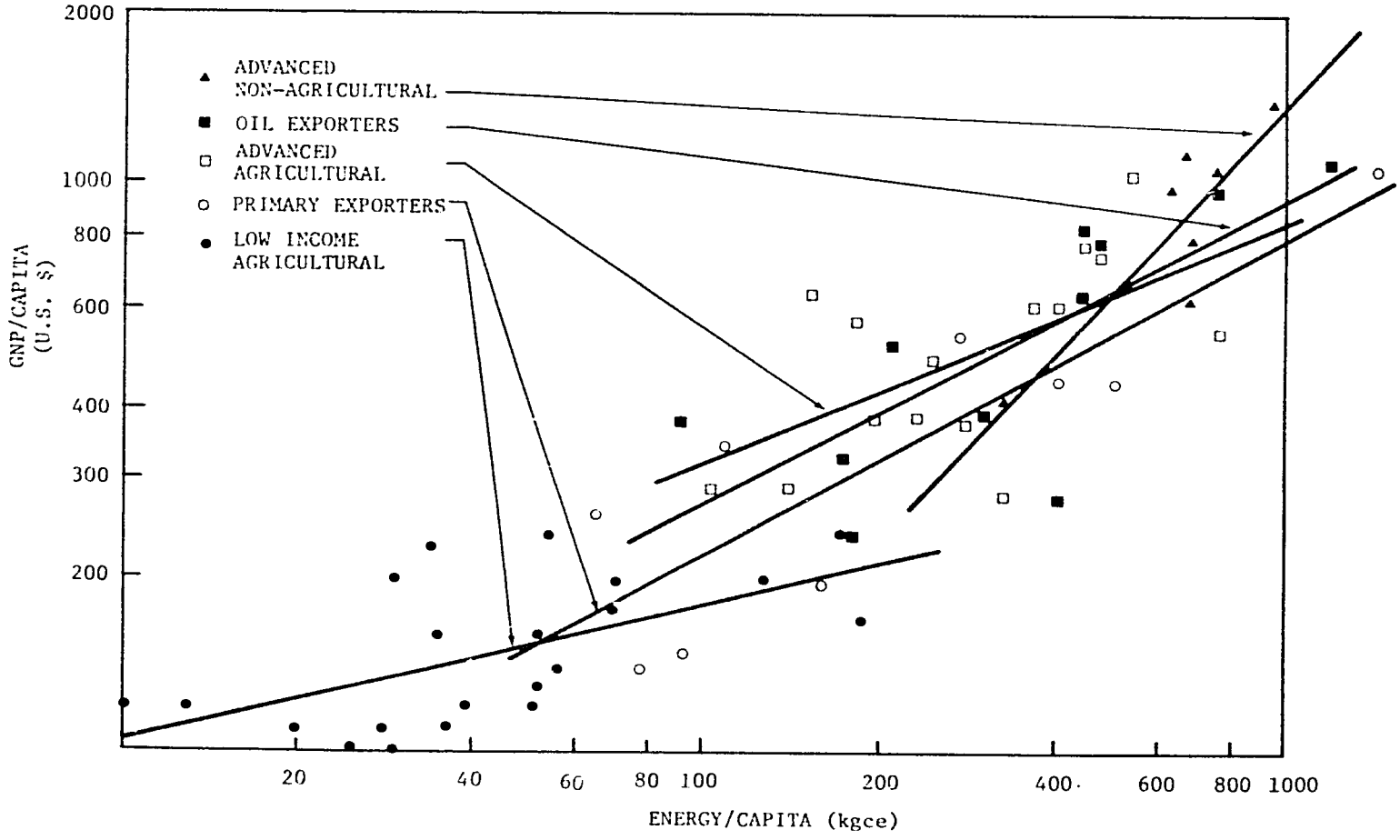


FIGURE 2
GNP/CAPITA VS. ENERGY/CAPITA

TABLE VI

GDP GROWTH RATE REGRESSION
(ALL COUNTRIES)

Run No.	Country Group	Number of Data Values	Dependent Variable (1)	Independent Variable (1)	Coef. B	Standard Error of B	F Statistic Coef.	F Statistic Reg.	r^2	Degrees of Freedom	P Significance Level of Regression
Additive on Growth Rates of Capital, Labor and Energy	All Countries	55	RGDP(2)	RGDI(2)	.18	.030	33.09	32.55	.66	3/51	P<.01
				RLABOR	1.34	.451	8.78				
				RENER	.13	.048	6.99				
			RAG	----------No Significant Variables----------							
			RIND	RGDI	.21	.062	11.88	14.52	.46	3/51	P<.01
				RENER	.25	.099	6.37				
				RLABOR	1.45	.920	2.48				

(1) Percent growth rates.

(2) "R" prefix stands for growth rate in the variable.

TABLE VII

GDP GROWTH RATE REGRESSION
(COUNTRY GROUPS)

Model	Country Group	Number of Data Values	Dependent Variable (1)	Independent Variable (1)	Coef. B	Standard Error of B	F Statistic Coef.	F Statistic Reg	r^2	Degrees of Freedom	P Significance Level of Regression
Additive on growth rates of capital, labor and energy	Advanced Non-Agricultural	7	RGDP	RGDI	.39	.097	16.59	16.59	.77	1/5	P<.01
			RAG	RENER	.49	.186	6.80	6.80	.59	1/5	.01<P<.05
			RIND	RGDI	.49	.094	27.24	27.24	.84	1/4	P<.01
	Oil Exporters	10	RGDP	RGDI	.16	.064	6.30	6.30	.41	1/9	.05<P<.10
			RAG	---------	No Significant Variable						
			RIND	RENER	.42	.256	2.71	2.71	.23	1/9	.10<P<.25
	Primary Exporters	7	RGDP	BLABOR	2.69	.719	14.02	11.85	.92	3/3	P<.01
				RGDI	.06	.023	6.88				
				RENER	-.14	.086	2.78				
			RAG	---------	No Significant Variable						
			RIND	BLABOR	5.35	1.885	8.05	7.71	.79	2/14	P<.01
				RGDI	.17	.095	3.31				
	Low Income Agriculture	17	RGDP	RGDI	.15	.085	2.95	3.19	.31	2/14	.05 P<.10
				RENER	.12	.074	2.69				
			RAG	---------	No Significant Variable						
			RIND	RGDI	.58	.142	16.83	16.83	.53	1/15	P<.01
	Advanced Agriculture	11	RGDP	RGDI	.18	.065	7.96	9.20	.80	3/7	P<.01
				RENER	.15	.091	2.86				
				BLABOR	.89	.546	2.66				
			RAG	RGDI	.22	.110	4.01	4.01	.31	1/9	.05<P<.10
			RIND	RENER	.55	.25	4.75	4.74	.35	1/9	.05<P<.10

(1) See Table 4-1 for definition of variable codes.

In comparison, there is little uniformity in the results shown by country group in Table VII. It is evident that high income countries in general have high rates of growth in all variables: GDP, capital, labor and energy. Similarly, low income countries have low growth rates. The regression picks up this relationship across countries. However, within a country group, the income spread is not large and the relationship is not seen.

In our interpretation, the real world situation is much more complicated than what may be explained by an elementary model. The unexplained variance between countries even within country groups is just too large. It appears that many more factors are operating than the few examined here, and that more accurate models would be much more complex.

The results of a comparison of GNP/Capita and percentage oil dependence showed that for all countries the correlation between these two variables was -.007. In other words, there is no statistically significant relationship to suggest oil dependent nations tend to be rich or poor.

Figure 3 shows the distribution of oil dependence among the developing countries in the world. The dependence on oil is greatest in central and eastern Africa and in Central America. It is interesting to note that oil exporting nations are not as oil-dependent as many oil importing countries, presumably because natural

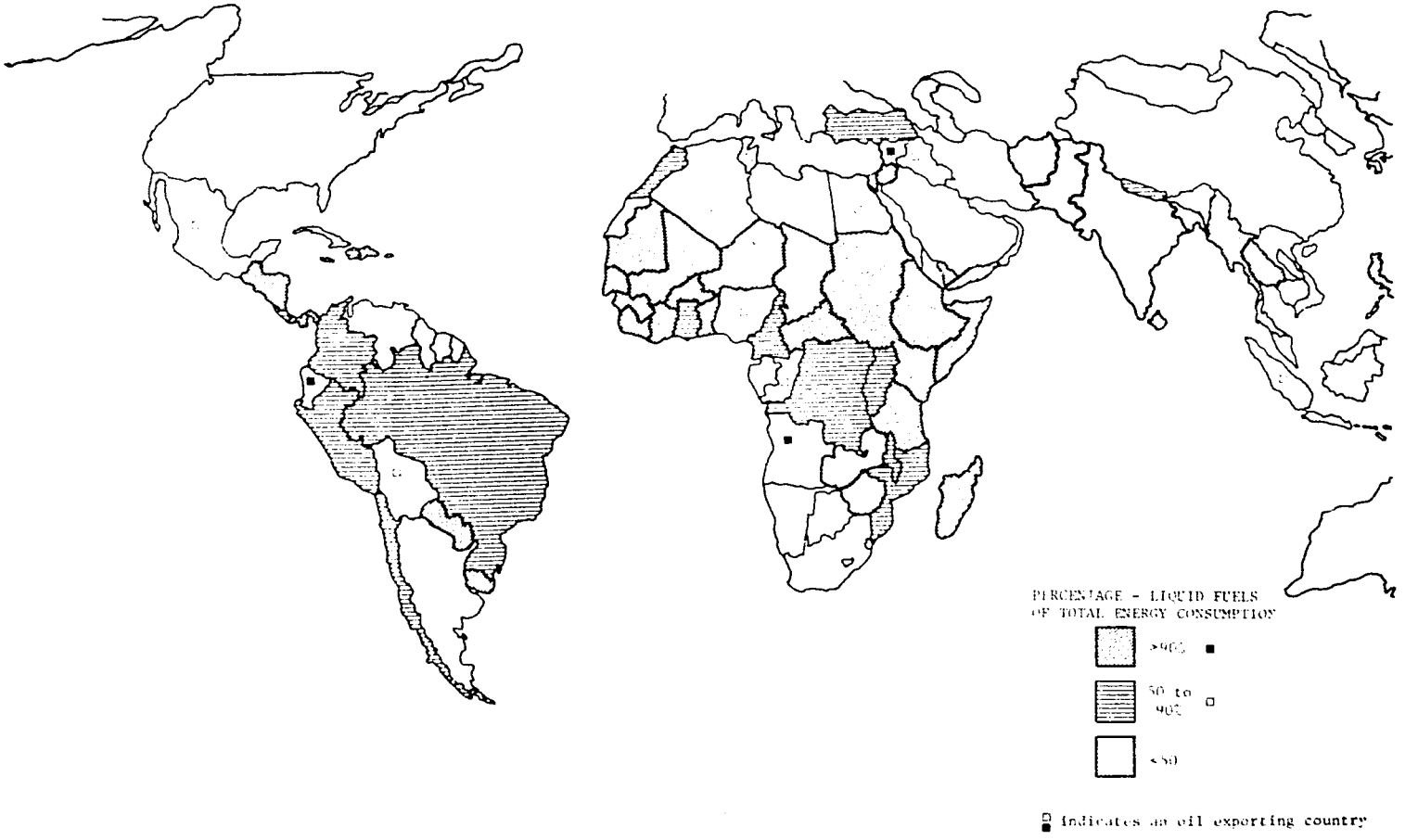


FIGURE 3
PETROLEUM DEPENDENCE CHART

gas tends to be produced in association with oil, and may be preferentially used for domestic purposes.

4.1.5 Discussion

The analysis just described has shown that there is an important relationship between energy and economic growth for developing countries. This is a significant result which has definite implications on the role of energy in development programs in developing countries.

A number of counter-intuitive or confusing results appeared when we attempted to interpret much more than overall energy-economic relationships. These attempts to look more closely at relationships through country stratification yielded more questions than answers.

First, we do not know why the apparent efficiency of energy use relative to economic production is higher for advanced non-agricultural countries than for low-income agricultural countries. One could conjecture that for poor countries a large portion of commercial energy (primarily oil) goes to subsistence rather than production. For instance, in a low-income country, petroleum may be mainly used in the form of kerosene for lighting and cooking. In contrast, in a more advanced economy, a large proportion of petroleum is used in industrial production or to make higher-value intermediate commercial products, such as petrochemicals or electricity. These are subsequently resold, and thus contribute more to GNP. To test this conjecture would require data on sectoral energy consumption in developing countries. It would be most useful to compare the primary usage of a

barrel of oil in a low income agricultural country with the corresponding usage of oil in an advanced non-agricultural country.

Second, there is a great deal of unexplained variance in the analysis performed. The differences in economies of different countries are apparently significant. The general models of economic-energy relations do not have the necessary detail to explain the variance.

The results showing little relationship between commercial energy consumption and agricultural contributions to GNP need to be discussed. It would be incorrect to conclude from these results that commercial energy is not important to the agricultural sector of the economy of developing countries. The work by Faidley[18] indicates that commercial energy inputs to agriculture, though small in size, are of importance in LDC development. The regressions in our study were based on total country commercial energy consumption. The analysis could not identify the small portion of total energy consumption applied to agriculture.

Finally, an analysis of energy-economic relationships for developing countries is truly incomplete without an assessment of the use of non-commercial energy resources. The current data on non-commercial energy use is very limited and preliminary. There is a need to determine meaningful methods for measuring and estimating this energy use and for incorporating it into economic assessment for developing countries.

4.2 The Effects of Petroleum Prices On Economic Growth Rates and Inflation Rates

4.2.1 Conclusions

The average economic growth rate per capita of non-oil-exporting LDC's dropped by more than half after 1973, from 3.1 percent to 1.5 percent. At the same time, the average inflation rate in these countries more than tripled from 7.7 percent to 24.9 percent. These effects strongly appear to have been caused by the oil price rise of 1973-74. In general, countries with lower energy (or petroleum) consumptions, both absolutely and relative to Gross Domestic Product, fared better than others.

In contrast, the economic growth rates per capita of oil exporting LDC's increased from 3.7 percent to 4.0 percent. Their inflation rates also increased, but by less than those of the non-oil-exporters, from 7.5 percent to 14.8 percent.

4.2.2 Approach

The basic assumption underlying the approach is that the sudden tripling or quadrupling of crude oil prices in 1973-74 will have had observable consequences on the rates of economic growth and inflation in LDC's. A further assumption is that investigation of these effects might yield insights into the energy-economy relationships of LDC's which will be helpful for policy formulation.

Although much work has been done on the impact of oil price rises on advanced or industrialized nations, there is little relevant to LDC's. Specifically for developing countries, Powelson has made an

investigation of the negative impacts of the oil price increase on LDC's.[20]

The influence of inflation on economic growth for LDC's has been investigated by Glezakos.[21] He concluded that general price instability was more deleterious than inflation as such, social equity considerations aside. This result is confirmed by Ip[22], who conducted a theoretical analysis.

In our analysis, two data bases have been assembled, one for the growth rate analysis, and one for the inflation analysis. They are listed Appendix A, Tables A-3 and A-4.

The analysis approaches are very similar for growth rates and for inflation. The parameter chosen to represent the economic growth rate is the (geometric) mean annual percentage change in gross domestic product per capita. The parameter chosen for inflation is the (geometric) mean annual percentage change in the consumer price index. Strictly, the GDP deflator is a better measure of inflation than the consumer price index. However, the latter was available for many more countries. The GDP growth rate data base includes 55 countries, and the inflation data base includes 79 countries.* The sources and characteristics of the data are discussed in Subsection 4.3.

The analyses start with examination of the mean pre-1973 and post-1973 growth and inflation rates for oil-exporting LDC's and for

*Data was not available for more countries.

non-oil-exporting LDC's. Then regression analyses are conducted to examine the differences between pre-1973 and post-1973 growth and inflation rates in terms of the other variables. These regression analyses are conducted for all the countries together and then for stratification of the countries based on type of economy.

4.2.3 Data Sources and Limitations.

The sources for the data used in these analyses are as follows:

- growth rates - International Monetary Fund[8] and United Nations[9]
- inflation rates-U.N.[9]
- GDP - World Bank[5]
- energy production and consumption-U.N.[11]
- population - IMF[8]

The assembly of time-series data for economic growth over sufficient periods of time presented some difficulties. The U.N. data, while it extended back to the 1950's, ended in 1974 or 1975. It was felt that this was an insufficient period after the oil price rises to obtain reliable values, since considerable year-to-year and cyclic variability could be seen in the time-series. The IMF data, on the other hand, while it included 1976 or 1977, only extended back to 1971. This was felt to be an insufficient period before the price rises.

The problem was resolved by converting the IMF data to the same format as the U.N. data, namely an index number of real GDP per capita, and matching the two series over the period 1971 through 1974 when common data was available. The agreement between the two series was

good for most countries*; cases where severe disagreements were seen were discarded.

The growth rate data in general was found to be quite sparse. Thus the sample of countries for which reasonably full data was available numbered only 55.

For inflation rates, the U.N. data generally extended to 1976. It was decided that this was an adequate length of time. The sample of countries in the inflation data base numbered 79, reflecting the greater availability of price data.

Inevitably, the data displays some weaknesses, having been derived from several different sources. This is especially true for the growth rate data base. Major inconsistencies have been eliminated as far as possible by cross-checking between different sources.

4.2.4 Results

Table VIII shows the mean economic growth rates per capita and the inflation rates for oil-exporting and non-oil-exporting LDC's, before and after 1973, together with the estimated standard errors of the means.

The results indicate that the per capita growth rates of nonoil-exporting LDC's dropped by more than half, from 3.13 percent to 1.45 percent after 1973. This change is statistically significant at the 0.1 percent level. In contrast, the growth rate of the oil exporting countries increased from 3.66 percent to 4.55 percent after 1973. The

*within 1 or 2%

TABLE VIII

MEAN ECONOMIC GROWTH RATES AND INFLATION RATES FOR LDC'S

Country Group	No.	Parameter	Mean Value	Standard Error of Mean
Non-Oil-Exporting LDC's	44	1965-73 Annual Economic Growth Rate (per capita)	3.13%	0.366
Non-Oil-Exporting LDC's	44	Post-1973 Annual Economic Growth Rate (per capita)	1.45%	0.414
		Mean Difference	-1.68%	0.438
Oil-Exporting LDC's	11	1965-73 Annual Economic Growth Rate (per capita)	3.66%	0.776
Oil-Exporting LDC's	11	Post-1973 Annual Economic Growth Rate (per capita)	4.55%	0.644
		Mean Difference	+0.89%	0.806
Non-Oil-Exporting LDC's	62	1966-73 Inflation Rate	7.74%	1.297
Non-Oil-Exporting LDC's	62	Post-1973 Inflation Rate	24.92%	5.968
		Mean Ratio	3.38	0.233
Oil-Exporting LDC's	17	1966-73 Inflation Rate	7.54%	2.283
Oil-Exporting LDC's	17	Post-1973 Inflation Rate	14.75%	1.545
		Mean Ratio	2.61	0.193

pre-1973 performance was about the same as the non-oil-exporting countries, while the post-1973 performance was significantly better at the 0.1 percent level. Thus, there appears to be a genuine difference in the economic growth rates after 1973 between oil-exporting and oil-importing LDC's.

