WORKING PAPER

Centre for Development Studies
Ulloor, Trivandrum
(India)

WORKING PAPER NO. 83

THE IMPACT OF THE RISE IN OIL PRICES ON INDIA

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February 1979

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INTRODUCTION

When oil prices rose fivefold between 1972 and 1974, the case of India seemed hopeless to many observers. In 1974 India's imports of oil and products came to 36 per cent, the trade deficit to 29 per cent of her export earnings: proportions that seemed unsustainable in the long run. Yet today India does not have an oil problem or a payments problem by all accounts. How was this transformation achieved? What did it cost in terms of lost income and employment? What technological changes did it occasion? These are the questions that this study seeks to answer. The emphasis is on the developments in the seventies; earlier developments are referred to only as essential background. It will be obvious that for the background I owe a great deal to previous studies, and in particular to those of Michael Tanzer (1969), Biplab Dasgupta (1971), David Henderson (1975) and R. Vedavalli (1976). The official energy surveys (India 1965; India 1974), though largely outdated for my purpose, have not been neglected; and the numerous studies of National Council of Applied Economic Research, my old training ground, have formed indispensable reading.

NOTE

All units used other than barrels are metric. Some Indian statistics refer to financial years running from April to March. Financial years are identified in the text by a prefixed F; F1974, for instance, stands for the financial year 1974-75.

The Rupee exchange rates have behaved as follows in recent years:

Rupees per unit of currency at the end of the year

	SDR	US $
1970	7,509	7,509
1971	7,853	7,21
1972	8,695	8,008
1973	9,808	8,130
1974	9.890	8.078
1975	10.462	8.937
1976	10.318	8.881
1977	10.137	8.626

I OIL IN THE INDIAN ENERGY ECONOMY

Divergent views are to be encountered on the role of oil in Indian energy consumption. After the spurt in oil prices in 1973 India was among the countries listed by the United Nations as most severely affected. The following assessment is typical of the general view prevailing in mid-1974:

> "India's imports of oil could well increase fourfold in value between 1973 and 1975 (from $415 million to $1,675 million). The forecast rise between 1973 and 1974 alone (about $720 million) equals 32% of her 1972 imports and about half her foreign exchange reserves. India has also been hit by the increased price of food. In addition her own food production will suffer as a consequence of the increased cost of fertilizers (both imported and home produced). According to World Bank projections India would have an increased financing need of about $800 million in 1974 over 1973 as a consequence of the oil price increase, of which a maximum of about $600 million could be covered by existing loan arrangements, drawing down of reserves, and potential borrowing from IMF and other public loan sources. This would leave an uncovered deficit of over $200 million. Unless special help is obtained (e.g. under bi lateral arrangements with Iran or from the new Special Fund of the United Nations), this implies either very restrictive import policies (with consequent disastrous results on economic growth and the spread of poverty), or a bigger expansion of exports (the scope for which is probably quite limited in the short term)." (Ellis 1974: 35-36)

There is also the alternative view, often expressed in India as well as elsewhere, that India is essentially a backward country with an overwhelmingly rural population which consumes little of commercial fuels and is therefore largely untouched by the rise in oil prices (see, for instance, Reddy and Prasad 1976: 6).

To an extent this divergence of views is due to a difference in focus. A concern about the impact of the rise in oil prices was based to a large extent on the resulting balance of payments difficulties. The playing down of their impact must, on the other hand, give more importance to those who are largely engaged in subsistence production or to the poor whose energy consumption is low. But in a large degree, the divergence is attributable to a multiplicity of concepts and the resulting multitude of divergent measurements.

Indian energy . . .

Indian energy consumption has been the subject of two official committees (India 1965, 1974) and a number of private studies (Henderson 1975; Kashkari 1975; Parikh 1976; National Council of Applied Economic Research 1960, 1965), which essentially deal with energy as fuel. Some newer studies take energy in a wider sense as heat and work of human use (Odend'hal 1972; Makhijani and Poole 1975; Bhatia 1975; Revelle 1976); they have been valuable in pointing out the large volumes of energy consumption ignored in conventional energy studies, in showing the interdependence of all forms of energy and in exploring the connection between human standards of living and the exploitation of natural resources by people and animals. As is to be expected with pioneering work, however, they adopt widely different concepts and therefore yield non-comparable results; they also deal with parts of the economy, and it is not always clear how the parts fit into the whole. An attempt has been made elsewhere (Desai 1978) to piece together information on the basis of a network of uniform concepts. Here we shall only present the relevant results.

Energy consumption may be measured at three levels, corresponding to which we have concepts of primary energy, final energy and useful energy. Primary energy is all energy directly and indirectly used for economic activity; it includes energy used by transforming industries like refineries and electric power stations, but excludes the energy that they supply. Final energy is the energy that is directly used for economic activity; it excludes the energy used by transforming industries and includes the energy supplied by them. Clearly, the difference between primary and final energy is the energy lost in transformation from one form into another. Finally, useful energy is the energy that finally results in work or heat actually used in economic activity. It is thus final energy discounted for the efficiency with which it is used. The efficiency of most energy-consuming processes is less than 50 per cent and often much lower. Hence useful energy consumption is only a fraction of final energy consumption and a still smaller fraction of primary energy consumption. However, the difference between primary and final energy consumption is large only where either power generation or human beings and animals are important suppliers of energy, for these three are relatively inefficient transformers of energy.

A. The picture . . .

A. The picture in 1970.

Aggregate energy consumption in 1970 in terms of all three concepts is summarized in Table I.1. As is to be expected, the primary energy estimates are dominated by human and animal labour. However, this dominance only implies that the calorific equivalent of the food eaten by human beings and animals is large in comparison to that of fuels consumed. This fact might be significant, for instance, if we are considering the relative advantage of more tractors and more animals. But as far as our present question of the contribution of oil to energy supply is concerned, it is the final or the effective energy consumption that is relevant.

TABLE I.1

AGGREGATE ENERGY CONSUMPTION 1970

	Primary energy		Final energy		Efficiency of use	Useful energy	
	KTJ	%	KTJ	%	%	KTJ	%
Commercial energy	2676	26.9	2191	35.4		664	47.6
Coal	1850	18.6	1388	22.4	20	278	19.9
Oil	805	8.1	636	10.3	45	286	20.5
Gas	21	0.2	10	0.2	60	6	0.4
Electricity	-	-	157	2.5	60	94	6.8
Non-commercial energy	3118	31.3	3583	57.9		524	37.6
Wood	2050	20.6	2021	32.7	15	303	21.7
Dung	-	-	471	7.6	10	47	3.4
Charcoal	-	-	23	0.4	30	7	0.5
Plant residues	468	4.7	468	7.5	10	47	3.4
Bagasse	600	6.0	600	9.7	20	120	8.6
Animate energy	4153	41.8	415	6.7		206	14.8
Human beings	691	7.0	69	1.1	40	28	2.0
Animals	3462	34.8	346	5.6	51	178	12.8
	9947	100.0	6109	100.0		1394	100.0

Source: Desai (1978)

Of the two, estimates of final energy consumption are more

reliable. . . .

reliable. Final energy estimates have by now been made for a large number of countries; their methodology is therefore well established, and their statistical basis is relatively firm. Useful energy estimates depend on efficiency parameters that are only approximate averages; hence they are subject to inevitable imprecision, and should be treated with great circumspection.

According to Table I.1, oil supplied only about 12 per cent of the final energy consumed; its contribution was appreciably less than that of coal among commercial fuels. But the picture in terms of useful energy was very different: oil supplied nearly a quarter of the useful energy. It was more important than coal or firewood, and twice as important as animal power. The difference is due to the relatively high efficiency in use of oil - over twice as high as that of coal and three to four times that of non-commercial fuels. The average efficiency in use of oil is low - 20-25 per cent - for industrial market economies (Economic Commission for Europe 1976: 64) because of the predominance of cars as oil users. They are, however, unimportant in India, where the proportion of gasolene in oil product consumption was only 7.5 per cent in 1970 (India 1974: 61); the major users of oil are industry, railways, trucks and rural households (Desai and Bhatia 1968). The Energy Survey Committee found oil to be 6.5 times as efficient as an equal weight of coal in competing uses (India 1965: 324). In view of the fact that fuels tend to be used where their efficiency is higher, we have assumed that oil was 2.25 times as efficient in use as coal on the average; its actual relative efficiency is probably higher and its share in useful energy consumption greater.

The share of oil in aggregate energy consumption understates its role for two reasons: oil-using sectors influence the level of activity in the rest of the economy, and other forms of energy cannot be substituted for oil without considerable loss of efficiency and consequent strain on alternative resources. Table 2, which gives 1970 energy consumption for four major sectors, will make this clearer. The figures for final energy and useful energy give different pictures; we shall concentrate on useful energy estimates which, imprecise as they are, portray more accurately the contribution of oil to energy ultimately

used as . . . . .

used as work, heat or light.

As Table I.2 indicates, the share of oil in useful energy consumption was about 8 per cent in agriculture as well as in industry. But it approached 60 per cent in transport, and 20 per cent in the residual sector, which is dominated by households.

TABLE I.2

ENERGY CONSUMPTION IN MAJOR SECTORS 1970

	Industry		Transport		Agriculture		Other		Total	
	KTJ	%	KTJ	%	KTJ	%	KTJ	%	KTJ	%
					A. FINAL ENERGY					
Coal	839	51.0	430	53.1	-	-	119	3.5	388	22.4
Oil	71	4.3	309	40.2	31	8.4	225	6.6	636	10.3
Gas	10	0.6	-	-	-	-	-	-	10	0.2
Electricity	111	6.8	5	0.7	14	3.4	27	0.8	157	2.5
Organic fuels	600	36.6	-	-	-	-	2983	87.4	3583	57.9
Manpower	10	0.6	1	0.1	51	15.9	7	0.2	69	1.1
Animal energy	-	-	12	3.0	272	73.9	51	1.5	346	5.6
	164	100.0	768	100.0	368	100.0	3412	100.0	6189	100.0
					B. USEFUL ENERGY					
Coal	168	42.3	86	35.8	-	-	24	4.1	278	19.9
Oil	32	8.1	139	57.9	14	7.6	120	17.6	286	20.5
Gas	6	1.5	-	-	-	-	-	-	6	0.4
Electricity	67	16.6	3	1.1	8	4.4	16	2.8	94	6.8
Organic fuels	120	30.2	-	-	-	-	404	70.4	524	37.6
Manpower	4	1.0	-	-	21	11.5	3	0.5	28	2.0
Animal energy	-	-	12	5.0	140	76.5	26	4.5	178	12.8
	397	100.0	240	100.0	185	100.0	574	100.0	1394	100.0
Aggregate energy-intensity (MJ/Rupee)	32.30		59.34		1.45				17.57	
Useful energy-intensity (MJ/Rupee)	7.87		19.27		1.12				4.14	

Source: Desai (1978)

The crucial . . .

The crucial importance of oil in transport is not surprising; what . . needs to be emphasized, however, is that it is not confined to road transport. India's railways are also heavily dependent on diesel oil, and their dependence has been growing. Diesel traction increased from 10 million to 103 million train-kilometres between F 1960 and F 1970, and accounted for 23.2 per cent of the total train-kilometres in F 1970 (India 1973 a). According to Indian railwaymen the efficiency of utilization of oil is 4½ times that of coal after allowing for the difference in thermal content (India 1974a: 6). The rate of advance of diesel traction has therefore depended less on relative prices than on the rate at which steam engines can be scrapped. This and related questions are further discussed in Chapter II.

The domestic sector uses kerosene oil for lighting and cooking. Its use for lighting is largely rural, for cooking mainly urban. As illuminant kerosene rapidly replaced vegetable oils in the late nineteenth century; from then until the second World War India was an important market for Russian, American and Anglo-Iranian kerosene over which a number of price wars were fought (Dasgupta 1971. 11-62). Today, kerosene as illuminant is a mass consumption good whose supply and price . are important policy variables for the Government of India. Kerosene supply has a great influence on the Government's decisions regarding refining capacity and imports; and its policy of keeping kerosene prices low leads to its being mixed with diesel oil and used in truck engines. The Government takes care to prevent kerosene shortages, and in spite of progressive increases in domestic refining capacity India has imported substantial quantities of kerosene in most years.

Looking at agriculture, it is interesting that commercial energy supplies nearly 20 per cent of its energy consumption. The final energy consumption of tractors in 1970 was probably no greater than 9-11 KTJ - almost certainly less than 5 per cent of total agricultural draught power, although it was rising rapidly. But diesel and electric pumps lifted 40 per cent of water from wells and tube-wells even on the assumption that the wells powered by animals and by pumps had the same rate of water delivery. Since the capacity of pumps is generally greater, it is possible that they supplied something like 60 per cent of water from minor irrigation works (Bhatia 1975: A1, A4). Nor are

traction and irrigation the only activities where Indian agriculture increasingly depends on oil. Farmyard manure consumption supplied it with about 500,000 tons of nitrogen in 1970; commercial fertilizer consumption in that year was 1.5 million tons of nitrogen (Food and Agricultural Organization 1974: 260). Thus in respect of both major ways of increasing land yields, irrigation and fertilizers, Indian agriculture was heavily and increasingly dependent on commercial energy and particularly on oil.

Thus, oil is put to such crucial uses in the agricultural, transport and domestic sectors that it is difficult for the Government to restrain its consumption. Its curbs have thus been restricted to two areas. One is personal transport, where constraints on the expansion of car output, taxes on cars and on petrol have together been used to keep down car ownership. The other is the industrial sector, where permission to use furnace oil is given selectively. Basically, the use of oil is allowed only if the use of coal instead is technically impossible or undesirable, as in glass, china or certain chemicals. In addition, some industries on the west coast to which the transport of coal is costly and faces bottlenecks are allowed to use oil; textiles, which have used oil since early times, are the major such industry. The curbs on the use of oil have, however, led industries to use not so much more oil as electricity; industries use over two-thirds of the power output, and the growth of their demand is among the major reasons for almost endemic power shortages. Power generation in its turn relies on oil for start-up and low-load operations.

In brief, oil plays a larger role in the Indian economy than is suggested by its share in aggregate energy consumption. Its importance to road as well as rail transport makes all other sectors dependent on it, including agriculture in which significant as subsistence production might be, at least half the output (in terms of value) enters the market. Further, the technologies on which growth in the productivity of agricultural land depends, namely irrigation and fertilizers, rely heavily on oil. Finally, oil enters the consumption of the poorest families as kerosene for lighting. Thus, precisely because oil consumption has been restricted, it is concentrated in

the most crucial areas of the economy.

B. Changes since 1955

It is impossible to say anything about changes in non-commercial energy over the years since reliable data are lacking; we shall therefore confine the analysis to commercial energy forms, namely coal, oil, gas and electricity. Their final consumption in selected years from 1955 to 1975 is given in Table I.3. It will be seen that while all other forms gained at the expense of coal, electricity did so most rapidly, while oil gained more slowly. Electricity consumption rose almost eightfold in the 20 years, while oil consumption quintupled and coal consumption rose nearly two and a half times. Total commercial energy consumption nearly tripled. NDP almost doubled in the same period; its energy intensity thus grew about 50 per cent.

TABLE I.3

COMMERCIAL FINAL ENERGY CONSUMPTION 1955-1975

	Unit	1955	1960	1965	1970	1975
		Original units				
COAL	Mill. t.	28.8	40.4	51.8	51.4	70.0
OIL	"	4.8	7.5	11.7	17.6	22.1
Light fractions	"	0.9	1.1	1.3	2.5	
Middle fractions	"	2.4	4.1	6.1	8.9	
Heavy fractions	"	1.5	2.4	4.3	6.2	
GAS	Bill. cbm.	-	-	0.3	0.7	1.2
ELECTRICITY	Bill. kwh.	7.1	14.0	26.7	43.7	55.0
Thermal	"	4.9	9.1	17.8	28.2	40.1
Nuclear	"	-	-	-	2.4	2.2
Hydro	"	3.7	7.9	15.2	25.2	27.9
Less losses	"	-1.5	-3.0	-6.3	-12.1	-15.2

KTJ

	Unit	1955	1960	1965	1970	1975
				KTJ		
COAL		778	1091	1399	1388	1890
OIL		201	319	498	747	939
GAS		-	-	5	10	19
ELECTRICITY		26	50	96	157	198
FINAL ENERGY CONSUMPTION		1005	1460	1998	2302	3046
				Per cent		
COAL		77.4	74.7	70.0	60.3	62.1
OIL		20.0	21.8	24.9	32.5	30.8
GAS		-	-	0.3	0.4	0.6
ELECTRICITY		2.6	3.4	4.8	6.8	6.5
		100.0	100.0	100.0	100.0	100.0

Source: Desai (1978)

The rise in energy intensity is to be expected in an economy whose structure is changing in favour of more energy-intensive sectors like industry and transport. In India, however, the rise in energy intensity seems to owe less to structural change than to a rise in sectoral energy intensities. As Table I.4 indicates, about three-fifths of the rise in energy consumption in 1955-70 was due to an increase in NDP and the rest to a rise in its energy intensity. Of the latter, nearly a half was due to the rise in the energy intensity of industry and agriculture. Considering the indeterminate but possibly sizeable rise in the energy intensity of the domestic sector, structural change could have accounted for only 10-15 per cent of the rise in its energy intensity and much less than half of the rise in overall energy intensity, which owed most to the rise in the energy intensity of industry.

