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ENERGY COST AND ECONOMIC DEVELOPMENT IN MALAYSIA

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I. INTRODUCTION

THE decade of the 1970s saw Malaysia joining the ranks of petroleum exporters. Although hydrocarbon resources have been explored since the mid-nineteenth century, it was only the almost fourfold increase in the price of crude oil in 1973—from U.S.$2.50 per barrel to U.S.$10 per barrel—that enabled Malaysia to extensively explore and extract crude oil from its offshore fields. Malaysia's production of crude oil rose from 18,000 barrels per day (b/d) in 1970 to 510,000 b/d in 1985. As a result, its foreign exchange earnings from petroleum exports have become very significant. In 1972, petroleum exports accounted for 4.6 per cent of total export earnings, compared to 27.4 per cent from natural rubber; by 1984, however, petroleum exports amounted to 22.6 per cent of total exports earnings, compared to 9.8 per cent for natural rubber. In 1985, in spite of the fall in the price of crude oil from a peak of U.S.$34 per barrel in 1982 to U.S.$27.50 per barrel, petroleum exports still amounted to 21.6 per cent of total export earnings.

Notwithstanding the increased petroleum export earnings, the wide fluctuations in crude oil price over the period 1970–85 did have adverse effects on the Malaysian economy. Inflation shot up from less than 1 per cent per annum in the period 1960–72 to above 15 per cent per annum in the period 1973–75, and about 8 per cent per annum in the period 1976–80 mainly on account of the increase in crude oil price in 1973 and again in 1978. By 1985, because of the decline in the price of crude, inflation stabilized to 3.9 per cent per annum. Further, the increase in the oil price over the period 1973–82 pushed up the production costs of many industries, leading to lower profitability and higher rates of business failures.

In this paper we shall discuss the impact of the wide fluctuations in energy cost—particularly the increase in the price of crude oil over the period 1973–82—upon the Malaysian economy. The Malaysian experience is interesting in that the wide changes in energy costs have both positive and negative economic impact. Its experience would be of relevance to other developing countries in a similar situation and stage of development.

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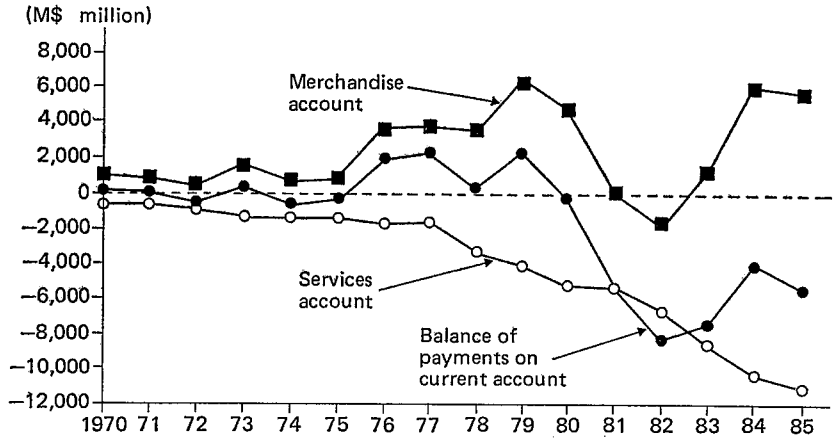
Fig. 1. Malaysia: Balance of Payments



Source: [17, various issues].

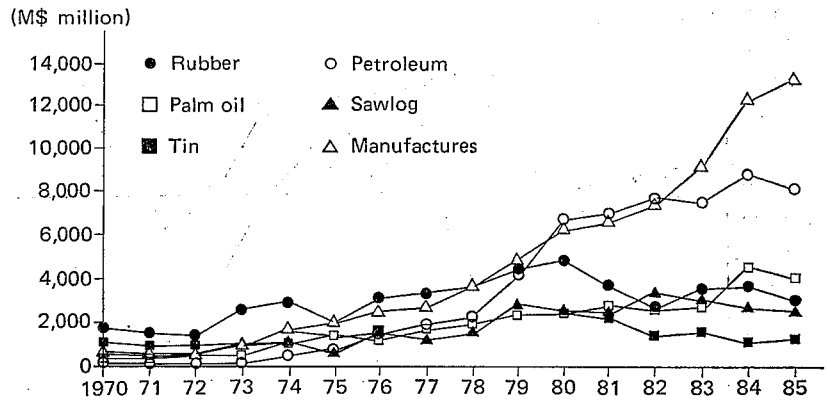
The paper is structured as follows. To enable the reader to appreciate the physical context of the topic discussed, in the next section we present a brief economic profile of the country. The current Malaysian energy policy is then discussed in Section III. In Section IV, we examine the impact of the wide fluctuations in energy costs on the Malaysian economy. Finally, a summary of conclusions and the policy implications of this study are discussed in Section V.

II. BRIEF ECONOMIC PROFILE

During the period of British Rule, economic development in Malaya was confined to tin-mining and rubber cultivation. After independence in 1957, however, the economic development of Malaya (and since 1963, Malaysia) was diversified to include a whole spectrum of agricultural activities such as oil palm, coconut, and cocoa cultivation. The industrialization process was also accelerated.

Agriculture, nevertheless, remained the dominant economic sector until 1985. In 1965, the gross domestic product (GDP) of the agricultural sector constituted 31.5 per cent of the national GDP, while the manufacturing sector's contribution was about only 10.4 per cent. However, by 1980, the agricultural sector's share of the GDP declined to about 22.9 per cent while that of the manufacturing sector expanded to 18.5 per cent. During the period 1981–85, the agricultural sector's share of the GDP declined further to 21.5 per cent while the manufacturing sector's share remained relatively constant at about 18.0 per cent. In terms of employment, the agricultural sector employed about 52 per cent of the total working population in 1965. By 1985, the percentage employed in the agricultural sector declined to 35.5 per cent while the manufacturing sector's employment contribution doubled from 8.4 per cent in 1965 to 15.7 per cent in 1985.

Fig. 2. Major Exports for Malaysia, 1970–85



Source: [17, various issues].

The rapid rate of industrialization over the 1970s enabled Malaysia to achieve a very high GDP growth rate of between 7 per cent and 8 per cent per annum over the period 1970–80. This had led to large balance-of-payments surpluses in the current account for the country over the period 1976–79. However, by the mid-1980s, the combined effects of the prolonged recession in the industrialized world together with a marked decline in the prices of Malaysian commodities, including petroleum, and large increases in the deficits of the service accounts due to large foreign borrowing[1] caused the country to suffer major deficits in balance of payments on its current account. In 1981, the deficits amounted to about M$5.3 billion and by 1985 had increased to M$11.0 billion (see Figure 1).

