

The Relationship Between Energy
Consumption and the Gross
Domestic Product for Trinidad
and Tobago (1970-1985).

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April 8, 1988.

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Acknowledgements :

I would like to thank my advisor Dr. Lonergan for approving my topic which I enjoyed immensely. Your help has proved invaluable over the entire academic year. Thanks for being there. I would also like to thank the Central Statistical Office and The Ministry of Energy and Natural Resources in Trinidad and Tobago for willingly providing me with the data that was necessary for this research. Finally, I would like to thank my fourth year colleagues whose help and inspiration kept it all together.

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CHAPTER 1:

INTRODUCTION:

Substantial debate has occurred throughout the world as to the relationship between energy consumption and economic growth. According to Cleveland et. al., the United States has a close correlation between various aspects of energy use and the gross domestic product (Cleveland,1984, pp.890-892). However, Ramage says that there is obviously no simple proportionality between G.D.P. and energy. India is used as an example:

In the developed countries, because they are indeed developing... the rate of growth of commercial energy consumption has tended to be considerably greater than the rate of growth of G.D.P. . In India during the 1960's the G.D.P. grew at about 3% a year and energy consumption at nearly twice this
(Ramage,1983,pp.276-277).

Therefore, one can see that the relationship tends to reflect the level of economic development and social well-being. Since there are no global trends in this relationship, case studies have to be done on a national scale. For the purpose of this paper, the islands of Trinidad and Tobago in the West-Indies will be examined. In Trinidad and Tobago it is said that the Gross Domestic Product (GDP) growth rate fluctuates in accordance with the growth rate of the petroleum industry (Black,1976,p.207).

HYPOTHESIS:

There exists a strong relationship between energy consumption and the Gross Domestic Product through the period from 1970 to 1985.

METHOD:

Firstly, a brief historical perspective of Trinidad and

Tobago will be given from the early 1900's to 1985. Energy data and its interpretation will then be given, and economic data and its interpretation will also be presented. The assessment of national energy consumption is done by using net energy rather than primary energy because it is a better indicator of consumer demand. Primary energy includes plant and animal fuels, crude oil, and associated gas. However, net energy includes primary energy, liquified gas, gasolenes , kerosene and turbo fuels, diesel and gas oil, heavy fuels, refinery gas and electricity. Finally, the relationship between energy consumption and GDP will be further examined by looking at a simple correlation and regression analysis and energy/GDP ratios will also be calculated.

The data that is used have been collected at two public agencies in Trinidad and Tobago. Energy data was collected at the Ministry of Energy and Natural Resources and economic data was collected at the Central Statistical Office.

TRINIDAD AND TOBAGO (AREA AND LOCATION) :

Trinidad and Tobago are two relatively small islands (Trinidad -4828 sq. km. and Tobago -300 sq. km.) and they are constitutionally joined together as the Republic of Trinidad and Tobago. The island of Trinidad is situated about 10 degrees North of the Equator, between 61 and 62 West Longitude in the Southern part of the Caribbean Sea. It is seven miles at the nearest point from the Venezuelan Coast from which it is separated by the Gulf of Paria and the narrow channels of the Bocas. It is the second largest of the group formerly comprising the British West Indian Islands.

The island of Tobago is situated about 11 degrees 9 minutes North of the Equator, 60 degrees 43 minutes West Longitude. It lies North-East of Trinidad from which it is separated by a channel about 19 miles wide (Central Statistical Office,1985, p.1).

CHAPTER 2

THE LITERATURE REVIEW:

The link between fuel use and the Gross National Product has been well-studied in the past two decades (e.g. Schurr and Netschert et. al. 1960). There have been different approaches to this topic where some authors have used an input-output analysis while others have used energy/GDP ratios and simple regression analysis.

The objectives of this chapter are to provide a context of the relationship between energy consumption and the gross domestic product by looking at previous studies on the topic. Basic background material of Trinidad and Tobago will be presented and an introduction to the method of approach will also be described.

PREVIOUS WORK IN THE AREA:

Conservation Foundation (1978) and Cleveland et. al. (1984) most recently have shown evidence of a strong correlation between GNP and fuel use as well as between annual rates of change of each.

Studies on the impacts of structural change on energy use have been done by Huettner (1982) and Hogan (1979) among others. They have argued that factor substitution and improvements in fuel efficiency have substantially reduced the amount of energy consumed per unit of economic output. Several authors (e.g., Stobaugh 1979 and Lovins 1977) have even suggested that 'decoupling' energy and GNP is possible and would allow the economy to continue and grow while decreasing energy consumption. However, the dependence of economic growth on accessible low-cost energy will not diminish to any great extent (Cleveland et. al. 1984, Costanza 1980).

INTERNATIONAL COMPARISONS OF ENERGY/GDP RATIOS:

International comparisons of energy and economic output are difficult to make. Energy consumption must be measured in a

common unit derived in the same manner across countries and must consider the different fuel mixes which define a country's energy use. Similar difficulties exist in comparing economic activity or output between different countries (Eden et. al. 1981 and Lonergan et. al. 1984). International comparisons also vary according to climate, industrial make-up and transportation networks (Rive, 1985). Often, such comparisons require assumptions about conversion rates between different currencies. Any use of international comparisons for understanding the relationship must first resolve these issues. These are solved by standardizing for energy quality and accounting for inflation.

STANDARDIZING FOR ENERGY QUALITY

Standardizing for energy quality provides a better measure with which to interpret the relationship between energy and economic development. It also substantially decreases the differences in energy/GDP ratios between regions and dramatically decreases the efficiency of regions dependent on very high quality energy forms such as electricity. The energy data was already standardized to oil equivalent units and thus, all forms of energy (e.g. plant and animal fuels, gasolenes) was converted to these units. Information was however available also in original units and the conversion factors are listed in Table 2.1.

Table 2.1 : CONVERSION FACTORS PROVIDED BY :O.L.A.D.E.
(Latin American Energy Organization)

<u>Item / Commodity</u>	<u>Factor</u>
PLANT AND NATURAL FUEL BAGASSE	0.19 toe per tonne
NATURAL GAS	0.0252 toe per mscf
CRUDE OIL	0.139 toe per barrels
LPG	0.093 toe per bbl.
GASOLENE - NAPHTAS	0.122 toe per bbl.
GAS DIESEL OIL	0.139 toe per bbl.
KEROSENE - TURBO FUEL	0.135 toe per bbl.
FUEL OIL / HEAVY FUELS	0.143 toe per bbl.
NON ENERGY PRODUCTS	0.139 toe per bbl.
OTHER ENERGY PRODUCTS	0.139 toe per bbl.
REFINERY GAS	0.0311 toe per mscf
ELECTRICITY	0.086 toe per MWh

Source: Supplied by the Ministry of Energy and Natural Resources.
Trinidad and Tobago.

HISTORY OF OIL PRODUCTION:

It was not until the years 1907 to 1914 that oil became a commercial venture - marked by the first export of crude oil in 1910, the establishment of refinery facilities in 1913-1914 and the production of 1 million barrels during the year 1914. Between 1950-1968 the annual oil production soared from 21 million barrels to a peak of 67 million barrels. After 1968, declining land production and a tapering off of marine production

resulted in an overall production decline over the next three years. It was not until major oil and gas discoveries by AMOCO off the South-East Coast in the late 1960's coming on stream in 1972 that production turned around and attained an all-time record high of 83.7 million barrels in 1978 (Ministry of Energy and Natural Resources, 1986, p.6).

ENERGY SUPPLY :

Trinidad and Tobago is one of the three countries in the Western Hemisphere with no hydroelectricity and no identifiable hydropotential, yet the per capita output of electricity is highest in all of Latin America. Almost all of the electricity is generated by natural gas, and rates are low because of the ready availability of the fuel. A small plant fueled by diesel oil is located on Tobago but it is used only for standby service; Tobago usually receives its electricity by means of underseas cable from Trinidad. The standby plant is placed into service when outages occur on the transmission lines (Black, 1976, p.225).

OIL RESERVES :

To date, some 2,200 million barrels have been produced, with remaining proven reserves estimated at 612 million barrels and probable reserves at 577 million barrels. These estimates exclude some 200 million barrels of condensate from undeveloped marine gas fields but include production from the Cassia natural gas field. About 80% of the probable remaining reserves are heavy oil deposits from onshore fields and the Gulf of Paria.

GAS RESERVES :

A significant number of large gas fields were discovered off the South East Coast and North Coast of Trinidad in the late 1960's and 1970's. Total gas reserves are shown in table 2.2.

Table 2.2 : Trinidad and Tobago's Recoverable Gas Reserves.

<u>Category</u>	<u>Mega Cubic Metres</u>	<u>Trillion Cubic Feet</u>
Proven	272	9.6
Probable	167	5.9
Possible	31	1.1
TOTAL	470	16.6

Source: Ministry of Energy and Natural Resources, 1986.

EXPLANATION OF THE OIL BOOM AND AFTER:

IMPACT ON TRINIDAD AND TOBAGO'S ECONOMY:

During the period 1974-1981 dramatic increases in Trinidad and Tobago's government oil revenues resulting from increases in both international oil prices (\$2.00 to almost \$40.00 per barrel) and domestic oil production (from a peak of 187,000 bbls. per day in 1978) fuelled GDP growth to over 6% per annum - more than double the previous eight-year average. At the height of the oil boom in 1981, petroleum sector revenue receipts comprised some 60% of the central government revenues; oil export revenues peaked at (U.S.) \$2.2 billion and net international revenues stood at (U.S.) \$3.4 billion. Central government expenditure, being the dominant influence in the economy, drove up factor costs (land, labour, capital, entrepreneurship) to unprecedented heights (Ibid., 1986, p.6). See Table 2.2.