Similarly, the results show the inflation rate more than tripled* in non-oil-exporting LDC's after 1973, rising from an annual rate of 7.7 percent to 24.9 percent. This rise is statistically significant at the 0.1 percent level. The inflation rate rose in oil-exporting LDC's also, but by a significantly smaller amount. It roughly doubled, from 7.5 percent to 14.8 percent. This is significantly lower than the non-oil-exporters at the 0.1 percent level.

To summarize, table VIII shows that non-oil-exporting and oil-exporting were roughly comparable in economic growth rates and inflation rates before 1973. After 1973, however, the oil exporters fared significantly better in both respects than the non-oil-exporters.**

The regression analyses of economic growth rates and inflation rates both attempt to discern relationships between the change in pre-1973 and post-1973 values (of economic growth rate or inflation) and other parameters, including energy self-sufficiency and energy consumption. These analyses are discussed separately.

---

*Note that the mean ratio as shown in the tables is not the same as the ratio of the means.

**Industrialized countries also showed a drop in economic growth rate (from about 5% to about 2%) and a rise in inflation (from about 7% to about 11%). Thus, their growth rates chopped more than LDC's, but their inflation rates rose much less.

Table IX contains the results of the analyses of the change in the GDP per capita growth rate. These analyses were undertaken using single and multiple linear regression techniques. The independent variable is, in all runs, the difference between the 1965-73 GDP per capita growth rate and the post-1973 rate. Twenty-four runs were made in all. Runs 1 through 6 will be discussed first, then runs 7 through 24. Runs 1 through 6 regressed the change in GDP per capita growth rate against six other variables for various stratifications of the countries.

The independent variables for runs 1 through 6 were:

- GDP per capita, US$, 1976 (GDPPC)
- 1965-1973 GDP per capita growth rate (GR6573)
- % Self-sufficiency in energy, 1972 (SSAE)
- % Self-sufficiency in liquid fuel (SSPT)
- total liquid fuel consumption kgce* 1972 (TPC)
- population in millions, 1972 (POP)

The country stratifications used were:**

- run 1 - all together
- run 2 - all excluding oil exporters
- run 3 - advanced non-agricultural
- run 4 - primary exporters
- run 5 - low-income agricultural

*Kilograms of coal equivalent
**See Chapter 3 for a description of these stratifications.

TABLE IX

REGRESSIONS FOR CHANGE IN GDP/CAPITA GROWTH RATE

Run No.	Country Group	Number of Obervations	Dependent Variable	Independent Variable	Coef. B	Standard Error of B	F Coef.	F Reg.	r^2	Degrees of Freedom	P Significance Level of Regression
1	All	55	DELTA	GR6573 SSAE TPC	-.5270 .0008 -.0012	.178 .00041 .00074	9.89 3.83 2.58	7.55	.307	3/51	P<.01
2	All Excluding Oil Exporters	44	DELTA	GR6573 TPC	-.3790 -.0015	.187 .00079	4.10 3.75	8.63	.296	2/41	P<.01
3	Advanced Non-Agricultural	17	DELTA	GDPPC	-.0013	.00066	4.19	4.19	.218	1/15	.05<P<.1
4	Primary Exporters	5	DELTA	TPC	-.0069	.00249	7.56	7.56	.621	1/3	.05<P<.1
5	Low-Income Agricultural	9	DELTA	SSPT	.0811	.0286	8.00	4.04	.303	2/6	.05<P<.1
6	Advanced Agricultural	11	DELTA	GR6573 SSAE	-.8670 -.0510	.321 .0246	7.29 4.30	4.96	.314	2/8	.01<P<.05

Variable Symbols:

DELTA - Change in GDP per capita growth rate
GDPPC - GDP per capita
GR6573- Growth rate 1965-73
SSAE - Self-sufficiency in energy
SSPT - Self-sufficiency in petroleum
TPC - Total liquid fuel consumption

TABLE IX (Continued)

Run No.	Country Group	Number of Data Values	Dependent Variable	Independent Variable	Coef. B	Standard Error of B	F Statistic Coef.	F Statistic Reg.	r^2	Degrees of Freedom	P Significance Level of Regression
7	All	55	DELTA	TPC	-.0222	.00072	9.96	9.96	.16	1/53	P<.01
8			DELTA	SSPT	------not significant-----			.45	.01	1/53	P>.25
9			DELTA	ENINT	-3.70	1.70	4.74	4.74	.08	1/53	.01<P<.05
10	All Excluding Oil Exporters	44	DELTA	TPC	-.0024	.00069	12.25	12.25	.23	1/42	P<.01
11			DELTA	SSPT	------not significant-----			.08	.02	1/42	P>.25
12			DELTA	ENINT	-5.24	1.75	9.00	9.00	.18	1/42	P<.01
13	Advanced Non-Agricultural	17	DELTA	TPC	-.0018	.00098	3.50	3.50	.19	1/15	.05<P<.10
14			DELTA	SSPT	------not significant-----			.03	.00	1/15	P>.25
15			DELTA	ENINT	------not significant-----			.01	.00	1/15	P>.25
16	Primary Exporters	5	DELTA	TPC	-.0069	.0025	7.56	7.56	.72	1/3	.01<P<.05
17			DELTA	SSPT	3.75	2.02	3.45	3.45	.53	1/3	.10<P<.25
18			DELTA	ENINT	-9.73	2.42	16.15	16.15	.84	1/3	.01<P<.05
19	Low-Income Agricultural	9	DELTA	TPC	------not significant-----			.69	.09	1/7	P>.25
20			DELTA	SSPT	.0468	.0268	3.05	3.05	.30	1/7	.10<P<.25
21			DELTA	ENINT	------not significant-----			.20	.03	1/7	P>.25
22	Advanced Agricultural	10	DELTA	TPC	------not significant-----			.23	.03	1/9	P>.25
23			DELTA	SSPT	------not significant-----			.00	.00	1/9	P>.25
24			DELTA	ENINT	------not significant-----			.04	.00	1/9	P>.25

Variable Symbols:

DELTA = Change in GDP per capita growth rate
ENINT = Inverse energy intensity of GDP
SSPT = Self-sufficiency in petroleum
TPC = Total liquid fuel consumption

- run 6 - advanced agricultural

For all LDC's and for non-oil-exporters (runs 1 and 2), the pre-1973 growth rate variable enters with a negative coefficient. This means that those countries which were growing most rapidly before 1973 suffered the largest declines in growth rates.

For these groups the total liquid fuel consumption also exhibited a negative correlation; countries with higher petroleum consumptions suffered greater declines in growth rates.

There is also an indication, when both oil-exporters and non-oil exporters are taken together, that the degree of self-sufficiency in energy showed a positive correlation with the change in growth rate. That is, countries with more indigenous energy fared better after 1973 than those with less.

These results are all intuitively plausible. However, although the relationships are significant ($P<0.01$), their explanatory value is not high. Only some 30 percent of the variance in growth rate changes is explained by these relationships.

No clear pattern emerges from runs 3 through 6. The results for advanced non-agricultural countries, primary exporters, and low-income agricultural countries are not significant at the 5 percent level. The results for the advanced agricultural countries show a negative correlation with both the pre-1973 growth rate and the self-sufficiency in energy. This latter is counter-intuitive.

The second sequence of runs comprises eighteen runs in all (runs 7 through 24), as noted above. These runs use the same six stratifications of the LDC's, based on type of economy. For each of the six stratifications, the change in growth rate is regressed in turn against:

- total liquid fuel consumption (TPC)
- self-sufficiency in petroleum (SSPT)
- inverse energy intensity of GDP* (ENINT)

At the 5 percent level of significance, the following results appear:

- Total liquid fuel consumption is negatively correlated with the change in growth rates for all countries together, for the non-oil-exporting countries, and for the primary exporters.
- Self-sufficiency in petroleum showed no significant correlations within these economic groupings.
- The inverse energy intensity showed significant negative correlations with the change in growth rates for all LDC's together, for the non-oil exporting LDC's, and for the primary exporters.

To summarize the results of the regression analysis of growth rate charges, it seems that countries with lower petroleum or energy consumptions, both absolutely and relative to GDP, fared better than others. Also, the countries which were growing more rapidly before 1973 suffered greater declines in growth rates after 1973. No systematic variations by type of economy were apparent.

Table X shows the results of the inflation rate regressions. The ratio of the post-1973 and pre-1973 inflation rates was used as the

*defined in kgce per U.S.$

TABLE X

REGRESSIONS FOR CHANGE IN INFLATION RATE

Run No.	Country Group	Number of Data Values	Dependent Variable	Independent Variable	Coef. B	Standard Error of B	F Statistic Coef.	F Statistic Reg.	r^2	Degrees of Freedom	P Significance Level of Regression
25	All	79	RATIO	No Significant Variables							
26	All Excluding Oil Importers	62	RATIO	No Significant Variables							
27	Advanced Non-Agricultural	17	RATIO	No Significant Variables							
28	Primary	8	RATIO	IPRE	-0.1910	0.0940	4.15	4.15	0.409	1/6	.05<P<.10
29	Low Income Agricultural	20	RATIO	SSPT IPRE	.0402 -0.346	0.0198 0.180	4.11 3.69	4.66	0.214	2/17	.01<P<.05
30	Advanced Agricultural	15	RATIO	TPC	-.0101	0.0033	9.47	9.47	0.42	1/13	P<.01

Variable Symbols:

IPRE = Pre-1973 inflation rates
RATIO = Ratio of inflation rates
SSPT = Self-sufficiency in petroleum
TPC = Total liquid-fuel consumption

dependent variable after a preliminary examination indicated a strong correlation between pre-1973 and post-1973 inflation rates. That is, countries with above average inflation before 1973 also tended strongly to have above average inflation after 1973. Since the main purpose of the analysis was to examine the change in inflation as a function of other variables, the ratio was used to eliminate this first-order effect.

The independent variables in the analysis were:

- percent self-sufficiency in energy (SSAE)
- percent self-sufficiency in liquid fuels (SSPT)
- total energy consumption, kgce/cap (TEC)
- total liquid fuel consumption, kgce/cap (TPC)
- population, millions (POP)
- pre-1973 inflation rate

The results of the multiple regression runs (25 through 30) were disappointing. In the first four runs, namely for all LDC's, for non-oil-exporters, for advanced non-agricultural and for primary exporters, no relationships were found which were significant at the 5 percent level. For the remaining two groups, low-income agricultural and advanced agricultural, significant relationships were found, but they bear no resemblance to each other.

For low-income agricultural LDC's the inflation ratio was found to be positively correlated with self-sufficiency in liquid fuel and negatively correlated with the pre-1973 inflation rate. For advanced

agricultural LDC's the ratio was found to be negatively correlated with liquid-fuel consumption. These results are, on the whole, counter-intuitive. It is possible that the details of changes in the inflation rate in a country are more highly influenced by internal political and economic considerations and decisions (such as money supply, interest rates, fiscal policy and government expenditure) or by the quantities of oil imports relative to all imports. It certainly appears that the variables investigated here are powerless to explain the specific changes observed.

4.2.5 Discussion

The analyses described in this section suggest a very strong causal link between the petroleum price rises of 1973-74 and a subsequent deterioration in the economic performance of LDC's. This assertion is not only supported by the data but is intuitively plausible. The policy implications for assistance are clear. The disappearance of cheap energy supplies worsened the LDC's economic growth; therefore, the restoration of cheap energy would improve it.

Of course, there are no more cheap energy supplies. However, the point remains that assistance which makes available new energy at competitive costs will help the economic development of LDC's. Further, if these new energy sources are protected from excessive future price rises, they would help insure against further deteriorations in the LDC's economic performance caused by petroleum price increases.

The lack of a discernible pattern in the stratified analyses is disturbing. There are two possible explanations. First, the independent variables used are inadequate to explain the major portion of variations in economic performance; and second, the quality of the data is so poor as to obscure the relationships for small groups of countries. There is probably some element of truth in both of these ideas. There certainly are variations in the data due to, e.g., cyclic economic effects or changes in data collection methods. Cyclic effects in particular can be significant. If an economy goes through a repetitive boom-slump cycle, the apparent growth rate can vary radically according as it is measured peak-to-peak, trough-to-peak, or peak-to-trough. Insufficient data was available to estimate or eliminate these types of effects in this analysis.

It is, of course, also true that year-to-year economic performance of LDC's is affected by many more factors than those considered here. Of particular interest for further work would be the effects of commodity (export) prices for the LDC's and perhaps some measure of the stimulatory or inhibitory effects of their domestic fiscal and monetary policies. In addition, the degree of dependence on foreign trade, industrial mix, extent of foreign aid and investment and political structure (e.g. democratic vs. dictatorship or capitalist vs. socialist) could be explanatory factors.(23)

4.3 Balance of Payments Analysis

4.3.1 Conclusions

The balance of payments (BOP) situation of non-oil-exporting LDC's has suffered a severe deterioration since 1973. The real BOP deficits were roughly three times higher in 1976-77 than in 1972-73. The deterioration strongly appears to have been caused by the increase in costs of oil imports since 1973. One of the most promising methods of alleviating the problem in the long run is clearly the development of indigenous energy resources in those LDC's which currently depend upon imported petroleum.

4.3.2 Approach and Data

The effects of the petroleum price rises of 1973-74 on the balance of payments position of LDC's has been investigated by Powelson[20] for certain LDC's. Our examination encompasses a larger sample. It is based on straightforward collection and examination of time series data. Two series were collected for each country, these being overall balance of trade data and balance of payments for petroleum only.

In detail, the overall balance of trade data were collected from IMF statistics (reference[8], as the sum of accounts 77aa through 77ag). This includes trade in merchandise and other goods, services and credit, and private and official unrequited transfers. It excludes direct investment and short and long-term capital, etc. The series covers 1971-1977. The figures on the petroleum balance were

computed from the import and export volumes given by the U.N. [11,12,13] multiplied by the world average petroleum price. The series covers 1972-76. Both series are corrected for inflation in the results presented here. A listing of the complete data base is given in Appendix A, Table A-5. Complete time series data were available for 40 non-oil exporters and 12 oil-exporters.

4.3.3 Results and Discussion

Table XI contains the mean overall balance of payments and mean petroleum balance data for oil-exporting countries and non-oil-exporting countries. These data are plotted in Figures 4 and 5. These results cover 40 non-oil-exporting LDC's and 12 oil-exporting LDC's. Thus the results are not comprehensive; however, we feel that they are representative.

The overall BOP for non-oil-exporters moves fairly well in step with their oil bills, although the gap widens in 1974 and 1975. This may be because our methodology has priced oil imports as if they were all crude oil while some fraction of them will in fact be the more expensive refined products. Thus, the oil bill may be underestimated.

For the oil-exporting countries it is interesting that the mean overall BOP shows an income for only one year, 1974, notwithstanding the enormous surpluses due to oil shipments after 1973. It appears that, after a lag of one year or so, the oil exporting countries expanded their imports to the point where they consumed all

TABLE XI

MEAN BALANCE OF PAYMENTS FOR LDC'S (1970 U.S. $)

	Year							
	1971	1972	1973	1974	1975	1976	1977	
Non-Oil-Exporters Overall B.O.P.	-148	-57	-330	-330	-350	-268	-253	40 Countries
Non-Oil-Exporters Petroleum B.O.P.	--	-49	-59	-203	-194	-203	--	
Oil Exporters Overall B.O.P.	-116	-180	-211	209	-647	-371	-275	12 Countries
Oil Exporters Petroleum B.O.P.	--	498	665	2032	1771	1966	--	

Table shows mean values for 40 non-oil-exporting countries and 12 oil-exporting countries.

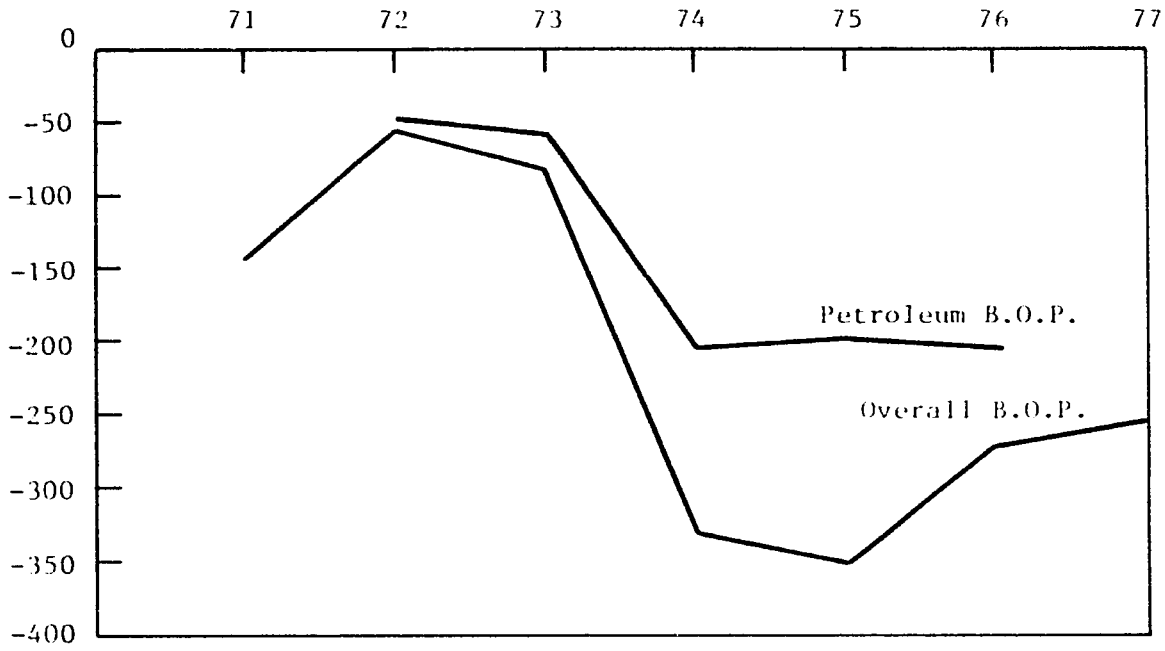


FIGURE 4
MEAN BALANCE OF PAYMENTS FOR NON-OIL EXPORTING LDCs
(U.S. $ x 10^6, 1970)