With respect to the export pattern, the major export items for Malaysia in the 1960s were rubber, tin, and sawlogs (see Figure 2). Petroleum, in the form of crude and partly refined petroleum, was a relatively small export item until the mid-1970s after which its export value expanded considerably and by 1980, overtook rubber as the major export earner for Malaysia. However, as a result of the success of the export-led industrialization strategy, by 1985 manufactured goods had become the major export item (with petroleum the second major export earner) for the country.

With respect to imports, consumer goods constituted the major category of imports for the country over the period 1961–70. However, again because of industrialization, imports of investment goods and intermediate goods had overtaken the value of imports of consumer goods by the mid-1970s. In fact, by the early 1980s, imports of investment and intermediate goods were about four times the value of the imports of consumer goods.

[1] The major bulk of the foreign borrowings were incurred over 1979–82 mainly to finance the government's counter-cyclic policy implemented then.

TABLE I

MALAYSIA: ENERGY PRODUCTION, TRADE, AND CONSUMPTION, 1970–84

Types of Energy	1970	1972	1974	1976	1978	1980	1982	1984
Crude petroleum (1,000 tonnes)								
Production	859	4,432	3,870	8,026	10,320	13,156	14,560	21,520
Exports	6,696	4,255	3,168	7,218	9,153	11,227	12,056	16,541
Imports	9,168	3,881	3,145	3,828	4,225	3,961	2,589	2,658
Consumption	5,331	4,058	3,847	4,570	4,790	5,450	5,093	7,637
Coal (1,000 tonnes)								
Production	—	—	—	—	—	—	—	—
Exports	—	—	—	—	—	—	—	—
Imports	12	4	19	22	14	49	107	300
Consumption	12	4	19	22	14	49	107	300
Natural gas (terajoules)								
Production	2,926	3,671	3,056	24,974	39,373	47,905	122,592[a]	405,790[a]
Exports	—	—	—	—	—	—	—	3.70[b]
Imports	1,833	5,191	12,800	18,500	21,200	25,000	—	—
Consumption	4,759	8,862	15,856	43,474	60,573	72,905	55,493	90,586
Electricity (million kWh)								
Production	3,543	4,313	5,308	6,446	7,963	10,186	10,905	13,186

Sources: [1, Vol. 14 (April 1983)] [1, Vol. 18 (July 1986)] [13] [21], National Electricity Board of the States of Malaya, *Statistical Bulletin*, August 31, 1984.

[a] Unit converted from mscf (million standard cubic feet) to terajoules using the conversion below: 0.9854×10^{12} joules $= 10^6$ cubic feet (1 mscf).

[b] Unit measurement for exports of natural gas for 1984 is in LNG million tonnes.

III. THE ENERGY SITUATION

Petroleum is the major energy source consumed by Malaysia. Since the early 1960s, petroleum contributed about 90 per cent of the nation's total consumption of energy. Table I details the production, trade, and consumption of the various categories of energy for Malaysia over the period 1970–84. While the consumption of petroleum has remained essentially steady at about 5 million tonnes per year, the amount of petroleum imported declined; from about 9.1 million tonnes in 1970 to 2.6 million tonnes in 1984. Further, the amount of petroleum produced increased from under 1 million tonnes in 1970 to 21.5 million tonnes in 1984.

Consequently, over the period 1970–84, Malaysia emerged from being a net importer to a net exporter of petroleum—the turning point being 1976. Likewise, with the completion of the Bintulu natural gas plant in Sarawak in 1983, Malaysia emerged to be a major exporter of natural gas. With respect to electricity generation, Malaysia's capacity tripled over the decade 1970–80 from about 3.5 million megawatts in 1970 to about 10 million megawatts in 1980 [7].

TABLE II

MALAYSIAN AND ARABIAN LIGHT CRUDE PRICES, 1971–85

Year	Malaysian Crude[a] (U.S.$/barrel f.o.b.)	% Chage in Malaysian Crude Price	Arabian Light (34°) (U.S.$/barrel f.o.b.)	% Change in Arabian Light Price
1971	2.36	—	1.91	—
1972	2.71	14.83	2.48	29.8
1973	3.95	45.76	3.01	21.4
1974	11.89	201.01	10.46	245.5
1975	12.41	4.37	11.51	10.0
1976	12.67	2.82	11.51	0
1977	14.10	10.50	12.08	4.9
1978	14.23	0.92	13.33	10.3
1979	21.09	47.97	24.00	80.0
1980	36.50	73.07	32.00	33.3
1981	38.98	6.79	32.00	0
1982	36.27	−6.97	34.00	6.2
1983	30.17	−16.82	29.00	−14.7
1984	29.34	−2.75	29.00	0
1985	27.76	−5.39	27.50	−7.6

Sources: [16, various issues] [20].

[a] Average weighted prices for Malaysian grades (i.e., Miri light crude, Labuan crude, Tembungo crude, Bintulu crude, Tapis blend, and Fairley-Baram equivalent).

Most of the country's oil and natural gas reserves are located off the shores of Trengganu, Sabah, and Sarawak. As of January 1986, the estimated Malaysian reserves of oil and liquified natural gas were 3.1 billion barrels and 1,400 billion cubic meters respectively. Given the relative importance of petroleum in the country's energy consumption, it is not surprising that the major focus of the country's energy policy is the optimal exploration and development of the country's offshore petroleum and natural gas resources consistent with the country's consumption needs. The major prongs of the petroleum exploration and development strategy are:

(i) encouraging more efforts to locate new petroleum reserves; and
(ii) determining the optimal level of petroleum production consistent with the country's petroleum needs and balance-of-payments position.

The authority responsible for the country's petroleum development strategy, the National Oil Corporation (Petronas), has the ultimate responsibility of determining the country's level of petroleum production; it also determines the sale price of Malaysian crude. This sale price generally follows the price of Arabian Light, but due to its very low sulphur content, the price of Malaysian crude is slightly above that of Arabian Light (see Table II).

The availability of petroleum and natural gas has enabled policy planners to plan on using these resources for further industrial development of the country. Table III details the petrochemical projects that have been developed in the country.

