A STUDY OF THE OIL INDUSTRY OF TRINIDAD AND TOBAGO

A STUDY OF THE OIL INDUSTRY OF TRINIDAD AND TOBAGO

By

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A Thesis

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ABSTRACT

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The emergence of the U.S.A. as a world economic power and the development of the Middle East oil resources created a set of circumstances which resulted in major competitive changes in the world oil economy and more specifically the world oil markets. In particular, one notes the shift from competition among a few international oil companies backed by powerful home governments to conflict bargaining in the world oil market between these companies and a cartel of oil producing and exporting countries (OPEC). Under the present conditions that characterize the world oil economy the foreign oil companies act in accord with their own best interests when they are in the strongest position and accede to necessity when they are weak and exposed. On the other hand host governments accede to necessity when they are weak and exposed and act in accord with their own best interests as they gain strength. This thesis studies the Trinidad oil industry in the context of the changes taking place in the world oil industry. It examines the changing power relationships between the government and the foreign oil companies and evaluates the extent to which Trinidad's petroleum legislation and the government's development policies

maximize the country's net direct and indirect benefits derived from the development of its hydrocarbon resources.

Some essential features of the thesis, therefore, are a dynamic analysis of the world oil market with special reference to the small host country; the development of cost estimates for crude production and refining in Trinidad, and the changes in these costs between 1956 and 1976; the estimation of the cash benefits accruing to the companies and to the government, and an evaluation of these benefits in terms of a maximizing strategy based on generalized conflict bargaining criteria.

Our analysis shows that the Trinidad government lacked the power to extract the maximum benefits from its oil resources prior to 1956. However, between 1956 and 1970 the government was able to successfully swing the balance of power more in its favour. It is felt, however, that, given the existing world oil market conditions, the government may not be getting a sufficiently large share of the rents earned by its marine oil resources. The government's development strategies as they relate to the use of oil revenues are rational and relevant to the situation of Trinidad as an economy of tiny scale.

In general, the American petroleum quota policies cause sub-optimization in the Trinidad refining industry. However, OPEC actions to raise prices and shift the balance of power from the oil companies to the host countries, combine with the new discoveries of marine crudes and natural gas in Trinidad to give the government greater leverage in bargaining with the oil companies and enhance Trinidad's position in the world oil market.

PRÉCIS

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La montée des Etats-Unis d'Amérique au rang de puissance économique mondiale ainsi que l'exploitation du ressources pétrolières du Moyen-Orient créerent un concours de circonstances qui résulterent en de profonds changements concurrentiels dans l'économie pétrolière mondiale et plus particulièrement, dans les marchés pétroliers mondiaux. On remarque plus spécifiquement le passage d'une situation de concurrence à quelques rares firmes pétroliéres internationales, celles-ci appuyées par de puissants gouvernements nationaux, à une situation de négociation antagonique entre ces mêmes corporations et un cartel des pays producteurs et exportateurs de pétrole (OPEP). Dans les conditions actuelles, caracteristiques de l'économie pétrolière mondiale, les compagnies pétrolières étrangèrent agissent conformément à leurs meilleurs intérêts quand elles se trouvent en position de force et adhèrent aux propositions ou se soumettent lorsqu'elles sont en position de faiblesse et vulnérables. Parallèlement les gouvernements d'occueil se soumettent aux conditions du groupe dans une situation de faiblesse et agissent en fonction de leurs meilleurs interêts lorsqu'ils se sentent plus puissants. Cette dissertation examine l'industrie pétrolière de Trinidad dans le contexte des changements structurels se produisant dans l'industrie pétrolière mondiale. Elle porte intérêt aux rapports de puissance variables entre le gouvernement et les firmes pétrolières mondiales; de plus elle évalue dans quelle mesure la législation pétrolière de Trinidad et les politiques gouvernementales de développement maximisent les avantages nets directs et indirects du pays découlant de l'exploitation de ses ressources en hydrocarbure. Certains points saillants essentiels de cette dissertation nous amènent donc à une analyse dynamique du marché mondial du pétrole avec une mention spéciale au petit pays d'accueil; l'évolution des prévisions des coûts pour la production brute et le raffinage à Trinidad ainsi que les changements dans ces mêmes coûtes entre les années 1956 et 1976, l'estimation ou approximation des avantages monetaires revenant aux firmes et au gouvernement, de même qu'une évaluation de ces avantages en fonction d'une strategie de maximization fondée sur des criteres généraux de négociation antagonique.

Notre analyse montre que le gouvernement de Trinidad s'avèra impuissant à retirer les avantages maxima de ses ressources pétrolières avant 1956. Toutefois, entre 1956 et 1970, celui-ci a réussi à ramener quelque peu la balance du pouvoir en sa faveur. Quoi qu'il en soit, nous croyons que, dans les conditions présentes du marché pétrolier mondial, le gouvernement sera incapable de s'approprier une part suffisamment importante des rentes provenant de ses ressources pétrolières marines. Les stratégies de développement du gouvernement telles qu'adaptées à l'utilisation des revenus tirés du pétrole apparaissent rationnelles et conséquentes à la situation de Trinidad en tant qu'économie de taille réduite.

Régle générale, les politiques américaines de contingentement pétrolier créent un emploi sous-optimal de l'industrie Trinidadienne du raffinage. Les mesures prises par l'OPEP pour majorer les prix et déplacer la balance du pouvoir des compagnies pétrolières entre les mains des pays d'accueil, de concert avec de nouvelles découvertes de pétrole brut marin et de gaz naturel à Trinidad, donneront cependent au gouvernement un plus grand poids lors de ses négociations avec les firmes pétrolières et amélioreront la position de Trinidad dans le marché mondial.

CHAPTER 1

INTRODUCTION

There is a symbiotic relationship between the organization of oil producing and exporting countries (OPEC) and the major oil consuming countries (Western Europe, U.S.A., Japan) of the free world which derives from the fact that the continous increase in the standard of living in the latter requires the production of goods and services which utilizes a technology that is biased in favour of petroleum (liquid and gaseous) based energy inputs. In turn, the OPEC countries depend on demand in the industrialized countries to create the markets for their huge surpluses of crude oil and to provide a flow of funds to finance their economic development programmes. In recent times the balance of power in this relationship has shifted to OPEC. It is unlikely that in the foreseeable future the dependence on hydrocarbons for energy and industrial materials will be reduced significantly.[1] One can expect, therefore, that the OPEC countries

[1] In the U.S.A. and European markets liquid fuels and natural gas shares are expected to vary between 50 and 76 per cent of total primary energy consumption well into the mid 1980's. See the following works: Economic Survey of Europe in 1971, Part I. The Economy from the 1950's to the 1970's, United Nations, prepared by the Secretariat of the ECE, Geneva (New York, 1972), p. 89; Sam H. Schurr and Paul T. Homan, Middle Eastern Oil and the Western World: Prospects and Problems (New York: American Elsevier Publishing Company, 1971), pp. 174-176; D. R. Knop and J. F. Roorda, "Economic Restraints on U.S. Energy Supply and Demand," Journal of Petroleum Technology, July 1975, pp. 803-812.

with 66.6 per cent of the "free" world reserves of petroleum will continue to control world market supply. Within the OPEC cartel there is a sub-group of the larger producers (Saudi Arabia, Iran, Kuwait) which can influence world oil prices by individual and direct action in the world market and which by their decisions to produce now or postpone production can determine the stability of the cartel.

In the world market the OPEC cartel on one hand and the large multinational corporations on the other, use their monopoly power to maintain the price of oil at levels several times the unit cost of producing a barrel. Initially the oil companies were able to capture most of the rents as a payment for their monopoly control over scarce knowledge and capital. However, in time the host countries (OPEC) were able to capitalize on the dependence of the consumer countries on petroleum, reduce the knowledge gap, and successfully exploit the weaknesses of the oil companies. Thus, through a process of aggressive bargaining, the OPEC countries shifted the balance of power and used it to redistribute rents in their favour. Because of the very large rents to be derived from the industry the conflict between the protagonists has been sharp and dramatic in its consequences. As might be expected, therefore, the literature on the economics and politics of oil has been concerned almost entirely with the continental producers, the major consumers, and the large multinational corporations.

Because of their large populations and huge endowments of petroleum resources the continental oil producers possess an inherent economic and political power which they can use to effectively redirect the benefits of their oil resources towards the fuller economic transformation of their economies. By contrast, very small economies with highly skewed resource bases in general seem to lack the power to achieve economic "take-off". The central problem is their inability to generate internally sufficient savings to finance continuous economic development. The small petroleum economy does not fit easily into either of these two groups; and the literature on the politics and economics of oil is not very informative to the planners of such an economy. This thesis is a study of the oil industry in one such country, Trinidad and Tobago: an open petroleum economy with limited alternative resources for development.

Trinidad has a land base of less than 2,000 square miles; accessible offshore territory of approximately 8,000 square miles, and a population of just over one million people. By world standards it therefore ranks as an economy of tiny scale.[1] It lacks the population and resource base to qualify as a world power; and its petroleum resources, though significant, are too small to qualify it for membership in OPEC. How much control can such an economy have over its resources and development? The scale of Trinidad's economy and in particular the size of its oil resources is a very important element in the evaluation and the formulation of its petroleum

[1]William G. Demas defined a small scale economy as one with a population of about five million people or less and a usable land area of ten to twenty thousand square miles. See Demas, The Economics of Development in Small Countries with Special Reference to the Caribbean, Centre for Developing-Area Studies, McGill University, Keith Callard Lectures, Series I (Montreal: McGill University Press, 1965), p. 22.

policies, and the determination of a development strategy. More specifically this thesis addresses its attention to the following questions. How would an oil industry based on small domestic reserves survive in an oligopolistic world oil market where the exercise of power determines the distribution of the benefits derived from the sale of the resource? What should the strategies of such a government be when bargaining with large multinational corporations, the annual sales of many of which exceed the combined gross product of several smaller nations? What should its policies be when faced with defensive tariff barriers in consumer markets where it has traditionally sold its oil and refined products? And what would be the government's best strategy for the use of its oil resources in the economic transformation of the country?

When viewed in the context of the world oil market the Trinidad oil industry occupies a very weak bargaining position relative to the large continental producers. It cannot significantly affect world crude supply and hence it cannot influence prices. In a specific market or markets, however, it may show considerable strength. Moreover, its importance to a particular company, or group of companies, may be such as to give it a clear bargaining advantage. The strategic location of the country may also be a source of considerable strength in oil bargaining.

Commercial drilling in Trinidad started in 1867[1] under

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[1]The first oil wells were drilled by Captain Darwent at Aripero at a depth of approximately 200 feet. See Trinidad's Oil, an illustrated survey of the oil industry in Trinidad, published by the Petroleum Association of Trinidad, 1952, p. 1.

British colonial rule; but the real commercial and strategic significance of its oil was not recognized until much later (1906) when the British Merchant Navy started converting its battleships to burn oil fuel. In 1906 the Governor of Trinidad and Tobago advised the West Indian Committee in London that the subject of Trinidad oil was of far more than local interest. He emphasized that "... it is a matter of imperial importance if Great Britain is found to possess a source of supply within easy reach, especially if control can be kept exclusively in British hands."[1] It was primarily because of this policy of exploitation that the indigenous labour force was systematically relegated to the unskilled and manual jobs in the industry, and that local government was prevented from developing any significant degree of competence and expertise in the technical and marketing operations of the industry. In fact it was only very recently that the country (i.e., its government and the labour force) was able to assert its rights to participate in major decisions affecting the industry. The factors responsible for this shift in power to local hands are pertinent to any assessment of the changes in the net social benefits accruing to Trinidad from its oil industry.

At this point it would be useful, as a background against which one can raise important points of analysis, to elaborate on

[1]Quoted in an article by V. C. Mulchansingh, "Oil Exploration in Trinidad - V", The Texaco Star, April 11, 1960, p. 7. Trinidad up to the immediate post World War II years remained the largest source of purely British oil (i.e., from British territory), a refueling base for the British Merchant Navy; and an important supplier of fuel to the American Navy at Chaguaramas between 1940 and 1962.

some of the more salient features of the Trinidad oil industry. By way of contrast we will begin by comparing the size and structure of the Trinidad oil industry with that of certain OPEC countries. In 1971 Trinidad produced 128,000 barrels of crude per day. Almost all of this was refined locally and exported to foreign markets. In contrast to this Kuwait exported 2.8 million barrels of its crude production per day; Iran, 4 million; Saudi Arabia, 4.2 million; and Venezuela, 1.6 million.[1] Although Trinidad increased its daily crude production to about 230,000 barrels per day at 1975, it is still by these standards a very small producer. The major function of the Trinidad oil industry until 1972 was refining. Recently exports of marine crudes have reduced the relative importance of exports of refined products as a foreign exchange earner. In contrast the major activity among the OPEC countries is crude production.

Trinidad's refinery capacity is roughly double its present crude production capacity so that a substantial part of the refinery throughput (about 60 per cent) consists of imports of foreign crudes. Most of these imports come from OPEC countries (Venezuela, Saudi Arabia, Indonesia, etc.) Foreign crude imports are handled mostly under processing agreements in accordance with contracts arranged by the international parent companies of the oil companies operating in Trinidad. Prior to 1972 the two most important oil companies in Trinidad were Texaco Trinidad Limited and Shell Trinidad Limited which owned 100 per cent of export refining capacity and accounted for all

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[1] <u>OPEC Information Bulletin</u>, January 1973, p. 13.

crude imports. Together with B.P. Trinidad they accounted for almost all crude produced in the country. However, since 1972 Amoco of Standard Oil (Indiana) has emerged as the single largest producer of crude oil (33.9 per cent of total production in 1973).

Prior to 1956 Trinidad's primary markets for refined products were located in the United Kingdom and Western Europe. However, changing conditions in the factor and product markets caused major adjustments in the marketing strategies of the multinational oil companies with the net result that after 1956 Trinidad's principal market became the U.S.A. This geographic redistribution of market shares was accompanied by a major switch in asset ownership from British to U.S. companies. The change from a colonial government to self rule did not initially bring with it a transfer of control of the oil resources to local hands. Because the Trinidad oil industry has always been controlled by international oil companies; and because of the hierarchical nature of the administrative structures of the world oil industry, decisions pertaining to the development of Trinidad oil resources would seem to have been made outside Trinidad. As policy decisions affecting the industry may have tended to be dictated by the global needs of the multinationals rather than domestic needs, serious questions are raised about the meaning of sovereignty and the possibilities for the economic transformation of a small petroleum host country like Trinidad that relies on revenues from its oil industry for financing economic development and at the same time continues to be dependent on foreign capital and expertise to develop its hydrocarbon resources. It is important, therefore, that one examines the relationship between the transnationals and the government and analyses the effectiveness of the government's bargaining policies with the oil companies at various phases of the development of the country from dependency (1956) to nationhood (Republic of Trinidad, 1976). In this respect studies in the extractive industries (especially copper and petroleum) provide us with the a priori expectation that the balance of power with respect to the control of these resources and the redistribution of total net benefits derived from them will swing over time from the transnationals to the host government or groups within the host country.[1] Theodore H. Moran[2] attributes this tendency to (1) the reduction in uncertainty (risk) after the initial commitment of capital and technology to the project; (2) the reduction in the country's knowledge gap with respect to the industry (i.e., the decrease in the companies' technological monopoly), and its increasing bargaining capacity; and (3) the push-and-pull of the dynamics of interest groups within the country.

The line of thought presented above suggests an historical analysis of the industry and a careful examination of its viability

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[1] See following works: Theodore H. Moran, Multinational Corporations and the Politics of Dependence: Copper in Chile (Princeton, N.J: Princeton University Press, 1974); Constantine V. Vaitsos, Intercountry Income Distribution and Transnational Enterprices (Oxford: Clarendon Press, 1974); Edith Penrose, The Growth of Firms, Middle East Oil and Other Essays (London: Frank Cass & Co. Ltd., 1971); Charles P. Kindleberger, American Business Abroad. Six Lectures on Direct Investment (New Haven and London: Yale University Press, 1969).

[2] Moran, pp. 135-172.

in the world oil economy, especially its position in foreign trade.[1] The viability of Trinidad's oil industry in foreign trade is critical to its economic development; changes in world oil prices and output have always been highly correlated with prosperity and stagnation in Trinidad. For instance, the oil sector contributed 28.6 per cent to Trinidad's GNP in 1952. This increased to 32 per cent in 1958 reflecting the increases in world oil prices and the expansion of crude output and refinery throughput in Trinidad. The decline in world oil prices after 1957 up to the Tehran Agreements in 1971 is strongly correlated with the decline in the rate of growth of the real GNP from an average rate of 9.7 per cent between 1955 and 1961, to just over 3 per cent between 1962 and 1966. Similarly, falling world prices after 1957 coinciding with a decline in output from Trinidad reserves resulted in the sector's smaller contributions to government's financing of its Second and Third Five-Year Plans. The oil industry's contributions to government recurrent revenues declined from 45 per cent in 1958 to 18 per cent in 1972 (Table 4.26).

While one does not expect Trinidad will escape the effects of a sustained decline in world petroleum prices, one expects it to benefit from major improvements in the world market. One must consider whether Trinidad can avoid having to bear a greater proportion of the burden implicit in price decreases and whether it can

[1]The well-known world oil consultant, Walter Levy, conducted a study in 1959 in which he examined the hypothesis that "the viability of Trinidad's oil operations depends on its position in foreign trade." The Trinidad Oil Economy (Government Printing Office: Trinidad, 1959), p. 1.

ensure that it benefits fully from an increase in world oil prices and/or improved domestic supply conditions. In examining these questions it is not sufficient to simply study the viability of the country's industry in the world oil market, for if the multinationals control the local industry such an approach is equivalent to an assessment of the viability of the oil companies in the world oil market. It is essential, therefore, that one also evaluates government policies with respect to foreign investment in the petroleum sector and examines the effectiveness of government bargaining with the companies regarding the distribution of the benefits derived from the development of the country's hydrocarbon resources. One needs, therefore, to compare actual policies against feasible alternatives. These alternatives will be determined by some bargaining model which incorporates the will to exercise power as an essential dynamic element of the decision criteria. Theodore H. Moran describes this exercise of power as a process of joint maximization; that is to say, "a process of on-going mutual adjustment in which foreign investors act in accord with their own best interests when they are in the strongest position and accede to necessity when they are weak and exposed while host governments accede to necessity when they are weak and act in accord with their own best interests when they gain strength."[1] Moran recognizes that maximization of the direct and indirect benefits to the country from the foreign controlled primary export sector is a matter of the exercise of power which does not

[1] Moran, p. 169.

necessarily rest with a single decision-maker but may rather be the outcome of the struggle of diverse groups, of successive administrations and their adversaries, to maximize their own power, position, or wealth as well as to advance their own conceptions of the national interest through the manipulation of policy.[1] It will be important, therefore, to examine the interplay of political and economic interests in Trinidad as determinants of domestic petroleum policy; and attempt to analyze the reasons for observed deviations from optimum policies, especially deviations which are clearly not attributable to ignorance or error.[2]

In summary, the purpose of this thesis is to carry out a careful analysis of Trinidad's petroleum industry in the world oil economy. It will present an historical analysis of the industry relating events in it to events in the world oil market and economy. It will evaluate existing government petroleum policies to see whether they conform to alternative policies suggested by optimizing strategies or a conflict bargaining model. That is, government petroleum legislation and changes in the legislation will be tested to determine whether in a short-term sense they maximize the net direct benefits from the oil industry to the country, and whether in

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[1] Ibid.

[2] Enrique A. Baloyra argues that in Venezuela the more "progressive" regimes advance the national interest more than the less progressive groups in bargaining with the oil companies. This cannot be generalized as a principle, however, since Moran shows that in Chile all groups in spite of ideology were very aggressive in dealing with the multinationals. See Enrique A. Baloyra, "Oil Policies and Budgets in Venezuela 1938-1968." Latin American Research Review, IX (Summer 1974), pp. 28-72.

the longer term (and in the absence of perfect knowledge) they are consistent with some acceptable development strategy for Trinidad and Tobago. The analysis will make critical use of related studies and selected techniques of economic theory, paying particular attention to theoretical differences due to the small scale of the economy of Trinidad. The major theoretical analysis is presented in Chapters 2 and 3 but important elaboration of principles stated in these chapters will for convenience of exposition be presented elsewhere in the text.

In order to assess whether the country is maximizing the net direct and indirect benefits derived from its petroleum export sector one must first have some measure of these benefits. That is, one must be able in an oligopolistic market situation to determine the size, among other things, of the effective taxable earnings rather than solely the declared ones. Moreover, one must be able to derive some measure of the different comparative strengths of the industry and define the limits for applying bargaining power over different periods of time. A knowledge of price and cost of production and refining is, therefore, essential to the analysis. A detailed study of cost in the Trinidad industry is, therefore, carried out deriving incremental cost per daily barrel of crude (supply price) and refining margins. These costs enable one to determine the expected rents (price-cost gap) to be derived from investment of capital in the additional barrel of crude for any given market price structure. These cost estimates make it possible to assess the viability of the Trinidad industry in various markets unencumbered by the technical research problems created by the existence of transfer pricing, and other forms of tax avoidance. It establishes an effective basis for assessing government tax policies with respect to the industry; and makes it possible, together with considerations of related transportation costs and tariffs in various markets, to get a better understanding of other important comparative advantages enjoyed by the industry and hence the effective bargaining strength of the government.

The use of incremental cost per additional daily barrel of crude produced gives an approximate measure of marginal cost. It is a superior measure of cost to the accounting averages so loosely used in many studies on oil. By using the Adelman model[1] for measuring incremental cost one can estimate costs which are comparable with other countries for which such costs are derived, whereas accounting averages differ widely from company to company and country to country, and for this reason are not comparable. Most important, however, it is on the basis of marginal cost that decisions to invest (increase output) are thought to be made, not average cost. According to Fritz Machlup "... the proportion of all business decisions that are based upon a marginalist way of thinking is sufficiently large to justify the economist's use of the marginal calculus in his model of the firm as a description of the process by which businessmen reach

[1] M. A. Adelman, The World Petroleum Market (Baltimore and London: Resources for the Future Inc., The Johns Hopkins University Press, 1972).

their decisions on prices and outputs."[1] Machlup argues further that even if businessmen were "thoughtlessly applying rigid rules of thumb, it might still be possible for the application of the marginal calculus in the theorist's model of the firm to yield results more closely in conformance with the observed actions of reality than the results obtained on the basis of any other postulate."[2] This marginalist view, of course, will be modified when considerations of social cost enter the decision making process, but ultimately under competition it is marginal cost that determines how decisions will be made.

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[1]Fritz Machlup, The Economics of Sellers' Competition (Baltimore: The Johns Hopkins University Press, 1952), p. 32.

[2]*Ibid*.

CHAPTER 2

THE ECONOMICS OF WORLD OIL

The world petroleum industry is a complex international economic structure. The industry produces from crude petroleum feedstock over 5,000[1] separate products, most of which are consumed by the highly developed countries either as (1) fuel (gaseous and liquid) for the production of energy, or (2) raw materials to feed the petrochemical[2] and electrochemical industries. The industry is characterized by a large volume of trade in crude and petroleum products which is unparallelled by any other mineral or other commodity in world trade. The international nature of the industry derives in part from the fact that a large proportion of the world's reserves are found in a few "under-developed" countries from which crudes are exported to refineries located in or near the major consumer markets in Western Europe, the U.S.A., Canada and Japan, where a high volume of demand for energy inputs is supported by continuous growth (GNP) associated with the economic transformation of their economies and financed by the rapid capital accumulation

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[1]Edward M. Davis, Canada's Oil Industry (Toronto: McGraw Hill Company of Canada Ltd., 1969), p. 3.

[2]G. Monnot, "Utilization of Petroleum Products", Techniques of Petroleum Development: Proceedings of United Nations Inter-regional Seminar on Techniques of Petroleum Development (U.N., New York, 23 January to 21 February, 1962), p. 227.

generated by that transformation.

It is not surprising, therefore, that the production and marketing of crude oil has been accomplished by the expansion of European and American capital abroad. It is this phenomenon of foreign investment through the multinational corporations (i.e., the internationalization of capital) that best characterizes the international form of the industry. All the processes from exploration to marketing are carried out by six large international producing enterprises ("majors") and a fringe of smaller but still very large units (some government owned). In general the "majors" (Standard Oil Company of New Jersey and affiliates (Esso); British Petroleum; Royal Dutch/Shell group; Texaco; Standard Oil of California (Socal); Gulf Oil Corporation, formerly Socony Mobil) consist of a top holding company with numerous associated and subsidiary operating companies.[1]

These transnational corporations are highly integrated vertically and horizontally and can exercise a great amount of power by virtue of their wide geographic dispersion and control of technology and capital. Professor Edith Penrose describing their power and corporate structure defines them as:

> ... autonomous international organizations with very widespread influence in international economic relations and often possessing great power. They are autonomous in the sense that they are effectively accountable to no outside body for their actions, although they are constrained by the policies of governments, by the actions of competitors, by the demands of

[1]The only exception is Royal Dutch/Shell which consists of two holding companies, one Dutch and one British: 60 per cent share to Royal Dutch and a 40 per cent share to Shell.

financial markets, and by similar considerations. They are international in the sense that they operate in many countries in the world, although such firms do in fact have a 'nationality' - that of the country in which the parent company is incorporated. The several subsidiaries are themselves often (but not always) incorporated in the countries in which they operate; if they are locally incorporated they can be looked on as 'nationals' of these countries, but they cannot independently form their own policies respecting many very important aspects of their operations. Finally, international firms are organizations, in the sense that the activities of the international group are carried on within an overall administrative framework and subject to overall policies laid down by their central administrative units.[1]

Two major behavioural characteristics of these firms are that the activities of the branch plants are carried on subject to overall policies laid down by their central administrative units, often backed by powerful home governments, and that they maximize retained funds net of dividends and taxes[2] over their global operations. An important corollary of the objective of maximizing retained funds net of dividents and taxes is that the companies always act to minimize their international tax burden. The fact that each multinational firm by definition, and de facto, has branches in many different countries puts it in a powerful position to exploit[3] colonized territories (controlled by the company's home government) or weak underdeveloped countries. The multinational can achieve these objectives either

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[1]Edith Penrose, "International Economic Relations and the Large International Firm," The Growth of Firms, Middle East Oil and Other Essays, p. 93.

[2]Ibid., p. 29.

[3]Use their superior power to prevent a territory or the nation state from acting to achieve its "fair" share of total rent.

directly as in the case of colonial territories or indirectly through economic boycotts,[1] bribery and/or corruption, as well as the skillful manipulation of the differential commercial and tax policies in the various producing and refining countries to their own advantage. Moreover, the multinationals have been able to establish and maintain an hierarchical world system through which the long-term goals and objectives of the enterprise is effected.

Charles P. Kindleberger, looking at the phenomenon of the rapid growth of direct investment by American firms abroad, stated that the superior technology and organizational techniques of the multinationals would ultimately lead to a world economy in which the role of the nation state as an economic unit will be replaced by the multinational corporation.[2] It was left to Stephen Hymer to formulate a model of such a world. Hymer,[3] applying location theory to Chandler and Redlich's scheme for analyzing the evolution of corporate structures,[4] formulated a three-level model of a world economy dominated by about 500 major international corporations with

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[1]The potential power of the international oil companies was demonstrated in the companies' major boycotts against the Bolsheviks in September 1922, Mexico in 1938, and the dramatic success of their boycott of Iran's oil exports in mid-1951. Michael Tanzer, The Political Economy of International Oil and the Underdeveloped Countries (Boston: Beacon Press, 1969), pp. 319-326.

[2]Kindleberger, p. 207.

[3]Stephen Hymer, "The Multinational Corporation and the Law of Uneven Development," Economics of World Order, ed. J. N. Bhagwati, (New York Law Fund, 1970), pp. 122-130.

[4]Alfred D. Chandler and Fritz Redlich, "Recent Developments in American Business Administration and their Conceptualization," Business History Review (Spring 1961), pp. 1-27.

their top management or major decision functions (i.e., setting goals and planning) concentrated within a few large cities close to the world's large financial markets. He called this level I. He argued that at level II there would be the regional headquarters responsible for the co-ordination and administration of day to day operations and the general implementation of policies. These were expected to be concentrated in the lesser cities where white collar workers are more readily available and communication facilities exist. Other regions and towns close to the source of raw materials, natural resources, and skilled labour act as production and local distribution centres (level III). The system can act to achieve its primary objectives on a global scale because senior management at level I controls the selection of the executive personnel and because, through budgeting, they allocate the funds to the operating divisions,[1] and determine the choice of technologies at various levels.[2]

According to Hymer this type of world economy encourages a certain social ranking based on salary differentials. The lowest paid will be at level III and the highest salaries will be at level I. At both the metropole and the regional levels large numbers will be excluded from the benefits ~~of the system~~. Moreover, the assumed need for common background and ease of communication at the high policy level (level I) leads to ethnic biases in the distribution of benefits

[1]Ibid., p. 120.

[2]The multinational can preserve its monopoly position by tying the sale of new advanced technology to that of earlier vintage. See Vaitos, pp. 8-18.

in the system as a whole, i.e., the higher up the hierarchy one goes the purer the ethnic concentration at the policy making level. The model, therefore, has certain inherent weaknesses of a socio-political nature that provoke challenges to its existence as a viable world system.

Hymer concludes that the multinational corporation because of its great power to plan economic activity, represents an important step forward over previous methods of organizing international exchange; it eliminates the anarchy of international markets and brings about a more extensive and productive international division of labour and opens up greater possibilities for social and industrial development. However, because of an almost single minded commitment to profit maximization, and the ability to establish branches in so many countries, thereby creating a vast network of connections and influences, it destroys the possibility of national seclusion and self-sufficiency, erodes the cohesiveness of national states[1] and creates a universal dependency of the "have nots" on the "haves". It creates hierarchy rather than equality, and it spreads its benefits unequally."[2]

While there are strong forces making for the kind of world market economy described by Hymer's three-level model there are more than sufficient countervailing forces to support the opposite view .

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[1]This view is ably supported by Professor K. Levitt's work Silent Surrender: The Multinational Corporation in Canada (Toronto: MacMillan Company of Canada, 1970).

[2]Hymer, p. 133.

expressed in the Marxist literature that ultimately the state will be the sole economic agency. The political economies of China, Russia and Cuba are cited as evidence in support. But quite apart from the Marxist thesis of political economy, the concept of sovereignty as described through the right to life, liberty and property which finds its highest form in a non-repressive collective (the nation state) poses a challenge (anti-foreigner syndrome, riots, guerilla war, etc.) to this threat of domination. The degree of sovereignty enjoyed by the nation state (assuming the state optimizes the individual's sovereighty) defines the measure of protection that the individual enjoys from aggressive external forces. The three-level model of international corporate organization is bound, therefore, to induce counter strategies from nation states as they move to negotiate the maximum benefits for their nationals from international exchange.

In carrying out its function the modern state often extends its role well beyond that envisioned for it in the classical free enterprise economy. The modern state often acts as an entrepreneur, and in competition with other decision makers in the international goods and factor markets. Robin Murray[1] distinguished six economic res publica, or state functions. (1) The guaranteeing of property rights, (2) economic liberalization, (3) economic orchestration, (4) input provision, (5) intervention for social consensus, and (6) the management of the external relations of a capital system.

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[1]Robin Murray, "The Internationalization of Capital and the Nation State," <u>The Multinational Enterprise</u>, ed. John H. Dunning, (London: George Allen and Unwin, 1971), pp. 268-271.

The latter function, management of external relations, is very important to the analysis in view of the emphasis placed on government as an economic agent. Murray defines this function as either aggressive: "... the support of the state's own private capital in its expansion into foreign economic territorial space;"[1] or defensive: "... defending quasi-monopolistic positions established by domestic capitalists relative to foreign capital."[2] The instruments of these strategies are identified as military power, foreign aid, commercial sanctions, financial sanctions, government controls within domestic territory.[3] In short, there is a wide range of options available to government that a true believer in the sanctity of the competitive free enterprise model would consider "political" (i.e., outside the market system) as opposed to economic. However, in a real world situation where Paretian optimality is not likely to be attainable the view is taken that a government's decision to select a given strategy (or set of options), which has in the view of the state a high likelihood of achieving a set of long run national economic objectives, constitutes a rational economic decision within the given market structure and is subject to critical evaluation on the basis of a dynamic theory of international economy. As the dynamic process of the "state" in transition from dependency to nation statehood evolves new patterns of relationships are revealed in the international goods and factor markets as the governments of developing

[1]Ibid., p. 271.

[2]Ibid.

[3]Ibid., pp. 272-273.

countries in their search for economic sovereignty use their power to alter old constraints in order to increase the likelihood of achieving national economic and social objectives. It is consistent with rational economic behaviour if a government (sovereign state) in its role as an economic agent formulates and implements strategies to ensure that a natural resource within its political boundaries is managed in such a way that its citizens derive over time the maximum net benefits possible from its sale and/or rental.

Imperfection in the world oil market makes it possible for crude oil to sell at a large profit margin. A substantial part of this surplus represents a pure rent[1] which the market mechanism is unable to allocate between the host country and the multinationals, i.e., the owners of the resources and the owners of capital and technology. Because of the absence of such a market distribution mechanism these rents have become the object of a dispute between host countries and companies as they resort to conflict bargaining as a means of dividing the surplus profits earned in crude markets. The host country has several strategies available to it for extracting its share of the surplus. Theoretically it could nationalize the oil industry. In such a case it would appropriate all of the rents. While this is a feasible solution the host country may not be able to achieve it. There are, however, other

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[1]Raymond F. Mikesell, ed., "Conflict in Foreign Investor-Host Country Relations: A Preliminary Analysis," Foreign Investment in the Petroleum and Mineral Industries, Case Studies of Investor-Host Relations (Baltimore: Johns Hopkins University Press, 1971), pp. 29-55.

feasible solutions involving joint production and ownership arrangements which are more possible to achieve. These are usually combined with various tax instruments (bonuses, surface fees, income taxes, royalties, state participation) which are consistent with the country's social and economic objectives. In general one would expect that the policies which are applied at any point in time will reflect the relative bargaining strengths of the country and the companies. For instance, in the early exploratory stages of the industry the government does not know whether there is oil or not. If the country lacks the skills, technology and capital required for the development of the industry from such a risky stage it will find itself at a disadvantage when bargaining with the oil companies which command a strong position. At this stage the host country's petroleum policies are weak. Consequently, a policy of nationalization may be most inappropriate.

However, after oil is found and oil fields delineated the initial advantage that the companies enjoyed as a result of uncertainty (geological risk) is considerably diminished. This is further reduced as the country accumulates technical knowledge of the industry and as local interest develops the competence and the will to systematically exploit its new advantage. According to this process the host country starts in a weak bargaining position and will therefore accept the smaller share of the potential surplus to be earned in the crude markets. However, over time one observes, especially in the extractive industries,[1] a shift in the balance of power away from the companies

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[1]Moran, pp. 8-11.

and the consumer countries towards the host countries with a commensurate increase in the share of the rents going to the host country. Eventually it may be possible, therefore, to nationalize the industry provided that action achieves the objective of maximizing the net benefits to the country.

Competition and the world oil market. Classical and neoclassical models of "market competition" deal with the market in the narrow context: situations in which price is determined by the interplay of supply and demand in a space and time situation where buyers attempt always to maximize their consumer surplus and suppliers always act to maximize their net profits. In such cases, when for a given level of income and demand no single supplier can improve his profit by changing supply or prices; when there is no tendency for new firms to want to enter the industry or established firms to disappear out of it, the market is said to be in full equilibrium and all firms are earning just a normal profit.[1] This classical case of perfect competition requires an infinite number of buyers and sellers in the market, perfect information, identical and increasing cost conditions for all suppliers. The market was by assumption inherently stable and once the system was disturbed from its place of rest competition induced by the optimization principle pushed it towards the same or some other equilibrium position.

In the world oil economy the perfect competition model as

[1] Joan Robinson, The Economics of Imperfect Competition (London: MacMillan & Co. Ltd., 1950), pp. 92-93.

stated above is inapplicable, if only for the simple reason that a state of perfect knowledge never occurs: most decisions must be made under varying degrees of uncertainty (geological, engineering, political), and conflict pertaining to market shares and distribution of rents, etc. The world oil market is characterized by competition among the few. It is possible that in such a market situation, if there is a sufficiently large number of firms in the market, competition (rivalry) may be intense enough to push prices down towards marginal costs. However, in the world oil market price and output policies are generally believed to have been not optimal (in the Paretian sense), for the market has been concentrated in the hands of a very few large vertically and horizontally integrated companies capable of establishing effective barriers to competition from smaller fringe companies and newcomers. Prior to the formation of OPEC they set the level of prices above cost by a process of implicit bargaining.