The rise in commercial energy intensity in agriculture and the domestic sector may not reflect any rise in their total energy intensity but may signify the substitution of commercial for non-commercial energy. Since both sectors are insignificant users of coal or gas, the commercial substitutes for non-commercial energy in their case are oil and electricity. However, in both sectors electricity was a

superior substitute . . . .

superior substitute for oil and is likely to have gained more. In irrigation where commercial energy use has been substantial, electric motors have lower capital and running costs than diesel pumps; for domestic lighting electricity provides a superior source to kerosene. Kerosene is also used for domestic cooking, but it is not clear whether the predominant use of organic fuels there has declined. Sectoral developments are discussed in more detail in Chapter II.

It is instructive to compare the growth of oil consumption in India with that in Western Europe, which has a similar pattern of fossil fuel resources. In 1955, Western Europe got three times as much energy from coal as from oil, while India got four times as much. By 1970 the proportions were reversed in Europe; in India, on the other hand, oil still supplied only half as much energy as coal. This was in spite of the faster growth of energy consumption in India, which should have facilitated a switch in fuels by reducing the need for conversion of coal-using equipment to oil. Why then was the changeover to oil so much slower in India? The answer emerges from a comparison of Table I.2 with Table I.5. Whilst only 4 per cent of the industrial energy consumption in India consisted of oil products in 1970, the proportion was 46 per cent in Europe. European railways had almost entirely given up coal, and 96 per cent of the energy consumed in transport came from oil; in India, coal still supplied more than half. In other sectors, 65 per cent of the commercial energy used in India came from oil, against 54 per cent of Europe; but commercial energy usage in agriculture and the domestic sector was so small in India that it made little difference overall. Briefly, oil had made much smaller inroads into the energy market in Indianindustry and in rail transport than it had in Europe. The reason lay in India's low import capacity and hence her capacity to consume oil.

Table I.4. . .

TABLE I.4

Sources of growth in commercial energy consumption
1955-1970

	Industry	Transport	Agriculture	Other	Total
			KTJ		
Growth of NDP	312	302	9	131	754
Structural change	85		-4		
Change in energy intensity	223	45	28	166	543
	620	347	33	297	1297
			Per cent		
Growth of NDP	24.0	23.3	0.7	10.1	58.1
Structural change	6.5		-0.3		
Change in energy-intensity	17.2	3.5	2.2	12.8	41.9
	47.7	26.8	2.6	22.9	100.0

Source: Desai (1978)

It is, of course, misleading to aggregate oil products as if they were fully substitutable; Table I.6 will help to correct this impression and clarify India's oil problem. The bulk of the demand in India, or the demand which carried weight from the policy-making point of view, was for middle distillates - kerosene for households and diesel oil for road and rail transport and agriculture - and Indian refineries used their flexibility to maximise their proportion. The proportion of middle distillates in refinery output was 50 per cent - far higher than in Western Europe or the USA. Owing to the small fleet of cars, on the other hand, the demand for gasolene was low, and its cut in refinery yield was only a third of the corresponding proportion in the States. A third of the output consisted of fuel oil, lubricants and other heavy ends. In Western Europe, on the other hand, the most profitable product was gasolene, which therefore determined capacity. After the demand for middle distillates - mainly diesel oil- was met,

almost a half of the output was left at the heavy end, most of which was sold to industry as fuel. In the United States, car ownership was even more widespread and gasolene consumption more important than in Western Europe; if all the demand for gasolene had been met by simple refineries it would have resulted in a large unsaleable surplus of heavy distillates. Hence much of the output of middle and heavy distillates was cracked and reformed to yield gasolene.

Apart from the 20 million tons of products refined in the country, India imported a further 3 million tons in 1974, of which 1.2 million tons were middle distillates, mainly fuel oil. Since 1974 was a year in which both oil and foreign exchange were in short supply, the import of fuel oil underlines the priority given to industries in which it is used and to the difficulty of replacing it by coal.

TABLE I.5

OECD Europe. energy consumption in major sectors 1970

	Industry		Transport		Other		Total	
	KTJ	%	KTJ	%	KTJ	%	KTJ	%
Coal	3761	29.7	105	1.8	2520	22.5	6386	21.5
Oil	5807	45.8	5609	96.3	6071	54.2	17487	58.9
Gas	1213	9.6	4	0.1	1165	10.4	2382	8.0
Electri-city	1890	14.9	107	1.8	1455	12.9	3452	11.6
	12671	100.0	5825	100.0	11211	100.0	29707	100.0

Source: OECD (1976): 51.

Table I.6 . . . . .

TABLE I.6

Demand and yield pattern of oil products in India, Western Europe and the USA 1974

	Gasolenes	Middle distillates	Others	Total
		(Million tons)		
India				
Consumption	3.273	11.178	8.304	22.755
Less Imports	-0.081	- 1.247	-1.627	- 2.955
Add Exports	0.139	0.115	0.018	0.272
	3.331	10.046	6.695	20.072
		(per cent)		
Refinery yields				
India	16.5	50.0	33.4	100.0
W.Europe	21.0	33.0	46.0	100.0
U.S.A.	48.0	28.0	24.0	100.0

Source: India (1975a): 59, 60. Tiratsoo (1976): 21

II. Consumption . . .

II CONSUMPTION PATTERN OF OIL PRODUCTS

At the end of the last chapter we showed the large share of middle distillates in Indian oil consumption, with heavy fractions following. In this chapter we shall take a more detailed look at the consumption of oil products, which is summarized for the years 1955-1977 in Table II.1.

A. Naphtha

The product whose consumption has risen fastest in recent years is naphtha. Prior to the development of petro-chemicals there was no demand for it. Since 1964, however, its use as feedstock for fertilizers was encouraged by the Government, and consumption rose rapidly. In the early seventies the demand for it exceeded supply; the Government consequently ordered new fertilizer plants to use fuel oil as feedstock. In 1973, 266,000 tons of fuel oil was consumed by the fertilizer industry in addition to 1,044,000 tons of naphtha. The fall in gasoline consumption after 1974 described below, permitted an increase in naphtha output, which rose by 350,000 tons between 1973 and 1975; naphtha offtake by the fertilizer industry rose by 400,000 tons, and fuel oil offtake by 90,000 tons (India 1977b). The increase in feedstock supply raised nitrogenous fertilizer output from 1.1 million tons in 1973 to 1.5 million tons in 1975 and further to 2 million tons in 1977. The rise in output enabled the Government to cut fertilizer imports in F1976. When consumption began to lag behind output in F1976, the Government introduced a subsidy. Prices were further reduced in October 1977. While the naphtha offtake of the petrochemical industry remained in the neighbourhood of 400,000 tons, the growing demand from the fertilizer industry raised naphtha consumption from 1.5 million tons in 1973 to 1.8 million tons in 1975 and 2.3 million tons in 1977.

B. Gasolene

The demand for gasolene, the next most important light distillate, has grown relatively slowly. The reasons for the slow growth can be inferred from Table II.2, which gives the number of gasolene-using vehicles from F1955 onwards together with their probable gasolene consumption profile in 1970. Over the years, the composition of vehicles

has changed . . .

has changed steadily so as to reduce the average fuel consumption per vehicle. At one end, the number of gasolene-using trucks and buses declined as the number of diesel carriers grew. At the other end, the number of two-wheeled vehicles rose rapidly relatively to cars among personal vehicles. Among two-wheeled vehicles, the share of the more economical scooters gained at the expense of motor cycles.

Retail prices of gasolene rose from Rs.1.44 a litre in 1972 to Rs.3.20 in 1974. The rise was so large that vehicle owners cut down mileage; gasolene consumption fell from 1.61 million tons in 1973 to 1.26 million tons in 1974. There was a sharp drop in the sales of cars

and jeeps . . . .

TABLE II.1

CONSUMPTION OF OIL PRODUCTS 1955-75 1/

(Million tons)

	1955	1960	1965	1970	1975	1976	1977
Light distillates	1.0	1.1	1.3	2.5	3.5	4.0	4.2
Naphtha	-	-	n	0.8	1.8	1.1	2.3
Gasolene	0.9	0.9	1.1	1.4	1.3	1.3	1.4
LPG	-	n	n	0.2	0.3	0.4	0.4
Other	0.1	0.1	0.2	0.1	0.1	0.1	0.1
Middle distillates	2.5	4.1	6.1	8.9	11.5	12.4	13.4
Kerosene	1.4	1.9	2.5	3.3	3.0	3.3	3.5
Aviation fuel	0.1	0.2	0.5	0.7	0.9	0.9	1.0
High-speed diesel oil	0.5	1.2	2.3	3.7	6.6	7.0	7.6
Light diesel oil	0.4	0.6	0.7	1.1	0.9	1.0	1.1
Other	0.1	0.1	0.1	0.1	0.1	0.2	0.2
Heavy distillates	1.3	2.4	4.3	6.2	7.2	7.3	7.5
Fuel oils	0.7	1.7	3.2	4.7	5.8	5.7	5.8
Bitumen	0.2	0.4	0.6	0.8	0.7	0.8	0.9
Other	0.4	0.3	0.5	0.7	0.7	0.8	0.8
Total	4.8	7.8	12.3	18.7	22.2	23.7	25.1

1/ Errors are due to rounding.

Sources: India (1965): 274-75, India (1974a): 61, India (1976b): 11
India (1976c) India (1978b): 48

Table II.2 . . . . .

TABLE II.2

Gasolene-using vehicles F1955-76 and Gasolene Consumption F1970[a]

	Number of vehicles (000)						Annual gasolene consumption per vehicle[c] (tons)	Gazolene consumption (1970) (Mill.t.)
	1955	1960	1965[b]	1970	1975	1976		
Motor cycles, scooters and rickshaws	41.0	94.6	241.7	608.7	(1200.0)	(1400.0)		
Motor cycles	41.0	88.4	81.2	572.1			0.260	0.149
Scooters			144.4					
Rickshaws	-	6.2	16.1	36.6			1.064	0.039
Cars, taxis and jeeps	203.2	309.6	455.9	669.7	(855.0)	(890.0)		
Estate and large cars	187.9	256.2	32.3	533.8	(740.0)	(765.0)	1.258	0.672
Small cars			326.9					
Taxis	15.3	22.7	35.7	63.6				
Jeeps	-	31.7	61.0	72.3	(115.0)	(125.0)	2.146	0.155
Large carriers	(154.0)	115.8	103.4	(130.0)	(170.0)	(180.0)		
Light trucks	(105.0)	68.5	32.0	(24.0)	(10.0)	(5.0)	3.627	0.087
Heavy trucks			14.4					
Buses	(34.0)	17.6	11.0	(106.0)	(160.0)	(175.0)	5.672	0.034
Others	(15.0)	29.7	46.0				1.556	0.156
Gasolene consumption of vehicles								1.292
Non-vehicular and defence								0.118
								1.410

[a] Figures in brackets are estimates based on registrations, output, imports, exports and scrap rates.

[b] Registration figures for (1) motor cycles and scooters, (2) large and small cars, (3) light and heavy trucks have been divided in the same proportions as the end-of-calendar-year figures estimated by NCAER (1971)

[c] Same as 1967 estimates (NCAER 1971: 78-79). Figures for (a) motor cycles and scooters, (b) large cars, small cars and taxis weighted by their 1967 proportions 1.4 kl of gasolene assumed to weigh 1 ton (India 1969: 63).

Sources: National Council of Applied Economic Research (1971: 63, 66, 74, 78-79). India (1975a: 264). India (1971b;

and jeeps from 55,000 in 1973 to 47,000 in 1974 and 31,000 in 1975 (Table II.3). Office workers in major cities began to share cars. In some cities which permitted private bus services (for instance Calcutta) mini buses built on jeep chassis were introduced; whilst the number of mini buses is not known, much of the increase in the number of large personnel carriers from 106,000 in 1970 to 175,000 in 1976 was accounted by them. In some cities (for instance Delhi) employees began to charter buses. The capacity utilization of such buses, used only to transport employees and school children, is low; but for people who earlier travelled by car or scooter, chartered buses nevertheless reduce costs, and a shift to them has reduced gasolene consumption.

The rise in gasolene prices led to a shift in the demand for cars: a buyers' market developed in Hindustan cars while Fiat cars (later renamed President), which had a higher fuel efficiency, continued to be in short supply. But the difference in fuel efficiency was not large enough, nor was the supply of different models elastic enough to restructure the market significantly towards smaller or more efficient cars.

More important than shifts in demand within the personal carrier market was the move from cars to scooters. While car sales fell drastically between 1973 and 1976, scooter and motor cycle sales rose from 127,000 in 1973 to 225,000 in 1976. In 1970 there were nearly as many cars as scooters on the roads; by 1976 there were almost twice as many scooters and motor cycles as cars.

Bicycle sales show no response to the rise in oil prices; on the contrary they fall in 1974 and 1975 The distances between the place of work and residence in Indian cities as well as climatic conditions make bicycles an inferior alternative to buses or scooters.

C. LPG

The sales of liquid petroleum gas were unaffected by the rise in prices; they rose steadily from 263,000 tons in 1973 to 356,000 tons in 1976. Over three-quarters of the LPG consumed is used for domestic cooking. It is the preferred urban fuel, cheaper than kerosene or electricity, and there is considerable excess demand for it. constrained by the shortage of gas cylinders. The rise in LPG sales thus largely reflects

an increase . . .

an increase in the supply of cylinders.

D. Kerosene

The most important among middle distillates is high-speed diesel oil (hsd). From 1957 till the end of 1973 kerosene bore lower taxes than hsd; consequently it was mided clandestinely with hsd. Hence official estimates understate the fuel consumption of vehicles and overstate kerosene consumed by the domestic sector. The quantity of kerosene diverted was estimated by the National Council of Applied Economic Research to be 800,000 tons in 1967 (NCAER 1971).[1/] A similar calculation for 1970 that we have made (Table II.4) gives a figure of 1.6 million tons. The prices of kerosene and hsd were equalized in November 1973; between 1973 and 1974, kerosene consumption fell by 600,000 tons. Thus, while the estimates vary considerably, anything between 600,000 and 1.6 million tons of kerosene was mixed with hsd and used in vehicles in the late sixties and early seventies.

Since 1974, some kerosene has often been mixed with petrol. It is not so close a substitute for petrol than for hsd, and cannot be mixed in the same proportion. There is no estimate of the quantity, but according to informed distributors it probably does not exceed 10 per cent of petrol consumption, or 120,000 - 150,000 tons. Apparently kerosene is more commonly added to the fuel used by scooters which might have consumed 300,000 - 350,000 tons a year by the mid-seventies.

Owing to the diversion to vehicular use, it is difficult to be definite about the non-vehicular offtake of kerosene, which is almost entirely domestic. But it looks as if, after a rapid increase in the fifties and early sixties, domestic kerosene consumption stabilized in the neighbourhood of 2 - 2.5 million tons, but started to rise again in the seventies towards the current annual rate of 3 - 3.5 million tons. The rise in prices after 1973 does not seem to have arrested the rise in offtake.

The major part of kerosene consumption is in rural domestic lighting; a small proportion is used for cooking, mainly in urban areas. The change in the trend of consumption is probably explained

1/ In addition to the excess of 323,000 tons of consumption by trucks and buses over hsd sales, 465,000 tons was used by tractors and irrigation pumps according to NCAER.

by the . . . . .

TABLE II.3

OUTPUT OF SOME ENERGY-USING DEVICES

	1971	1972	1973	1974	1975	1976	1977
Cars and Jeeps	50,268	52,128	55,248	46,812	31,416	38,556	47,862
Cars	39,240	39,540	42,180				
Buses & trucks	40,608	37,428	42,288	39,000	38,000	42,324	36,628
Diesel buses	10,440	8,580	9,120				
Diesel trucks	23,652	21,288	24,084				
Tractors	16,452	17,460	23,532	29,064	32,388	36,672	33,156
Motor cycles & scooters (000)	107	111	127	140	171	225	223
Bicycles (000)	1928	2,245	2,543	2,494	2,209	2,644	3,083
Stationary diesel engines (000)	84	73	134	110	140	107	131
Electric pumps (000)	204	266	338	265	289	248	
Light bulbs and tubes (million)	123	140	138	145	146	183	175
Hurricane lanterns (000)	2,712	3,468	2,388	2,856	1,860	2,196	2,410
Battery cells (million)	551	618	602	634	545	599	632
Radios (000)	1,956	1,920	1,656	2,064	1,524	1,680	1,806

Sources: India (1975b; 1976b; 1977a; 1977b; 1977c).

by the decline of kerosene as an illuminant and a rise in its consumption for cooking.