TABLE III

PROPOSED MALAYSIAN PETROCHEMICAL DEVELOPMENT PROGRAMME

Project	Capacity	Cost (M$ Million)	Manpower	Natural Gas Consumption	Location
Off-shore gas pipeline	104 miles 30", submarine trunkline of capacity 400 mscf/d	720	—	—	Kerteh, Trengganu
Gas processing	130 mscf/d 400 mscf/d Extraction of ethane, propane, and butane and their condensation; also LNG	132	70	130 mscf/d (1984) 400 mscf/d (1987)	Kerteh, Trengganu
Ammonia/urea plant (ASEAN project)	360 (Ammonia) 540 (Urea)	781	360	Treated natural gas (40–80 mscf/d)	Bintulu, Sarawak
Petrochemical complex	Ethylene (200) Propylene (20–40) HDPE (85) LDPE (120)	2,100	200	Ethane (205) Treated natural gas (as fuel)	Kerteh, Trengganu
Ammonia plant	450	770	470	Treated natural gas (40 mscf/d)	Kerteh or Telok Kalong, Trengganu
Methanol plant	450	520	130	Treated natural gas (45 mscf/d)	Telok Kalong, Trengganu

Source: [21].

Note: Mscf/d denotes million standard cubic feet per day. All other unspecified units are in thousand tonnes per day.

TABLE IV

MALAYSIA: DOMESTIC PRICES, TAXES, AND SUBSIDIES OF PETROLEUM PRODUCTS, 1973–85

Product	Tax/Subsidy	1973	1975	1977	1979	1981	1983	1985
Premium petrol	Price (ringgit/gal)	2.59	3.10	3.38	3.69	4.91	4.82	5.05
	Taxes:							
	excise duty[a]	1.30	1.30	1.41	1.31	1.11	1.63	1.75
	import duty[b]	1.40	1.40	1.31	1.31	1.11	1.63	1.75
	surtax	—	—	—	—	—	—	—
	sales tax	—	—	—	—	—	—	—
	Subsidies	—	—	—	—	—	—	—
Diesel	Price (ringgit/gal)	0.92	1.00	1.18	1.30	2.10	2.10	2.65
	Taxes:							
	excise duty[a]	0.36	0.36	0.01	0.01	0.01	0.01	0.03
	import duty[b]	—	—	0.01	0.01	0.01	0.01	0.03
	surtax	—	—	—	—	—	—	—
	sales tax	—	—	—	—	—	—	—
	Subsidies	—	—	0.05	0.46	0.86	0.54	—
Kerosene	Price (ringgit/gal)	0.71	0.81	0.82	1.30	2.10	2.10	2.90
	Taxes:							
	excise duty[a]	0.05	0.05	0.01	0.01	0.01	0.01	0.07
	import duty[b]	0.05	0.05	0.01	0.01	0.01	0.01	0.07
	surtax	—	—	—	—	—	—	—
	sales tax	—	—	—	—	—	—	—
	Subsidies	—	—	0.44	0.51	1.04	0.74	—

Source: [18].

[a] Applicable for locally produced products.

[b] Applicable for imported products.

The liquified natural gas (LNG) project in Bintulu, with a peak production capacity of 6 million tonnes per annum has been completed at a cost of M$3.6 billion. Besides the Bintulu project, the other projects include the offshore gas pipeline project, the gas processing plant for the production of ethane, propane, and buthane, and the petrochemical complex. These projects in total call for an investment of about M$8.6 billion, and represent an ambitious programme of petrochemical development in Malaysia.

Besides petroleum and natural gas, hydro-power can potentially provide a significant amount of the energy needed by the country. In 1978, it was estimated that Malaysia had a potential for generating 1.9 gigawatts of hydro-power [7]. The National Electricity Board (NEB) has a programme for steadily diversifying its dependence on petroleum to hydro-power for electricity generation. This programme calls for the construction of about 200 mini-dams throughout the country. Further, the NEB is also constructing a major 250 megawatt natural-gas power station in Paka, Trengganu. This power station represents the first of a series of gas-fired power stations to be built and by 2,000, it is hoped that hydro-

power and gas-fired power will provide more than 50 per cent of the total electricity generated in the country.

At the micro-level, the major energy policies are directed at the rates of taxes and subsidies on various petroleum products, and at the tariff rates for electricity. Table IV details the taxes and subsidies of petroleum products for the period 1973–85.

Relatively large subsidies have been provided for kerosene and diesel; these subsidies were offset by the large excise duty levied on petrol. In late 1983, however, the government removed all subsidies on kerosene and diesel. It also expressed a policy intention to minimize the adverse impact of this move on poor households though policies to achieve this have not been specified yet.

Electricity tariff rates are determined by the NEB and are divided into three groups—domestic, commercial, and industrial users. Over the period 1960–80, the Malaysian electricity tariff rates were generally low by international standards. However, in 1981 these tariffs were increased to comparable international standard though industrial consumers continued to be subsidized in the form of special industrial tariff rates.

IV. ECONOMIC IMPACT OF CHANGES IN ENERGY COST

Having presented the energy situation, in this section we shall discuss the impact of the wide changes in energy cost on the economic performance of the country.

A. *Energy Cost and Sectoral Growth Rates*

Since numerous factors contribute towards the growth rates of the major economic sectors of the country, it is not possible for us to analyze in isolation the impact of fluctuations in energy cost (particularly over the period 1973–82) on the growth rates of each of the economic sectors. However, because petroleum products are classified as one sector in the 1970 and 1975 input-output (I-O) tables,[2] using the I-O approach we can evaluate the aggregate impact of any change in the petroleum output on the Malaysian economy. We know that

$$(I-A)X=Y \tag{1}$$

and

$$X=(I-A)^{-1}\,Y, \tag{2}$$

where

X = column $(x_1, \ldots, x_n)$, where x_i is the output of economic sector i;
Y = column $(y_1, \ldots, y_n)$, where y_i is the "final demand" of economic sector i;
A = matrix of a_{ij} where a_{ij} is the amount of output of sector i required for the production of one unit of sector j; and
I = identity matrix.

[2] The 1970 I-O table was prepared by the Malaysian Department of Statistics [15] while the 1975 I-O table was prepared by the Institute of Developing Economies [10].

Thus, to analyze the impact of a change in the output of the petroleum sector on the final demand of the economy, we can assume a unit change in output of the petroleum sector (say sector j) and zero change (or no change) in the other sectors.

Let $\Delta X=(0, 0,\cdots, x_j=1, 0, 0,\cdots, 0)$. From equation (1) we have

$$\Delta Y=(I-A)\Delta X, \tag{3}$$

where ΔY is the change in the final demand due to a unit change in output of the petroleum sector (ΔX).