According to William Fellner[1], in an oligopolistic market situation involving a few firms there will be implicit bargaining between sellers, which will tend to lead to implicit agreements. Moreover, he says uncertainty about expected total available joint profits in the markets in which the rival firms do business, as well as uncertainty about the relative skills of competitors, make firms

[1]William Fellner, Competition Among the Few (New York: Augustus M. Kelley, 1965), Preface v-vii. See also Fritz Machlup, Economics of Sellers' Competition (Baltimore: Johns Hopkins University Press, 1952).

reluctant to trade direct "market shares" for higher joint profits. That is, firms are more likely to engage in implicit bargaining for individual market shares than for a share in the available maximum profits of a pooled aggregate of firms. The existence of these uncertainties minimizes the likelihood of the formation of a successful cartel among the companies in a dynamic oligopolistic market model. So that in general firms in such a situation tend to maximize individual profits along their market sharing demand curves taking care not to violate the implicit agreements governing their relationships with their rivals. The essential property of these implicit agreements or "approved" methods of market share competition is that, in contrast to price cutting, they require skill as expressed in product change and advertising. In the oil industry this kind of competition is easily identifiable in the products market. One may conclude, therefore, that when there is a small group of firms in a competitive market situation there is very little or no price competition and that under competition among the few, downward pressure on prices comes mostly from surpluses caused by established companies miscalculating future demand, or from new competitive fringe companies entering the market under the lure of the "price-incremental cost gap". Adelman places great importance on the price-cost gap as the major force in the world oil market pushing prices toward marginal cost. He argues that this market price is not an equilibrium price, therefore, it is not stable and that it may be displaced or disrupted at any time by "one or more self-serving individuals who will try to appropriate the price-incremental cost gap,"[1] but he admits that it can be maintained if "strong enough barriers against the forces of competition can be established."[2]

M. S. De Chazeau and A. E. Kahn[3] identified vertical integration as the major deterrent to competition in the industry. M. A. Adelman more recently, however, made the important observation that integration, in and of itself, does not constitute an effective barrier to competition; but rather it is the competitive advantage represented by "integration into crude produced with wide profit margins"[4] in the Middle East, Venezuela and Africa that puts at the disposal of the "majors" the power to keep out potential or drive out existing competitors by accepting, if necessary,over a long period of time composite product prices below incremental refining cost per barrel. In such a situation rents are earned only at the level of crude production. The independent refiner cannot, without adequate independent supplies of crude oil, exist for long in the face of severe competition in the product market. In spite of these structural and organizational barriers to competition Professor Adelman, like Professors Hartshorn and Penrose, believed that prices would in the long run gravitate towards incremental cost in the Middle East because of the great temptation to increase output to take advantage of the very large profit margin represented by the

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[1]Adelman, The World Petroleum Market, p. 14.

[2]Ibid.

[3]Melvin S. De Chazeau and Alfred E. Kahn, Integration and Competition in the Petroleum Industry (New Haven: Yale University Press, 1959), p. 115.

[3]Adelman, p. 99.

price-cost gap. These predictions were based on optimistic pre-1970 forecasts of world recoverable reserves in the eighties and nineties. More recent analyses and forecasts of world reserves presented at the Ninth World Petroleum Congress[1] have been much less optimistic. It is predicted that with 75 per cent of the Middle East total recoverable reserves estimated to be already discovered, worldwide crude oil production is expected to peak sometime in the late 1980's or 1990's and decline thereafter. Long-run elasticities of supply are, therefore, expected to be much smaller than those implied in the analysis supporting the thesis of falling world crude oil prices. According to theorists predicting falling prices, world potential reserves were expected to be more than adequate to meet expected demand.[2] Future prices alone, therefore, were expected to regulate the supply of crude oil by determining the optimal level of investments in the development of known reservoirs, and the optimal level of investments in exploration. It is argued that market uncertainties associated with future prices in an oligopolistic market put pressure on the companies to quickly recover capital sunken in exploration and development. Established companies will tend to get crude out of the ground and to the market before potential rivals enter the market lowering prices. It was expected that the host governments would continue to actively

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[1]Carl J. Lawrence, "Supply Problems, Technical Development Tackled by World Petroleum Congress," The Oil and Gas Journal, May 25, 1975, pp. 62-63.

[2]Adelman, pp. 37, 38.

promote policies of increasing output to maximum capacity because of their growing dependency on oil revenues to finance economic development. These combined pressures were expected to create excess supply thus pushing prices downward to incremental cost by a process of price chiselling. This argument underestimated the capacity of the governments of the oil producing and exporting countries to exercise effective monopoly power in the world oil market through explicit agreements among themselves as an international oil cartel (OPEC) controlling supply in that market and consequently price. Most oil experts recognized the potential of such a cartel; but prior to 1971 they tended, on the basis of the history of failure associated with most cartels in commodities, including oil, to heavily discount the possibility of long term success for the OPEC cartel.

Adelman spoke of the likely long-term impact of the actions of the Organization of Petroleum Exporting Countries (OPEC) on prices in the following terms:

> ... the governments are less able to operate a successful cartel than the companies. Not only do they lack the companies' experience, but they also lack the intercompany contacts at two levels: crude production and sales (the joint ventures) and the refined product markets. These contacts are necessary for sound decisions on when to meet competition, when to beat it, when to disregard it. ... Furthermore, their entry will increase the number of competitors at both levels.[1]

thus tending to increase competition and reduce prices.[2]

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[1]Adelman, p. 224.

[2]Ibid.

Writing on the eve of the Tehran and Tripoli settlements in 1971 Adelman underestimated the strength of future world demand for energy relative to available supplies. He also underrated the ability of the governments of the oil producing and exporting countries to acquire production and management skills and to act in concert "... to exact even higher prices despite the wide (and now even wider) margin between prices and the real costs of production."[1] He also discounted too heavily the capacity for collusion between the oil companies and the host countries against consumers. The success of the oil producing and exporting countries (OPEC) in exacting higher prices in spite of the wide margins already existing in the world oil markets between cost and price at 1969 underlies the bargaining strength of the producing countries and the degree of monopolistic power they amassed in the twenty year period between the Iranian crisis (1951-54) and the Vienna Conference of October 1973. 1971 saw the end of the era of cheap fuels and marked the advent of a "sellers market" replacing the buyers market of the 1960s.

In the present world oil market situation OPEC effectively controls supply and sets prices. How effectively they could maintain this control in the future depends on (1) the ease with which consuming countries can economize on the use of petroleum based energy and the nature of the shifts in the elasticity of demand for fuels versus other energy sources, (2) the stability of the cartel in the face of major reductions in world demand at present prices.

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[1]See Foreward to M. A. Adelman, The World Petroleum Market, by Sam H. Schurr, p. v.

With respect to (1), the shift to other forms of energy cannot be complete nor immediate. The expected rate of technological break-through in the development of alternative sources of energy is a critical factor in future price reductions for crude oil and its products. Some idea of the length of time involved can be obtained by examining the time gap between present technology and the new technology required for producing alternative sources of energy. The upper limit of that time gap is a point in time at which, based on an assessment of present knowledge, it would be possible to perfect and develop new methods of deriving energy from any one or all known possible alternative sources. The time gap between the present technology and the development of the new technology which would increase the elasticity of supply relative to demand is a function of the present stock of knowledge and the rate of capital investment in research and development (R. and D.). The experts agree that long-term alternatives to crude oil as a source of energy are restricted to nuclear fission, solar power, and hydrogen economy. Research is going on now on all these sources, but at present research and development levels one cannot expect any major change in the situation for the next twenty-five to forty years; with major capital investments of \$5-\$10 billion in research and development (up to and including the first self-liquidating plant investment) the gap can be shortened to twenty to twenty-five years (see following table). It is obvious that the cartel can effectively raise prices now to at least the level of expected incremental cost (long-run supply price) of producing crude oil in the consumer markets. It can pursue the policy over a time interval of about twenty-five years, or up until at least the year 2000, provided there are no major new finds of oil reserves; but even so, this still gives a probable time lag of about ten to fifteen years before any such new reserves are brought to market.

TABLE 2.1

ESTIMATED TECHNOLOGICAL TIME GAP

FOR ALTERNATIVE SOURCE OF ENERGY

Alternative Sources of Power	Time in which available as major commercial source	
	With present R. & D. funding	With R. & D. funding $5-$10 billion
Nuclear fission	25-40 years	20 years
Solar power	30-35 years	20-25 years
Hydrogen economy	Will never be available	20 years

Source: Astronautics and Aeronautics, "Prospecting for Energy," a publication of The American Institute of Aeronautics and Astronautics, August 1973, p. 28.

This suggests that long-run elasticities of demand at higher prices are likely to be significantly larger than short-run elasticities. Recent empirical results for the U.S. market and the world oil markets show long-run elasticities for gasolene, kerosene, distillate and residual fuels quite responsive to price changes.[1]

There is some evidence[2] that at present high prices short run demand elasticities, especially in the household and industrial sectors, are much greater than at previous lower prices.[3] Since the demand for crude oil is a derived demand these empirical results support the a priori expections that major reductions in demand for crude oil could occur even in the short term. If the cartel is unstable major reductions in demand in the household sector at present high prices cannot be easily distributed among the members of the cartel, primarily because of the unwillingness and inability of some members to absorb the loss of revenues and social cost involved. Individual self serving members in the cartel may ultimately seek to avoid penalties by making independent long term market arrangements. This will of course lead to competitive rivalry among the members of the cartel and a general weakening of prices in the market. The present structure of prices in the market can, therefore, only be maintained if the OPEC countries can overcome any instability associated with a producers cartel arrangement. Some theory of cartel behaviour is, therefore, essential if one is going

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[1]Michael Kennedy, "An Economic Model of the World Oil Market," The Bell Journal of Economics and Management Science (Autumn 1974), vol. 5, no. 2, p. 558. Kennedy derived elasticities of -1.0 for gasolene, -0.5 for kerosene, -0.5 for distillate, and -1.0 for residual fuels in determining demands in world markets. Similar results were derived for the U.S.A. market by The Data Resources Incorporated Energy Policy Model: A Detailed Description (Data Resources Inc., Lexington, Mass.), 1974. See also Knop and Roorda, p. 805.

[2]*Ibid*.

[3]This reflects improvements in efficiency in the use of energy as a result of the increased cost of fuels.

to predict long-run price behaviour in the world oil market. If one assumes that the cartel is unstable then no doubt prices will eventually converge towards incremental barrel cost. Nevertheless, since in the long run the world recoverable reserves cannot be reasonably assumed to be unlimited the largest low cost producers (i.e. the Persian Gulf countries) will still be able to regulate prices to some extent by withdrawing crude from or putting it on the market. If on the other hand the cartel can work out an internal system of production sharing and financial subsidies for weaker members then prices can be maintained.

Eighteen oil consuming countries (excluding France) working on the theory that the OPEC cartel is inherently unstable in the face of major reductions in demand established the International Energy Association which set as one of its major policy objectives in 1975 the reduction of world demand for crude by two million barrels per day. Their expectations have not been realized because they did not take into consideration the huge stock of wealth that the cartel, and in particular some of its members, may have accumulated from increasing output and prices since 1971 and the fact that this may have reduced the utility of additional revenues per barrel for those members to the point that a reduction in revenues resulting from maintaining prices at present levels or even increasing them further may have very little effect on total utility. For these members (saver countries) their immediate cash needs are small relative to the flow of funds, and for them accumulating idle balances may be less desirable than leaving their oil in the ground. They are, therefore, likely to discount profits at a higher interest rate than the other members (spender countries) of the cartel whose cash needs to finance ambitious development plans are large.[1] What one has, therefore, is a two-part cartel in which the two groups (saver countries and spender countries) have different objectives and different degrees of bargaining power. Pindyck and Hnyilicza show that each one of the two groups will maximize the weighted sum of their respective sets of objectives (sums of discounted profits)[2] by co-operating in the setting of prices and the allocation of their shares of total output over time. They will reach some rational co-operative agreement on the market shares because failure to do this would mean their losing the opportunity to determine the level of crude prices relative to cost and to maximize the group's share of rents earned by the industry. The payoffs to each group under co-operative agreements is obviously much greater than payoffs attained at the threat point, i.e., no agreement and ruinous competition. In fact any solution that would divide the associated net incremental gains in a proportion directly related to the losses incurred by not making any agreements would be more acceptable provided both parties are rational and have the ability to

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[1] Pindyck classified the saver countries as Saudi Arabia, Libya, Iraq, Abu Dhabi, Bahrain, Kuwait and Qatar; the spender countries as Iran, Venezuela, Indonesia, Algeria, Nigeria and Ecuador. Robert S. Pindyck, Gains to Producers from the Cartilization of Exhaustible Resources (Cambridge, Massachusetts: Massachusetts Institute of Technology, May 1976), MITEL76-012WP.

[2] Esteban Hnyilicza and Robert Pindyck, Pricing Policies for a Two-Part Exhaustible Resource Cartel: The Case of OPEC (Cambridge, Mass: M.I.T., April 1976), MITEL76-008WP.

make binding agreements. Pindyck and Hnyilicza[1] show that the output strategy which ensures optimal prices over time requires that the saver countries in the cartel produce nothing for the first ten to twelve years while the spender countries produce the entire residual market demands facing the cartel.[2] When the reserves of the spender countries are exhausted the saver countries will then begin to produce. In both cases the spenders and savers can exploit the slow lag adjustment in the market to price increases. The authors suggest a more practical policy whereby saver countries initially cut back production more than spender countries but then expand production after ten or fifteen years either with agreed-upon cutbacks by spender countries or with a drop in prices. This policy describes more accurately what is happening in the world market at present where Saudi Arabia, Iraq and other saver countries have been absorbing the initial cutbacks in world demand for oil, while Iran, Indonesia and others maintain production (Venezuela being the exception). More recently Saudi Arabia indicated its intention to increase output and hold prices to a 5 per cent increase while the other countries announced their intention to reduce output and put prices up by 10 per cent. The agreement of the cartel members to accept differential price arrangements but make compensating changes in their ratio of production shares is consistent with the model of cartel behaviour described above. As long as the cartel can continue to behave in this

[1] Ibid., pp. 14-23.

[2] The cartel is considered as a residual supplier meeting demands that competitive fringe suppliers cannot meet.

consistent economic manner prices will at least remain at about U.S. $12.00 per barrel in real terms. The power of the cartel to maintain or increase its present level of prices will in the long run depend on the rate of technological progress in the world energy sector. That is, the longer it takes to develop the technology necessary to produce alternative sources of energy the more effectively will the cartel be able to control prices in the world oil market. In the short run prices cannot be increased beyond some level which will ruin the world economic system. Beyond the year 2000 it is conceivable that prices can exceed U.S. $20.00.[1]

The above analysis strongly suggests that fundamental changes in the structure and dynamics of the world oil market have taken place over time making it feasible to use a theory of competition (among a few firms) to explain price and output policies in some specific time period, and cartel behaviour to explain these policies at another. A brief historical view of the market from 1880 to the present will serve to support this hypothesis and allow us to examine the extent of any collusion between the companies and host governments against consumers of refined products.

The world oil market has fluctuated between monopoly and competition throughout the period 1880 up to the Iranian crisis (1951-1954). During that period the companies dominated the market. The principal dynamic factor making for competition in the market was the discovery of new oil reserves and the entry of newcomers to the

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[1]The following studies give price projections which support these speculations, and which in this author's view are more consistent with this analysis. Hnyilicza and Pindyck. Knop and Roorda, pp. 803-806.

market. By 1932, however, the majors had established firm control of the world's most important oil concessions and effectively controlled crude production and product sales. Between 1950 and 1956 high profit margins and access to new concessions in the Middle East, Venezuela, Africa and Indonesia attracted new and smaller international companies to the industry, i.e., the independents and consumer government owned companies.[1] The competition from these fringe companies eroded the market shares of the majors after 1956. For instance, in 1955 the majors accounted for 92 per cent of all crude produced outside the U.S. and the communist bloc countries; refined 81 per cent of petroleum products in that area; and accounted for 70 per cent of product sales in 1960 (Table 2.2). By 1971 their share of crude production declined from 92 per cent in 1955 to 72 per cent, while other companies increased their share of the market to 28 per cent. This decrease in output was also reflected in the majors' refining operations which declined from 81 per cent of market capacity in 1955 to 59 per cent in 1971.

For almost ten years after World War II, the so-called "Golden Years", very little occurred to disturb the structure of oil prices or fundamentally to alter the pattern of control of the industry. Professors M. A. Adelman and Edith Penrose both advance the argument that in the mid-fifties the world supply potential for crude oil, in terms of the development capital sunk in known reserves, by

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[1]Ente Nazionale Idrocarburi of Italy and France's Bureau de Recherche de Pétrole, known as ERAP (Enterprise de Recherche d'Activités Pétrolières) since January 1966.

TABLE 2.2

APPROXIMATE SHARES OF THE EIGHT MAJORS IN OIL

OPERATIONS OUTSIDE U.S. AND COMMUNIST BLOC AREA

(Figures are percentage of totals)

Year	Production	Refining	Product Sales
1955	92	81	n/a
1960	84	74	70
1965	76	58	66
1971* (7 majors)	72	59	63

Source: Z. Mikdashi, The Community of Oil Exporting Countries (New York: Cornell University Press), p. 49.

*Estimates based on data obtained from B.P. Statistical Review of World Oil Industry, 1971, pp. 6, 23; Petroleum Press Service, May 1973, p. 168; First National City Bank, Petroleum Department, Energy Memo, January 1973; United States Department of the Interior, Offices of Oil and Gas, Overview of Domestic Petroleum Supply Situation, March 2, 1973, p. 37.

far exceeded the demand at ruling prices. Adelman argues that the price increases in 1953 and 1957 initiated by the U.S.A. and promptly followed by many companies in the world market were not a response to competitive supply and demand; in fact both were continued in the face of over-supply resulting from excess capacity. The real cause can be attributed to barriers to trade and tacit collusion. Professor Penrose observes that, quite apart from tacit collusion among the companies to control supplies of crude on the world market, the effect of excess production capacity was masked by "... the

[1] Adelman, pp. 156-158.

consequences, first, of the Iranian conflict, which kept large amounts of oil off the market for three or four years, then the Korean War, and finally the Suez Crisis, which quickly followed and further disrupted oil supplies for a short period."[1] Up until about 1965 world supplies of crude oil were remarkably well adjusted to demand at ruling prices in spite of the existence of excess production capacity and the fact that prices were above the cost of finding and developing additional supplies of oil.[2]

In spite of this excess capacity, prices remained stable or increased up until 1957. The effect of this excess capacity and increasing pressure on prices by new producers (independents and government oil companies) began to make itself felt by the mid-fifties. The failure of an effective competition to materialize in the early fifties, despite the price-cost gap and the existing potential to increase supply at the ruling price, must be attributed to an exercise of monopoly by the companies.

The old established internationals, Standard Oil of New Jersey, Shell and British Petroleum made several attempts in the late twenties and the thirties to limit competition and to agree on market shares and prices. The best known attempt is the "As Is" or the Achnacarry Agreement of 1928. New discoveries in Venezuela, Saudi Arabia, Bahrain and Kuwait, however, frustrated this and subsequent agreements. The option open to Standard Oil of New Jersey, Shell and British Petroleum was to ensure that the newly discovered reserves would be

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[1]Edith Penrose, "Monopoly and Competition in the Petroleum Industry," The Growth of Firms, Middle East Oil and Other Essays, p. 191.

[2]Ibid.

in the hands of companies who had market outlets and would not go after other companies' markets and cut prices to dispose of their oil. Also, since some companies had more oil than they could sell in their respective markets, while others did not have sufficient, a pattern of co-operation developed among the companies to solve these problems. As a result one sees the rapid development of the producing consortium (joint ownership of producing companies) and long-term supply contracts as a part of the market clearing mechanism. Apart from this development of explicit co-operation in the market, the fact that there were so few companies meant that at the very least each group had considerable information about the plans of the others, and made it easy to ensure orderly movements or control over the rate of supply without explicit collusion among the companies, i.e., in the form of a cartel or otherwise. According to Adelman "... the structure of the industry was, and is, a barrier to competition."[1]

It is this power to exercise monopoly that the oil producing and exporting nation states set out to take over: what they want is more monopoly power not competition. The first major international battle between the Persian Gulf countries and the oil companies started with the Iranian crisis in 1951. That ended in the fall of Mosadeq. But by 1968 the OPEC countries could declare that the foreign oil companies should earn only the going rate of return on capital plus an allowance for risk.[2] This set the stage for a new

[1]Adelman, p. 100.

[2]OPEC Bulletin, "Declaratory Statement of Petroleum Policy in Member Countries," Res. XVI 90, August 1968, pp. 1-5.

series of conflict bargaining between the oil companies and the host-countries over the division of rents, and resource control. Between the Tehran and Tripoli Conference in 1971 and the Vienna Conference of October 1973 the price of Middle East crude oil increased by more than 300 per cent from an average price of about U.S. $1.85 to $8.00-$10.00 (f.o.b.) in world markets. The fact that oil taxes per barrel increased by more than 300 per cent between 1970 and 1973 to about $8.00 per barrel is evidence of the dramatic shift in the balance of monopoly power from the companies to the oil exporting nation states.

Government - company harmony. The protagonists in the world oil market game seemed to be poised for a major confrontation just before Tehran (1971). M. A. Adelman argues that the threats of the OPEC nations before January 20, 1971 would not have been credible in view of their failure to make mild attempts at production regulation work in 1965 and 1966. He argues that the OPEC nations were unprepared for conflict and that their unity would have been severely tested and probably destroyed. However, because the United States government capitulated and accepted the demands of the OPEC nations in exchange for a promise of stable and predictable prices, the threats became credible and thereafter they were guaranteed to be made often.[1] Whether Adelman is correct in his analysis and prescription of strategy for Tehran or not is academic at this point.

[1]Adelman, "Is the Oil Shortage Real? Oil Companies as OPEC Tax Collectors," in A Reordered World, ed. Richard N. Cooper (Washington, D.C: Potomac Associates, 1973), pp. 189-192.

What is important is that the companies and the governments of consuming countries decided to opt for a policy of co-operation rather than conflict. The relationship between the companies and the producing country governments became one of harmony[1] in the sense that the increases in taxes in 1971 and again in October 1973 by the OPEC countries were welcomed by the multinationals as an opportunity to increase their margins and returns on investment in both crude and products. Adelman provides evidence to show that from mid-1972 there could be no fear of shortages of oil and in fact that there was excess production capacity relative to existing prices.[2] The fact that prices have risen in spite of excess supply is strong evidence of collusion, not just between the companies but between the companies and the host governments. On one hand as individual competitors "... they are vulnerable to producing-nation threats to hit them one at a time."[3] On the other, "... as a group, they can profit by a higher tax through raising prices in concert;"[4] and "... the higher tax is that clear signal to which they respond without communication."[5] Despite the dramatic increase in taxes in January 1974 the majors' earnings increased so dramatically through price increases in the world product markets that it became a matter of grave concern to the consuming governments that consumers were paying an excessive penalty in this non-zero sum game involving conflict.

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[1] Ibid., p. 189.

[2] Ibid., pp. 182-187.

[3] Ibid., p. 189.

[4] Ibid.

[5] Ibid.

To summarize, we have considered the dynamic process in which the world oil market was transformed from a state in which competitive rivalry exists between the majors and less established small companies (the newcomers and independents) to a state in which a two-part cartel meets to regulate the prices of crude oil. The motivating force in the transformation from one state to the other can be attributed to the existence of huge economic rents in crude production.

Adelman[1] shows that no rents are earned in the transportation of crude; and that severe competition in the consumer segment of the world oil market keeps the rate of return in refining at a level 12 per cent or less. Under the competitive conditions that existed in the product markets during the period 1957 to 1970 it would seem clear, therefore, that rents were earned only in production. The existence of large profit margins at the production level has attracted new companies wishing to appropriate a share of the price-cost gap. To gain a share of existing markets these companies chiselled prices. In response, the majors yielded shares of the market rather than risk ruinous price wars. Once the newcomers gained access they moved quickly to consolidate their positions through vertical integration from production to refining. Eventually they began to observe the rules of implicit bargaining that characterized the structure of the market. Theoretically it would appear that newcomers would be attracted until the number of companies increase to the point that competition reduces the price-cost gap to zero.

[1] Adelman, The World Petroleum Market, pp. 103-130.

But the resource is an exhaustible mineral resource with a limited supply. This means that the likelihood of future threats from newcomers will be limited by the present low probability of finding new resources, and rising cost. Moreover, the host governments, finding the rents earned by this natural resource a major source of revenues for financing economic transformation, have a vested interest in taking over and maintaining the monopoly structure of the market. The potential net benefits from forming a producers' cartel of nation states is great enough to make it worthwhile, so that one sees the development of a sort of two-part cartel which maximizes the collective net benefits to the group by increasing prices and varying production quotas within the group over time according to its members' current cash needs.

The action of the host countries in restricting supply and raising prices of crude by increasing their tax share of the surplus so created has two major effects on the companies' behaviour. The companies when confronted with such monopoly action against them seek to diversify their asset holdings and in general restructure their market strategies. They attempt to make their profits accrue where they are not subject to the tax policies of the cartel. The companies also use the tax increases as a signal for collectively increasing product prices in excess of refining margins. Thus competition in product markets tends to be replaced by collusion among the companies.

CHAPTER 3

THE SMALL SCALE PETROLEUM ECONOMY IN THE WORLD OIL ECONOMY

Introduction. The small scale petroleum economy is one which produces and refines crude oil for export; but those exports represent such a small proportion of the world oil market that they cannot influence prices in any significant way. The mechanism of the world oil market described above, therefore, operates quite independent of decisions made with respect to output levels of the small petroleum economy. On the other hand, what happens in the world oil market has a major impact on the development of such an economy; for oil exports represent a very large proportion of the total value of its exports, and the government's expenditures are largely financed by revenues derived from such exports.[1]

Apart from the dynamics of world oil market operations, other major external non-market forces affect the small scale petroleum economy profoundly, i.e., petroleum import policies with respect to foreign markets for crudes and/or products, and changes in the investment policies of international oil companies seeking to avoid the risks of operating in certain host countries. Some of these

[1]Dudley Seers, "The Mechanism of an Open Petroleum Economy," Social and Economic Studies, vol. 13, no. 2 (Institute of Economic and Social Research, University of the West Indies, June 1964), p. 233.

commercial and investment decisions are political but since they set constraints on the ability of the small petroleum economy to act in its own interest they require some discussion before one proceeds with a more general theoretical analysis.

Prorationing and the mandatory quota system in the United States have been supported at various times by American based companies (especially the "independents") and the American government for different reasons. For the "independents" that do not own foreign sources of cheap crude oil and, therefore, find themselves at a competitive disadvantage with the "majors" in the U.S.A., the mandatory quota system is an invaluable protectionist device. For the government it is a protectionist device as well as a conservationist policy. The general objectives of this and subsequent U.S. policy is to achieve self sufficiency in energy by 1985[1] in order to reduce the risk of having U.S. military security and economic development too dependent on foreign nation states.[2] The implicit cost of this risk to the nation is high enough to have made the then government (President Ford and his advisers) consider raising domestic oil prices by U.S. $7.00-$8.00 as a compensation to the companies for additional cost that they would incur (in investing at home) as a result of the

[1]National Petroleum Council (NPC), U.S. Energy Outlook: 1971-1985 (Washington, D.C: December 1972).

[2]Because the long run cost of finding oil outside the U.S.A. is so small (U.S. 20-50 cents) relative to finding in the U.S. (U.S. $7.00-$8.00) American oil capital moved abroad: gas and oil footage drilled declined steadily after 1953. A recent study pointed out the inevitability of an increasing dependency of the U.S. on foreign suppliers (especially the Middle East) if there are no changes in its petroleum policies. See NPC, U.S. Energy Outlook: 1971-1985.

difference between the maximum economic finding cost (MEFC)[1] in the U.S.A. and the MEFC outside the U.S.A.[2]

The concept of MEFC suggests that the movement of capital abroad would follow a certain economic logic: it would first move to low cost production regions with large reserves (Middle East, Venezuela, Canada, Africa) then to the more high cost and less accessible regions (North Sea, Alaska). In such a situation the small relatively high cost producer would, except for fortuitous historical circumstances, be the last to benefit from these capital movements. However, the need to hedge against social and political risks in some host countries, as well as the motivation to benefit from the advantage of supplies close to widely dispersed world markets dictate the strategy of each company developing optimal production and supply networks. This makes the circumstances relating to the development of the oil industry of the small petroleum economy less fortuitous. For instance, the multinationals tend to avoid increasing investments (or making new investments) in a region if the risks of loss of capital due to these circumstances are high. If, however, the petroleum resources of a region are very large as well as very profitable, and a company can establish in its global network alternative production and distribution systems to meet the contingency of sudden supply

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[1]Adelman describes the MEFC as the predictable increase in development cost. Adelman, The World Petroleum Market, p. 13.

[2]An econometric study by Michael Kennedy of the University of Texas suggests that the gap between expected U.S. demand for crude oil and U.S. production of crude oil will be reduced within the order of two million barrels daily if per barrel taxes or import duties of $7.00-$8.00 are implemented and retained. This is, however, based on the optimistic assumption of a high supply elasticity of .67 as opposed to the NPC's conservative estimate of .33. Kennedy, pp. 566-570.

disruptions it will continue to invest in that region at the production level but will hedge its risks by locating as much of its operations and hence its profits elsewhere,[1] away from the monopoly control of that host country and the associated uncertainties of supply. The resources of the small petroleum economy especially if located near to major consumer markets may under uncertainty have great strategic value as a backup supply system. The Trinidad oil industry and the refining centers in the Caribbean should be examined in this context.

The Caribbean, located within the sphere of the boundaries set by the Monroe Doctrine, provided a more secure investment climate and as it were became a part of the American "petroleum defence line". Once the lower political risks and the strategic location of the Caribbean were established, the investments in exploration, development and refining operations followed. Thus the companies' policy of diversification and the forces making for geographic segmentation of the markets for refined products triggered the expansion of production and refinery capacity in the Caribbean and Latin America, making 1956 a watershed in the history of the Caribbean as a refining centre. In the case of Shell International and Texaco International growth of refinery capacity in the Caribbean and the Latin American

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[1]Moran, "New Deal or Raw Deal in Raw Materials," in <u>A Reordered World</u>, ed. Richard N. Cooper (Washington, D.C: Potomac Associates, 1973), p. 174.

region was achieved at the expense of growth in the Middle East,[1] thus reflecting the differential risk associated with the two regions.

The shift in the oil companies' marketing strategies, however, was greatly influenced by American commercial policy. This policy virtually excluded Middle East oil from the U.S. markets, but favoured Western Hemisphere crudes. It allowed imports of all crudes from Venezuelan and Canadian origins and all imports into the west coast (District 5) where domestic production had seriously declined. There was to be no control of residual fuel for military use or for bunkering ships in foreign trade. On the east coast (District I) all other imports of crude oil and products were to be restricted to a percentage of production not greater than the ratio of such imports to production in some base year.

This act formally insulated the U.S. market from outside competition by creating an official barrier to trade in higher value products and crude. The selective form of the quota system meant that Caribbean refineries had to be content with producing "bottom of the barrel products" subject to their being able to get access to other markets, i.e., Western Europe, the U.K. and Japan. But accessibility

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[1]Shell International reduced its refinery throughput in the Middle East from 135,000 barrels per stream day at 1957 to 94,200 barrels per stream day at 1960. At the same time it increased its capacity in Trinidad, Curaçao, Aruba and Latin America from 508,800 barrels per stream day to 887,500 barrels per stream day. Texaco's share of total output of refined products in the Middle East remained constant between 1957 and 1966 (about 11.6 per cent). In Latin America and the Caribbean, however, its share of total refinery capacity almost doubled from 5 per cent in 1957 to 9.3 per cent at 1966. See Adelman, The World Petroleum Market, Tables III-C-1 and III-C-2, pp. 325-332. The position of British Petroleum International, which had few or no retail distribution outlets in the western segment of the world oil market, remained unchanged with respect to the Middle East and the Caribbean area.

to these markets is limited by the build up of refinery capacity in and around them in response to competitive market pressures and government policies aimed at maximizing foreign exchange savings. With these preliminary theoretical considerations and the dynamic economic analysis of Chapter 2 one can now proceed to develop an analytical framework for studying the Trinidad oil industry and evaluating government policies with respect to the exploitation of its hydrocarbon resources.

The Small Scale Petroleum Economy

The following analysis presents the case of a small scale economy endowed with relatively small reserves of a single mineral resource (hydrocarbons) and located close to a large consumer of energy. It is assumed that these hydrocarbon resources are initially controlled and commercialized by foreign suppliers of capital and technology; and that the discovery of hydrocarbon reserves continues to require imports of foreign technology and capital for their development. The broad objective of government policy is to maximize the country's share of the net benefits derived from these resources over time subject to the amount of power that it can exercise against the foreign oil companies.

The amount of power that the host government accumulates over time relative to the multinationals will determine whether its strategy will be simply that of a revenue collector; an active partner in some form of joint-venture with the companies; or the sole exploiter of its natural resource. These options imply different levels of power and the will to exercise it effectively. The analysis in Chapter 2 shows that the major producers largely because of the size of their resource base[1] and their population[2] have been able to amass and use this power. Size is, therefore, a critical variable in the balance of power bargaining model. In more general terms the scale of the economy and its level of skills determine the degree of its independence or its capacity to exercise power in either a threat situation or a negotiable context: the scale of the economy defines the size of those factors which determine the benefits that the country can offer foreign investors, i.e., the variety and depth of natural resources and the availability of (relatively cheap) skilled labour. The smaller the variety and depth of natural resources and the greater the scarcity of skilled labour and management skills (i.e., the smaller the size of the country) the more dependent the country is on foreign "know-how" and capital and hence the less potential it can be expected to have for aggressive action aimed at maximizing the net direct and indirect benefits from its natural resource(s). It is important, therefore, to examine the mechanism of the small scale economy with one mineral resource in order to get a better understanding of the limitations of size on such a country's economic development and independence.

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[1]Represent potential market control and relative strength in a cartel.

[2]Represent available manpower and potential for defensive or aggressive action.

The economics of development in an open small scale petroleum economy. William Demas writing in his book on the economics of development in small countries[1] draws special attention to the case of the "enclave" type of underdeveloped economy. He says that this type of economy may experience increases in certain important economic indices such that GDP, domestic capital formation, imports and exports, and its level of per capita national income may even attain respectably high levels; yet this expansion may be due entirely to a boom in exports of the primary resource produced in the enclave sector of the economy; and the boom may be either short-lived or secular, depending on the physical availability of the particular commodity within the country at a reasonable real cost and on the price it commands in world markets. Demas concludes that where such secular economic expansion results in rising per capita income but the country remains an enclave economy, it would be a profound mistake to say the growth in the enclave sector necessarily constitutes economic development or self-sustained growth. Demas, drawing on the experience of the Third World countries, makes the important observation that self-sustained growth apart from requiring the internal generation of sufficient domestic savings in both the public and private sectors to maintain the growth rate, also requires a transformation of the structure of production such that the following seven elements of change are effected:[2]

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[1]Demas, pp. 16-19.

[2]*Ibid.*, pp. 19-20.

1. The degree of dualism between the productivity of different sectors and regions is reduced.
2. Surplus labour is eliminated and drawn into high-productivity employment.
3. Subsistence production is eliminated and a national market is established for goods and services.
4. The share of manufacturing and services in Gross Domestic Product is increased in response to the changing composition of demand.
5. The volume of inter-industry transactions increases, mainly as a result of the growth of the manufacturing sector.
6. The ratio of imports in GDP falls in the long run - although the volume of imports increases absolutely - and the composition of imports shifts away from consumer to intermediate and capital goods.
7. The economy becomes not only more diversified but more flexible and adaptable, as a result of underlying political, social and institutional changes.

The last condition is very important for the small under-developed country whose economy is dominated by one mineral resource that is controlled by foreign multinational corporations. The risk of loss of social and political and economic independence associated with development by foreign capital has been described above in an analysis of Stephen Hymer's three-level world economy. The social and economic inequalities associated with that system lead one to conclude that while economic diversification is essential to the process of economic transformation it must be accompanied by a transfer of control to local hands if full development (i.e., economic, political, and social) is to be achieved. In a small scale petroleum economy now emerging from colonialism this requires a transformation of the political and social institutions, i.e. structural changes in the traditional power relationships of the country. In the small petroleum open economy it is the government that must effect these changes if it wants to reduce the inequalities inherent in such a system of international production, for the multinationals controlling the high wage petroleum sector are concerned with maximizing private profits not the social benefits to the host country. They are not concerned with the structural transformation described by Demas, for the oil sector is an enclave of the world oil economy with its decision making nodes located outside the country (at least in the initial stages of development) at level I of Hymer's model of international industrial organization. Because of the extremely hierarchical structural arrangements of this international system of economic production, manufacturing profits accrue mainly at level I because the external economies and complementaries which produce these profits are located there. Moreover, the multinational uses intra-firm transactions and transfer pricing to ensure that profits occur where they want them. The affiliates of the multinationals operating at the resource base (Hymer's level III) neither have the power nor the incentive to transfer profits earned in the mineral resource sector to the underdeveloped sectors of the host economy.

For it is in the best interest of the parent companies to either re-invest profits in the sector or transfer them elsewhere in the global system. In such a system of industrial organization very little change in the structure of production of the resource base country can be expected without host government intervention in the market system, possibly through direct government participation in and ownership of industries. One is, of course, mindful of the warning of Bauer and Yamey on the question of government promotion of industrial enterprise, that "a general lack of enterprise in a country does not in itself set up a presumption of such initiative in the public sector."[1] But this simply puts constraints on what government can be expected to do effectively at any given stage in the development process, not what it ultimately will be able to undertake as the process unfolds.