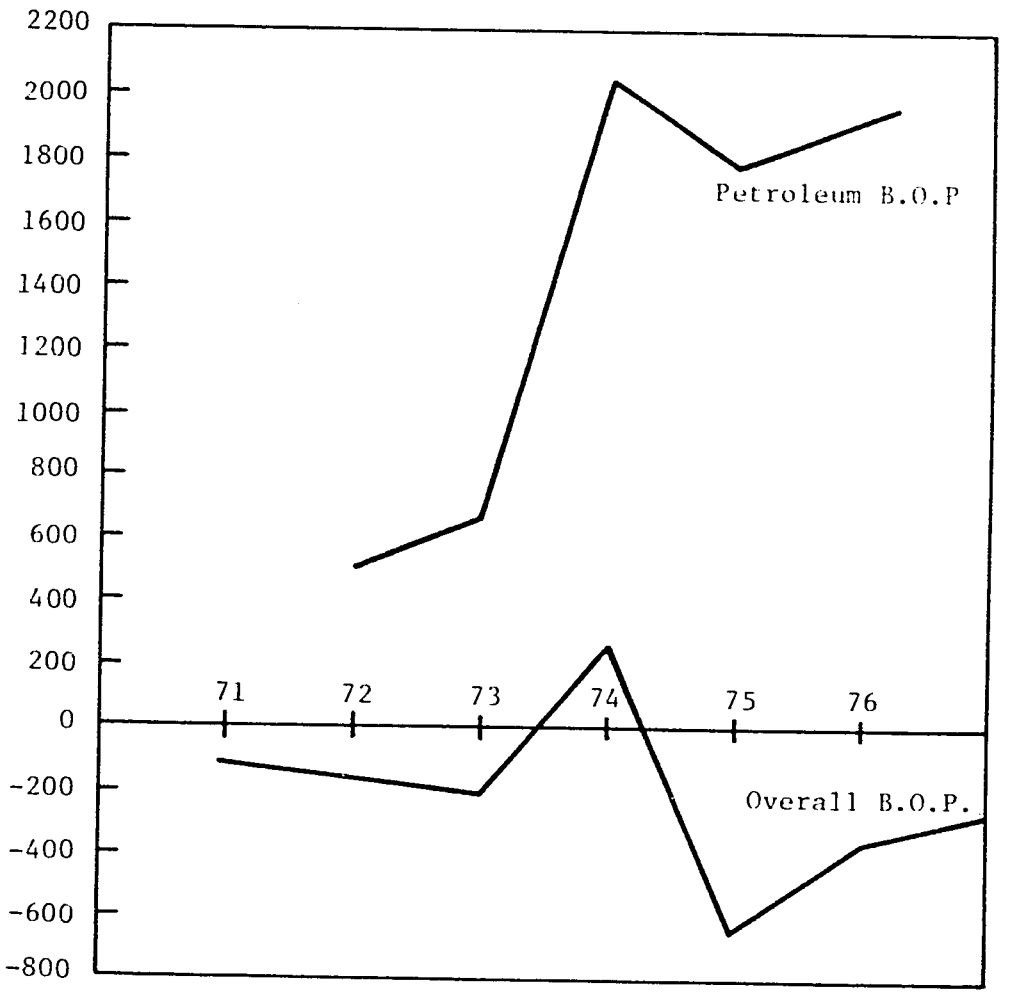


FIGURE 5
MEAN BALANCE OF PAYMENTS FOR OIL-EXPORTING LDCs
(U.S. $ x 10^6, 1970)

the newly-increased oil revenues. Since the BOP situation of the non-oil-exporting LDC's did not much improve, it is likely that the bulk of these imports came from the industrialized countries. It should be noted that the oil exporting countries analysed here exclude some of the countries with the largest BOP surpluses, such as Kuwait, Bahrain, and the United Arab Emirates.

The overall BOP position of the non-oil-exporting LDC's shows a slow improvement from 1975 on through 1977. However, their deficits at the end of 1977 were still two to three times larger than in 1971-1973. This situation clearly will put severe strains on their economies if it continues into the 1980's, since their ability to cover these losses by borrowing is limited. The development of indigenous energy sources is clearly one of the more important ways in which their BOP's can be improved, since it attacks directly the cause of the problem.

5.0 ENERGY AND SOCIAL DEVELOPMENT

5.1 Conclusions

The analyses conducted have shown that there are significant relationships between the Physical Quality of Life Indicator (PQLI) and both Gross Domestic Product per capita (GDPPC) and Total Commercial Energy Consumption per capita (TEC). These relationships are largely unaffected by the type of economy in the country (agricultural, industrial, mixed, etc.) and by the geographical location of the country. They appear to be conditioned, however, by the cultural orientation of the country as expressed by its choice of religion; Buddhist or Hindu countries have lower GDPPC or TEC values, on the whole, than Christian countries for given PQLI, and Christian countries have lower values than Islamic countries. There is also more variability among the PQLI-energy and PQLI-GDPPC relationships of lower-income countries than among those of higher income countries.

5.2 Approach

It is clear that, when we speak of "social development" or "the quality of life", we mean something quite different from the level of economic activity, and something which cannot be measured in economic terms. Unfortunately, the quality of life is a much more elusive concept than the Gross National Product, and no fully satisfactory method of measuring it has been developed.

Various attitude surveys have been made which have attempted to measure directly the respondent's satisfaction with life.[24] However, little data of this type is available for LDC's, and it also

seems open to methodological questions which might make intercomparability between different cultures difficult. Perhaps the best approach to measuring the Quality of Life is the Physical Quality of Life Indicator (PQLI) formulated by the Overseas Development Council.[25] The PQLI is linear function of: the infant mortality rate (per thousand live births), m; the life expectancy in years at age one, e; and the adult literacy rate, a. The original definition of PQLI scaled these factors on a 0-100 base, with 0 corresponding to the worst observed performance, and 100 corresponding to the best possible performance. These three indices were then averaged to obtain the PQLI. For our purposes, the PQLI can be expressed as:

$$PQLI = -0.15*m + 0.855*e, +0.333*a +1.90$$

This measure has been used as the basis for the following analysis; its strengths and weaknesses are discussed in Subsection 5.5. Alternative indices of physical well-being are discussed by Sheehan and Hopkins.[26] These indices include nutrition indicators, access to clean water, and housing.

The data base used for the PQLI analysis is shown in detail in Table A-6, Appendix A. The data base contains, for a sample of 110 LDC's, the following elements:

- life expectancy, e,
- infant mortality, m
- adult literacy, a
- type of economy (as defined in Section 2)

- an indicator of PQLI data quality
- GDP/Capita in U.S.$, 1974 (GDPPC)
- Energy Consumption/Capita, kgce, 1975 (TEC)
- population, millions, 1975 (POP)
- an indicator of energy and economic data quality
- a geographical region variable
- a cultural (religion) variable

A detailed description of the data, its sources, and its quality follows in Subsection 5.3.

Multiple and simple linear regression analyses have been used to search for meaningful and significant relations between the PQLI and energy and economic data for all the countries together, and for various stratification of the countries. In general, PQLI has been used as the dependent variable and the natural logarithm of the GDP/Capita (GDPPC) or Energy Consumption/Capita (TEC) has been used as the independent variable. This transformation was made because of the highly non-linear nature of the PQLI-GDPPC relationship (see Section 5.4). In general, oil-exporting countries have been excluded from the analyses. Their incomes and energy consumptions have greatly expanded so recently that their PQLI's do not appear to have had time to catch up.

An analysis has also been undertaken of the relationships between the three components of the PQLI (namely, infant mortality, life expectancy, and literacy).

5.3 Data Limitations

The PQLI component data have been assembled from the World Bank,[6] the United Nations,[9],[10] and the Overseas Development Council.[24] Between them, these sources should give three estimates for life expectancy, infant mortality, and adult literacy.* The full table is reproduced in Appendix A in Table A-7. This table also shows the date to which the data refers. There are many gaps in the data, and there is also also considerable disagreement between the sources. It can be seen, for instance, among just the first few countries, the infant mortality estimates (per thousand live births) for Algeria are 36 (World Bank), 86 (U.N.) and 145 (ODC). For Angola, the range is even more, the corresponding figures being 24, 24, and 203. Generally, agreement is better for the life expectancy and (to some extent) for the literacy estimates.

It is clear that a wide range of uncertainty must surround PQLI estimates derived from this data. Depending on whether the most pessimistic or the most optimistic estimates were taken, the PQLI values for the first three countries could range from 3 to 18 (for Afghanistan), from 33 to 53 (for Algeria) and from 11 to 47 (for Angola).

Variations between sources appear to be lower for countries with higher PQLI's. This is probably due to better statistical and recording systems in those countries.

---

*Generally, life expectancy is given at birth, e_o. This has been converted to life expectancy at age one, e, by the formula: $e = e_o/(1-m/1000)$.

Estimates for e, m, and a have been formed by averaging the available estimates, except in some rare cases where the data appeared obviously strange. These cases included the estimates of 24 for infant mortality for Angola. In general, old data (from before 1960) was discarded.

5.4 Results

5.4.1 Unstratified Runs

Figure 6 shows PQLI plotted against the natural logarithm of the GDP per Capita (GDPPC) for 78 non-oil-exporting LDC's. There is a clear relationship which appears to follow the form of an S-curve.

Table XII tabulates the results of several linear regressions. PQLI was used as the dependent variable all through. In run 1, the independent variable is GDPPC, and the data base consists of 99 countries (including oil exporters). The F-value obtained is 12.4, which is sigrificant at the 1 percent level. The value of the coefficient of determination, r^2, is only 0.113. Thus, although the relationship is significant, it explains relatively little of the variation in PQLI. The removal of oil-exporting countries from the analysis (run 2) increases the F-value to 94.6 and the value of r^2 to 0.555. This relationship is highly significant.

The linearity of the relationship is improved by taking the natural logarithm of GDPPC (run 3). The F-value now becomes 193, and r^2 becomes 0.718. This result corresponds to the points plotted in Figure 6. This log-linear relationship has been used as the basis for

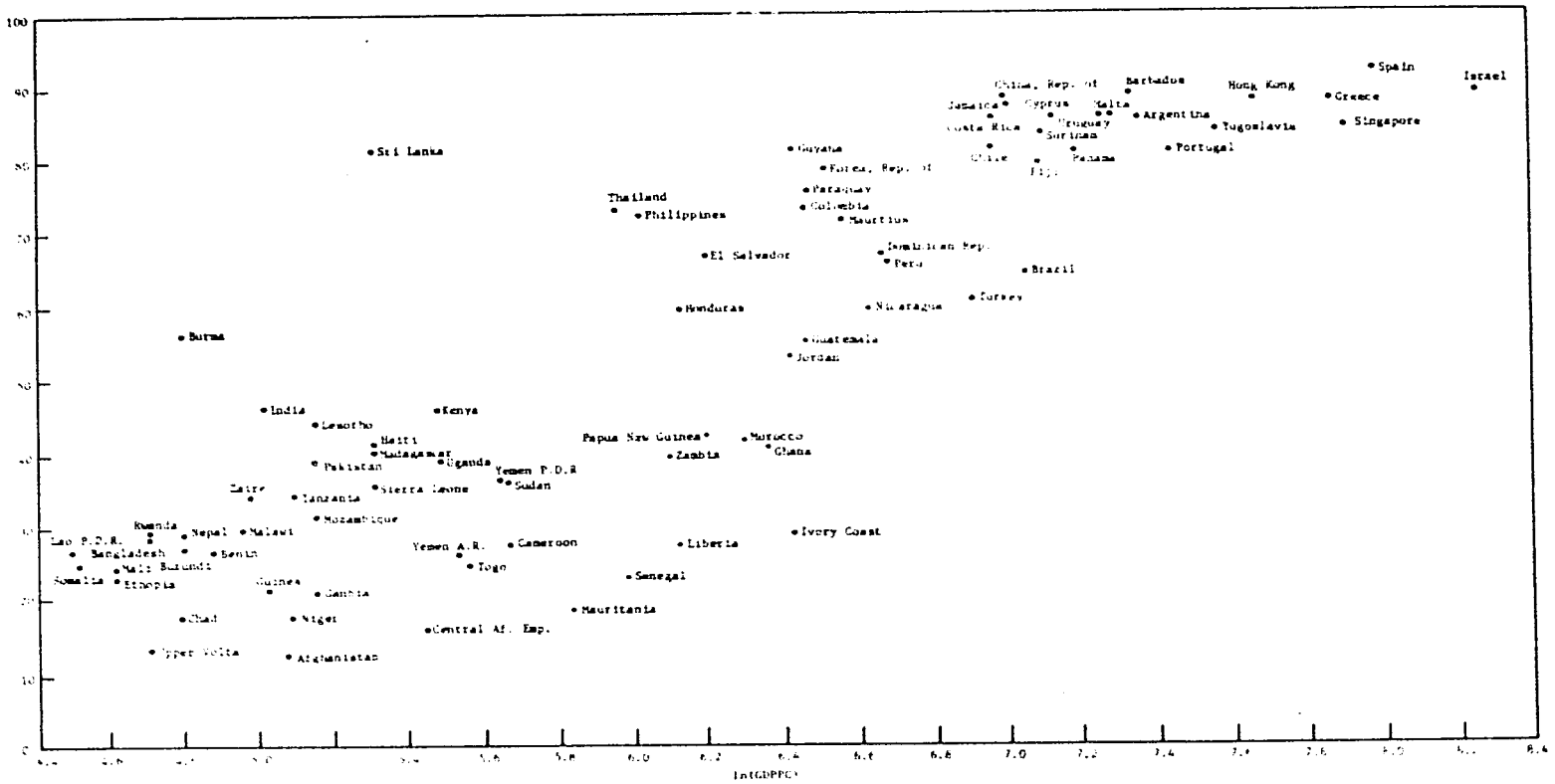


FIGURE 6
POLI VS. NATURAL LOGARITHM OF GDP PER CAPITA, LN (GDPPC)

TABLE XII

PQLI REGRESSION ANALYSES (UNSTRATIFIED)

Run No.	Countries	Dependent Variable	Independent Variable	Coef. B	Standard Error of B	F	r^2	Degrees of Freedom	P Significance Level of Regression
1	All	PQLI	GDPPC	0.0047	0.0013	12.4	0.113	1/97	<.01
2	All Excluding Group 2 (Oil Exporters)	PQLI	GDPPC	0.0259	0.0027	94.6	0.555	1/76	<.01
3	All Excluding Group 2 (Oil Exporters)	PQLI	La(GDPPC)	21.72	1.56	193.1	0.718	1/76	<.01
4	All Excluding Group 2 (Oil Exporters)	La(PQLI)	La(GDPPC)	0.448	0.038	138.4	0.645	1/76	<.01
5	All Excluding Group 2, GDPPC < 450	PQLI	La(GDPPC)	13.04	5.37	5.91	0.135	1/38	.01<.05
6	All Excluding Group 2, GDPPC >450	PQLI	La(GDPPC)	21.76	3.66	35.3	0.510	1/34	<.01
7	All Excluding Group 2, DAT = 1	PQLI	GDPPC						
8	All Excluding Group 2	PQLI	La(TEC)	13.59	1.00	186.4	0.702	1/79	<.01
9	All Excluding Group 2	PQLI	La(TEC) & La(GDPPC)	7.81 11.27	2.69 3.95	8.4 8.1 } 110.1	} 0.721	} 1/75	} <.01
10	All Excluding Group 2 DAT = 1	PQLI	GDPPC	.0224	.0036	39.8	0.554	1/32	

Variable Symbols:

GDPPC = GDP per capita
PQLI = Physical Quality of Life Indicator
TEC = Total Energy Consumption per capita

further analyses as the results are not improved by the use of a log-log relationship (run 4).

In examining Figure 6, it appears that the variability of the PQLI decreases for higher-income LDC's. This is supported by the results of runs 5 and 6 (Table 5-1), which deal with non-oil-exporting LDC's with GDPPC $\leq$ 450 and GDPPC $>$ 450, respectively.* The relationship for the higher-income stratification is much more significant.

This result may reflect a genuinely greater variability of PQLI's among lower-income countries. On the other hand, it may merely reflect the fact that data quality for lower income countries tends to be worse. As noted in Sub-section 2, there was disagreement between the sources for lower-income, lower-PQLI countries. An indicator variable (DAT) was inserted in the data base to reflect the quality of the PQLI data. DAT was set to a value of 1 if the agreement between the sources of data was good, and to 0 otherwise. Table XIII shows the criteria for "good agreement." DAT was set to 1 if the estimates met either criterion for each parameter.

Run 7 shows the effect of restricting the data set to countries with "good data" (i.e., DAT=1). It can be seen that the agreement obtained is not much different from the comparable run with DAT unspecified (run 2). This implies that the variation in PQLI reflects genuine differences in conditions rather than data errors.

*The value of $450 per capita was chosen to give roughly equal numbers of countries above and below this value. Ln (450)=6.11.

TABLE XIII

DEFINED TOLERANCES FOR PQLI DATA

Number of Estimates*	Parameter		
	e	m	a
Two estimates available	5% or 3 years	10% or 4 per thousand	10% or 4 percentage points
Three estimates available	8% or 4 years	15% or 6 per thousand	15% or 6 percentage points

*DAT = 0, if only one estimate is available.

The table entries show the maximum acceptable spreads of estimate values in both percent and absolute terms. The data is "acceptable" if either criterion is met for all three parameters. Considering the life expectance, estimates of 30.0 years and 33.0 years would be within tolerance (since the spread ±3 years); so would be estimates of 70.0 and 73.5 years (spread ±5%).

Runs 8 and 9 examine the relationship between PQLI and the per capita total energy consumption (TEC) expressed in kgce. Run 7 uses Ln(TEC) as the independent variable, and run 8 use both Ln(TEC) and Ln(GDPPC) in a multiple regression analysis.** PQLI shows about as good a relationship with Ln(TEC) as with Ln(GDPPC). The use of both variables does not significantly improve the relationship.

An analysis of variation of PQLI with population failed to show any relationship. The F-value was 0.02. This is so low that the results of the regression run are not reproduced here; it would be somewhat misleading to report the regression parameters of a relationship of such low significance level.

Some work published by ODC introduces the concept of the Disparity Reduction Rate DRR.[27] This concept implies that an improvement of the PQLI from, say, 90 to 95 is in some sense as significant or as important as an improvement from 50 to 75. Without exploring the idea too deeply, this appears to imply a kind of non-linear valuation of the PQLI, and raises the possibility of using mathematical transformations, such as subtraction and inversion to make the valuation linear again, which would perhaps facilitate analysis.

5.4.2 Stratified Runs

This subsection describes runs which have been made with the sample of countries stratified in various ways. The intention is to

*The degrees of freedom vary slightly between runs because of missing TEC and GDPPC data values.

cast light on the causes of variations of PQLI with a given GDPPC or TEC level. Because slightly better results were obtained using Ln(GDPPC) as the independent variable for the unstratified runs, this variable is used here. Little difference would be expected if Ln(TEC) were used.

Three stratifications have been examined:

- by type of economy
- by geographical region
- by culture (religion)

5.4.2.1 Stratification by Type of Economy. Table XIV shows the results of five regression runs (number 11 through 15) using PQLI on the dependent variable and GDPPC as the independent variable. These runs are stratified by economy type on the same basis as used in the economic analyses described in Section 4. The results of runs 1 and 2 are reproduced for comparison. No significant relationships were found for the oil exporters and the low income agricultural countries.