Before we compare the values of ΔYs computed from equation (3) for 1970 and 1975, it should be pointed out that the ΔYs for 1970 were computed on the basis of the 60-sector I-O table prepared by the Malaysian Department of Statistics The ΔYs for 1975 were computed on the basis of an appropriate aggregation of the 105-sector I-O table prepared by the Institute of Developing Economies, Tokyo into a 60-sector table for comparison with the 1970 60-sector I-O table. The extent to which the ΔYs computed reflected the reality, therefore, crucially depended on the original assumptions adopted by the relevant agencies in the computation of the I-O tables. This caveat notwithstanding, the overall order of magnitudes of the ΔYs could still be taken to indicate the extent of influence energy costs have on the final demand.

The ΔYs computed from equation (3) for 1970 and 1975 are presented in Table V (columns 1 and 2). Generally, over the period 1970–75, primary sectors such as rubber and oil palm (sectors 1–6) and processing of resource-based products such as meat and dairy products, grain mills and animal feed, and rubber processing (sectors 8–9, 11–16, 19–20, and 25–26) remained relatively independent of the changes in petroleum output.

This may be due to the relatively small proportions of fuel consumed in these sectors. An exception is the vegetable and animal oil sector (sector 10) which experienced a significant increase in its dependence on petroleum sector output (from M$0 change in value of final demand due to a M$1.00 change in value petroleum sector output in 1970, to M$1.50 change in final demand due to a M$1.00 change in value of petroleum sector output in 1975). This may be due to the fact that crude palm oil processing (the major activity in this sector) is very fuel intensive. Similarly, fuel-intensive sectors such as industrial chemicals (sector 22), other metal products such as metal fabrication (sector 32), electrical machinery (sector 34), electricity and water supply generation (sectors 38–39), and the service sectors such as hotels and financial institutions needing extensive air-conditioning (sectors 43–60) also showed a more pronounced dependence on petroleum sector output.

It is also interesting to analyze the impact of a unit change in the final demand of the petroleum sector on the output of the various economic sectors.

Let $\Delta Y=(0, 0,\cdots, y_j=1, 0, 0,\cdots, 0)$. From equation (2), we have

$$\Delta X=(I-A)^{-1}\Delta Y, \tag{4}$$

TABLE V

IMPACT OF CHANGE IN PETROLEUM OUTPUT

	Sector	π_1 (1)	π_2 (2)	β (3)	∂_1 (4)	∂_2 (5)
1	Other agriculture	0	0	0.52		
2	Rubber planting	0	0	0.12		
3	Oil palm	0	0	1.13	0.45	0.40
4	Livestock	0	0	0.13		
5	Forestry & logging	0	0	0.31		
6	Fishing	0	0	0.07		
7	Mining & quarrying	0.1	0	2.77	0.11	0.11
8	Meat & dairy products	0	0	[a]		
9	Canned fruit, etc.	0	0	[a]		
10	Vegetable & animal oil	0	1.5	2.31		
11	Grain mills	0	0	0.09	0.09	0.06
12	Bakeries & confectionery	0	0			
13	Other food preparations	0	0	0.59		
14	Animal feed	0	0			
15	Breweries & soft drinks	0	0	0.09	0.05	0.03
16	Tobacco products	0	0		0.05	0.07
17	Textile	0	0.5	1.30	0.29	0.20
18	Apparel & footwear	0	0.1	0.38	0.35	0.32
19	Sawmills	0	0	0.28	0.22	0.14
20	Furniture & fixtures	0	0	0.19	0.30	0.26
21	Paper & printing	0	0.3	1.18	0.17	0.11
22	Industrial chemicals	1.1	2.8	7.06		
23	Paints, etc.	0	0	1.45	0.10	0.06
24	Other chemical products	0	0.9			
25	Rubber processing	0	0	0.54		
26	Rubber products	0	0		0.16	0.07
27	Plastic products	0	0	1.32		
28	China & glass products	0	0.03	0.14		
29	Cement, lime & plaster	0	0.3	0.15	0.10	0.11
30	Other non-metallic products	0	0.2	0.27		
31	Basic metal industries	0	0	3.27	0.06	0.07
32	Other metal products	0.9	2.5	3.35	0.16	0.10
33	Non-electric machinery	1.2	0	9.31	0.25	0.12
34	Electrical machinery	0	4.3	1.70	0.10	0.10
35	Assembly of motor vehicles	0	0.8		0.11	0.04
36	Other transport equipment	0	0	0.02		
37	Other manufactured products	0	1.4	2.45	0.18	0.09
38	Electricity	0.5	1.7	2.96	0.12	0.09
39	Water supply	0.2				
40	Construction	0	0.9	1.35	0.29	0.29
41	Wholesale & retail trade	2.5	4.6	8.34	0.23	0.23
42	Transport & storage	5.2				

TABLE V (Continued)

	Sector	π_1 (1)	π_2 (2)	β (3)	∂_1 (4)	∂_2 (5)
43	Hotels & restaurants	0				
44	Communications	0.1			0.20	0.15
45	Financial institutions	0				
46	Insurance	0.2				
47	Real estate & dwellings	0.3				
48	Business services	0.1			0.03	0.03
49	Educational services	0				
50	Health & veterinary services	0.1				
51	Recreational & cultural services	0	6.3	10.73		
52	Motor vehicle repair	0			0.42	0.37
53	Other personal & household services	0				
54	Government economic services	0.2				
55	Public administration and defence	0.3			0.29	0.25
56	Government community services	0.1				
57	Producers of non-profit services	0				
58	Domestic services of households	0			[b]	[b]
59	Imputed bank service charges	0				
60	Unclassified	0	3.3	4.48		

Sources: [10] [15] [16, various issues] [12].

Note: π_i=change in final sector demand (in M$ value) due to unit value (in M$) change in petroleum sector output (i=1=year 1970; 2=year 1975).

β=change in sectoral output (in M$ value) due to unit value (in M$) change in final petroleum sector demand for the year 1975.

∂_i=labor coefficients (in 10^{-3} units of man-day) of economic sector (i=1=year 1970; 2=year 1975) due to a unit change in the output (in M$) of the petroleum sector.

[a] Included in sectors 12–14.

[b] Included under sectors 50–54.

where ΔX is the change in output due to a unit change in the final demand of the petroleum sector (ΔY). From Table V (column 3) it can be seen that the effect of a unit change in the final demand of the petroleum sector is very pronounced in 1975. For example, taking the service sectors (sectors 43–60), we find that a M$1.00 increase in the final demand of petroleum had resulted in a M$10.73 increase in the aggregate output of these sectors. Similarly, a M$1.00 increase in the final demand of petroleum had resulted in a M$8.34 increase in the total output of wholesale and retail trade, and transport and storage (sectors 41 and 42).