After 1981, the world economy witnessed a complete reversal of the 1974-1981 situation. Oil prices declined and subsequently tumbled to \$12.00 per barrel by July 1986. Domestic oil production declined to 160,000 barrels per day during the same month (Ibid., 1986, p.6).

DEVALUATION OF THE TT DOLLAR:

The effects of the December 1985 devaluation of the TT dollar by 50%, on the oil industry have been mixed. On the one hand, oil companies' export income increased by 50% in TT dollar

terms and so did Trinidad and Tobago's government tax revenue; while the aggregate oil wage bill remained the same (more so in the labour intensive land production and refining sectors) thereby improving the profitability of oil companies. On the other hand, the aggregate costs of imported capital equipment increased, more notably in the highly capital intensive offshore oil operations (Ibid.,1986,pp.6-7). In the 1986 budget speech delivered on the 12th December,1985, the exchange rate of the TT dollar vis a vis the U.S. dollar was \$3.60, where the exchange rate before was TT \$2.40 to the U.S. dollar (Central Statistical Office,1987,p.3).

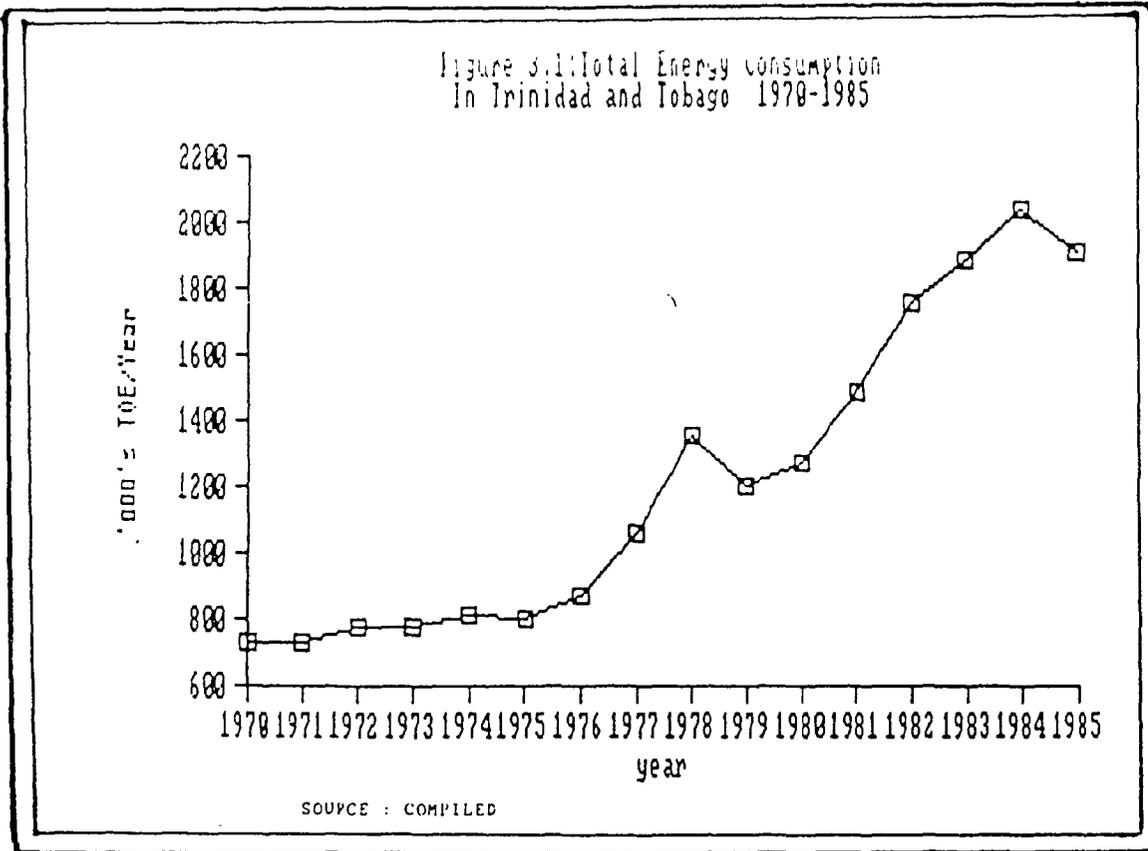
CHAPTER 3: The Energy Trends

In this chapter an overview of the use of energy in Trinidad and Tobago's economy during the period 1970-1985 is provided. Energy use is disaggregated by four energy types: bagasse (i.e. remains of the sugar cane after the juice is removed and it is often re-used as fuel in the sugar mills), associated natural gas, petroleum products and electricity. The economy has been divided into three economic sectors: residential-commercial-public, transport and industrial-agricultural.

The Growth of Energy Consumption:

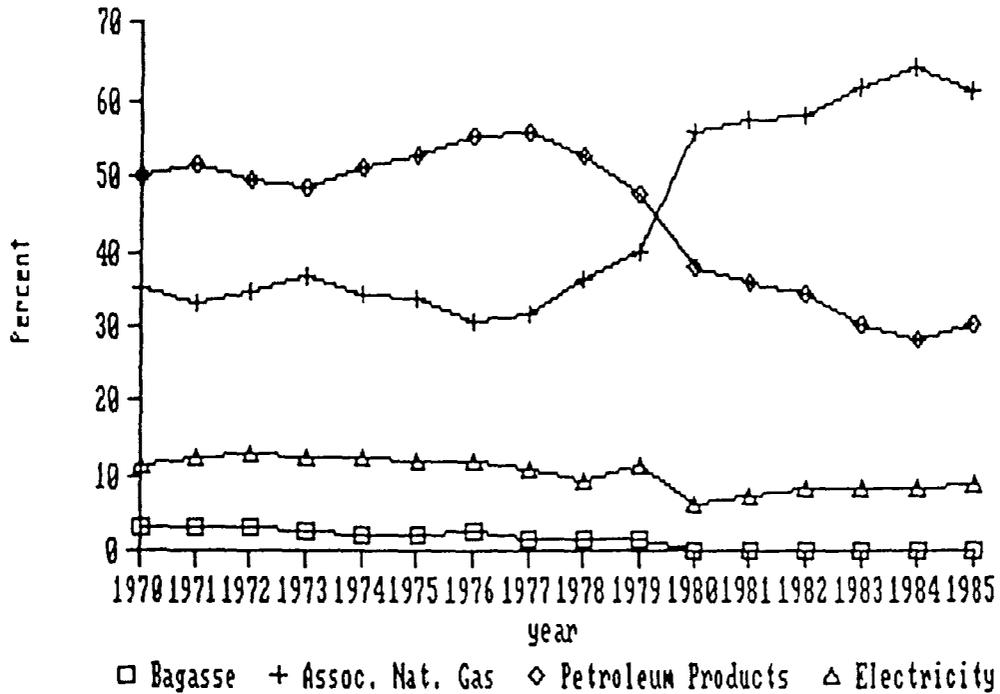
The change in total energy use in Trinidad and Tobago's economy between 1970 to 1985 is shown in Figure 3.1. Energy consumption estimates for the period were derived by annual statistics published by the Ministry of Energy. This data represent total final energy consumed by the residential-commercial-public, transport and industrial-agricultural sectors for each year. The measurement unit is in thousand tons of oil equivalent units. These data are the only continuous record of energy used by the Trinidad and Tobago economy available.

Figure 3.1: Total Energy consumption
In Trinidad and Tobago 1970-1985



Energy consumption has grown steadily since 1970 but major declines have occurred in 1979 and 1985. During the period 1974 to 1982 petroleum prices in the international market rose significantly and so did an increase in both production and consumption (Figure 3.1).

Figure 3.2 : Consumption of Energy
By Type (1970-1985).