There are other serious problems associated with the small petroleum economy. Because of its small size it has critical gaps in its natural resource base. It lacks that great variety of resources that is essential for the kind of intersectoral dependence that precedes sustained economic growth. This skewness in the resource base means that it becomes impossible to build up the large intermediate and capital goods producing industries which are thought to be pivotal to economic transformation. The greater the gaps in natural resources, therefore, the greater the need to import capital and intermediate goods as inputs to the development process

[1] P. T. Bauer and B. S. Yamey, The Economics of Under-Developed Countries (Cambridge: The University Press, 1957), p. 161.

and hence the greater the degree of its vulnerability to external changes. This situation may be further aggravated by the continued existence of rigid colonial economic structures which favour the importation of most consumer goods. Also the size of the domestic market is too small to create incentives to growth (economies of scale) based entirely on import substitution. Its industrial development, therefore, depends on being able to find external markets for output from its new manufacturing enterprises.

In the petroleum economy growth in national output in the primary resource sector does not automatically have the disequilibrium growth effect that Hirschman talks about in The Strategy of Economic Development.[1] Import leakages, large capital outflows, poor linkages between the petroleum growth sector and the rest of the economy, and the general paucity of resources, lead to a rapid convergence of the growth process. In particular the paucity of resources and the small market size act as severe constraints on the effective transformation of the small petroleum producing economy. Indeed it is believed that many small economies could never achieve fully self-sustained growth unless they form a kind of customs union with countries which have complementary resources.[2] In any case the small petroleum economy, because of its great dependence on a wasting resource must give urgency to the question of transformation. The long-term future of

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[1]Albert O. Hirschman, The Strategy of Economic Development (New Haven: Yale University Press, A Yale Paperbound, 1961), pp. 62-75.

[2]Demas, pp. 56-62. See also, Allister McIntyre, Decolonization and Trade in the West Indies: The Caribbean Transition (Rio Piedras: Institute of Caribbean Studies, University of Puerto Rico, 1970).

the country cannot be left to depend indefinitely on the fortunes of such a resource and the political and economic risks associated with decisions made outside the country pertaining to its exploitation.

To avoid the problems of stagnation that may result when the resource vanishes completely and foreign investors withdraw from the sector, the government must pursue a policy of economic change which makes the economy ultimately less dependent on growth in the petroleum sector.

In the initial stages of structural transformation capital is very scarce (expensive) since the domestic economy does not generate sufficient savings to meet the needs for infrastructural investment capital and private investment capital. Moreover, foreign capital tends to move between economies with similar standards of living as opposed to moving from the highly developed economies to the underdeveloped economies with small markets.[1] A major strength of the petroleum economy, however, is that the cost-price gap for crude oil is likely to be very large. This represents a major source of savings which the government can divert away from consumption into economic development programmes. It is only government that can be expected in its public role to use this surplus for transforming the economy; for it is not in the interest of the multinationals to maximize anything other than private profits. It is expected, therefore, that, especially in the small open petroleum economy, the host

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[1]Harry G. Johnson, "Comparative Cost and Commercial Policy Theory for a Developing World Economy," Wicksell Lectures 1968 (Stockholm: Almqvist & Wiksell (sic) 1968), pp. 32-33.

government will maximize its share of the surplus earned in the hydrocarbon sector and use these resources to transform the economy; and this will mean in many instances direct participation in the investment process apart from the usual infrastructural investment in roads, hospitals, sewage, utilities, education, research, and other state functions essential to industrial and social development.

In the small developing petroleum economy (as well as the large petroleum economy) there is a constant pressure to gain complete control over capital locked up in its petroleum resources. This pressure becomes [illegible] intense as knowledge about the oil bearing structures accumulates and the host country learns more about the industry and builds up a greater bargaining capacity. Moreover, national aspirations for independence demand that the growth and power of foreign multinationals be limited. In the large petroleum economies (Venezuela, Iran, Libya, Saudi Arabia) nationalization seems to have emerged as a strategy for achieving these objectives. It is not clear, however, that nationalization will, in the case of the small petroleum host country, optimize the long run benefits to the nation. For while theoretically nationalization of the petroleum resources would mean getting the maximum possible public revenue,[1] in practice inefficiency due to lack of skills, lack of access to markets, retaliation from the multinationals and their governments

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[1]There is a theoretical maximum represented by the difference between the present value of investment per barrel (expected incremental barrel cost) and present value of expected prices for barrels delivered throughout the life of the resource.

may mean a much smaller cash flow than if the multinationals were allowed to develop the resource under certain "condition pressures",[1] or a mixture of government ownership, joint-venture ownership, and foreign ownership.

The small petroleum economy is very vulnerable in its early transition from dependency for it lacks the political and economic power to effect a total transfer of power from foreign interests to domestic interests. The domestic market is so small that it must export either crude oil and/or products in order to make the investment worthwhile. Moreover, since it is the major source of revenue it must accelerate exports in order to meet its pressing needs for capital to finance economic development projects. Access to external markets is, therefore, essential to its development of a viable oil industry and the successful economic transformation of the economy. For a petroleum economy that is in transition from colonialism to "independence" one would therefore expect that a policy of nationalization may be politically inadvisable and even economically unfeasible.

More specifically, during the early stages of such a transition the host country is weak and the oil companies very strong. The multinationals are, therefore, unlikely to yield control over resources that are important to their global strategies. They may, on the other hand, be only too ready to give up marginal concessions which they maintain as a continuing social and political obligation

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[1]Chapter 8, pp. 266-269.

or as a minor defensive marketing operation. The discovery of new resources, however, opens up opportunity for government to create new relationships and derive fresh approaches. It gives the government an opportunity to utilize the experience of the past in making decisions about the future control and development of the national resources, and use its increased bargaining power to maximize the benefits to the nation. The relative strength of the host country may also benefit from the fact that in recent times technological advances in pre-exploration survey techniques and in drilling techniques have reduced the risks of finding considerably. Moreover, the scarcity of technical know-how and the former resistance to making capital available to underdeveloped countries for investment in such surveys have been considerably reduced as a result of the provisions of assistance through the United Nations technical programmes and the more liberal lending policies of the World Bank. The initial monopoly bargaining power that the oil companies held, therefore, as a result of uncertainties associated with finding oil has been reduced or partly transferred to the underdeveloped host country.

Notwithstanding this, the small developing nation state is short on skills and domestic capital. These two factors, quite apart from the barriers created by the structure of the world oil market, may prove for the small country to be the greatest deterrent to the development of a viable government owned oil industry after the initial exploration surveys prove positive. The shortage of skills can only be partially overcome by the use of technical services offered by the various United Nations programmes and through consultation with the OPEC countries. This is very minimal. The shortage of domestic capital accumulation is a function of underdevelopment and cannot be easily overcome except by acquiring low interest loans. These are not easily obtained for high risk oil ventures unless the country has achieved a certain level of expertise in that area. Funds are more likely to be made available if the project has a high feasibility rating.

The advisability of the government of a small country going into the oil industry alone at the exploration stage will depend on the stock of skills built up in the past, on the probability of finding in that country, the cost of extraction, the level of recoverable reserves, and the kind of linkages with consumer markets that are possible. It seems that the higher the probability of finding, the greater the level of recoverable reserves and the lower the cost of extraction (i.e., the greater the accessibility), the more advisable it is that the government should set up a government owned enterprise; but the greater the risk, the poorer the economic feasibility of the reserves, the less directly it should become involved in its development. In general, the government should not become involved in marginal projects. It should share risk with private enterprise in medium risk projects and completely control low risk projects. Let us make a selective examination of some of the advantages and disadvantages associated with three types of corporate structures that may be used in the development of the oil resources of a small country, i.e., government ownership, joint-ventures, and private ownership involving multinationals.

The national company. The structure of the national oil company will not be unlike that of the multinational oil companies. Since domestic markets are small it will have to seek entry to foreign markets, but because of the high degree of concentration in the crude and production markets and the high degree of vertical integration the company would have to establish refining and retail outlets in foreign consumer markets. This should not be difficult for the small producer (100,000-200,000 barrels per day) since its entry into a major market would hardly be noticeable. For instance, it should be possible to buy into a small petroleum refinery and marketing enterprise in the U.S.A. or some European markets. Also it could be an aggressive competitor without being a threat to the world structure of prices. This forward integration would be essential to its long term survival and secure growth. This contract market arrangement reduces the risk associated with arm-length market sales. In the case of the U.S. markets it also makes it possible to avoid the sub optimum strategy of having to use the total output of the small petroleum economy for producing bottom of the barrel products. Take the case of a hypothetical small producer-refiner in the Caribbean area. By investing in downstream operations in the U.S. it could avoid the U.S. mandatory quota system and in so going derive a higher netback on domestic crudes by catering to the higher value product markets from behind those trade barriers. This is particularly true because in the U.S. markets the quota system keeps the prices of products artifically high, and market concentration and expected domestic supply shortages create the conditions for major increases in the prices of refined products.

One can still capitalize on the tendency for the present mandatory quota system, petroleum taxation laws, and pollution laws to force refineries to locate outside the U.S. in nearby Caribbean and Latin American areas. This policy may, however, require imports of foreign crudes since it may be more profitable to ship domestic crudes to its refineries in foreign markets. Getting supplies of crude in excess of domestic supply, however, may require that the government enter into a joint-venture domestic refining operation with multinational corporations that have adequate supplies of crude as well as access to markets for lower value products. In this case a processing fee is charged and the government shares in the profits net of taxes. It would not be feasible for government to establish a national enterprise in this case unless it could be certain of secure crude supplies. And it could not be certain of securing these supplies if it had to buy from its competitors. The best strategy would be, therefore, to establish a joint-venture operation. The question arises, however, why would an international company want to enter into a joint-venture refining operation with any particular government enterprise to provide fuel oil to the U.S. market. Why would it not locate elsewhere, where it does not have to share its profits. The small petroleum country may be in a position to offer the company other opportunities in the form of joint operations in petrochemical and natural gas production. This would give the country a competitive edge over other territories where there are no known hydrocarbon resources. In relationship to other countries that do have hydrocarbons, other factors such as strategic location, and low social and political risks may operate to give the small host country a competitive advantage.

Joint-venture. The joint-venture operation involving the host government and foreign suppliers of capital and technology offers several advantages to the small nation state if it is structured effectively. If the foreign company is a small company that is very dependent on the new resources of the small host country the country can extract the maximum concessions economically consistent with maximizing joint profits. The government may stipulate that it will not become a partner until the discovery of oil is verified; furthermore, that its share of the partnership will be paid from current production. Government may choose to pay its debt to the company with an interest rate lower than the internal-rate-of-return used to evaluate the project. Since under state participation government shares risk with the companies then this strategy does not trigger responses which reduce the stock of economically recoverable reserves. Provided government never participates in marginal projects state participation is a very good strategy for maximizing the discounted net cash flows to the host country.[1]

The joint-venture form of state participation can be used to ensure that effective control of the natural resource remains in local

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[1]Anton Petro Hendrick Van Meurs, Petroleum Economics and Offshore Mining Legislation (Amsterdam-London-New York: Elsevier Publishing Co., 1971), p. 125.

hands, and as a vehicle for building up domestic knowledge about the industry and hence the bargaining capacity of the government. Government must be careful, however, to see that the structure of these agreements is such that it does not find itself essentially guaranteeing capital loans to foreign companies and generally fostering the entrenchment of foreign interest in the country.

A joint-venture company must pay taxes as well as share its after tax profits between local and private foreign interests. Therefore, if the management of the company is such that the foreign interest has effective control it is in its best interest to use its power to transfer untaxed income through the use of interaffiliate charges (royalties on technology supplied, charges for research and development and other global overheads etc.) and so avoid declaration of total actual profits in the host country. This of course reduces the net benefits to the host country. Vaitos argues that "government pursuing explicit or implicit policies which encourage joint ventures might paradoxically bring about, in the absence of other complementary policies, a higher transfer abroad of income generated in their countries by joint ventures than in the case of wholly owned subsidiaries."[1] This means that government majority ownership of shares is a desirable policy if it is combined with effective control over all aspects of decision making. In the case where private domestic investors have a sizable but minority interest, the tax regulations and policies applying to foreign investment must define

[1]Vaitos, p. 116.

clearly the conditions under which these charges will be tax deductable.

The foreign multinational. The situation is considerably different when production, refining and marketing, and transportation are in the hands of a multinational corporation. When that corporation holds a strong competitive position in the world product markets and has large rich crude concessions in several producing regions it is in an excellent position to exploit as well as facilitate the development of the small petroleum economy. The foreign multinational company will, however, act to influence the total market situation in the best interest of its global operations. It can do this by using its power to determine transfer prices of products and materials as well as interaffiliate charges in order to transfer incomes earned in one country to any other country on a continuous basis through its global network. These transfers of income appear as cost in one country at one point in time due to fiscal considerations, but appear as reported and/or planned investments in other countries at another point in time. Thus "global after-tax profits can be minimized through profit minimization in certain countries with corresponding inter country income distribution effects."[1] In the absence of government policies these global strategies may on the average militate against the host country over a number of years. A multinational may also enter into collusion with other companies and host governments to restrict the supply of

[1]For a discussion on the determinants of transfer pricing see Vaitos, Chapter VI, pp. 96-118.

crude, and thus increase prices more than proportionately in the consumer markets. Such a policy would clearly benefit the small scale petroleum economy if its government is vigilant, for in these circumstances the company is more likely to tolerate "condition pressures" higher than normal for the geological territory.

The global investment strategy of the multinational company may not be in the long term interest of the country's development. For instance, the global strategy of the multinational company may be that its refineries in the small petroleum economy should produce a product mix with a higher percentage of residual fuels than its refineries in the nearby large consumer market. In this way it observes the requirements of the commercial policies of the powerful nation state in which this market is located. Its operations there benefit from the artificially high product prices created by such a policy, while at the same time its operations in the host country benefit from a higher profit margin than it could realize on the production of fuel oil in the consuming country.

The multinational company with large reserves of cheap crude in other countries will find it in its interest to substitute these cheap crudes for the more high cost domestic crudes in its refineries located in the small petroleum country. Thus local production suffers as exploration and investment expenditures are deferred. This may occur despite the fact that the cost-price gap may make it more than economically feasible to develop domestic oil resources more fully. A large international company, such as British Petroleum, which on a global scale has a very large surplus of crude oil production over refinery capacity, can optimize its profit position by phasing out its production operations in small producing countries where cost may be four to five times production costs in its Middle East concessions. A national enterprise in the small petroleum country, however, with no such alternative crude oil reserves elsewhere could maximize the national benefit from these domestic resources by taking advantage of the cost-price gap in the world oil market, since in general it could sell all its output at going prices. In short, what is marginal to the multinational company is not marginal to the small nation state.

What can one say then about the strategies of the small petroleum economy in the world oil market? It would seem that in the small economy no less than the large continental economies the striving for absolute sovereignty as a national objective will produce situations in which the government representing interest groups in the society will attempt to maximize the net indirect and direct benefits of the petroleum resources to the country. The small petroleum economy, however, lacks the power to pursue this objective as effectively as the large producer since it cannot influence behaviour and prices in an oligopolistic world oil market dominated by a producers' cartel (OPEC) and the multinationals. Its size, however, does give it some advantages in the sense that for some reasonable cost of production it can sell its entire output at the going prices which are likely to be several times the production cost. The existence of an aggressive OPEC Cartel which has set prices at about ninety times the cost of production in Africa and the Middle East benefits the small high cost producer. Some of the weaknesses (lack of political and economic power) of the small petroleum country have the effect that they make it a low risk territory and therefore relatively attractive to the oil companies which seek to escape the uncertainties with which they are confronted by the large oil producing countries at the production level. The small petroleum economy, however, is not completely helpless in the face of the powerful multinationals; neither do the multinationals nor large international companies possess absolute power: they do have weaknesses in their global structures which can be exploited by the small petroleum country. A great deal of the strength of the multinationals derives from the lack of technical knowledge in the host countries about the oil industry and the scarcity of capital for the development of their natural resources. This power is taken over by the host country as it acquires more knowhow. The more knowledge the government accumulates the greater is its capacity to bargain with the oil companies and consequently the more likely it is to maximize the flow of funds from the export of its hydrocarbon resources. The acquisition of knowledge is not dependent on size and in recent times this has been greatly facilitated by international institutions like the United Nations, the World Bank, and OPEC. The small petroleum economy must, therefore, systematically build up knowledge which would allow it to replicate the organizational structures essential for operating the industry at all levels. This must be a part of its development strategy for the country. In the exercise of any monopoly power it acquires from the companies it must be careful to ensure that it does not make itself a supplier in the last resort. (In a sense its small scale minimizes this possibility.) It is not absolutely clear exactly what policy the small petroleum economy should adopt with respect to ownership and control of its petroleum resources. That would depend on the point on the learning curve that the country is at with respect to the management of the industry and the level of economic transformation the country has achieved. In the early stages of development, however, it is unlikely that its dependency on foreign capital, technology, and markets will allow it to implement decisively a policy of nationalization.

Considering the relative bargaining strength of such an economy it would seem that a policy of joint-venture operations combined with an optimal tax system and complementary procedures for preventing tax avoidance through interaffiliate charges and transfer pricing would be the most feasible and consistent with the twin objectives of local control and the maximization of net benefits over time. There are certain aspects of the industry which the small host government may find it easy to nationalize without any risk of serious retaliation, i.e., domestic marketing of refined products and service base refining operations. One should proceed with care here, however, for these operations earn only moderate, if any, profits so that these risks should be shunted to private interests (foreign or domestic). There are, however, other long term benefits that the country may derive from government nationalizing these downstream operations. It may provide the opportunity for learning about the industry by being involved in its operation. Moreover, transformation of the industry over time to comply with the long-term development objectives of the country may be only possible if such operations are removed from foreign control. In such cases the benefits are not immediately observable: they occur over time and as the new structures evolve. In general the small host country with limited hydrocarbon resources must use the tax revenues derived from these resources to bring about the maximum transformation of the economy that it is possible to achieve before the resources are exhausted.

CHAPTER 4

THE GROWTH AND DEVELOPMENT OF THE TRINIDAD OIL INDUSTRY

This chapter gives an historical analysis of the development and growth of the Trinidad oil industry. Its main focus is on the years after World War II and in particular on the period starting 1956. Much of the discussion is concerned with four large companies: Amoco, Texaco Trinidad, B.P. Trinidad and Shell Trinidad. Amoco is a wholly owned subsidiary of Standard Oil (Indiana); B.P. Trinidad sold all its producing assets in 1969 to the joint-venture corporation, Trinidad-Tesoro Oil Company,[1] and the Trinidad government nationalized Shell Trinidad in August 1974, renaming it The Trinidad and Tobago Oil Company (Trintoc).

Two main areas are considered, one dealing with the finding and development of Trinidad hydrocarbons, and the other with the refining industry. The analysis which follows deals with events in these two sectors of the Trinidad oil industry in relationship to events in the world oil economy; and growth in the industry as it relates to growth in the Trinidad economy. In a more general sense this chapter provides background material essential to an understanding

[1] For a detailed listing of companies operating in Trinidad from 1951 see Appendix 4-A. Also see notes to this Appendix for detailed description of changes in companies - Table 4-A-1.

of subsequent chapters.

Hydrocarbon Resources in Trinidad and Tobago

Trinidad is geologically an extension of Venezuela (Figure 4.1). This geological relationship with Venezuela has for a long time kindled the hope that perhaps deep reservoirs will be found that would be as prolific as those in Venezuela (Maracaibo). None have so far been found in the old land or in the south west marine concessions (Figure 4.2). However, the new marine areas (Figure 4.2) around the island offer good prospects that such hopes may eventually be realized.[1] The following sections deal with the relative size of Trinidad's hydrocarbon resources and their development.

The size of Trinidad's oil and gas reserves. Table 4.1 shows proven reserves in the old concessions at January 1964, 1967 and 1968. Recent discoveries of important oil and gas fields on the East Coast Continental Shelf of Trinidad have changed this reserve situation dramatically and the relative importance of the established oil companies in the country. New geological evidence shows significant reserves of oil and gas in the Gulf of Paria, the Caribbean Sea, and Columbus Basin and in the deep waters off the East Coast.

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[1] K. M. Persad, "Hydrocarbon Potential of the Trinidad Area," Society of Petroleum Engineers of AIME, Trinidad and Tobago Section, papers presented at the Conference held on April 2-3, 1976, pp. 122-126.

TABLE 4.1

PROVEN RESERVES IN TRINIDAD AND TOBAGO

1964, 1967 AND 1968

(Crude oil in 000 bbls; gas in 10^9 scf)

Operator	Proven crude oil	Reserves natural gas
Trinmar*	190,305	704,370
Shell	50,539	423,275
Texaco	183,168	1,252,390
British Petroleum	98,857	62,369
Premier	2,713	116
Total Proven Reserves January 1, 1964	525,582	2,442,520
Total Proven Reserves January 1, 1967	580,000	n/a
Total Proven Reserves January 1, 1968	612,000	n/a

Sources: Report of the Commission of Enquiry into the Oil Industry of Trinidad and Tobago, 1963-1964 (London: André Deutsch, 1964), p. 21.

Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Annual Report, 1967, p. 2; 1970, p. 2.

*Consortium of Texaco, Shell and B.P.

In 1964 the country's proven reserves of crude and associated natural gas were estimated to be 525.6 million barrels and 2.4 trillion scf respectively. Texaco accounted for 46.8 per cent of the crude reserves, British Petroleum for 30.9 per cent and Shell for 21.7 per cent. Texaco alone controlled more than 60 per cent of the associated gas reserves. The data in Table 4.1 suggest marginal increases in proven reserves of crude between 1964 and 1968. However, a more realistic estimate of these reserves may be obtained by revising the data in Table 4.1 upward to one billion barrels of crude in order to reflect the ultimate recovery from secondary methods.[1]

In 1969 Amoco struck oil and gas on the East Coast Continental Shell of Trinidad. This success led to more extensive exploratory surveys in the Caribbean Sea, the Gulf of Paria and the south marine areas. Apparently the new areas considered as having good potential for gas and oil exploration[2] involve marine territory about four to five times the size of Trinidad and Tobago, i.e., about 7,000 to 9,000 square miles (Figure 4.2). Perhaps it is too early to make firm estimates of these reserves. However, a geological analysis of the

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[1]The final report of the Commission of Enquiry into the Oil Industry of Trinidad and Tobago (Mostofi Report) gives this revised figure as a more realistic estimate than that submitted in the technical estimates reported in Table 4.1. It used a recovery rate of 20 per cent as opposed to 13.4 per cent. This revised figure makes allowances for increases in recovery from secondary methods while the lower estimate in the table does not. Report of the Commission of Enquiry into the Oil Industry of Trinidad and Tobago, 1963-1964 (Mostofi Report)(London: André Deutsch, 1964), p. 20.

[2]Several news releases by successive Ministers of Petroleum and Mines between 1968 and 1976. See especially the text of a speech of the Minister of Petroleum and Mines for Trinidad and Tobago, Mr. Overand Padmore. The Express (Trinidad), "The Minister of Petroleum and Mines, Address to Latin American and West Indian Ministers, Caracas," September 15, 1972.

marine areas has been prepared by Mr. K. M. Persad of Trinidad-Tesoro Petroleum Company,[1] which supports earlier speculations that these reserves are substantial. Persad puts the probable recoverable reserves of crude oil in Trinidad at seven billion barrels; and the estimate for natural gas is put at 35 trillion cubic feet.[2] He believes that at a rate of production of one billion cubic feet per day there is enough gas for ninety years. With some luck and drilling deeper wells he feels that there may be enough for 200 years. Geologists at the Ministry of Petroleum and Mines feel that Persad's estimates are optimistic and are the result of a theoretical geological analysis that does not take into consideration market and other economic factors. More conservative estimates suggest that ultimate hydrocarbon reserves may be eleven trillion cubic feet of natural gas and from four to six billion barrels of crude oil.[3] In any case

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[1]Persad.

[2]Seventy-five per cent of these reserves are still to be discovered. Persad, pp. 125-126.

[3]Trinidad's proven natural gas reserves off the east coast are reported (World Oil and Gas Journal, May 26, 1975, p. 69) to be five trillion cubic feet, that is .2 of one per cent of world reserves. Since no major shift in redistribution of world reserves is expected in the future, undiscovered reserves for Trinidad may, in a very global sense, be expected to be .002 x 3,000 trillion scf of gas or six trillion cubic feet of gas. Therefore Trinidad's ultimate reserves of natural gas are probably in the order of eleven trillion cubic feet, a rather conservative estimate when compared to Persad's thirty-five trillion. The lower estimate for crude oil is based on historical performance. The geological history of the area suggests reserves of one billion barrels of oil per 2,000 square miles of land and accessible marine area. Since land and marine areas are between nine and twelve thousand square miles ultimate reserves can be expected to be about four to six billion barrels of crude.

Trinidad's hydrocarbon reserves are very small relative to world ultimate reserves (proven plus prospective reserves),[1] which have recently been reported to be 740 billion barrels for crude oil. Undiscovered potential reserves are estimated to be 963 billion barrels.[2] With respect to gas the economically recoverable reserves from known fields in the world are put at 2,300 trillion cubic feet and the undiscovered potential is estimated to be about 3,000 trillion cubic feet.[3] Because of its small hydrocarbon resource base, Trinidad's potential as a crude supplier on the world oil market (i.e.,"free market") has always been very small. Table 4.2 below shows that in 1970 its total crude production was only 1.7 per cent of free world market supply (including Trinidad's output) and that this decreased to about half of one per cent in 1973. This has increased somewhat since 1973 but it is still under 2 per cent. Trinidad's relative supply potential is not likely to improve in the future. Moreover, given modern technology in shipbuilding and the consequent increasing size of tankers, although Trinidad's crudes are located near to the large consumer markets in the U.S.A. and Canada

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[1] Prospective reserves are those additional quantities which have a reasonable probability of being recovered with foreseeable technology and something approaching current cost/profit relationships. They also include the probable reserves in the extensions to proved reservoirs and in underdeveloped reservoirs which have been drilled, as well as reserves which are likely to be developed with the aid of fluid injections or other existing or prospective technologies.

[2] "World Oil and Gas Reserves", The Petroleum Economist, June 1975, pp. 203-204. Estimates prepared by J. D. Moddy, T. D. Adams and M. A. Kirby. See also similar estimates published in The Oil and Gas Journal, May 26, 1975, pp. 62-63.

[3] The Petroleum Economist, June 1975, pp. 204-205.

TABLE 4.2

TRINIDAD CRUDES IN THE WORLD OIL MARKET

Year	Total crude available on world market (000 b/d)	Crude production Trinidad (000 b/d)	Total supply (incl. T'dad) (000 b/d)	T'dad & Tobago share of total supply (percentage)
1950	3,348	57	3,405	1.7
1951	6,978	95	7,073	1.3
1966	16,315	150	16,465	0.9
1968	19,501	185	19,686	0.9
1973	32,540	165	32,705	0.5

Sources: M. A. Adelman, The World Petroleum Market (Baltimore: The Johns Hopkins University Press, 1972), Tables III-2, III-3, pp. 80-81, p. 90.

B.P. Statistical Review of the World Oil Industry (London: 1973).

this does not guarantee it a great competitive advantage over other crudes, for as the cost of transportation decreases with the increase in tanker sizes crude oil transported from distant points of origin becomes more competitive in these markets.

The situation is somewhat different in the case of natural gas. Trinidad gas resources enjoy a distinct advantage by virtue of their location near to the large U.S. gas markets. The technology relating to the transportation of natural gas is such that it is economically more feasible to transport gas over short distances than long distances. Moreover, gas is in immediate short supply whereas oil is not. Trinidad's closeness to the U.S. market and its very strong reserve position in the Western Hemisphere,[1] therefore, give it a strong competitive position as a potential exporter of natural gas. If Persad's estimates of Trinidad gas reserves are close to accurate and if the gloomy world forecast of new finds of hydrocarbon reserves are realized gas may give Trinidad the "push" forward that its crude oil resources did not.

Major oil fields. The search for oil in Trinidad started in the 1860's. By 1914 exploration and development activities had added 6.2 billion barrels of oil-in-place or 62 per cent of the total amount of oil discovered up until 1963 (Table 4.3). By 1952 86 per cent of the oil-in-place at 1963 (ten billion barrels) was already discovered. The natural drive mechanism operating in the old land and marine fields is the solution gas type. Because of the inefficiency of this drive system only 10-20 per cent of oil-in-place is considered recoverable. Of the eleven major fields discovered by 1963, the Fyzabad, Palo-Seco, and the Soldado (marine) fields accounted for 72 per cent of proven reserves (as per Table 4.3).

The next major set of oil fields were discovered between 1969-1971 on the East Coast Continental Shelf of Trinidad, i.e., the Teak-Galeota fields about twenty-five miles offshore (Figure 4.2).

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[1]M. A. Kirby and T. B. Adams estimate Venezuelan gas reserves at 25.4 trillion cubic feet and South American at 47.2 trillion. If one uses Persad's estimates Trinidad's reserves are at least as great as Venezuela's and about 75 per cent of South American reserves. The Oil and Gas Journal, May 26, 1975, p. 69.

TABLE 4.3

SUMMARY OF STATISTICAL DATA ON OILFIELD AREAS OF TRINIDAD AND TOBAGO

(millions of barrels)

Areas	Date of discovery		Original oil-in-place		Cumulative oil production to 12/31/63		Proven oil reserves at 12/31/63	Production reserve ratio
Guayaguayare	1902		336		27		11	4.3
Parrylands	1908		1,605		154		30	9.6
Brighton	1909		480		37		24	6.8
Penal-Barrackpore	1911		662		76		25	9.9
Fyzabad	1914		3,110		325		126	14.5
Sub-total		62%	6,193	72.6%	619	43.9%	216	
Oropouche	1923		20		2		1	9.4
Palo-Seco	1929		1,142		76		68	10.1
Coora-Quarry	1936		952		65		25	10.1
Sub-total		21%	2,114	16.8%	143	19.1%	94	
Ortoire-Moruga	1952		206		32		19	5.2
Other areas			81		8		-	-
Total land		86%	8,594	94%	802	66.9%	329	
Marine								
Soldado	1954		1,393		51		161	10.6
T.P.D. - N.Marine	1959		13		-		2	
Sub-total		14%	1,406	6%	51	33%	163	
Total at 1963			10,000		853		492	

Source: Report of the Commission of Enquiry into the Oil Industry of Trinidad & Tobago 1963-1964, (London: André Deutsch, 1964) Exhibit No. 9, p. 72.

The size of these fields is not yet public information but Persad's estimates put them at about 50 per cent of the potential capacity of all possible marine fields around the island. These discoveries represent a major turning point in the Trinidad oil industry as an exporter of crude oil and liquified natural gas. Production from these fields since 1972 has increased Trinidad's crude production to the point that it now ranks fourth after Venezuela, Canada and Ecuador as an exporter of crudes in the Western Hemisphere.

The historical pattern in the development of oil resources in Trinidad, like many other countries, has been to produce from the land reserves first and then move outward to the more costly marine resources. The present situation in Trinidad is that land reserves are in an advanced state of decline (unless new ways are found to recover more oil from the old reservoirs) and the country must look to the marine territories for its new reserves.

At 1951 all Trinidad oil came from inland fields. By 1954 the Soldado marine fields were discovered. The production from these fields reversed the decline in annual crude output and made the marine areas the most important contributors to total annual output. For instance, in the period 1940-1955 land production levelled off at about 21.5 million barrels per annum (see Tables 4.4 and 4-A-4). However, in the following period, 1955-1960, all companies, but especially Texaco, increased their investment in exploration and development drilling. As a result there was a significant increase in crude production from land concessions during this period.

TABLE 4.4

SUMMARY OF CRUDE OIL PRODUCTION FOR TRINIDAD AND TOBAGO

1940-1971

(millions of barrels)

Period	Average crude oil production	Land production average	Marine production average	Marine* deviated production average	Major discoveries during period
1940-1955	21.5	21.4	-	0.7	Ortoire-Moruga (1952)
1956-1960	36.2	36.2	2.9	2.1	T.P.D. North Marine (1959)
1961-1965	48.4	30.9	16.0	1.5	None
1966-1971	57.2	31.4	24.8	1.0	Navette field in Guayaguayare North East Soldado fields Trinidad East Coast Continental Shelf fields.

Source: Appendix 4-A, Table 4-A-4.

*Production from wells drilled at an angle (deviated) from land to reservoirs in marine territory.

Production reached a peak of 34.5 million barrels in 1959 and declined thereafter except for a brief increase in output between 1966 and 1968 resulting from the discovery of Texaco's Navette field in Guayaguayare.

Land operations accounted for 86.2 per cent of cummulative output of crude for the period 1956 to 1960 while marine operations (excluding marine deviated wells) accounted for 8 per cent. In the following decade the impact of the Soldado fields on production was realized and the share of marine production in output increased from 8 per cent to 33 per cent in the period 1961-1965, and 43 per cent in the period 1966-1971. The steady decline in the land concessions after the late fifties was reinforced by the decline in the Soldado fields after 1968. By the early sixties the signs of rapid decay in the industry had become obvious. Old concessions were already in decline and it was becoming increasingly difficult to find new areas for drilling. The gloomy prospects for the future of the industry caused the government to set up the Mostofi Commission in August 1963 to report on "... the present situation and future prospects of the oil industry in Trinidad and Tobago in the context of the economics of the world oil industry."[1]

The East Coast Continental Shelf: exploration. Just as the Soldado find reversed the decline in output which started in the late fifties, the discovery of gas and oil fields on the East Coast Continental Shelf of Trinidad rolled back the gloomy implications of

[1] The Mostofi Report, p. 9.

of the Mostofi Report with respect to the Trinidad oil industy. Drilling began on the East Coast Continental Shelf in 1962. The original company[1] ceased drilling that year, and no further drilling was undertaken until November 1967 (11.9 thousand feet were drilled in 1967) by Amoco. Between November 1967 and September 1970 eighteen exploratory wells were drilled. Between November 1967 and April 1969 the company spent T.T. $25 million on eight wells.[2] In May tests of wells showed oil and natural gas available in considerable quantities. The initial production rates for some oil wells were reported to range between 2,000 - 4,000 barrels per day. The crude was light crude with API 30-33.9 degrees, virtually sulphur free and found at depths between 4,200 and 12,200. The pace of exploration drilling increased and a second rig (Mariner T) was contracted for four to five months. It began exploratory drilling in February 1970[3] at a reported cost of U.S. $25,000 per day.[4] By December 1970 thirteen wells were reported to be completed and one continuing[5] so that between 1967 and 1970 twenty-one wells were completed.

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[1]Pan American Oil.

[2]Trinidad Guardian, April 30, 1969, Clippings File, Library, Economic Planning Unit (EPU), Trinidad. This company was reported elsewhere in the report to be spending approximately T.T.$30,000 per day during this period on drilling.

[3]Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Monthly Bulletin, 1970, p. 3.

[4]Trinidad Guardian, February 4, 1970, Clippings File, Library, EPU.

[5]Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Monthly Bulletin, 1970, p. 5.

Development phase. The company began development drilling offshore at Point Radix (OPR or Teak A) in September 1970. A twelve well development project was initiated at an estimated cost of T.T. $7.4 million.[1] Total expenditures on exploration and development at March 1972 were estimated at U.S. $62.5 million. Table 4.5 gives a breakdown of exploration and development expenditures by Amoco in Teak A and Teak B up to March 1972. It is estimated that approximately U.S. $35.6 million was spent on exploration during the period November 1967 to October 1971, and that U.S. $27 million was spent on the development of the Teak A and Teak B fields between September 1970 and March 1972. These estimates are derived from a weak data base and therefore need to be tested for their reliability. A comparison of these estimates with actual cost in a region of similar geological structures and environmental conditions will serve as a reasonable measure of their accuracy.

Costs in East Coast Continental Shelf fields vs. costs in the Java Sea. Detailed information on the geology of Trinidad's East Coast Continental Shelf area is not available; however, general information about the area seems to suggest that it bears some rough resemblance to that of the south east Sumatra and north west Java marine territories.[2] The petroleum bearing marine areas on this vast

[1] Express (Trinidad), October 5, 1970, Clippings File, Library, EPU.

[2] An article recently published in the Journal of Petroleum Technology describes the territory and development there in some detail. H. J. Ramsay, Jr. and H. A. Nedom, SPE - AIME Independent Indonesian American Petroleum Co., "Exploration and Development of a New Petroleum Province - Java Sea, Indonesia," Journal of Petroleum Technology, April 1973, pp. 395-401.

TABLE 4.5

BREAKDOWN OF CAPITAL EXPENDITURES BY AMOCO

BETWEEN EXPLORATION AND DEVELOPMENT AT MARCH 1972

Exploration expenditures	Capital outlay* U.S. $ 000
1) Teak A General - November 1967-April 1969	12,500
2) Teak A - May 1969-October 1970	4,500
3) Teak B	12,750
4) Tourmentine and other	5,800
Sub-total - Exploration	35,550
Development expenditures	
5) Teak A - (nine wells) September 1970-March 9, 1972	3,700
6) Teak B - (two wells) January-March 1972	2,250
7) Undersea pipelines and export terminal	21,000
Sub-total - Development	26,950
Total	62,500

Notes:

1) See text.
2) Assume six months at U.S. $25,000 per day (see text).
3) Express (Trinidad), January 23, 1972, reports expenditure of over T.T. $30 million on Teak B. Only two development wells were drilled by March. Exploration expenditure = U.S. $15 million - (90 days x U.S. $25,000 per day).
4) Residual item.
5) See text.
6) 90 days x U.S. $25,000.
7) Express (Trinidad), ~~August 18,~~ 1971.