In order to examine the employment implications of a unit change in the output of the petroleum sector as well as a unit change in the final demand of the petroleum sector, we need to compute the labor coefficients (i.e., labor input per unit output) of each of the economic sectors from the 1970 and 1975 I-O tables. Let these labor coefficients be

$$L=(l_1, \ldots, l_n).$$

Thus, a unit change in the output of the petroleum sector (assumed sector j) will induce a change of l_j units in labor employed. From Table V (columns 4 and 5) it can be seen that the l_j for 1975 is very small indicating that in 1975 the employment implication of a unit change in output of the petroleum sector was much less than that of the corresponding 1970 figure. This shows that the Malaysian petroleum sector had become much more capital-intensive over the period 1970–75, due possibly to the utilization of more capital-intensive technologies in the sector over the referred time-frame.

With respect to the employment implication of a unit change in the final demand of the petroleum sector, from equation (4), we know that the change in labor requirement ΔL due to a unit change in the final demand of the petroleum sector (ΔY) is

$$\Delta L=L\,\Delta X=L\,(I-A)^{-1}\,\Delta Y.$$

The ΔL figures for 1970 and 1975 are 0.0528 and 0.0306 man-days per M$ increase in the final demand of the petroleum sector, respectively. These figures show that over the period 1970–75, the employment implication of the changes in the final demand of the petroleum sector had also become less pronounced. Thus both the direct and indirect employment implications of the petroleum sector contracted considerably over the period 1970–75 mainly as a result of the utilization of more modern (and fuel-efficient) technologies in response to fuel price increase.

B. *Oil Price and Balance of Payments*

As stated previously (see Figure 2), in the early 1970s the major export earners rubber and manufactured goods. By 1983, petroleum had emerged as the second largest export earner for the country, overtaking the export earnings of rubber. In fact, since 1970, the proportion of export earnings derived from petroleum and gas to total export earnings for Malaysia has increased steadily (see Table VI) from 3.9 per cent in 1970 to 15.3 per cent in 1978, and 21.6 per cent in 1985. The increase in the export earnings of petroleum and gas is due to the expansion of crude oil output from 34 million barrels in 1972 to 111 million barrels in 1982, as well as the steady increase in crude oil price over the period 1973–82.

However, since 1982 the price of crude oil has declined substantially, from U.S.$34 per barrel in 1982 to U.S.$27.50 per barrel in 1985. This, together with a ceiling which Malaysia imposes on its total output of crude oil per annum, has led to a decline in export proceeds generated by this sector, in particular over the period 1984–85.

The decline in crude price since 1982 was due to a combination of factors, including the global economic slowdown, a persistent oversupply situation, a slackening in demand and continued switching by users to alternative sources of energy. In late 1984, these factors cumulated in a series of deliberate price cuts by oil-producing countries in order to maintain their world market shares. The

TABLE VI

MALAYSIA: EXPORT AND IMPORT OF PETROLEUM AND GAS, 1970–85

Year	Total Malaysian Exports (M$ Million)	Export of Petroleum & Gas (M$ Million)	% of Petroleum & Gas Exports to Total Exports	Total Malaysian Imports (M$ Million)	Import of Petroleum & Gas (M$ Million)	% of Petroleum & Gas Imports to Total Imports
1970	5,163	201	3.9	4,340	103.6[a]	2.4
1971	5,017	390	7.8	4,421	108.2[a]	2.5
1972	4,854	223	4,6	4,695	110.4[a]	2.4
1973	7,559	268	3.5	6,896	119.1[a]	1.7
1974	10,390	757	7.3	11,190	421.0[a]	3.8
1975	9,900	727	7.3	11,070	538.8[a]	4.9
1976	11,780	1,550	13.2	9,610	696.5[a]	7.3
1977	15,200	1,896	12.5	12,640	858.9[a]	6.8
1978	16,216	2,481	15.3	13,123	1,312.0	10.0
1979	24,219	4,210	17.4	17,161	1,259.0	7.3
1980	28,201	6,709	23.8	23,539	1,879.0	8.0
1981	28,218	6,918	24.7	26,675	2,094.0	7.9
1982	26,640	6,694	28.9	28,275	1,544.0	5.5
1983	32,828	7,871	24.0	30,721	1,639.0	5.3
1984	38,654	8,738	22.6	32,967	1,291.0	3.9
1985	38,007	8,206	21.6	33,250	1,160.0	3.4

Sources: [3, various issues] [17, various issues].

[a] Import of crude petroleum only.

downward pressure on prices was compounded by a shift in demand from light (low-sulphur) to heavy crude oil, as a consequence of technological changes in the refining industry which reduced significantly the cost of refining heavy crude. Consequently, the price differential between light and heavy crude oils narrowed from about U.S.$3 per barrel in 1983 to about U.S.$1.50 per barrel by 1985. This had an adverse effect on Malaysian crude oil exports, since Malaysian crudes are mainly of the low-sulphur variety. This observation notwithstanding, since the early 1980s Malaysia's total export earnings has increased at a more rapid rate than that of petroleum and gas, indicating the country's gradual diversification of its exports earnings away from petroleum and gas to other sectors such as manufactured goods and palm oil. With respect to imports, as can be seen from Table VI, the proportion of the country's imports of petroleum and gas to total imports has declined steadily—from 10.0 per cent in 1978 to 3.4 per cent in 1985.

According to the Malaysian Treasury, Malaysia's national revenue changed by about M$100 million a year for every U.S.$1 change in the price of a barrel of crude oil at the 1983 price [20].

At the end of 1982, the average price of Malaysian crude was U.S.$35.65 per barrel; its petroleum exports amounted to 12.2 million tonnes and earned M$7,332 million. If the Malaysian crude price were to change by U.S.$1 per barrel, it would indicate a 2.8 per cent price change, and export earnings would change

by M$205 million. In 1982, Malaysia also imported M$753 million of petroleum. A 2.8 per cent change in price would change the expenditure by about M$21 million.

Assuming the change in petroleum exports and import values are strictly parallel for both accounts, a 2.8 per cent change in crude price would change the country's export earnings by M$184 million. However, it must be pointed out that Malaysia's import of petroleum included not only crude oil from the Middle East but also high-value refined petroleum products such as lubricants and aviation fuel. In an oligopolistic market where the prices of high-value petroleum products are likely to be upward elastic, but downward inelastic, it is more likely that a 2.8 per cent increase in the price of crude would increase Malaysia's imports by more than M$21 million, and a 2.8 per cent decrease would result in Malaysia's imports contracting in value by less than M521 million. Thus, on a net basis, the country's exports earnings would change by an amount which is less than M$184 million with every U.S.$1.00 per barrel change in the crude oil price. This indicates that the Malaysian Treasury's estimates of M$100 million change in the national revenue for a U.S.$1.00 per barrel change in the crude oil price is not unrealistic.