E. Rural lighting

In rural domestic lighting the substitutes for kerosene (if we exclude the traditional vegetable oils, especially castor oil and coconut oil, whose use as lighting materials virtually ceased at the turn of the century with the arrival of cheap Russian kerosene) are dry cell torches and mains electricity. Electricity is of course the preferred substitute; but it is only available to those who have a connexion, and is expensive. However, there seems to have been a considerable movement from kerosene to torches in the last 15 years. The output of hurricane lanterns was over 5 million in the fifties and early sixties; in 1975-1977 it was 2.2 million. The output of battery cells went up in the same period from 200 million to 600 million. The change is very evident to air travellers. In the fifties a flyer could spot a village from the oil lamps twinkling at night. Electric torches can, however, be switched on and off at will (which is why lighting by torches is cheaper than by kerosene lanterns); villages therefore show fewer lights today.

But lights have begun to reappear - electric this time. For since the mid-sixties there has been a powerful drive to take electricity to villages. The proportion of villages connected to the power system was about a third in 1975 (India 1976a: 641-42). The population covered would be higher since larger villages got power first; but the proportion of population getting electricity in villages would be below 100 per cent. Nevertheless, an appreciable proportion of the rural population has acquired electric lighting, mainly in the last ten years, and has abandoned kerosene as an illuminant. The output of battery cells has stabilized around 600 million in the seventies despite the new demand from transistor radios (transistors cheapened radios and freed them from mains connexions; consequently their output went up from about 200,000 a year in the late fifties to 1.5 - 2 million a year in the seventies). The output of electric bulbs, about 30-40 million in the late fifties, was 120-140 million in the early seventies and reached 180 million in 1976 (Table II.3)

Table II.4 . . . . .

Number of HSD-using Prime Movers 1955-76 and Consumption of HSD-Kerosene F 1970[a]

	Number of prime movers (000)						Annual HSD consumption per mover[b] (t)	HSD-Kerosene consumption '70 (Mill t)
	1955	1960	1965	1970	1975	1976		
Trucks	17.0	106.3	220.3	(310.0)	(400.0)	(420.0)	8.944	2,773
Light		3.9	14.0					
Heavy		102.4	206.3					
Buses	10.0	40.2	63.5	(85.0)	(125.0)	(135.0)	12.911	1,097
Small		17.7	31.1					
Large		22.5	32.4					
Other vehicles	-	6.9	21.7	(50.0)	(75.0)	(80.0)	4.771	239
Tractors	21.0	31.0	54.0	(100.0)	(250.0)	(290.0)	3.070	307
Irrigation pumps	122.5	230.0	449.1	(750.0)	(1500.0)	(1700.0)	0.753	565
Railway engines								466
HSD consumption								5,447
Kerosene consumption								1,558
								7,005

[a] As for table II.3

[b] See table II.3, footnote c.

Source: National Council of Applied Economic Research (1971: 22, 74, 87, 88). India (1975a: 58, 264).

F. Domestic cooking

In domestic cooking, organic fuels - firewood, dungcakes and straw - have been dominant (Table I.1). Among commercial fuels, coal was used in eastern India near the coal mines (Table II.1). Kerosene had only a minor use in cooking, most of it being used for lighting. However, it seems to have become increasingly popular in the seventies. The impelling factor was probably the growing scarcity and rising price of firewood. But cost apart, urban households have apparently become more convenience-conscious. They were made so initially by the advent of bottled LPG in 1968. By April 1976 there were 2.4 million domestic LPG consumers with 4 million cylinders; a population of over 12 million, largely urban, was thus using gas as the domestic fuel.[1/]

After 1972, however, there was growing excess demand for LPG. In Delhi alone 130,000 people were on the waiting list for LPG at the end of November 1977; the number added to consumers in April-November 1977 was 3,000, and oil companies were refusing to add any more to the waiting list. In the circumstances, it is possible that frustrated applicants for LPG turned to kerosene as the available convenience fuel. The switchover to kerosene was also stimulated by the introduction in the market of new kerosene stoves that were less dangerous and more fuel-efficient than the standard primus stove.

G. HSD

Table II.4 gives the trend in the number of prime movers using hsd from 1955 together with the probable breakdown of the consumption of hsd and kerosene in 1970. As we remarked in the previous section, hsd-using prime movers also used appreciable quantities of kerosene. Despite that, hsd consumption has grown rapidly in the last 20 years; the proportion of hsd in total product consumption rose from 10 per cent in 1955 to 30 per cent in 1977. Substitution has worked in favour of hsd in a number of different ways. Road transport has gained in relation to railways; within road transport petrol engines have given way to diesel engines in large trucks and buses. In irrigation, hsd-driven pumps have gained in relation to those using light diesel oil (ld). In railways, diesel traction

1/ This and subsequent information on domestic users of LPG was given in answer to questions in Parliament during 1977.

has replaced . . .

has replaced steam traction. In irrigation as well as railways, however, diesel has a third competitor, namely electricity.

H. Irrigation

In irrigation, electricity is a superior substitute for diesel as well as kerosene at current market costs: an electric pump costs less than a diesel pump, its running costs are lower and it is easier to maintain and repair. But power distribution costs are not fully charged to rural consumers; hence on equal terms electricity would be somewhat less attractive than it is under present conditions. The official view is that electricity is preferable to diesel oil since it is produced from home-mined coal while diesel oil is obtained from imported crude. The supply of electricity for pumps is a major force behind the rural electrification drive, and the number of pumps "energised" - that is, connected to the power network - is a statistic of considerable policy interest and has shown phenomenal growth. From 56,000 in 1955, the number of energized pumps rose to 200,000 in 1960, 500,000 in 1965, and 1.6 million in 1970; in 1975 it was in the neighbourhood of 3 million.

I. Railways

In railways there was some electrification, especially of suburban lines in Bombay and Calcutta, starting from 1925, but coal was the dominant fuel. The post-war international trend towards diesel and electric traction was hardly noticed, and a factory was built with a capacity of 168 steam engines a year in 1950 (India 1971a: 27).

However, by the late fifties, as the growth of heavy industries gathered pace, bulk traffic grew rapidly, especially in the coal-steel belt of West Bengal, Bihar, Orissa and MP, and the resulting traffic congestion could be relieved only by construction of more lines or introduction of faster electric or diesel engines. The latter solution was much the cheaper one. Chittaranjan Locomotive Works, built initially to make steam engines, began to make electric engines as well from 1955. But introduction of electric engines required extensive track facilities for transmission of power and was highly capital-intensive. It was therefore economical only after traffic had risen

over a . . . . .

over a certain threshold level. Besides, track electrification took time; the only short-term solution was to introduce diesel engines, which could replace steam engines at all traffic levels and with little additional investment on the track. Hence about 400 diesel engines were imported, and finally a new diesel engine factory was built in 1963 with a capacity of 150 engines.

By the sixties it was doubtful whether steam engines were economical for any traffic except shunting; but to utilize capacity and labour, the railways continued to build steam engines till 1971. The stock of steam engines went down slowly through attrition; but neither the rate of attrition nor the growth of traffic could accommodate all the diesel and electric engines that could be produced, and their production capacity was grossly underutilized.

According to a 1970 study (National Council of Applied Economic Research 1970), a cost comparison of diesel and electric traction based on actual prices except for diesel oil whose price was taken net of taxes favoured diesel traction up to the highest traffic density levels on Indian railways; if diesel oil was priced inclusive of taxes which exceeded 200 per cent of its net cost, the breakeven point came to 15-20 million gross ton-kilometres a year, reached only on certain tracks in heavy use. The rate of interest was taken to be 6 per cent; more realistic interest levels would have been still more favourable to diesel traction. Railways generally preferred assumptions that were more favourable to electric traction and derived a lower breakeven point of 8-9 million gtkm (India 1971a: 15).

Within three years of the close-down of steam engine production came the rise in oil prices. Traffic also stagnated after 1972 (India 1976b: 21), and absorption of diesel and electric engines slowed down. The introduction of electric engines depends on electrification of tracks which is subject to long lags; so between the two options left to the railways, there can be no significant shift from diesel to electric traction up to F 1978. But the Fuel Policy Committee (India 1974a: 71) recommended accelerated electrification; railways' diesel oil consumption, currently approaching 700,000 tons, would rise to 800,000 tons by late eighties and then stabilize as electric traction takes over increasing traffic. Electrification will increase capital-intensity,

not only . . . .

not only on account of investment by railways, but also owing to the greater investment required in power stations than in refineries per unit of useful energy.

Railways compete as carriers and as users of diesel oil with road transport, and one may ask what effect the rise in oil prices did or would have on road-rail competition. As in other countries, railways in India had lost much traffic, especially high-rated traffic, to road transport. The railways' view of road transport is understandably dim. They point out, for instance, that they need only 4 litres of diesel oil to carry 100 ton-kilometres, while road transport uses 24 litres (India 1971a: 16). Road transport employs more people per unit of traffic (National Council of Applied Economic Research 1960b); but this really means that the railways make more efficient use of labour as well as fuel. Whilst their absolute investment requirements are large, it is doubtful whether railways need more investment per unit of carrier capacity than road transport. Thus, the railways apparently make more efficient use of almost all major inputs.

And yet railways have been the losers in competition. The reasons usually given hold little substance. Taxation is, if anything, much heavier on road transport than on railways; and whatever may have been the situation once, road transport more than pays for roads in taxes. And whilst roads do carry the more valuable, high-rated traffic, the railways can, if they wish, compete for it. Although railway rates on such traffic might have been too high once, rate changes over the years have given them ample opportunities to adjust the rates. Railway rates do by and large reflect their costs; high-rated mixed traffic is more expensive for them to carry than low-rated bulk traffic.

The reason why railways make losses is two-fold; the lumpiness of their investment makes the minimum economic traffic between any two of their terminal points high, and their capital-intensity raises their breakeven point. This means that there are only a limited number of points in the country that generate sufficient traffic to sustain railways. Even in their heydey, most of the railways' traffic moved between a small number of ports and an equally small number of inland

assembly points . . . .

assembly points. Even the small area of the country accessible by railways does not generate enough volume of traffic to utilize sections of them adequately; extension of transport facilities can therefore only come through road transport which has a much lower breakeven point. Road transport is a relatively small-scale, high-cost industry that caters to small pockets of demand. And as the emergence of small buses and trucks shows, a further reduction in its scale has a market to exploit even though it may raise average costs.

A rise in oil costs raises road costs more both because fuel costs form a higher proportion of costs and because road transport depends more on oil than railways; the relative costs should therefore change in favour of railways. But given the distribution of transport demand, the markets for road and rail transport have a limited overlap, and little diversion of traffic can be expected as a result of the change in costs. The sparse evidence available shows none. As mentioned earlier, railway traffic declined in 1974; its recovery in 1976 was due to increased movement of bulk commodities like ores, iron and steel, cement and sugar which are not carried by road.

In the longer run, if there is a large and lasting change in relative cost of road and rail transport, it could affect location patterns: it could reverse the twentieth-century trend towards dispersal of industries and growth of second-rank cities, and favour the growth of a handful of megalopolises. But such a change would take decades to become evident.

J. Fuel oil

There is a range of heavy distillates with widely varying specific gravities. At the heavier end there are thick and viscous products with end uses as lubricants or in road construction, and the heaviest ones are solid wax and petroleum coke. If we exclude those products, most of what remains is fuel which, unless further processed, is only good for burning furnace oil.

Furnace oil has two advantages over coal. First, it is easier to transport and handle, being a liquid; and it leaves residue on burning. Second, it is a more concentrated fuel. It can give a higher

temperature and . . .

temperature and more heat in less space, accelerate combustion and hence give a greater output from the same burning equipment. However, its high sulphur content causes air pollution when used in large quantities. It has two particularly common uses. In blast furnaces, it saves on metallurgical coke and raises the output of pig iron; and in power generation, it facilitates the raising of steam at low loads and increases the range of capacity utilisation.

Fuel oil consumption rose rapidly till 1970: it grew more than two-fold in 1955-60, nearly doubled again in 1965, and grew another 50 per cent in 1970. The impetus came from growing refinery output. As Indian refineries lacked reforming and visbreaker facilities, heavy oils could not be converted into lighter products, and the only use for them was as industrial fuel. Oil companies developed markets for them in a wide range of industries. The user industries fall into five major groups (Table II.5).

(a) Industries where the cleanness of furnace oil helps: While coal burning leaves a great deal of ash, oil burns cleanly; this can make a difference to the quality of the product where the raw materials and the fuel are mixed together. The non-metallic industries - cement, glass, ceramics and refractories - are important examples. Many chemical industries - synthetic fibres, dyestuffs and fertilizers for instance - use oil for the same reason.

(b) Dispersed industries: A number of agriculture-based industries are dispersed in the countryside and small towns, and find oil more convenient owing to its ease of transport. They also generally find oilburning equipment cheaper and more compact. Among such industries are tea, sugar, vegetable oils and hydrogenated oil.

(c) Energy-intensive industries: The energy consumption of these, mainly metallurgical industries is so heavy that even marginal use of oil can result in a large absolute level of consumption. Among them are iron and steel, castings, forgings, pipes, tubes and non-ferrous metals.

(d) Industries near the west coast: These industries which are remote from coal mines and near to the major refineries, have been

the earliest to use furnace oil. Chief among them are cotton textiles and rayon.

(e) Marine transport: The smaller the oil engine, or the higher its power output per unit of volume, the lighter the fuel it uses. Engines of ships are large enough to run on fuel oil, and coastal and international navigation is an important user of oil.

In the late sixties, the surplus of fuel oil disappeared. A shortage of refining capacity developed as a result of a hiatus in investment. The shortage affected the fuel oil output more because with the erection of naphtha-based fertilizer plants, the demand for light distillates went up and the proportions of middle and heavy fractions were cut. The share of fuel oils in refined products went down from 28.4 per cent in 1966 to 24.7 per cent in 1970. The demand for fuel oil had, however, gathered momentum, and could only be met by imports, which rose from virtually nothing in 1968 to over 2 million tons in 1973.

When oil prices rose in 1973 and 1974, the Government relied largely on the consequent rises in product prices, reinforced by taxes, to restrain consumption. Oil costs of industries, however, constituted only a small proportion of their total costs, and it was feared that their demand for fuel oil was inelastic. At the same time the scope for the substitution of coal for oil was thought to be the highest in industry. Hence the Government introduced physical allocation of fuel oil. A standing committee on furnace oil was set up for the purpose. Initially users' quotas were fixed at the level of their 1973 level; then cuts were imposed based on a judgment regarding the possibilities of substitution. A firm could get a higher allocation if it made a case that it needed more fuel oil for exports, for import substitution or to cater to defence demand. New firms had to be recommended by one of the designated sponsoring authorities for their application for a quota to be considered. A consultancy group was also set up to study individual firms' fuel consumption and suggest ways of reducing fuel oil consumption.

It is difficult to judge the success of the Government's policy. Detailed figures of sectoral consumption are available only till 1975

(Table II.5) . . . .

TABLE II.5

Sectoral Consumption of Fuel Oil, 1970, 1973 and 1975

	Fuel oil consumption (thousand tons)			Sector output				Oil input-output ratio			
	1970	1973	1975	Unit	1970	1973	1975	Unit	1970	1973	1975
AGRICULTURE	178	222	144								
INDUSTRY	2728	3610	3264								
Iron and steel	311	439	324	000 t	4820	4810	5314	$/1000 t	64	91	58
Cement	129	204	74	"	13956	15812	16236	"	9	14	5
Fertilizers	90	266	356	"	763	1056	1188	"	118	252	300
Aluminium	91	110	115	"	161	154	167	"	565	714	689
Sugar	39	59	46	"	3744	3820	4646	"	10	15	10
Textiles	590	650	590	Index	100	104	101	Index	100	106	99
Chemicals	493	795	796	"	100	128	132	"	100	126	123
Engineering	318	361	295	"	100	122	127	"	100	93	73
Ceramic and glass	155	219	171								
Other	512	507	497								
TRANSPORT	482	418	363								
Road transport	3	3	3								
Railways	55	61	53	m.train-km	35	36	36	t/mill.t	1590	1704	1464
Waterways	198	205	170								
Bunkers	226	149	137								
MINING	45	35	181	Index	100	107	128	Index	100	73	314
POWER	1216	1648	1853	m.MWH	55800	66324	70128	t/MWH	22	25	26
	4651	5933	5805								

Sources: India (1977c); India (1977d).

They show a fall in oil consumption per unit of output in most industries and quite substantial falls in iron and steel, cement, sugar and railways. But three sectors increased their oil input-output ratios substantially, namely fertilizers, power and mining.

Fuel oil was used only as fuel in fertilizer plants: the first plant using furnace oil as feedstock was commissioned only this year. While naphtha was used by most nitrogenous fertilizer plants as feedstock, some used it as fuel as well. But the rise in the fuel oil input was not due to its substitution for naphtha, for the naphtha input per ton of nitrogen went up from 989 kg. in 1973 to 1217 kg. in 1975.