*U.S. $1.00 = T.T. $2.00

continental shelf are located in very shallow waters, less than 300 feet. The same is true for the Teak A and Teak B areas in Trinidad. The Java Sea geology is described as complex, the same is true of the Trinidad marine geology. The drilling conditions are perhaps more favourable than those in Trinidad where strong winds are experienced and wave conditions have been known to stop work on several occasions. The Trinidad fields are nearer to the coast (i.e., between 10-30 miles) and therefore supply conditions are much easier than in the Java-Sumatra Bilton-Kalimantan sea areas where the size of the territories (179,650 square miles) requires a three day journey by boat from the major fields to the mainland supply points. Oil is found at depths averaging 5,000 feet and not exceeding 10,000 feet, while in the Trinidad case most wells are between 4,200 and 12,200 feet. The crudes are of similar quality. In both areas crudes are of excellent refining quality and low sulphur content, usually 0.1 per cent or less. Also production rates of wells in both areas range between 2,000 and 4,000 barrels per day. Serious exploration and development drilling started about the same time (1967-68) in both areas. Producing wells in both cases have not shown any decline in flows since commercial production started in 1971-1972. Both the Cinta fields in south east Sumatra and the East Coast Continental Shelf fields in Trinidad have "sanding in" problems. In view of these drilling and other operational similarities one would expect cost in the Java Sea (especially in the Cinta fields area) to be similar to that in the Trinidad East Coast Continental Shelf area (i.e., up to depths of 300 feet). The more detailed data for the Java Sea area serve, therefore, as a cross-check on that obtained for Trinidad from scattered secondary sources.

In the Cinta fields (Java Sea) the first four wells required an average of twenty-four days to drill and complete, and the last four an average of eighteen-and-one-half days. In the Arjuna area the first six wells required an average of twelve days and the last six an average of twelve days, and one well was cased in eight days. Total Java Sea rig operating costs were in the range of U.S. $25,000 per day, depending upon equipment used. Development drilling cost per well for an eight well platform in south east Sumatra area is estimated at U.S. $572,000. These operation conditions are similar to the Trinidad situation where eleven development wells incurred a total drilling cost of U.S. $5,950,000 or U.S. $540,900 per well.

A breakdown of exploration and production expenditure for the Java Sea is presented below. The outlays in the various categories indicate that the estimates for the Trinidad situation are realistic. The south east Sumatra investment situation is particularly relevant to Trinidad's experience. Since wells are generally deeper in Trinidad one might expect lower drilling cost per well for the Cinta fields in south east Sumatra; but Trinidad drilling platforms are set to drill twelve wells as compared with eight wells per platform in the Cinta fields. This makes, therefore, for considerable savings in drilling cost.

This section showed the growth and decline of the land reserves, and the subsequent rise in the importance of the marine territories of Trinidad as new sources of future output of oil and

TABLE 4.6

JAVA SEA INVESTMENTS THROUGH 1973

	South East Sumatra (U.S. $ mn)		North West Sumatra (U.S. $ mn)	
Exploration		38.9		39.6
Production				
Drilling	7.9		21.0	
Production facilities	9.4		14.0	
Pipelines and mooring	7.4		7.1	
Other	1.2	25.8	1.4	43.5
Investment through 1972		64.7		83.1
Estimated investment 1973		46.0		77.0
Estimated through 1973		110.7		160.1
Footage of wells 1972	60,400		152,700	

Source: Journal of Petroleum Technology, April 1973, p. 401.

gas. Complete statistics on capital expenditures in the industry are not available but the sharp decline in footage drilled on land relative to the marine areas[1] is indicative of the diversion of exploration and development expenditures from land to marine operations. This shift of emphasis has become necessary because of rising cost on land; and feasible because of cost saving improvements in marine drilling technology,and rising crude prices since 1971.

[1]Land operations after showing a 79 per cent increase in footage drilled in 1971 over 1970 declined by 33 per cent from 700,000 feet in 1971 to 528,000 feet in 1973. In contrast marine drilling increased from 234,000 feet in 1971 to 426,000 feet in 1973, i.e., 82.3 per cent increase over 1971. See Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Monthly Bulletin, vol. 8, no. 12, December 1971, p, 9; Monthly Bulletin Petroleum Industry, December 1973, Section A.

Thus Trinidad's new deposits of marine crudes, besides being known to exist in commercial quantities, can be expected to be extracted on a competitive basis with crudes of approximately the same quality elsewhere. The competitiveness of Trinidad oil in world markets will be discussed below after incremental costs are derived in Chapter 6. An understanding of the relationship between production and refining in Trinidad is pertinent to the estimation of costs in the industry and the discussions which follow. The following section analyzes the growth of refining in Trinidad and the role of the refining sector in the development of the country's hydrocarbon resources.

The Refining Function in Trinidad's Oil Industry

Early mining legislation (pre-1956) governing the oil industry in Trinidad required that any company producing 100,000 tons of crude oil per year (2,000 b/d) must refine part of its output in Trinidad.[1] The intention of the legislation was to maximize Britain's benefits from these resources by ensuring that, if possible, all profits from the industry accrued in Trinidad (i.e., British territory) where it was taxable, and that the British Admiralty had access to adequate supplies of fuel oil. From the early beginnings of the industry, therefore, external political and military considerations shaped the legal framework that ensured the development

[1] The Mostofi Report, p. 53. The power to exercise this authority was vested in the Governor under the provisions of the Oil Mining and Refining Ordinance, Chapter 26, no. 3.

of a vertically integrated industry. Moreover, developments in 1956 and thereafter strengthened the role of refining. In this respect the entrance of Texaco to the Trinidad oil industry is of particular importance; for one of the conditions of purchase of the Trinidad Oil Company by Texaco Company (now Texaco Inc.) in 1956 was that Texaco would undertake to operate the Pointe-a-Pierre refinery at full capacity and, if possible, to expand throughput facilities.[1]

Growth in refining. Texaco's purchase of the Trinidad Oil Company's assets marked the beginning of a major expansion of refinery capacity in Trinidad. Growth in refinery output outstripped growth in crude production between 1956 and 1972, thus changing the structure of the refining operation from a resource base (pre-1956) to service base operation. At 1951 refinery capacity in Trinidad was rated at about 100,000 barrels per day. Of the total capacity, 80,000 barrels per day were accounted for by Texaco Trinidad's Pointe-a-Pierre refinery and 20,000 barrels per day by Shell Trinidad's Point Fortin refinery. This capacity remained fixed between 1951 and 1957.

In general at 1956 refinery throughput for the Trinidad industry was supplied largely from indigenous crude production. The country's total refinery capacity of 100,000 barrels per day was matched by a crude production capacity of 80,000 barrels per day (Table 4-A-4). By 1962, however, Shell's refining capacity increased

[1]Ibid., p. 27. See also White Paper covering the intended purchase of The Trinidad Oil Company by Texaco Company presented by the Chancellor of the Exchequer to the British Parliament in June 1956.

by 150 per cent over 1956 to 50,000 barrels per day and Texaco's by 213 per cent to 250,000 barrels per day (Table 4.7). Meanwhile the share of indigenous crudes in refinery throughput fell from 80 per cent at 1956 to 40 per cent by 1962. Shell's crude output declined steadily after 1968 from 32,000 barrels per day to 24,600 barrels per day at 1973. Total refinery capacity continued to rise during the period 1960 to 1970. This increase is reflected in the fact that between 1960 and 1970 the index for crude oil runs to still increased from 100 to 189 (Table 4.8). Actual distillation capacity at 1970 was 450,000 barrels per day. Texaco accounted for 80 per cent of this capacity. As refining capacity increased during 1960-1970 crude oil imports increased rapidly replacing lagging domestic production. The index for imports doubled between 1960 and 1968 and increased further to 251 at 1970, while that for domestic supply (production less exports) increased from 100 in 1960 to 158 in 1968 and decreased to 111 at 1970 (Table 4.8). The contribution of domestic crude to refinery throughput decreased, therefore, from 40.4 per cent at 1962 to 26.8 per cent at 1970, imports of crude, of course, representing the major contribution of 73.2 per cent (Table 4.7).

The declining share of indigenous crudes in refining throughput after 1956 is partly due to (1) diminishing returns to scale in B.P's, Shell's and Texaco's land and marine crude production operations in Trinidad, (2) the rapid expansion of refinery capacity to meet Texaco's increasing output of crudes from concessions in Venezuela and the Middle East as opposed to Trinidad, and (3) in

TABLE 4.7

CRUDE RUNS TO STILL BY REFINERY AND BY SOURCE - TRINIDAD

(millions of barrels per annum)

By refinery	1962		1963		1965		1968		1970	
Shell	17.3		17.0		17.0		26.3		29.9	
Texaco	92.0		102.7		120.2		125.0		125.0	
Total	109.3		119.7		137.2		151.3		154.9	
By source										
Indigenous	44.1	(40.4%)	45.6	(38.0%)	43.6	(31.8%)	59.1	(39.1%)	41.5	(26.8%)
Foreign*	65.2	(59.6%)	74.1	(62.0%)	93.5	(68.2%)	92.2	(60.9%)	113.3	(73.2%)
Own account imports	12.0	(10.9%)	11.9	(10.0%)	-	-	0.5	(0.3%)	11.0	(7.1%)
UPA imports	53.2	(48.7%)	62.2	(52.0%)	93.5	(68.2%)	91.7	(60.6%)	102.3	(66.1%)

Sources: Commission of Enquiry into the Oil Industry of Trinidad and Tobago, 1963-1964 (London, André Deutsch, 1964), p. 24 (data for 1962, 1963).

Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Annual Report 1970, p. 16.

Government of Trinidad and Tobago, C.S.O., Quarterly Economic Report, 1970, 1971, 1972.

*Texaco accounted for all foreign imports up until 1968 when Shell began importing low sulphur crudes for the first time from Africa.

TABLE 4.8

CRUDE OIL RUNS TO STILL TRINIDAD AND TOBAGO

1960-1970

(1960 = 100)

Year	Domestic supply		Crude oil imports		Total crude oil runs to still		Throughput b/d
	mn bbls	Index	mn bbls	Index	mn bbls*	Index	(000s)
1960	38	100	45	100	82	100	225
1961	42	111	63	140	104	127	285
1962	45	118	65	144	109	133	298
1963	45	118	75	164	120	146	328
1964	47	124	83	184	128	156	351
1965	45	118	93	207	137	167	375
1966	51	134	93	207	144	176	394
1967	59	155	80	177	189	170	380
1968	60	158	91	202	151	184	414
1969	51	134	104	231	154	188	422
1970	42	111	113	251	155	189	425

Sources: Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Annual Statistics of Production, Drilling and Refining, 1960-1970; Annual Report, 1970.

*Do not add due to rounding and inventory adjustments.

general the availability of cheaper crudes outside of Trinidad.

In 1964 Capon estimated the country's known land reserves had reached maturity and predicted that after 1964 crude oil and gas output would decline rapidly.[1] The forecast of that report, with the exception of the shortlived improvements[2] in crude production between 1966 and 1968, has proven to be accurate. The decline, already evident in the Shell and B.P. land concessions, continued unchecked (Figure 4.3) into the 1970s despite some initial efforts by Shell, and after 1969 by Trinidad-Tesoro (formerly B.P.) to reverse it. After the initial successes that Texaco experienced between 1966 and 1968 in its Guayaguayare fields, output from its concessions declined dramatically from 82.2 thousand barrels per day in 1967 to 38 thousand barrels per day in 1971 and decreased further to 27.4 thousand barrels per day at 1973. Trinidad Northern Areas' (the south west marine fields) output of crude declined from 68.5 thousand barrels per day at 1967 to 51 thousand barrels per day in the period 1972-1973 (Tables 4-A-1, 2, 3).

In a real sense, therefore, most of the forces shaping the structure of the Trinidad oil industry during the late fifties and

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[1] See Table 6.1 for O. A. Capon's estimates of production from 1964 to 1968.

[2] Most improvements in production that took place in 1966-1968 are attributed by the Ministry to the discovery and development of a small producing area north of the Soldado block; and in-filling and extension of the Guayaguayare field; improvements in the production techniques, especially sand bracing techniques, e.g., thermal oil recovery; and the increasing use of gas-lift, especially in the Soldado area. Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Mimeographed paper on Petroleum, 30 December, 1966; Monthly Bulletin, vol. 4, no. 12, December 1967, p. 3.

the sixties were outside the control of the Trinidad government.[1] Neither the government, nor for that matter the local affiliates of the three majors operating in Trinidad, had any control over the choice of technology used in the industry nor the ultimate slate of refined product produced. It was the changes in the global marketing strategies of Shell International and Texaco International, not a decision of the government, which together with the decline in production from Trinidad's land reserves was responsible for the development of Trinidad as a service base refining centre. For instance, the development of Texaco's refinery as a complete refining complex must be attributed, on one hand, to American petroleum policy which forced U.S. oil companies to locate the production of residual fuel oils outside the U.S. and, on the other, to the search of those companies for a safe investment climate for processing crudes from their Venezuelan and Saudi Arabian concessions. All expansion and modernization of Trinidad refineries since 1956 has been determined by the growth in the U.S. East Coast demand for fuel oils, changes in the nature of that demand (higher quality fuels); and the fact that initially the new refinery capacity was geared to use imported sour crudes as feedstock.

The multinationals behave in Trinidad in much the same way that they behave elsewhere. Their relationships in Trinidad often reflect their competitive practices in the world oil markets. This might at times not have been in the best interest of Trinidad. For

[1]Between 1956 and 1961 Trinidad still had a type of Crown colony government with internal self rule.

instance, the Trinidad affiliates of Shell International, Texaco Inc., B.P. International (now Trinidad-Tesoro), and Standard Oil of Indiana as a rule do not purchase crudes from each other, except in the case of Shell and B.P. where special exchange agreements existed prior to 1969.[1] In 1968 it took a threat from the government to revoke Shell's licence before Shell agreed to buy Trinidad-Tesoro's (formerly B.P.) crudes at U.S. $1.56 per barrel. Shell initially refused on the grounds that it could get foreign crudes at U.S. $1.25.[2] In general, as stated earlier, all major decisions of the multinational oil companies are made at headquarters (Level I) which co-ordinates a vast network of vertically and horizontally integrated activities. This means that the company's affiliates in different parts of the world or regions operate according to the dictates of the parent company. This is particularly so in the area of corporate planning and finance. Farrel's research on the Trinidad situation reveals that Texaco Trinidad's production schedules must be approved by the parent company in New York and its representatives must defend budgets before head office executives. The refining operations are even more closely controlled in the sense that head office assigns the product requirements at the beginning of each year, provides the foreign crudes required to mesh its Trinidad crude output and leaves it up to the Trinidad affiliate to produce the assigned out-

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[1]The Mostofi Report, p. 28.

[2]Interview with Shell Trinidad officials and government official, April 1974.

put as best it can.[1] Texaco Incorporated controls all foreign marketing of its Trinidad operations, so that the ultimate disposition of refined products is not known exactly. While Shell Trinidad had more autonomy in its marketing operations than Texaco Trinidad, the significance of this should be tempered by the fact that Shell's operations in Trinidad represented primarily a defensive market strategy of the parent company. Shell Trinidad's refinery was a simple grass-roots operation, topping crudes and doing semi-processing for the parent company's refinery complex in Curaçao. It also serviced Shell's market obligations in the Caribbean and surrounding areas.

The absence of strong bargaining power on the part of the local government at 1956 gave Shell and Texaco a free hand in shaping the structure of Trinidad's oil industry after 1956. It was in the interest of these companies, given the developments in the U.S.A. (quota system) and increasing competition in European markets, to use Trinidad as a marketing and a refining centre specializing in residual fuels for the U.S. East Coast markets, using local crudes as far as possible and blending them with sour crudes from Venezuela and Saudi Arabia. Despite the fact, therefore, that by the mid-sixties Texaco had developed a complete refinery system which included a petrochemical complex, residual fuel oil represented at least 50 per cent of the product slate of both refineries[2] (Table 4.9)

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[1]Trevor Michael A. Farrell, "The Multinational Corporations, The Petroleum Industry and Economic Development in Trinidad and Tobago" (Ph. D. dissertation, Cornell University, Ithaca, N.Y., January 1974), pp. 139-150.

[2]Unlike Texaco, Shell remained essentially a simple grass-roots operation.

TABLE 4.9

REFINERY PRODUCTION BY PRODUCTS AND COMPANIES

TRINIDAD AND TOBAGO, 1963

	TEXACO		SHELL	
	000 bbls	%	000 bbls	%
Gasolene	16,479	16.1	2,795	16.4
Jet engine fuel	5,912	5.8	-	-
White spirit	64	-	-	-
Vapourizing oil	236	0.2	-	-
Kerosene (burning oil)	3,342	3.3	34	0.2
Gas and diesel oils	14,776	14.3	5,221	30.7
Fuel oils	57,997	56.5	8,330	49.0
Lube oil and grease	-	-	2	-
Bitumen	-	-	228	1.3
Petrochemicals	204	0.2	-	-
Other and unfinished products	(77)	-	146	0.9
Gas and loss	3,739	3.6	254	1.5
	102,672	100.0	17,010	100.0

Source: E. L. Bertrand and W. McLeod, "Petroleum Industry of Trinidad and Tobago" (Ministry of Petroleum and Mines, Trinidad, June 1964. Mimeographed).

Low value products (fuel oil and gas and diesel oils) accounted for about 80 per cent of Shell's output and 70 per cent of Texaco's. The general structure of demand has not changed since 1963. Fuel oil still accounts for 60 per cent of refinery output (Table 4.10). There have been major changes, however, in the quality of products and the variety of products that characterize the remaining 40 per cent. Both companies have had to upgrade the quality of fuel oils to meet sulphur content specifications in the U.S. East Coast market. As a result Texaco has added a desulphurization unit to its refinery complex. This came on stream in 1973. The manufacture of petro-chemicals has increased significantly in response to rising demand in the U.S.A. The quality of motor gasolene has been greatly improved. The industry now produces sufficient lube oils to supply local industrial needs and export to other Caribbean countries.

The decision of the multinationals to use Trinidad as a refining and marketing centre to service the U.S.A. East Coast market and the surrounding Caribbean area had certain implications for crude production in Trinidad, and for its transactions in crude oil with the rest of the world. Either Trinidad would meet the increased demand from new resources or the companies would have to bring crude from their concessions located in other countries.

<u>Refinery inputs: crude</u>. After 1956 two major characteristics emerged in the pattern of Trinidad import transactions in crude petroleum. First, as Trinidad crude production declined, and as its importance as a refining centre increased, Texaco International

TABLE 4.10

PERCENTAGE DISTRIBUTION OF MAIN REFINERY PRODUCTS 1973-74

(based on bbls)

	1973	1974
Fuel oils	60.2	58.6
Motor gasolene	14.4	14.7
Gas/diesel oil	11.3	10.9
Aviation fuels	6.2	6.9
Kerosene	5.7	4.8
Lube oil greases	1.0	1.1
Petrochemicals	1.0	1.1

Source: Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Monthly Bulletin Petroleum Industry, July - December 1974, p. 39.

transported crude oil from Venezuela and Saudi Arabia to the Texaco Trinidad refinery complex. In more recent times, Libya, Indonesia, Colombia and Ecuador have become important sources of crude supply. Also by 1968 rising cost in Shell Trinidad's land concessions caused that company to start importing crudes from Nigeria for processing (on own account)[1] in order to meet its market obligations in the Caribbean and surrounding markets. Table 4.11 shows the changing pattern in the sources of crude supply to Trinidad over the period 1963 to 1972. The decline in the importance of Venezuelan crudes

[1]See Express (Trinidad), December 12, 1968 for timing of these imports.

(from 66.7 per cent in 1969 to 13.4 per cent in 1972) and Saudi Arabian crudes (from 36.4 per cent in 1965 to 26.0 per cent in 1972) contrasts sharply with the rise in importance in Libyan, Indonesian and other crudes.

TABLE 4.11

IMPORTS OF CRUDE OIL UNDER PROCESSING AGREEMENT

(Percentages)

Country	1972	1969	1965	1963*
Venezuela	13.4	66.7	50.0	43.0
Colombia	0.1	2.4	12.8	16.0
Saudi Arabia	26.0	12.9	36.4	39.0
Libya	23.2	9.4	-	-
Indonesia	20.0	2.2	-	-
Rest of world	17.2	6.4	0.7	2.0
Total	100.0	100.0	100.0	100.0

Source: Government of Trinidad and Tobago, C.S.O., Overseas Trade, 1963, 1965, 1969, 1972.

*Not strictly comparable: based on total imports of crude and partly refined petroleum. Prior to 1965 no information available for imports under processing agreement.

The next major characteristic was the increasing proportion of crude imports used in special processing for other refineries as opposed to purchases for processing on own account.[1] In 1962 48.7 per cent of refinery throughput represented foreign crudes under processing agreements (UPA), by 1968 it increased to 60.6 per cent and by 1970 to 66.1 per cent (Table 4.7). In contrast imports for own account processing declined from 10.9 per cent in 1962 to a negligible amount in 1968 (0.3 per cent) and increased to 7.1 per cent in 1970 as a result of imports by Shell Trinidad Limited (Trintoc 1974) to reduce the "excess" refinery capacity resulting from the decline in crude production from its domestic concessions and its increase in distillation capacity from 60,000 to 80,000 barrels per day. Table 4.12 shows the importance of UPA processing activity in the refining and marketing operations. During the period 1966 to 1972 more than 94 per cent of the total value of crude imports into the petroleum sector represented UPA transactions. For the same period between 71 and 88 per cent of exports (excluding bunkers) of petroleum products were UPA (70 to 80 per cent including bunkers).

Although after 1956 Trinidad became less of a resource base and more of a service base refining centre, refining continued to dominate the country's economic activity. This is underscored by the fact that in 1962 the oil sector accounted for 29 per cent of

[1]Crude and products moving under processing arrangements (UPA) are not imports or exports as defined in classical economic theory but rather are transfers of commodities between parent company and affiliates or between affiliates of the same company.

TABLE 4.12

IMPORTANCE OF TRINIDAD PETROLEUM TRADE

UNDER PROCESSING AGREEMENTS 1966-1972

I M P O R T S

	(1) Petroleum crude & partly refined	(2) Under processing agreement - UPA	(3) UPA imports / Total petroleum imports (2)/(1)
	T.T. $ mn		
1966	385.1	383.6	.996
1967	349.0	350.4	1.004
1968	458.4	452.2	.997
1969	498.3	494.5	.992
1970	563.1	529.9	.941
1971	653.3	623.2	.954
1972	686.3	656.6	.956

E X P O R T S

	(4) Petroleum products (ex. bunkers)	(5) Petroleum products (inc. bunkers)	(6) UPA	(7) UPA/ Col.4	(8) UPA/ Col.5
	T.T. $ mn				
1966	485.7	528.2	369.1	.760	.699
1967	487.8	532.3	347.9	.713	.654
1968	606.6	660.9	531.7	.877	.805
1969	598.7	647.0	446.9	.746	.691
1970	610.5	669.9	476.0	.780	.711
1971	660.4	723.0	573.6	.869	.793
1972	694.5	760.9	546.6	.787	.718

Sources:. Government of Trinidad and Tobago, C.S.O., Overseas Trade 1970, Part B, pp. 20-21; Overseas Trade, Monthly Report, vol. 21, no. 12, December 1971; vol. 22, no. 12, December 1972; Annual Statistical Digest, 1971-72, no. 21, p. 164.

the GNP (Trinidad) and that most of this accrued from sales of refined products to foreigners. For instance, a statement of earnings in the industry for 1962 (Table 4.13) shows that the production sector sold 87.9 per cent of its output to local refineries. In contrast the refining sector earned 92.5 per cent of its revenues from sales to foreigners. Eighty-one per cent of this represented sales of petroleum products manufactured on own account, and 11.5 per cent processing fees. The latter amount is considerably smaller than might be expected, however, one must bear in mind that this figure is net of the cost of the crude inputs whereas export sales include the cost of crude oil (i.e., about 75-80 per cent of the value of earnings).

TABLE 4.13

TRINIDAD PETROLEUM INDUSTRY: FUNCTIONAL STATEMENT OF COMBINED EARNINGS - DECEMBER 31, 1962

	PERCENTAGES			
Revenues	Production	Refining	Marketing	Total
Domestic sales	87.9	7.3	57.2	7.8
Export sales	9.3	80.9	41.5	82.4
Sales of gas - domestic	2.7	-	1.3	0.4
Processing fees	-	11.5	-	9.2
Other operating fees	0.1	0.3	-	0.1
	100.0	100.0	100.0	100.0

Source: Report of the Commission of Enquiry into the Oil Industry of Trinidad and Tobago 1963-1964. (London: André Deutsch, 1964).

The significance of foreign sector sales (92 per cent of total earnings) compared with domestic sales (8 per cent of total earnings) underlines the importance of external factors in determining the viability of the Trinidad oil industry in the world oil market. The most important external factors can be summarized as market "competition", changes in prices and market shares.

World prices and the Trinidad oil industry. From 1956-1972 Trinidad oil exports consisted almost entirely of refined products. While it is a fact that product prices in Trinidad are not subject to discounting below posted prices as they are in other refinery centres, an escape from general price trends would be unnatural. The trend for world petroleum product prices at posted levels for the years 1956 to 1963 is shown in Figure 4.4. A continuous downward trend is observed throughout the sixties in all markets. The weighted average price for main products in the Caribbean Sea dipped from approximately U.S. $2.80 per barrel at the beginning of 1961, to below U.S. $2.65 in mid-year of 1962, and settled in a plateau below U.S. $2.70 for 1963 as prices for fuel oils were somewhat higher during the winter season for 1962-1963 due to extremely cold weather in Western Europe, Canada and the U.S.[1] The erosion process which depressed refined product prices is a direct result of the weakening of crude prices in the world oil market after 1957. Table 4.14 shows the general downward trend in product prices after 1960 using Rotterdam prices as an index of price changes in the

[1]The Mostofi Report, p. 28.

world product markets.[1] In general these prices are close to realized prices for Venezuela. They differ largely by a transportation charge (45 cents).

TABLE 4.14

ROTTERDAM PRODUCT PRICES, 1960-1970

Year	Regular gasolene	Gas-diesel oil	Heavy fuel oil	Value per barrel of crude charge
	U.S. ¢ per gallon			U.S. $
1960 (June-Dec.)	7.0	7.5	1.91	2.47
1961	6.8	7.8	1.86	2.45
1962	6.4	8.4	1.78	2.54
1963	5.4	8.8	1.79	2.49
1964	5.2	6.7	1.74	2.13
1965	5.3	5.7	1.81	2.02
1966	5.9	6.2	1.72	2.12
1967 (Jan.-May)	6.1	5.8	1.70	2.05
1967 (June-Dec.)	11.1	9.2	2.10	3.24
1968	7.2	8.1	1.76	2.53
1969	5.5	7.4	1.51	2.04
1970 (Jan.-May)	5.0	6.6	2.10	2.24
1970 (June-Dec.)	6.5	9.2	3.33	3.19

Source: M. A. Adelman, The World Petroleum Market (Baltimore The Johns Hopkins University Press, 1972), Appendix Table VI-B-I, pp. 365-366.

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[1]After mid-1962 the Caribbean ceased to be the principal basis for determination of world product prices (posted). European markets had grown so large that Europe became the pivot. Adelman, The World Petroleum Market, pp. 167-168.

In general keeping with the downward trend in product prices and hence the netback on domestic crudes, arm length sales of Trinidad crudes showed a drastic drop in price from U.S. $2.56 in 1962 to U.S. $1.57 in 1970 (Table 4.15). Prices started increasing again after the 1971 Tehran Agreements and on January 1, 1974 in keeping with the dramatic price increases of the Persian Gulf producers, Trinidad set the tax reference prices of its Soldado crude oil at U.S. $13.73 per barrel; and for its East Coast Continental Shelf crudes (Amoco) at U.S. $14.93 per barrel.[1] The average values of crude exports to the U.S. and Puerto Rico in January-February 1974 were U.S. $13.08 and U.S. $12.98 per barrel respectively.[2]

The general indications are that the prices of Trinidad petroleum products and crude were highly correlated with movements in prices on the world market: when market prices decreased in the late fifties and the sixties the prices of Trinidad petroleum products and crudes decreased. When prices increased as a result of OPEC actions Trinidad benefited by comparable increases for its crudes and products. It is important to examine whether Trinidad's oil industry was able to maintain or improve its position in the world oil market. The following section therefore deals with Trinidad refined products in world trade.

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[1]Government of Trinidad and Tobago, Budget Speech, 1974, p. 53.

[2]Government of Trinidad and Tobago, C.S.O., Overseas Trade, January-February 1974.

TABLE 4.15

AVERAGE VALUES OF CRUDES EXPORTED F.O.B.

1962-1974

Year	Average value in W.I. $ (T.T. $ after 1965)	Average value in U.S. $
1962	4.37	2.56
1963	4.35	2.54
1964	4.31	2.52
1965	4.27	2.49
1966	4.20	2.45
1967	n/a	n/a
1968	4.05	2.03
1969	3.32	1.66
1970	3.14	1.57
1971	3.29	1.65
1972	5.06	2.53
1973 (August-December*)	11.88	5.94
1974 (January-February)	24.10	12.05

Sources: Report of the Commission of Enquiry into the Oil Industry of Trinidad and Tobago, 1963-1964 (London, André Deutsch, 1964).

Government of Trinidad and Tobago, C.S.O., Overseas Trade, 1965-1972, 1974.

*Due to large scale revisions in Trinidad Trade Statistics it was impossible for C.S.O. to integrate January-July 1973.

Trinidad refined products and world petroleum trade. Despite the major increases in growth of refinery capacity (340 per cent between 1951 and 1971) achieved by the Trinidad oil industry, the refinery operation lost ground steadily relative to refinery capacity in the rest of the world (excluding North America and the communist countries). Trinidad's refinery capacity would have had to increase eightfold in order to maintain, or improve, its position slightly over 1951. Trinidad's share of world equity in refining capacity outside North America and the communist countries (Table 4.16) declined from 2.3 per cent in 1951 to 1.4 per cent in 1971 as a result of the rapid build-up of capacity in Western Europe relative to Trinidad (and the Caribbean). European capacity increased from 1,391 thousand barrels per day in 1951 (32.5 per cent of world refinery capacity) to 15,850 thousand barrels a day in 1971 (50.5 per cent of world refinery capacity). Competition, market fragmentation, and the general shrinkage in world trade in petroleum products[1] acted as constraints on the growth of refining in the Caribbean and caused a major redistribution of its petroleum exports. The Caribbean's share (including Trinidad's) of world trade in petroleum products declined from 49.8 per cent in 1962 to 47.1 per cent in 1972 (Table 4.17). By comparison Trinidad's share declined from 15 per cent (30 per cent of Caribbean exports) to 5 per

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[1]Since the 1950s trade in refined products has decreased relative to trade in crude oil. For example, between 1962 and 1972 total world exports of crude have more than tripled while total exports of refined products have increased by less than 50 per cent. B.P. Statistical Review of the World Oil Industry, 1962-1972.

TABLE 4.16

REFINING CAPACITY BY REGION

(EXCLUDING NORTH AMERICA AND COMMUNIST COUNTRIES)

1951-1971

	1951		1957		1966		1970		1971	
	000 b/d	%	000 b/d	%	000 b/d	%	000 b/d	%	000 b/d	%
Western Europe	1,391	32.5	2,902.9	38.4	9,526.9	46.6	14,430	50.9	15,850	50.5
Africa	68	1.6	98.4	1.3	704.5	3.4	730	2.6	870	2.8
Middle East	938	21.9	1,260.6	16.7	1,955.2	9.7	2,280	8.0	2,370	7.6
Australasia	21	0.5	257.4	3.4	670.3	3.3	660	2.3	710	2.3
Japan	*	*	430.1	5.7	2,211.2	10.8	3,330	11.7	3,800	12.1
Far East (excl. Japan)	301	7.0	401.1	5.3	1,074.3	5.3	2,020	7.1	2,350	7.5
Caribbean (excl. Trinidad)**	1,198	27.9	1,562.3	20.7	2,236.2	10.9	3,180	11.2	3,430	10.9
Trinidad	99	2.3	141.0	1.9	390.0	1.9	440	1.6	440	1.4
South America	272	6.3	496.3	6.6	1,657.4	8.1	1,290	4.5	1,510	4.8
	4,288	100.0	7,549.6	100.0	20,426.0	100.0	28,360	100.0	31,330	100.0

Sources: Report of Commission of Enquiry into the Oil Industry of Trinidad and Tobago, 1963-1964 (London: André Deutsch, 1964), Exhibit no. 4.

B.P. Statistical Review of the World Oil Industry (London), 1970, 1971.

M. A. Adelman, The World Petroleum Market (Baltimore: The Johns Hopkins University Press, 1972), Tables III-C-I and 2.

*Negligible.

** Includes Cuba, Centeal America south of Mexico, Colombia, Puerto Rico.

TABLE 4.17

PERCENTAGE DISTRIBUTION OF TOTAL WORLD EXPORT TRADE

IN PETROLEUM PRODUCTS

1962-1972

	1962 %	1972 %
U.S.A.	4.6	4.2
Canada	0.4	4.3
Caribbean	49.8	47.1
(Trinidad)	(15.0)	(5.0)
Other Western Hemisphere	0.8	0.6
Western Europe	4.9	6.1
Middle East	23.5	19.1
North and West Africa	0.8	0.5
East and South Africa, S. Asia	0.1	0.2
South East Asia	4.2	5.5
Japan	0.4	0.4
Australia	0.7	0.2
U.S.S.R., E. Europe and China	9.6	11.2
	100.0	100.0

Source: B.P. Statistical Review of the World Oil Industry (London), 1962-1972.

cent in 1972. This drastic decline can partly be accounted for by lags in production resulting from downtime during refinery improvements and unscheduled shutdown,[1] but a major part of it is due to competition from new refineries in the Caribbean. Trinidad's share of existing export refinery capacity in the Caribbean (Table 4.18) declined by 6 percentage points from 28.9 per cent in 1969 to 22.8 per cent in 1973. In fact even if Trinidad refineries were operated at full capacity (500,000 b/d) in 1972 they would have accounted for only 9 per cent of world petroleum trade (5,310 thousand b/d)[2] showing a decline equivalent to that experienced in its share of Caribbean export refinery capacity (6 percentage points). In spite of this competition the industry expanded, making Trinidad the largest refining complex in the Caribbean both in terms of the complexity of its refining operation and total capacity (Table 4.18). In the process of this growth the direction of its trade shifted from European to Western Hemisphere markets, especially the U.S.A.

Trinidad oil industry and product export markets 1956-1974. The distribution of Trinidad's crude and product exports for 1956 is shown below in Table 4.19. Out of a total of 96.4 thousand barrels of product exports per day about two-thirds went to Europe and West Africa. (The United Kingdom, Sweden, and the Canary Islands together accounted for more than half of total exports.) Another 26 per cent went to the nearby areas in the Caribbean and Central America and

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[1] See page 125.

[2] B.P. Statistical Review, 1972, 1973.

TABLE 4.18

REFINERY CAPACITY IN THE CARIBBEAN EXPORT TERRITORIES

	Existing capacity 1969 000 b/d	Planned capacity 1973 000 b/d	Percentages 1969	Percentages 1973
Trinidad	400	500	28.9	22.8
Aruba	460	460	33.2	21.0
Curaçao	300	430	21.7	19.6
Bahamas	-	450	-	20.5
Puerto Rico	155	280	11.2	12.8
Virgin Islands (U.S.)	70	70	5.0	3.2
	1,385	2,190	100.0	100.0

Source: Appendix 4-B, Table 4-B-1.

TABLE 4.19

DISTRIBUTION OF TRINIDAD OIL EXPORTS, 1956

(000 b/d)

	Total*	Europe and West Africa	North America	Caribbean and Cent. America	South America
Products**	96.4	64.3	5.2	12.1	12.9
%	(100)	(66.7)	(5.4)	(12.6)	(13.4)
Gasolene	28.6	15.3	2.2	8.8	2.3
%	(100)	(53.5)	(7.9)	(30.8)	(8.0)
Kerosene	9.2	7.3	-	1.0	0.9
%	(100)	(79.3)	-	(10.9)	(9.8)
Distillates	21.3	16.3	-	1.2	3.8
%	(100)	(76.5)	-	(5.6)	(17.8)
Residual	35.6	25.4	3.1	0.9	5.8
%	(100)	(71.3)	(8.7)	(2.5)	(16.3)
Crude oil	10.2	0.6	9.6	-	-
%	(100)	(5.9)	(94.1)	-	-

Sources: Government of Trinidad and Tobago, Annual Overseas Trade, 1956; The Trinidad Oil Economy, 1959, p. 17.

*Includes other areas not shown separately.