The regression lines are plotted in Figure 7 with the non-significant lines shown dotted. No clear pattern emerges as it appears that the variations in slope and position of the lines depend mostly upon the differences in GDPPC in the country groups. The only exception to this is the oil exporters. Their PQLI's bear little relationship to their GDPPC's. For instance, Kuwait has a GDPPC approaching $16,000 while its PQLI is only 72. It appears overall that the PQLI-GDPPC relations are not greatly different for different types of economies.

TABLE XIV

PQLI REGRESSION ANALYSIS STRATIFIED BY TYPE OF ECONOMY

Run No.	Countries	Dependent Variable	Independent Variable	Coef. B	Standard Error of B	F	r^2	Degrees of Freedom	P Significance Level of Regression
1	All	PQLI	GDPPC	.0047	.0013	12.4	0.113	1/97	<.01
2	All Excluding Group 2	PQLI	GDPPC	.0259	.0027	94.6	0.555	1/76	<.01
11	Group 2 (Oil Exporters)	PQLI	GDPPC	.0017	.0013	1.7	.082	1/19	>.10
12	Group 1&3, GDPPC 255 (Advanced Non-Agric.)	PQLI	GDPPC	.0064	.0019	11.0	.379	1/18	<.01
13	Group 4 (Primary Exporters)	PQLI	GDPPC	.0640	.0124	26.8	.748	1/9	<.01
14	Group 5&6, GDPPC 255 (Low Income Agric.)	PQLI	GDPPC	.0962	.0568	2.9	.107	1/24	>.10
15	Group 5&6, GDPPC 255 (Advanced Agric.)	PQLI	GDPPC	.0523	.0120	19.0	.528	1/17	<.01

Variable Symbols:

GDPPC = GDP per capita
PQLI = Physical Quality of Life Indicator

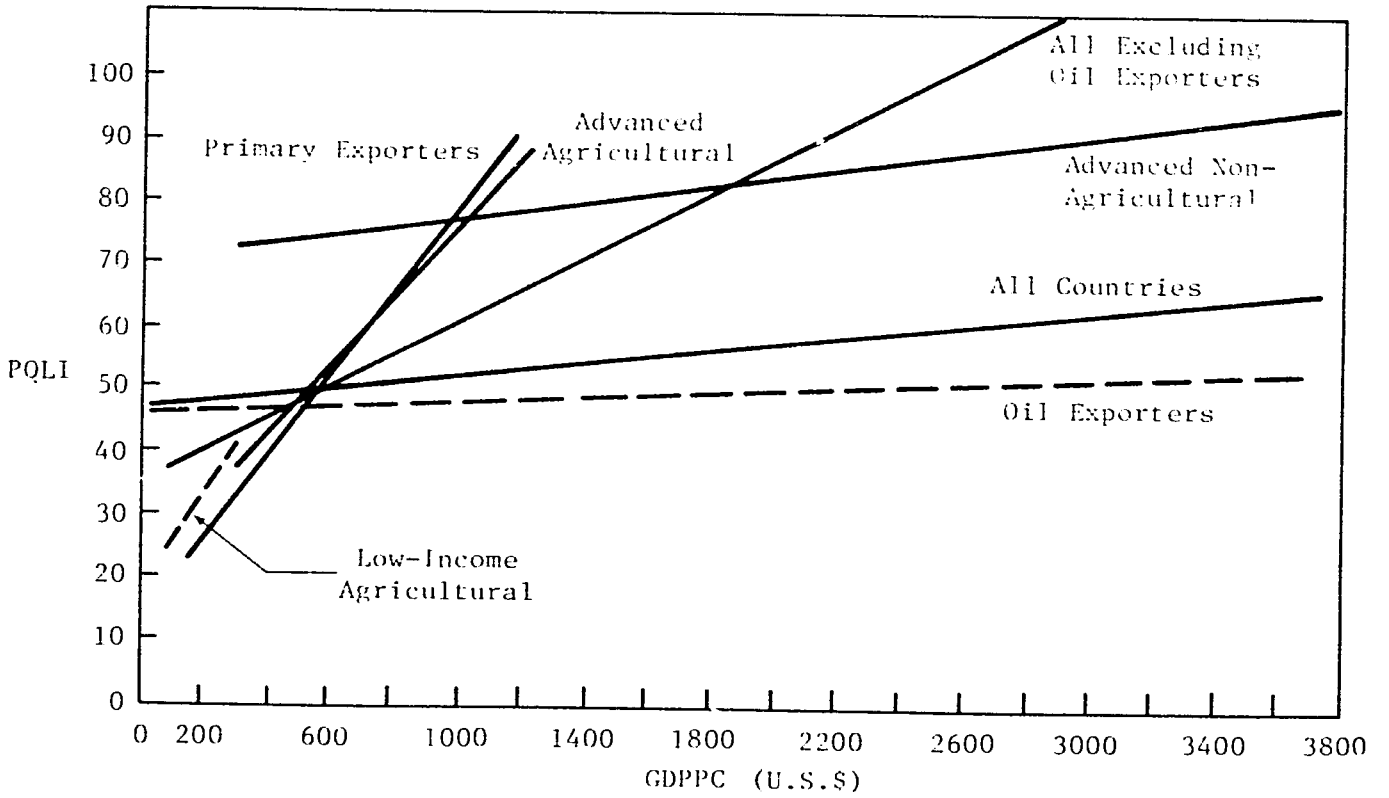


FIGURE 7
REGRESSION ANALYSES FOR PQLI STRATIFIED BY TYPE OF ECONOMY

5.4.2.2 Stratification by Geographical Region. The non-oil-exporting countries were stratified into the following regions:

- Africa South of the Sahara
- North Africa
- Middle East
- South Asia
- East Asia
- Central America and Caribbean
- South America
- Europe

Table XV shows the results obtained by regression analyses using this stratification (runs 16 through 23). PQLI was used as the dependent variable and Ln (GDPPC) as the independent variable. The results of run 3 are reproduced by companion purposes.

Figure 8 shows the plotted regression lines (non-significant lines are shown dashed). The majority of the lines fall close to the all-countries line. The exception is Africa. The Africa line seems to indicate a genuine difference between Africa and the rest of the developing world. The rate of increase of PQLI with GDPPC is much lower for these countries - approximately one half to one third that of the rest of the world.

5.4.2.3 Stratification by Religion. Religion was chosen as a convenient indicator of potential cultural differences between countries, because quantified data on religious affiliations are available

TABLE XV

PQLI REGRESSION ANALYSIS STRATIFIED BY GEOGRAPHICAL REGION
(NON-OIL-EXPORTING LDC'S)

Run No.	Countries	Dependent Variable	Independent Variable	Coef. B	Standard Error of B	F	r^2	Degrees of Freedom	P Significance Level of Regression
3	All Excluding Group 2 (Oil Exporters)	PQLI	Ln(GDPPC)	21.72	1.56	193.1	0.718	1/76	<.01
16	Southern Africa	PQLI	Ln(GDPPC)	10.38	4.07	6.52	0.220	1/23	.01<p<.05
17	North Africa	PQLI	Ln(GDPPC)	7.82	4.37	3.20	0.390	1/5	>.10
18	Middle East	PQLI	Ln(GDPPC)	25.02	3.33	56.47	0.919	1/5	<.01
19	South Asia	PQLI	Ln(GDPPC)	76.59	26.27	8.50	0.739	1/3	.05<p<.10
20	East Asis	PQLI	Ln(GDPPC)	15.30	3.85	15.78	0.664	1/8	<.01
21	Central America & Caribbean	PQLI	Ln(GDPPC)	23.91	4.20	32.42	0.802	1/8	.01
22	South America	PQLI	Ln(GDPPC)	9.02	7.84	1.32	0.159	1/7	.10
23	Europe	PQLI	Ln (GDPPC)	11.23	5.07	4.91	0.621	1/3	.05 p .10

Variable Symbols:

GDPPC = GDP per capita
PQLI = Physical Quality of Life Indicator

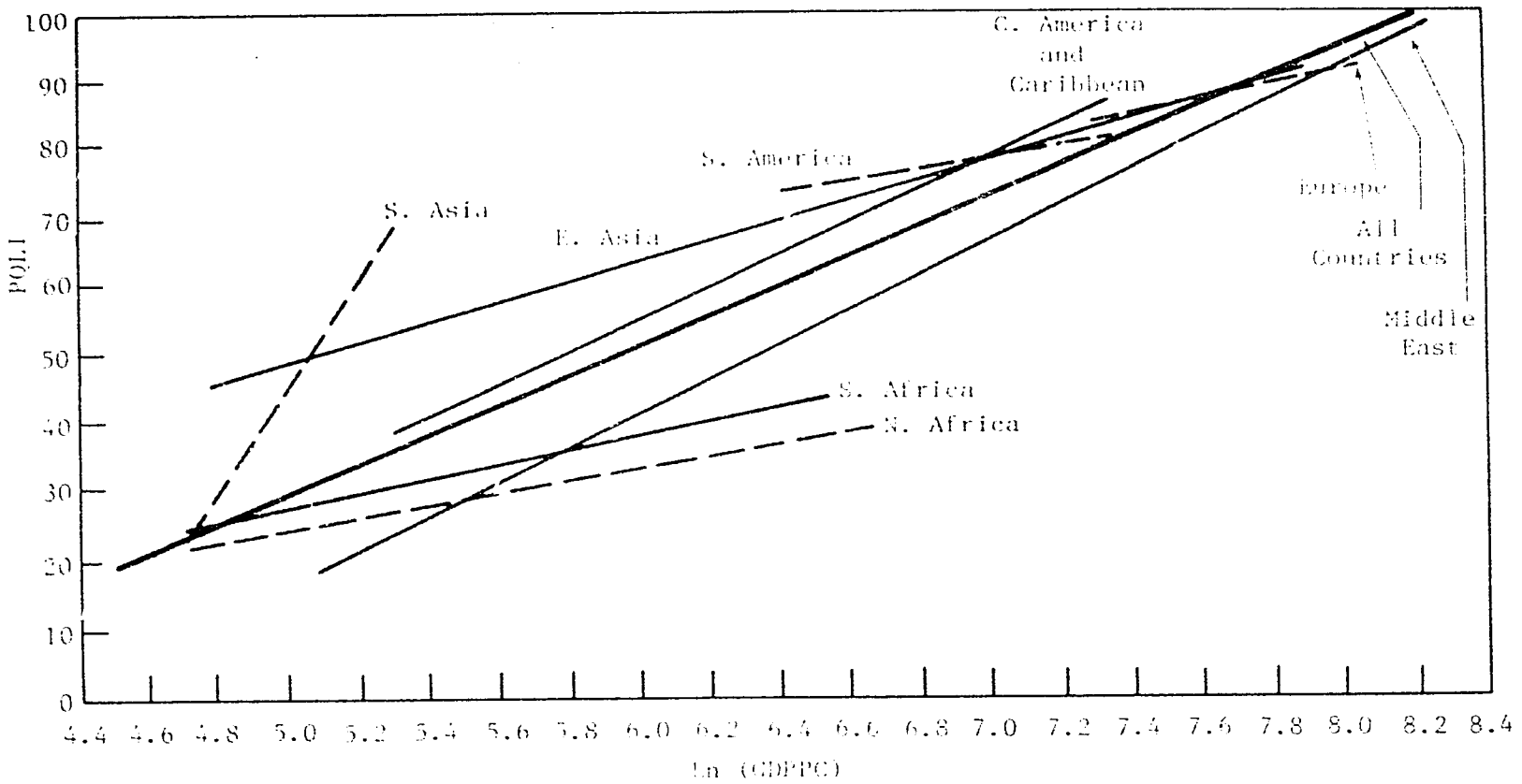


FIGURE 8
REGRESSION ANALYSIS FOR PQLI
STRATIFIED BY GEOGRAPHICAL REGION
(NON-OIL-EXPORTING LDCs)

for many countries. The non-oil-exporting countries were stratified into the following religious groups, based upon the dominant religion in the country:

- Hindu & Bhuddhist
- Christian
- Islamic
- Mixtures of the above religions

It was impossible to classify all the countries on this basis. No information was available for many African countries, and for some countries the dominent religions appeared to be primitive, tribal, or animistic. These were, however, insufficient countries of these types to support regression analysis. The classification was based upon published information.[28,29] Regression analyses have been performed for this stratification with PQLI as the dependent variable and Ln(GDPPC) and Ln(TEC) as independent variables (runs 24-23). The results of these runs are documented in Table XVI. The results of runs 3 and 8 are reproduced for comparison purposes.

Figure 9 shows the regression lines. It appears that cultural or religious factors condition the PQLI-GDPPC relationship. Hindu and Bhuddhist societies have the the lowest GDPPC for a given PQLI, then Christian, then Islamic. This view is supported by the fact that the mixed societies occupy a middle position. The rate of increase of PQLI with Ln(GDPPC) for the Hindu and Bhuddhist countries appears to be over twice that of the Islamic countries.

expectancy and (to some extent) for the literacy estimates.

It is clear that a wide range of uncertainty must surround PQLI estimates derived from this data. Depending on whether the most pessimistic or the most optimistic estimates were taken, the PQLI values for the first three countries could range from 3 to 18 (for Afghanistan), from 33 to 53 (for Algeria) and from 11 to 47 (for Angola).

Variations between sources appear to be lower for countries with higher PQLI's. This is probably due to better statistical and recording systems in those countries.

---

*Generally, life expectancy is given at birth, e_o. This has been converted to life expectancy at age one, e, by the formula: $e = e_o/(1-m/1000)$.

TABLE XVI

PQLI REGRESSION ANALYSIS STRATIFIED BY RELIGION
(NON-OIL-EXPORTING LDC'S)

Run No.	Countries	Dependent Variable	Independent Variable	Coef. B	Standard Error of B	F	r^2	Degrees of Freedom	P Significance Level of Regression
3	All Excluding Oil Exporters	PQLI	Ln(GDPPC)	21.72	1.56	193.1	0.718	1/76	<.01
24	Hindu and Bhuddist	PQLI	Ln(GDPPC)	45.35	13.63	6.73	0.627	1/4	.05<p<.10
25	Christian	PQLI	Ln(GDPPC)	19.99	1.62	152.3	0.864	1/24	<.01
26	Islamic	PQLI	Ln(GDPPC)	15.62	4.02	15.1	0.579	1/11	<.01
27	Mixed	PQLI	Ln(GDPPC)	24.50	4.62	28.0	0.800	1/7	<.01
8	All Excluding Oil Exporters	PQLI	Ln(TEC)	13.59	1.00	186.4	0.702	1/79	<.01
28	Hindu and Bhuddist	PQLI	Ln(TEC)	10.91	5.70	3.67	0.423	1/5	>.10
29	Christian	PQLI	Ln(TEC)	10.65	1.44	55.0	0.688	1/25	<.01
30	Islamic	PQLI	Ln(TEC)	12.40	2.26	30.1	0.733	1/11	<.01
31	Mixed	PQLI	Ln(TEC)	12.83	3.14	16.7	0.676	1/8	<.01
32	All Excluding Oil Exporters Bahamas, Netherlands Antilles	PQLI	Ln(TEC)	14.54	1.05	190.3	[illegible]	1/77	<.01
33	Christian, Excluding Bahamas, Netherlands Antilles	PQLI	Ln(TEC)	13.57	1.44	89.5	0.795	1/23	<.01

Variable Symbols:

GDPPC = GDP per capita
PQLI = Physical Quality of Life Indicator
TEC = Total Energy Consumption per capita

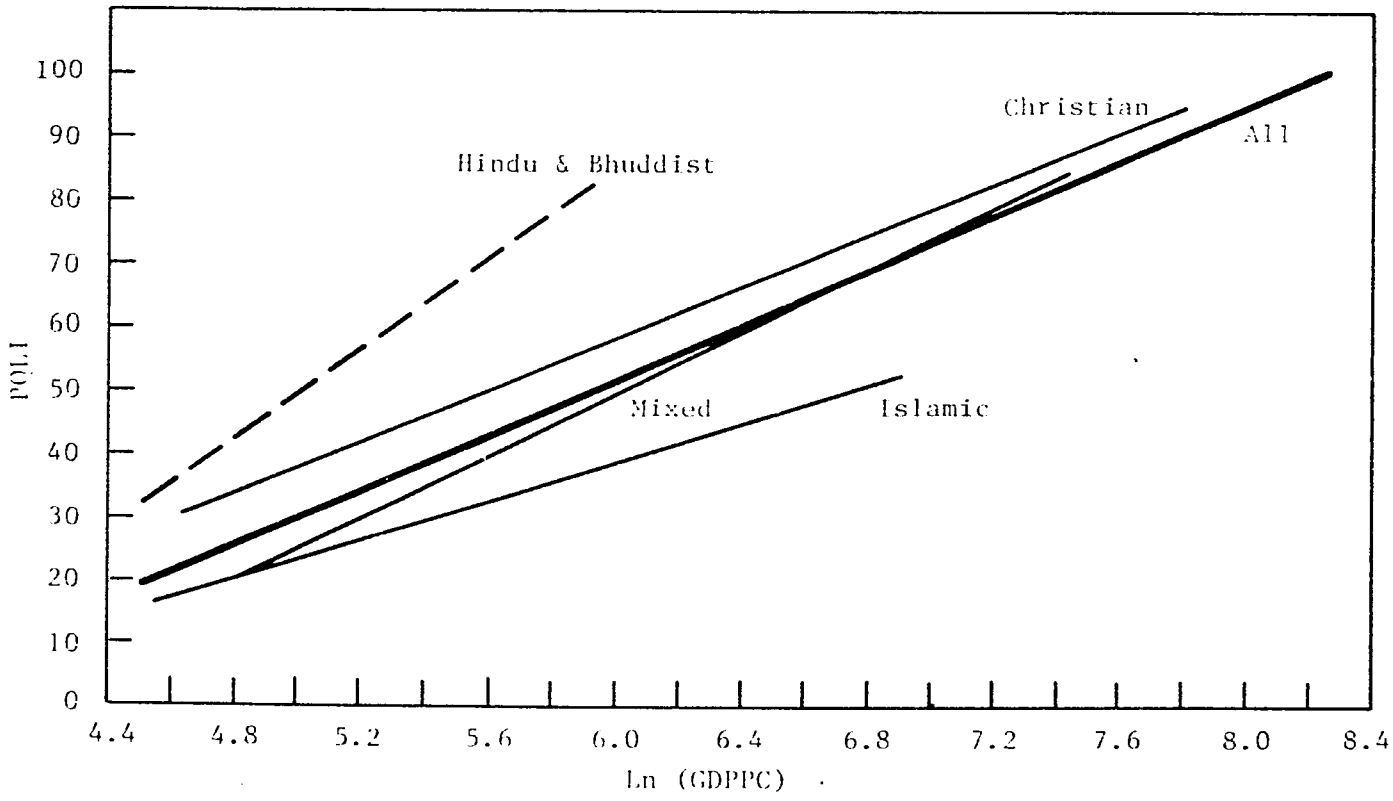


FIGURE 9
REGRESSION ANALYSIS FOR
PQLI STRATIFIED BY RELIGION
(NON-OIL-EXPORTING LDCs)

A similar picture is revealed in Figure 10 which shows the regression lines for PQLI as a function of Ln(TEC), although the differences between societies are not so strongly apparent. The quality of the regression lines is improved by excluding the Bahamas and the Netherlands Antilles. The status of these islands as processing and trans-shipment ports for large quantities of petroleum appears to have distorted their energy consumption figures.