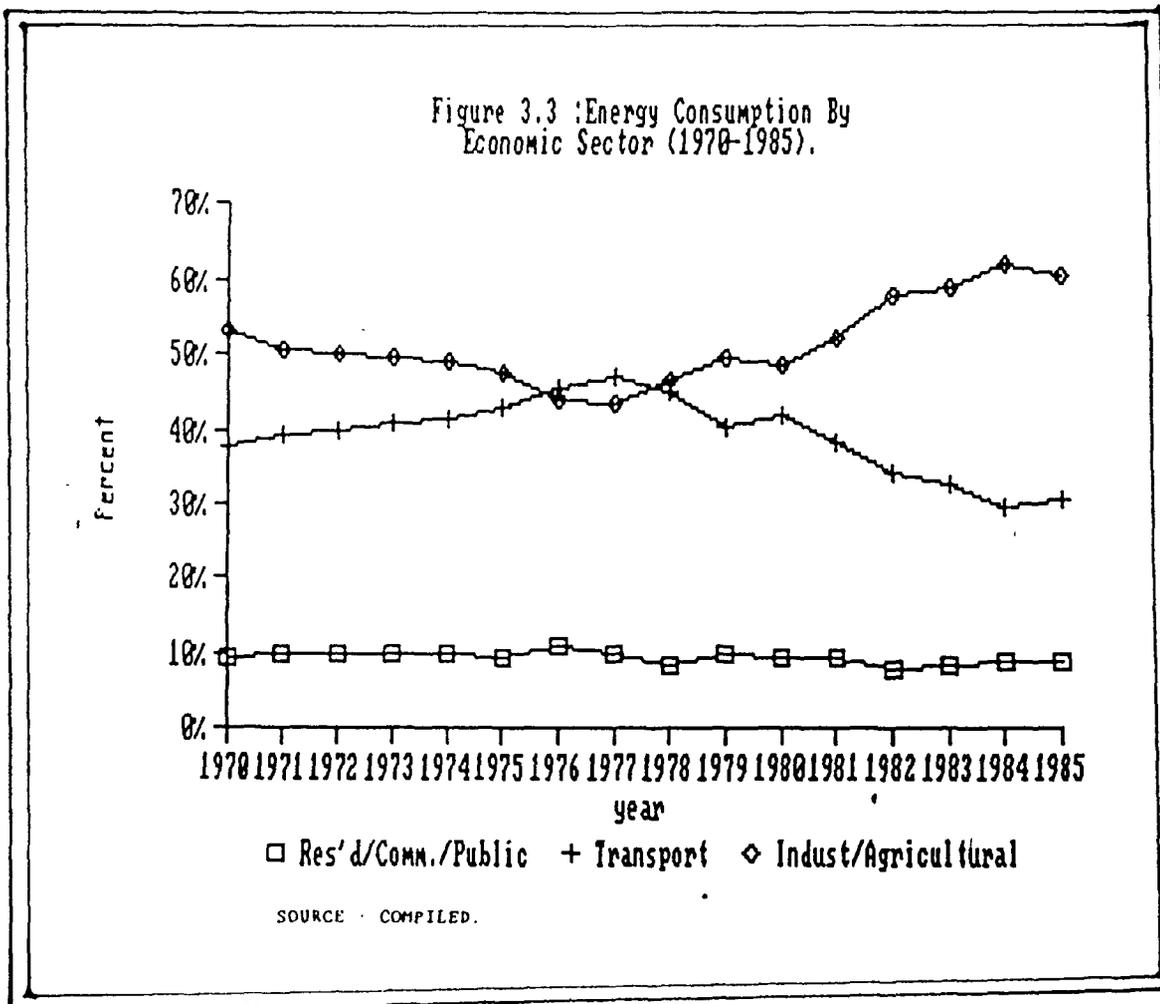
SOURCE : COMPILED.

Trends in the composition of Energy Use:

Examining only total energy use in the economy conceals changes in the types of energy making up total energy use. The type of energy required to produce goods and services varies across the sectors of the economy. Changes in the relative importance of different sectors will therefore result in changes in the importance of different energy types. Technological change is also important in determining the mix of energy used in the economy because advances in technology enable both new sources in energy to be exploited and the more efficient use of existing energy sources.

Figure 3.2 illustrates the percentage of total energy consumed by type of energy for the years 1970 to 1985. In 1985, associated natural gas accounted for 61% of energy consumed while petroleum contributed 30% and electricity 9%. By 1980, bagasse declined to 0% or it was probably used in very minute quantities too small to quantify in the unit of measurement.

Associated natural gas showed an overall steady increase and petroleum showed an overall decline from 50% in 1970 to 30% of total energy consumption in 1985. Electricity on the other hand has been comparatively constant with a slight decline from 11% in 1970 to 9% in 1985.



Trends in Sectoral Energy Use:

Figure 3.3 illustrates the percentage of energy consumed by the economic sectors. The residential-commercial-public sector has remained fairly constant over the time period staying at around 10% of the total consumption. The transportation sector increased until 1977 to 47% and gradually decreased with a few fluctuations to about 31% in 1985. The industrial-agricultural sector decreased until 1977 with a low of 43% and gradually increased to 60% in 1985. So, the industrial-agricultural sector consumes the greatest proportion of energy. Data in the type of energy used by sector are not presently available.

This section has shown that while total energy consumption has grown during the period 1970 to 1985. there has been considerable change in the types of energy used and its intensity in the economic sectors. The changes in the energy rates have been that of a slow, constant rate of change through the 1970's to a relatively high and unstable rate of growth through the 1980's.

CHAPTER 4:

The Economic Trends

DEFINITION OF THE GROSS DOMESTIC PRODUCT:

The Gross Domestic Product is the total value of all goods and services produced in the country within a given period of time. This is measured after deducting the costs of goods and services used up in the process of production, but before deducting allowances for the consumption of fixed capital. It represents the value-added by the factors of production (land, labour and capital). It includes all returns of foreign investment as well (Central Statistical Office, 1987, p.13).

Since the Gross Domestic Product is a market value measured in TT Dollars, the question of time poses a problem. A dollar in 1970 does not have the same value as a dollar in 1985. This means that one must account for inflation in the analysis. This is done by using 1970 as a base year (with a value of 100) and comparing all other values relative to the 1970 value. This is done through a mechanism called the GDP deflator. In essence, it is the current value divided by the constant value and multiplied by 100 (Central Statistical Office, 1987, p.26).

Historical Perspective:

Going back in time, the characteristic feature of the Trinidad and Tobago economy in the mid 1960's was that of an open economy, very much dependent on external forces, with severe structural problems. The major problems were domination of the

economy by the petroleum sector, heavy dependence on imports, especially food and raw materials, lack of diversification of the domestic production of goods and services, a high degree of concentration of exports on a few primary commodities, persistently high levels of unemployment and foreign control of key sectors in the economy.

However, as a consequence of much political development from self-government in 1956 and independence in 1962, policies were introduced by the government of the day (The People's National Movement (P.N.M.) to restructure the economy to overcome some of the structural problems.

Two of the major proposals were :

- (a) Development of the infrastructure of the economy through public sector capital expenditure.
- (b) Introduction of an import substitution policy through protection of local manufacturers, as well as putting in place policies designed to increase domestic agricultural production. In this respect, fiscal incentives were offered to attract both local and foreign control.

(Central Statistical Office, 1987, p.1).

As part of the diversification from dependence on oil and sugar, financial assistance and supporting incentives were given to nationals to get into small and large businesses. Primary emphasis was also given to projects which generated a high level of employment and those which forged linkages with the rest of the economy. To support local manufacturing production, there were some elements of protectionism in the form of tariff barriers and prohibition of imports by means of quota and 'negative listing' (Central Statistical Office, 1987, p.2).

The Domestic Economy (1970-1985):

The main economic highlights were the GDP at current prices (Figure 4.1) shows a much more significant increase during the

time period with a range in 1970 of TT \$1643 million dollars to TT \$19175 million dollars in 1982.

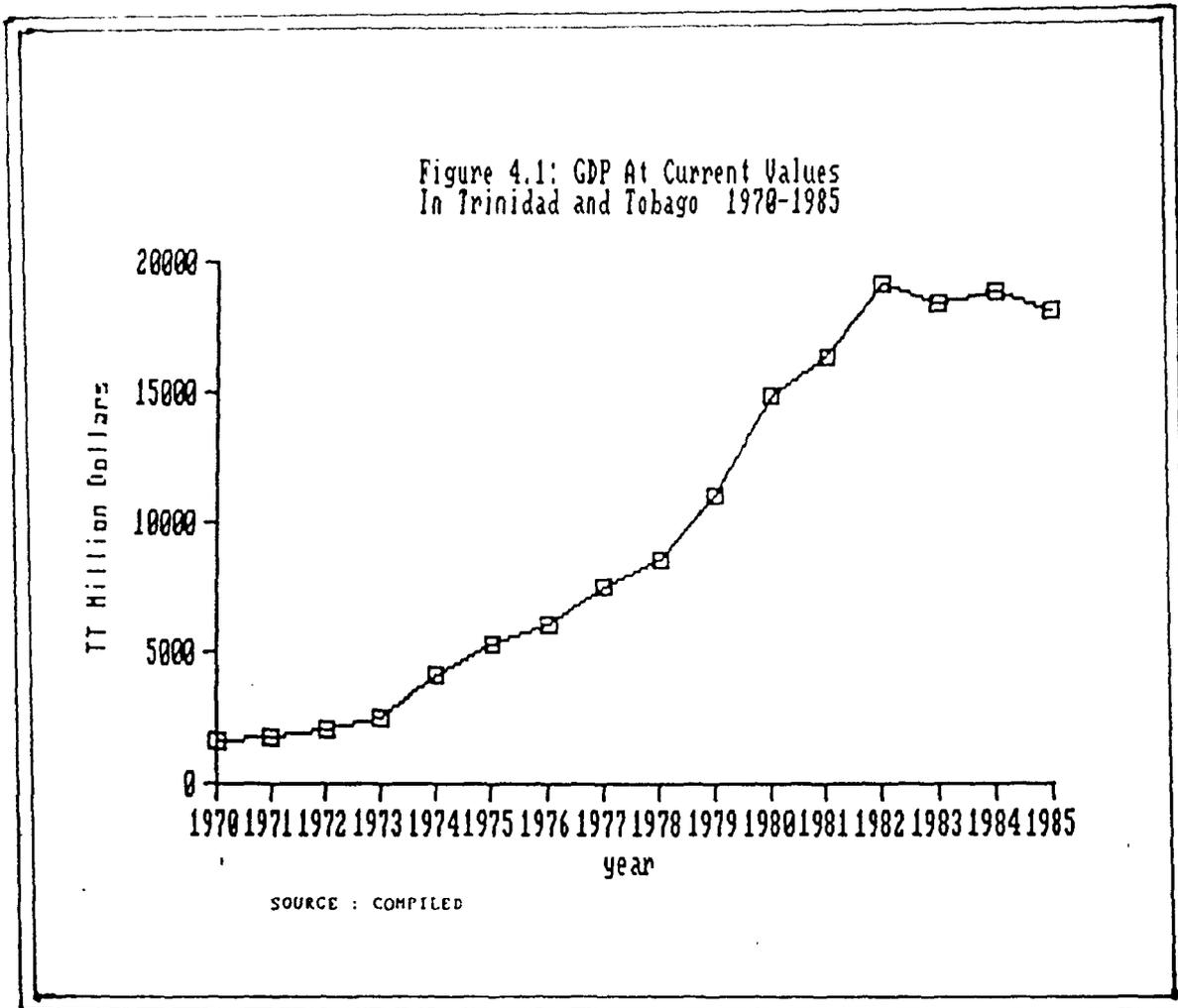
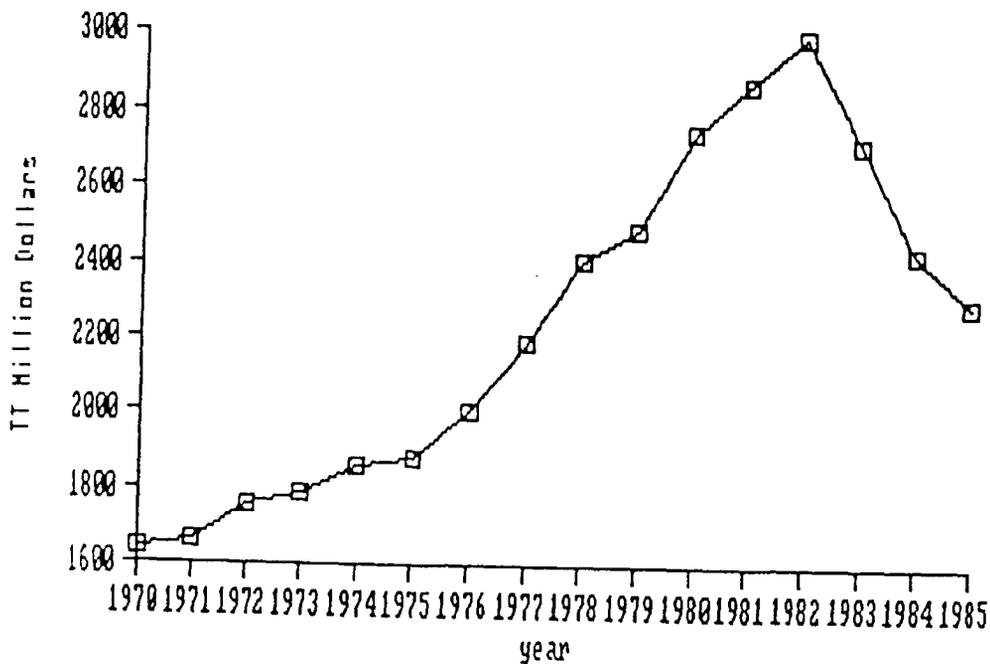