**Includes other products not shown separately.

South America. A mere 5.4 per cent went to North America. Approximately 37 per cent of these products represented residual fuel oils and over 70 per cent were shipped to European and West African markets compared with 8.7 per cent to North American markets. By 1963 the shift in product exports from European markets to the U.S. market was dramatic. Table 4.20 indicates that the U.S.A. and Puerto Rico accounted for 37.5 per cent of all Trinidad exports of product compared with 5.4 per cent for all North America in 1956. The U.K. and the European Common Market accounted for about 30.2 per cent and the Caribbean Sea and nearby areas accounted for about 8 per cent. By 1970 the shift had become even more pronounced. The U.S.A. and Puerto Rico now accounted for 59.8 per cent, the U.K. and European Common Market accounted for 14.7 per cent and the Caribbean Sea and nearby areas for 8.5 per cent.

It has been suggested earlier that this shift was due to a policy decision by Texaco International to avoid risk by making Trinidad its refining centre for its Western Hemisphere marketing operations. But a more general economic explanation is in order here. In a dynamic oliogopolistic market situation one may find that there is a tendency for the pressure of competition in the form of quality of service and brand names to be such that the feedback between the marketing and the manufacturing process is so shortened that significant advantage can be gained in having the refining function, and in some cases the entire manufacturing function, located near to the market. These market factors, plus pressure from various governments to provide employment

TABLE 4.20

TRINIDAD AND TOBAGO EXPORTS OF REFINED PRODUCTS

TO FIVE PRINCIPAL MARKETS

Country	1963 volume mn bbls	% total	1970 volume mn bbls	% total	Percentage change 1963--1970
U.S.A. and Puerto Rico	40.9	37.5	86.7	59.8	112
U.K.	19.1	17.5	5.5	3.8	-71
European Common Market	13.7	12.4	15.9	10.9	16
Caribbean Sea and nearby area	8.5	7.9	12.3	8.5	45
Bunker sales	10.9	10.0	10.3	7.1	-5
Other	16.0	14.7	14.2	9.8	-11
Total	109.1	100.0	144.9	100.0	33

Sources: Report of the Commission of Enquiry into the Oil Industry of Trinidad and Tobago, 1963-1964 (London: André Deutsch, 1964), Exhibit Nos. 22, 23.

Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Annual Report, 1970, Appendix V, p. 36.

and save on foreign exchange by having refineries built within their countries, have created a tendency, in the last fifteen years, for a rapid build up of refineries in or near to the major energy consuming markets. This has resulted in the general shrinkage of world trade in petroleum products described above and dramatic regionalization of the pattern of this trade. The redistribution of trade observed in Trinidad's case is partly a result of that regionalization of world trade in petroleum products. Trinidad benefits from its closeness to major suppliers of crude in Venezuela, Colombia and Ecuador, and to the large consumer markets for fuel oil in the East Coast U.S.A. This strategic location gives it a comparative transportation advantage in U.S. markets over European competitors.

<u>Trinidad's position in the U.S. crude petroleum and products import market</u>. Traditionally the U.S. has imported crude and particularly petroleum products from the Western Hemisphere. Concern among government officials and the "independents" about competition from foreign refiners and cheap Middle East crudes resulted in the implementation of a mandatory quota system in 1959. Since 1959 the policy has been modified significantly; and several categories of refined products such as petrochemicals and finished specialty products are now allowed to be imported, as are refined products from the Virgin Islands (U.S.) and Puerto Rico which enjoy preferential treatment. In PAD Districts I-IV (Table 4.21), which constitute the major markets for the Caribbean supplier, the special categories and the non-controlled category (residual fuel oil)

TABLE 4.21

U.S. PETROLEUM IMPORTS* 1969-1972

(mm b/d)

	1969	1970	1971	Program 1972
	Districts I-IV			
Crude and unfinished				
Refining companies	543	487	663	657
Carry-over	74	-	-	-
Petrochemical companies	85	84	102	94
From Canada	349	448	493	540
From Mexico	30	28	29	36
OIAB set-aside	-	-	-	36
Unallocated	-	-	-	43
Total	1,081	1,047	1,287	1,406
Finished products (ex. resid.)				
Virgin Islands	15	15	15	15
Puerto Rico	45	45	64	64
Defense Department	-	-	-	20
Total	60	60	79	99
Total controlled 12.2 ratio	1,141	1,107	1,366	1,505
Other imports				
Bonded light products	83	90	112	130
Shipments from Puerto Rico	47	58	30	50
Virgin Islands (ref. prod.)	8	2	17	20
No. 4 fuel oil	75	70	66	75
No. 2 fuel oil	18	30	61	45
Canadian finished products	30	42	12	60
Canadian & Western Hem. LPG	-	6	36	90
Asphalt	13	17	20	30
Imports for petrochemical exports	-	-	-	40
Total	274	315	354	540
Residual fuel	1,244	1,513	1,560	1,665
Total Districts I-IV	2,659	2,935	3,280	3,710
Total District V	507	484	640	629
Total U.S. imports	3,166	3,419	3,920	4,339

Source: National Petroleum Council, U.S. Energy Outlook: 1971-1985 (Washington, D.C.: 1972), p. 277.

*Independent Petroleum Association of America, Media Meeting IPAA, New Orleans, May 1972.

accounted for 1.9 million barrels or 57.6 per cent of the total imports of 3.3 million barrels in 1971.

Table 4.22 shows that the U.S. continues to import most of its petroleum products from the Western Hemisphere--91 per cent in 1971 and 89 per cent in 1972, and that the Caribbean area is the greatest supplier, accounting for almost 60 per cent in 1971 and 53 per cent in 1972. Canada as a single supplier accounted for 6 per cent in 1970 and 10 per cent in 1972. Other Western Hemisphere countries accounted for about 25 per cent.

This apparent favourable position of the Caribbean in the U.S. market is restricted largely to the supply of residual fuel oil (except in the case of the U.S. Virgin Islands and Puerto Rico). Trinidad with 20 per cent of the Caribbean export refinery capacity accounts for a significant part of this trade in residual fuel oils. Trinidad exported 211,000 barrels of products per day to the U.S. East Coast markets in 1971 and 191,000 barrels per day in 1972. This represented approximately 10 and 8 per cent respectively of all finished products imported to the U.S. (Table 4.22). However, bottom of the barrel products (Bunker "C" and other fuel oils) represented 69 per cent in 1971 and 79 per cent in 1972 of Trinidad's total exports of petroleum products to the U.S.A. Semi-refined oil and aviation gas under 100 octane accounted for most of the other 20 per cent (Table 4.23) in 1972.

There are three very important features of Trinidad's position in the U.S. market for crude and petroleum products that need some explanation. First, with respect to refined products,

TABLE 4.22

U.S. IMPORTS OF CRUDE OIL AND REFINED PRODUCTS

(000 b/d)

Country or Area	1971 Crude	1971 Products	1971 %	1972 Crude	1972 Products	1972 %
Canada	721.4	136.9	6.2	853.6	249.4	10.1
Mexico	-	27.8	1.3	-	21.4	0.9
Caribbean	311.6	1,304.9	59.4	283.1	1,314.2	53.3
(Trinidad)	(15.0)	(210.6)	(9.5)	(32.0)	(190.6)	(7.7)
Other Western Hemisphere	2.9	526.8	24.0	15.1	614.6	24.9
Total Western Hemisphere	1,035.9	1,996.4	90.9	1,151.8	2,199.6	89.2
Non-Communist Europe	-	130.4	5.9	-	158.0	6.4
North Africa	88.3	1.9	0.1	211.5	17.5	0.7
West Africa	99.0	4.7	0.2	258.6	10.9	0.4
Middle East	340.2	44.0	2.0	426.1	47.7	1.9
Other Eastern Hemisphere	117.2	11.9	0.5	166.4	22.1	0.9
Communist area	-	6.8	0.3	0.9	10.7	0.4
Total Eastern Hemisphere	644.7	199.7	9.1	1,063.5	266.9	10.8
Grand total	1,680.6	2,196.1	100.0	2,215.3	2,466.5	100.0

Sources: U.S. Department of the Interior, Office of Oil and Gas, Overview of the Domestic Petroleum Supply Situation, March 2, 1972.

American Petroleum Institute, Annual Statistical Review (Washington, D.C: April 1973).

TABLE 4.23

TRINIDAD EXPORTS OF PETROLEUM PRODUCTS TO THE U.S.A.

1970, 1971 AND 1972

(000 barrels per year)

	1970		1971		1972	
Processing Agreement						
Semi refined oil	3,274		5,429		2,799	
Aviation gas under 100 octane	9,918		8,218		8,019	
Bunker "C" fuel	27,524		16,431		10,174	
Other fuel oils	25,823		24,313		34,716	
Sub-total	66,539	84%	54,391	71%	55,708	80%
Other Processing						
Semi refined oil	-		6,475		315	
Aviation gas under 100 octane	-		3,286		2,981	
Motor gas	-		36		-	
Gas oil	-		3		21	
Diesel oil	-		441		120	
Bunker "C" fuel	3,306		3,875		3,622	
Other fuel oils	9,487		8,305		6,796	
Lubrication oil	225		72		22	
Total	79,557	100%	76,884	100%	69,585	100%
Barrels per day	217,964		210,641		190,644	

Source: Government of Trinidad and Tobago, C.S.O., Overseas Trade, 1970, 1971, 1972.

between 1970 and 1975 Trinidad exports to that market have been declining both in absolute and percentage terms. This reflects in part competition from other Caribbean refiners and the fall off in demand in the East Coast market for fuels with high sulphur content (i.e. exceeding one per cent). The Texaco desulphurization plant which came into full stream in 1973 was expected to reverse this trend but shortages of crude supplies during the Arab oil embargo and various refinery shutdowns at the Trintoc plant kept refinery output at about 50 per cent of full capacity. For the first six months of 1975 daily exports of refined products to the U.S. were 88,000 barrels per day,[1] i.e., 5 per cent of all U.S. imports of refined oils and 3 percentage points below its 1972 share of that market.

The second feature is that about 80 per cent of all exports of petroleum products to the U.S. are carried on under processing agreements between the parent companies and their Trinidad affiliates, thus maximizing the service nature as opposed to the resource base structure of the Shell and Texaco operations on the island.

Finally, prior to 1971 Trinidad exports of crude oil were very small. Shipments to Canada and the U.S.A. between 1960 and 1971 were largely re-exports of foreign crudes as indicated by the discrepancies between total domestic crude exports and exports of domestic and foreign crudes to the U.S. and Canada (Table 4.24).

[1]Oil and Gas Journal, Mid Year Report, July 28, 1975, p. 73.

TABLE 4.24

TRINIDAD CRUDE PETROLEUM EXPORTS TO U.S.A. AND CANADA

1963-1972

(000 bbls per year)

Year	Domestic exports and foreign re-exports: U.S.A.	Canada	Total	Total* domestic exports
1963	2,592.5	3,772.8	6,365.3	n/a
1969	6,846.2	2,146.4	8,992.6	873.7
1970	3,867.1	238.2	4,105.3	3,204.0
1971	5,428.6	-	5,428.6	582.0
1972	11,648.4	1,316.4	12,964.8	13,279.4

Source: Government of Trinidad and Tobago, C.S.O., Overseas Trade, 1963, 1969, 1970, 1971 and 1972.

*No breakdown of domestic exports by country available.

After 1971 domestic crude exports to the U.S. increased from about 32,000 barrels per day (1971) by 253 per cent to 113,000 barrels per day for the first six months of 1975[1] or 3.2 per cent of petroleum imports for that period. The rapid increase in domestic crude exports to the U.S. after 1971 was partly offset by the decline in exports of refined oils so that Trinidad's share of U.S. imports of total crude petroleum and refined oils declined from 222,600 barrels per day[2] (4.8 per cent) to 200,000 barrels per day (4 per cent) at 1975.[3]

Growth in the Trinidad Oil Industry and the Economy (1952-1970)

Growth in the petroleum sector has always been a major factor influencing prosperity and depression in the Trinidad economy. This growth in turn is linked to fluctuations in the world oil market as they affect prices of crude and petroleum products. For instance, the Trinidad petroleum sector contributed 28.6 per cent to Trinidad's GNP in 1952. This increased to 32.4 per cent in 1958 (Table 4.25) reflecting the increases in world oil prices and expansion of crude output and refinery throughput in Trinidad. The decline in world oil prices after 1957 up to the Tehran Agreements in 1971 coincides with the rapid decline in Trinidad oil reserves after 1964. The result is a dramatic decline in growth of value added in the sector from

[1] *Ibid.*

[2] *Ibid.*

[3] *Ibid.*

TABLE 4.25

SECTOR SHARES IN GROSS DOMESTIC PRODUCT

TRINIDAD AND TOBAGO 1952-1970

	PERCENTAGES					
	1952	1958	1962	1965	1968	1970
Agriculture, forestry, fishing, quarrying.	17.7	13.7	10.8	8.6	8.3	7.6
Oil, ashphalt, gas (incl. mining and refining)	28.6	32.4	29.0	23.9	24.0	20.4
Manufacturing and construction	16.3	17.2	18.6	21.8	21.3	21.6
Other activities incl. government public utilities and distribution	37.3	36.8	41.6	45.8	46.3	50.4
Total	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Government of Trinidad and Tobago, C.S.O., The National Income of Trinidad and Tobago, 1952-1962.

Government of Trinidad and Tobago, House of Representitives, Budget Speech, January 1972 (Appendix).

Government of Trinidad and Tobago, Third Five-Year Plan, 1969-1973.

11 per cent between 1955 and 1961 to a no growth situation between 1962 and 1966. The decline in the sector is reflected in the decline in real GNP from an average rate of growth of 9.7 per cent between 1955 and 1961 to a growth rate of 3-3.5 per cent in the period 1962-1966. Over the entire period 1962 to 1968 real growth of GNP only averaged 4.3 per cent per annum.[1] As a result of world market and domestic supply conditions the share of the oil sector in GNP declined from 32.4 per cent in 1958 to 24 per cent in 1968. This decline was not compensated for by the growth in net value added by the new dynamic sectors of the economy. For intance, the share of the manufacturing and construction sectors in GNP remained constant at about 21 per cent throughout the period 1962-1970.

As may be expected the decline in the oil sector resulted in a decline in the contribution of the industry to government revenues, and income. Government revenues from the sector declined from 45 per cent of its general revenues in 1958 to 31 per cent in 1962 and further to 21 per cent in 1971 (Table 4.26). This was partly responsible, through a multiplier effect, for the sluggish growth in the public sector in the late sixties and the low growth rate in per capita income. Per capita income grew by only 2 per cent per annum during the period 1962 to 1968.

The decline in Trinidad's petroleum sector during the sixties is reflected in the diminished importance of oil in the country's trade. The share of petroleum exports in visible export trade declined from 84 per cent in 1968 to 77 per cent in 1971

[1]Government of Trinidad and Tobago, Third Five-Year Plan, 1969-1973, p. 11.

TABLE 4.26

GOVERNMENT REVENUES AND OIL REVENUES

1956 - 1975

	Government revenue* T.T. $ mn	Oil revenue* T.T. $ mn	Percentage of government revenues
1956	87.6	33.2	38
1958	130.0	57.4	45
1962	165.6	60.9	31
1966	204.8	63.8	31
1967	214.5	66.8	31
1968	255.2	96.1	37
1969	294.0	77.2	26
1970	303.7	70.2	23
1971	339.3	71.7	21
1972	398.3	73.5	18
1973	474.2	109.1	23
1974	1,196.7	810.8	68
1975	1,686.5	1,184.2	70

Sources: Government of Trinidad and Tobago, C.S.O., An Analysis of Government Revenue and Expenditures 1966-1971, January 1974.

Government of Trinidad and Tobago, Second Five-Year Plan 1964-1968.

Tables 8.3 and 8-A-1.

*Does not include capital receipts.

reflecting the decline in world oil prices and Trinidad's output of crude. The price increases in 1971 and again in 1974, as well as the increased production of crude oil after 1972, have, however, reversed this trend: the share of Trinidad's petroleum exports in total visible trade rose from 77 per cent in 1971 to 90 per cent in 1974 (Table 4.27). The changing position of the Trinidad oil industry in world oil trade had a significant influence on the share of the value of petroleum exports accruing to the government. This declined from 13.9 per cent in 1962 to 12.3 per cent in 1968, to 8.8 per cent in 1972, and increased to 23.7 per cent in 1974, reflecting the dramatic increase in world oil prices effective January 1974 and the implementation of the Trinidad government new tax policies. The contribution of the oil sector to Trinidad government revenues consequently rose from an all time low of 18 per cent in 1972 to approximately 70 per cent in 1975.

Having presented an historical analysis of the Trinidad oil industry, examining some of its responses to major trends and relationships in the world oil industry, we will now turn to making projections of world demand for Trinidad's hydrocarbons.

TABLE 4.27

TRINIDAD'S TOTAL VISIBLE AND PETROLEUM TRADE, AND GOVERNMENT OIL REVENUES (PERCENTAGE OF PETROLEUM EXPORTS)

1962, 1968-1974

A: TOTAL VISIBLE TRADE (T.T. $ mn)

	1962	1968	1969	1970	1971	1972	1973	1974
Exports	592.0	932.5	949.2	963.1	1040.2	1071.5	1368.3	4166.0
Imports	605.6	840.1	965.4	1087.0	1314.2	1471.1	1536.4	3778.0

B: TOTAL PETROLEUM TRADE (T.T. $ mn)

	1962	1968	1969	1970	1971	1972	1973	1974
Exports	438.7	780.2	732.3	743.5	805.7	831.5	1123.0	3759.0
Imports	278.4	409.1	510.3	578.1	665.4	692.9	788.8	2715.4

C: (B) AS A PERCENTAGE OF (A)

	1962	1968	1969	1970	1971	1972	1973	1974
Exports	74.0	84.0	77.0	77.0	77.0	78.0	82.0	90.0
Imports	46.0	49.0	53.0	53.0	51.0	47.0	51.0	72.0

D: GOVERNMENT OIL REVENUES AS PERCENTAGE OF PETROLEUM EXPORTS

	1962	1968	1969	1970	1971	1972	1973	1974
	13.9	12.3	10.5	9.8	9.9	8.8	9.7	23.7

Sources: Government of Trinidad and Tobago, Review of the Economy, 1975, Appendix 23, p. 74.

Government of Trinidad and Tobago, C.S.O., Overseas Trade, 1963.

Government of Trinidad and Tobago, Third Five-Year Plan, 1969-1973, p. 167.

Table 6.2.

CHAPTER 5

WORLD DEMAND FOR TRINIDAD HYDROCARBONS

1975-1985

Making long-run forecasts is hazardous. In the case of oil and gas, forecasting supply and demand is particularly so because of the geological uncertainties associated with estimating long-run supply; the difficulties of predicting the technologies for developing alternative sources of energy, and determining income elasticities for fuels in a highly imperfect world oil market. Despite these difficulties, however, one must take a look forward before committing large amounts of capital to finding and developing these resources, or before implementing energy policies now with the hope of maximizing net benefits to the country later. Generally one is seldom without some information that will allow one to make at least systematic speculations about the future. In this respect the past often serves as an imperfect reflection of the future. And although projections of historical trends may not tell exactly what the future will be like, yet they could be useful indicators for a skilful decision maker. In this chapter we will make projections of foreign demand for Trinidad oil and gas over the next decade based on the trends and relationships revealed in the previous chapter. It is assumed that, except for the development of a natural gas industry, the structure of Trinidad's petroleum industry will remain unchanged. That is, essentially an export refining centre specializing in lower value products. This approach will make it possible to examine the implications of such a policy in terms of changing market conditions, i.e., expected long-run decline in hydrocarbon reserves, increases in oil prices, and changes in energy policies governing specific markets.

Abstracting from the discussion in Chapter 4 one can define the demand for Trinidad petroleum products and natural gas partly as a function of the net demand for imports of energy (fuels) in the U.S.A., and U.S. energy policies governing these imports; and partly as a function of demand for energy imports in the rest of the world. Since the early 1950s the trends in Trinidad petroleum exports to these two segments of the world oil consuming market have been moving in opposite directions: demand for Trinidad's petroleum products has been increasing in the U.S.A. but declining in European markets. The decline in European markets has been attributed to import substitution and the development of energy self-sufficiency among some of these countries. The estimate of Trinidad's exports to European markets can, therefore, be obtained by deriving the long-term rates of decline in these exports. Demand in other markets outside the U.S. is less systematic (i.e., of a random nature) and reflects the companies' use of their Trinidad refineries as a back-up system to meet short-term and seasonal supply shortages at various points in their global supply network. The forecast in these cases is based on an averaging process and intuition. Exports to the U.S. markets will be based on more sophisticated forecast procedures in the sense that several comprehensive studies using a systems approach have recently become available which forecast U.S. imports of petroleum and natural gas at 1985, given various assumptions with respect to growth in drilling activity, drilling success, availability of alternative sources of energy (coal, nuclear, hydro, synthetic fuels), and prices of foreign oil. It is a question, therefore, of estimating Trinidad's competitive share of these imports in the period 1975 to 1985.

U.S. demand for oil and gas and its implications for Trinidad. It is a widely held view that the present regulated prices of gas in the U.S. are so low that it is unprofitable to explore for more gas. This is advanced as an explanation of the fact that additions to existing reserves lag behind the rate of usage. Several studies on the gas industry show that even if prices increase the deficit (supply-demand imbalance) is likely to persist well beyond the year 2000.[1] Some energy economists, however, argue that if prices are increased sufficiently the deficit can be completely removed.[2] At present negotiable prices, however, it is profitable to move LNG from Trinidad to the U.S.A.,

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[1]U.S., Congress, House, Sub-Committee on Communications and Power of the Committee on Interstate and Foreign Commerce. Bill to Amend the Natural Gas Act, Hearings on H.R. 253, 92nd Congress, 1st sess., September 1971, p. 377.

[2]Paul M. MacAvoy and Robert S. Pindyck, "Alternative Regulatory Policies for Dealing with the Natural Gas Shortage," The Bell Journal of Economic and Management Science, Autumn 1973, vol. 4, no. 2, pp. 488-493.

and it is expected that the shortage in gas is so imminent and serious that the U.S. government will soon have to deregulate prices and allow them to adjust to the market demand price. Given current forecast of shortages the U.S. can take all the gas which Trinidad can supply over the next twenty-five years. This is estimated to be in the range of 500 million cubic feet per day to one billion cubic feet per day. By 1983 expected growth in Trinidad demand for its own gas will compete with potential foreign demand. Estimates of Trinidad's gas requirements for use in industry and electric utilities have been made for the period 1974-1983. This demand is expected to rise from 39 million cubic feet per day in 1974 to 156 million cubic feet per day at 1976 and to 446 million cubic feet per day in 1983. This will provide for the anticipated gas needs for Trinidad and Tobago Electric Company and new industries, i.e. Tringen, additional ammonia plants, an iron and steel plant, an aluminium smelter, a furfural plant, and other miscellaneous requirements.[1] Since current productive capacity of known reserves is rated at 500 million cubic feet per day the question is, therefore, whether it pays Trinidad to export its gas or use it on domestic energy-based or energy-intensive industries. Discussion of this is, however, deferred to Chapter 8.

In developing a forecast of U.S. imports of crude and petroleum products the results of two recent studies of the U.S.

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[1]Government of Trinidad and Tobago, The Trinidad Gas Transmission System, Acting Minister of Petroleum and Mines (Office of the Prime Minister, 27 September, 1974), release no. 525, p. 1.

energy situation will be used, the National Petroleum Council's study of the U.S. energy outlook,[1] and a paper by D. R. Knop and J. F. Roorda.[2] Both analyses follow a comprehensive systems approach. The NPC study considers the effect of other existing and potential sources of energy on the demand for petroleum fuels as the incremental cost of finding crude oil within the U.S. increases. However, it makes a weak implicit assumption that demand for energy is independent of prices. Hence its estimates are noticeably much higher than those of Knop and Roorda[3] who assume that price elasticities will be higher at higher prices. The results from the Knop and Roorda study are more appropriate to this analysis. However, a comparison of the two sets of estimates provides some measure of the effect of higher crude prices on the demand for Trinidad petroleum products in U.S. markets. Table 5.1 shows estimates of U.S. oil imports 1975 to 1985 under the assumptions of Supply Case II and Supply Case III of the NPC study[4] and for Knop and Roorda Supply Case. If we accept the

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[1]NPC., U.S. Energy Outlook: 1970-1985.

[2]Knop and Roorda, "Economic Restraints on U.S. Energy Supply and Demand," July 1975.

[3]This study uses several specialized models in a systematic fashion, taking care to ensure the consistency between variables of the various models. Knop and Roorda, p. 803.

[4]Under Supply Case II (Case II) drilling for oil and gas is assumed to grow at a rate of 3.5 per cent per year with very optimistic finding rates per foot drilled. The problems of nuclear energy are assumed to be easily and quickly solved. It is also assumed that synthetic fuels and coal will be available at a moderate build-up rate. Case III is less optimistic than Case II, i.e., trends in oil and ~~gas finding~~ rate per foot drilled are lower. Case III reflects actual experience more closely than Case II.

TABLE 5.1

U.S. OIL IMPORTS 1970-1985

FOR NPC CASES II AND III AND KNOP AND ROORDA MODEL

(mn b/d)

Supply Case	1970	1975	1980	1985
II	3.4	7.4	7.5	8.7
III	3.4	8.5	10.6	13.5
Knop and Roorda Supply Case	3.4	6.2	8.0	9.8

Sources: National Petroleum Council, U.S. Energy Outlook: 1970-1985 (Washington D.C: 1972), p. 24.

Journal of Petroleum Technology, July 1975, p. 810.

conclusion of the NPC study that Supply Case III is most likely to occur, the forecasts (projections) of total imports of petroleum products into the U.S. would have been 8.5 million barrels per day at 1975 rising to 10.6 million barrels per day in 1980 and 13.5 million barrels per day at 1985. The Knop and Roorda Supply Case shows that when the impact of higher prices is taken into consideration imports of crude and petroleum products can be expected to be considerably reduced. U.S. oil imports at 1974 prices are shown as 6.2 million barrels per day in 1975 compared with 8.5 million barrels per day for NPC Case III, and 9.8 million barrels per day for 1985 as compared with 13.5 million barrels per day for NPC Case III. These differences are very significant, and a priori one can expect them to have a direct effect on demand for Trinidad products. U.S. energy policies defining the ratio of petroleum products to crude oil in its total imports of fuels will also affect the future demand for Trinidad products. For instance, a policy which stipulates maximum refinery requirements implies that total supply of petroleum liquids would have to be in the form of crude oil to be refined in the U.S.A. This would affect Trinidad's refinery industry very adversely. On the other hand, a policy of minimum refinery requirements implies that all imports are refined products. This may mean a greater demand for refined products (in volume and variety) from Trinidad. Both policies in their extremes could mean a change in the structure of the Trinidad oil industry.

Since to date there have been no major swings in policy to one extreme or the other it may be safe to accept the assumptions of the NPC study that future refinery capacity is likely to be on the high side of the midrange value,[1] i.e., 65-75 per cent crudes in fuel imports. In short, Trinidad petroleum exports to the U.S.A. may be expected to remain constant or decline. The first expectation is further supported by the fact that the largest proportion of the imports of fuels is highly likely to be for the East Coast markets where Trinidad products are most competitive.[2] The following section derives projections of U.S. demand for Trinidad petroleum products for 1975 and 1985.

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[1]NPC., U.S. Energy Outlook, p. 280.

[2]Ibid., p. 276. NPC study shows that in accordance with Case III ten million barrels per day will be imported into PAD I at 1985, i.e., 77 per cent of total imports of petroleum liquids. This ratio would also apply to the Knop and Roorda estimates.

Estimates of U.S. demand for Trinidad petroleum products. The projections (Table 5.1) of total imports of fuels into the U.S.A. at 1985 are not given in terms of categories of imports. However, a breakdown into fuel oils and other products can be obtained by assuming that the structure of petroleum imports will be 50 per cent crude and 50 per cent residual fuels and other products throughout 1975 and 1985.[1] The ratios are likely (interpreting the NPC assumptions of U.S. energy policy) to change to 65 per cent crude, 28 per cent residual and 7 per cent other products by 1985. Table 5.2 shows estimates of Caribbean and Trinidad exports of petroleum products for 1975 and 1985 using NPC and Knop-Roorda data. When 1974 high prices are taken into account and the crude content of imports is 50 per cent (Knop and Roorda Supply Case I) Trinidad exports of petroleum products to the U.S. are estimated to increase from a level of 218,000 barrels per day at 1970 to 270,000 barrels per day at 1975 and ultimately to 441,000 barrels per day at 1985. However, if crude import content is increased to 65 per cent of total fuel imports (Knop and Roorda Supply Case II) then Trinidad exports decline to just under 200,000 barrels per day in 1975 and rise to 311,000 barrels per day at 1985, i.e., more than 100,000 barrels below Knop and Roorda Supply Case I. In the first case Trinidad petroleum exports to the U.S.A. at 1985 will be about 88 per cent of present refinery capacity and in the second it will be about 62 per cent. In order to

[1]An IPAA forecast of imports shows a breakdown of 46.9 per cent crude, 40.4 per cent residual fuels and 12.7 per cent other products for 1972. Quoted in NPC., U.S. Energy Outlook, p. 277.

TABLE 5.2

ESTIMATES OF U.S. DEMAND FOR TRINIDAD PETROLEUM PRODUCTS,

AND PROJECTIONS OF TRINIDAD TOTAL EXPORTS 1975-1985

(000 b/d)

	1975			1985			Caribbean exports to U.S.		Trinidad exports to U.S.	
	Residual	Other Products	Total	Residual	Other Products	Total	1975	1985	1975	1985
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Case II	2,985	935	3,910	3,515	1,105	4,620	2,346	2,772	352	416
Case III	3,436	1,080	4,516	5,443	1,711	7,154	2,710	4,292	407	644
Knop & Roorda Supply Case I			3,000			4,900	1,800	2,940	270	441
Knop & Roorda Supply Case II			2,170			3,460	1,302	2,076	195	311

Notes: Column (7) = Column (3) x 0.60
Column (8) = Column (6) x 0.60
Column (9) = Column (7) x 0.15
Column (10) = Column (8) x 0.15

get a complete assessment of the implications of this shift in policy towards maximum refinery requirements one needs to consider demands for Trinidad petroleum products in other markets.

Estimates of total exports of refined products. In order to estimate total potential exports of refined products from Trinidad in 1975 and 1985 it is also necessary to make projections of the demand of the following markets for Trinidad products: Latin America, Europe, foreign bunker sales, and other areas such as Africa, Canary Islands, Japan, Philippines, Taiwan, etc. Table 5.3 shows estimates for 1975 and 1985. It is assumed that exports to Latin America increase at 3 per cent per annum over the period 1971-1985. This was the average growth rate for the period 1968-1971. Exports to Europe are assumed to decline at a rate of 4 per cent per annum between 1971 and 1985.

By 1985 the impact of the North Sea finds is expected to have made itself felt in Europe. Britain will in all probability be self-sufficient in fuels.[1] And in general Western Europe is expected to supply about 45 per cent of its total demand for energy by 1982 from the North Sea oil and gas deposits.[2] One can assume, therefore, that

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[1] The Oil and Gas Journal, November 10, 1973, p. 30. W. R. Warman, Exploration Manager of British Petroleum Co. Ltd. told a North Sea Conference in Houston (mid-November 1973) that the British sector of the North Sea fields will produce about three million barrels per day by the early 1980s which is approximately equivalent to the U.K. projected requirements at that time.

[2] The Petroleum Economist, "Mer du Nord: Production et Rentabilité," Tableau I, II, Juillet 1974, p. 252. "North Sea Slow to Yield," January 1974, pp. 16-17. The North Sea is estimated to produce about 5-6 million b/d of crude by 1982. Of this 3-4 million b/d will be produced by the British sector. Dr. Birks of B.P. estimates that the potential gas output is 9.5 billion cfd in the period 1980-1982. The British sector will produce two-thirds.

TABLE 5.3

ESTIMATES OF EXPORTS OF TRINIDAD REFINED PRODUCTS

TO SELECTED AREAS, 1975 AND 1985

(000 bbls)

	1968	1971	1975*	1985*
Central America	1,536	2,474	-	-
South America	10,715	12,296	-	-
West Indies	10,389	10,630	-	-
	22,640	25,400	28,575	38,430
Europe	26,993	24,274	20,617	1,000
Other	8,213	3,079	3,000	3,000
Foreign Bunkers	10,479	10,713	12,000	12,000
	68,325	63,466	64,182	54,430

Source: Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Annual Report, 1968, 1971.

*Estimates

by 1985 this vast increase in indigenous crude and gas, the rapid expansion of refinery capacity in Europe,[1] and the planned shift from fuel oils to gas, coal and nuclear power,[2] will reduce Trinidad (and Caribbean) exports of refined products considerably. The amount of exports to Europe in 1985 is arbitrarily put at an amount of one million barrels.

Table 5.3 indicates that Trinidad can be expected to experience a decline in its volume of exports of refined products to markets outside the U.S.A. In 1975 exports to markets outside the U.S.A. are expected to increase slightly to 175,000 barrels per day

[1]Petroleum Press Service, September 1971, pp. 335-336. "No Let Up in Refinery Expansion," February 1970, pp. 46-49.

[2]The Petroleum Economist, "Vers une nouvelle stratégie de l'énergie," Juillet 1974, p. 254.

and then decline to 149,000 by 1985. In addition to this shrinking demand in Europe, in the Caribbean and Latin America area Trinidad continues to face competition from growth in new domestic refineries and additional new export refinery capacity which make inroads into local markets also.[1] Estimates of total exports of refined products to all markets are shown in Table 5.4.

TABLE 5.4

ESTIMATED EXPORT POTENTIAL FOR TRINIDAD REFINED PRODUCTS RELATING TO U.S. SUPPLY CASES II, III, 1975-1985

(000 b/d)

	Trinidad Exports to the U.S.A.		Exports to other markets		Total exports	
	1975	1985	1975	1985	1975	1985
Case II	352	416	175	149	527	565
Case III	407	644	175	149	582	793
Knop & Roorda Supply Case I	270	441	175	149	445	590
Supply Case II	195	311	175	149	370	460

[1] Petroleum Press Service, "Caribbean Island Refineries," January 1969, pp. 14-16. September 1971, Table II, p. 335.

For the Knop-Roorda Supply Case I total potential exports of refined products from Trinidad to all markets are expected to be 445,000 barrels per day at 1975; and 590,000 barrels per day at 1985. No adjustment for prices was made in demand from other markets. An examination of the difference between Case III and the Knop-Roorda Case for the U.S. exports suggests a 30 per cent adjustment. That is, total demand is more likely to be 390,000 barrels per day in 1975 and 545,000 barrels per day at 1985, with lower limits of 315,000 barrels per day (1975) and 415,000 barrels per day (1985).

Total production of refined products is equal to total exports plus local consumption. Local consumption in 1970 was 3.6 million barrels;[1] assuming an increase in energy consumption of 8 per cent[2] one derives estimates of local consumption of refined products at 15,000 barrels per day at 1975 and 33,000 barrels per day at 1985. Table 5.5 gives estimates of total production of refined petroleum products for 1975 and 1985. These estimates are worked out for Supply Cases II, III and Knop and Roorda (adjusted) Supply Cases I and II. The total refinery capacity required to produce these outputs is also derived. The policy implications are clear; if current U.S. import policies remain unchanged at 1974 prices Trinidad refinery capacity should remain fixed throughout the mid-seventies.

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[1]Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Annual Report, 1970, p. 37.

[2]Rate used by S. H. Schurr and P. T. Homan to estimate energy consumption for Caribbean area. Schurr and Homan, p. 172. This 8 per cent rate is based on past trends in real GNP growth and does not include new energy demands expected from planned energy-intensive industries; but this is largely a demand for natural gas and as such it does not affect the estimates in this section.

TABLE 5.5

ESTIMATES OF TOTAL DEMAND FOR REFINED PRODUCTS AND REFINERY CAPACITY REQUIRED AT 1975 AND 1985

(000 b/d)

	Total exports		Local consumption of products		Total demand		Required* refinery capacity	
	1975	1985	1975	1985	1975	1985	1975	1985
Case II	527	565	15	33	542	598	605	667
Case III	582	793	15	33	597	826	666	922
Knop & Roorda I	390	545	15	33	405	578	452	645
Knop & Roorda II	315	415	15	33	330	448	368	500

*Assuming that refinery operates at 0.95 capacity; and using estimates of throughput in Table 5.6

By 1985, however, additional capacity of just over 100,000 barrels per day will most likely be required. If on the other hand U.S. import policy shifts towards one of maximum refinery requirements, then there will be excess capacity in Trinidad during the mid-seventies which will be just used up by 1985. It would seem, therefore, that refining capacity should not be increased beyond present capacity. It must be remembered, however, that this capacity refers only to distillation capacity for producing mainly fuel oils for the U.S. and other markets. There will be at least need for another desulphurization plant of 50,000 barrels per day if local East Coast crudes are not used. Present market conditions suggest caution in planning future capacity along the traditional market strategies of the multinationals.