The nation's 1983 national revenue was M$18,608 million and the average 1983 price for Arabian Light crude U.S.$29.00. The elasticity of national revenue with respect to the world crude price (as reflected by Arabian Light crude) is therefore:

$$\hat{e}=\frac{\text{Change in export earning/total national revenue}}{\text{Change in Arabian Light price/price of Arabian Light}}=0.156$$

The computed value of $\hat{e}$ ($=0.156$) indicates that in 1983, any change in the crude price would have some significant influence on Malaysia's national revenue position. This figure, however, is considerably less than that of major oil exporting countries such as Nigeria and Indonesia.

In order to analyze the impact of fluctuations in the oil price on the balance of payments, we have also computed the rate of change in the value of petroleum imports to total export receipts [6] for Malaysia. This concept is a more aggregative indicator (and therefore a better indicator) of the real cost of changes in petroleum price on Malaysian export receipts than specific indicators such as the general terms of trade or specific terms of trade for petroleum. This ratio is defined to be:

$$z=p^*-p+q^*-q, \tag{5}$$

where

p^* = the growth rate of money price of petroleum imports,
p = the growth rate of money price of total imports,
q^* = the growth rate of quantity of petroleum imports, and
q = the growth rate of quantity of total exports.

Equation (5) can be derived as follows.

TABLE VII

ANNUAL CHANGE IN PETROLEUM IMPORTS TO EXPORTS RECEIPTS (z)

Year	p^*	p	q^*	q	$z=p^*-p+q^*-q$
1971	−46.3	−2.8	−53.0	6.0	−102.5
1972	−4.4	−3.2	−6.4	−0.9	−6.7
1973	7.9	51.9	−3.9	10.5	−58.4
1974	253.5	38.3	6.8	−0.9	222.9
1975	26.9	−9.5	17.2	1.5	52.1
1976	30.4	45.6	15.7	14.1	−13.6
1977	23.3	11.3	18.5	−5.2	35.7
1978	8.1	14.3	13.5	19.2	−11.9
1979	35.6	41.7	4.3	20.1	−21.9
1980	49.2	16.4	−10.5	10.0	12.3
1981	11.4	−3.9	−9.7	−3.8	9.4
1982	4.7	15.6	−0.2	4.1	−15.2
1983	23.6	6.7	−4.0	13.9	−1.0
1984	−16.7	7.0	20.5	14.1	−17.3
1985	−4.8	0.9	9.8	3.6	0.5

Sources: [1, Vol. 14 (April 1983)] [1, Vol. 18 (July 1986)] [3, various issues] [14, various issues].

Let V^*, P^*, and Q^* be money value, money price, and quantity of petroleum imports; V, P, and Q be money value, money price, and quantity of exports. Then the ratio of the value of petroleum imports to export receipts is:

$$Z=V^*/V=P^*Q^*/PQ. \tag{6}$$

Let the corresponding lower case letters denote instantaneous rate of change in the variable concerned (for example, $v=\Delta V/V$ as $\Delta V\to 0$), we have

$$\begin{aligned} z&=v^*-v \\ &=p^*+q^*-p-q \\ &=(p^*-p)+(q^*-q). \end{aligned}$$

From Table VII, it is clear that for the period prior to 1973, the annual changes in petroleum imports to total export receipts were negative, indicating that Malaysia's growth in export receipts more than compensated for the growth in import expenditures for petroleum in those years. This was the era of low oil prices and also when Malaysia's dependence on oil export earnings was relatively insignificant (for example, in 1973, petroleum and gas contributed only 3.5 per cent of Malaysia's total export earnings). However, for the period 1974–75 the annual change in petroleum imports to total export receipts became positive, indicating that Malaysia's growth in petroleum imports in these years were more than the corresponding growth in total export receipts. As can be seen from Table II, over this period, oil prices increased substantially, but Malaysia had yet to emerge as an import oil exporter—by 1975, petroleum and gas contributed only about 7.3 per cent of Malaysia's total export earnings, hence the positive

values for z. However, since 1978, with Malaysia becoming a significant net petroleum exporter, Malaysia's annual change in petroleum imports relative to total export receipts have generally become negative again. Over this period, with major discoveries of oil wells in Malaysia, the condition of petroleum and gas to the country's total export earnings increased significantly; for example, in 1982 petroleum and gas accounted for 28.9 per cent of the nation's export earnings.

The two major variables that would have some impact on z are obviously the change in the world price of crude oil (as represented by Arabian Light crude), and the change in the price of Malaysian crude. Let these two independent variables be x_1 and x_2 respectively (see Table II).

In order to analyze the exact relationship between z and these two independent variables, we ran a multiple regression of z against x_1 and x_2 over the period 1972–85 and obtained the following equation:

$$z = \underset{(1.5)}{-11.06} + \underset{(-0.08)}{0.86x_1 - 0.05x_2}, \qquad R^2 = 0.68, \; n = 14.$$

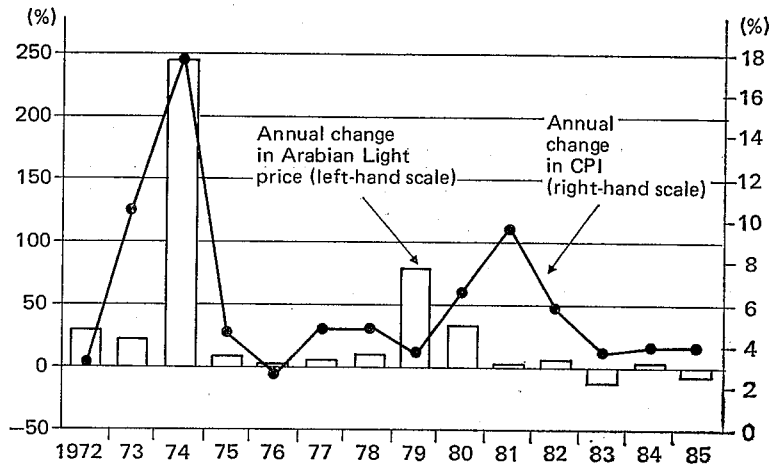
The above regression equation demonstrates the strong positive influence that a change in world crude oil prices has on z and the marginal negative influence that a change in Malaysian crude prices has on z. These significant influences are to be expected, since with an increase in world crude prices, one would expect Malaysia's annual change in petroleum imports relative to export receipts to become positive, while an increase in Malaysian crude prices would cause the nation's annual change in petroleum imports relative to export receipts to become negative.