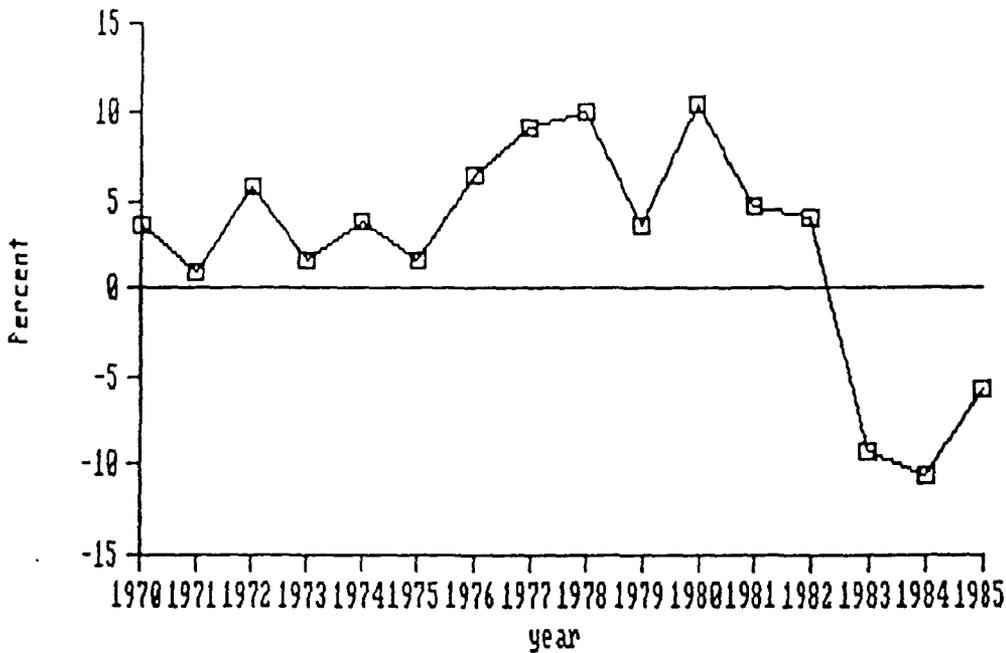
Figure 4.3 : GDP at Constant(1970)Values
In Trinidad and Tobago (1970-1985).



SOURCE : COMPILED.

However, as illustrated in (Figure 4.3), inflation was exceptionally high and that was taken account by using constant 1970 values (Figure 4.3). Here, the rates of change are similar from 1970 to 1982 but the actual dollar values are considerably less. However, with the constant values after 1982, the rates of change seem more pronounced. This can be seen in Figure 4.4 where the percentage change fluctuates frequently but it is always recorded as a positive change until 1983 and a further negative change in 1984 (with a percentage change of -10.6) and then an increase again to -5.6%.

Figure 4.4 : GDP at Constant Values
By Percentage Change



SOURCE : COMPILED.

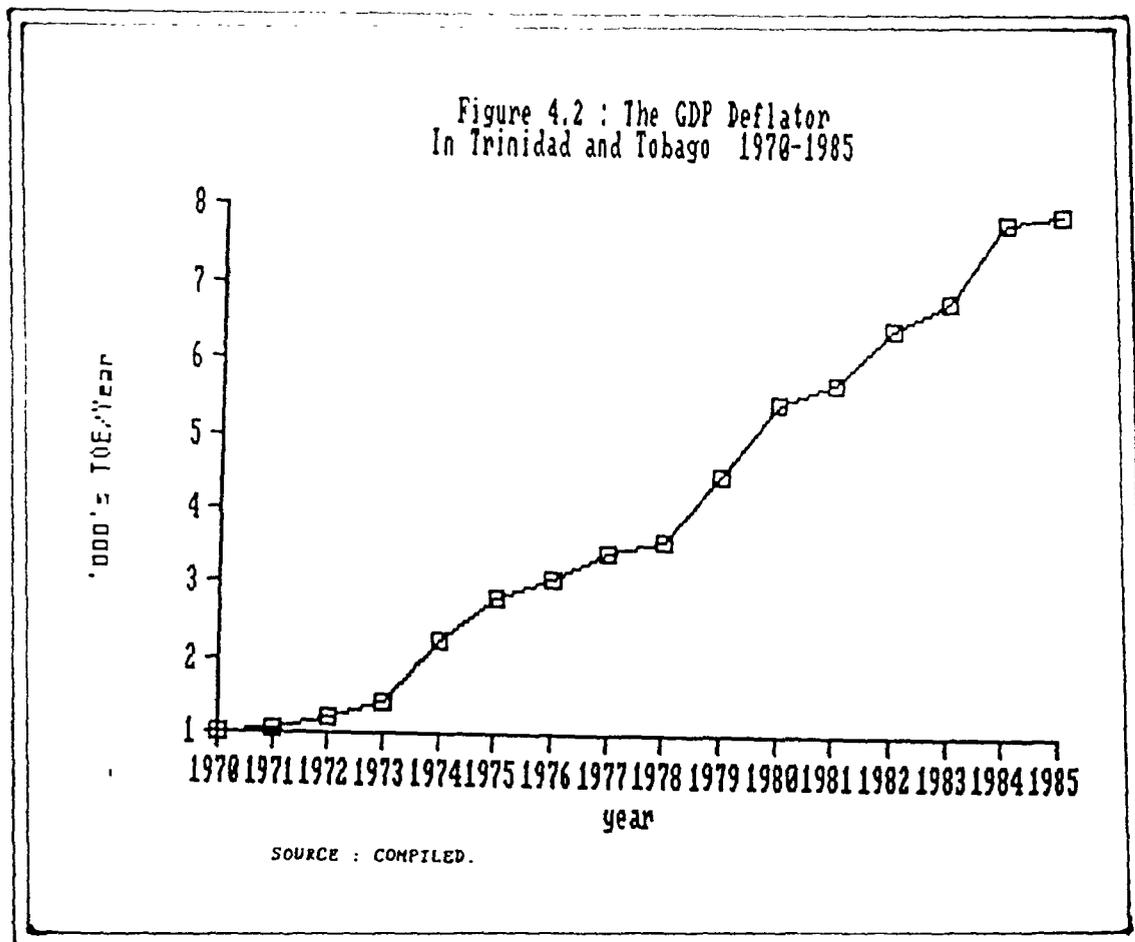
These fluctuations can be explained in reports on the domestic economy made by the Central Statistical Office for three time periods: 1966-1973, 1974-1982 and 1983-1985.

1970-1973:

During the eight-year period 1966-1973, economic growth measured by the average annual growth rate of the real gross domestic product was 3.1%. Severe fluctuations in the export of major agricultural crops such as sugar, cocoa and coffee, brought about by the unfavourable weather and adverse conditions on the world market, also contributed to the sluggish growth.

However, some sectors performed creditably, for

example, Manufacturing, Petroleum, Construction and Government. Due to the high rates of inflation (as seen in Figure 4.2), 11.2% in 1972 and 21.2% in 1973, Gross Domestic Product at current prices showed an average growth of 11% having its highest increase in 1973.