Import implications for Trinidad and Tobago. Given the present rate of production and the reserve situation in Trinidad, it is reasonable to assume an increase in output from approximately 230,000 barrels per day at 1975 to 300,000 barrels per day at 1985. This is based on the assumption that production of Trinidad crudes from land and older marine areas can be stabilized at existing prices, and increased from the East Coast Continental Shelf, Northern Marine, Gulf of Paria, and Columbus Basin. Table 5.6 below shows estimates of refinery throughput, total domestic production of crude, and imports of crude for Trinidad and Tobago at 1975 and 1985. These estimates with respect to 1985 are, of course, more speculative because of the greater uncertainty relating to estimates of output based on undiscovered recoverable reserves at 1985. However, an expanded role of domestic production in the future of the Trinidad refining industry as suggested is not an unreasonable projection. At present world market prices, however, for light low sulphur crudes it may profit Amoco to sell its marine crudes on a world market which pays a premium for crude with high motor gasolene yields, rather than process it and sell it as fuel oils at a much lower price. This, plus the fact that Trinidad refineries are built for refining sour crudes, may mean that future barrels of Trinidad oil will not be available for refining in Trinidad. This is not necessarily a bad thing since it could mean an expanded market for the Trinidad oil industry in the U.S.A. For instance, Texaco Trinidad would most likely retain its East Coast market on the basis of imported crudes, and Amoco crudes will go to its refineries in the East Coast U.S. markets at premium prices. Total export of fuels may, therefore,

TABLE 5.6

ESTIMATES OF REFINERY THROUGHPUT, DOMESTIC PRODUCTION

AND IMPORTS OF CRUDE FOR TRINIDAD AND TOBAGO, 1975, 1985

(000 b/d)

	1975			1985		
	Imports	Production	Throughput*	Imports	Production	Throughput*
Case II	375	200	575	334	300	634
Case III	433	200	633	576	300	876
Knop & Roorda (adjusted)						
Supply Case I	229	200	429	313	300	613
Supply Case II	150	200	350	175	300	475

*Adjusted for 6 per cent refinery loss.

increase or tend to remain constant as the decline in refined product exports are offset by increases in marine crude exports. Total exports may, however, decline in the 1990s after crude production reaches its peak. Any expansion in the scale of Trinidad's oil industry beyond that suggested in Table 5.5 (Knop and Roorda Supply Cases) will have to be based on the development of the country's natural gas resources. In any case the emphasis on export refining may have to be reduced to free energy resources for planned domestic industrial usage. Moreover, the structure of petroleum trade may be altered to reflect a more optimum combination of energy products to chemical products as compared with the present almost 100 per cent energy products structure of exports. Further examination of the feasibility of these alternatives and the net discounted benefits to be derived from them, as well as the benefits that may have accrued in the past, requires estimates of costs in production and refining. The following chapter will analyse historical costs and estimate long-run costs in the Trinidad oil industry.

CHAPTER 6

COSTS IN THE TRINIDAD OIL INDUSTRY

The analysis in Chapters 4 and 5 leaves unanswered some fundamental questions relating to the benefits accruing from the development of Trinidad's hydrocarbon resources. It is important to know whether the net direct benefits derived from these resources are being maximized and what part of these benefits accrue to the Trinidad government as opposed to the oil companies. To answer these questions one needs some measure of benefits. One good index of total net direct benefits is the discounted flow of revenues in excess of marginal cost over the life of the asset. In the previous chapters we presented estimates of world market prices for crude and its products, and developed forecasts of these prices up to 1985. Since world oil prices are given for the small host country, it remains only to determine marginal cost of crude production and refining in Trinidad in order to determine the total net benefits accruing from its oil industry.

This chapter contains derivations of incremental cost per daily barrel for both crude and composite product produced from crude of a given quality. In it are presented an historical analysis of changes in cost relative to changes in prices in the world oil market, and tests of the notion traditionally promoted by the companies that as the oil business in Trinidad is more expensive than in most places the companies are not "making money". An evaluation of whether the Trinidad government is maximizing its share of total net benefits derived on the basis of these costs will be presented in Chapter 8. The first part of this chapter presents the Adelman model for measuring long-run cost of producing crude and applies it to the Trinidad case; the second part deals with long-run cost in refining: it sets out a theoretical model for the development of historical and long-run costs in the Trinidad refining industry. Finally the third part deals with the profitability of the Trinidad oil industry.

Long-run Cost in Crude Production

Model: the measurement of incremental cost per daily barrel of crude. There are two elements of costs involved in the production of the incremental barrel of crude oil: (1) capital or development costs, and (2) operating or extraction costs. The first relate to expenditures on the drilling of a well or wells into a known reservoir. The second pertain to the extraction of crude oil, that is, outlays on the equipping of wells and the building of surface facilities such as pipelines, gas separation units and storage facilities. This section presents the Adelman model for measuring capital and operating costs in an extractive resource industry.[1]

In crude oil production it is the well that is the productive

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[1]This model is based on the work of M. A. Adelman, The World Petroleum Market, and Paul Bradley, The Economics of Crude Petroleum Production (Amsterdam: North Holland Publishing Co., 1976).

unit, but since each well in a known reservoir is interdependent with the other wells it is logical to deal with the reservoir as the productive unit. Moreover, each reservoir is a self-contained system with a fixed quantity of crude oil; therefore, for any given technology one cannot increase the ultimate quantity of recoverable crude oil from a reservoir by drilling more wells in the reservoir, one can only extract a given recoverable quantity in a shorter period by drilling a certain number of widely spaced wells;[1] or extract the same quantity in a longer period of time by drilling fewer wells. Drilling more wells means making a greater capital outlay in order to recover a given quantity of crude oil from a given reservoir in a shorter time period than the initial capital outlay associated with one well would have achieved. In addition, the development of a reservoir requires not only the initial capital outlays which create new production capacity but continued investment to replace capacity lost as a result of the natural rate of decline associated with the reservoir.

Let the area under the curves in Figure 6.1 represent the amount of crude recoverable from a given reservoir under different drilling programmes. Assume that the areas under the two curves are equal; $q_1(t)$ is the level of output associated with the initial capital investment (I_t) at time t, such that if the initial investment is not increased the recoverable oil will be exhausted at time t_1; $q_2(t)$ is the level of output associated with increased investment in the drilling of additional wells in the reservoir. Then

[1]If the wells are not widely spaced well interference reduces the productive potential of each well.

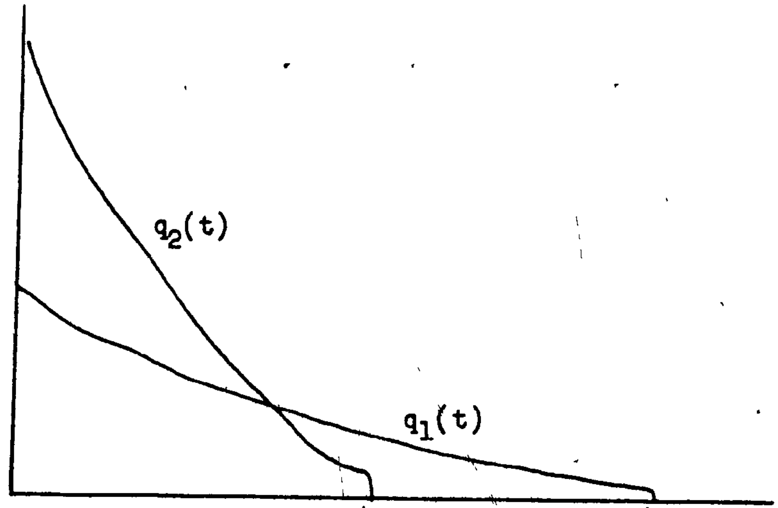

FIGURE 6.1

OIL SUPPLY: INVENTORY MODEL

$dq_1/dt > dq_2/dt$ means that increased investment in drilling causes crude deposits to be used up more quickly, i.e. at time t_2 as compared with time t_1. Given the relationships above and assuming that output declines exponentially, we can now write the following equations:

$$a = h({}^{q}t/_{R}t) \qquad 6.1$$

where a is the rate of decline

R_t = total recoverable reserves at time t.

$$q(t) = f(I_t) \qquad 6.2$$

The ratio $\Delta q/\Delta I_t$ increases initially as investment (capacity) increases over time, but ultimately declines for a given reservoir or basin or field, i.e., incremental cost increases as cumulative production increases. Since initial investments are always known and the initial output per well is usually available it it possible to determine the initial outlay required to produce the initial increment in output

This, however, must be discounted over the life of the resource in order to determine the capital cost of producing the incremental barrel of crude oil.

The present value of capital required to produce an incremental barrel of crude over the life of the project (i.e., time T) is in the discrete case.

$$I = \sum_{t}^{T} Zq_t \left[1/(1 + r)^t\right] \qquad 6.3$$

where

I = development investment

q_t = output of crude at time t attributed to I

T = total number of production periods

$1/(1 + r)^t$ = the discount factor applied to returns from period t with discount rate r

Z = development cost per barrel of crude

Z is an unknown and can be solved for in the following expression:

$$Z = \frac{I}{\sum_{t}^{T} q^t \left[1/(1 + r)^t\right]} \qquad 6.4$$

Since the rate of decline in production and rate of output in any future period is more likely to be a continuous function of time equations 6.3 and 6.4 can now be rewritten as follows:

$$I = \int_0^T Zq(t)e^{-rt}dt \qquad 6.5$$

$$Z = I/\int_0^T q(t)e^{-rt}dt \qquad 6.6$$

where

$q(t)$ = a function representing output at time t associated with investment I

T = duration of the production period (life of resource)

e^{-rt} = discount factor applied to returns at time t with discount rate r.

In equations 6.5 and 6.6, q(t) can be replaced by the production profile $q_o e^{-at}$ where "a" represents the rate of decline in a reservoir and q_o is the initial output. The new equations are the following:

$$I = \int_o^T Z q_o e^{-(a + r)} dt \qquad 6.7$$

$$Z = I/q_o \int_o^T e^{-(a + r)} dt \qquad 6.8$$

I/q_o is the investment required per initial daily barrel of crude. The integrated segment is the present barrel equivalent factor (PBE).

In order that a reservoir becomes a productive unit it requires a flow of funds to cover the current costs (Y) incurred in bringing the incremental daily barrel of oil from in the ground to the well head (lifting cost), moving it to stock tanks, processing it in gas oil separators, gathering and loading it.[1] These costs are estimated over the life of the project and must be "present worthed" or "levelized". Operating or extraction cost per barrel is derived by solving the following equation for Y:[2]

$$\int_o^T E(t)e^{-rt}dt = \int_o^T Yq(t)e^{-rt}dt \qquad 6.9$$

where

E(t) = extraction expenditure as a function of time.

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[1]Secondary recovery method not considered at this point.

[2]For a detailed account see the following works: Bradley, pp. 126-127; Adelman, The World Petroleum Market, p. 52.

By putting $q(t) = q_o e^{-at}$

where

$q(t)$ = output at time t

q_o = initial output

a = the decline rate

it can be shown that for t = T, Y is given by:[1]

$$Y = \frac{E \int_o^T e^{-rt} dt}{q_o \int_o^T e^{-at} e^{-rt} dt} = \frac{E}{q_1} \left(\frac{a + r}{r} \right) \qquad 6.10$$

Total incremental cost per daily barrel is given by adding equations 6.8 and 6.10, i.e. Z + Y.

The capacity investment model outlined above (equations 6.5 to 6.10) can be generalized to measure incremental cost for a basin or region by summing total cost per incremental barrel over all reservoirs. The aggregated cost so derived is merely an approximation of the economists's concept of marginal cost; for as in most practical situations it is very difficult to obtain data that would enable one to estimate development cost for every reservoir in a basin or region. Such estimates can best be interpreted as average cost per incremental barrel. Even more important, serious problems arise as a result of the fact that time series data may be used, so that it is not always possible to distinguish between the effect of "movement along the supply curve prevailing within a period and shifts of the curve" due to innovation[2] and/or the discovery of new reserves. Notwithstanding

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[1]Bradley, p. 126. E is assumed to be constant as long as the reservoir is being produced, regardless of the rate of output, q.

[2]*Ibid*., p. 36.

these weaknesses, we can now derive estimates of the incremental cost of production in Trinidad for 1963-1968.

Accounting cost and cost per incremental daily barrel of crude in Trinidad, 1963-1968. The estimates of cost derived below are based on data pertaining to the three major companies operating in Trinidad. However, since these companies account for about 98 per cent of the total production of crude (Table 6.1) and 100 per cent of refining output the results obtained are representative of the industry as a whole. Between 1963 and 1968 crude output for the three major companies increased by 18.7 million barrels, or 51,233 barrels per day (Table 6.1). This increase in daily output represents only the net increase in capacity, that is, gross increase less loss in capacity. It is reasonable to assume that capital expenditures in this period were partly allocated to replacing the decline in productive capacity and partly to adding new capacity. To measure incremental cost, therefore, one needs an estimate of loss of capacity. The decline rate of reservoirs is a good index of loss of capacity.

For Trinidad a rough estimate of the decline rate can be obtained by taking the reciprocal of the reserve ratio ($^R/_q$). Trinidad's proven reserves at 1968 were about eleven times its annual production. Therefore, the decline rate at that point may have been about 9 per cent per annum. This estimate seems to be supported by the history of the performance of the industry.[1] Making allowances

[1]Dr. D. R. Craig in a study on oil and gas conservation in Trinidad pointed out that the rate of depletion of remaining recoverable reserves in Trinidad increased from about 8 per cent per year during the early 1930s to some 12 per cent per year in the 1956-1959 period. Craig, Oil and Gas Conservation in Trinidad (Calgary, Alberta:November 1960), p. 18.

TABLE 6.1

TRINIDAD AND TOBAGO CRUDE OIL PRODUCTION: ACTUAL AND FORECAST, 1963-1968

	Units	1963	1964	1965	1966	1967	1968
Texaco	Mns barrels	18.4	17.4	17.6	22.8	30.0	29.7
Shell	Mns barrels	5.1	4.9	4.8	4.7	4.3	3.6
British Petroleum	Mns barrels	8.4	9.5	9.7	9.7	9.7	8.4
TNA*	Mns barrels	15.3	16.6	15.7	17.4	20.3	24.2
Total major companies	Mns barrels	47.2	48.4	47.8	54.6	64.4	65.9
Percentage of total companies		.97	.97	.98	.98	.99	.99
Total companies		48.7	49.7	48.9	55.6	65.0	66.9
Production three major companies	000 b/d	129.3	132.6	131.0	149.6	176.4	180.5
O. A. Capon submission to Commission of Enquiry	000 b/d	-	145.8	141.7	130.4	118.5	108.5

Sources: O. A. Capon, Report on Estimates and Reserves of Crude Oil and Natural Gas for Trinidad and Tobago, Ministry of Petroleum and Mines, 1964.

Appendix 4-A, Table 4-A-1.

*TNA is a holding company consisting of Texaco, Shell and British Petroleum (in May 1969 B.P. sold its shares to Trinidad Tesoro).

for the improvement in the reserve position as a result of the development of the Soldado reservoirs, it is very possible that the decline rate may have been in the range of 8 to 12 per cent per annum for the period 1963-1968. Output grew at the geometric rate of approximately 7 per cent per annum in the five year period 1963 to 1968. That is, net capacity grew at a rate of about 7 per cent per annum. The sharp decline in output after 1968 suggests that the decline rate may in fact be closer to 12 per cent, say 11 per cent, and the growth in capacity (allowing for secondary recovery)[1] possibly 10 per cent. That is, gross new capacity must have been at least 107,600 barrels per day (Case I) or 2.1 times the net increase of 51,233 barrels per day in order to offset the natural decline in output of reservoirs. The actual performance for this period was much better than expected (see Table 6.1), but this is due largely to the unusual production performance in the Guayaguayare fields during 1967 and 1968.

As a cross check, another estimate of gross capacity (Case II) is derived, using output data prepared by Mr. O. A. Capon, a United Nations technical adviser to the Mostofi Commission (see Table 6.1). Mr. Capon made projections of crude output after 1964 assuming no new discoveries and a limited number of rigs operating in the territory. His forecasts indicated that output would decline at a geometric rate of about 4 to 4.5 per cent per annum. According to these projections

[1]Ten per cent of annual output at 1964. O. A. Capon, Report on Estimates and Reserves of Crude Oil and Natural Gas for Trinidad and Tobago, Ministry of Petroleum and Mines, 1964.

the cumulative production for the five years 1964-1968 would have been 625 to 645 thousand barrels per day, the gross capacity created by the development outlays made in that period.

The Mostofi Report showed that total developmental expenditures by the major companies were expected to be about W.I. $185 million[1] or U.S. $108 million[2] for the five year period 1964-1968,[3] that is, the initial investment required during that period to produce future daily incremental barrels of crude was about U.S. $900 to $1,000 (Table 6.2).

TABLE 6.2

INVESTMENT PER DAILY INCREMENTAL BARREL OF TRINIDAD CRUDE, 1964-1968

	Gross capacity added 1964-68 000s barrels daily (1)	Development investment 1964 - 1968 U.S. $ mns (2)	Investment per daily barrel U.S. $ (2)/(1)
Case I	108	108	1,000
Case II	125	108	864

[1]Mostofi Report, p. 33. The Commissioners reported estimates of planned expenditure on drilling and capital investments for the three major companies as W.I. $300 million. The outlays for drilling, production and inland transportation of crude oil were given as W.I. $185,000,000.

[2]Conversion factor W.I. $1.71430 to U.S. $1.00.

[3]A review of Reports and Monthly Bulletins of the Ministry of Petroleum and Mines seems to indicate that this U.S. $108 million would have been spent almost entirely on development as opposed to exploration (wildcats, Lahee class A2, A3).

Assuming a project life of twenty years, a decline rate of 0.11 and a discount rate of 0.20, development capital costs per daily barrel for Case I and Case II are as follows:

Case I Number of present barrel equivalents[1] = 3.70 x 365 = 1,350

Capital cost per daily barrel = $\frac{1000}{1350}$ = U.S. \$0.74

Case II Capital cost per daily barrel = $\frac{864}{1350}$ = U.S. \$0.64

In Table 6.3 production costs are shown for the major companies for the year ending December 1962. Operating expenditure per barrel (expenditure on lifting, well repairs, storage, loading, etc.) is obtained by taking a weighted average of land and marine operations. The per barrel cost (T.T. \$0.44 or U.S. \$0.26) when multiplied by the discount factor $\left(\frac{a + r}{r}\right)$ gives long-run operating cost per daily incremental barrel, i.e., Y = (1.55)(0.26) = U.S. \$0.40.[2] This operating cost is very high compared with that for the Middle East, Venezuela, and Africa. However, it reflects the companies' policy of increasing expenditures on secondary recovery methods as a means of offsetting the rapid decline in output from land concessions.

Total cost per incremental daily barrel of crude can now be derived by adding the estimates of operating and capital cost derived above. This is in the order of U.S. \$1.04 or U.S. \$1.14 per daily incremental barrel depending on which method is used to derive gross capacity added. These costs compare favourably with those derived by other methods.

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[1]The PBE discounting factor 3.70 is obtained directly from Appendix 6-A for a = 0.11 and r = 0.20.

[2]See equation 6.10.

TABLE 6.3

TRINIDAD PETROLEUM INDUSTRY CRUDE OIL PRODUCTION COSTS FOR THREE MAJOR OIL COMPANIES

DECEMBER 31, 1962 - T.T. $

	Land operations			Marine operations			Total operations		
	000s	Average cost per bbl	Per-centage	000s	Average cost per bbl	Per-centage	000s	Average cost per bbl	Per-centage
Barrels produced	33,592			14,632			48,224		
Lifting costs, well repairs, storage etc.	17,152	.511	20.7	3,755	.257	9.1	20,907	.434	16.9
Royalties	13,322	.397	16.1	10,642	.727	25.9	23,964	.497	19.3
Overhead	16,494	.491	20.0	4,709	.322	11.4	21,203	.440	17.1
Depreciation	12,830	.382	15.5	4,606	.315	11.2	17,436	.362	14.1
Sub-total	59,798	1.781	72.3	23,712	1.621	57.6	83,510	1.732	67.4
Drilling costs (incl. dry holes)*	24,165	.719	29.2	17,424	1.191	42.4	41,589	.862	33.6
Expenses billed to affiliates	(1,241)	(.037)	(1.5)	-	-	-	(1,241)	(.025)	(1.0)
Total crude oil production costs	82,722	2.463	100.0	41,136	2.812	100.0	123,858	2.568	100.0

Source: Submission by Peat, Marwick & Mitchell to Commission of Enquiry into the Oil Industry of Trinidad and Tobago.

*One of the major companies expenses the cost of casing at the time a well is drilled rather than capitalizing and amortizing such costs over the life of the producing property. Information is not available to determine what effect, if any, this policy has on the crude oil production costs.

Table 6.4 shows average costs (accounting averages) from various sources. Some of the weaknesses of accounting costs have already been discussed (Chapter 1). Despite these disadvantages, however, the averages in Table 6.4, rows 1, 2 and 3, provide, in accordance with economic theory, a sort of upper limit to incremental cost derived by Adelman's method and therefore serve as a cross check. The data show unit costs to have been very stable throughout the period 1960 to 1965, averaging U.S. $0.99, or less than marginal cost, for the more productive concessions, and U.S. $1.52, or exceeding marginal cost, for the less productive concessions. While there are obvious weaknesses with the data base used to estimate marginal cost for the Trinidad industry, the estimates of U.S. $1.04 to U.S. $1.14 per incremental daily barrel appear to be supported by historical costs in the industry.

The estimates of marginal costs derived above are for the territory as a whole and do not give the incremental cost associated with a particular field. However, one would expect that in the most productive fields[1] such as Guayaguayare, Palo Seco, Fyzabad, Forest Reserve, and Soldado, cost may have been less than $1.00 per incremental daily barrel (probably about 80-90 cents). Since Texaco owns about two-thirds of these reserves the position of that company relative to Shell and British Petroleum in the Trinidad industry is obviously strong. It would seem that within the Trinidad industry Shell and B.P. operated the marginal fields which in a monopolistic

[1] Table 4.3.

TABLE 6.4

COMPARISON OF DAILY PER BARREL COSTS FROM VARIOUS SOURCES FOR TRINIDAD AND TOBAGO

BEFORE ROYALTIES AND CORPORATE TAXES - 1960-1968

U.S. $

	1960	1961	1962	1963	1964	1965	1964-1968
1. Commission of Enquiry Estimates (Trinidad Oil Industry)	.94-1.47	1.03-1.66	1.01-1.43	.99-1.52	-	-	-
2. Peat, Marwick & Mitchell Co. Submission to Commission of Enquiry (3 major companies)	-	-	1.21	-	-	-	-
3. B.P.'s Submission to Government of Trinidad and OWTU (B.P. land operations only)	1.54	1.59	1.38	1.59	1.47	1.49	-
4. Incremental cost: cash flow method (3 major companies)							
Case I	-	-	-	-	-	-	1.14
Case II	-	-	-	-	-	-	1.04

Sources: Report of Commission of Enquiry into the Oil Industry of Trinidad and Tobago 1963-1964 (London: André Deutsch, 1964), p. 31.

Tables 6.2, 6.7, 6.12, 7.2, Appendix 6-C.

Note: All costs are exclusive of royalty charges and taxes.

market would earn only monopoly rents, while Texaco operated those fields that would earn differential rents, plus monopoly rents.

The measures of incremental cost derived above are largely historical and do not adequately reflect the future. They pertain to development and operating expenditures during the period 1956 to 1970 and, therefore, reflect the fact that known land reserves were already in an advanced state of decline, and that in the latter part of the period the three majors were investing very little on exploration. The cost of finding more oil on land, it will soon be seen, was about to exceed the MEFC in Trinidad's marine areas, and it is the latter which is relevant for the future.

Long-run cost of production: Trinidad marine fields, 1970-1985. It is generally expected that output from Trinidad's land reserves will continue to decline or stagnate. Future barrels of oil are expected to come largely from the East Coast Continental Shelf fields, the North Marine fields, the Gulf of Paria and the South Marine area. Estimates of capital expenditures in exploration and development presented in Table 4.5 for the Teak A and Teak B fields off Point Galeota (Figure 4.2) show capital development costs at 1972 to be U.S. $26,950,000. On the basis of this, and information pertaining to the number of productive wells drilled and their initial productive capacity, one can derive MEFC and quasi long-run supply price of crude oil in Trinidad.

Between September 1970 and March 1972 eleven development wells were drilled (nine in the Teak A reservoir and two in the Teak B reservoir). Wells in this area have output capacity in the range 1,000 to 5,000 barrels per day. If we assume that the lower limit represents the effective capacity, then initial development capital per barrel is U.S. \$2,450 (U.S. \$26,950,000/11 x 1,000). This gives a capital cost per incremental daily barrel equal to U.S. \$1.81 for a = 0.11 and r = 0.20. Because of the sanding-in problems associated with these fields operating cost is arbitrarily put at twice cost in the south west marine fields (Table 6.3), i.e., U.S. \$0.25.[1] When this is multiplied by $\frac{a + r}{r}$ one obtains a discounted operating cost of U.S. \$0.38 per barrel. Total development and operating cost is, therefore, U.S. \$2.19. An output of 1,000 barrels per day, however, is considerably below the productive capacity of the East Coast Continental Shelf fields. In fact, since 1972 capacity has been greatly increased and major sanding-in problems reduced, so that in 1976 output from forty-seven wells in the Amoco concession exceeded 2,000 barrels per well per day. At a level of 2,000 barrels per day capital cost per PBE is likely to be U.S. \$905, giving total costs per incremental daily barrel equal to U.S. \$1.29. Should the rate of output increase to 3,000 barrels per well cost will tend to fall further towards U.S. \$0.99 per incremental daily barrel (Table 6.5).

These costs do not take into consideration the fact that as the rate of output per well increases the rate of decline increases It is necessary, therefore, to examine what may happen to cost when

[1]This makes allowance for the higher operating costs due to workovers in the region and the fact that south west marine fields are located in water depths between 100 and 200 feet as compared with Teak fields which are located in water of 300 feet depth.

TABLE 6.5

AMOCO CONCESSIONS: INCREMENTAL COST PER DAILY BARREL

A.

Decline rate	Incremental cost per daily barrel at various rates of output per well per day			
	1,000	2,000	3,000	4,000
.07	1.96	1.15	.88	.74
.08	2.02	1.19	.91	.77
.09	2.08	1.22	.93	.79
.10	2.15	1.27	.97	.82
.11	2.19	1.29	.99	.84
.12	2.27	1.34	1.02	.87
.16	2.52	1.49	1.04	.97
.20	2.77	1.64	1.26	1.07

B.

	Incremental barrel cost assuming 50 per cent increase in drilling cost at outputs 3,000 and 4,000	
.07	1.06	.83
.08	1.09	.86
.09	1.12	.88
.10	1.17	.92
.11	1.19	.94
.12	1.23	.98
.16	1.25	.99
.20	1.51	1.20

output approaches the maximum for the area (5,000) and the decline rates shift upwards.

For the last three years all wells in the East Coast Continental Shelf have been producing on natural flow. Because wells are producing below capacity one may assume that the decline rate is quite low, probably about 8 per cent. One can develop and compare incremental cost per daily barrel assuming an 8 per cent decline rate and an output of 1,000 barrels per well per day; a decline rate of 9 to 10 per cent and an output of 2,000 barrels per well per day; a decline rate of 11 to 12 per cent and an output of 3,000 barrels per well per day; a decline rate in excess of 12 per cent and an output of 4,000 barrels per well per day. The incremental cost per daily barrel for each of the cases above is as follows (Table 6.5 A.): about $2.00 per barrel when the area is operating well below 50 per cent capacity and the decline rate is 8 per cent; $1.27-$1.29 when it is operating at 50 per cent capacity with a decline rate of 9 to 10 per cent; $0.99-$1.02 when 75 per cent capacity is reached with a decline rate of 11 to 12 per cent; and for output close to full capacity incremental cost will be about $1.07 at a decline rate of 20 per cent, a sharp increase over the cost at a decline rate of 12 per cent and output of 4,000 barrels per well per day. Because of the linearity assumptions implicit in the model with respect to the relationship between the decline rate and increase in productivity it would seem to be always a good policy to push production rates to close to full capacity. However, getting to full capacity in the Trinidad situation has a cost attached to it. Assume that to get the output up to optimum from 2,000 to 4,000 barrels per well per day requires an additional investment about 50 per cent as large as the initial drilling costs, i.e. $270,455 per well. This would add between eighteen and twenty-five cents to cost at an output of 3,000 barrels per well and nine to thirteen cents at 4,000 barrels per well per day. (Table 6.5 B.). It is quite clear that it would be the best policy to incur this capital expenditure to achieve the increase in capacity since incremental cost per barrel will decline from $1.20 to about $1.00 per barrel as output per well per day increases and the decline rate increases from 8 per cent to 16 per cent. This represents a kind of quasi long-run cost per incremental daily barrel for wells in water depths 200-400 feet.

Table 6.6 shows cost multiplying factors indicating variation in cost with water depth. The factors show variations in cost relative to typical land operations on a world wide basis. Further examination of cost components in Table 6.6 indicates that per barrel cost in water depths at 600 feet is about double the cost of wells in shallow waters (100 feet); and for wells in water depths 1,000 feet it is about three to five times that cost, for any given territory. The major components of this unit cost are costs related to production facilities and development drilling. According to world wide experience then one can expect that when drilling in Trinidad starts in water depths at 600 feet and beyond (probably some time after 1985) incremental cost may increase three to five times, i.e., $3.00-$5.00 per incremental daily barrel.

TABLE 6.6

VARIATION OF COST WITH WATER DEPTH

Cost component	Cost multiplying factor in water depths*		
	100 feet	600 feet	1,000 feet
Exploration drilling	2	2.5-4.0	4.0
Development drilling	2	4.0-5.0	5.0-8.0
Production facilities	2	2.0-3.0	6.0-6.1
Pipelines	2	2.0-4.0	4.0-6.0

Source: "Finance and Economics of Offshore Operations," Harold B. Leeton et al. (Shell Oil Company), World Oil, July 1973, p. 93.

*The factor for land equals 1.

Incremental cost in developed fields. Some wells will have a per barrel daily cost considerably less (10 to 25 per cent) than the estimated quasi long-run cost of $1.00. Wells developed in fields in close proximity to already developed fields (Teak-Galeota fields) will be linked with the production facilities already serving those fields. This will result in considerable savings in the overall investment cost of putting those wells into production. Some idea of incremental cost of the barrel of oil produced from wells so located can be obtained by making the following assumptions for the Trinidad situation:

1. Eleven new wells are to be drilled.
2. Drilling cost per day remains unchanged.
3. Capital requirements for laying underwater pipelines, equipping wells, providing shore facilities, and loading-facilities, will be either a) 50 per cent of that required for Teak A and Teak B

production platforms at March 1972, or b) 75 per cent of that required for Teak A and Teak B.

Table 6.7 shows the expected changes in incremental cost per barrel of crude produced in the east coast field, Trinidad and Tobago, for wells operating at different levels of output per day and in close proximity to Teak A and Teak B or the Teak-Galeota fields. The analysis suggests that one can expect incremental cost per barrel for the surrounding fields to be in the range of $0.75 to $0.90 for a decline rate of .11 and a discount rate of 20 per cent, and a 50 per cent reduction on facilities cost.

Table 6.8 shows cost for various decline rates under assumptions 1 to 3 a). It is obvious that cost does not respond very quickly to changes in the decline rate. For outputs 2,000 and 3,000 barrels per well per day incremental daily barrel cost remains in the range U.S. $0.75 to $1.08 for decline rates between .07 and .16. That is for an increase in the decline rate of 129 per cent the cost varies by 44 per cent with output variations between 2,000 barrels per well and 3,000 barrels per well.

Table 6.9 shows cost when initial facilities cost is reduced by 25 per cent. The variation in cost for wells producing at a rate between 2,000 and 3,000 barrels per day is in the range U.S. $0.77 to U.S. $1.15 for decline rates .07 to .12. The less productive wells exceed quasi long-run cost ($1.00) for decline rates greater than .08.

It would seem that the cost of producing an extra barrel from a known reservoir in an east coast marine field that is already being developed is about U.S. $0.75 to U.S. $1.00 (Table 6.8); while the

TABLE 6.7

LONG-RUN SUPPLY PRICE FOR EAST COAST TRINIDAD CRUDES

AT VARIOUS LEVELS OF OUTPUT (1970-85)*

Output barrels per well per day (1)	No. wells (2)	Development capital U.S. $ (3)	Initial capital per well U.S. $ (4)=(3)/(2)	Initial capital per barrel (5)=(4)/(1)	No. PBEs (6)	Initial cost per PBE U.S. $ (7)=(5)/(6)	Operating cost U.S. $ (8)	Total cost U.S. $ (9)=(7)+(8)
1,000	11	16,450,000	1,495,455	1,495	1,351	1.11	.38	1.49
2,000	11	16,450,000	1,495,455	748	1,351	.55	.38	.93
3,000	11	16,450,000	1,495,455	498	1,351	.37	.38	.75
4,000	11	16,450,000	1,495,455	373	1,351	.28	.38	.66

*Assumes a 50 per cent reduction in initial facilities cost.

TABLE 6.8

INCREMENTAL PER BARREL COST FOR VARIOUS DECLINE RATES AND

A 50 PER CENT REDUCTION IN INITIAL FACILITIES COST

Output per well per day (barrels)	Initial capital per barrel	Decline Rates							
		a=.07	a=.08	a=.09	a=.10	a=.11	a=;12	a=.16	a=.20
		US $	US $	US $	US $	US $	US $	US $	US $
1,000	1,495	1.33	1.37	1.41	1.46	1.49	1.54	1.72	1.88
2,000	748	.83	.86	.89	.92	.93	.97	1.08	1.19
3,000	498	.67	.69	.72	.74	.75	.78	.87	.95
4,000	373	.59	.60	.62	.65	.66	.68	.77	.84

TABLE 6.9

INCREMENTAL PER BARREL COST FOR VARIOUS DECLINE RATES AND

A 25 PER CENT REDUCTION IN INITIAL FACILITIES COST

Output per well per day (barrels)	Initial capital per barrel	Decline Rates							
		a=.07	a=.08	a=.09	a=.10	a=.11	a=.12	a=.16	a=.20
		US $	US $	US $	US $	US $	US $	US $	US $
1,000	1,973	1.64	1.69	1.75	1.81	1.84	1.91	2.12	2.17
2,000	987	.99	1.02	1.05	1.09	1.11	1.15	1.28	1.33
3,000	658	.77	.80	.82	.86	.87	.90	1.01	1.06
4,000	493	.66	.69	.71	.74	.74	.78	.87	.92

expected cost per barrel of bringing into production a well that is in a new field considerably removed from existing production facilities is likely to cost about U.S. $1.20 to U.S. $1.25 per barrel (Table 6.9). This applies, however, only to wells in water depths of 200-400 feet and for which output levels exceed 1,000 barrels per well per day. As drilling extends into waters exceeding 400 feet and up to 1,000 feet cost is expected to rise to as high as U.S. $4.00-$5.00 per incremental daily barrel. At the present world market price of U.S. $12.00 (real terms), forecast to last at least until 1985, the gap between cost and price is large enough to maintain continued interest by both the Trinidad government and the oil companies in the development of Trinidad's marine territories beyond 1985. At present cost the surplus, after making allowances for 20 per cent profit on all development outlays, is about U.S. $10.00. The Trinidad government levies a 50 per cent tax on profits, while royalties and other payments to government amount to about 15-20 per cent. On each barrel, therefore, the Trinidad government gets about U.S. $7.00 leaving the companies a surplus of about $3.00 per barrel. This will be reduced considerably as development pushes outward into deeper waters. Cost can be expected to rise to U.S. $5.00 so that at a real price of $12.00 per barrel the surplus will be about U.S. $7.00. At present tax rates per barrel the Trinidad government will get about $5.00 per barrel and the companies about $2.00 per barrel in 1974 dollars. This is about four times the amount the companies can expect to get in the Middle East or Venezuela, i.e., between U.S. $0.40 and U.S. $0.60 per barrel.

If one considers the Trinidad situation in terms of nominal tax reference prices for 1974 and 1975 the government tax take is even higher than indicated above. Tax reference prices as set by the Minister of Petroleum and Mines were U.S. $14.93 for East Coast Continental Shelf crudes and U.S. $13.73 for Soldado and other crudes at January 1, 1974. In 1975 there were about three increases in the price so that by January 1, 1976 these prices stood at $17.43 and $16.23 respectively. Even when adjusted for inflation at a rate of 15 per cent these prices are still high ($14.00-$15.00) thus reflecting the high quality and profitability of crudes from the East Coast Continental Shelf fields.

From the discussion in Chapter 5 it is clear that the refining function dominated the Trinidad oil industry throughout the period 1956 to 1973. The rapid decline in the old concessions during the 1960s made refining even more important. Because of the integrated structure of Trinidad's oil industry it is imperative that one derives costs in refining during that period in order to determine profitability in the industry as a whole and assess government policies and the oil companies' strategies. The following section deals with long-run cost of refining in the Trinidad oil industry.