5.4.3 Analysis of PQLI Components

There are significant correlations between the components of PQLI, namely life expectancy (e), infant mortality (m), and adult literacy (a). Table XVII shows the correlation matrices for these parameters and the PQLI, for all LDC's in the data base and for all LDC's excluding oil exporters. These matrices show the values of r, the correlation coefficients.

These results call into question the usefulness of basing the PQLI on the three parameters when correlations of over 0.95 are obtained between the PQLI and a single parameter. The whole question of indicators of the quality of life, both physical and otherwise, urgently requires deeper investigation.

5.5 Discussion of Results, and Implications

The analyses described in Subsection 5.4 have demonstrated conclusively the existence of relationships between the PQLI and both Per-Capita Gross Domestic Product and Per-Capita Energy Consumption for LDC's. They have provided strongly suggestive evidence that the

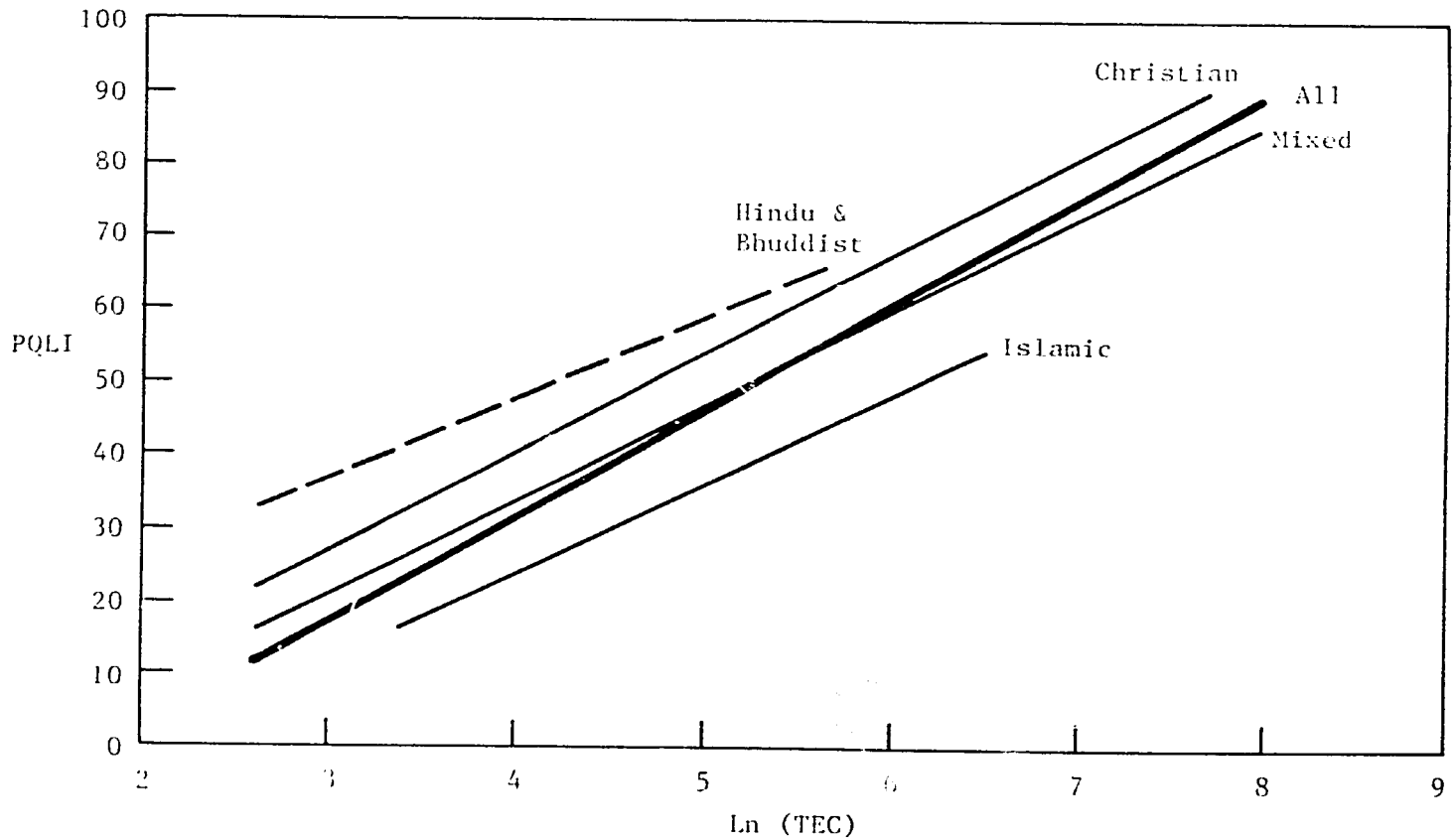


FIGURE 10
REGRESSION ANALYSIS FOR PQLI
AGAINST ENERGY CONSUMPTION STRATIFIED BY RELIGION
(NON-OIL-EXPORTING LDCs)

TABLE XVII

CORRELATION MATRICES FOR PQLI, LIFE EXPECTANCY (e), INFANT MORTALITY (m), AND ADULT LITERACY (a)

		PQLI	e	m	a
All Countries	PQLI	1.000	0.951	-0.945	0.963
	e	0.951	1.000	-0.851	0.880
	m	-0.945	-0.851	1.000	-0.856
	a	0.963	0.880	-0.856	1.000
All Countries, Excluding Oil Exporters	PQLI	1.000	0.955	-0.946	0.970
	e	0.955	1.000	-0.851	0.879
	m	-0.946	-0.851	1.000	-0.875
	a	0.970	0.899	-0.875	1.000

forms of these relationships are largely independent of the type of economy and the geographical location of the country, but are influenced by the general culture of the country expressed in its choice of religion. It is possible, of course, that cultural bias affects the way in which the components of the PQLI are measured.

The rise of PQLI with increasing GDPPC is most rapid at lower incomes; there is a distinct leveling off as the GDPPC exceeds $500 to $1000 or so. Further, there are greater variations among the PQLI levels of lower-income countries and these variations appear to reflect genuine differences in conditions rather than data errors.

The implications of these results depend in part upon the acceptance of the PQLI on a reasonable measure of the quality of life. The strong correlations between the three components of the PQLI have been pointed out in the preceding subsection. Their correlations imply that the components are at least partly measuring the same thing. This is undoubtedly a weakness of the PQLI. Another weakness is that, as its name implies, it only covers physical attributes. Non-physical attributes, such as social structures, opportunities for self-development, political freedom, etc., may be significant in affecting people's satisfaction and happiness, particularly in more developed countries. Finally, the form of the PQLI implies certain trade-offs between its component parts. Thus, for the PQLI, a rise of 1 percentage point in the literacy rate is equivalent to a rise of 0.39 years in life expectancy, or a drop of 2.2 in the infant mortality rate. It

is not clear if the originators of the PQLI intended to make these particular implicit value judgments or, indeed, on what basis such judgments can be made. However, at present, the PQLI is by far the best non-economic indicator that is available.

From an energy policy standpoint, perhaps the most interesting implication that can be drawn is the PQLI's can perhaps be improved with relatively limited increases in commercial energy usage. It is then possible that rural development and the use of "appropriate technology", in a relatively non-energy-intensive way, may have considerable potential in raising the quality of life if a society chooses to take advantage of the possiblities. What is important is not energy usage or economic production in and of itself, but the way in which these goods are used. The policy implication here is that great thought should be given to the social ramifications of assistance, and preference should be given to those activities which will most raise the quality of life for a given usage of natural resources or capital investment.

APPENDIX A

LISTINGS OF DATA BASES

TABLE A-1: GNP-Energy Data Base

This Table contains records for 70 countries. The number before each country name refers to the master LDC List (Table I). Countries are organized according to increasing GNP/Capita values. The columns following the country names contain:

- Gross National Product/Capita in U.S. $, 1976. (World Bank[6])
- Agricultural portion of GNP/Capita in U.S. $, 1976. (World Bank[6])
- Industrial portion of GNP/Capita in U.S. $, 1976. (World Bank[6])
- Per Capita Energy Consumption in kilograms of coal equivalent, 1975. (World Bank[6])
- Gross Domestic Investment in U.S. $, 1976. (World Bank[6])
- Arable Land and Permanent Crop Land/Capita, Hectares. (FAO[17])
- BNL Economy Type[7]
- Fraction Liquids Fuel Consumption. (U.N.[11])

TABLE A-1

GNP-ENERGY DATA BASE

32	ETHIOPIA	100	50	15	29	10	.48	6	.943
63	MALI	100	38	17	25	19	1.69	6	.970
7	BANGLADESH	110	65	9	28	7	.12	6	.351
85	RWANDA	110	57	24	14	00	.22	6	.679
90	SOMALIA	110	34	9	36	37	.32	6	1.000
105	UPPER VOLTA	110	37	21	20	18	.91	6	1.000
15	BURMA	120	56	13	51	13	.32	6	.910
16	BURUNDI	120	77	18	13	13	.33	6	.938
20	CHAD	120	62	17	39	18	1.71	6	1.000
70	NEPAL	120	78	12	10	11	.16	6	.793
10	BENIN	130	51	26	52	26	.92	6	1.000
61	MALAWI	140	63	31	56	38	.44	6	.696
111	ZAIRE	140	22	42	78	48	.24	4	.511
39	GUINEA	150	64	50	92	18	.73	4	.990
44	INDIA	150	71	34	221	29	.27	3	.243
1	AFGHANISTAN	160	38	22	52	16	.61	6	.469
73	NIGER	160	75	38	35	26	3.19	6	1.000
69	MOZAMBIQUE	170	76	26	186	15	.32	6	.509
76	PAKISTAN	170	54	41	183	29	.27	3	.362
97	TANZANIA	180	81	29	70	38	.42	6	.956
41	HAITI	200	90	38	30	22	.19	6	.899
60	MADAGASCAR	200	58	40	71	26	.31	6	.935
88	SIERRA LEONE	200	64	46	116	30	1.32	4	1.000
92	SRI LANKA	200	74	42	127	30	.14	5	.943
19	CENT AFR EMP	230	85	53	34	51	3.28	6	.940
45	INDONESIA	240	69	82	178	55	.14	2	.607
52	KENYA	240	72	55	174	46	.16	6	.929
103	UGANDA	240	132	19	55	14	.45	6	.899
108	YEMEN A.P.	250	00	00	49	00	.26	6	1.000
99	TOGO	260	65	55	65	70	.99	4	1.000
39	EGYPT	280	81	84	405	67	.07	2	.881
109	YEMEN PDR	280	64	45	328	67	.10	6	1.000

TABLE A-1 (Continued)

15	CAMEROON	299	96	58	104	40	.67	6	.755
63	SUDAN	299	119	46	140	72	.47	6	.994
3	ALGERIA	330	96	85	174	26	.33	2	.907
65	GUATEMALA	340	119	126	103	142	.72	4	.945
74	NIGERIA	390	87	100	90	125	.21	2	.754
98	THAILAND	430	114	95	284	59	.41	6	.959
11	BOLIVIA	360	106	125	303	72	.58	2	.778
42	HONDURAS	360	115	94	232	74	.30	5	.930
97	SENEGAL	490	109	64	105	59	.67	5	1.000
91	PHILIPPINES	410	119	134	324	127	.13	3	.954
112	ZAMBIA	460	62	190	504	70	.58	4	.453
58	LIBERIA	450	130	157	404	126	.23	4	.946
30	EL SALVADOR	470	127	103	248	73	.16	6	.935
24	DOMIN. REP.	520	78	224	209	172	.47	2	.957
60	MOROCCO	540	113	168	274	157	.45	4	.803
84	INDONESIA	550	88	220	764	127	.39	5	.165
36	GHANA	580	294	145	192	52	.27	6	.744
49	IVORY COAST	610	152	122	344	140	1.31	5	.583
51	JORDAN	610	95	171	409	122	.47	6	1.000
23	COLOMBIA	630	170	189	671	113	.21	3	.580
37	GUATEMALA	630	90	82	237	126	.27	5	.968
2	ECUADOR	640	141	166	442	147	.70	2	.973
78	PARAGUAY	640	224	141	153	160	.40	6	.923
72	NICARAGUA	750	172	210	479	143	.65	6	.959
27	DOM. REPUBLIC	780	164	290	451	179	.21	5	.988
96	SYRIAN A.R.	790	133	281	477	214	.74	2	.940
80	PERU	800	128	249	682	129	.21	3	.830
101	TUNISIA	940	176	292	447	260	.28	2	.815
2	ALGERIA	990	69	564	754	495	.44	2	.519
102	TURKEY	990	287	277	630	218	.67	3	.709
25	COSTA RICA	1040	219	270	544	220	.25	5	.837
21	CHILE	1050	105	410	765	116	.56	1	.503
50	JAMAICA	1070	66	428	1427	182	.13	4	.994
67	MEXICO	1090	104	382	1221	233	.45	2	.636
13	BRAZIL	1140	91	445	679	296	.34	1	.799
77	PANAMA	1310	90	90	865	357	.33	3	.988
47	IRAQ	1390	111	917	713	90	.46	2	.822
106	URUGUAY	1390	203	445	942	167	.68	1	.938

TABLE A-2: GDP-Energy Growth Rate Data Base

This Table contains records for 55 countries. The number before each country name refers to the master LDC list (Table 1). Countries are organized according to increasing GNP/Capita values. The columns following the country names contain:

- Gross Domestic Product (average annual growth rate percent) 1970-76. (World Bank[6])
- Average annual growth rate in Agricultural portion of GDP (percent), 1970-76. (World Bank[6])
- Average annual growth rate in Industrial portion of GDP (percent), 1970-76. (World Bank[6])
- Average annual growth rate in Services portion of GDP (percent), 1970-76. (World Bank[6])
- Average annual growth rate in Gross Domestic Investment (percent), 1970-76. (World Bank[6])
- Average annual growth rate in Labor Force, 1970-75. (World Bank[6])
- Average annual growth rate in Commercial Energy Consumption, 1970-74. (U.N.[1])
- Average annual growth rate in Population, 1970-75. (World Bank[6])
- BNL Economy Type[7]
- Gross National Product/Capita in U.S. $, 1976. (World Bank[6])

TABLE A-2

GDP-ENERGY GROWTH RATE DATA BASE

32 ETHIOPIA	2.5	0.9	1.6	4.4	-0.7	2.0	1.3	2.6	6	100
90 SOMALIA	2.1	-1.2	10.3	8.0	15.5	2.7	4.3	2.4	6	110
105 UPPER VOLTA	3.3	3.2	7.0	1.8	4.7	1.8	3.3	2.3	6	110
15 BURMA	3.3	2.5	2.8	3.0	-0.9	1.6	1.0	2.2	6	120
16 BURUNDI	1.4	1.0	4.3	1.1	3.0	1.7	-3.4	2.1	6	120
20 CHAD	0.9	-1.3	8.1	-0.6	3.1	1.5	-7.9	2.1	6	120
10 BENIN	2.3	-0.3	9.8	6.0	4.4	2.0	4.1	2.7	6	130
61 MALAWI	8.9	5.5	12.4	11.4	9.7	1.9	7.9	2.3	6	140
111 ZAIRE	4.3	1.9	5.0	5.0	7.8	1.9	0.7	2.7	4	140
44 INDIA	2.7	1.4	3.8	2.4	4.6	2.0	4.6	2.1	3	150
73 NIGER	-0.4	-4.0	10.0	0.8	-0.2	2.5	9.8	2.7	6	160
69 MOZAMBIQUE	-2.0	2.1	-3.8	-2.1	-3.4	1.5	1.9	2.4	6	170
76 PAKISTAN	3.6	1.6	4.1	5.0	-4.2	2.6	1.0	3.0	3	170
97 TANZANIA	4.2	2.5	2.9	2.8	2.9	2.4	25.2	2.7	6	180
41 HAITI	3.2	1.6	8.8	2.4	12.5	1.4	-0.8	1.6	6	200
60 MADAGASCAR	0.3	1.2	2.0	4.5	-2.4	2.3	2.4	3.1	6	200
88 SIERRA LEONE	2.0	2.0	-3.0	4.0	-5.4	1.8	0.1	2.5	4	200
92 SRI LANKA	2.9	1.2	3.0	3.7	-0.3	2.5	1.4	1.7	5	200
19 CENT AFR EMP	0.9	1.9	4.7	-1.8	4.0	1.8	-1.0	2.2	6	230
45 INDONESIA	8.3	4.0	12.4	7.3	17.9	2.2	10.0	2.4	2	240
52 KENYA	4.8	1.6	9.8	5.1	-1.7	2.6	9.1	3.5	6	240
103 UGANDA	-0.1	1.3	-6.7	-3.2	-11.5	2.4	-6.3	3.3	6	240
99 TOGO	4.1	3.0	7.0	3.7	13.6	2.1	3.2	2.6	4	260
39 EGYPT	7.6	3.0	4.3	13.4	23.6	2.5	5.8	2.2	2	280
18 CAMEROON	2.7	3.4	3.3	0.7	9.5	1.4	0.1	1.9	6	290
93 SUDAN	6.1	8.8	2.8	7.5	12.5	2.7	2.1	2.1	6	290
3 ANGOLA	1.1	-0.7	11.6	3.0	-4.3	2.0	9.2	0.1	2	330
74 NIGERIA	7.4	-0.2	12.6	9.5	19.3	2.1	18.6	2.5	2	380
98 THAILAND	6.5	4.3	8.2	6.9	6.6	2.9	7.5	2.9	6	380

TABLE A-2 (Continued)