1974-1982:

A comparatively higher level of economic activity was achieved during the period (1974-1982) than in the previous period (1966-1973). Gross Domestic Product grew at an average annual rate of 6.2% in real terms and 20.9% in nominal terms. The percentage change from 1973 to 1974 reached an unprecedented high of 63.5% at current prices. This sharp upturn in the economy resulted from the steady and continuous increase of petroleum production from 1972 to 1977 together with the substantial increase in oil prices post 1973 caused by unusually high increases on the world market.

Virtually, all other sectors, Manufacturing, Construction, Transport, Distribution and other Services experienced significant growth rates. Propelled by the buoyant growth of the petroleum sector and the consequent increase in revenue received by Government which, in turn, was injected into the economy through the recurrent and capital expenditure of Government, there was considerable increase in economic activity in the non-oil sector.

The services sector, broadly defined to include other non-material producing goods sectors, transportation, distribution, government, and financial intermediaries, expanded considerably in response to the buoyancy of the economy with the most significant growth being observed in the transportation sector.

1983-1985:

Real Gross Domestic Product which had maintained an annual increase of 5.6% during the preceding five years (1978-1982), fell by 9.2% in 1983, thus signalling the end of the period of economic expansion which began in late 1973. Output continued its decline in 1984 and 1985. This decline was directly related to the fall in domestic crude oil production which began in 1979 and falling oil prices on the world market (Central Statistical Office, 1987, pp.15-16).

This section has shown that the Trinidad and Tobago economy has been that of an open economy, very much dependent on external forces and there have been a lot of policies to lessen this dependence. During the same period however, the inflation rate was exceptionally high and the cost of living increased dramatically. The Gross Domestic Product has also been very dependent on petroleum production and the prices of oil on the international market.

CHAPTER 5:

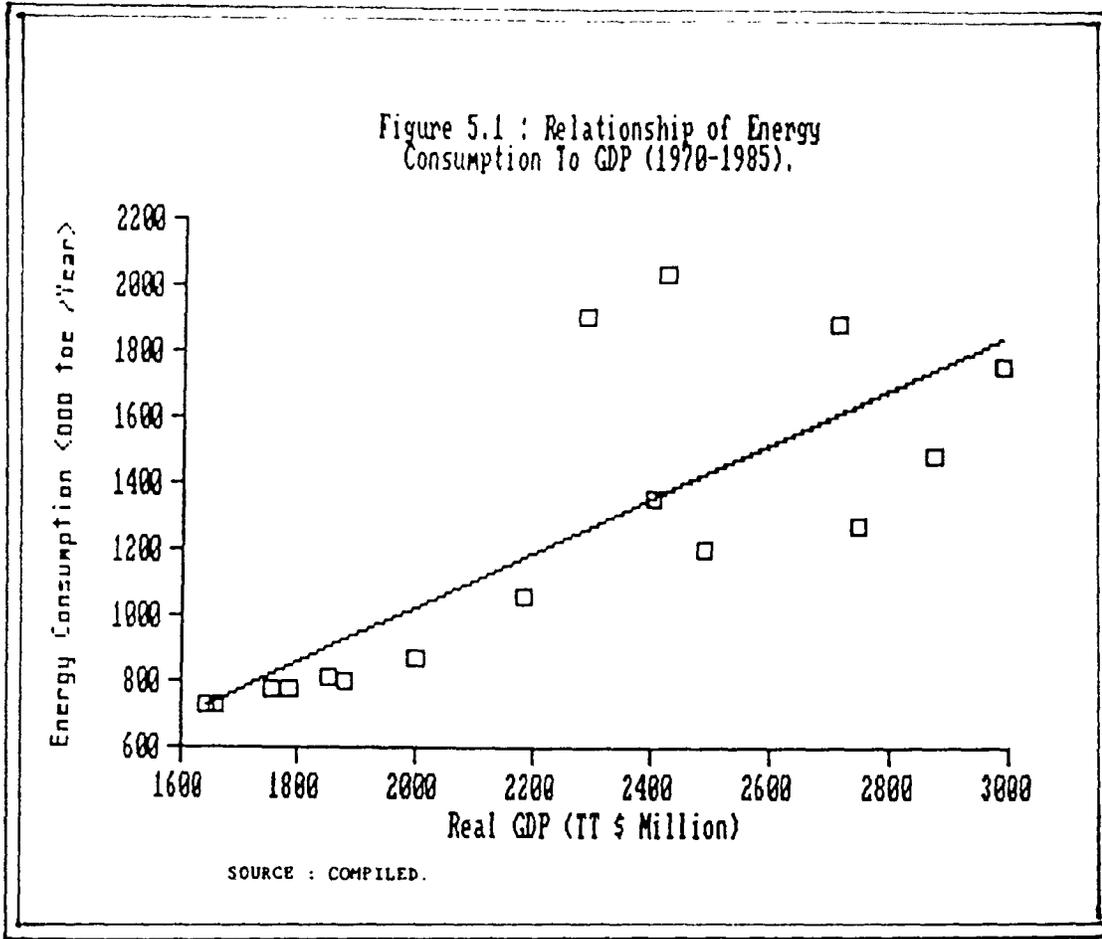
This chapter will focus directly on the relationship between energy consumption and economic growth for Trinidad and Tobago because the previous discussion in Chapters 3 and 4 briefly summarized the main attributes of energy use and economic well-being for the period 1970 to 1985. Its main purpose was to provide an indication of the trends that took place during that period of time. The suggestions of a close link between these two variables will now be investigated in the following discussion of the energy-economic relationship mainly by using a simple correlation and regression analysis and then looking at energy/GDP ratios.

THE CORRELATION AND REGRESSION ANALYSIS:

By looking at these two variables together, the Gross Domestic Product is considered to be the independent variable on the x-axis and energy consumption is considered to be the dependent variable on the y-axis (see Figure 5.1). This figure shows that the relationship is not as clear as one would expect. In 12 out of 16 years, the regression line overestimates the actual level of energy use and in three years (1983, 1984 and 1985) it underestimates the level of energy use.

Generally, in the early 1970's, the points fit the regression line much closer than in the 1980's. This means that energy consumption and the Gross Domestic Product were much more closely linked in the 1970's than in the 1980's. The fact that there is not a more significant relationship between both variables denotes the extent to which other sectors of the Gross Domestic Product played a more important role in the overall Gross Domestic Product, as opposed to energy consumption.

Figure 5.1 : Relationship of Energy Consumption To GDP (1970-1985).



THE COEFFICIENT OF CORRELATION (R):

R can yield a value between -1 to 1. If there is no relationship at all, then R will yield a value of 0. However, R only measures the strengths of linear relationships (of which this study is) and a strong correlation does not necessarily imply a cause-effect relationship (Freund, 1981, p.443).

The Coefficient of Correlation in this study yields a value of .789. This means that about 79% of the total variation of energy consumption can be attributed to the relationship with the Gross Domestic Product. This figure is regarded as much lower to studies done in other parts of the world (see Table 5.2.).

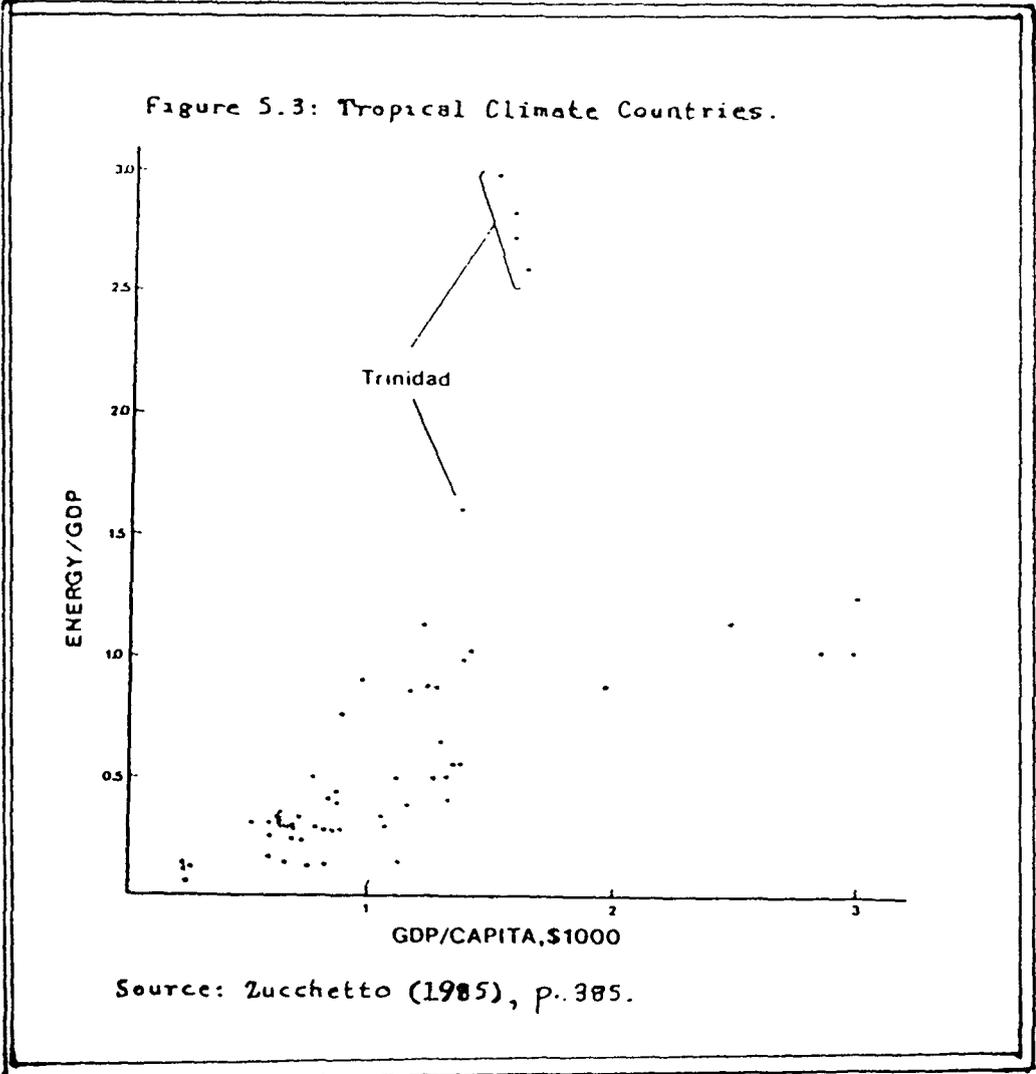
Table 5.2 International Regressions of GDP versus Energy Use
From 1960-1977 .