Fuel oil is used in steam power plants for the additional heat input required when the load is low. According to the engineers who run the power stations, plants supplied by Bharat Heavy Electricals Limited (the only maker of large 110 and 200 MW thermal unit, and a government owned corporation) require oil firing even at high loads. BHEL denies this, but has not been asked to demonstrate it on the plants it has supplied. In the meanwhile, steam plants continue to use fuel oil inputs. However, a number of previously oil-fired units have been converted to coal.

The large rise in the consumption of fuel oil in mining is apparently due to the acquisition of excavating and ore handling machinery. Coal mines also have, it seems, acquired diesel-powered lifts and pumps.

All three industries - fertilizers, power and mining - are priority industries with many linkages, and are largely government-owned. Apparently their importance and influence were too strong for the Furnace Oil Standing Committee to check their fuel oil consumption.

The 1975 fuel oil consumption of the sectors other than these three industries was 518000 tons lower than what it would have been if their fuel input coefficients had remained at 1973 levels. So fuel oil rationing apparently saved considerable oil. The savings in fuel oil consumption up to 1975 could thus have been as high as 10 per cent of the 1973 consumption.

It is . . .

It is also possible that efforts to reduce fuel oil consumption tathered pace after 1975. In an answer to a Parliament question,[1] the Government claimed that 290,000 tons of fuel oil were saved in 1977 - 50,000 tons through improvements in efficiency and 240,000 through a switchover to coal. In discussions Government officials gave an estimate of annual savings of a million tons of fuel oil achieved over the three years F 1974- F1976 - 300,000 tons through efficiency increases and 700,000 tons through a changeover to coal. The details of these savings will take some time to emerge; but if the official claims hold, they would signal a significant success in the policy of oil conservation.

K. Conclusion

In the two decades before 1973, oil product consumption grew at an average annual rate of 10 per cent. About a half of it consisted of middle distillates, principally kerosene which was the main illuminant in villages, and had whose consumption rose rapidly with the growth of road transport. Nearly a third consisted of heavy fractions, whose growing domestic supply found a market in industry, power and marine transport. Nearly a sixth consisted of light distillates, principally gasolene whose consumption tended to lag behind owing to the replacement of gasolene trucks and buses by diesel ones, relatively slow growth in the number of cars, and a shift in personal transport to scooters and motor cycles. After 1968, however, the commissioning of naphtha-based fertilizer plants raised the rate of growth of demand for light distillates.

Between 1972 and 1974 the import price of crude rose more than fivefold (Table IV.1). Refining margins, however, did not rise proportionately. Hence import prices of heavy distillates rose somewhat less than fivefold, prices of middle distillates slightly under fourfold and prices of light distillates slightly over three-fold.

Prices in India rose even less because about a third of the crude was domestic, and its cost lagged behind the rapidly rising import price. The Government set up a fund to subsidize imported crude from the surplus realized on domestic crude and thereby equalized

the price . . .

1/ Starred question No 3605, 13 December 1977.

the price of both. It also prevented rifiners' margins, taxes and distributors' margins from rising proportionately. So although the quintupling of crude import prices roughly quadrupled the average cost of crude, product prices only doubled.

Two of the produces were singled out by the Government for particularly high price increases. The price of gasolene was raised by 125 per cent and the price of furnace oil was raised by 150 per cent between the beginning of 1973 and of 1975. As a result, gasolene sales fell by a quarter. The fall in the demand for gasolene led refineries to produce more naphtha, and the increased supply of feedstock helped raise the output of fertilizers and petrochemicals.

The price effect on furnace oil sales cannot be isolated since physical controls on its consumption were also applied. But as a result of both, fuel oil consumption fell by 2 per cent between 1973 and 1974. The fall was much larger in most industries; among those industries in Table II.5 for which output figures or indices are available, and whose fuel oil coefficients came down, consumption in 1975 was half a million tons lower than it would have been if their coefficients had remained at their 1973 level - a fall of almost 20 per cent of their 1973 consumption. But a rise in the fuel coefficients of three industries - fetilisers, power and mining - raised consumption by over 200,000 tons, and a rise in industrial production added another 200,000 tons; so the actual consumption of fuel oil fell only by 100,000 tons between 1973 and 1975.

In the course of readjusting oil product prices, the Government equalized the prices of kerosene and of hsd in November 1973. Kerosene being a mass consumption good, its price was raised only 60 per cent between the beginning of 1973 and of 1975; hence the price of hsd, which used to be priced above kerosene, rose only 22 per cent. In the context of the general rise in prices the real cost of hsd actually fell and at a time when the total demand for oil products was stagnant, hsd sales rose 27 per cent in 1973-1975. The equalization of kerosene and hsd prices ended the adulteration of hsd by kerosene; because of this as well as of the rise in its price, kerosene sales fell 12 per cent in 1973-1975.

The largest . . . . .

TABLE II.6

Composition of Retail Prices of Some Oil Products in Calcutta, 1973 and 1975

(Rs./ton on January 1)

	Gasolene		Kerosene[1]		HSD		Furnace oil	
	1973	1975	1973	1975	1973	1975	1973	1975
Ex-Refinery price	1228	2870	555	929	721	907	247	668
Taxes	175	316	28	51	125	155	37	65
Central	150	295	28	51	100	134	17	45
State	5	1	-	-	5	1	-	-
Municipal	20	20	-	-	20	20	20	20
Transport	14	14	33	18	10	10	6	20
Refinery to depot	-		-	-	-	-	-	-
Depot to dealer	14	14	-	-	10	10	6	20
Dealer to retailer	-	-	8	18	-	-	-	-
Retailer to consumer	-	-	25[2]	-	-	-	-	-
Storage	-	-	24	-	-	-	-	-
Dealer	-	-	7	-	-	-	-	-
Retailer	-	-	17[2]	-	-	-	-	-
Trader's margin	43	70	10	52	44	28	10	7
Dealer	43	70	10	8	44	28	10	7
Retailer	-	-	-[2]	44	-	-	-	-
	1460	3270	650	1050	900	1100	300	760

1/ Dealers or owners of petrol stations are the retailers in all products except kerosene. Kerosene is sold mainly by grocers, though a few pumps also sell it retail.

2/ The retailer's margin is included in the transport and storage costs allowed to him. The transportation charge to consumers in particular goes largely to the retailers since few of them actually deliver it to the consumer's door step.

Sources: India (1975d); India (1976e); 68-70.

The largest declines in consumption were experienced by lubricants, whose sales fell 29 per cent in 1973-75, and bitumen, whose sales fell 38 per cent. The prices of both were raised appreciably, and in the case of bitumen, the financial stringency that followed the rise in oil prices led public authorities to cut down road building and maintenance.

The growth of demand was resumed after 1975, though not at pre-1973 rates. Product sales rose 12 per cent between 1975 and 1977. If we compare the consumption pattern in 1973 and 1977, the proportion of naphtha rose from 6.5 to 9.2 per cent and the proportion of hsd from 23.1 to 30.2 per cent. The proportion of gasolene fell from 7.1 to 5.5 per cent, fuel oils from 26.4 to 23.1 per cent, bitumen from 5.0 to 3.6 per cent, lubricants from 2.8 to 1.8 per cent and kerosene from 15.3 to 14.0 per cent; the consumption of all except kerosene fell absolutely.

The changes in the demand pattern accentuated the predominance of middle distillates, whose share went up from 48.9 to 53.5 per cent; the surge in naphtha and LPG sales also raised the share of light distillates from 15.5 to 16.8 per cent. The proportion of heavy fractions correspondingly fell from 35.6 to 29.7 per cent.

To sum up, the trend in consumption till the late sixties was away from light distillates and toward middle distillates; the refinery output pattern and the consumption pattern were adjusted to each other through regular imports of kerosene and occasional exports of gasolene. The growing output of fuel oil was found a market at home through the development of industrial markets.

In the late sixties, new fertilizer plants created a market for naphtha, and the gasolene surplus disappeared. At the same time, the demand for fuel oil outstripped output, and large imports had to be made. Refinery output lagged behind demand because of indecision on new refineries and of conflicts between the Government and the majors on the price to be allowed for imported crude. As a result, imports supplied a sixth of the domestic consumption in 1973; in fuel oils imports supplied almost a third (Table II.7).

(Table II.7 . . . . .

TABLE II.7

Output and Consumption of Crude Oil and Products, 1973 and 1977

(Thousand tons)

	Output		Net imports		Consumption	
	1973	1977	1973	1977	1973	1977
Crude oil	7198	10185	13446	14700	20518	24431
Light distillates	3404	4024	203	221	3491	4189
of which LPG	259	377	-	-	263	382
Gasolene	1647	1370	-9	-	1605	1368
Naphtha	1368	2150	167	221	1454	2286
Middle distillates	9805	11875	1337	1689	11004	13407
of which Kerosene	2631	2488	830	1023	3451	3498
HSD	5039	6989	222	666	5193	7575
LD	1079	1187	289	-	1348	1139
Heavy ends	5916	6897	2040	661	7987	7473
of which Fuel oils	3931	5246	1943	698	5932	5807
Lubricants	470	404	96	12	635	461
Bitumen	1167	909	-	-49	1134	898
All refined products	19125	22796	3735	2387	22483	25074

Sources: India (1977d); India (1977e).

After 1973 the Government made intensive efforts to increase domestic crude output and to restrain consumption, especially of fuel oil. As a result, crude output rose by 3 million tons between 1973 and 1977; together with a rise in crude imports of a million tons, refinery throughput rose 4 million tons, yielding 3.7 million tons of products. The rise in output was accompanied by a rise in consumption of 2.6 million tons and a fall in imports of 1.3 million tons (the balance of 200,000 tons being accounted for by inventory changes).

(III Crude supply . . . .

III CRUDE SUPPLY AND REFINERY CAPACITY

Supplying a market with oil products entails three steps: securing the supply of crude oil, refining it and setting up marketing and storage facilities for the products. If a country or firm imports oil products, it can select them and set up facilities to sell them only. But a refiner must market all the products the refinery yields: he cannot set up a marketing organisation for just a few of them. In practice, refineries in regions with unbalanced demand for products export some of them, often at a loss: BP, for instance, charges less for fuel oil fob Bandar Mahshahr in Iran and Exxon fob Ras Tanura in Saudi Arabia than either they or the respective governments charge for crude oil. Profitable refineries may burn off unwanted products. Gas is flared by refineries in most less developed countries, and the products flared in the gas vary in value. But by and large, a refiner must find markets for all major distillates of his refinery.

A Majors' refineries

In the late forties India was importing 2-3 million tons of oil products a year; while middle distillates - kerosene and diesel oil - accounted for over 40 per cent of demand even then, the demand pattern was diverse enough to justify one or more refineries. Crude supplies were, however, controlled at that time by the major international companies, which refined their own crude and set up their own marketing facilities. Hence they were the only ones that were capable of setting up refineries; and of them, only three - Burmah Shell, Standard Vacuum and Caltex - had marketing organizations in India. The Government, interested in saving foreign exchange costs, invited all three to set up refineries, which they did in 1954-55. The savings thereby would have been equal to refining costs, which were 20-30 per cent of the cost of crude in 1966-1967 (India 1969: 24; Vedavalli 1976: 94).

However, the Government failed to make the majors share the equity of their refinery investment with itself or with Indian citizens: all three refineries were fully owned subsidiaries of the majors. The issue involved, as shown by Tanzer (1969), was the tying of the refineries to the crude produced by the majors. Whilst a higher transfer

price for . . . . .

price for crude meant lower profits for the refineries, the production of the crude was far more profitable and subject to the lower taxes than refining. Admission of Indian interests into refinery equity would have generated pressures to reduce the supply prices of crude to the refineries when the market price drifted below the majors' transfer price. Hence the majors needed to keep the full ownership of the refineries if they were to maximise profits.

In the fifties, non-major oil companies began exploring for crude. They were either companies from countries that had a deficit in oil but no major oil companies (one of the majors - Burmah Shell - was British-Dutch; the rest were American), such as CFP of France and ENI of Italy, or smaller American companies whose profits were limited by price control at home and which were looking for more remunerative crude abroad. Some of the crude found by these companies started coming into the market in the late fifties. The USSR, which was an important exporter before the War, also re-entered the market. Since most refineries were, however, owned by majors, the market for the non-major oil was narrow and the oil was sold at discount. In some markets the majors also gave discounts below the posted price to match the non-majors' offer prices (cf Dasgupta 1971: 185-206). There was no unified market in crude, and the discount varied widely from transaction to transaction. But the average discount in the early sixties was probably of the order of 15 per cent, and went up to 40-50 cents a barrel or 20-25 per cent in some transactions - equal to the foreign exchange savings made by the Indian Government by inducing the majors to set up refineries. In effect, therefore, the Government had assured the majors of a secure market for their crude without gaining much in return.

The Government tried in a number of ways to make the majors reduce their crude import prices. It secured an offer of 3.5 million tons at a discount of 20-25 per cent from the USSR in 1960, and tried to make the majors refine it; but they refused, and the contract had to be cancelled. It tried to limit the refineries to their licensed throughput, but had to back down in 1963 when demand, augmented by defence purchases, could only be met by the refineries. It appointed

successive price enquiry committees in the hope that publicity would make the majors more cooperative. In 1965 it rationed foreign exchange to the refineries, making them choose between paying out less for crude and reducing throughput. From 1960, when the Government became aware of discounts, and asked the majors to reduce their crude prices. The oil companies imported oil from their own sources at discounts which, however, never fully reflected the market situation; their crude price remained a matter of contention with the Government through the sixties. Although the Government could obtain cheap crude from abroad, it could not get it refined, nor could it market the refined products. It was thus powerless to prevent the majors from charging India higher prices than they were charging other customers through intermediaries - until the Government built up its own refining capacity and marketing organization.

B Home crude and state refineries

Meanwhile, oil discoveries in the fifties established new reserves of over 100 million tons, and gave the Government a base on which to build up its own refining capacity. The first new discovery was made by Burmah Oil in 1953 at Digboi, where it had been running a small refinery since 1899. Burmah Oil wanted to refine the oil it had found, but after the Government refused to let it, a company jointly owned by the Government and Burmah Oil was set up in 1959 and took over the rights to the crude. Two state-owned refineries were constructed, a 750,000-ton one at Nunmati (Assam) in 1962 with Romanian assistance and a million-ton one at Barauni (Bihar) with Soviet assistance in 1964 to use the Assam crude.

Further, the Government obtained Russian help in oil exploration, which led to the discovery of oil in Gujarat in 1958. On the basis of 75 million tons discovered by the early sixties, a million-ton refinery was built at Koyali in 1965. Both the Barauni and Koyali refineries were expanded to 3 million tons by 1968. A marketing organization was simultaneously built up, and protected by preventing the majors from expanding their own marketing network.

By 1965, therefore, the Government had its own refineries; and though their capacity covered only a small part of the home market, the

marketing network being built up couldhandle imported refined products if necessary. With their monopoly over the Indian market broken, the majors increased discounts until by 1965 they were fairly near to the international level. Whilst the Government continued to argue that they were overcharging, the difference between the price charged by the majors and the price considered fair by the Government was down to 5-10 per cent by the late sixties.

However, the Government strategy of building up an alternative supply network based on home-produced oil gradually ground to a halt after 1965. There were no fresh major discoveries in Gujarat, and the oil found could not justify expansion of refinery capacity beyond 3 million tons in Koyali. Whilst the reserves in Assam could justify further expansion, their exploitation was costly owing to their depth and remoteness from consumption centres; further, Assam oil, which is highly aromatic and paraffinic, requires more processing and gives less valuable products. Hence the cost of refined products based on Assam crude was far above the cost of products from imported crudes.

The next most promising area for exploration was off the shore of Gujarat, but it required the acquisition of offshore drilling technology and was expected to be far more capital-intensive than on-shore exploration. The world oil market in the late sixties was slack, and there was a general expectation of a progressive fall in crude prices. Meanwhile, the Oil and Natural Gas Commission, the Government's prime exploration agency, had ground to a halt because drilling had been stressed at the expense of finding or recovering oil, worn-out equipment had not been replaced and machinery to learn out of experience had not been set up (India 1972c). In the circumstances, the Government shifted emphasis away from home-produced oil, and built the next two refineries with the help of non-major independent companies.

C Imported crude and state-managed refineries

The pattern adopted in the second half of the sixties was to build refineries with some shareparticipation of non-major oil companies which also undertook to supply oil for a number of years; the Government took the majority of the shares and managed the refineries.

The first . . . . .

The first such refinery at Cochin with a capacity of 2 million tons was built with Phillips, an American non-major, which took 25 per cent of the equity. Initially Phillips had a contract to supply crude for 15 years from October 1966, which it passed on to Standard Oil of California, and Socal charged the same price as the majors. Thus, bringing in Phillips made no difference to the cost of crude. This was clearly unsatisfactory to the Government, and led to a modification of the contract. According to the new agreement, the capacity was to be raised to 3.5 million tons, The crude price was made more responsive to market conditions, but Phillips was guaranteed a 10 per cent return on its shares net of taxes (India 1969: 27-29). In effect, therefore, the Government secured crude supplies to the refinery at flexible prices, at the cost of promising Phillips at least 10 per cent on its investment.