C. *Oil Price and Exchange Rate*

As can be seen from Figure 2, Malaysia's export earnings are generated by a variety of commodities—including petroleum—and manufactured goods. Thus, even in 1982 when the oil price was at its peak, the petroleum sector contributed only about 28.9 per cent of total export earnings. This curtailment of over-dependence on oil earnings had been deliberate. Since the mid-1970s, when the country emerged as a substantial exporter of oil, it had pursued a conservative policy of oil exploitation by placing a production ceiling of about 500,000 b/d to allow its oil resources to be conserved over a longer time-frame. At the same time, developmental efforts aimed at accelerating the pace of industrialization and agricultural modernization were enhanced. This is demonstrated vividly by the fact that even in 1982 export earnings generated by the manufacturing sector equaled those of the petroleum sector.

Given this diversified base of Malaysia's export earnings, and that a major portion of Malaysia's export earnings from the petroleum sector were kept as reserves with major financial institutions abroad, the sustained increase in oil price over the 1970s could be said to have created no major artificial appreciation in the value of the Malaysian ringgit. Unlike countries such as Nigeria, where the oil boom of the 1970s enabled the government to embark on a developmental strategy based solely on oil proceeds (by 1980 oil accounted for 97 per cent of its export earnings) leading to substantial artificial appreciation of its real exchange

Fig. 3. Malaysia: Oil Price and Consumer Price Index (CPI)



Source: [17, various issues].

rate and creating a typical example of the so-called Dutch disease [5], such a phenomena did not occur in Malaysia. Hence, even in 1986, with the dramatic decline of the oil price to under U.S.$10 per barrel, Malaysia still enjoyed substantial surpluses in its trading account. The Malaysian ringgit declined somewhat against major currencies such as the U.S. dollar and the British pound. However, it depreciated by more than 50 per cent against the Japanese yen. This was due mainly to the strength of the yen itself rather than the weakness of the ringgit. By the end of 1986, the speculative pressure on the Malaysian ringgit—which was extremely strong in mid-1986—subsided and, in fact, by early 1987 the ringgit appreciated against world currencies such as the U.S. dollar and the Singapore dollar.

D. *Energy Cost and Inflation*

Another impact of the increase in petroleum prices is the inflationary pressures that this brings upon the domestic economy. Since the Malaysian economy is relatively open, its consumer price index (CPI) could be influenced by the world petroleum price.

In Figure 3, we have plotted the annual change in CPI over the period 1972–85 and the annual change in the world crude price (as reflected by the Arabian Light crude price). The close correspondence between the two rates is remarkable and indicates the major influence the world oil price has upon the inflation rate of the country.[3] Over the period 1973–78, there was an almost instantaneous relationship

[3] The Pearson correlation coefficient between the annual increase in Malaysian CPI and annual increase in the Arabian Light crude price is 0.07 ($p<0.01$), indicating that the two are significantly correlated.

between the increase in the oil price and the increase in the Malaysian CPI; over the period 1979–85, this relationship lagged by about one–two years, mainly on account of the fact that since the mid-1970s the Malaysian government has institutionalized controls on prices of essential items thus delaying the impact of the increase in oil prices on the CPI.

The annual change in CPI jumped from about 10 per cent in 1973 to almost 18 per cent in 1974, an increase of about 8 per cent within one year. Since 1975, however, the rate of increase in CPI has declined significantly; by 1985 the annual increase in CPI had stabilized to about 3.9 per cent. The slowdown in the increase of CPI reflects largely the weakness in overseas demand due to the slower economic growth rate in the major industrialized countries (Malaysia's principal trading partners) and to world recession. The sluggish demand from the external sector contributed to the slowdown in income growth, decline in domestic demand and reduced pressures for imports.

In order to determine systematically the factors that influenced the CPI, we ran a stepwise regression of the annual increase in CPI against a number of possible independent variables including the annual change in world crude price, the annual change in the Malaysian money supply, the terms of trade, and the price index for controlled items. The data collected and utilized were for the period 1970–85. The best regression fit found from the stepwise regression analysis is:

$$y = 5.463 + 0.032\,x_1, \qquad R^2 = 50,\ n = 16,$$
$$(t = 3.04)$$

where

y = the annual change in CPI and
x_1 = the annual change in Arabian Light crude oil.

The above equation, gives additional evidence that the world crude price has indeed a very pronounced effect upon the CPI and ultimately the standard of living of the Malaysian population. This variable by itself has explained about 50 per cent of the variance in the annual increase in the CPI for the period 1970–85.

E. *Income and Price Elasticities of Demand for Petroleum Products*

In terms of policy implications, it would be interesting to analyze the income and price elasticities of demand for petroleum products in Malaysia. Chee [4] has estimated the income and price elasticities using both static and dynamic models. In static analysis, the demand for petrol (a surrogate for petroleum products) is assumed to be as follows:

$$G_t = \alpha_0 Y_t^{\alpha_1} P_t^{\alpha_2} C_t^{\alpha_3} S_t^{\alpha_4}, \tag{7}$$

where

G_t = demand for petrol in time period t,
Y_t = disposable income in time period t,

P_t = petrol price in time period t,
C_t = motor vehicle operating cost index (excluding fuel) in time period t, and
S_t = stock of petrol-driven motor vehicles in time period t.

The income and price elasticities of demand for petrol can be estimated using equation (7) by taking natural logs on both sides of the equation, i.e.,

$$\ln G_t = \ln \alpha_0 + \alpha_1 \ln Y_t + \alpha_2 \ln P_t + \alpha_3 \ln C_t + \alpha_4 \ln S_t, \tag{8}$$

where

α_1 = income elasticity of demand for petrol and
α_2 = price elasticity of demand for petrol.

Static analysis assumes instantaneous adjustment of demand to income and price change. In real life, households' reaction to price and income changes tend to be delayed by several time periods. To account for this delay in the adjustment of demand to income and price changes, dynamic analysis is used for the estimation of price and income elasticities.