Long-run Cost in Refining

Long-run cost in refining is the expected increase in cost necessary to produce an incremental daily composite barrel of refined products from a crude of specific quality. It is the annual capital cost (ACC) plus direct operating costs per incremental barrel. In theory estimates of long-run refining cost can be developed by using a discounted cash flow method. In practice, however, it is extremely difficult to forecast future technology in refining and direct operating cash outlays in the distant future. The estimates for Trinidad derived below represent, therefore, historical trends which are assumed to hold true in the future. The methods for estimating the two components of refining cost are set out below.[1]

Model: Annual capital cost. Adelman defines annual capital cost (ACC) as the sum of dollar values associated with the following elements of capital cost:

1. Annual return on equity (AER).
2. Interest on debt capital.
3. Debt repayment (amortization).
4. Income tax.

He argues that since the refinery operation is subject to taxation like any other industry the company can and must consider the rate of taxation in making decisions about new investments.[2]

Since long-run price in a competitive market situation will just cover the annual capital cost (ACC) plus the operating cost necessary to produce the incremental unit of output (a barrel of product), the firm earns no surplus profits and net earnings before taxes are equal to ACC less depreciation less interest charges.

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[1]The method used in deriving refinery costs in this section is borrowed from M. A. Adelman, The World Oil Market.

[2]At the level of the crude production function, however, most payments to host governments are determined by a bargaining process. Income taxes on oil are determined as a part of this bargaining process and are, therefore, ignored in measuring supply price for crude oil production.

Income tax is some percentage of net earnings, which in general will be assumed to be 50 per cent.

One can now define annual equity return (AER) as follows:

$$\begin{aligned} AER &= ACC - \text{interest} - \text{debt repayment} - \text{income tax} \\ &= ACC - \text{interest} - \text{debt repayment} - 1/2(ACC - \text{depreciation} \\ &\qquad - \text{interest}) \\ &= 1/2\ ACC + 1/2\ \text{depreciation} - 1/2\ \text{interest} - \text{debt repayment.} \end{aligned}$$

This gives

$$ACC = 2(AER) - \text{depreciation} + \text{interest} + 2(\text{debt repayment}) \tag{6.11}$$

One needs to develop a method for deriving AER before estimating ACC. If we define equity capital required (E) as the present value of future streams of earnings (i.e., AER), then E is as follows:

$$E = (AER)\int_0^T e^{-rt}dt \tag{6.12}$$

where

T = service life of asset

r = annual rate of discount on equity capital.

From equation 6.12 one derives

$$(AER) = E/\int_0^T e^{-rt}dt \tag{6.13}$$

It is now possible to determine what annual equity return must be earned in order to induce one dollar investment on an initial daily barrel of product, given the life of the service and the rate of discount. For instance, assume a refinery investment of \$100 per daily barrel of which \$50 represents the equity portion, then \$50 is the present value of future annual equity returns (AER) that is:

$$\$50 = (AER)\int_0^T e^{-rt}dt \text{ and } AER = \$50/\int_0^T e^{-rt}dt.$$

There is an implicit assumption in this formula that the refinery is producing at full capacity from the moment it starts operations. However, since trial runs and starting difficulties are likely to affect the first year's earnings we will follow Adelman and deduct a factor of 0.5 from the denominator to equation 6.13 to adjust for this.[1] The following example for the Caribbean situation serves to illustrate the use of this method. Assume a discount rate of 12 per cent on capital invested in refinery operations,[2] a twenty year service life on equipment and plant, a 10 per cent depreciation rate, and that 50 per cent of the capital requirements are borrowed.[3] Then, according to equation 6.13, AER = $50/\int_0^{20} e^{-(20 \times 0.12)} dt = 50/7.91 =$ \$6.32, and the adjusted estimate of AER is 50/7.41 = \$6.75. Applying the information above to equation 6.11 gives the following estimate of annual capital cost per \$100 invested in refinery capacity: ACC = 2(6.75) - 10.00 + 3.00 + 1.26 = \$7.76, at full capacity operation. This is what would be required to make the investment (\$100) barely worthwhile after paying taxes, interest, and making payments into a fund to amortize the debt. Stated differently, the capital cost per day would be \$0.000213 per dollar invested in refinery capacity (i.e. \$7.76/365 x 100). In order to derive the capital cost per incremental barrel of products produced by a

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[1] Adelman, The World Petroleum Market, p. 372.

[2] For instance, according to the Mostofi Report the sales-earnings ratio (before taxes) for Trinidad's refining industry was 11 per cent in 1962. The Mostofi Report, Exhibit no. 26, pp. 103-104.

[3] The latter assumption is in keeping with the Chase Manhatten Bank's forecast that about 40 per cent of all capital requirements in the oil industry will have to be met from sources external to the industry in the next fifteen years. Chase Manhatten Bank (CMB), Capital Investments of the World Petroleum Industry, 1971, p. 5.

refinery of a specific size and utilizing a particular technology, one must first make adjustments for capacity to the coefficient developed above and multiply it by the initial capital per daily barrel required by such a refinery.

From the discussion above it is clear that in order to derive capital cost per composite barrel of refined products one needs to develop estimates of gross new capacity in refining. Gross new capacity during the year (G_n), which is net capacity plus replacement capacity, may be calculated by the following formula:

$$\begin{aligned} G_n &= 1/2(J_{n+2} - J_{n+1}) - 1/2(J_{n+1} - J_n) - .04J_n \\ &= 0.50J_{n+2} - 0.46J_n \end{aligned} \qquad 6.14$$

where J_n represents capacity on January 1 of the year n. This formula assumes that expenditures in any one year are partly to provide capacity which will not be completed until the next year;[1] and that capacity is depleted at a rate of 4 per cent per annum.

Direct operating cost. Because of the complex nature of the refining process it is not possible at times to tell at what point in the operation a by-product of the process becomes an input to it, and at what cost. This difficulty is further complicated by the complexity of the technology utilized. As a result of these and other difficulties a more direct approach is therefore used in estimating operating cost. Operating cost is defined as those elements of purchased power, labour and materials (catalyst, lead, other chemical inputs) which vary directly with the volume of output. M. A. Adelman, in estimating

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[1]Adelman, The World Petroleum Market, Appendix V-C, p. 368.

direct operating cost, uses an estimate derived by M. E. Hubbard[1] of 15 cents a barrel for a 140 thousand barrels per day refinery outside of Europe. Hubbard's estimates exclude fuel cost which is about $0.05-$0.06 per barrel in the Western Hemisphere outside of North America. This suggests a direct operating cost of about $0.20 per barrel, a figure which compares favourably with operating cost ($0.155) derived from estimates of refining cost[2] prepared for Shell Trinidad Limited by Mr. B. Ali[3] (Table 6.13). It would seem, therefore, that refinery operating cost in the Caribbean probably falls in the range $0.16-$0.20 per barrel, i.e., approximately U.S. $0.18. The lower limit reflects more closely costs in Trinidad. Elsewhere in the Caribbean and Latin America these costs may be considerably higher. In the Virgin Islands, for instance, total refining cost was reported in 1967 to be less than 50 cents and cash or operating cost less than 20 cents.[4] Having derived some plausible estimates of operating costs in the Caribbean and Trinidad for a grass-roots refinery, and having established a method for developing annual capital cost, estimates of refining cost in Trinidad will be developed below.

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[1]*Ibid*., p. 374.

[2]See below, Table 6.13.

[3]Mr. Ali was formerly a chemical engineer at Shell Trinidad. He was hired in 1973 by the Ministry of Petroleum and Mines as a chemical engineer specialist. He has twenty years experience in the industry.

[4]*Chemical and Engineering News*, May 15, 1967, p. 28.

Incremental cost per composite barrel of product, Trinidad.

The Commission of Enquiry into the Oil Industry (1963-1964) in Trinidad obtained projections from three major operators concerning capital investment for 1964-1968 inclusive. Planned investment on refining installations, increase of refinery capacity, etc. was estimated to be W.I. $115 million for the five year period 1964-1968 or U.S. $67 million[1] ($13.4 million per year). Between the period 1964-1968 Trinidad refinery capacity increased from 363,000 barrels per day[2] to about 440,000 barrels per day, or at a geometric rate of 4 per cent per annum. Examination of the absolute increases in throughput per year (Table 6.10) shows that, on the average, this net increase in runs to still was approximately 14,000 barrels per day in each of the five years. If one assumes that capacity was replaced at a rate of 4 per cent per annum it can be shown that on the average gross capacity added each year was about 31,400 barrels per day.[3]

Assuming that U.S. $13.4 million was spent each year, the average capital requirement per daily barrel during this period was probably in the order of U.S. $430. Annual capital cost per daily

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[1] The Mostofi Report, p. 33. There are indications that a least U.S. $12 million of this amount would have been spent for the year 1965 (Petroleum Times, February 19, 1965, p. 90).

[2] The Mostofi Report, p. 24

[3] Petroleum Times, February 19, 1965, p. 90. Texaco started a plant to manufacture aromatic compounds in 1965; by mid-1966 it was expected to add 1,008,000 barrels to annual capacity. By mid-1965 it completed a paraffin plant adding 1,500 barrels per day to capacity. This gives net capacity added of 31,658 barrels per day over two years or an average of 15,829 barrels per day in each of the two years. Compares favourably with column (3) Table 6.10.

TABLE 6.10

CALCULATIONS OF GROSS CAPACITY ADDED TRINIDAD

Year Jan. 1 (1)	Capacity 000 b/d (2)	Net increments during year 000 b/d (3)	Capacity replaced during year 000 b/d (4) = (2) x .04	Gross capacity added 000 b/d (5) = (3) + (4)
1964	362.0	14.5	14.5	29.0
1965	376.5	15.1	15.1	30.2
1966	391.6	15.7	15.7	31.4
1967	407.3	16.3	16.3	32.6
1968	423.6	16.9	16.9	33.8
Total Gross Capacity Added 1964-1968				157.0

barrel can now be derived according to the assumptions set out in Model I, Cases I and II, and Model II, Cases I and II.

Model I: the 50:50 tax model.

Case I assumes a 12 per cent discount rate, 10 per cent depreciation, a twenty year service life, a debt to total capital ratio of .50, and a 50:50 corporate tax arrangement. Under these assumptions capital cost per U.S. $100 invested per daily incremental barrel is 2.12 cents. This assumes 100 per cent capacity. However, making adjustments for capacity utilization of .88 and .95, and expressing capital cost in terms of each dollar invested, one obtains capital cost per incremental daily barrel equal to U.S. $0.000242 and $0.000224 respectively. Multiplying these costs by the initial capital required (U.S. $430 per daily barrel) in Trinidad gives annual capital cost per incremental barrel in

Trinidad of 9.6 cents if only 95 per cent capacity is being used, and 10.4 cents if 88 per cent capacity is being used.

Case II makes the same assumptions as Case I except that depreciation is fixed at a rate of 6 per cent per annum. In Case II annual capital cost per dollar invested in an incremental daily barrel is U.S. $0.000322. Making adjustment for .95 and .88 capacity utilization gives U.S. $0.000339 and $0.000366. Annual capital cost per barrel in the Trinidad situation would be 14.6 cents and 15.7 cents respectively.

Assuming direct operating cost is about 16 cents per incremental barrel then total incremental cost per daily composite barrel of refined product for Trinidad is as follows:

Model I, Case I.

Assuming maximum capacity utilization (.95 factor)
= 9.6 + 16 = 25.6 cents (U.S.)

Normal capacity utilization (.88 factor)
= 10.4 + 16 = 26.4 cents (U.S.)

Model I, Case II.

Assuming maximum capacity utilization (.95 factor)
= 14.6 + 16 = 30.6 cents (U.S.)

Normal capacity utilization (.88 factor)
= 15.7 + 16 = 31.7 cents (U.S.)

By way of comparison let us look at the case in which a 40 per cent income tax is charged and examine it to see what effect changes in income taxes from 40 per cent to 50 per cent may have on cost, and by extension the competitive position of Trinidad.

Model II: the 40:60 tax model.

Model II, Case I assumes a 12 per cent discount rate, a 10 per cent depreciation rate, a 6 per cent interest rate, a twenty years service life, and income taxes at 40 per cent of net profits. With a 40 per cent tax rate

ACC = 5/3(AER) + 5/3(debt repayment) - 2/3(depreciation + interest

= 5/3(6.75) + 5/3(.63) - 2/3(10) + 3 = $8.63.

That is capital cost per dollar invested in a daily barrel of product is U.S. $0.0002364 at 100 per cent utilization of capacity. At .88 utilization it is U.S. $0.000268 and at .95 utilization it is U.S. $0.000249.

Case II assumes a depreciation rate of 6 per cent. Capital cost per dollar per daily barrel for this Case is U.S. $0.0003095. Adjustment for a .88 utilization factor puts it at U.S. $0.000352, and for .95 utilization at U.S. $0.000326. One can now calculate total cost per incremental barrel assuming 10 per cent (Case I) and 6 per cent (Case II) depreciation rates. Total incremental cost per daily barrel of products is as follows:

Model II, Case I.

Assuming maximum capacity utilization (.95 factor)
= 10.7 + 16 = 26.7 cents (U.S.)

Normal capacity utilization (.88 factor)
= 11.5 + 16 = 27.5 cents (U.S.)

Model II, Case II.

Assuming maximum capacity utilization (.95 factor)
= 14.0 + 16 = 30.0 cents (U.S.)

Normal capacity utilization (.88 factor)
= 15.1 + 16 = 31.1 cents (U.S.)

Costs derived by Model I and Model II are for all practical purposes the same, indicating that capital cost does not seem to change substantially with changes in the level of taxation (i.e., within the mid-range) and, therefore, would not affect the competitive position of Trinidad in the world oil market. Increases in the depreciation rate, however, do cause a significant savings in capital cost requirements (i.e., income taxes) and consequently reduce total incremental costs.[1] On the other hand, decreases in depreciation rates increase cost significantly.

It is not possible with the identity (6.11) used to calculate ACC to observe, a priori, and make generalizations about the behaviour of annual capital costs in response to changes in income taxes, unless one knows what decisions will be made about the debt equity ratio, and its effect on the discount rate for that particular host country. The dynamics of the capital market and the responses of management to changes in that market are not automatically accounted for in the methods used above. Adelman works out (Table 6.11) the effect of change in the assumptions of discount rate, service life, depreciation and interest rate on annual capital cost, but there is no dynamic model to predict the relationship between these various market elements. One is left, therefore, to make assumptions based on an intuitive understanding of the situation. This study does not rise above that weakness.

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[1]Note the change in cost between Case I and Case II for both models.

TABLE 6.11

EFFECT OF CHANGE IN ASSUMPTIONS OF DISCOUNT RATE, SERVICE LIFE, DEPRECIATION, AND INTEREST RATE ON ANNUAL CAPITAL COST

Discount rate (per cent) / Service life (yrs)	A. Twice annual equity return				
	15	17	20	25	30
8	12.40	11.60	10.73	9.82	9.29
10	13.36	12.63	11.86	11.09	10.65
12	14.90	14.20	13.50	13.16	12.45
14	16.50	15.85	15.20	14.62	14.33
16	17.83	17.28	16.86	16.47	16.23

B. Depreciation charge		C. Interest charge		D. Twice debt repayment	
Rate (per cent)	Amount ($)	Rate (per cent)	Amount ($)	Service on debt life (years)	Amount ($)
5	5	4	2.00	15	1.39
6	6	5	2.50	17	1.33
7	7	6	3.00	20	1.26
8	8	7	3.50	25	1.20
9	9	8	4.00	30	1.17
10	10	9	4.50	-	-

Example:	A	-	B	+	C	+	D	=	Total
	(16, 17)		(10)		(8)		(25)		
	$17.28	-	$10	+	$4.00	+	$1.20	=	$12.48

Source: M. A. Adelman, The World Petroleum Market (Baltimore: The Johns Hopkins University Press, 1972), Appendices to Chapter VI, Table VI-C-5, p. 379.

Note: Per $100 invested ($50 equity and $50 debt), annual capital charge equals: 2(equity return) - depreciation + interest + 2(debt repayment).

The costing methods outlined above are very useful in decision making situations where one has to determine the advisability of expanding refinery output. In an historical context, therefore, an analysis of changes in the cost per incremental barrel of products is pertinent to an understanding of some of the developments that took place in the Trinidad refinery industry during the sixties and early seventies. Moreover, it sets the background against which a rigorous discussion of profitability and taxation of the industry may be conducted.

Competitive change in refining, Trinidad: an historical cost analysis. The Shell Trinidad submission to the Mostofi Commission reported refinery cost at U.S. $0.33 per barrel for its Point Fortin refinery over the period 1963-1964. The refinery was not at that time operating at maximum efficiency. In particular Shell argued that on the basis of the norm for the industry, the refinery could be operated with half the manpower it actually employed.[1] In the face of increased market competition and falling prices the company advanced a plan to reduce cost per barrel by a) increasing utilization of capacity, b) reducing labour input by increasing automation, and centralizing process control and other refinery operations. It estimated that these changes would reduce cost downward from U.S. $0.33 to $0.29 per barrel.[2]

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[1]The Mostofi Commission: paper submitted by Shell Trinidad to the Commissioners, Ministry of Petroleum and Mines, 1965 (Typewritten).

[2]*Ibid.*

In order to meet market competition the company introduced innovations aimed at improving its product yield and quality per barrel of crude throughput. In 1963 and 1964 it invested a total of T.T. $10 million in secondary processing.[1] The company also made several moves to reduce cost. Between 1965 and 1967 it embarked on a major labour retrenchment programme; and tried to maximize capacity utilization by increasing throughput from its domestic inland crude production operations, but its drilling programme failed.[2] In 1968 it increased its capacity to 70,000 barrels per day and in 1969 to 80,000 barrels per day, at what a senior Shell official described as a negligible outlay (less than U.S. $500,000). To further benefit from economies of scale in refining and transportation, in July 1970 Shell announced a T.T. $10 million project to increase capacity at its Point Fortin refinery from 80,000 barrels per day to 100,000 barrels per day.[3] The major part of this expenditure went towards centralization, modernization of plant, and extension of utilities and other facilities. In addition, Shell spent T.T. 5.5 million to increase facilities for berthing long-range tankers (75,000 dead weight tons).

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[1] T.T. $5 million on 800-ton a day platformer (1963); T.T. $5 million on kerosene hydrotreater and hydrogenation unit (1964). Public Relations release, Shell Trinidad Limited, April 1, 1963, p. 3.

[2] Report of Tripartite Committee on Retrenchment in the Oil Industry Trinidad and Tobago. Twelve man committee made up of representatives of government, O.W.T.U., Texaco, Shell and B.P. July 19, 25, 30, 1968 and August 2, 7, 9, 12, 15, 1968.

[3] Shell Topics, a Fortnightly Newspaper for Shell Trinidad Employees and their Families, Friday, July 10, 1970, no. 479, pp. 1, 5.

These facilities were essential for handling increases in imports of low sulphur crudes and the export of final products. It also reduced the cost of transportation per barrel of product shipped in larger tankers.

Between 1963 and 1973, therefore, Shell spent more than T.T. $25 million (U.S. $13 million) on its refinery expansion. This resulted in a net addition to capacity of 40,000 barrels per day, with the accompanying increase in utility capacity and offsite facilities. That is, the initial capital outlay per barrel per day was approximately U.S. $325.00. Using the present value method discussed above, and assuming a 12 per cent discount on capital, a twenty year service life, 6 per cent depreciation, and 6 per cent interest charge on debt capital, one derives an annual capital cost per daily barrel of U.S. 11.9 cents. Assuming an operating cost of U.S. $0.16 one obtains total cost per incremental daily barrel of refined products equal to U.S. $0.28 for the period 1963-1973; using a 10 per cent depreciation rate gives incremental cost equal to U.S. $0.26 per barrel, both indicating a downward trend in cost of refining during this period. These costs compare favourably with the accounting estimates presented in Tables 6.12 and 6.13. The cost of producing a daily incremental barrel of refined product for Shell is shown as U.S. $0.23 in 1970 (Table 6.12) and U.S. $0.30 for

1972-1973 (Table 6.13).[1]

TABLE 6.12

REFINERY PROCESSING COSTS BY COMPANY

TRINIDAD, 1970 - U.S. $

Cost category	Texaco	Shell
Direct refinery expenses	.1400	.0445
Storage and handling	.0475	.0215
Fuel and utilities	.0575	.0265
Corporation and general expenses	.0265	.0850
Blending costs	.0030	-
Total operating expenses	.2745	.1775
Depreciation	.0335	.0495
Total	.3080	.2270

Source: Peat, Marwick & Mitchell Accounting Study 1970, reproduced in Trevor Michael A. Farrell, The Multinational Corporations, The Petroleum Industry and Economic Underdevelopment in Trinidad and Tobago (Ph.D. dissertation, Ithaca, N.Y.: Cornell University, 1974), p. 194.

[1]The large difference between the two periods can be partly explained by capital expenditures undertaken in the period 1971-1972 which are not reflected in the 1970 Accounting Study. The Accounting Study 1970 uses only depreciation cost as a measure of capital cost. In the case of Shell depreciation costs at 1970 are largely a reflection of actual capital expenditures made in 1963 and 1964 and are, therefore, small. Capital cost might, therefore, have been underestimated in the 1970 study.

TABLE 6.13

REFINING COST FOR SHELL TRINIDAD REFINERY

1972-1973

(100,000 b/d capacity)*

	U.S. $ per barrel
Depreciation	.065
Fuel	.045
Labour	.077
Materials	.033
Overheads	.080
Total	.300

*Estimates prepared by chemical engineer employed with Shell Trinidad Limited (1973).

The preceding discussion suggests that for a grass-roots refinery in Trinidad the cost per incremental composite barrel of refined products is likely to be U.S. $0.26 to $0.30. This does not, however, adequately reflect refining cost for the more complex Texaco refinery.

Texaco Trinidad. Historical data on refining cost for Texaco is not as easily available. However, on the basis of interviews with various government officials of the Oil Audit Section of the Inland Revenue Department (Trinidad) it would seem that cost per barrel for refining at Texaco refineries may be about 50 per cent higher than that for Shell. The data in Table 6.12 reflect this. Ali also suggested that because of the complexity of Texaco's operation its cost would be about 1.50 times that for Shell Trinidad. It would seem, therefore, that on the basis of Shell's incremental per barrel cost for 1963-1973 Texaco's cost is likely to have been U.S. $0.40 to U.S. $0.45 per barrel of refined product. This does not include the cost of desulphurization.

Competition and the cost of desulphurization. In 1970 Texaco announced plans to invest U.S. $80 million in a 90,000 barrel per day desulphurization plant at Point-a-Pierre. The new anti-pollution laws governing the quality of fuels consumed in East Coast American markets require that fuel oil for heating and other energy purposes contain less than 0.5 per cent sulphur. Since Texaco Trinidad's refinery was geared to refining "sour" crudes from Venezuela and Saudi Arabia it became necessary for it to desulphurize its fuel oils if it were to keep its share of the American market for imports of petroleum products.

Using the Venezuelan experience (Cordon), Ali estimated that a desulphurization plant producing its own hydrogen inputs and including a sulphur recovery unit, would require at 1969 prices a capital outlay of about U.S. $48 million. Such a plant would produce about 100 tons of hydrogen a day which is the approximate requirement for producing 90,000 barrels per day of desulphurized distillates.

Ali assumed that the plant capacity announced by Texaco would suggest the following system: a deep flashing system at 420° C., 25 mm vacuum distillation capacity and producing about 60 per cent desulphurization distillates from every barrel of fuel oil. He estimated capital requirements for such a plant at U.S. $47.5 million, that is, U.S. $30 million for a hydro-desulphurization unit (including production of hydrogen at 100 tons per day), and U.S. $17.5 million for a vacuum distillating plant - 100,000 barrels per day (estimated generously at double capital requirement of a 50,000 barrels per day unit). The Texaco Trinidad plant has a long-term contract to buy hydrogen from Federation Chemicals Limited, so that total capital outlay is actually less than indicated above by about U.S. $8.5 million, the estimated cost of building a hydrogen plant producing 100 tons of hydrogen per day.[1] However, for the purpose of this analysis capital outlay will be regarded at U.S. $50 million for the new complex.

Total operating and capital cost per barrel of desulphurized fuel oils is presented in Table 6.14 as U.S. $0.54 per barrel. The estimate for operating cost (U.S. $0.25 per barrel) is comparable with North American experience.[2] Nelson[3] shows that costs per barrel for hydrogen treating or hydro-desulphurization varies from U.S. $0.045 to U.S. $0.40 per barrel of fuel oils. In particular, high boiling, already cracked or cycle stocks that contain large amounts of sulphur,

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[1]On the basis of these estimates prepared by Ali it would seem that Texaco over-stated its capital requirements to the government by U.S. $30 to $40 million.

[2]These estimates do not take into consideration any savings accruing from concessions under the Aid to Pioneer Industry Act.

[3]W. L. Nelson, Guide to Refinery Operating Costs, "Operating Costs - hydro-desulphurization (Costimating, OGJ, June 13, 1960)," Tulsa, Oklahoma: The Petroleum Publishing Co., p. 94.

TABLE 6.14

ESTIMATES OF COST PER BARREL FOR A

90,000 B/D DESULPHURIZATION UNIT, TRINIDAD, 1969

		U.S. cents
Operating cost per barrel for deep flashing unit		
Items of cost		
Utilities	2.5	
Maintenance and labour	1.5	
Overheads and materials	2.0	
		6.0
Operating cost per barrel for desulphurization and sulphur recovery unit		
Utilities	4.0	
Catalyst	1.0	
Maintenance	2.0	
Materials, labour, overhead	3.5	
Hydrogen	7.5	
Sulphur recovery	1.0	19.0
Total operating cost per barrel (excluding capital cost)		25.00
Capital cost (assuming 12 per cent discount rate over 15 years)		29.00
Total operating and capital cost (per barrel)		54.00

Source: Estimates prepared by chemical engineer employed by Shell Trinidad Limited (1973).

require severe[1] operating conditions and, therefore, add approximately U.S. $0.12 to $0.25 to operating costs per barrel of fuel oils.[2] The cost per barrel of desulphurized distillates derived in Table 6.14 applies only to 60 per cent of the output of Texaco refinery operations. For instance, Texaco refinery has a distillation capacity of about 360,000 barrels of crude per day geared to producing about 60 per cent fuel oils, that is, approximately 200,000 barrels per day. The desulphurization plant will transform approximately 100,000 barrels per day of these high sulphur fuel oils into low sulphur (0.2 to 1.0 per cent) fuel oils.[3] While it is true, therefore, that desulphurization adds U.S. $0.54 to the cost of producing an incremental barrel of high sulphur residual fuel oils, in terms of a composite barrel of refined products containing 60 per cent of such fuel oils it adds only U.S. $0.32 (i.e., .60 times U.S. $0.54). As a direct result of the improvement in quality, therefore, the estimated cost of a composite barrel of refined products (Texaco) increases from U.S. $0.40 to $0.72 or at the upper range of the

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[1]This condition requires larger circulation of hydrogen, more consumption of hydrogen, higher temperatures, more frequent regeneration of catalyst, and often a higher reaction pressure.

[2]These costs are 1956 costs but it is assumed that they are more or less representative of costs at 1965-1969. The assumption is that technical improvements offset increases in material and labour costs.

[3]Government of Trinidad and Tobago, Review of the Economy 1972 (Government Printery: 1973), p. 5. It should be noted that the desulphurized fuels will be fed back into Texaco's general refinery complex for blending fuel oils at sulphur levels suitable to various market specifications.

scale from U.S. \$0.45 to \$0.77.[1] These costs are significantly lower than costs in North Western Europe for a complete grass-roots refinery producing desulphurized fuels. Cost there is estimated to be between U.S. \$0.90 and \$1.00 (see Chapter 7, p.208).

The prices of residual fuel oil increased sufficiently after 1971 to make it very profitable for Texaco to invest in a desulphurization plant. For an additional cost of 54 cents U.S. per daily barrel residual fuel with more than one per cent sulphur could be raised to the quality of residual fuel oil with about half of one per cent sulphur. In contrast the margin between the prices of these two products at 1973 was about U.S. \$1.00, almost twice as great.[2]

The rapid increase of refinery capacity observed in the Caribbean (Bahamas, Virgin Islands) and Venezuela (Cordon desulphurization plant) is in response to this profitability. There is a real possibility that this competition, plus reductions in demand

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[1]These costs may be too high since savings resulting from blending rather than desulphurizating all distillates are not considered; they do not incorporate the saving in capital cost due to possible hidden income tax concessions in the form of rapid write-offs on the surplus capital requirement (about U.S. \$30 million) that probably went into updating existing plant and equipment; nor does it account for capital cost savings that may arise from the arrangements to buy hydrogen inputs from Federation Chemicals Limited.

[2]In 1971, December 1, Platt's Oilgram (quoted in Monthly Bulletins, Ministry of Petroleum and Mines, Trinidad and Tobago, 1971, June 1973) posting for Gulf Coast cargoes shows price of Bunker C fuel oil (more than 1 per cent sulphur) at U.S. \$2.00 per barrel. In October 1971 it was quoted at U.S. \$2.50 and was as high as U.S. \$3.25. This price increased to U.S. \$2.80 at 1973 reflecting demand pressure. On the other hand Bunker C fuel oil with a maximum sulphur content of 0.6 per cent has fluctuated between U.S. \$3.25 and U.S. \$3.80 per barrel. It was posted at U.S. \$3.80 per barrel on December 1,1971 and U.S. \$3.75 per barrel at June 1, 1973.

for fuels in response to the higher prices established in 1974, will cause prices for fuel oil to be reduced. It is unlikely, however, that the price-cost gap for fuel oils can be completely eliminated before 1985 unless the monopoly power of the OPEC cartel is broken.

The analysis above was conducted largely on a company basis. In the ensuing discussion on profitability, and government taxation policies with respect to the oil industry (Chapter 8), one will need to have a more general measure of cost in refining suited to the level of aggregation used in that analysis. The following section develops industry-wide incremental cost in refining for Trinidad.

<u>Industry-wide incremental refining costs</u>. In the period 1963 to 1975 Trinidad taxes on corporate profits varied between 40 per cent and 50 per cent (1975). However, in determining industry-wide incremental refining cost, estimates of cost derived on the basis of Model I, Case II which assumes a 50 per cent income tax arrangement will be used. Since capacity in the two refineries has expanded at different rates and in different time periods; because the complexity of the two refineries is very different, and modernization of plant and equipment has proceeded at different rates and also in different time periods, there are serious problems associated with any interpretation of industry-wide costs in such a situation. However, the essence of good methodology is simplicity, so that industry-wide cost per incremental barrel will be derived by taking weighted averages of cost for the two refineries.

In Table 6.15 two methods of preparing industry-wide cost are summarized. One method uses an engineering adjustment factor to raise cost for Shell up to corresponding cost for Texaco, and then weights these two sets of cost on a 20:80 basis (i.e. the companies' shares of total refinery capacity in Trinidad).[1] The other method assigns to Texaco incremental cost derived by the present value method for the period 1963-1968, and to Shell for the period 1969-1973, then weights these two costs by the share of the two companies in total refinery capacity in Trinidad. The weighted average for the industry is given as $(.20)(.28) + (.80)(.32) = .31$. Making allowances for the cost reducing effects of technical improvements in the industry since 1964, the industry-wide estimate of U.S. $0.31 is comparable with estimate of U.S. $0.34[2] derived by the Mostofi Commission for the period 1963-1964. The industry-wide figure ($0.31) approximates more closely an average cost per incremental barrel in which the residual fuel component has a sulphur content in excess of one per cent. The cost per incremental composite barrel of desulphurized middle distillates and residual fuels is U.S. $0.57.[3] The short-run industry-wide supply

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[1]Derived on the basis that Shell's capacity is 100,000 barrels per day, and Texaco's is 400,000 barrels per day.

[2]The Commission figure covers total refinery expenses for the various types of crude oil refined in Trinidad for their own account by the Trinidadian operators, including capital service and share of overhead expenses with exclusion of crude oil costs. The average is indicated before taxes. Mostofi Report, p. 32.

[3]That is, (.20)(Shell incremental cost) + (.80)(Texaco incremental cost plus desulphurization cost) $= (.20)(.32) + (.80)(.32 + .32) = .57$. See page 195 for derivation of Texaco desulphurization cost per barrel of crude charge.

TABLE 6.15

AVERAGE COST AND COST PER INCREMENTAL DAILY BARREL OF PRODUCTS BY COMPANY AND FOR THE INDUSTRY - TRINIDAD AND TOBAGO

Unit	Method	Average cost U.S. $	Cost per incremental daily barrel U.S. $
Excluding desulphurization costs			
Shell Trinidad	Accounting average	0.30	-
Shell Trinidad	P.V.	-	0.28
Texaco Trinidad	P.V.	-	0.32
Texaco Trinidad	Adjustment factor 1.50	0.45	0.42
Combined industry	P.V.	-	0.31
	Adjustment factor 1.50	-	0.39
Including desulphurization costs			
Texaco Trinidad	P.V.	-	0.64
Texaco Trinidad	Adjustment factor 1.50	0.77	0.74
Combined industry	P.V.	-	0.57
	Adjustment factor 1.50	-	0.63

Notes: Estimates based on calculations for Model I, Case I, p. 183.

P.V. = Present value cost outlays per barrel.

price or direct operating cost can be shown to be U.S. $0.36.

A comparison of the two methods shows that the results do not diverge markedly. For instance, the present value (P.V.) method yields cost per incremental daily barrel of U.S. $0.32 for Texaco; the corresponding estimate using the 1.50 adjustment factor is U.S. $0.42. For the combined industry (Trinidad) the P.V. method yields cost per incremental daily barrel of U.S. $0.31; the adjustment factor method gives an estimate of U.S. $0.39. These estimates, however, exclude desulphurization cost. When desulphurization cost is included the P.V. method gives cost for the combined industry of U.S. $0.57 as compared with U.S. $0.63 for the adjustment factor approach.

Profitability of Trinidad Oil Industry

One can now return to the question of the profitability of the operations of the oil companies in Trinidad. The marginal cost analysis presented above strongly suggests that in the two decades 1956-1975 the Trinidad oil companies made a good return on their investments. In this section we will explore this in more detail. Table 6.16 derives estimates of surplus profits earned in high cost fields and low cost fields in Trinidad, and the netback price of crudes for the period 1960 to 1968. Surplus profits are defined as earnings in excess of a 20 per cent return on capital invested in production and/or a 12 per cent return on capital invested in refinery capacity. The analysis which follows relates only to sales in the U.S. East Coast market. However, since that is the most

TABLE 6.16

ESTIMATES OF SURPLUS PROFITS AND NETBACK

ON CRUDE OIL IN TRINIDAD OIL INDUSTRY

(U.S. $ per daily barrel)

	1960	1961	1962	1963	1964-68
Cost per barrel	.94-1.47	1.03-1.66	1.01-1.43	.99-1.52	1.04
Refining margin	.32	.32	.32	.32	.32
Freight cost to U.S. East Coast	.30	.30	.30	.30	.30
Total per barrel cost (cif)	1.56-2.09	1.65-2.28	1.63-2.05	1.61-2.14	1.66
Caribbean prices	2.75	2.73	2.68	2.63	1.72
Surplus profits					
High cost fields	.66	.45	.63	.49	-
Lower cost fields	1.19	1.08	1.05	1.02	0.06
Netback*	2.13	2.11	2.06	2.01	1.10

Sources: Table 6.12, Figure 6.4, Table 6.4.

*Netback equals price per composite barrel of product minus refining margin per barrel minus freight cost per barrel.

important market for Trinidad refined products the data presented provide significant information about the profitability of the country's industry.

The estimated netback on Trinidad crudes used in refined products sold in the U.S. East Coast markets and the Caribbean ranged between U.S. $2.00 and $2.13 in the period 1960 to 1963; but decreased dramatically to about U.S. $1.10 in the period 1964-1968. Consequently surplus profits in the low cost fields (mainly marine and some land fields owned by Texaco) fell from U.S. $1.19 in 1960 to U.S. $1.02 in 1963, and virtually disappeared in the period 1964 to 1968. In the high cost fields (mainly land) surplus profits fell from U.S. $0.66 at 1960 to about U.S. $0.50 in 1963. These fields would have probably earned less than 20 per cent on any capital invested in them during the period 1964 to 1968. This partly explains why both B.P. and Shell began cutting back on investment in production in the early sixties; and why Shell sought to treat its operations in Trinidad as if they were entirely service refining.

In general the industry earned more than 32 per cent on its investments during the first half of 1960-1970, and at least 32 per cent in the second half of that decade. These conclusions are further supported by the fact that Shell increased distillation capacity in 1968 and 1969 by 20,000 barrels per day at a negligible capital investment[1] which probably resulted in a per barrel saving to the company of U.S. $0.10; that is, it probably costs Shell 15 cents to produce the incremental daily barrel of product from the

[1]See page 188.

new capacity installed in 1968 and 1969. Moreover, the accounting study done by Peat, Marwick and Mitchell in 1970 showed operating margins[1] as 35.5 per cent for Texaco, 30.5 per cent for Shell Trinidad, and 35.4 per cent for Trinidad Tesoro (Appendix 6-D-1). These measures of operating margins are not strictly comparable with the concept of returns to capital used in the analysis above. However, they are good indicators of profitability. All the estimates above seem to strongly support earlier evidence disproving the oil companies' claim throughout the period 1956-1970 that they were not "making money".