Next, a 2.5 million-ton refinery was set up in Madras in whose capital the National Iranian Oil Company and American International Oil Company each took 13 per cent shares. The refinery was to get 42 million tons of crude over 22 years from Amoco's concession in Iran at a constant discount of 28 cents a barrel off the posted price. There was a clause for a reduction in price if other buyers were charged less for Darius crude, but it was too vague to rely on.

A third arrangement of a similar kind was made for a 2.5 million-ton refinery in Haldia. There was to be no foreign investment in equity, but CFP and Romania were to give credit and supply equipment and technical assistance. The oil supply contract was for 9 million tons at a million tons a year or 50 per cent of throughput whichever was greater, at a constant discount of 40 cents; if the price moved substantially out of line with market trends there were to be consultations. The refinery was greatly delayed by the rising oil prices and the drop in the growth of domestic demand in the early seventies but finally went on stream in 1975.

Thus in the third phase, the Government took the help of foreign companies to build refineries and secured long-term supply of oil for them. However, the prices and terms of the oil supply agreements were soon overtaken by the events in West Asia.

D. Links with . . . . .

D Links with oil producing countries

The buyers' market in oil ended rapidly in 1970. The closing of the Tapline by Syria in May and the enforced reduction of output by Libya in September reduced the flow of oil to Western Europe by 75 million tons. While it could be made up by shipping oil from the Gulf round the Cape of Good Hope, the longer haul led to a shortage of tankers. When demand in Europe went up in the following winter, product prices rose sharply, and prepared the stage for the entry of OPEC into crude price determination (Chevalier 1975:35-41). The Teheran Agreement in February 1971 raised the posted prices of Gulf crude from $1.80 to $2.18 a barrel, and brought an end to discounts. The Tripoli Agreement that soon followed raised the price of North African crude by 77 cents a barrel (Ellis 1974: 10).

However, a more significant event was the signing of the Participation Agreement between oil companies and the Arab oil producing countries - Saudi Arabia, Kuwait, Abu Dhabi and Qatar - in October 1972. It gave the producing countries a 25 per cent share in concessions forthwith, to be raised eventually to 51 per cent. A 25 per cent share in output, together with a 12.5 per cent royalty and a 55 per cent tax on profits, gave the producer states over 70 per cent of the sale price, apart from putting at least a quarter of the crude at their disposal. In Iran the crude had belonged to NIOC since the nationalisation of 1951; and in Iraq IPC was nationalised in June 1972. Thus by the end of 1972 all West Asian oil producing countries had acquired significant control over the price and output of their oil (Chevalier 1975: 55). Libya assumed majority control of oil companies operating there in September 1973; and when three demurred, nationalised them in February, 1974.

The control over output and prices thus won was first effectively exercised by OAPEC during and after the Arab-Israeli War in October 1973. The reference price was raised in two stages to $11.65 per barrel for Gulf crude and $15.768 for Libyan crude from 1 January 1974, and output was cut to make the price rise stick. By then, it was clear that the producing countries were in command, and European countries rushed to make direct deals with them.

By 1974, . . .

By 1974, therefore, the main reason for the Indian Government's collaboration with oil companies, major or minor, namely their control of oil supply, had disappeared; then India could bypass oil companies, and deal directly with OPEC states for crude.

Actually, the Government had begun to look for direct deals even earlier. The price increases forced by OPEC in 1971 and 1972 sharpened the conflict between the Government and the major oil companies over their crude import price. By 1972 the expansion of home crude output was also nearing its end, and the Government had to look abroad for further increases in supply. Soundings were made among the Arab states. In 1973 the Government obtained 1.1 million tons (with an undertaking to supply the same quantity for three years) from Saudi Arabia. The USSR had no crude to spare that year. The Government obtained about 7 million tons of crude; but it was not enough, and the differences with the majors did not permit full utilization of their capacity. To meet the demand, therefore, the Government had to import a record 3.7 million tons of products, mostly kerosene and furnace oil (Table II.7).

The quadrupling of the oil price after the Arab-Israli war in October 1973 turned the problem of availability into one of ability to pay: the Government started looking for oil on credit and barter. Saudi Arabia refused both on its 1.1 million tons; but Iran, Iraq, and Abu Dhabi gave Rs.2.3 billion in full or part credit, and Iran agreed to buy 300,000 tons of cement and 65,000 tons of steel in 1974 and 100,000 tons of aluminium every year. The USSR also supplied about 3 million tons of oil and a million tons of kerosene on the usual rupee payment terms. The Government's borriwing campaign largely met its objectives, and 1974, which began with serious forebodings for the balance of payments, ended with undiminished reserves and oil imports that were only marginally below the previous year's record 17.2 million tons (including products).

The groundwork done in 1973 and 1974 enabled the Government to start 1975 with offers of 9 million tons from Iraq, Iran, Saudi Arabia and the United Arab Emirates, and credit lines of about $250 million from Iran and Iraq. With import needs of 14 million tons, the Government had some room for manoeuvre vis-a-vis the three majors, whose

refineries imported 6.75 million tons a year. This leeway was useful, since 1975 was the year in which their 25-year guarantees against nationalization expired, and the Government could negotiate changes in the ownership and management of the refineries.

The majors had anticipated the forthcoming change and sought new agreements with the Government early as 1971; but the Government did not make up its mind. Essentially the majors were seeking an agreement on the pattern of Cochin and Madras refineries, where Phillips and NIOC respectively had taken minority holdings in return for a right to supply crude. The events of 1972 and 1973, however, greatly increased the world supply of crude from oil-producing states at the expense of oil companies, and freed the Government from its dependence on the latter (Vedavalli 1976: 54-59). Still, the Government, with characteristic caution, agreed with Exxon in March 1974 to buy a 74 per cent share in equity immediately and the rest in seven years, setting the pattern for similar deals with Shell and Caltex.

However, the Government's efforts to get crude directly from oil-producing states succeeded so well in the next two years as to remove its dependence on the majors. In 1975 it had a small surplus to play about with. In 1976, Iran and Iraq offered more oil; and the sudden improvement in the balance of payments described in Chapter IV left sufficient foreign exchange for oil imports. In the longer run, offshore oil reserves (discussed below) not only made dependence on crude from the majors unnecessary but could best be used in the oil refineries of Exxon and Shell at Bombay. Hence the Government bought out all three majors' investments in India. The last one to be bought was the Caltex refinery in January 1977. Now only the half-million ton refinery of Assam Oil, a subsidiary of BP, remains out of the fully owned refineries of its crude from Oil India. It markets its products only in the Assam region. Thus for the first time the Government now has almost complete control of oil refining and marketing in India.

E Oil - offshore and onshore

The prospects for exploration were unpromising in the late sixties. The refining of Assam oil was uneconomic at the crude and

product prices . .

product prices prevailing then, while wildcats in Gujarat were not yielding significant discoveries. Besides, it looked as if world crude prices would come down further and oil would be in abundance. Oil constituted only about 10 per cent of imports and was not of great significance in the balance of payments. Hence the Government's policy at that time was to build coastal refineries based on imported oil, with or without foreign technology and minority holdings. But the Oil and Natural Gas Commission, which had been specially built up for exploration, could not be closed overnight; it had manpower, rigs and facilities which had to be found work. So it was allowed to continue drilling about 10[illegible] wells a year. Most of its drillings were in Assam and Gujarat and predominantly in the latter where oil was to be found at 1500-2000 metres against 4000-4500 metres in Assam; ONGC could drill three times as many wells in Gujarat as in Assam and could be sure of an immediate market for the oil it found. But although it drilled in 72 out of the 100 promising onshore structures identified in Gujarat, it found precious little oil. It did in Assam, but the new finds remained unexploited.

It was established by the late sixties that the most promising structures in Gujarat were offshore. But neither ONGC's skills nor its equipment were of any use there; offshore rigs had to be bought, together with offshore technology. Offshore technology was mainly available in the United States which had large offshore production in the Carribean; but the Arabian Sea presented a more serious problem in the form of higher tides. In the years that followed, the decisions on offshore drilling were just postponed.

When the oil market began to harden in 1971, the urgency of offshore exploration struck the Government. By that time there was a world boom in off shore drilling, led by exploration in the North Sea, and rigs were difficult to get. Finally a mobile jack-up platform was ordered from Mitsubishi. It arrived in June 1973, and a one-year contract was given to Offshore Drilling Company of USA to train ONGC personnel. Drilling quickly struck oil. Two more platforms - this time semi-submersible ones - were acquired from Hankon Magnus of Norway and Dalmmchoy of Great Britain in August 1975, by which time reserves of over 200 million tons were proved on Bombay High. A contract was

given to . . . . .

given to McDermett of USA to manufacture four production platforms in their fabrication yards in Dubai and to instal submarine pipelines and two single-buoy moorings. Two further fields were discovered off Gujarat in 1976 - an oil-field in Bassein High and a gas field in the South Tapti structure.

In May 1976, ONGC started taking off 2000 barrels a day from two wells and shipping it to Bombay; 228,000 tons of oil was produced offshore in 1976. In early 1977 the first single-buoy mooring was set in place and a 80,000-ton mother ship leased from the Shipping Corporation of India was coupled to it. With this storage facility in place, output rose to 1.4 million tons in 1977. Exploration also gathered pace: in 1977 five rigs were drilling offshore; 12,533 metres were drilled and 19 wells completed.

The current rate of production is 80,000 barrels a day. But the transport system cannot work in the monsoon, as the mother ship cannot be safely anchored to the SBM in the 16-foot waves. In the last two years, the production wells were shut off for 80 days in the monsoon. Further, 1.3 million arbic metres of associated gas is being flared every year.

However, it is expected that a 30-inch oil pipeline and a 26-inch gas pipeline from Bombay High to Uran across Bombay harbour will be commissioned by May. Their capacity of 20 million tons of oil and 14 million tons of gas is sufficient to cover further discoveries; immediately they will transport 5 million tons of oil and 1.5 million cubic metres of associated gas a year. By May 1979 the oil pipeline will be connected with North Bassein field and carry 6 million tons from Bombay High and 1 million tons from Bassein High. A pipeline will also be laid for non-associated gas from the South Bassein field to the Gujarat coast, and inter-connected with the pipeline to Uran.

Peak production will be reached in the early eighties; what it will be, it is too early to predict. The first figures put out were around 14 million tons. More recent ones are in the range of 9-10 million tons; a lower peak would apparently increase total recovery. The rate of exploitation will undoubtedly depend on the Government's reading of crude price trends and on further offshore

discoveries if . . .

there are any. Drilling have been made in only about a half of the currently known shallow structures; although proving of reserves will take longer, oil or gas has been struck in nearly all. Further, there are other structures in the deeper continental shelf which are almost entirely untouched yet.

In addition to offshore work in India, ONGC is involved on a small scale in Iran. It took a one-sixth share, in partnership with NIDC and Phillips, in a 8000-sq.km. area off Iran in 1964, and gets 600,000 tons a year as its share. In November 1973, it took another offshore area of 4500 sq. km. on a service contract from NIDC (Henderson 1975 : 56). It has also taken survey and drilling contracts in Iraq and Tanzania (India 1977e : 12).

While ONGC had its hands full drilling off the Gujarat coast, the Government offered offshore concessions in other areas to foreign companies in June 1973. Concessionaires could do seismic work in 9 of the 10 blocks (all except the west coast of Gujarat) into which the coastline was divided. If the results were promising, they could choose a 5000 square kilometre area for drilling. In 1974, seismic survey were done by Reading and Bates in Kutch, north-west of Gujarat, and by Carlsberg off the shore of West Bengal. Both American firms signed production-sharing contract in which the Government took a 35 per cent working interest from the start and allowed cost recovery up to 40 per cent of yield. Natomas-Carlsberg started drilling from a leased ship in November 1975, but surrendered the concession in September 1977. Reading and Bates started drilling in mid-1976. In December 1975, the Canadian Assmera group signed a similar production-sharing contract for the Cauveri basin near Madras, in which, however, cost recovery was allowed up to 30 per cent. ONGC itself has taken up an area off the Kerala coast and recently begun drilling.

Whilst exploration for new oil could be fruitful only in the long run, immediate relief could only come from existing oilfields. The onshore oilfields in Gujarat were running out and were yielding wax and water with the oil; with further drillings and secondary recovery, their output has been held steady at just over 4 million tons. The Assam oilfields, which were unattractive at the low oil

prices prevailing in 1960s, because more viable with the rise in prices. Over the years ONGC had gone about drilling wells in Assam; when it found oil, it capped the well and moved to another structure. In 1972, only three of the six fields discovered in southern Assam were being exploited (India 1974a: 25). In 1974, 60 per cent of the wells were not producing and needed workovers. Gathering and treatment facilities were inadequate, and the pipeline to Gauhati and Barauni refineries had no spare capacity. The Rudrasagar field with reserves of 30 million tons was producing about 100,000 tons a year which was moved by truck to Gauhati; and the Galeki field, which promised to be a major producer, awaited the arrival of deep drilling rigs (Henderson 1975: 129). Since then transport facilities have been improved, and the output of the Assam fields, which supplied 3 million tons of oil in 1974, is now approaching 5 million tons.

The change in the crude supply pattern and in the ownership of refineries has also modified the Government's policy on refinery size. The high cost of gathering and transport of crude in Assam dictated small refineries placed near oilfields. There are two refineries in Assam with a capacity of 500,000 and 800,000 tons respectively, and a third million-ton refinery is being built. Owing to the differences with the majors on crude import prices the Government did not allow them to expand capacity, although they achieved some capacity expansion by successive process improvements. In order to spread risks, the refineries built in partnership with independents - Haldia, Madras and Cochin - were all built with a capacity 2.5-3 million tons each. Consequently, only 13 per cent of the present capacity is in refineries with a capacity over 5 million tons (Table II.8).

Now, however, that ownership questions are settled and it is clear that the bulk of oil supplies in the next 15 years will come from West Asia and from fields off the western coast, refineries can be built to minimize transport costs and exploit economies of scale. The immediate plans include expanding the Koyali refinery from 4.3 to 7.3 million tons; the expansion is nearly complete. The Koyali refinery and the two Bombay refineries, which have a confirmed capacity of 8.55 million tons, will utilize the oil from the Bombay High and Gujarat fields. The West Asian oil being currently refined

in Bombay . . . .

in Bombay will be piped from Kutch to a 6-million ton refinery in Mathura which will serve the growing North Indian market. When the Mathura refinery is commissioned in 1980, the proportion of capacity in refineries with a capacity over 5 million tons will rise to 50 per cent.

To sum up, the rise in oil prices forced the Government to make quick decisions on problems of exploration and exploitation that had been shelved for some years. The results were slow to emerge. But the offshore production to come in the next two years may well enable India to resume a rapid rise in its oil consumption, continue the recent improvement in its balance of payments, and develop a more sophisticated petrochemical industry.

IV. Oil imports . . . .

IV OIL IMPORTS AND THE BALANCE OF PAYMENTS

In F1970 India imported 11.7 million tons of crude oil at a cost of Rs.1.1 billion; in addition it imported 1.1 million tons of oil products at a cost of Rs.293 million (Table IV.1), consisting mainly of kerosene and furnace oil. By F1975 prices had increased sevenfold; the same volume of imports would have cost Rs.9.6 billion, or 68 per cent of India's F1970 exports. In fact, India imported more - 14.2 million tons of crude and 1.9 million tons of products costing Rs.12.3 billion - in F1975. How were these seemingly impossible imports paid for?

The answer must be somewhat approximate since the two sources of trade statistics - customs data and payments data - differ. The customs figures show a rise of Rs.10.9 billion in the value of oil imports between F1970 and F1975; payments data show a rise of Rs.9.3 billion. This increase of Rs.9.3 billion was over 30 per cent of the rise in aggregate imports, which came to Rs.30.2 billion. Besides oil, India also paid more for imports of food, fertilizers and iron and steel, which together added Rs.12.1 billion to the imports (Table IV.2).

A. Balance of payments

Apart from the rise in imports, reserves rose by Rs.8.3 billion in F1975 whereas in F1970 they had fallen by Rs.0.9 billion. Thus, imports and reserves together required almost Rs.40 billion of additional finance in F1975. Table IV.3 shows where the resources came from.

Between F1970 and F1975, exports just about tripled; the rise of Rs.27.8 billion in exports supplied 70 per cent of the additional funds. Invisibles provided Rs.6.2 billion or 16 per cent, the rest being provided by capital inflow.

Among invisibles, most of the contribution came from private transfers - chiefly remittance of Indians abroad - which rose by Rs.3.1 billion, and from travel - mainly tourism - which brought in an additional Rs.1.6 billion. The rise in remittances owed much to the savings of Indians who went to the booming oil-production countries of West Asia.