11	BOLIVIA	6.0	5.5	4.9	7.3	3.0	2.4	8.7	2.7	2	390
42	HONDURAS	2.9	-0.6	7.2	3.0	2.4	3.0	2.2	2.7	5	390
81	PHILIPPINES	6.3	4.6	8.7	5.1	12.2	2.7	3.6	2.8	3	410
112	ZAMBIA	3.1	3.2	3.4	4.4	-8.5	2.4	7.7	2.9	4	440
58	LIBERIA	2.9	4.0	0.3	9.4	16.2	1.5	-0.5	3.3	4	450
68	MOROCCO	4.9	0.6	7.8	5.5	18.2	2.8	11.9	2.4	4	540
36	GHANA	2.0	1.3	4.2	3.8	-0.3	2.1	5.8	2.7	6	580
49	IVORY COAST	6.5	3.5	7.9	7.7	9.0	1.9	14.7	4.2	5	610
51	JORDAN	5.1	2.6	16.0	2.9	5.0	2.9	9.0	3.2	6	610
23	COLOMBIA	6.5	4.5	6.7	8.1	0.4	3.2	4.3	2.8	3	630
28	ECUADOR	10.7	5.7	14.2	14.0	10.4	3.2	8.1	3.5	2	640
79	PARAGUAY	6.5	5.9	7.7	6.8	20.1	3.0	10.8	2.7	6	640
72	NICARAGUA	5.7	5.7	7.3	4.8	6.3	3.2	5.9	3.3	6	750
27	DOM REPUBLIC	8.9	3.0	14.1	9.7	18.2	3.1	10.8	2.9	5	780
96	SYRIAN AR	7.0	6.4	11.1	4.3	13.5	2.6	5.3	3.3	2	780
80	PERU	5.7	0.6	6.2	8.4	11.4	3.0	4.0	2.9	3	800
101	TUNISIA	9.4	9.2	10.1	9.7	13.5	2.3	15.6	2.3	2	840
2	ALGERIA	6.2	-8.7	16.4	-4.6	18.1	2.8	15.6	3.2	2	990
102	TURKEY	7.2	4.9	9.5	10.6	12.0	1.8	9.9	2.5	3	990
25	COSTA RICA	6.5	3.8	8.0	7.1	7.0	3.8	7.8	2.5	5	1040
21	CHILE	-1.2	0.5	-2.2	-1.3	-3.0	2.5	2.4	1.8	1	1050
50	JAMAICA	0.5	1.3	-3.0	-1.5	-4.0	1.1	2.8	1.8	4	1070
67	MEXICO	5.5	1.4	6.6	4.3	10.3	3.3	8.1	3.5	2	1090
13	BRAZIL	10.6	5.5	11.6	13.1	16.3	2.9	11.9	2.9	1	1140
47	IRAQ	9.5	-2.0	10.0	10.4	36.8	3.0	12.2	3.3	2	1390
106	URUGUAY	0.7	-0.7	1.7	3.9	-0.8	1.0	0.9	0.4	1	1390

TABLE A-3: Economic Growth Rate Data Base

This Table contains records for 55 countries. The number before each country name refers to the master LDC list (Table I). The numbers following the country name are, in order, with sources:

- Geometric mean annual percentage change in GDP per capita, 1960-73. (UN[8], IMF[9])
- Geometric mean annual percentage change in GDP per capita, 1965-63. (UN[8], IMF[9])
- Geometric mean annual percentage change in GDP per capita, 1973-year "Y". (UN[8], IMF[9])
- Year "Y"
- GDP per capita, 1976, in U.S. $. (World Bank[6])
- Percentage self-sufficiency in energy 1972. (UN[11])
- Percentage self-sufficiency in petroleum, 1972. (UN[11])
- Total energy consumption per capita, kgce, 1972. (UN[11])
- Total liquid-fuel consumption per capita, kgce, 1972. (UN[11])
- Population 1973, millions. (IMF[8])
- BNL economy type[7]

TABLE A-3

ECONOMIC GROWTH RATE DATA BASE

4ARGENTINA	2.89	2.98	-0.6176	1550.	96.	100.	1809.	1358.	24.70	1
11BOLIVIA	2.95	3.35	2.6777	390.	339.	287.	266.	202.	5.33	2
13BRAZIL	4.18	5.84	4.3977	1140.	40.	28.	548.	435.	100.6	1
15BURMA		-0.49	3.0376	120.	92.	98.	59.	51.	28.9	6
21CHILE	1.57	0.93	-2.4476	1050.	69.	45.	1476.	730.	9.90	1
23COLOMBIA	2.62	3.36	2.6475	630.	160.	206.	623.	340.	22.3	3
27DOMINCN. REP	3.48	6.05	2.3877	780.	1.	0.	427.	425.	4.43	5
28ECUADOR		7.90	5.5877	640.	308.	316.	306.	294.	6.60	2
29EGYPT		0.49	3.9776	280.	147.	157.	321.	289.	35.6	2
30EL SALVADOR	1.90	1.12	1.9978	490.	7.	0.	210.	196.	3.77	6
32ETHIOPIA		1.54	-1.2976	100.	3.	0.	35.	33.	26.2	6
33FIJI		5.31	3.6575	980.	3.	0.	491.	491.	0.55	6
36GHANA	0.31	0.37	3.0075	580.	28.	0.	159.	114.	9.36	6
37GREECE	7.01	6.74	1.9277	2590.	29.	0.	1566.	1059.	8.93	3
38GUATEMALA	2.75	3.09	3.0177	630.	3.	0.	238.	231.	5.74	5
41HAITI	0.07	0.71	4.1176	200.	6.	0.	31.	29.	4.44	6
42HONDURAS	1.40	1.28	1.1378	390.	6.	0.	247.	233.	2.60	5
43HONG KONG		6.05	5.5276	2110.	0.	0.	1041.	1035.	3.44	3
44INDIA	1.18	1.48	1.3376	150.	85.	40.	191.	47.	574.00	3
45INDONESIA	1.67	3.13	3.9377	240.	426.	570.	158.	110.	129.00	2
47IRAQ		1.93	7.2675	1390.	1399.	1656.	751.	627.	10.41	2
48ISRAEL	5.61	5.53	0.6678	3920.	105.	105.	2798.	2742.	3.28	1
50JAMAICA	4.05	4.69	-4.3176	1070.	1.	0.	1452.	1443.	1.97	4
52KENYA		3.38	-0.3176	240.	3.	0.	151.	141.	12.50	6
52KOREA,REP OF	6.69	8.84	8.7876	670.	3.	0.	830.	446.	34.10	1
58LIBERIA		3.08	-0.6576	450.	5.	0.	394.	373.	1.63	4
61MALAWI		3.51	2.0977	140.	8.	0.	53.	37.	4.79	6
67MEXICO	3.28	3.04	0.0077	1090.	94.	93.	1131.	722.	56.16	2
68MOROCCO	0.88	1.03	4.6876	540.	23.	2.	234.	180.	16.31	4
70NEPAL		-0.36	0.0075	120.	6.	0.	15.	12.	12.06	6

TABLE A-3 (Continued)

72NICARAGUA	3.44	1.27	0.3878	750.	5.	0.	405.	384.	2.01	6
74NIGERIA	3.31	3.96	5.0575	380.	2971.	3782.	72.	57.	59.66	2
76PAKISTAN	1.87	1.15	0.7778	170.	61.	13.	180.	79.	66.23	3
77PANAMA	4.53	4.30	-1.8477	1310.	1.	0.	859.	859.	1.57	3
78PAPUA-NG		4.82	-1.2677	420.	4.	0.	194.	187.	2.56	6
79PARAGUAY	1.84	2.00	4.8677	640.	8.	0.	123.	113.	2.50	6
80PERU		1.75	-0.7578	800.	71.	68.	603.	502.	14.63	3
81PHILIPPINES	2.29	2.54	3.2078	410.	2.	0.	329.	321.	40.12	3
82PORTUGAL	6.20	6.49	-1.7977	1690.	12.	0.	1080.	901.	8.56	3
84RHODESIA,S		3.14	-1.9676	550.	88.	0.	685.	140.	5.90	6
86SAUDI ARABIA		8.77	7.2377	4480.	5899.	11549.	924.	468.	8.45	2
88SIERRA LEONE		1.19	0.0075	200.	0.	0.	83.	83.	2.67	4
89SINGAPORE	6.17	8.55	4.9977	2700.	0.	0.	2065.	2063.	2.19	1
91SPAIN	6.27	5.59	1.6477	2920.	29.	1.	1791.	1160.	34.86	1
92SRI LANKA		2.58	3.0077	200.	5.	0.	149.	140.	12.86	5
95SYRIA	3.24	2.35	6.3077	780.	262.	278.	511.	464.	6.89	2
97TANZANIA		2.65	1.8477	180.	4.	0.	73.	70.	14.37	6
98THAILAND	4.54	4.86	4.3478	380.	3.	0.	310.	301.	39.69	6
101TUNISIA	3.63	4.23	4.8477	840.	340.	376.	324.	292.	5.44	2
102TURKEY	3.42	4.25	4.0977	990.	53.	35.	567.	387.	38.09	3
103UGANDA	0.69	0.27	-3.7276	240.	13.	0.	69.	63.	19.41	6
106URUGUAY	-0.40	-0.27	2.1376	1390.	4.	0.	986.	935.	2.99	1
107VENEZUELA	2.06	1.15	3.2477	2570.	999.	1951.	2427.	1180.	11.28	2
110YUGOSLAVIA	5.48	5.26	4.4076	1680.	72.	37.	1641.	611.	20.96	1
112ZAMBIA		-0.62	-2.1177	440.	53.	0.	309.	165.	4.64	4

TABLE A-4: Inflation Data Base

This Table contains records for 79 countries. The number before each country name refers to the master LDC list (Table 1). The numbers following the country name are, in order, with sources:

- Geometric mean annual percentage change in Consumer Price Index, 1966-73. (UN[9])
- Geometric mean annual percentage change in Consumer Price Index, 1973-year "Y". (UN[9])
- Year "Y"
- GDP per capita, 1976, in U.S. $. (World Bank[6])
- Percentage self-sufficiency in energy, 1972. (UN[11])
- Percentage self-sufficiency in petroleum, 1972. (UN[11])
- Total energy consumption per capita, 1972, kgce. (UN[11])
- Total liquid-fuel consumption per capita, 1972, kgce. (UN[11])
- Population, 1973, millions (IMF[8])
- BNL economy type[7]

TABLE A-4

INFLATION DATA BASE

1	AFGHANISTAN	2.61	7.2176	160.	514.	0.	44.	30.	18.29	6
2	ALGERIA	9.27	15.2376	990.	1462.	1835.	351.	195.	15.77	2
4	ARGENTINA	30.17	167.4076	1550.	96.	100.	1809.	1358.	24.7	1
7	BANGLADESH	4.51	17.7077	110.	41.	0.	29.	16.	73.2	6
11	BOLIVIA	8.87	22.5776	390.	339.	287.	266.	202.	5.33	2
13	BRAZIL	7.70	29.8576	1140.	40.	28.	548.	435.	100.6	1
15	BURMA	3.62	27.9776	120.	92.	98.	59.	51.	28.9	6
16	BURUNDI	3.11	12.8076	120.	0.	0.	14.	13.	3.60	6
19	CENT.AF.EMP.	4.65	12.0076	230.	7.	0.	54.	51.	1.72	6
20	CHAD	4.41	9.9876	120.	0.	0.	21.	21.	3.87	6
21	CHILE	58.2	347.3476	1050.	69.	45.	1476.	730.	9.9	1
23	COLOMBIA	10.93	22.4676	630.	160.	206.	623.	340.	22.3	3
24	CONGO	3.62	9.9876	520.	202.	214.	207.	185.	1.28	2
25	COSTA RICA	5.02	16.4976	1040.	15.	0.	490.	416.	1.87	5
27	DOMINICN REP	4.52	11.7476	780.	1.	0.	427.	425.	4.43	5
28	ECUADOR	6.85	16.3776	640.	308.	316.	306.	294.	6.6	2
29	EGYPT	3.41	10.1576	280.	147.	157.	321.	289.	35.6	2
30	EL SALVADOR	2.00	14.4776	490.	7.	0.	210.	196.	3.77	6
32	ETHIOPIA	2.11	14.1076	100.	3.	0.	35.	33.	26.2	6
33	FIJI	7.67	12.9776	980.	0.	0.	491.	491.	0.55	6
36	GHANA	5.33	40.1076	580.	28.	0.	159.	114.	9.36	6
37	GREECE	4.20	17.6676	2590.	29.	0.	1566.	1059.	8.93	3
38	GUATEMALA	2.95	13.4 6	630.	3.	0.	238.	231.	5.74	5
41	HAITI	5.07	12.6276	200.	6.	0.	31.	29.	4.44	6
42	HONDURAS	2.98	7.9176	390.	6.	0.	247.	233.	2.60	5
43	HONG KONG	6.50	14.7374	2110.	0.	0.	1041.	1035.	3.44	3
44	INDIA	7.74	7.9576	150.	85.	40.	191.	47.	574.	3
45	INDONESIA	42.9	25.9976	240.	426.	570.	158.	110.	129.	2
46	IRAN	3.95	12.7876	1930.	1522.	2277.	1010.	545.	31.3	2
47	IRAQ	4.11	9.5876	1390.	1399.	1656.	751.	627.	10.41	2
48	ISRAEL	7.95	36.6776	3920.	105.	105.	2798.	2742.	3.28	1
49	IVORY COAST	4.28	13.7776	610.	2.	0.	331.	325.	4.65	5
50	JAMAICA	8.20	18.0776	1070.	1.	0.	1452.	1443.	1.97	4
51	JORDAN	6.08	15.6976	610.	0.	0.	340.	340.	2.54	6
52	KENYA	9.5	14.0076	240.	3.	0.	151.	141.	12.5	6
53	KOREA,REP OF	11.28	21.5176	670.	45.	0.	830.	446.	34.1	1
55	LAO PDR	10.03	40.1576	90.	11.	0.	83.	79.	3.18	6
58	LIBERIA	6.02	12.7176	450.	5.	0.	394.	374.	1.63	4
59	LIBYA	3.5	7.7276	6310.	12162.	11375.	647.	646.	2.25	2
60	MADAGASCAR	3.62	11.6076	200.	3.	0.	74.	68.	7.57	6

TABLE A-4 (Continued)

61 MALAWI	5.57	11.6076	140.	8.	0.	53.	37.	4.79	6
62 MALAYSIA	[illegible].68	7.9776	860.	115.	119.	527.	497.	11.31	2
63 MALI	7.64	8.3776	100.	4.	0.	25.	22.	5.38	6
65 MAURITANIA	5.66	12.0 74	340.	0.	0.	123.	118.	1.26	4
67 MEXICO	6.15	18.0576	1090.	94.	93.	1131.	722.	56.16	2
68 MOROCCO	2.23	8.2 76	540.	23.	2.	234.	180.	16.31	4
69 MOZAMBIQUE	6.02	9.5076	170.	29.	0.	150.	84.	8.82	6
70 NEPAL	3.75	8.6376	120.	6.	0.	15.	12.	12.06	6
73 NIGER	4.83	11.6276	160.	0.	0.	29.	29.	4.3	6
74 NIGERIA	5.53	23.3376	380.	2971.	3782.	72.	57.	59.66	2
76 PAKISTAN	4.07	18.6376	170.	61.	13.	180.	79.	66.23	3
77 PANAMA	3.24	8.0376	1310.	1.	0.	859.	859.	1.57	3
78 PAPUA-NG	2.22	13.4776	490.	4.	0.	194.	187.	2.56	6
79 PARAGUAY	4.16	11.7476	640.	8.	0.	123.	113.	2.50	6
80 PERU	8.86	24.6376	800.	71.	68.	603.	502.	14.63	3
81 PHILIPPINES	3.84	16.2076	410.	2.	0.	329.	321.	40.12	3
82 PORTUGAL	8.92	20.3476	1690.	12.	0.	1080.	901.	8.56	3
84 RHODESIA	2.14	9.4776	550.	88.	0.	685.	140.	5.90	6
86 SAUDI ARABIA	10.3	24.4 8	4480.	5899.	11549.	924.	468.	8.45	2
87 SENEGAL	4.77	16.2076	390.	0.	0.	159.	159.	4.04	5
88 SIERRA LEONE	3.75	16.0676	200.	0.	0.	83.	83.	2.67	4
89 SINGAPORE	4.20	7.16 6	2700.	0.	0.	2065.	2063.	2.19	1
90 SOMALIA	1.95	17.0076	110.	0.	0.	34.	34.	3.01	6
91 SPAIN	6.74	16.6776	2920.	29.	1.	1791.	1160.	34.86	1
92 SRI LANKA	5.78	6.5176	200.	5.	0.	149.	140.	12.86	5
93 SUDAN	2.36	16.6376	290.	1.	0.	122.	121.	15.00	6
96 SYRIA	5.21	15.3776	780.	262.	278.	511.	464.	6.89	2
97 TANZANIA	9.0	15.79 7	180.	4.	0.	73.	70.	14.37	6
98 THAILAND	3.62	10.6876	380.	3.	0.	310.	301.	39.69	6
99 TOGO	3.74	14.1576	260.	0.	0.	79.	79.	2.12	4
100 TRINIDADETOB	6.08	16.4076	2240.	282.	445.	4357.	2295.	1.05	2
101 TUNISIA	3.30	6.3776	840.	340.	376.	324.	292.	5.44	2
102 TURKEY	11.95	18.1076	990.	55.	35.	567.	387.	38.09	3
103 UGANDA	7.94	45.8176	240.	13.	0.	69.	63.	19.41	6
106 URUGUAY	58.70	69.1576	1390.	4.	0.	986.	935.	2.99	1
107 VENEZUELA	2.40	8.5676	2570.	999.	1951.	2427.	1180.	11.28	2
110 YUGOSLAVIA	11.74	18.9576	1680.	72.	37.	1641.	611.	20.96	1
111 ZAIRE	12.39	27.8 75	140.	29.	0.	84.	47.	22.9	4
112 ZAMBIA	4.97	12.1876	440.	58.	0.	509.	165.	4.64	4

TABLE A-5: Balance of Payments Data

This Table contains records for 65 countries. The numbers before the country names refer to the master LDC list (Table I). Each country has two lines of records. The seven numbers in the first line after the country name given the overall B.O.P. situation for the years 1971 through 1977 in constant 1972 U.S. dollars. These were obtained from IMF data[8], lines 77aa through 77ag. Missing values are coded as 99999.99 for recognition by the computer system. The five decimal numbers after the country name on the second line give the petroleum payments position, in current dollars for 1972 through 1976. These were obtained as explained in the text, by using U.N. figures for petroleum exports and imports[11, 12, 13] multiplied by average petroleum prices for that year. The final integer refers to the BNL economy type[7].