In dynamic analysis [2] [8] [22], it is assumed that the demand for petrol in period t is related to the other explanatory variables as follows:

$$G_t = \alpha_0 Y_t^{\alpha_1} P_t^{\alpha_2} C_t^{\alpha_3} S_t^{\alpha_4} G_{t-1}^{\alpha_5} N_t^{\alpha_6}, \tag{9}$$

where now N_t = population in time period t. Again, taking natural logs on both sides of equation (9), we can estimate, using multiple regression, α_1 and α_2, the income and price elasticities, respectively.

Using quarterly data for the period 1971–79, the income and price elasticities for petrol have been estimated by Chee using equations (7) (static analysis) and (9) (dynamic analysis). The results obtained are as follows:

	Static Analysis	Dynamic Analysis
Income elasticity	0.004	0.008
Price elasticity	−0.52	−0.14

The results indicate that both the price and income elasticities for petrol are relatively inelastic compared to those of industrialized countries. For example, Houthakker and Taylor [8] estimated that the income and price elasticities for petrol in twelve OECD countries were 1.66 and −10.3, respectively. Transportation (automobile or public transport) represents the major use of petrol in Malaysia. The lower elasticities for the Malaysian case may not be surprising if one examines the car density in Malaysia, which is only 75 per 1,000 population compared to a corresponding figure of 500 per 1,000 in the United States. In Malaysia, cars are still used mainly for the basic needs of commuting to work, transportation of goods, and vital communications and not so much for entertainment and leisure purposes as is the case in most OECD countries. Hence, the generally lower price and income elasticities of petrol in relation to OECD countries.

The above comments notwithstanding, it must be noted that there are some

limitations to the estimations of Chee. In both equations (7) and (9), major consumers of petrol such as the manufacturing sector and the services sector were not included. It could be argued that these two sectors—particularly the fuel-intensive manufacturing activities—would have higher price elasticities for petrol and petroleum-based fuels. Further, in the dynamic equation (9), it could be argued that a one-period lag in G_t may not capture the complete lag effects of previous demand for petrol on present demand. A declining summation lag effect (such as a Koyck lag [11, p. 157]) could have captured more completely the lag effect on present demand.

Within the context of the limitations of Chee's study, using the price elasticity coefficients and assuming that the stock of vehicles remains stable, the percentage price increase that is required to achieve a certain percentage of reduction in consumption of petrol is given as follows:

Percentage of reduction in consumption of petrol	5	10	15	20	25	30
Required % of increase in price of petrol	36	71	107	142	179	214

The above results indicate that if the price mechanism alone were to be used for reducing the demand for petrol, the price increases would have to be fairly substantial before a significant decrease in the consumption of petrol could be realized.

V. CONCLUSIONS AND POLICY RECOMMENDATION

A. *Summary of Findings*

After the nearly fourfold increase in crude oil in 1973, Malaysia became a net exporter of crude oil and natural gas and derives substantial export earnings from the petroleum and natural gas sector. By 1982 Malaysia's revenue from oil was so substantial (at 28.9 per cent of total export earnings) that the petroleum sector became its major export sector. However, since then, the country has gradually decreased its dependence upon petroleum; manufactured goods and cash crops such as palm oil have assumed greater significance as export earners.

Through an analysis of the I-O tables for 1970 and 1975, it was found that the economy's final demand sectors have grown to be more dependent on the petroleum-sector output. Further, as a result of the increase in energy cost, the employment generation capacity (both direct and indirect) of the petroleum sector was significantly reduced over the period 1970–75. Increased energy cost is also a major factor determining the increase in the inflation rate of the country for that period; this factor alone accounted for 50 per cent of the variance in the Malaysian CPI.

Because of the relatively low vehicle to population ratio in Malaysia and the fact that the major proportion of its current vehicle usage is for basic needs, the price elasticity of demand for petrol was found to be low. This implies that the price mechanism alone is ineffective as an instrument for controlling the demand for petroleum.

B. *Policy Implications*

It has been estimated that at the current rate of crude oil production, Malaysia's crude oil reserves will be depleted within the next twenty years. Thus, the country's major energy policy strategy should be to reduce its over-reliance on oil and encourage the development and utilization of other more abundant energy sources. This is particularly important with the projected softness of the world market for oil over the remaining period of this decade.

Although the increase in oil price since 1973 has made Malaysia a significant petroleum exporting country, the Malaysian government has not been able to put into more effective use its earnings derived from oil exports. The major bulk of its earnings from the petroleum sector are still placed as fixed reserves in local and foreign banks. The government should adopt a more ambitious investment strategy for its earnings from oil to enable the country to progress beyond the period when its oil reserves are depleted. In this respect, Malaysia possesses extensive reserves of hydro-power. Vigorous efforts ought to be made to tap these sources of power, so that the country's hope of generating 50 per cent of its electricity from hydro-power by 1990 can be realized.

Apart of export earnings from oil could also be used to finance research and development programmes for the development of fuel-efficient technologies in resource-based manufacturing industries. Some of these fuel-efficient technologies could include utilization of solar power and recycling of "waste heat" for productive use. Since these industries are based on locally produced raw materials, they could become extremely competitive in the world market. This would ultimately result in more efficient and productive multiplier effects of the oil export earnings on the domestic economy.

The relatively significant elasticity of Malaysia's revenue with respect to oil price suggests that appropriate policies are needed to continue to diversify Malaysia's over-dependence upon oil as an export earner. This could be achieved by reducing the rate of growth of imports, particularly the import of capital goods and equipment associated with industrialization needs. In this respect, policy options such as an import substitution strategy for encouraging the domestic production of capital goods and equipment and more investment incentives for accelerating the domestic production of resource-based industries could be implemented.

On the domestic front, policies ought to be formulated to achieve structural adjustments that reflect the changes in fuel prices. The removal of subsidies on the prices of both kerosene and diesel is the first step in this direction. In the long run, incentives ought to be provided to encourage greater use of LNG for household heating and public transportation needs. These incentives could include lower taxation rates for vehicles using LNG and household income tax deductions for purchase of equipment for cooking and heating using LNG. This could encourage greater domestic consumption of LNG, which is available in abundance off the coast of Trengganu, Sabah, and Sarawak.

The increase in fuel prices over the period 1973–82 has been a major factor

causing the acceleration of the inflation rate. In order to minimize the impact of fuel prices on inflation, policies could be introduced to encourage the use of mass transportation systems. This could be achieved through improving and expanding the road systems within the major metropolitan centers, and the provision of better railway and highway connections between these metropolitan centers. Other policies could include area licensing schemes for restricting the entry of private vehicles into the business districts of major cities such as Kuala Lumpur and Penang during peak hours, and the provision of tax-deduction incentives for transportation companies to modernize their bus fleets.

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