The rise . . . .

The rise in capital inflow was almost entirely in official loans from abroad, which added Rs.7.6 billion. While India had repaid the International Monetary Fund Rs.1.5 billion in F1970, in F1975 it drew Rs.2.1 billion. However, credits given by India (mainly trade credits) rose from Rs.3.4 billion in F1970 to Rs.8.4 billion in F1975, and partly offset the rise in official loans. The net contribution of foreign aid to the additional finance requirements was marginal.

TABLE 17.1

IMPORTS OF CRUDE OIL AND OIL PRODUCTS F 1970-76

Year	Distillates			All products	Crude oil	Oil and products
	Light	Middle	Heavy			
	(Volume - 000 tons)					
F 1970	26	415	653	1,096	11,657	12,753
F 1971	88	1,747	343	2,158	12,979	15,137
F 1972	115	1,332	2,023	3,470	12,016	15,486
F 1973	215	1,488	1,927	3,630	13,947	17,577
F 1974	54	1,252	1,410	2,716	14,490	17,206
F 1975	46	1,110	763	1,919	14,165	16,084
F 1976	178	1,434	1,066	2,678	13,904	16,582
	(Value Rs. million)					
F 1970	13	97	184	294	1,059	1,353
F 1971	34	515	117	496	1,475	1,941
F 1972	34	22	266	592	1,448	2,040
F 1973	96	7[illegible]	356	1,457	4,171	5,602
F 1974	56	1,088	876	2,020	9,549	11,589
F 1975	79	1,127	552	1,758	10,518	12,256
F 1976	241	1,593	767	2,674	11,016	14,120
	Unit value (Rs./ton)					
F 1970	482	234	280		91	
F 1971	507	180	342		114	
F 1972	292	230	131		121	
F 1973	448	324	289		299	
F 1974	1,042	869	621		653	
F 1975	1,723	1,016	698		743	
F 1976	1,374	1,112	718		828	

Source: India (1971b; 1972b; 1973b; 1974b; 1975c; 1976c; 1977g).

TABLE IV.2

COMPOSITION OF IMPORTS F1970-F1976

(Rs.billion)

		F1970	F1973	F1975	F1976
Foodgrains		2.13	4.73	13.43	8.79
Raw materials & intermediates		8.91	16.61	27.63	29.15
Of which	Cotton	0.99	0.52	0.28	1.30
	Mineral oil & products	1.36	5.60	12.26	14.12
	Vegetable oils	0.39	0.65	0.17	1.18
	Fertilizers	1.00	2.27	5.92	2.61
	Chemicals	0.68	0.83	1.22	1.37
	Iron & steel	1.47	2.50	3.12	2.20
	Non-ferrous metals	1.19	1.40	1.00	1.60
Capital goods		4.04	6.74	9.68	10.08
Of which	Machinery	2.58	4.27	5.77	6.59
	Electrical goods	0.70	1.30	2.01	1.73
	Transport equipment	0.67	0.95	1.57	1.47
Other goods		1.26	1.48	1.92	2.73
		16.34	29.55	52.65	50.74

Sources: India (1976f); 106
India (1978a): 101

TABLE IV.3

BALANCE OF PAYMENTS, F1970 - F1975

(Rs.billion)

	F1970	F1970	F1972	F1973	F1974	F1975
A. CURRENT ACCOUNT						
Imports (cif)	17.2	20.0	21.5	27.3	41.6	47.4
Exports (fob)	14.0	15.6	19.0	23.5	31.8	41.8
Trade balance	-3.2	-4.4	-2.5	-3.8	-9.8	-5.7
Travel	0.1	0.1	0.2	0.4	0.8	1.7
Transport	0.3	0.4	0.5	0.4	0.8	0.6
Investment income	-2.3	-2.3	-2.6	-2.6	-1.7	-1.7
Official transfers	0.5	0.7	0.4	0.3a/	0.1	1.8
Private transfers	1.2	1.6	1.5	1.9	2.7	5.3
Other invisibles	0.1	-0.1	-	-0.2	0.7	0.9
Current Account (Net)	-3.3	-4.0	-2.5	-3.6	-6.4	2.9
B. ERRORS AND OMISSIONS	-0.8	-0.7	-0.3	-2.1	-3.0	-2.4
C. CAPITAL ACCOUNT						
Private capital	-0.3	-	-0.1	-0.4	-0.3	-0.5
Banking capital	-0.1	0.1	-0.2	-	-0.5	0.3
Official capital	3.6	5.6	2.7	7.7	10.2	8.0
Loans	6.6	6.2	5.9	8.3a/	10.7	13.3
IMF drawings	-1.5	-	-	0.6	4.8	2.1
Amortization	-1.9	-2.1	-2.5	-2.5	-2.4	-2.8
Other	0.5	1.5	-0.7	1.3	-2.9	-4.5
Capital Account (Net)	3.2	5.7	2.5	7.3	9.5	7.9
D. CHANGES IN RESERVES b/	-0.9	1.0	-0.3	0.8	0.1	8.3

a/ Excludes the adjustment of Rupee balances accumulated under the PL-480 agreement with the United States.

b/ Includes changes in value due to exchange rate changes.

Sources: Reserve Bank of India (1977c): 816, S 746-47.

B. Exports

Let us take a closer look at the rise in exports, which provided over two-thirdsof the additional resources (Table IV.4).

Most of the products whose exports rose rapidly fall into two groups: food and machinery. Among food products, fish and coffee were relatively new commodities with strong upward trends which continued into the seventies. Sugar is exported occasionally when there is a surplus over home consumption. In the aftermath of the green revolution, the price of wheat lagged behind, and farmers turned increasingly from wheat to sugarcane. Large sugar surpluses were thus created just at a time when there was a world shortage of sugar; hence export earnings from sugar were high in F1974 and F1975. The international inflation in 1974 and 1975 improved the export earnings from some of the other exports as well, such as cashewnuts, tea, oilcake and tobacco.

Cheap skilled labour and steel at controlled prices give India an advantage in the manufacture of machinery, whose exports have exhibited a strong upward trend. There is considerable variety in the machinery exported: industrial machinery, prime movers, generators, power transmission equipment, cars, trucks etc; the markets are equally wide-ranging. Another product which uses cheap skilled labour is precious stones, which are imported raw and cut and polished for re-export. Garments are a new labour-intensive export that has gained much ground in the seventies.

Finally there is one product whose rise in export volume is probably more apparent than real, namely silver, whose official exports rose from nothing in F1972 to Rs.1.74 billion in F1975. Large hoards of silver are held by the rural population in the form of ornaments. In recent years it has begun to dishoard silver, which used to be smuggled out of the country to pay for gold and other illegal imports. In F1974 the State Trading Corporation entered the silver market to export it officially. When Mrs. Gandhi's Government imposed an emergency in June 1975, the powers acquired were used, inter alia, to imprison smugglers without trial. As a result, the State Trading

Corporation acquired . . . . .

Corporation acquired a monopoly of silver exports, and recorded exports of silver doubled in a single year.

The rise in oil prices led to a sympathetic rise in the prices of three types of commodities: those whose feedstock came from oil such as plastics, fertilizers and organic chemicals, their competitors like leather and cotton textiles, and energy intensive products like steel and cement.

India has been a high-cost producer of oil-based products. Since oil is imported, the policy has been to set up capacity only to cover the limited home consumption of oil-based products. Their home markets are small and in some cases (e.g. plastics) further restricted by high excise taxes. Hence the scale of output tends to be low in this group of process industries with pronounced economies of scale, and costs are high. No significant exports could therefore be expected, and in fact India is a net importer of fertilizers and chemicals.

India is an important producer of cotton textiles and leather; but the policy in their case is to rely largely on local raw materials, which are in inelastic supply. Between limited raw material supply and the large home consumption, only a small surplus is left for export. The volume of exports in this group was virtually static in F1970 - F1975.

Among energy-intensive goods India has a significant output of iron and steel, cement and aluminium, and has abundant raw materials and energy resources for all three none of which depends exclusively on oil. For steel and cement the construction boom in the oil-producing countries of West Asia also opened up a market. Nevertheless India failed to build up sizeable exports of these products. In iron and steel, labour-management problems prevented the full utilization of capacity. In cement, cost-plus prices fixed by the Government have caused the industry to operate at high levels of capacity utilization to break even. Consequently, capacity has tended to lag behind home demand, and little surplus is available for export. The build-up of aluminium capacity has been hampered by a shortage of electricity and the consequent reluctance of state electricity boards to give the

industry cheap . . . .

Table IV.4

COMPOSITION OF EXPORTS - F1970-F1976

(Rs.billion)

		F1970	F1973	F1975	F1976
Food and animals		4.13	6.66	12.39	
Of which	Fish	0.27	0.81	1.25	1.80
	Fruit & nuts	0.54	0.79	1.02	
	Sugar	0.29	0.43	4.75	1.48
	Coffee	0.25	0.46	0.67	1.14
	Tea	1.48	1.45	2.37	2.93
	Feed stuffs	0.59	1.80	0.96	2.23
Beverages and tobacco		0.33	0.71	0.98	
Oils and fats		0.07	0.31	0.35	0.53
Fuels and lubricants		0.12	0.15	0.36	0.33
Raw materials		2.52	3.56	5.27	
Of which	Oilseeds	0.06	0.34	0.69	
	Cotton	0.16	0.37	0.45	0.27
	Iron ore & scrap	1.17	1.33	2.14	2.39
	Non-ferrous ores	0.17	0.20	0.44	
Chemicals		0.36	0.57	0.90	1.09
Manufactured goods		6.16	9.87	13.33	
Of which	Leather	0.72	1.66	1.91	2.64
	Textile yarn	0.35	0.30	0.24	
	Cotton fabrics	0.98	2.95	2.13	0.54
	Jute goods	1.89	2.26	2.45	2.01
	Wool and coir mats	0.16	0.31	0.49	
	Cement	0.03	0.04	0.22	
	Precious stones	0.42	1.51	1.23	
	Iron and steel	0.91	0.58	1.17	
	Silver	-	0.06	1.74	2.83
Machinery and vehicles		0.75	1.15	2.55	5.54
Other manufactures		0.76	1.73	3.11	
Of which	Garments	0.30	0.95	2.00	2.57

(Contd.....

Table IV.4 (contd)

	F1970	F1973	F1975	F1976
b/f	15.20	24.71	39.24	7.49
Other goods	0.05	0.07	0.07	
Total exports	15.24	24.78	39.31	51.43

Sources: India (1972b); India (1978a): 102.

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industry cheap bulk power.

Thus, India failed by and large to exploit the commodity shortages and price rises that followed the rise in oil prices because it had either insufficient supply of raw materials, insufficient capacity or inadequate technology. But for some years India's export structure was shifting towards new labour-intensive manufactures; this trend accelerated in the world trade boom of the early seventies. India rapidly increased its export earnings as a result, albeit at the cost of worsened terms of trade.

C. Terms of trade.

Owing to India's week competitive position in energy-intensive goods and goods whose prices went up with those of oil, the rise in Indian exports was accompanied by a considerable worsening of terms of trade. Barter terms of trade were the same in F1970 and F1973, but in the next two years they underwent a deterioration of 34 per cent. The rise in exports of 18 per cent in F1973-75 could not prevent a significant erosion of imports (Tables IV.5 & IV.6).

The rises in oil prices was the major element in the worsening of the terms of trade; the tripling of oil prices between F1973 and F1975 would by itself have caused a worsening of 21 per cent. But there was a further deterioration of 13 per cent. Thus, India was a net loser from the restructuring of relative prices that following the rise in oil prices; the rise in exports it achieved was in spite of rather than

because of . .p.63

Table IV.5

PRICE AND VOLUME INDICES OF IMPORTS

F1970 - F1976

(F1968 = 100)

	UNIT VALUE				VOLUME			
	F1970	F1973	F1975	F1976	F1970	F1973	F1975	F1976
Food	95	k74	265	261	74	78	134	92
Cereals	93	182	266	273	68	77	145	98
Beverages & tobacco	97	115	153	168	28	27	59	35
Oils and fats	128	138	208	230	156	244	46	266
Mineral fuels and lubricants	80	156	489	538	202	427	299	312
Raw materials	95	117	172	198	111	83	66	92
Pulp & waste paper	113	129	271	309	104	69	58	19
Wool	92	234	188	236	156	120	20	105
Cotton	102	125	144	268	107	137	22	54
Crude fertilizers and minerals	73	91	167	150	131	151	139	157
Chemicals	110	137	345	226	62	91	79	71
Chemicals	109	113	256	239	75	113	85	70
Dyes	115	158	251	261	90	73	54	65
Fertilizers	108	155	439	219	41	76	72	66
Manufactured goods	117	136	231	223	118	156	120	121
Paper, board etc.	113	147	319	317	121	108	97	107
Textiles	98	112	144	167	103	67	119	59
Iron and steel	113	129	247	218	151	218	144	117
Copper	130	151	160	164	118	119	35	72
Nickel	153	123	165	199	144	122	168	242
Tin	117	180	240	247	65	60	51	62
Machinery	94	115	210	232	79	106	90	82
Non-electric machinery	88	120	224	246	79	94	74	72
Electric machinery	98	84	173	180	87	182	159	118
Transport equipment	121	156	211	248	74	87	104	94
Other manufactured goods	117	136	238	274	112	121	123	88
Scientific instruments	118	167	289	355	120	103	107	76
ALL IMPORTS	100	138	280	278	87	114	111	97
INCOME TERMS OF TRADE					82	91	75	56

Sources: Reserve Bank of India (1977a): S78; (1972c): S755-56.

Table IV.6

PRICE AND VOLUME INDICES OF EXPORTS - F1970 - F1976

(F1968 = 100)

	UNIT VALUE				VOLUME			
	F1970	F1973	F1975	F1976	F1970	F1973	F1975	F1976
Food	101	151	209	214	112	121	163	162
Fish	103	179	224	298	134	220	253	270
Fruit and nuts	104	148	189	218	86	84	96	100
Sugar	71	145	310	202	394	281	1453	706
Coffee	126	146	181	411	111	175	205	155
Tea	96	97	142	154	99	95	106	123
Oilcake	108	244	157	223	104	141	111	203
Beverages & tobacco	104	127	193	204	93	165	158	167
Oils and fats	132	303	207	182	45	86	141	232
Mineral fuels & lubricants	104	149	440	384	100	85	67	70
Raw materials	104	131	193	204	114	128	129	138
Cotton	112	154	192	262	93	151	148	94
Ores and scrap	100	104	184	201	125	132	127	131
Manufactured goods	111	156	201	232	92	105	110	145
Leather goods	102	217	251	335	97	109	110	108
Floor coverings	108	163	228	265	93	123	137	184
Cotton cloth	110	170	213	246	101	157	114	153
Jute goods	105	125	145	133	83	83	78	68
Iron and steel	147	175	275	283	78	42	54	173
Metal goods	121	147	238	253	134	153	200	302
Machinery and vehicles	104	140	180	181	166	188	325	373
Other manufactured goods	108	131	163	166	151	283	410	620
Clothing	100	130	155	159	205	498	878	1392
Footwear	122	134	228	235	102	109	105	137
ALL EXPORTS	106	146	197	210	106	125	147	174
BARTER TERMS OF TRADE	106	106	70	76				

Sources: Reserve Bank of India (1977a): S79; (1977c): S757-58

because of the shortages that followed in the wake of the rise in oil prices.

A deliberate policy of depreciation of the exchange rate was followed in F1970-75, primarily in the belief— justified by the events - that it would stimulate exports. But the depreciation had little to do with the worsening of the terms of trade. Between 1970 and 1972 the Rupee depreciated 14 per cent in terms of the SDR (IMF 1977: 174); the terms of trade, however, actually improved 17 per cent. From 1972 till 1975 both the exchange rate and the terms of trade moved in the same direction, but the exchange rate less so - 17 per cent against a 44 per cent worsening of the terms of trade. Indian exporters and importers are by and large price-takers rather than price-setters, and the exchange rate policy probably had little effect on the terms of trade. What it did achieve was to redistribute income from the importers to the exporters, and thereby reinforce other policies, including import control and export subsidies, aimed at improving the balance of trade.

D. Bridging the payments gap.

While the rise in the cost of imports between F1975 and F1976 is seen ex-post to have been largely met by increased export earnings and receipts from emigrants and tourists, the rapid widening of the trade deficit from Rs.2.5 billion in F1972 to Rs.3.8 billion in F1973 and Rs.9.8 billion in F1974 threatened at the time to wipe out the reserves of Rs.11 billion, and made the payments situation precarious (Table IV.3). After years of import control, there was no scope for cutting down imports without causing a shortage of foodgrains or raw materials. The government had therefore to look urgently for credit.