Country	Coefficient	Correlation
Australia		0.85
Belgium		0.81
Canada		0.93
Finland		0.96
France		0.97
Greece		0.98
Ireland		0.88
Israel		0.91
Italy		0.98
Japan		0.97
Netherlands		0.97
New Zealand		0.96
Norway		0.94
Portugal		0.97
South Africa		0.95
Spain		0.96
Sweden		0.91
Turkey		0.99
U.S.A.		0.95
West Germany		0.97

Source: Zucchetto (1985), p.384.

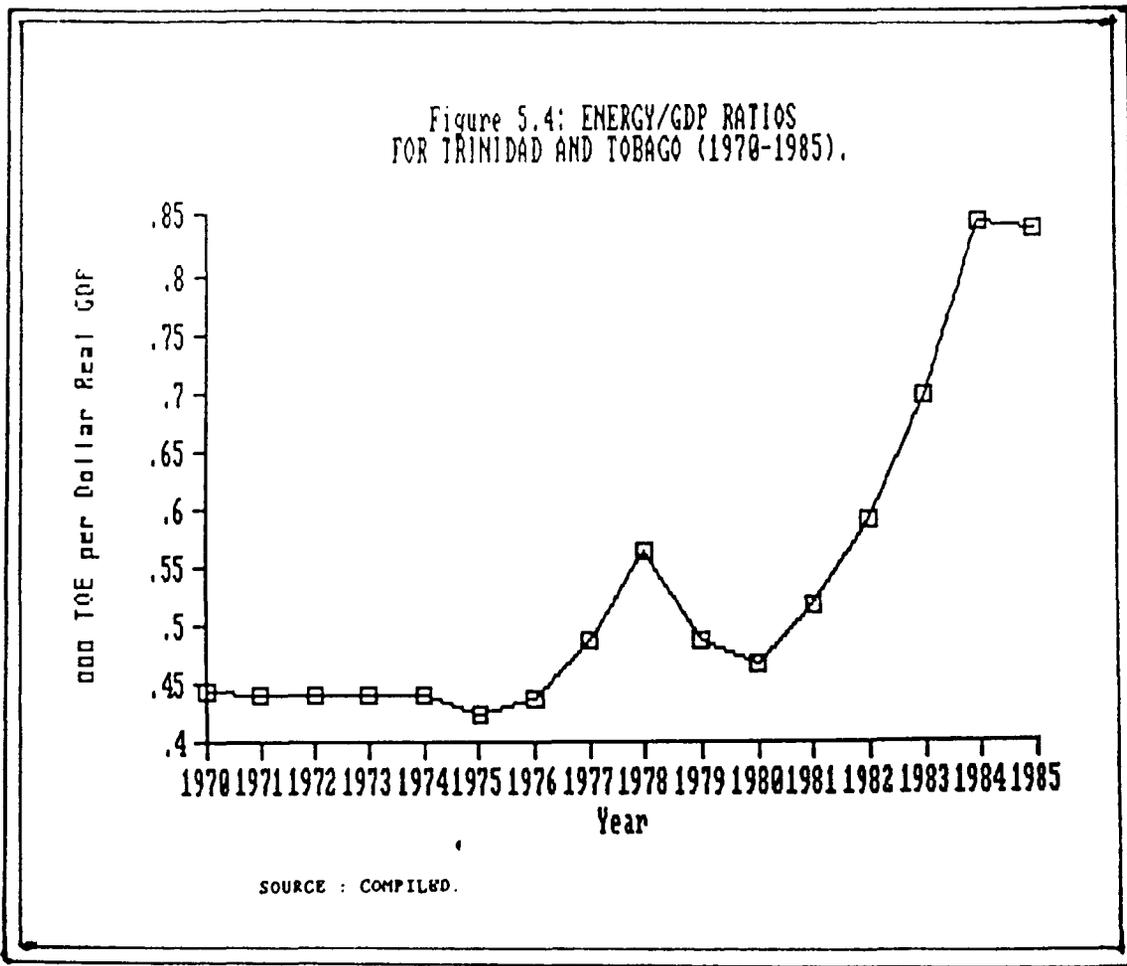
As mentioned earlier, one must take caution in comparing correlation coefficients internationally because of different fuel mixes, climate, industrial make-up and transportation networks. It is generally observed that higher economic output corresponds to higher levels of energy consumption and, typically, linear regressions are used to quantify this relationship. James Zucchetto did a study that took into account the effects of climate. It could be argued that since many of the underdeveloped, low GDP/ Capita countries are located in warmer climates, their low E/GDP ratios may be a consequence of low heating requirements. In order to correct for

climate two groups of countries with two distinct climates were selected (one group tropical climate, the other dry and desert) and pooled data for several years were plotted. The results of his study yield that the countries in the tropical climate between E/GDP and GDP/Capita (linear correlation coefficient = 0.3; if Trinidad outliers are left out $R^2 = 0.7$). Trinidad is an outlier because of much higher than average per capita level of autos, industrial activity, cement production and nitrogen fertilizer output (ed. Calzonetti, 1985, pp. 385-386) (see Figure 5.3.).

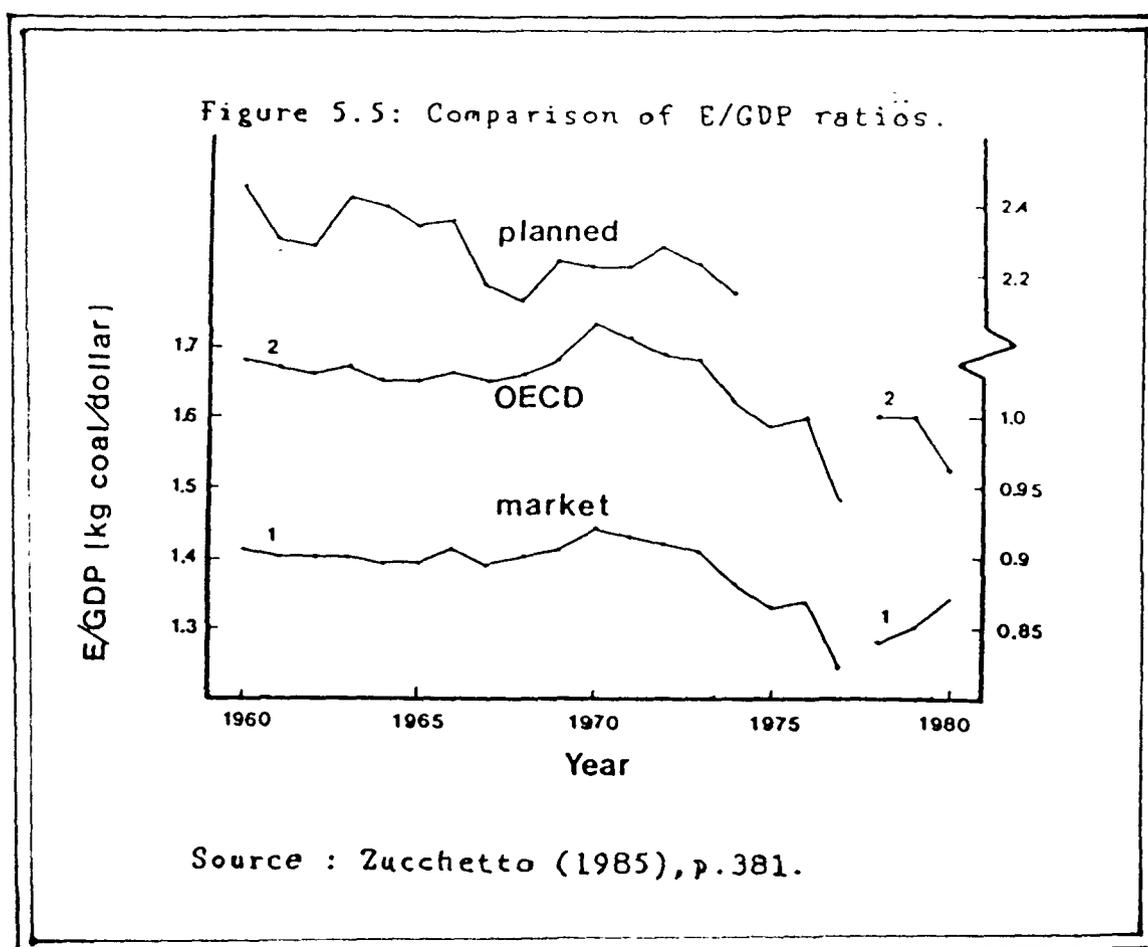


ENERGY /GDP RATIOS:

An E/GDP ratio represents the relationship between energy consumption and economic productivity. This ratio can be interpreted as the amount of energy required to generate one dollar of Gross Domestic Product. Or, it can also be interpreted as; one dollar can purchase the amount of energy depicted by the ratio (Ramage, 1983,pp.276-278). Changes in the relationship between energy consumption and GDP in Trinidad and Tobago over the period are illustrated in Figure 5.4.