TABLE A-5

BALANCE OF PAYMENTS DATA

2	ALGERIA	45.	-150.	-420.	137.	-1306.	-656.	-1619.
	ALGERIA	939.1	1271.6	4193.6	4349.7	4682.9	2	
4	ARGENTINA	-407.	-227.	671.	101.	-1011.	955.	99999.99
	ARGENTINA	-50.4	-115.5	-503.2	-410.1	-502.2	1	
7	BANGLADESH	99999.99	-235.6	-239.7	-408.	-448.4	-193.6	-202.0
	BANGLADESH	-18.4	-16.7	-62.4	-84.6	-85.6	6	
11	BOLIVIA	-41.7	-45.2	-19.7	100.4	-123.6	-75.3	-122.5
	BOLIVIA	42.8	70.4	547.7	213.2	217.9	2	
13	BRAZIL	-1706.	-169.1	-2039.	-6493.	-5501.	-4874.	-3382.
	BRAZIL	-464.2	-843.1	-3160.9	-3171.6	-3670.2	1	
15	BURMA	-44.5	-46.5	-56.2	-6.2	-62.6	-25.0	-72.4
	BURMA	-3.9	-1.9	-18.4	0.	0.	6	
18	CAMEROON	-46.2	-54.9	-15.8	-14.5	-119.8	-68.5	-48.6
	CAMEROON	-6.4	-8.5	-29.5	-36.4	-33.1	6	
19	CENT.AF.EMP	-9.3	1.1	-2.7	-12.4	-29.2	4.1	-13.2
	CENT AF EMP	-1.2	-1.5	-3.7	-3.6	-4.3	6	
20	CHAD	3.4	12.0	-6.4	-3.5	-47.4	-3.8	-20.0
	CHAD	-1.2	-2.1	-6.5	-7.5	-7.8	6	
21	CHILE	-206.	-472.	-264.	-154.	-445.	117.	-342.
	CHILE	-78.1	-86.7	-373.5	-249.8	-319.2	1	
23	COLOMBIA	-474.	-190.	-52.	-302.	-85.	134.	300.
	COLOMBIA	75.8	74.6	143.5	104.3	7.5	3	
24	CONGO	-69.5	-93.7	-73.9	-80.0	-197.1	-168.9	-134.9
	CONGO	3.4	49.0	211.3	159.6	173.2	2	
25	COSTA RICA	-119.1	-100.1	-106.0	-228.5	-171.0	-149.6	-157.0
	COSTA RICA	-11.1	-16.1	-52.5	-59.9	-60.7	5	
26	CYPRUS	-15.3	-30.4	-73.9	-62.2	-29.2	-7.4	-61.4
	CYPRUS	-16.0	-21.7	-61.4	-58.2	-64.0	6	
27	DOMNCN REP	-135.5	-47.7	-92.5	-233.6	-58.5	-181.2	-184.2
	DOM REP	-30.7	-51.2	-192.6	-212.2	-197.7	5	
28	ECUADOR	-162.8	-77.4	6.1	32.4	-172.9	-0.4	-254.2
	ECUADOR	46.8	229.0	632.7	566.8	673.2	2	
29	EGYPT	-213.	-460.	-526.	-1135.	-1373.	-1063.	-835.
	EGYPT	71.4	47.0	27.1	343.3	635.7	2	
30	EL SALVADOR	-14.9	11.8	-41.4	-115.3	-73.0	-5.2	6.6
	EL SALVADOR	-9.4	-15.7	-56.2	-65.6	-67.9	6	
32	ETHIOPIA	-47.1	8.1	71.2	47.6	-25.6	-61.2	99999.99
	ETHIOPIA	-9.6	-15.9	-63.7	-64.2	-26.2	6	
34	GABON	18.7	-3.9	-34.1	180.	45.6	20.4	29.6
	GABON	115.4	180.6	869.2	1025.1	976.7	2	

TABLE A-5 (Continued)

35	GAMBIA	-1.02	-0.21	-3.94	4.85	8.87	-12.41	-5.42
	GAMBIA	-.4	.-5	-1.9	-3.1	-2.9	6	
36	GHANA	-151.8	109.2	119.3	-147.2	-1.3	-66.0	29.3
	GHANA	-18.5	-21.2	-73.2	-70.0	-73.7	6	
38	GUATEMALA	-51.2	-11.5	7.4	-88.6	-51.7	-59.5	-42.1
	GUATEMALA	-18.0	-25.0	-91.3	-101.4	-110.8	5	
40	HAITI	4.0	6.6	-0.8	-42.6	-20.7	-15.3	-36.5
	HAITI	-2.4	-3.2	-11.8	-12.9	-12.4	6	
41	HONDURAS	-23.5	-12.6	-32.5	-90.6	-94.1	-80.6	-93.6
	HONDURAS	-8.9	-30.0	-41.4	-51.5	-37.6	5	
44	INDIA	-669.	-151.	-501.	1036.	-116.	1172.	99999.99
	INDIA	-300.4	-427.6	-1529.9	-1492.4	-1521.1	3	
45	INDONESIA	-388.	-333.	-449.	513.	-872.	-675.	-35.
	INDONESIA	858.5	1377.7	5025.3	4546.9	5293.0	2	
47	IRAQ	200.	546.	756.	2249.	2126.	99999.	9999999.99
	IRAQ	1332.0	2414.1	8306.0	9603.8	9719.6	2	
49	IVORY COAST	-110.0	-96.7	-207.3	-52.4	-301.7	-185.0	-278.2
	IVORY COAST	-19.7	-32.7	-117.8	-118.7	-130.5	5	
50	JAMAICA	-179.3	-196.7	-234.0	-78.9	-222.2	-224.9	-47.4
	JAMAICA	-47.8	-71.4	-243.2	-264.5	-272.2	4	
51	JORDAN	-62.2	3.7	11.2	7.6	52.9	61.1	9.7
	JORDAN	-12.7	-17.3	-69.4	-79.8	-106.8	6	
52	KENYA	-116.3	-68.2	-119.2	-264.4	-184.2	-63.5	-39.4
	KENYA	-33.7	-44.8	-173.2	-185.3	-149.5	6	
53	KOREA, REP	-883.	-372.	-299.	-1741.	-1493.	-228.	7.
	KOREA	-235.0	-343.4	-1388.6	-1471.2	-1634.2	1	
59	LIBYA	764.	239.	63.	1573.	-53.	1810.	2026.
	LIBYA	2121.1	2720.2	6672.8	6804.3	8685.5	2	
60	MADAGASCAR	-43.	28.	-10.	-28.	-55.	-17.	-15.
	MADAGASCAR	-9.0	-11.6	-32.5	-49.6	-39.8	6	
61	MALAWI	-34.6	-49.2	-26.1	-30.4	-52.1	-31.4	-26.6
	MALAWI	-2.3	-3.1	-11.3	-11.2	-13.1	6	
63	MALI	-9.5	-11.6	-26.8	-30.9	-41.5	-31.4	2.4
	MALI	-1.8	-2.3	-9.3	-10.7	-10.4	6	
65	MAURITANIA	99999.	9999999.99	13.5	40.6	-53.2	-63.2	-85.2
	MAURITANIA	-2.1	-2.7	-9.1	-9.4	-10.0	4	
66	MAURITIUS	-5.6	15.4	0.5	46.7	13.9	-26.8	-54.0
	MAURITIUS	-5.6	-7.4	-26.8	-28.3	-31.1	6	
67	MEXICO	-871.	-916.	-1337.	-2470.	-3176.	-2532.	-1241.
	MEXICO	-59.4	-157.0	-196.2	266.6	290.5	2	

TABLE A-5 (Continued)

68	MOROCCO	-62.	48.	92.	197.	-419.	-1017.	-1305.
	MOROCCO	-395.	-59.9	-267.2	-276.0	-277.6	4	
72	NICARAGUA	-46.4	21.7	-62.3	-220.9	-145.3	-29.2	-135.
	NICARAGUA	-11.0	-15.4	-59.6	-69.3	-73.5	5	
73	NIGER	16.8	11.9	23.3	-11.3	-7.0	99999.9999999.99	
	NIGER	-1.6	-2.6	-8.7	-10.4	-10.5	6	
74	NIGERIA	-423.	-343.	-9.	4208.	34.	-254.	-626.
	NIGERIA	1719.2	2520.4	9875.5	7894.0	9379.8	2	
76	PAKISTAN	-503.	-241.	-65.	-787.	-827.	-559.	-501.
	PAKISTAN	-67.1	-87.1	-329.3	-346.0	-345.0	3	
77	PANAMA	-76.5	-98.6	-105.0	-192.7	-132.5	-130.8	-112.6
	PANAMA	-63.0	-79.7	-239.9	-282.5	-219.4	3	
79	PARAGUAY	-23.3	-5.3	-15.1	-46.0	-55.8	-45.8	99999.99
	PARAGUAY	-4.3	-6.6	-25.7	-22.4	-27.8	6	
80	PERU	-34.	-31.	-248.	-623.	-1210.	-886.	-640.
	PERU	-31.9	-36.9	-150.2	-240.7	-215.1	3	
87	SENEGAL	-26.6	10.7	-95.8	-56.3	-67.6	99999.9999999.99	
	SENEGAL	-28.3	-39.3	-129.7	-131.6	-135.8	5	
88	SIERRA LEON	-20.6	-9.3	-27.4	-52.2	-49.6	-42.1	-26.7
	SIERRA LEON	-6.1	-9.8	-35.3	-35.8	-35.3	4	
90	SOMALIA	0.8	-7.2	-36.6	-44.3	-0.1	-51.4	-23.0
	SOMALIA	-1.3	-2.0	-7.8	-9.7	-9.7	6	
92	SRI LANKA	-37.8	-32.6	-23.8	-116.7	-86.4	-4.6	95.0
	SRI LANKA	-35.7	-44.6	-140.6	-138.9	-127.8	5	
93	SUDAN	-43.8	-51.8	23.8	-236.6	-338.2	-123.0	-51.7
	SUDAN	-35.6	-49.1	-168.0	-167.7	-164.9	6	
94	SURINAM	-7.3	-5.5	-14.7	0.6	103.3	-30.1	99999.99
	SURINAM	-10.6	-16.7	-45.8	-59.9	-56.4	4	
96	SYRIA	-59.	30.	319.	143.	73.	-574.	-114.
	SYRIA	68.6	79.2	303.8	554.3	550.9	2	
97	TANZANIA	-103.8	-65.7	-101.6	-230.9	-180.2	-33.8	-8.7
	TANZANIA	-14.2	-25.9	-69.5	-68.5	-85.7	6	
98	THAILAND	-182.	-52.	-44.	-76.	-477.	-325.	-766.
	THAILAND	-131.2	-201.7	-730.9	-733.8	-793.4	6	
99	TOGO	-3.6	-13.0	-5.7	113.1	-57.2	99999.9999999.99	
	TOGO	-2.3	-3.0	-10.1	-10.0	-12.1	4	
101	TUNISIA	7.	-4.	-57.	25.	-144.	-289.	-373.
	TUNISIA	50.1	54.9	234.1	320.7	196.8	2	

TABLE A-5 (Concluded)

102	TURKEY	25.	124.	582.	-545.	-1452.	-1459.	-2318.
	TURKEY	-146.2	-219.3	-868.8	-936.1	-1207.6	3	
103	UGANDA	-90.5	16.3	40.5	-20.8	-44.2	31.9	47.5
	UGANDA	-8.3	-10.2	-37.0	-36.0	-33.7	6	
105	UPPER VOLTA	0.8	3.4	2.4	-2.8	-32.7	99999.9999999.99	
	UPPER VOLTA	-1.1	-1.7	-6.5	-7.5	-7.2	6	
106	URUGUAY	-76.1	58.8	35.2	-113.9	-148.8	-54.8	-68.0
	URUGUAY	-39.4	-46.6	-173.8	-136.5	-192.8	1	
111	ZAIRE	-130.1	-365.5	-264.1	-405.2	-471.1	99999.9999999.99	
	ZAIRE	-15.8	-20.6	-78.0	-68.4	45.5	4	
112	ZAMBIA	-258.	-210.	135.	33.	550.	15.3	229.
	ZAMBIA	-12.1	-26.7	-70.5	-107.7	-84.2	4	

TABLE A-6: PQLI Data Base

This table contains records for 108 countries. The number before the country name refers to the master LDC list (Table I). The numbers following the country name are, in order, with sources:

- Life expectancy at birth, years. (UN[9], World Bank[6], O.D.C.[25])
- Infant mortality per 1000 line births. (UN[9], World Bank[6], O.D.C.[25])
- Adult literacy rate, percent. (UN[10], World Bank[6], O.D.C.[25])
- Data consistency indicator for PQLI data (see text)
- BNL economy type.[7]
- GDP per capita, 1976, U.S. $. (World Bank[6])
- Total energy consumption per capita, 1975, kgce. (UN[11])
- Population, millions, 1975. (IMF[8])
- This variable not used
- Geographical region: 1 = S. Africa, 2 = N. Africa, 3 = M. East, 4 = S. Asia, 5 = E. Asia, 6 = Central America and Caribbean, 7 = S. America, 8 = Europe*
- Religion type: 1 = Hindu and Bhuddist, 2 = Christian, 3 = Islamic, 4 = Mixtures, 5 = Traditional or Tribal, 9 = Unknown

*Israel is counted as a European country

TABLE A-6

PQLI DATA BASE

1	AFGHANISTAN	38.	230.	9.	6	0	160.	52.	14.	1	3	3
2	ALGERIA	53.	116.	29.	2	0	990.	754.	16.2	1	2	3
3	ANGOLA	39.	203.	8.	2	0	330.	174.	5.5	1	1	9
4	ARGENTINA	68.	59.	93.	1	1	1550.	1754.	25.7	1	7	2
6	BAHRAIN	63.	78.	40.	2	0	9999.	11819.	0.3	0	3	3
7	BANGLADESH	41.	147.	22.	6	0	110.	28.	80.4	1	4	3
8	BARBADOS	67.	28.	99.	3	1	1510.	1175.	0.2	0	6	2
9	BELIZE	47.	34.	87.	6	0	9999.	547.	999.9	0	6	9
10	BENIN	41.	130.	13.	6	0	130.	52.	3.2	1	1	9
11	BOLIVIA	48.	117.	40.	2	0	390.	303.	5.8	1	7	2
12	BOTSWANA	50.	97.	33.	6	0	9999.	99999.	999.9	0	1	9
13	BRAZIL	60.	109.	65.	1	0	1140.	670.	110.0	1	7	2
15	BURMA	51.	98.	62.	6	0	120.	51.	30.8	1	5	1
16	BURUNDI	43.	146.	13.	6	1	120.	13.	3.8	1	1	5
17	CAMBODIA	45.	139.	42.	5	1	9999.	16.	8.1	0	5	1
18	CAMEROON	41.	137.	17.	6	0	290.	104.	7.6	1	1	9
19	CENT.AF.EMP.	38.	190.	7.	6	1	230.	34.	1.8	1	1	9
20	CHAD	36.	160.	9.	6	1	120.	39.	4.1	1	2	9
21	CHILE	65.	64.	89.	1	1	1050.	765.	10.5	1	7	2
22	CHINA (REP)	71.	20.	84.	1	0	1070.	1427.	16.3	1	5	8
23	COLOMBIA	62.	81.	79.	3	0	630.	671.	24.2	1	7	2
24	CONGO,PR	44.	180.	29.	2	0	520.	209.	1.4	1	1	9
25	COSTA RICA	67.	38.	89.	5	1	1040.	544.	2.0	1	6	2
26	CYPRUS	71.	27.	76.	6	1	1240.	1419.	0.6	0	3	2
27	DOMINCN REP	59.	61.	62.	5	0	780.	458.	4.3	1	6	2
28	ECUADOR	60.	67.	68.	2	1	640.	442.	7.3	1	7	2
29	EGYPT	55.	103.	31.	2	0	280.	405.	38.1	1	2	3
30	EL SALVADOR	59.	56.	59.	6	1	490.	248.	4.1	1	6	2
31	EQ GUINEA	44.	109.	20.	6	0	9999.	97.	999.9	0	1	9
32	ETHIOPIA	39.	123.	6.	6	0	100.	29.	28.7	1	2	2
33	FIJI	70.	41.	64.	6	1	1150.	487.	0.6	0	5	5
34	GABON	37.	204.	19.	2	0	30.	1070.	0.5	0	1	9
35	GAMBIA	40.	165.	8.	6	0	170.	73.	0.5	0	1	3
36	GHANA	47.	111.	31.	6	0	580.	182.	10.1	1	1	9
37	GREECE	71.	23.	83.	3	1	2590.	2090.	9.1	1	9	2
38	GUATEMALA	53.	75.	46.	5	1	630.	671.	6.5	1	6	2
39	GUINEA	41.	175.	9.	4	0	150.	92.	5.7	1	1	9
40	GUYANA	65.	51.	87.	4	0	610.	931.	0.8	0	7	9

TABLE A-6 (Continued)

41	HAITI	53.	133.	22.	6	0	200.	30.	4.7	1	6	4
42	HONDURAS	55.	57.	50.	5	0	450.	221.	2.8	0	6	2
43	HONG KONG	71.	14.	81.	3	1	2110.	1119.	4.5	1	5	9
44	INDIA	53.	124.	34.	3	0	150.	221.	620.4	1	4	1
45	INDONESIA	48.	131.	60.	2	1	240.	178.	135.2	1	5	3
46	IRAN	55.	112.	41.	2	0	1930.	1353.	34.3	1	3	3
47	IRAQ	55.	80.	45.	2	0	1390.	713.	11.5	1	3	3
48	ISRAEL	72.	22.	84.	1	1	3920.	2806.	3.6	1	9	8
49	IVORY COAST	44.	146.	15.	5	0	610.	366.	7.0	1	1	9
50	JAMAICA	70.	20.	83.	4	1	1070.	1427.	2.1	1	6	2
51	JORDAN	53.	78.	42.	6	0	610.	408.	2.8	1	3	3
52	KENYA	50.	74.	27.	6	0	240.	174.	13.3	1	1	5
53	KOREA (REP)	62.	54.	88.	1	0	670.	1038.	36.0	1	5	8
54	KUWAIT	68.	41.	55.	2	1	15480.	3718.	1.1	1	3	3
55	LAO PDR	40.	175.	28.	6	0	90.	63.	3.3	1	5	1
56	LESOTHO	46.	136.	53.	6	0	170.	9999.	1.2	0	1	2
57	LEBANON	63.	59.	77.	6	0	9999.	928.	3.2	0	3	5
58	LIBERIA	45.	159.	11.	4	1	450.	404.	1.6	1	1	5
59	LIBYA	53.	130.	25.	2	0	6310.	1299.	2.5	1	2	3
60	MADAGASCAR	42.	86.	37.	6	0	200.	71.	9.1	1	1	4
61	MALAWI	42.	145.	23.	6	1	140.	56.	5.2	1	1	5
62	MALAYSIA	64.	36.	56.	2	1	960.	560.	12.7	1	5	3
63	MALI	38.	143.	18.	6	0	100.	25.	5.8	1	2	9
64	MALTA	71.	16.	75.	3	1	1450.	1156.	0.3	0	9	2
65	MAURITANIA	39.	187.	11.	4	1	340.	108.	1.4	1	2	3
66	MAURITIUS	63.	40.	61.	6	1	700.	275.	.9	0	4	5
67	MEXICO	64.	57.	75.	2	0	1090.	1221.	62.0	1	6	2
68	MOROCCO	53.	133.	23.	4	1	540.	274.	17.2	1	2	3
69	MOZAMBIQUE	44.	109.	11.	6	0	170.	186.	9.5	1	1	9
70	NEPAL	44.	152.	15.	6	0	120.	10.	12.9	1	4	1
72	NICARAGUA	53.	67.	57.	5	0	750.	479.	2.3	1	6	2
73	NIGER	40.	131.	3.	6	0	160.	35.	4.7	1	1	3
74	NIGERIA	40.	160.	20.	2	0	380.	90.	77.1	1	1	9
76	PAKISTAN	51.	125.	17.	3	1	170.	183.	71.3	1	4	3
77	PANAMA	66.	40.	79.	3	1	1310.	865.	1.7	1	6	2
78	PAPUA NEW G	48.	106.	32.	6	0	490.	278.	2.8	1	5	9
79	PARAGUAY	62.	63.	80.	6	0	640.	153.	2.6	1	7	2
80	PERU	55.	68.	72.	3	0	500.	682.	15.8	1	7	2