Most of the increase in loans in F1973 and F1974 came from the World Bank and its soft-loan window, the IDA. Little came from the USA and Western Europe, the traditional aid donors. For the first time in F1974, Iran gave credit on oil sales of $120 million, and Iraq of $100 million. In F1975 they gave $165 million and $70 million respectively; further Iran agreed to finance a large iron ore project on the west coast of India from which it could get its ore requirements.

However, most . . . . .

However, most aid is project aid; its disbursement takes years while projects are planned and carried out, and it does not furnish foreign exchange to meet current needs, for it generates fresh import requirements that it is designed to meet. What India needed to finance the trade deficit was aid in terms of commodities India would have imported anyway, or untied credits. Hence oil credits helped, as did the oil and kerosene supplied by the USSR on barter; but they did not go far. For immediately available foreign exchange India turned to the International Monetary Fund, which lent it Rs.7.5 billion over the two years (Table IV.7)[1/]. Being designated as a country that was most severely affected by the rise in oil prices, India also got grants of Rs.1.3 billion from the United Nations Emergency Fund.

In FY1972, debt servicing absorbed three-quarters of the gross aid of Rs.6.8 billion. However, service payments rose only slowly, and largely as a result of loans and grants from international institutions - the Fund, the Bank and the UN - net aid utilized rose from Rs.1.7 billion in FY1972 to Rs.13.4 billion in FY1974 and Rs.15.2 billion in FY1975.

To finance these deficits the Government looked for credit. It first drew on the International Monetary Fund; it obtained about $400 million on its normal lines of credit, and got another $200 million from the Special Oil Facility which came into being at the end of 1974. In FY1975 it got a further $200 million from the Oil Facility (International Monetary Fund 1977: 174). India got little from the World Bank. The Bank's type of project assistance was not suited to the relief of balance of payments difficulties; besides, India with its precarious balance of payments qualified for credit from IDA, which had lent it four times as much as the Bank, but IDA's funds were too stretched to give India any relief.

The OECD (1977) claims that its net bilateral aid to India rose from $457 million in 1973 to $602 million in 1974 and $820 million in 1975. But OECD figures are so much higher than Indian figures of aid received (India 1976c: 49) that they must include considerable sums that India does not regard as aid. However, OECD as well as press

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1/ These figures from Government budgets are slightly higher than those from the balance of payments estimated by the Reserve Bank of India.

Table - IV.7 OFFICIAL LOANS AND GRANTS, F1972-F1976

(Rs-billion)

	AUTHORIZED					UTILIZED					
	F1972	F1973	F1974	F1975	F1976	F1972	F1973	F1974	F1975	F1976	F1977
LOANS	6.4	11.3	14.8	21.9	8.1	6.7	10.4	18.8	20.2	12.9	
International Monetary Fund	-	-	-	-	-	-	-	5.7	1.8	-3.1	-4.
Consortium	6.4	10.3	13.0	11.7	6.8	6.2	7.9	9.0	9.9	9.7	
IBRD	-	0.5	1.3	0.9	2.8	0.3	0.3	0.4	0.4	0.7	
IDA	2.5	4.4	5.8	7.1	-	1.3	2.6	3.2	4.3	4.8	
USA	0.3	0.2	1.4	0.2	0.9	0.5	0.7	0.7	0.4	-	
UK	1.1	1.6	1.1	-	-	1.3	1.3	1.1	0.6	0.2	
Germany	0.6	0.9	1.1	1.2	1.3	0.8	0.8	1.0	1.6	1.3	
Others	1.9	2.7	2.3	2.3	1.8	2.0	2.2	2.6	2.6	2.7	
Oil-producing countries	-	-	1.8	10.2	1.3	-	0.4	1.6	4.0	2.5	
Other countries	-	1.0	-	-	-	0.5	2.1	2.5	4.5	3.8	
GRANTS	0.4	0.4	1.9	4.4	3.9	0.1	0.2	2.8	0.8	2.5	
United Nations 1/	-	-	0.7	0.6	-	-	-	0.5	0.8	-	
Consortium	0.4	0.4	1.2	3.7	3.3	0.1	0.2	0.4	1.9	2.4	
UK	-	-	-	2.4	1.8	-	-	-	0.8	1.3	
Canada	0.1	0.1	0.4	0.5	0.6	0.1	0.1	0.3	0.4	0.5	
Sweden	0.2	0.2	0.3	0.3	0.5	-	-	0.1	0.4	0.3	
Others	0.1	0.1	0.5	0.5	0.4	-	0.1	-	0.3	0.3	
Other countries	-	-	-	0.1	0.1	-	-	-	0.1	0.1	
TOTAL LOANS AND GRANTS	6.8	11.7	16.7	26.5	12.9	6.8	10.6	19.7	23.0	15.4	11.1
Less REPAYMENTS						-3.3	-4.0	-4.1	-4.6	-5.1	-5.9
Less INTEREST						-1.8	-2.0	-2.2	-2.2	-2.3	-2.5
NET LOANS AND GRANTS						1.7	4.6	13.4	16.2	7.8	2.7

1/ UN Emergency Operation Fund

Sources: EC Survey 77-8: 45, 105, 110. IMFI.78

reports suggest that Iran gave about $120 million as oil credit in 1974 and another $165 million in 1975, while Iraq gave about $100 million in 1974 and $70 million in 1975. Together with smaller credits from Kuwait and Abu Dhabi, the total oil credits were about $250 million in 1974, $300 million in 1975 and $500 million in 1976. All these countries gave part credit on concessional terms against oil sales. Saudi Arabia was the only country that took full payment in cash.

The total net Government borrowings from abroad rose from Rs.3 billion in F1972 to 5 billion in F1973, Rs.7 billion in F1974 and Rs.11 billion in F1975. Grants from abroad, which fell to a negligible sum in F1972 and F1973 rose to Rs.1 billion in F1974 and Rs.3 billion in F1975. The value of imports rose from Rs.19 billion in F1972 to Rs.50 billion in F1975. Of the increase, Rs.20 billion or 60 per cent was financed by increased exports; Rs.11 billion, or almost all the rest, was financed by loans or grants. Thus whilst the Government managed to maintain oil imports and avoid running down reserves, it had to limit imports and borrow heavily till 1975 in order to balance payments.

E. The transformation in F1976 and F1977.

In F1976, the balance of trade swung round dramatically from a deficit of Rs.12 million to a small surplus. The reasons were twofold. First, the terms of trade, which had been worsening since F1972, improved by 9 per cent in F1976 (Table IV.6). Second, there was a fall in imports of 20 per cent over the previous year.

The fall was due almost entirely to increased output at home, much of it in publicly owned large-scale industries (India 1977f : Reserve Bank of India 1977b). The output of nitrogenous fertilizers rose from 1.2 million tons in 1975 to 1.5 million tons in 1976, while imports fell from 1.8 million tons in April-December 1975 to 1.1 million tons in the same period of 1976. Similarly, net exports of iron and steel rose from nothing to 1.8 million tons as output rose from 5.6 to 6.3 million tons. Looking at industry as a whole, it appears that the spurt in its output began in 1975, and especially that the

improvement in coal supplies and rail capacity in that year were a pre-condition for the expansion of 1976. Further, the fall in imports during 1976 was due not only to the rise in output but also to a slackening of demand and accumulation of inventories. Thus, a rise in public sector industrial output triggered off an industrial recession, and the resulting change in the domestic balance of supply and demand led to a sharp fall in imports.

Comparing F1976 with F1972, the previous year in which trade nearly balanced, we find that the terms of trade worsened 30 per cent in the four years, and the resulting gap was filled by a fall of 10 per cent in imports and rise of 28 per cent in exports. The fall in imports was achieved mainly by large-scale industries in predominantly public ownership, the increase in exports by relatively small-scale, labour-intensive, skill-intensive industries.

In F1976 there was also a considerable inflow of funds, apparently from Indians resident abroad. It is not clear how far it consisted of remittances and how far of investment; but its volume was so large that it must have had a substantial element of capital inflow. In 1975 foreign investors were assured of convertibility into dollars or sterling if they invested in high-yield term deposits in banks; the assurance apparently succeeded in attracting funds.

Information is still accumulating about the developments in F1977. Exports increased from Rs.51 billion in F1976 to Rs.57 billion in F1977 (payments figures). Imports rose from Rs.51 billion to Rs.59 billion, resulting in a small trade deficit. Food imports fell in F1977 following two years of good harvests; but the favourable balance of payments in F1976 led to liberalization of imports, and non-food imports rose by a third. Most of the rise was in raw material imports; machinery imports rose little.

Invisible earnings also rose significantly. Emigrants' remittances, which brought in about Rs.5 billion in F1975, are reported to have risen to Rs.15 billion in F1976 and Rs.19 billion in F1977. Earnings from tourism rose from Rs.1.7 billion in F1975 to Rs.2.8 billion in F1977. The number of tourists rose 14 per cent to 534,000 in 1976,

and arrivals . . . . .

and arrivals in early 1977 were running 20 per cent ahead of the previous year. Earnings of Indian consultancy and construction firms in West Asia are also reported to be increasing rapidly.

It was noted earlier that the loans received in F1974 and F1975 did not add to foreign exchange supply because aided projects took time to be implemented; conversely, aid utilization continued at a high level in F1976 and F1977 out of aid authorized earlier. Although repayments to the International Monetary Fund reduced net disbursed aid from Rs.16.2 billion in F1975 to Rs.2.7 billion in F1977, the concomitant improvement in current account earnings led to a steady accumulation of reserves, which rose from a level of Rs.6 billion (excluding SDRs) in F1973 and F1974 to Rs.14.9 billion at the end of F1975, Rs.28.6 billion at the end of F1976 and Rs.46.8 billion at the end of F1977.

This persistent rise in reserves finally convinced the Government that the payments crisis created by the rise in oil prices was over, and led after March 1976 to considerable liberalization of imports. After the exercises in liberalization, imports of few commodities are under quantitative control. The imports of a number of commodities are banned; they are chiefly consumer goods and goods produced domestically on a small scale and at a high cost, such as drugs and chemicals. The imports of most other commodities, especially machinery and raw materials, are more or less freely allowed but for import duties. The import licensing system in operation since World War II is still retained as a precaution against an unmanageable spurt in imports, but has been greatly simplified.

V CONCLUSION

The rise in oil prices threw the Indian balance of payments into disarray, generated strong inflationary pressures, caused hardship and unrest and possibly led to the imposition of an authoritarian government, temporary as it proved. But the crisis contained elements that ameliorated its full impact. For one thing, the rise in oil prices itself restrained the rise in the consumption of oil products, especially of two products that loomed large in the budgets

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of their consumers, namely petrol for cars and kerosene for rural lighting. The prices of oil products rose much less than those of crude because the Government restrained refiners' and distributors' margins; nevertheless, the rate of growth of oil product consumption fell from 6-7 per cent inthe fifties to 4 per cent in the seventies. For another, the rise in oil prices led to the boom in oil-producing countries which attracted a large number of migrant workers, whose remittances home significantly buttressed the balance of payments. Finally, the world inflation set off by the rise in oil prices provided a favourable environment for exports.

Nevertheless, these favourable features could hardly make the crisis disappear. In F1974 India ran a trade deficit of almost Rs.10 billion, over one-and-a-half times its total reserves. In the short run, payments could be balanced only by borrowing, which India did principally from the International Monetary Fund and the United Nations Emergency Fund. But in its search for funds India established a new relationship with oil-producing states, especially Iran and Iraq, which was fruitful in a number of ways. First, it resulted in direct deals between the Government and the oil-producing states. It thereby bypassed the major oil companies, whose profit-taking the Government had for years been unable to control, and paved the way for their takeover. Second, it attracted investment in Indian Industrial and power projects from Iran, Kuwait and the United Arab Emirates. Finally, it provided an entrés into the West Asian market for Indian construction and consultancy firms, including a number of public sector firms.

The Government did not have much scope for reducing imports, which were pared down to essentials anyway. Hence its attempts to improve the balance of trade centred mainly on macro-economic policy. In F1973 and F1974, inflation made it impossible to get a grip on revenue and expenditure; however, the Government, which owned most of the banking system, severely restricted credit and made it expensive in 1974. As a result, agricultural prices began to fall in the autumn of 1974 as the harvest approached - the first time they fell in the seventies.

Once the . . . . . .

Once the back of domestic inflation was broken, the Government found it easier to get a grip on fiscal policy. A deficit of Rs.6.9 billion in the overall budgets of the central and state governments in F1974 was wiped out in F1975 and balance achieved; the deficits in F1976 and F1977 were Rs.3.3 billion and Rs.2.1 billion respectively (India 1978a: 75). Credit control has, however, been much less strict in the last two years because of the rise in foreign exchange reserves and the demand for credit generated by accelerated industrial growth. But two excellent crops have helped to keep prices stable.

Finally, the Government pushed forward domestic exploration and production of oil. Although the probability of offshore oil was established in 1967, the crucial decision to import the necessary equipment and technology was only taken in 1972 under the pressure of rising oil prices. Since then, however, exploration has been pursued with vigour. Offshore oil began to flow in 1976; and against a current crude throughout of 27 million tons the current offshore output is 4-5 million tons, rising towards 9 million tons by 1980. Thus, offshore oil may turn out to be the most effective element of Government policy in the long run.

It is impossible to assess the relative importance of autonomous factors, such as the restraint on oil consumption exercised by price rises, the emigration of workers and the upward trend in exports, or to distinguish it entirely from that of policy variables, especially since the rise in exports is partly dependent on official incentives. But it is fairly clear that without the Government's early efforts to obtain credit and to declate the economy, the terms of trade would have deteriorated even further. It may be argued that the loss of income through deflation offset the loss that would have arisen from a worsening in the terms of trade. But in 1973 and 1974 the expansion of output was held up by supply bottlenecks rather than by lack of demand; deflation could therefore hardly have resulted in much loss of output.

A Income effect

We may now turn to the macro-economic effects of the rise in oil prices. What matters here is not the rise in itself but the deterioration

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in the terms of trade that it led to. The problem is to decide the base year from which to reckon the deterioration. We have chosen F1972 as the year immediately preceding the spurt in oil prices. But it may be noted that this gives a somewhat larger estimate of the loss from worsening terms of trade then, say, F1970 or F1971 would since the terms of trade in F1972 were more favourable than earlier or later.

In Table V.1 we have calculated what would have been the cost of oil imports if their prices had risen at the same rate as the average for all exports, and deducted it from their actual cost to obtain the rise in cost due to a worsening of the terms of trade. The excess cost has been divided by the year's GNP to get an idea of the proportional loss of income sustained because of the faster rise in oil import prices. The loss of income in F1973 was 0.5 per cent, while in the next three years it was about 1.5 per cent of the GNP.

We may similarly calculate the cost of deterioration in the general terms of trade, which owed a great deal directly and indirectly to the rise in oil prices. The cost calculated in Table V.2, rises from 0.6 per cent in F1973 to an average of 2.7 per cent of GNP in F1974-F1976. Thus, 2.7 and 1.5 per cent of GNP are the upper and lower limits of the loss of income arising from the rise in oil prices, and 2 per cent may be regarded as a reasonably close estimate.

Of this 2 per cent, about a half can be attributed to the rise in kerosene prices alone. In the absence of more recent estimates, we may refer to a National Sample Survey which estimated that kerosene absorbed 1.1 per cent of consumer expenditure in 1963-64 (India 1968). If this proportion had persisted into the seventies, and if the expenditure-elasticity of kerosene consumption had been zero, the doubling of kerosene prices between 1973 and 1976 would have reduced real incomes by 1.1 per cent. In fact, average consumer prices rose about 15 per cent, real per capita incomes rose 5 per cent and kerosene consumption fell 5 per cent in 1973-1976; so we get a Paasche estimate of the fall in real incomes due to the rise in kerosene prices of 0.9 per cent. Between these upper and lower limits, 1 per cent may be taken to be a reasonable estimate.

The estimates of the terms of trade effect are compared in Table V.2 with the actual growth in real GNP. In F1974, the sharp fall of 2.6

per cent . . .

per cent through the terms of trade effect coincided with the negligible overall rise in GNP of 0.5 per cent. Agricultural output fell by 3.5 per cent in the crop year 1974-75 (that is, July 1974 to June 1975); foodgrain imports rose from a negligible figure in F1972 to Rs.4.7 billion in F1973 and Rs.7.6 billion in F1974. Thus, it was the poor domestic performance that made the terms of trade effect so difficult to absorb. In the crop year 1975-76 agricultural output rose 15 per cent; and to guard against shortages and damp down inflation the Government imported Rs.13.4 billion's worth of foodgrains in F1975. This rise in foodgrains supply, together with a 10 per cent increase in industrial output, finally corrected the balance of payments effects of the rise in oil prices in F1976. The terms of trade effect, however, will persist much longer.