A trend of less fuel efficiency can generally be seen from the overall period. From 1970 to 1974, the ratio remained relatively constant at .45. In 1975 it decreased to .42, rose in 1978 to .56 declined again to .46 in 1980 and rose to .83 in 1985. Therefore, fuel efficiency in the economy decreased to almost 50%. This may suggest that in the last 15 years, the Trinidad and Tobago economy has become more energy intensive because the economy has required more energy to produce a unit of output. This increase in the ratio can also be attributed to the decline in the real GDP. Normally, in most other countries, the E/GDP ratio has declined substantially in the late 1970's (see Figure 5.5.).



However, it is difficult to interpret these trends in terms of energy efficiency because of the existence of trade. Monitoring an E/GDP ratio over time for a given economy might indicate trends in energy efficiency. However, changes in this ratio might also reflect changes in the structure of an economy. Foreign trade data tend to be distorted because of the petroleum refining industry. Large quantities of crude oil are imported for processing and then exported as refined petroleum products. The leading export by far is petroleum and derivative products. The level grew steadily after the first petroleum export was made in 1910 until by the 1970's, it accounted for between 80 and 83 percent of all annual exports (Black, 1976, pp. 233-234). From 1979 to 1981, energy consumption increased faster in relation to the Gross Domestic Product. These trends are in keeping with the period when oil production and refining declined with the concomitant decline in the energy sector's own consumption. During the period under review, imports of primary energy decreased from 7.3 million TOE in 1979 to zero in 1983, reflecting the decline and ultimate cessation of crude oil imports for processing - under agreement between Texaco and its affiliates. These imports were being phased out ever since Texaco's assets were offered for sale in 1981-1982 and were discontinued in 1983 prior to the sale of the refinery to the government in 1985. since there is no foreign trade in natural gas or bagasse, the external trade in energy relates entirely to crude oil imports and exports (Ministry of Energy and Natural Resources, not published, pp.5-11). With respect to the export of primary energy, the decline in crude exports in the 1980's merely reflects the decline in AMOCO's offshore production, all of which is exported (see Table 5.6.).

Table 5.6 : Production, Exports and Imports For Trinidad An Tobago.

<u>Year</u>	<u>Production</u>	<u>Exports</u>	<u>Imports</u>
1970	10325	21562	16076
1971	9486	20181	15008
1972	9910	20970	15176
1973	11590	21630	14504
1974	12844	21806	14235
1975	14244	17755	7854
1976	14422	21631	12211
1977	15536	19535	9438
1978	15751	18510	7968
1979	15270	16822	7265
1980	15870	16981	7305
1981	14622	13632	5375
1982	14206	11734	3263
1983	13754	8485	1128
1984	15068	8362	932
1985	15603	8320	790

Source: Compiled.

Furthermore, energy consumption grew faster in relation to the Gross Domestic Product from 1982 to 1983 because gas consumption increased as a non-energy form in the growing petro-chemical industry (mainly ammonia and steel in these years) leading to the relative increase in energy consumption viz-a-viz the Gross Domestic Product (Ibid.,p.11).

In order to explain the low coefficient of correlation and the recently high E/GDP ratios, consumption patterns in Trinidad and Tobago are described. By the standards of developing nations, Trinidad and Tobago is a wealthy country, one in which the income is fairly evenly distributed and the entire population participates in the market economy. Furthermore, during the 1970's, the average family's standard of living rose in response to the newly independent country's policy of creating employment, redistributing income, and providing subsidies to low-income groups in the form of free or inexpensive public services, health care, education, and housing (Black,1976,pp.129-130).

In the early 1970's a consumer economy was emerging. Between 1962 and 1971 the amount spent on refrigerators had doubled, and in the early 1970's the per capita consumption of newsprint was the highest in the Caribbean area. A 1972 businessman's publication reported one registered motor vehicle for every eleven persons and one telephone for every seventeen. It also reported, however, that with the exception of Guyana the Trinidadian cost of living was the lowest among the Commonwealth Caribbean states. Nevertheless, the increasing maturity of the economy was shown also in one of the less desirable characteristics of a developed country; Trinidadians were learning to throw things away. A newspaper article in mid-1975 noted that a two-week campaign in the Port-of-Spain (the capital city) area alone had resulted in the removal of 350 automotive vehicles. The most troublesome of the economic problems was the chronically high and combined effects of unemployment and underemployment. It was estimated that one-third of the population at any given time was failing to participate in the country's progress. According to the 1971-1973 household budgetary survey, it was revealed that the overall proportions of expenditures were similar to those of a developed country in the sense that considerably less than half were devoted to food and other non-durable consumer goods and considerable amounts were expended on such items as wearing apparel and household furniture and furnishings (see Table 5.7).

Table 5.7 : HOUSEHOLD CONSUMPTION SURVEYS

<u>Item</u>	1971/72	1975/76	1981/82
Food	30.4	35.3	30.7
Beverages	4.5	4.2	5.7
Tobacco	1.6	1.2	1.2
Clothing	14.0	15.3	15.7
Footwear	3.3	3.9	3.9
Furniture etc.	11.0	9.3	11.1
Medical care	2.7	3.0	2.7
Transport	16.9	12.9	16.7
Entertainment	1.6	1.5	1.8
Education	2.2	.2	1.8
Personal care	1.9	1.8	2.3
Miscellaneous (Excluding rent)	6.6	7.4	5.0
TOTAL	100.0	100.0	100.0

Source: Revised data on Household Budgetary Surveys.
(National Accounts Division).

Taken From A Guide to the Report on the National Income of
Trinidad and Tobago 1966-1985. Central Statistical
Office, 1987, p.5.

The household budgetary survey did not include information on income set aside as savings, and data concerning life insurance premiums and other special forms of savings were too incomplete to indicate a pattern (Black, 1976, pp.130-133).

The per capita income was the fourth highest in the Western Hemisphere overall, and the country ranked thirty-fifth in the world, a fairly high ranking for a small population. The distribution of GDP indicates that trade and petroleum have alternated as the leading sector (see Table 5.8.).

Table 5.8 : TRINIDAD AND TOBAGO, DISTRIBUTION OF GROSS DOMESTIC PRODUCT, 1960, and 1970-1972.
(in percent)

<u>Sector</u>	1960	1970	1971	1972
Trade	19.6	15.0	14.9	15.6
Petroleum, refining, mining	18.4	17.7	15.3	14.5
Government	-	11.2	14.0	14.0
Transport and Communication	4.6	15.5	14.2	13.6
Manufacturing	15.5	11.7	11.6	12.3
Construction	14.2	5.6	7.7	7.3
Other Services	13.0	4.7	6.3	6.7
Finance	-	5.4	5.7	5.9
Agriculture, Forestry, Fishing	14.7	7.2	4.6	4.6
Rental	-	3.7	3.6	3.5
Utilities	-	2.3	2.1	2.0
TOTAL	100.0	100.0	100.0	100.0

- 1 Included in other Services
- 2 Included in Trade
- 3 Sugarcane Production accounted for nearly 2 % annually from 1970 to 1972.
- 4 Included in Construction.

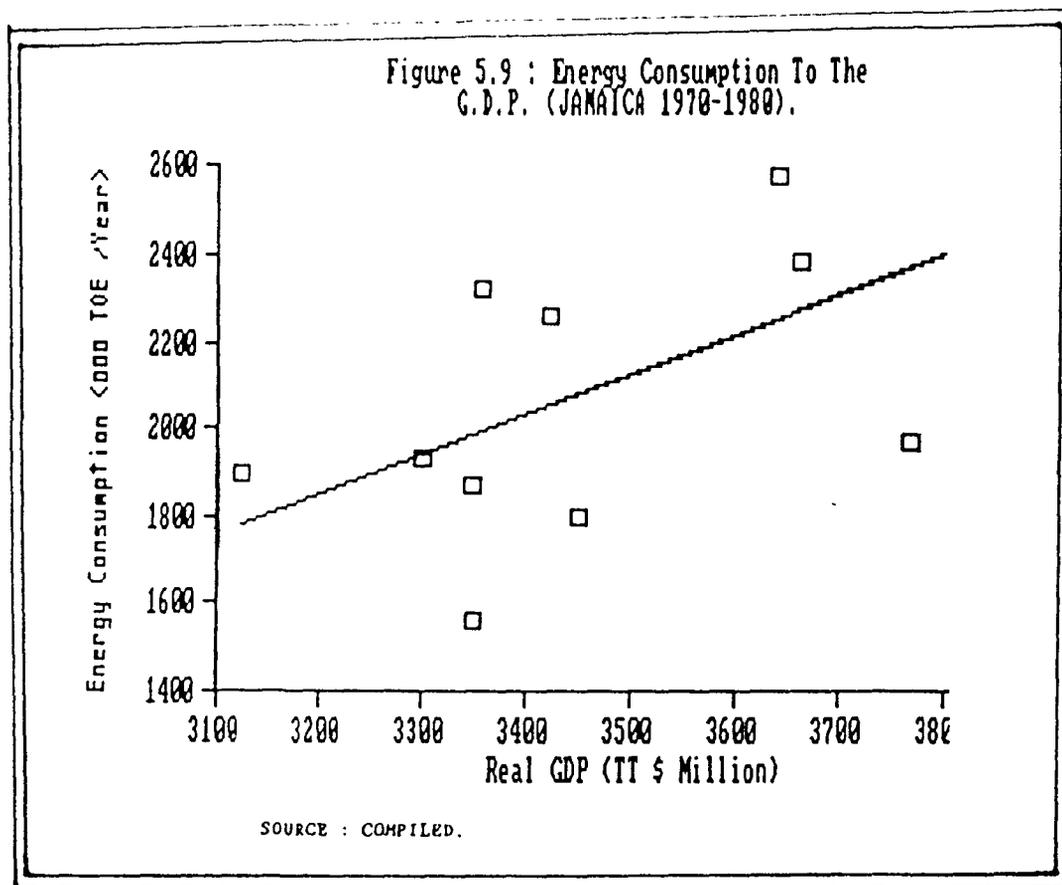
Source : Black, Area Handbook for Trinidad and Tobago, 1976, p.211.