TABLE A-6 (Concluded)

81	PHILLIPINES	58.	70.	84.	3	0	410.	326.	43.3	1	5	2
82	PORTUGAL	69.	39.	71.	3	1	1690.	933.	9.7	1	9	2
83	QATAR	47.	138.	13.	2	0	9999.	18423.	0.1	0	3	3
84	RHODESIA	52.	122.	39.	6	1	9999.	805.	999.9	0	1	9
85	RWANDA	41.	131.	18.	6	1	110.	14.	4.2	1	1	2
86	SAUDI ARABIA	45.	152.	14.	2	0	4480.	1398.	8.6	1	3	3
87	SENEGAL	40.	137.	8.	5	0	390.	195.	5.1	1	1	9
88	SIERRA LEONE	44.	136.	32.	4	0	200.	116.	3.1	1	1	4
89	SINGAPORE	70.	13.	73.	1	1	2700.	2151.	2.3	1	5	9
90	SOMALIA	41.	177.	19.	6	0	91.	36.	3.3	1	1	3
91	SPAIN	72.	11.	91.	1	1	2920.	2147.	35.7	1	9	2
92	SRI LANKA	67.	46.	79.	5	1	200.	127.	13.8	1	4	1
93	SUDAN	49.	122.	15.	6	0	290.	140.	15.9	1	2	3
94	SURINAM	66.	30.	94.	4	1	1200.	2834.	0.4	0	7	5
95	SWAZILAND	44.	168.	36.	5	0	9999.	99999.	999.9	0	1	9
96	SYRIA	56.	53.	44.	2	0	780.	477.	7.7	1	3	3
97	TANZANIA	43.	165.	40.	6	0	180.	70.	15.1	1	1	9
98	THAILAND	58.	47.	80.	6	0	380.	284.	43.0	1	5	1
99	TOGO	39.	137.	15.	4	0	260.	65.	2.3	1	1	5
100	TRINIDAD+TOB	67.	34.	91.	2	1	2240.	3132.	1.[illegible]	1	6	2
101	TUNISIA	54.	108.	37.	2	0	840.	447.	5.[illegible]	1	2	3
102	TURKEY	56.	67.	52.	3	0	990.	630.	41.2	1	3	3
103	UGANDA	50.	160.	32.	6	1	240.	55.	11.9	1	1	9
104	UN ARAB EM	47.	138.	21.	2	0	1400.	13503.	0.7	0	3	3
105	UPPER VOLTA	36.	182.	4.	6	1	110.	20.	8.2	1	1	9
106	URUGUAY	69.	49.	90.	1	1	1390.	942.	2.8	1	7	2
107	VENEZUELA	65.	47.	80.	2	1	2570.	2639.	12.4	1	7	2
108	YEMEN AR	45.	158.	8.	6	1	250.	49.	6.0	1	3	3
109	YEMEN PDR	45.	98.	21.	6	0	280.	97.	1.7	1	3	3
110	YUGOSLAVIA	68.	38.	84.	1	1	1680.	1930.	21.5	1	9	5
111	ZAIRE	44.	132.	26.	4	0	140.	78.	25.4	1	1	2
112	ZAMBIA	45.	159.	46.	4	0	440.	504.	5.1	1	1	4

TABLE A-7

PQLI DATA

Country	Life Expectancy at Birth (years), e_o				Infant Mortality (per 1000 live births), m				Adult Literacy Rate (%), r			
	W.B.(6)		U.N.(9)	ODC(25)	W.B.(6)		U.N.(9)	ODC(25)	W.B.(6)		UNESCO(10)	ODC(25)
	60	75			60	75			60	75		
Afghanistan	33	35	40 (70-75)	40	-	269	-	190	8	14	6 (65)	8
Algeria	46	53	53 (70-75)	53	36	-	86 (65)	145	-	35	26 (71)	26
Angola	32	39	39 (70-75)	38	-	24	24 (72)	203	-	-	3 (50)	10-15
Argentina	65	68	68 (70-75)	68	62	59	59 (70)	59	91	93	92 (71)	93
Bahamas	-	-	66 (69-71)	66	-	-	35 (75)	35	-	-	90 (63)	90
Bahrain	-	-	-	63	-	-	-	78	-	-	40 (71)	40
Bangladesh	39	42	36 (70-75)	46	-	140	-	153	-	23	22 (61)	22
Barbados	-	-	65 (59-61)	69	-	-	28 (76)	28	-	-	98 (60)	98
Belize	-	-	47 (48)	-	-	-	34 (72)	34	-	-	87 (60)	87
Benin	38	-	41 (70-75)	41	110	-	110 (61)	149	-	10	8 (62)	20
Bolivia	-	-	47 (70-75)	48	-	-	77 (65)	157	-	40	39 (60)	40
Botswana	-	-	44 (70-75)	56	-	-	-	97	-	-	33 (64)	33
Brazil	60	-	59 (60-70)	61	70	-	-	109	61	64	66 (70)	66
Burma	-	53	50 (70-75)	50	-	56	195-300(52)	140	58	67	60 (62)	60
Burundi	-	45	42 (70-71)	42	-	138	150 (65)	150	10	10	14 (62)	14
Cambodia	41	45	-	45	-	-	127 (59)	150	-	-	41 (63)	42
Cameroon	39	-	41 (70-75)	41	72	-	-	137	-	12	19 (62)	19
Central Af. Emp.	44	-	35 (70-75)	41	200	-	190 (60)	190	15	-	7 (62)	7
Chad	34	39	32 (70-75)	38	-	-	160 (63-64)	160	-	15	6 (63)	6
Chile	64	68	63 (69-70)	63	125	79	56 (75)	56	84	90	88 (70)	88
China, Rep. of	64	71	-	70	31	14	-	25	54	82	-	85
Colombia	61	65	61 (70-75)	61	100	56	97 (73)	90	-	74	81 (73)	81
Congo, P.R. of	45	-	44 (70-75)	4[illegible]	200	-	180 (60)	180	-	50	16 (61)	20
Costa Rica	66	71	63 (62-64)	68	71	38	38 (75)	38	84	89	88 (73)	89
Cyprus	-	-	71 (73)	71	-	-	2[illegible] (74)	27	-	-	76 (60)	76
Dominican Rep.	53	61	58 (59-61)	58	101	43	43 (74)	96	-	51	67 (70)	68
Ecuador	57	65	56 (62-74)	60	100	70	66 (75)	66	67	69	67 (62)	68
Egypt, Arab Rep. of	51	58	53 (60)	53	109	101	101 (74)	108	20	40	26 (60)	26
El Salvador	51	62	58 (60-61)	58	76	58	55 (76)	55	51	63	57 (71)	57
Eq. Guinea	-	-	44 (70-75)	44	-	-	53 (65)	165	-	-	-	20
Ethopia	34	38	38 (70-75)	42	-	-	84 (63)	162	-	-	6 (65)	6
Fiji	-	-	70 (70-75)	70	-	-	41 (75)	41	-	-	64 (46)	64
Gabon	-	-	35 (60-61)	41	-	-	229 (60)	178	-	-	13 (60)	25
Gambia	-	-	40 (70-75)	40	-	-	-	165	-	-	6 (62)	10
Ghana	42	47	44 (70-75)	49	113	63	156 (60)	115	-	25	43 (70)	25
Greece	69	72	69 (60-62)	72	40	24	23 (76)	23	80	82	84 (71)	84
Guatemala	48	57	49 (63-65)	53	92	75	75 (74)	75	38	47	46 (73)	46
Guinea	40	-	41 (70-75)	41	156	-	216 (55)	175	7	-	9 (65)	9
Guyana	-	-	61 (59-61)	68	-	-	51 (72)	50	-	-	87 (60)	87
Haiti	54	59	50 (70-75)	50	200	150	-	115	10	20	23 (71)	23

Note: Data vintage is shown in parentheses for U.N. and UNESCO.

TABLE A-7 (Continued)

PQLI DATA

Country	Life Expectancy at Birth (years), e_o				Infant Mortality (per 1000 live births), m				Adult Literacy Rate (%), r			
	W.B.(6)		U.N.(9)	ODC(25)	W.B.(6)		U.N.(9)	ODC(25)	W.B.(6)		UNESCO(10)	ODC(25)
	60	75			60	75			60	75		
Honduras	43	56	54 (70-75)	55	52	34	34 (75)	103	47	61	45 (61)	45
Hong Kong	65	71	71 (71)	72	38	15	14 (76)	14	71	90	77 (71)	77
India	49	57	41 (51-60)	49	139	122	122 (71)	129	24	36	33 (71)	34
Indonesia	44	-	48 (60)	48	82	-	125 (62)	137	47	62	57 (61)	60
Iran	-	58	51 (70-75)	57	-	120	-	104	15	50	37 (71)	37
Iraq	-	59	53 (70-75)	53	-	104	33 (70-75)	104	15	26	24 (65)	26
Israel	70	73	72 (75)	71	31	22	23 (58)	22	84	84	84 (61)	84
Ivory Coast	36	44	44 (70-75)	44	-	-	138 (58)	154	9	20	5 (62)	20
Jamaica	66	71	65 (59-61)	68	52	20	20 (76)	20	82	86	82 (60)	82
Jordan	49	54	52 (59-63)	53	54	22	36 (66)	97	36	62	32 (61)	32
Kenya	43	50	49 (69)	50	-	51	51 (73)	119	-	40	19 (62)	20-25
Korea, Rep. of	53	61	65 (70)	61	58	38	-	70	71	92	88 (70)	85
Kuwait	58	67	69 (70)	69	-	44	34 (76)	44	-	-	55 (70)	55
Lao P.D.R.	40	40	40 (70-75)	40	-	-	-	175	20	-	28 (62)	28
Lesotho	38	46	46 (70-75)	46	-	114	181 (56)	114	-	40	59 (66)	59
Lebanon	57	63	63 (70-75)	64	-	-	14 (60)	59	-	68	-	86
Liberia	37	44	45 (71)	45	-	159	159 (71)	159	9	15	9 (62)	10
Libyan A.R.	45	53	53 (70-75)	53	-	-	-	130	-	-	22 (64)	27
Madagascar	36	44	38 (66)	44	69	53	102 (66)	102	-	40	33 (53)	39
Malawi	35	41	43 (70-72)	43	-	142	151 (70)	142	-	25	22(66)	22
Malaysia	52	59	65 (70-74)	68	69	35	33 (75)	41	23	60	55 (70)	53
Mali	35	38	38 (70-75)	38	123	120	120 (60)	188	5	10	3 (62)	5
Malta	-	-	71 (76)	70	-	-	17 (76)	14	-	-	66 (63)	83
Mauritania	36	39	39 (70-75)	39	-	-	187 (65)	187	5	10	11 (65)	11
Mauritius	-	-	63 (71-73)	63	-	-	40 (76)	40	-	-	61 (62)	61
Mexico	56	63	65 (75)	65	74	50	55 (70-75)	66	62	76	74 (70)	74
Morocco	45	53	53 (70-75)	53	149	117	149 (62)	133	17	26	21 (71)	21
Mozambique	36	44	44 (70-75)	44	-	93	93 (65)	140	-	-	11 (62)	11
Nepal	36	44	44 (73)	44	-	-	-	152	10	19	12 (71)	13
Netherlands Ant.	-	-	62 (66-70)	62	-	-	20 (73)	28	-	-	92 (71)	93
Nicaragua	46	53	53 (70-75)	53	70	46	46 (73)	110	38	57	57 (61)	58
Niger	36	39	42 (70-75)	39	200	162	200 (59-60)	200	5	-	1 (62)	5
Nigeria	34	41	37 (65-66)	41	207	163	-	157	25	-	15 (62)	25
Oman	-	-	-	47	-	-	-	138	-	-	-	-
Pakistan	42	51	51 (70-75)	51	142	113	124 (68)	139	16	21	15(61)	16
Panama	61	67	66 (70-75)	66	57	36	36 (76)	47	78	82	78 (70)	78
Papua New Guinea	39	48	48 (70-75)	48	-	-	-	106	-	32	-	32
Paraguay	54	62	62 (70-75)	62	90	74	39 (71)	65	84	81	80 (72)	80
Peru	49	56	54 (60-65)	56	92	65	58 (72)	80	61	72	72 (72)	72
Philippines	49	58	58 (70-75)	58	85	72	59 (74)	80	72	87	83 (70)	83
Portugal	62	68	69 (74)	69	78	38	39 (75)	39	62	70	71 (70)	71
Qatar	-	-	-	47	-	-	-	138	-	-	-	10-15

TABLE A-7 (Concluded)

PQLI DATA

Country	Life Expectancy at Birth (years), e_0				Infant Mortality (per 1000 live births), m				Adult Literacy Rate (%), r			
	W.B.[6]		U.N.[9]	ODC[25]	W.B.[6]		U.N.[9]	ODC[25]	W.B.[6]		UNESCO[10]	ODC[25]
	60	75			60	75			60	75		
Rhodesia	44	52	52 (70-75)	52	-	-	122 (5.)	122	-	-	39 (62)	39
Rwanda	36	41	41 (70-75)	41	-	133	127 (70)	133	10	23	16 (62)	16
Saudi Arabia	37	45	45 (70-75)	45	-	-	-	152	-	-	12 (62)	15
Senegal	36	40	40 (70-75)	40	193	158	93 (60)	159	5	10	6 (61)	5-10
Sierra Leone	36	44	44 (70-75)	44	-	-	-	136	7	15	7 (63)	10
Singapore	63	70	68 (70)	71	35	14	12 (76)	12	-	75	69 (70)	75
Somalia	35	41	41 (70-75)	41	-	-	-	177	-	50	1 (62)	5
Spain	68	72	72 (70)	72	44	12	11 (76)	11	87	94	90 (70)	90
Sri Lanka	61	68	66 (67)	68	57	45	45 (72)	47	61	78	78 (71)	81
Sudan	41	49	49 (70-75)	49	159	132	94 (56)	141	-	15	15 (66)	15
Surinam	-	-	65 (63)	66	-	-	30 (66)	30	-	-	84 (64)	84
Swaziland	-	-		44	-	-		168	-	-		36
Syrian Arab R.	46	54	57 (70)	57	31	22	22 (72)	114	30	53	40 (70)	40
Tanzania	37	45	41 (67)	44	190	-	163 (67)	167	17	63	28 (67)	28
Thailand	49	58	56 (60)	61	49	27	26 (76)	89	68	82	79 (70)	79
Togo	34	41	35 (61)	41	127	121	127 (61)	163	10	12	16 (70)	16
Trinidad & Tobago	62	70	66 (70)	66	45	38	34 (75)	31	-	90	92 (70)	92
Tunisia	46	54	54 (70-75)	55	74	63	125 (69)	135	-	55	24 (66)	32
Turkey	49	57	54 (66)	57	-	-	15 (67)	119	40	55	51 (70)	51
Uganda	43	50	50 (70-75)	50	160	-	160 (59)	160	25	25	35 (62)	35
Un. Arab Em.	-	-	-	47	-	-	-	138	-	-	21 (68)	21
Upper Volta	32	38	32 (70-75)	38	182	-	182 (70-75)	182	7	-	1 (62)	5-10
Uruguay	67	70	69 (63-64)	69	47	48	49 (75)	49	90	91	90 (63)	90
Venezuela	57	65	65 (70-75)	65	54	46	45 (75)	49	65	82	76 (71)	82
Yemen A.R.	37	45	45 (70-75)	45	-	160	-	155	10	10	3 (62)	10
Yemen P.D.R.	37	45	45 (70-75)	45	-	40	-	155	-	10	27 (73)	27
Yugoslavia	62	68	68 (70-72)	68	88	41	36 (76)	36	77	85	83 (71)	84
Zaire	40	44	44 (70-75)	44	104	-	104 (55-58)	160	-	15	31 (62)	31
Zambia	39	45	45 (70-75)	44	-	-	259 (50)	159	41	43	47 (69)	47

REFERENCES

1. J. Darmstadter, P.D. Teitelbaum, and J.G. Polach, Energy in the World Economy, Resources for the Future, 1971.

2. J. Darmstadter, J. Dunkerley, and J. Alterman, How Industrial Societies Use Energy, Resources for the Future, 1977.

3. J. Dunkerley, International Comparisons of Energy Consumption, Resources for the Future, 1978.

4. A. Lambertini, Energy and Petroleum in Non-Opec Developing Countries 1974-1980, World Bank, 1976.

5. B.J. Choe, Energy Consumption in Developing Countries, World Bank, 1979.

6. World Bank, World Development Indicators, 1978.

7. P.F. Palmedo, R. Nathans, E. Beardsnorth, and S. Hale, Energy Needs, Uses and Resources in Developing Countries, Brookhaven National Laboratory, BNL 50784, March 1978.

8. International Monetary Fund, International Financial Statistics.

9. United Nations, Statistical Yearbook, 1977, 1978.

10. United Nations Educational, Scientific and Cultural Organization, UNESCO Statistical Yearbook, 1976, 1977.

11. United Nations, World Energy Supplies 1950-1974, 1976.

12. United Nations, World Energy Supplies 1971-1975.

13. United Nations, World Energy Supplies, 1972-1976.

14. International Labor Office, Year Book of Labor Statistics, 1978.

15. International Labor Office, 1950-2000 Labor Force, six volumes, 1977.

16. Food and Agriculture Organization of the United Nations, FAO Production Yearbook 1977, Vol 31, 1978.

17. B.A. Stout, Energy for Worldwide Agriculture, FAO, (to be published).

REFERENCES (Cont'd)

18. Food and Agriculture Organization of the United Nations, State of Food and Agriculture 1976.

19. R.L. Plackett, Principles of Regression Analysis, Oxford University Press, 1960.

20. J.P. Powelson, The Oil Price Increase: Impacts on Industrialized and Less Developed Countries.

21. C. Glezakos, Inflation and Growth: A Reconsideration of the Evidence from LDC's, J. Developing Areas, 12, 2, Jan. 1978.

22. P.C. Ip, Price Stability and Economic Welfare, J. Agric. Econ. 27 227-233, 1976.

23. I. Adelman and C.T. Morris, Society, Politics and Economic Development, Johns Hopkins, 1967.

24. G.H. Gallup, Human Needs and Satisfactions: A Global Survey, Pub. Opin. Q., 40, pp 459-67, Winter 1976-77.

25. Overseas Development Council, The United States and World Development: Agenda 1979, 1979.

26. G. Sheehan, and M. Hopkins, Meeting Basic Needs: An Examination of the World Situation in 1970, International Labour Rev., 1977, 117, 5, September-October 1978.

27. J.P. Grant, Disparity Reduction Rates in Social Indicators, Overseas Development Council Monograph No. 11.

28. J. Paxton (Ed.), The Statesman's Year-Book 1978-1979, McMillan, 1978.

29. Whitaker's Almanac, 1977.