Table V.1

INCOME EFFECT OF THE RISE IN OIL PRICES F1972-F1976

		F1972	F1973	F1974	F1975	F1976
Index of oil import prices	(F1968=100)	62	156	472	489	538
Index of export prices	(")	120	146	183	197	210
Index of oil import volume	(")	391	427	201	299	312
Actual cost of oil imports	(Rs billion)	2.04	5.60	11.57	12.26	14.12
Cost of oil imports at F1972 terms of trade	(")	2.04	2.70	2.32	2.56	2.85
Excess cost of oil imports	(")	-	2.90	9.25	9.70	11.27
GNP at current prices	(")	431.59	537.04	632.03	649.96	690.47
Excess cost as proportion of GNP	(Per cent)	-	0.53	1.46	1.49	1.63

Sources: India (1978a): 57, 101
(1977c): S 755-S 758
S 745
Reserve Bank of India (1977a) : S 72 S 78, S 79.

Table V.2

INCOME EFFECT OF DETERIORATION IN THE TERMS OF TRADE - F1972 - F1976

		F1972	F1973	F1974	F1975	F1976
Index of import prices	(F1968=100)	97	138	239	280	278
Index of export prices	(")	120	146	183	197	210
Index of import volume	(")	391	427	291	299	312
Actual cost of imports	(Rs billion)	18.67	29.55	45.19	52.65	50.74
Cost of imports at F1972 terms of trade	(")	18.67	26.16	28.76	34.36	32.01
Excess cost of imports	(")	-	3.39	16.43	18.29	18.73
GNP at current prices	(")	431.59	537.04	632.03	649.96	690.47
Excess cost as proportion of GNP	(Per cent)	-	0.63	2.60	2.81	2.71
Growth rate of GNP at 1972 prices	(")	-	5.2	0.5	8.5	1.6

Sources: As for Table V.1.

Against the terms of trade effect, however, one should balance the rise in GNP through the earnings of emigrants to the Middle East. No reliable estimates of these earnings are available. But the remittances of Indians abroad came to Rs.19 billion in F1977, or about 2.5 per cent of GNP, and officials put the share of the Middle East at well over a half. Hence it is possible that by F1977, the terms of trade effect was neutralized to a subatantial extent by emigrants' income

B. Employment effect

What change in employment would have accompanied the fall in GNP due to the rise in oil prices? This question cannot be answered with any . . . .

with any degree of accuracy in the absence of employment statistics. Only the more obvious changes in the demand for labour can be pinpointed.

There are a number of labour-intensive industries associated with the motor vehicle, in which a fall in employment or in the work load can be inferred from the fall in petrol consumption. An industry which has been obviously affected is three-wheeled and four-wheeled taxis, which are easier to catch in the cities than they were before the rise in oil prices; interviews with taxi-drivers confirm the impression of slackened demand. Employment in car repairs also appears to have fallen; there are fewer wayside repairers, and there has been especially a fall in the number of repairers who are not attached to a petrol pump. The fall in the output of cars was noted earlier (Table II.3). Whilst employment in such "organized" industries as cars would not fall in proportion to output, a fall in work available and in earnings was inevitable.

This is just the direct effect of the rise in petrol prices on the employment in car-dependent occupations. In addition, there would be indirect effects arising from the fall in the real incomes of car-owners. An average car-owner typically spent 15-20 per cent of his income on running costs of his car (including repairs); hence the real income effect of the rise in petrol prices on this class was substantial.

Although the real income effect of the rise in kerosene prices was only of the order of 1 per cent; by contrast, it was spread over a much larger population; and it probably reduced the demand for a wider range of goods. In this way, the employment effect of the rise in oil prices was diffused throughout the economy.

One can expect the general fall in employment to have been smaller than the fall in real income for two reasons. For one thing, a proportion of the fall in output would have been absorbed in a fall in productivity; for another, the productivity in oil-dependent industries was probably higher than the average for the economy. Hence it is likely that the employment effect was less and perhaps considerably less than the 2 per cent fall in real incomes. But even if

it were . . . . .

it were 1 per cent of total employment, it would amount to 2 million workers. The number of migrants to the Middle East is very uncertain; informed guesses place it at over 300,000 and below a million. Whatever it may be in this range, it is almost certainly much smaller than the loss of employment as a result of the rise in oil prices.

Though it is well below the above orders of magnitude, one should mention the rise in employment in coal mining. Average number employed rose from 449,000 in 1973 to 502,000 in 1975. Although output rose by 6 per cent in 1976, employment in the first 8 months indicated that the annual figure would probably be slightly below that for 1975 (India 1977c). Output in 1977 is estimated to be almost the same as in 1976, so employment is unlikely to have risen. Hence there was a gain of about 50,000 in the number employed between 1973 and 1977. However, only a part of the rise could be attributed to the switch from oil to coal. Coal output rose from 78 million tons in 1973 to 101 million tons in 1977, or by 23 million tons. In Chapter II we cited an official estimate of 700,000 tons of fuel oil replaced in industry by coal. The coal required to replace the oil was probably in the neighbourhood of 2-3 million tons, or not much above 10 per cent of the rise in coal output. So the rise in employment in coal mining that could be attributed to direct substitution of coal for oil is unlikely to be much above 5,000. However, indirect substitution through coal-based electricity in industry as well as in irrigation could well raise the figure significantly. Nevertheless, the maximum figure that could be arrived at would be in the 20,000-30,000 range - considerably lower than the overall employment effect and the number of emigrants.

Thus it is difficult to avoid the conclusion that the rise in oil prices led to a net fall in total employment. The fall is unlikely to be as low as a million or higher than three million; two million is probably the best but a highly approximate estimate.

C. Redistribution effect.

On income distribution we have no recent data; the last

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published NSS expenditure survey refers to 1970-71. We must therefore build up a picture largely on the basis of inference.

We may note at the outset that the rise in oil prices and the concomitant rise in coal and electricity prices did not directly affect the distribution of money incomes except to the extent that incomes in those industries rose. Their effect on income distribution was essentially indirect; the incidence of the consequent price rises on different income groups was uneven. The effect was on the distribution of real incomes rather than of money incomes.

About four-fifths of oil products are consumed in industry and transport, and a rise in their price affects income-earners only indirectly. This is true for instance of naphtha used in fertilizer manufacture, hsd used in goods transport and fuel oils used in industry and in power generation. The effect on real income distribution of the rise in oil prices transmitted through these intermediate goods and services is largely impredictable. It is not even certain that the prices of final goods were invariably raised thereby. We have, for instance, pointed out earlier that because the price of hsd and kerosene are equalized and the price of kerosene held down, the price of hsd rose less than the average of wholesale prices. Thus, the real current cost of road transport, both of goods and passengers, probably came down. The price of naphtha was raised; but the consumption of nitrogenous fertilizers rose nevertheless from 1.7 million tons in F1973 to 2.7 million tons in F1976. Apparently there was considerable excess demand for fertilizers earlier; the rise in oil prices reduced the demand for gasolene, raised the supply of naphtha and hence of fertilizers. It is therefore possible that the increased supply squeezed out the scarcity margins realized on fertilizers by intermediaries and that the final buyers were little affected by the price rise. Thus, the redistributive effects of the rise in the price of oil products where they were used as an intermediate product are extremely complex and virtually unpredictable.

We are on firmer ground with two oil products that are used as consumer goods, namely kerosene and gasolene. The effect of the rise in the prices of these products among their users is clear.

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The expost price elasticity of their consumption was very low; an approximate doubling of their prices led to a fall of about a quarter in gazolene consumption and a sixth in kerosene consumption; and a good proportion of the latter fall was probably due to the fact that hsd ceased to be adulterated with kerosene. Independent evidence from the NSS survey of expenditure on fuel and light (India 1968) confirms this. And low price elasticity implies low income and substitution elasticities. In other words, the rise in the prices of kerosene and gasolene had a substantial income effect and tended to stick, in the short run at any rate.

Income elasticity below unity implies that the proportion of income spent on a commodity would vary inversely with income; this again is confirmed by the NSS survey. Hence if the substitution effect is small, the effect of a change in the price would be regressive. Among their respective users, therefore, the rise in the price of kerosene and gasolene worsened real income distribution.

This applies to each price rise individually; it is much more difficult to predict the combined effect of the rises in the two prices. The effect of the rise in the price of kerosene was spread right across all income groups, but was not substantial since the expenditure on kerosene was only 1.6 per cent of total expenditure even for the lowest expenditure group. The rise in the price of gasolene, on the other hand, mainly affected only the small group of users of cars and taxis; the number of cars and taxis is under a million even now. But this group spent a large proportion - 15-20 per cent - of its income on gasolene. There is unavoidable uncertainty about the average income, and the expenditure on gasolene would vary from town to town according to average distances travelled; but neither fact can disguise the substantial income effect on car users. The effect on users of scooters, motor cycles and scooter taxis was probably not so severe, but certainly more so than on the less affluent section of the population, and the overall effect of the rises in the price of kerosene and gasolene was to reduce inequality in real incomes.

This, however, is only the first-round effect. The savings propensity in India being low, a large multiplier effect of any

initial change in incomes must be expected. Unless technology is changing rapidly, the distribution of the successive rounds among income groups will be similar to the average income distribution, and will tend to swamp first-round income effects. Hence it may be inferred that the rise in the price of kerosene had little overall impact on income distribution, and only the rise in the price of gasolene left an enduring influence. Hence it is likely that in the aggregate, oil price rises somewhat reduced income inequalities.

D. Technological effects.

Technology is circumscribed by capital; the possibilities of changing technology in the short run are limited because equipment cannot be changed rapidly. The only exception to this in the case of oil products are certain furnaces and boilers used in industry and in power generation which can use either coal or furnace oil or varying proportions of both, or can be converted from the use of one to the other. Conversion to coal has been undertaken in India with active Government encouragement.

In power generation, a number of boilers in plants at Uttaran and Dhuvaran in Gujarat and at Barauni in Bihar, which were oil-fired earlier, were converted to coal-firing. The savings were, however, offset by the exhaustion of lignite mines at Neiveli which required the use of oil in Neiveli power station. The plant will go back to lignite when the new mine being developed nearby comes into production. Apart from these large plants, there are a number of small diesel generators in outlying places where the demand for power is small; but their total consumption of oil is limited, and they are being phased out as the places get connected to the power grid.

Apart from oil-fired boilers, steam plants in coal-fired stations are also fed with oil to keep them going when the load is low. According to power engineers, the new steam plants built by Bharat Heavy Electricals require oil even when running at a high load. Apparently, BHEL has not been able to show yet that they do not. So steam plants continue to use oil; but oil conservation officials claim that the oil requirements per kwh have been brought down.

Industry uses . . . .

Industry uses a number of oil products for different uses. It uses light distillates, mainly naphtha, for chemical uses. It uses furnace oils of certain kinds to fire furnaces for smelting metallic ores or making cement, glass, porcelain and bricks. It also uses diesel or furnace oil to fire boilers and to furnish motive power. Coal is theoretically substitutable for oil in all these uses, but there are limitations. Coal cannot be directly used for oil as chemical feedstock. Coal-using chemical plants can be built, but their capital costs are appreciably higher. India is building two coal-based fertilizer plants, but their construction periods have been inordinately long; neither is near completion.

Coal can be substituted for oil in furnaces and boilers provided these are designed to use either fuel and the substitution does not affect the quality of the product. It was in this area that the Government forced the pace of conversion by resorting to physical allocation of furnace oil. The policy was not ineffective: by 1977 annual savings of 700,000 tons of furnace oil were being made (including savings made in power generation). But the conversion only halted the rise in furnace oil consumption, which continues to be many times larger than the savings.

Finally, we might mention the change in irrigation from diesel to electric power which was not prompted by the rise in oil prices but probably received a fillip from it. Irrigation with electric motors was cheaper even before the oil prices rose and was limited only by power distribution. The rise in oil prices, however, led the Government to accelerate the extension of power lines to villages and thereby facilitate the installation of motors. The rise also led the Government to favour electrification of railway lines; but owing to the long gestation lags in electrification, railways continued to expand their fleet of diesel engines and to raise their diesel consumption.

E. Changes in consumption patterns.

In consumption no less than in production, replacement or conservation of oil products requires a change in equipment - in this case,

in consumer . . . . .

in consumer
durables. Whether in lighting, in cooking or in transport, the fuel is related to the device, and the two must be changed together. The cost of consumer durables is high in relation to incomes, and consumers are by and large as slow to change their durables as firms are to change their capital equipment, at any rate in India. But in all areas where oil products were used, there were well-established trends in the acquisition of consumer durables which the rise in oil prices accentuated.

In lighting, the extension of electric power to villages, undertaken primarily to supply power for irrigation and small industries, also brought them domestic lighting. Lighting with kerosene-using lanterns, which earlier was being replaced by electric torches among the rural poor, began to be replaced by electric lights among the better-off rural population as mains electricity became available.

In cooking again major changes in the consumption pattern emanated from supply changes. The rise in gasolene prices reduced the demand for it and enabled refineries to produce more liquefied petroleum gas, for which there was considerable excess demand. The demand continued to outstrip supply; but as a result of the oil price changes there was a substantial extension of cooking by gas.

In transport, the rise in gasolene prices led car-owners to seek cheaper forms of transport. In some cities they began to pool cars: a number of car-owners travelling between the same points of residence and work would share the car, each using his car in turn. More commonly, a number of commuters would charter a bus to transport them from a common place of work to a common residential area. In a number of cities, minibuses or luxury buses began to run which charged higher fares than the normal bus service and provided more comfort and less congestion. Thus, the egalitarian transportation system which provided all with the same standard of service at the same fares, which characterised Indian towns, has been increasingly replaced by a more differentiated system providing varying standards of service to people in different income brackets.

F. Implications . . . . .

F. Implications of changes in energy profile.

In production as well as consumption, it is clear that oil products have been partially replaced by coal and electricity in a number of uses. This is also reflected in the overall rates of growth of consumption. Some estimate is called for of the effects of this change in energy consumption pattern on the economy.

Ton for ton, coal is more labour-intensive than oil; the disproportion is even greater if the relative efficiencies in use are taken into account. The picture is slightly less clear in the case of substitution of electricity for oil. The efficiency of utilization of electricity is generally extremely high in thermal and mechanical uses such as predominate in industry. But the efficiency of utilization of coal in power generation is very low - the average in India is only 25 per cent. Hence the overall efficiency of electricity rarely exceeds 20 per cent, and its labour intensity (including the employment in the mining of required coal) will almost certainly be higher than of oil.

However, the higher labour intensity of coal or electricity does not mean that substitution effects set in train by higher oil prices will invariably increase employment. Forwhile the precise magnitudes depend a great deal on whether a coal mine is open-cast or a deep mine, on the character of the seams, on the degree of mechanisation, etc., the capital costs of coal are by and large higher than those of oil on a replacement basis; so also are the costs of power. Hence the replacement of oil by coal or electricity will raise the capital-output ratio in the energy sector and will require a higher rate of investment for the same rate of growth. This can be said on the basis of costs in the energy producing sector itself. In the energy-using sector, the capital costs of electric equipment are often lower than of oil-using equipment. For the whole economy, the investment required in coal mining and power generations would predominate since both are highly capital-intensive industries.

Hence unless the overall investment rate is raised, it is likely that a changeover from oil would reduce the growth rate of

the economy. . . . . .

the economy. The effect on the rate of growth of employment is less certain since the labour-intensity of the energy sector would increase. But employment in the energy sector is such a small proportion of total employment that a fall in the growth rate of GNP would be accompanied by a similar fall in the growth rate of employment.

This course of developments cannot be traced in the behaviour of the Indian economy in 1973-1977 because there was considerable underutilization of capacity in coal mining and in power generation. As a result, what substitution did take place did so without fresh investment (or without a rise in capacity through fresh investment) in coal and power, without a rise in capital-output ratios, and without even a commensurate rise in employment.

Nor might these conclusions apply to the future, at any rate in the long run. For with the growing scarcity of oil, capital costs in oil production are also going up. Immediately, the increase is due to the fact that with the progressive exhaustion of reservoirs on land, oil is being increasingly obtained offshore, and offshore capital costs are appreciably higher. In the longer run, the success rate of exploration wells will decline, and the capital costs per successful well must increase. Hence a point must come when the capital costs of oil are as high as those of coal.

Our analysis thus points to two conclusions, one for the medium run and one for the longer run. In the medium term, oil exploration will be an activity with a high rate of return. The cost of winning oil from existing facilities and refining it is so much lower than the cost of an equivalent quantity of coal that success in finding oil must command a high premium. However, once the rate of success has been brought down to the level where oil has no advantage over coal, the average capital-output ratio in the energy sector will be significantly higher than now, and economies - including India - will either be investing a significantly a higher proportion of their GNP or growing more slowly.

It should be pointed out, however, that we have presupposed the absence of a radical improvement in technology. In the present

state of .

state of technology, coal and power are the most competitive substitutes for oil. All other sources of energy either are limited in supply (for instance, wind power, wave power or biomass) or have high capital costs (for instance, solar power or geothermal power). If a technological breakthrough significantly reduces the capital costs of coal (for instance, in situ gasification) or of solar power (for instance, a cheap solar cell or an efficient stirling engine), the rise in capital-output ratios may be avoided - and the future may be more like the present.

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