For years, tourism was not as important to the economy of Trinidad and Tobago as it was to that of the other Caribbean islands. Trinidad and Tobago did not pursue tourist promotion as avidly as others did. The official policy towards tourism was guided by three social principles : to preserve national dignity there must be free access to all beaches (that is, no beaches may be reserved for hotel guests only); casinos are not permitted; and no land can be sold to foreigners - it can only be leased on long terms. The principle was designed to prevent speculation. Yet tourism has shown some increase - total visitors rose from 315,000 in 1972 to 371,000 in 1973 - and it brings in foreign exchange - TT \$ 117 million in 1973, which was more than sugar exports brought in that year. Tourists come either for the

beaches or for the country's cultural attractions, which include the annual Carnival - considered the major attraction held on the Monday and Tuesday before the beginning of Lent - the steel bands, calypso, music, limbo dances, and village folklore contests. Tourists who prefer beaches and the idyllic life usually go to Tobago. The largest percentage of tourists are termed temporary halt tourists, such as cruise ship passengers. Their stay tend to be short and their expenditure small (Black,1976,pp.239-240).

COMPARISON WITH JAMAICA:

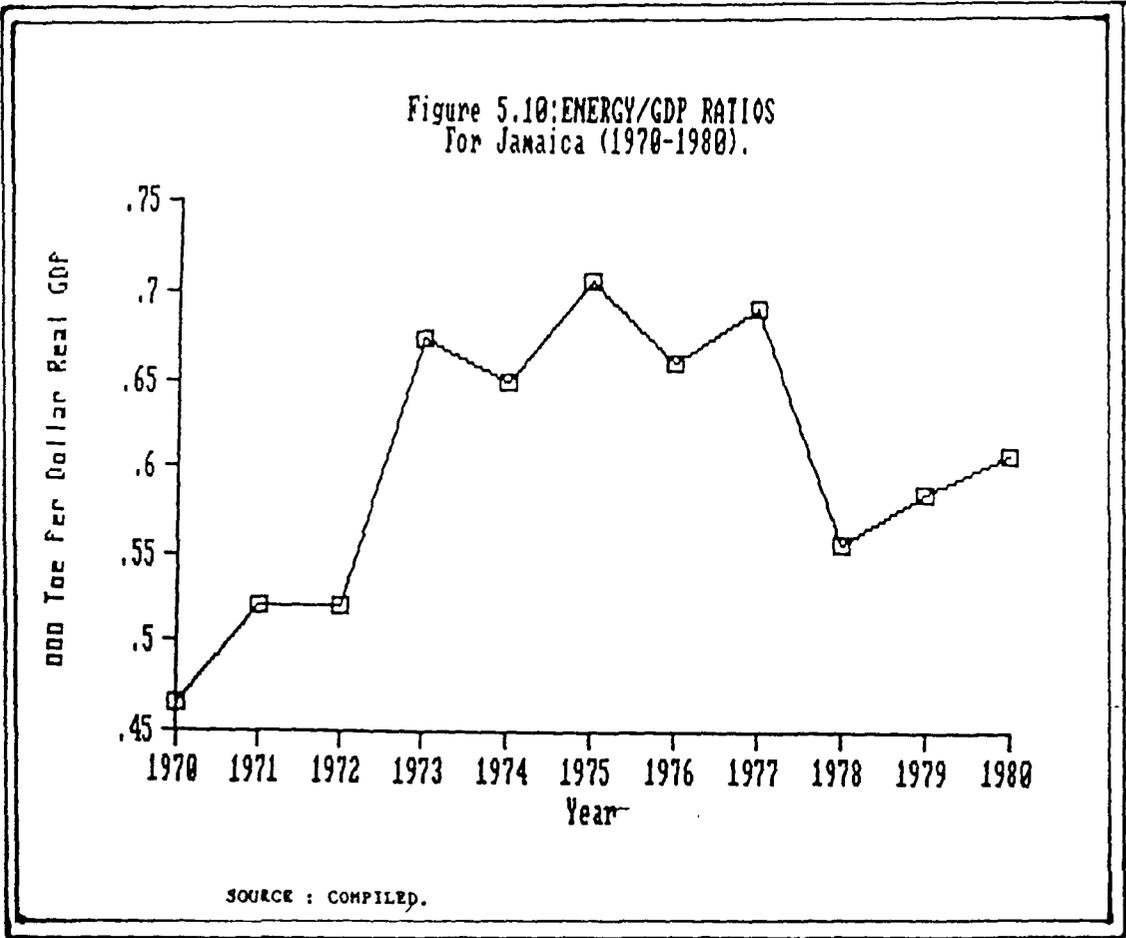
Since other countries have relatively high correlation coefficients (as seen in Table 5.2), a comparison of Jamaica was conducted to see if this is representative of a 'small island economy' with a high degree of openness and therefore more susceptible to external changes in the world economy. Energy data was collected from the Yearbooks of World Energy Statistics and economic data was collected from the Yearbook of National Accounts Statistics. However, all of the information was not available in as much detail as Trinidad and Tobago. Energy consumption was also in thousand TOE units but the GDP information had to be transferred to 1970 constant dollars (see Figure 5.9.).



The correlation and regression analysis was done for Jamaica for the years 1970 to 1980 because the data was only available until 1980. The results yield that the correlation coefficient was .588, a much lower value than that of Trinidad and Tobago. Therefore, energy consumption is less attributable to the relationship with the Gross Domestic Product than the case with Trinidad and Tobago. It seems likely that the tourism sector may play a much more important role in relation to the Gross Domestic Product in Jamaica, but information is not available to say if this is the case or not.

E/GDP ratios were also done for Jamaica and the results show that over the period 1970 to 1980, the Jamaican ratios are higher

than the ratios for Trinidad and Tobago for the same time period (1970 to 1980). Trinidad and Tobago's E/GDP ratios ranged from .424 in 1975 to .485 in 1979 whereas, Jamaica's E/GDP ratios ranged from .465 in 1970 to .707 in 1975. Changes in the Jamaican E/GDP ratios are illustrated in Figure 5.10.



Reasons for the weak relationships between energy consumption and the Gross Domestic Product can possibly be attributed to what constitutes to the GDP and the extent of these contributions. It is likely that in small-island economies, sectors like tourism and agriculture play an important part in the economic wealth of that country and they are not as energy intensive as say manufacturing. In more developed countries, manufacturing contributes a much higher percentage to the GDP and this sector is very energy intensive so, a higher correlation is expected. Furthermore, lower rates of energy consumption is used in small-island economies than in more developed ones and this may alter the relationships.

CHAPTER 6 :
SUMMARY AND CONCLUSIONS :

In Chapter One, an introduction of the topic at hand and on the study area was given. In Chapter Two, previous work on the topic was presented to guide the findings for the Trinidad and Tobago data. It was noted that there have been strong correlations between energy consumption and the Gross Domestic Product in case studies done previously but the Trinidad and Tobago relationship was not as strongly correlated.

By looking at the energy trends in Chapter Three, the results indicate that energy consumption has increased over the years but the types of energy used have varied considerably. There has been a shift in the use of energy from the highest percentage of petroleum products in the 1970's to the highest percentage of associated natural gas in the 1980's and most of the energy consumption is used by the Industrial-Agricultural sector.

Chapter Four has indicated that GDP rose constantly until 1982 and then it decreased sharply until 1985. In the 1960's, there was a heavy reliance on the petroleum sector. In the 1970's, the petroleum sector did remarkably well and revenue from that sector was channelled to other sectors. In the 1980's, GDP declined and this was related to the decline in domestic crude oil production and the drop in oil prices on the world market.

Chapter Five has indicated that the Trinidad and Tobago economy do not have as high a correlation as other countries that were studied before. Explanations have been presented and some include the openness of the economy to external forces like the price of crude oil, or that there may be little incentive for conservation. The E/GDP ratios have shown that the countries have become more energy intensive and less fuel efficient. The data was then compared to Jamaica to see if the relatively low correlation and high E/GDP ratios were typical of small-island economies. The results yield that the correlation coefficient was even lower and so, energy consumption is not as tightly

coupled to the GDP. The E/GDP ratios have been higher indicating less fuel efficiency and/or more energy intensive but there have been many upturns and downturns in these ratios.

Therefore, authors like Stobaugh and Lovins have said that decoupling energy is possible that is, energy consumption can decline and GDP can increase simultaneously but the opposite has occurred in Trinidad and Tobago. It has been mentioned that the data has been distorted because of the importing and refining of crude oil and then exporting the refined products.

The Trinidad and Tobago economy is still quite dependent on the petroleum sector but there have been attempts to diversify the economy by increasing the amount of local agricultural production and reducing the imports of food, and also there have been attempts to increase the production of ammonia, steel and light manufacturing.

Therefore, the hypothesis is accepted even though the correlations and the ratios are not as high as those of more developed nations. Since most studies conducted on this topic have a high correlation, this study has confirmed that there are no global trends of this relationship and it tends to reflect the level of economic development and social well-being.

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