The profitability of the Trinidad oil industry after 1970 has been greatly enhanced by the discovery of new oil fields in Trinidad and by the monopolistic increase in prices by OPEC in the world crude markets and the multinationals in the consumer markets for refined products. Comparisons of incremental cost derived in this chapter with current and projected prices seem to indicate that surplus profits between 1974 and 1976 may have been in the order of U.S. $10-$12 (1974 dollars) per barrel of crude. Since this author argues that prices will remain fixed at current levels or increase somewhat, it is reasonable to suggest that the marine crude producing companies can be expected to continue to enjoy a good return on investments.

The companies have been able to improve their profit position in refining by increasing capacity and upgrading technology between 1956 and 1973. Some idea of the economies of scale that may have

[1]Ratio of earnings before taxes to sales.

accrued to Texaco during the sixties as a result of this expansion and the modernization associated with it is provided by two papers presented to the World Petroleum Congress, 1975.[1] W. F. Brown shows that for a complete grass-roots facility operating on light Arabian crude producing fuel oil by atmospheric residual desulphurization, there could be as much as a 60 per cent saving in capital cost per incremental daily barrel as distillation capacity increases from 50,000 barrels per day to 500,000 barrels per day. This ability of large refineries to turn out products at a lower unit cost than their smaller competitors can, theoretically, exist up to capacity levels of 500,000 barrels per day. Brown's analysis shows that the return on investment increases from 7.5 per cent for a 50,000 barrels per day refinery upward to 12.5 per cent for a 300,000 barrels per day refinery and virtually levels out thereafter.[2] Brown argues, therefore, that the optimum size plant may with present technology be 250,000 to 300,000 barrels per day. According to this argument Texaco would not gain any further advantage from expanding beyond its present capacity, but it also strongly suggests that Texaco may have profited substantially from the economies of large scale associated with its growth in the last two decades. Prices fell between 1957 and 1970 but so did the cost of refining in Trinidad for both Shell and Texaco.

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[1] "Aspects of Refining," The Petroleum Economist, July 1975, pp. 259-261. A report on the findings of two papers presented to the World Petroleum Congress (Tokyo): W. F. Brown, "Economies of Scale in Refining, Storage and Distribution;" J. G. Mills and J. A. Benn, "Refinery Design and Operation in the Seventies."

[2] The Petroleum Economist, July 1975, p. 259.

While the general conclusion that the Trinidad oil industry has been and continues to be profitable is interesting, it does not tell much about the benefits accruing to the country. As stated earlier this depends on the power of the government to maximize its share of any surpluses earned in the industry; and the way it uses these net cash benefits to transform the economy. Chapter 7 will examine the relative strengths and weaknesses of Trinidad and the oil companies, and Chapter 8 will assess whether government is maximizing net benefits in terms of its relative strength and in the context of some economic strategy for development.

CHAPTER 7

BARGAINING STRENGTH OF COMPANIES AND THE TRINIDAD GOVERNMENT

What are the strengths and weaknesses of the Trinidad government relative to the oil companies, and by extension what is its capacity to exert power in its bargaining with the multinationals over the distribution of the benefits derived from the country's hydrocarbon resources? How effectively has the government used its power in dealing with the oil companies? The first question has been partly dealt with in Chapter 6 in terms of the profitability of oil in Trinidad; for the opportunity to make profits in oil enhances the attractiveness of Trinidad as a host country and its bargaining power. There are, however, other factors which are important in determining the relative bargaining strength of Trinidad. This chapter will examine these factors and make an overall assessment of the government's power before going on to deal with how effectively it uses its power to maximize its share of the total net benefits accruing from the industry.

Trinidad is strategically located in terms of its export refining operations, and its potential as an exporter of natural gas. It enjoys the advantage of being close to major sources of crude oil and at the same time near to the large U.S. energy markets.

In this respect its significant deposits of high quality marine crudes and major deposits of natural gas make it very attractive to the oil companies.

If, as many believe, long-run tanker rates decline, this will no doubt reduce the competitive advantage in transportation that this proximity gives Trinidad over other refiners.[1] However, with respect to its Caribbean sister islands, Trinidad will continue to be preferred as a refining centre because of its hydrocarbons. For the opportunity cost of not locating in Trinidad is much greater than that for Jamaica, Barbados, and other islands where there are no known hydrocarbon deposits.

The presence of natural gas in Trinidad provides a greater opportunity for horizontal and vertical integration. A company can, therefore, hedge against market uncertainties more easily or take greater advantage of the opportunities for making profits. Moreover, because of the existence of a well established oil industry in Trinidad there are external economies of scale which accrue there that are not available in areas which do not have an established oil industry. For instance, it required less capital per barrel for Texaco and Shell to expand existing capacity in Trinidad rather than build new facilities in an area where there is no refining or oil industry. Some idea of the savings in capital costs is suggested

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[1] The total reduction in transportation cost between the Middle East and East Coast U.S. is estimated by J. C. Carver to be about 50-60 per cent. See J. C. Carver, "Petroleum Transportation Economics - Mammoth Tankers, Deep Water Ports and the Environment," (Exxon Corporation, New York, paper presented to a New York symposium, May 28, 1972).

by Brown's study on economies of scale in refining. It would seem that for a 50,000 and 300,000 barrel per day grass-roots refinery (atmospheric desulphurization) built in an area where no refining industry exists, the incremental capital cost per daily barrel is $1.15 and 65 cents respectively; whereas in the case of expansion of existing facilities it is 43 cents per barrel for an additional 50,000 barrels per day, 36 cents for an additional 100,000 barrels per day, and 31 cents for an additional 200,000 barrels per day.[1]

In addition to these economies of scale, companies locating in Trinidad benefit from external economies associated with a good public roads system, adequate supplies of electricity, and other public utilities. For instance, Texaco was able to save on the capital cost of building a hydrogen unit to feed its desulphurization plant by purchasing hydrogen from Federation Chemical.[2] Trinidad also offers an investment environment that is relatively free of the kind of social and political risks that have plagued the oil companies for the last two decades in the Middle East and Venezuela. In these countries the tax take per barrel of crude is very high (about 80 per cent of unit price) and the companies have lost control over profits in production. By contrast, in Trinidad the tax take per barrel is considerably less and the companies still have considerable guarantees that their assets will not be nationalized.

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[1]The Petroleum Economist, July 1975. The lower capital costs are derived by omitting certain offsite capital costs and the cost of other facilities that would have been built when the main plant was constructed.

[2]Federation Chemical modified its existing plant to provide the required demand.

The question is whether Trinidad is not giving up too much of the value of its assets in order to attract companies to invest in finding and taking oil out of the ground. This will be deferred until Chapter 8, after the following discussion of the strategic importance of Trinidad's hydrocarbons to the individual oil companies.

Strategic Importance of Trinidad's Hydrocarbons to Individual Oil Companies

In a world-wide context Trinidad must at present be considered a high cost producer of crude oil. This pertains mainly to crude output from inland fields where cost per incremental daily barrel is about three times cost in Venezuela, eleven times cost in the Persian Gulf, and seven times that of African producers (Table 7.1). In the near future almost all of Trinidad's crudes will come from marine areas.[1] By 1985 cost of producing marine crudes will be substantially less than cost on land. The incremental cost of producing a barrel from marine wells in water less than 400 feet will be about U.S. $1.00. This compares favourably with expected cost in the U.S.A. of U.S. $6.00 per barrel.[2] However, after 1985 as drilling moves into water depths greater than 400 feet cost will rise sharply upward to about U.S. $5.00 per barrel. Since an increasing amount of the world's future demand

[1] At present 80 per cent of all oil produced comes from marine areas. Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Monthly Bulletin, January 1977, p. 1.

[2] NPC., U.S. Energy Outlook, p. 63.

TABLE 7.1

COMPARISONS OF DEVELOPMENT AND OPERATING COST AND LONG-RUN SUPPLY PRICE

FOR TRINIDAD, U.S.A., VENEZUELA, THE MIDDLE EAST AND AFRICA

(U.S. $)

		COST PER BARREL					
	Development investment per daily barrel (1)	Development (2)	Operating including pipelines (3)	Total (4)	Operating plus development mid-80s (5)	Freight advantage over Persian Gulf (6)	Long-run supply price 1970-1985 (7)
United States 1960-63	2,280	1.048	.168*	1.22	-	-	-
Trinidad and Tobago 1964-68	1,000	.74	.40	1.14	1.75**	-	1.00
Venezuela 1966-68	417	.351	.101	.462	-	.42	.64
Africa:							
Libya 1966-68	129	.074	.085	.159	-	.34	.54
Algeria 1966-68	293	.180	.100	.280	-	.37	.57
Nigeria 1965-68	165	.094	.070*	.164	-	.26	.46
Persian Gulf:							
Iran Consortium 1963-69	90	.047	.050	.097	.14	-	.20
Iraq 1966-68	47	.025	.045*	.070	.12	-	.20
Kuwait 1966-68	114	.060	.045	.105	.20	-	.20
Saudi Arabia 1966-68	78	.041	.045	.086	.18	-	.20

Sources: Tables 6.4 and 6.7.

M.A. Adelman, The World Petroleum Market (Baltimore: The Johns Hopkins University Press, 1972), p. 76.

*Excludes pipelines.

**Based on estimated cost of east coast concessions. The assumption is that the long-run incremental barrel will have to come from the east coast (possibly the north coast): mid-point of range U.S. $1.20 - U.S. $2.19 - see text.

for hydrocarbons will have to be supplied from high cost marine and more hostile and less accessible territories, Trinidad's comparative cost position will improve considerably as the 1990's approach, and with this its attractiveness.

In a small host country like Trinidad one can reach misleading conclusions by conducting an analysis entirely in such aggregate terms: too much information is lost. At the level of the company the picture may change considerably; for while aggregate industry cost in Trinidad may be high relative to cost elsewhere, for an individual company cost of production from certain fields may be much lower than for the industry, and very competitive in a global context. As shown earlier, some companies in Trinidad earned differential rents in the late fifties and the sixties while others earned no rents. This was primarily dependent on the distribution of rich and poor reservoirs between companies. To the extent, therefore, that the dependency of a company is related to the share of the present value of its total earnings contributed by its operations in Trinidad, it is imperative that one examines the strategic importance of its Trinidad resources within that company's global system of operations. The following sections examine the strengths and weaknesses of the individual companies operating in Trinidad relative to those of the government.

<u>The "majors": Shell Trinidad</u>. Table 7.2 shows the relationship between production and the refining function for the Shell group on a world-wide basis for the period 1969-1973. Shell

TABLE 7.2

SHELL GROUP REFINERY THROUGHPUT, GROSS CRUDE OIL PRODUCTION AND OFFTAKE UNDER SPECIAL ARRANGEMENTS 1969-1973

(000 b/d)

	1969	1970	1971	1972	1973
U.S.A.	626	688	731	739	732
Canada	72	78	79	93	94
North America	698	766	810	832	826
Rest of Western Hemisphere	1,049	1,094	1,062	946	948
(Trinidad)	(32)	(30)	(30)	(25)	(24)
Europe	19	18	17	27	39
Africa	413	558	708	776	779
Middle East	1,397	1,527	1,562	1,567	1,684
Far East and Australia	147	169	212	289	332
TOTAL PRODUCTION	3,723	4,132	4,371	4,437	4,608
Purchases under special supply contracts	964	937	936	912	843
TOTAL CRUDE SUPPLY	4,627	5,069	5,307	5,349	5,451
Refinery throughput	4,638	5,042	5,022	5,139	5,554
Shell Trinidad refinery throughput		(80)		(68)	(66)

Sources: Standard and Poor, May 31, 1974.

Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Monthly Bulletin, 1969, 1970, 1971, 1972, 1973.

Trinidad's crude production and refinery output was never an important part of the group's total world-wide production. In 1973 the Shell group produced 4.6 million barrels of crude per day and purchased under special supply contracts 0.8 million barrels per day. By contrast Shell Trinidad produced a mere 24,000 barrels of crude per day, or one-half of one per cent of the group's world-wide production in 1973. Shell Trinidad's refinery throughput was 66,000 barrels per day, or 1.8 per cent of the group's world-wide refinery throughput. However, in terms of Shell International's western market commitments outside of the U.S.A.[1] output of crude from its Trinidad operations during the period 1956 to 1965 was significant. In fact it was not until 1967 that rising cost of production in Trinidad relative to Venezuela and Nigeria caused the company to start systematically phasing out production, and transforming its refinery from a resource to a service base refinery operation. Shell International's decision in 1970 to expand and modernize its refinery in Trinidad using Venezuelan and Nigerian crudes in part reflects the importance of Shell Trinidad's refining operation in the parent company's western supply system, as well as its need to remain competitive in the U.S. East Coast market. Shell's operations in Trinidad remained a defensive market strategy, so that Shell International's investment decision in 1970 may have been based more on the expectations that total additional revenues would be sufficient to cover total cost rather than that of price equal to or greater than incremental cost.

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[1]The company had market obligations in the Caribbean amounting to 19,000 barrels per day.

In any case the company made profits and (as Trintoc) continues to do so. In December 1975 the Minister of Petroleum and Mines announced that after thirteen months of operation as a state owned enterprise Trintoc (formerly Shell) made a net profit of T.T. $32.7 million and paid taxes of T.T. $123.8 million. The taxes paid in that brief period exceeded the T.T. $96 million the government paid to acquire all the assets in 1974. The ongoing profitability of the enterprise underlines the sincerity of Shell's declaration on being faced with nationalization that it was not a willing seller and that it wished to remain in business in Trinidad and Tobago.[1]

However, it would seem that Shell was prepared to stay in Trinidad only if it was permitted to run down its assets in production and limit its refining operations to the size of its markets in the Western Hemisphere. Looking at it from the global perspective of Shell International one could easily justify this policy as a defensive market strategy; but the government considered Shell Trinidad's rationalization of its operations to meet the global requirements of the parent group inconsistent with the social and broader economic role the government defined for it: an expansive operation. The government in justifying its acquisition of Shell Trinidad Limited stated clearly that it was "not an isolated and ad hoc example of government participation in industry in Trinidad and Tobago but within the context of clearly stated government policy"[2]

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[1]Government of Trinidad and Tobago, House of Representatives, <u>The Purchase of Shell Trinidad Limited</u>, Release 526, September 30, 1974, p. 5.

[2]<u>Ibid.</u>, p. 2.

to diversify the economy of the country and use the oil industry as the dynamic sector for generating growth and financing this diversification. It pointed out that the company's performance was poor compared with "developments in the industry elsewhere in Trinidad by the other companies where every effort was made to increase production, to maintain the producing facilities in good order and, above all, to maintain and if possible to increase employment levels."[1]

Texaco Trinidad. Unlike Shell Trinidad, Texaco Trinidad Inc. plays a major role in Texaco International's world-wide operations. Its operations in Trinidad cannot be easily replaced without a major and very costly reorganization of the company's Western Hemisphere marketing strategy. Moreover, Texaco Trinidad's crude output is by no means insignificant when compared with the output of affiliates of the International company in other countries. For instance, Texaco Trinidad's share (Table 7.3) of Texaco's world-wide crude production was 5.6 per cent in 1966 and 2.4 per cent in 1971, compared with 2.7 per cent in Colombia, 5.8 per cent in Venezuela, and 5.5 per cent in Africa. Texaco's major oil reserves are located in Saudi Arabia (which accounted for 54 per cent of its output in 1971), Iran, Indonesia, Venezuela and Libya, but it depends on output from many smaller concession areas (Table 7.3) to maintain its output levels and the geographic dispersion it needs to minimize its risks and offset tax burdens: the government's overpricing of crude in Venezuela is generally counteracted by increased output in the

[1] Ibid., p. 4.

TABLE 7.3

TEXACO INCORPORATED WORLD-WIDE GROSS PRODUCTION OF

CRUDE OIL AND NATURAL GAS LIQUIDS*

1966-1971

	1966	1967	1968	1969	1970	1971
Trinidad	5.6	6.1	5.6	4.0	3.1	2.4
Colombia	3.1	2.7	2.2	3.1	3.1	2.7
Venezuela	15.7	12.7	11.0	9.5	7.8	5.8
Middle East	61.2	62.4	60.8	57.3	59.4	66.8
Saudi Arabia	50.3	51.0	50.0	46.7	47.7	54.4
Iran	8.7	9.3	8.8	8.7	9.6	10.4
Bahrain	2.2	2.1	2.0	1.9	1.7	1.5
Dubai	-	-	-	-	0.4	0.5
Indonesia	10.7	10.0	11.5	14.8	16.9	14.7
Africa	2.9	3.9	6.5	9.1	7.5	5.5
Libya	2.9	3.9	6.5	9.1	7.4	5.3
Nigeria	-	-	-	-	0.05	0.2
Germany	0.9	1.9	1.8	1.7	1.6	1.5
Australia	-	0.2	0.4	0.5	0.6	0.5
Other	-	0.06	0.05	0.1	0.05	-
Total world (excluding North America and Communist countries)	100.0	100.0	100.0	100.0	100.0	100.0

Source: Appendix 7-A, Table 7-A-1.

*Including liftings in Saudi Arabia and Indonesia and equity in other non-subsidiary companies: note also units expressed in percentages.

Middle East, Africa, Indonesia, Colombia, and Trinidad (Table 7-A-1). Trinidad is, therefore, a very important producing area in the Texaco scheme of things. It is, however, at the refining and marketing end of its operations that the importance of Texaco Trinidad becomes most obvious. In 1970 (Table 6-D-1) the operating margin percentage of sales was 10.6 per cent on marketing, and 27.6 per cent at the refining level of activities as compared with 15.4 per cent for production. The refinery complex processed 17.3 per cent of the company's world-wide crude oil runs to still in 1966 and 11.5 per cent in 1971. It was exceeded only by the U.S.A. with 40.6 per cent in 1966 and 34.5 per cent in 1971. With a huge capacity of 400,000 barrels per day Texaco Trinidad accounted for 16.3 per cent of Texaco International's equity in world-wide refining capacity at 1968 and 15.4 per cent at 1969 (Table 7.4). Its importance, measured as a percentage share of refinery throughput declined relative to that of affiliates in Europe and the Far East, whose respective shares increased from 12.9 per cent to 22.3 per cent between 1966 and 1971, and 7.4 per cent to 12.5 per cent (Table 7.5). If one drops the U.S.A. and Canada from the analysis and considers Texaco as a supplier of refined products to the world market (see Table 7.6), the importance of Trinidad becomes clearer. In 1966 crude runs to the Trinidad refinery were 32.4 per cent of total runs to refineries serving the "world market". This declined to 19 per cent in 1971 while its Western European refineries increased from 24 per cent in 1966 to 36.9 per cent in 1971 and the Far East from 13.7 per cent to 20.7 per cent. But no single country outside North America surpassed the

TABLE 7.4

TEXACO INTERNATIONAL EQUITY IN WORLD-WIDE

REFINING CAPACITY BY AREAS

1968, 1969

Country	Number of refineries	Rated capacity 000 b/d	Average rated capacity per refinery 000 b/d	Total capacity percentage*
U.S.A.	12	925	77.1	37.7
Trinidad	1	400	400.0	16.3
Other Western Hemisphere	12	168	14.0	6.8
Eastern Hemisphere	38	961	25.3	39.2
Totals 1968	63	2,454	39.0	100.0
Totals 1969		2,600		

Source: Texaco Star, August 29, 1969.

*Share of world capacity, 1968.

TABLE 7.5

TEXACO INCORPORATED WORLD-WIDE REFINERY RUNS

CRUDE, NATURAL GAS LIQUIDS, DISTILLATES*, 1966-1971

(Per cent)

	1966	1967	1968	1969	1970	1971
U.S.A.	40.6	39.9	37.9	36.3	34.9	34.5
Canada	5.8	5.8	5.6	5.3	5.1	5.0
North America	46.4	45.7	43.5	41.6	40.0	39.5
Trinidad	17.3	15.1	15.0	13.8	13.0	11.5
Latin America	3.4	3.2	2.9	2.4	2.9	3.5
West Germany	2.0	6.0	6.7	6.6	6.2	6.3
United Kingdom	5.2	4.6	5.1	4.8	4.6	4.8
Other Western Europe	5.7	4.5	6.2	10.1	10.5	11.2
Africa	0.6	1.0	1.0	1.0	0.9	1.1
Middle East	12.0	12.1	11.5	11.2	9.8	9.4
Far East	7.4	7.6	7.9	8.4	11.9	12.5
Other **	-	-	0.1	0.1	0.1	0.2
Total world-wide	100.0	100.0	100.0	100.0	100.0	100.0

Source: Appendix 7-B, Table 7-B-1.

*Including interest in non-subsidiary companies.

**Unclassified.

TABLE 7.6

TEXACO INCORPORATED WORLD REFINERY RUNS

PERCENTAGE DISTRIBUTION, 1966-1971

	1966	1967	1968	1969	1970	1971
Trinidad	32.4	27.9	26.6	23.6	21.7	19.0
Latin America	6.4	6.0	5.1	4.1	4.8	5.8
West Germany	3.8	11.1	11.9	11.4	10.4	10.4
United Kingdom	9.6	8.5	9.1	8.3	7.6	8.0
Other Western Europe	10.6	8.4	11.0	17.3	17.5	18.5
Africa	1.1	1.8	1.8	1.7	1.5	1.8
Middle East	22.3	22.3	20.3	19.1	16.3	15.5
Far East	13.7	13.9	14.0	14.4	19.9	20.7
Other	-	-	0.2	0.2	0.2	0.3
Total world (excluding North American and Communist countries)	100.0	100.0	100.0	100.0	100.0	100.0

Source: Appendix 7-B, Table 7-B-1.

Texaco Trinidad's performance (Table 7.6).

In spite of the rapid expansion in Europe and the Far East Texaco Trinidad still retains its importance as the largest single refinery complex in the Texaco International world-wide refining operations outside the U.S.A. The average rated capacity for its refinery in Trinidad at 1968 was 400,000 barrels per day as compared with 39,000 barrels per refinery per day for its world-wide operations (Table 7.4). In the Western Hemisphere, for instance, its daily crude capacity was rated at 361,000 barrels per day at 1973, with a catalytic cracking capacity of 28,000 barrels daily and a reforming capacity of 24,000 barrels. This performance is surpassed only by Texaco's Port Arthur (Texas) refinery complex with a crude capacity of 400,000 barrels a day, a cracking capacity of 135,000 barrels daily and a reforming capacity of 60,000 per day.[1] Texaco Trinidad's desulphurization plant keeps Texaco Trinidad's refined products competitive in the U.S. East Coast markets. Texaco Trinidad's operation is so important in the total Texaco complex that Port-of-Spain is considered the company's "largest single marine terminal world-wide".[2] Texaco Trinidad represents by world standards a huge financial investment which can not, in the Texaco International market situation, be easily replaced by an operation elsewhere.

The prospects for vertical and horizontal expansion using natural gas and marine petroleum feedstocks are good for Texaco

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[1] Standard and Poor, April to May 1974, vol. 35, no. 15, May 31, 1974, p. 9653.

[2] Statement by Mr. Tom Wilson, President of Texaco Trinidad Limited, Trinidad Guardian, March 15, 1970.

Trinidad. The company has recently been granted new offshore concessions representing about one million acres of marine territory in the East Coast Continental Shelf area, the Columbus Channel to the south of the island and the Gulf of Paria (see Figure 4.2). This comes at a time when Texaco's international concessions in other parts of the world are being nationalized and its land reserves in Trinidad are in rapid decline. The company and the government of Trinidad have entered into joint-venture petrochemical projects based on natural gas feedstock to be transported by the government pipeline to the Point Lisas industrial site. As compared to Shell Trinidad and B.P. Trinidad, Texaco represents an expansive operation in Trinidad and as such its contributions are considerable. But it also would stand to lose much were it not to be able to operate in Trinidad; and this gives the government considerable bargaining leverage.

<u>The "independents": Trinidad-Tesoro</u>. Trinidad-Tesoro Petroleum Company Limited by acquiring all the oil and gas producing properties of the B.P. group in 1969 brought to an end a production operation which was at that time even more marginal to B.P. International than Shell Trinidad was to Shell International. B.P. Trinidad could not even be described as a defensive strategy given B.P. International's world market situation. It was a mere vestige of the colonial past. Some Trinidad economists argued that the government should have nationalized B.P. Instead the government chose to set up a joint-venture operation with Tesoro Petroleum Corporation of the U.S.A.

Tesoro Petroleum Corporation is a very small integrated international company. Up until 1969 it was short on crude and long on products. At June 30, 1972 the company held refinery equity rated at 43,000 barrels per day. Of this amount 30,000 is located in Alaska. At 1968 total crude production was 3.4 thousand barrels per day; after the joint purchase of B.P. assets (July 1969) its oil and gas production increased to 25.4 thousand barrels per day at 1970 and 25.6 thousand barrels at 1971, thus closing the gap between its production and refining activities (Table 7.7). The coming on stream of its Alaskan refinery opened up the gap again in 1973 but the contribution of Tesoro's concessions in Trinidad is not diminished.

The impact of the joint venture on Tesoro Petroleum's total net earnings is substantial. The net income for Tesoro Petroleum Corporation Limited increased from $1,677,000 in 1968 prior to the purchase of B.P. to $4,697,000 after the acquisition of these assets. In the fiscal year 1973 Trinidad-Tesoro produced 39,811 barrels of crude oil daily and 30,502 MCF of natural gas daily: 49.9 per cent of this belonged to Tesoro Petroleum Corporation and 50.1 per cent to the Trinidad government. The increase in Tesoro Petroleum Corporation's oil and gas production after 1968 (Table 7.7) is, therefore, entirely due to the acquisition of the B.P. assets in Trinidad and the output of its concessions on the East Coast Continental Shelf of Trinidad (i.e. off Point Galeota). Revenues from oil and gas sales for Trinidad-Tesoro were U.S. $41.5 million and net earnings were U.S. $12.5 million. When net earnings in Trinidad at December 31, 1973 are compared with net earnings of $19.9 million on the consolidated

TABLE 7.7

PRODUCTION AND REFINING STATISTICS

TESORO PETROLEUM CORPORATION, 1967-1973

(Average daily barrels)

	Oil and gas production	Refinery through-put	Crude oil gathered	Estimated crude oil output Trinidad interest
1967	3,227	10,377	21,187	-
1968	3,373	10,220	32,545	-
1969	9,146*	12,850	33,510	n/a
1970	25,435*	23,710**	34,167	21,190
1971	25,609*	30,908**	36,709	20,233
1972	25,624*	36,803**	40,610	19,686
1973	28,398*	43,119**	66,500	19,823

Sources: Standard and Poor, March 30, 1973; May 31, 1973.

Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Monthly Bulletin, 1970-1973.

*Includes interest in Trinidad-Tesoro Petroleum Corporation.

**Includes Tesoro-Alaskan Petroleum Corporation during start up.

earnings statement for the international company for the same period it becomes quite obvious that the major contribution to earnings in 1973 was from the Trinidad operations.[1]

In a real sense the weak, small Tesoro Petroleum Corporation is the "dwarf" in the relationship with the Trinidad government. But Tesoro Petroleum Corporation benefits from this relationship. It has no doubt been responsible for Tesoro Petroleum Corporation being recently granted mining concessions in Indonesia. Trinidad's presence in this joint venture may also be giving Tesoro Petroleum access to capital that it did not have before. In 1971 the U.S. Import-Export Bank made Trinidad-Tesoro a loan of T.T. $4.1 million and guaranteed an additional T.T. $4.1 million from other sources to finance material imports from the U.S. for (1) drilling operations in the east coast of Trinidad, (2) improvements of oil tanker docking and loading facilities at Point d'Or, (3) a five point mooring system to accommodate tankers up to 70,000 tons, and (4) on shore storage facilities as well as pumping capacity. The total cost of the project was estimated at T.T. $14.4 million. The re-payment of the loan was to begin June 15, 1972 at a rate of 6 per cent on outstanding balances, and was to be completed in ten semi-annual instalments.[2] It seems unlikely that Tesoro Petroleum Corporation, a company whose shares are rated as B in Standard and Poor could on its own collateral negotiate loans on such favourable terms in the world financial market at 1971. The

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[1]The financial data used above were obtained in the <u>Standard and Poor</u>, May 31, 1974, pp. 9979-9980.

[2]<u>The Trinidad Guardian</u>, January 21, 1971. See also <u>The Express</u> (Trinidad), January 22, 1971.

government guaranteed loans for Trinidad-Tesoro averaging T.T. $15 million in the period 1969-1970 and T.T. $23.2 million for 1971-1973.[1] Tesoro Petroleum perhaps enjoys too favourable a position in this joint venture in terms of what it has to offer.

Amoco of Standard Oil (Indiana). Standard Oil Company (Indiana) may not be a "major", but it is a very large and powerful company in the U.S.A. It is fully integrated and conducts operations in forty-nine states and in over thirty foreign countries. In 1972 refined products accounted for 48.3 per cent of sales and operating revenues (including excise taxes), crude oil for 13.6 per cent, natural gas for 5.5 per cent, chemical products and fertilizers for 11.1 per cent, other operating revenues for 21.5 per cent.[2] The overseas operations of Standard Oil (Indiana) are conducted by Amoco International Finance Corporation and Amoco International Oil Company.[3] Amoco International Oil directs exploration, production, refining, transportation and marketing outside North America from its headquarters in Chicago. Since 1967 Standard of Indiana's crude oil production in the U.S.A. (except Texas) has either remained constant or declined (Table 7.8). The company has stepped up its search for oil outside the U.S.A. in the last five years. The major increases in output over the five years 1967-1972 are accounted for by foreign production,

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[1] Government of Trinidad and Tobago, The White Paper No. 2 on Public Sector Participation in Industry, 1975, p. 7.

[2] Standard and Poor, May 31, 1974, p. 3719.

[3] On July 1, 1962 all activities outside North America were consolidated in one major subsidiary.

TABLE 7.8

NET CRUDE OIL PRODUCTION FOR STANDARD OIL (INDIANA) WORLD-WIDE OPERATIONS

1967, 1970, 1971, 1972

(000 b/d)

Countries and states	1967	Percen-tage	1970	Percen-tage	1971	Percen-tage	1972*	Percentage change 1967-1972
U.S.A.								
Texas	218		252		250		279	28
Louisiana	60		71		74		66	10
Oklahoma	24		27		29		24	0
Wyoming	59		58		57		56	- 5
Kansas	13		10		10		10	-25
New Mexico	26		26		23		21	-19
Alaska	-		6)					
Other states	39		16)		26		31	-33
Total U.S.A.	439	(78.8)	466	(62.6)	469	(61.0)	487	11
Canada	41		58		63		78	90
Total North America	480	(86.2)	524	(70.4)	532	(69.2)	565	18

TABLE 7.8 continued

NET CRUDE OIL PRODUCTION FOR STANDARD OIL (INDIANA) WORLD-WIDE OPERATIONS

1967, 1970, 1971, 1972

(000 b/d)

Countries and states	1967	Percentage	1970	Percentage	1971	Percentage	1972*	Percentage change 1967-1972
Foreign operations (Amoco)								
Egypt	16		107		88		66	313
Argentina	-		43		47		51	-
Iran	50		46		62		67	34
Trinidad	-		-		-		25	-
Other foreign	11		24		40		44	300
Total foreign	77	(13.8)	220	(29.6)	237	(30.8)	253	228
Total world-wide	557	(100.0)	744	(100.0)	769	(100.0)	818	47
Crude refinery capacity (excluding Wales, Singapore, India)	995		1,125		1,073		1,125	
Crude production as a percentage of refinery capacity	56.0		66.1		71.7		72.4	

Sources: Moody's Industrial Manual, May 1974.

Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Monthly Bulletin, December 1973.

*Revised

which grew by 228 per cent as compared with 47 per cent for its world-wide operation during the same period (Table 7.8). In 1972 the Trinidad output from the East Coast Continental Shelf was 25,426 barrels per day, that is, 9.9 per cent of Standard of Indiana's total production outside North America. In December 1973 the company's output in Trinidad had climbed to an average for that month of 68,000 barrels per day making the Trinidad Amoco concession a more important crude producer than its oil concession in any single state in the U.S.A. with the exception of Texas. It approximates Amoco's Canadian output and is more important than any of its other foreign production operations. Almost all of the company's foreign operations concentrate on crude oil production for the American market. Of a total world refinery crude capacity of 1,320,000 barrels per day at December 31, 1972, including interests in other companies, only 298,000 represented overseas refinery capacity. That is, 87.5 per cent of its total refinery capacity was located in the U.S. market. The total production of Amoco Trinidad is shipped to the U.S.A. to help close the large imbalance between the production and refining operations of the parent company. Standard of Indiana produced only 72.4 per cent of its refinery throughput in 1972 (Table 7.8).

When one considers that various company officials of Amoco Trinidad[1] and the Minister of Petroleum and Mines,

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[1] Trinidad Guardian, September 29, 1972, speech by President and General Manager of Amoco Trinidad, Mr. Orville D. Gaither, to South Trinidad Chamber of Industry and Commerce. He gave an estimated output by the end of 1974 of 140,000 barrels per day.

Mr. O. Padmore,[1] have issued news releases indicating that Amoco Trinidad's east coast fields have a potential productive capacity of 150,000 to 200,000 barrels per day,[2] the importance of these fields to the lagging production of Standard Oil (Indiana) is dramatic. Even more important, the crude from Amoco Trinidad's offshore oil fields is of very high quality. It has an API range of 35°-45° and a sulphur content of less than one per cent.

Since gasolene and the middle distillates constitute 73.3 per cent of Standard Indiana's product sales (Table 7.9) and since 85 per cent of these sales are in the U.S.A. where pollution legislation is most stringent (especially on the East Coast), the quality of the oil from Trinidad going to Amoco refineries in the U.S. East Coast gives the company a strategic and competitive advantage over other companies in a world oil situation where "sweet" crudes are very scarce. Most of the Trinidad crude from Amoco's offshore deposits go to its Virginia refineries (PAD I District) serving the East Coast product market. In December 1973 Amoco Trinidad's production of crude was 67,000 barrels daily, enough to supply the parent company's refinery capacity in the PAD I District (see Table 7.10), and by 1976 it had almost doubled its 1973 output.[3]

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[1] Express (Trinidad), Friday, September 12, 1972, an address by the Minister of Petroleum and Mines, Mr. Overand Padmore, to Latin American and West Indian ministers in Caracas. The Minister announced a potential output of 200,000 barrels per day.

[2] See also Persad and Chapter 4 of text, pp. 77-79.

[3] For the first two quarters of 1976 its average daily output was 125,000 barrels.

TABLE 7.9

STANDARD OIL OF INDIANA MARKETING OPERATIONS 1972

Products	Output (000 b/d)	Share of total percentages
Gasolene (including natural)	546	44.5
Home heating oils, kerosene, diesel oils	353	28.8
Residual fuel oils	109	8.9
Other products	218	17.8
	1,226	100.0

Source: Moody's Industrial Manual, 1974, p. 2952.

TABLE 7.10

STANDARD OIL OF INDIANA REFINERY CRUDE CAPACITY

AT DECEMBER 31, 1972 BY PAD DISTRICTS

United States	Crude capacity (000 b/d)	Percentages
PAD I	69	6.8
PAD II	455	44.5
PAD III	320	31.3
PAD IV	178	17.4
PAD V	-	-
Total	1,022	100.0

Source: Moody's Industrial Manual, May 1974, p. 2950.

Perhaps even more important to Amoco than the oil fields are the large quantities of natural gas that it has found on the Trinidad east coast. Given the scarcity of natural gas in the U.S.A. and the expected increases in its price, it will be economically feasible to ship liquified natural gas from Trinidad to U.S. markets. In February 1972, therefore, Standard Oil (Indiana) completed an agreement with People's Gas Company which provides for the liquifaction and delivery of over 3.5 trillion cubic feet of offshore Trinidad natural gas to U.S. markets over twenty years, beginning in 1977. The agreement is subject to approval by Trinidad and U.S. government regulatory agencies.[1] The Trinidad government has recently declared that priority will be given to its use for the development of the country's industrial potential.[2]

One can now summarize the importance of Trinidad to the oil companies operating in its boundaries and in so doing assess the bargaining power of the country against these companies. One measure of this importance is the ease with which a company can shut down its operations or have its assets in Trinidad nationalized without serious inconvenience to its world-wide operations. Texaco Trinidad's operations are very complex and large relative to Texaco's world-wide operations and, therefore, cannot be replaced easily. Texaco Trinidad

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[1] Standard and Poor, May 31, 1974, p. 3720.

[2] Trinidad and Tobago News, Office of the High Commissioner of Trinidad and Tobago, Ottawa, June 1974, pp. 4-5. An interview with Prime Minister, Dr. Eric Williams.

is central to Texaco International's operations in the Western Hemisphere. As such Texaco Trinidad is likely to absorb pressure from the host government to act more in keeping with the interests of Trinidad's development plans as opposed to Texaco's global strategies elsewhere. But apart from this the opportunity for expansion of its petrochemical operations based on the large natural gas resources in the country would constitute a significant opportunity cost to the company in terms of profits foregone. Amoco Trinidad offers Standard Oil of Indiana bright prospects for long-run supplies of gas and oil to bolster its lagging production in the U.S.A. It cannot, given its imbalance between refinery capacity and crude output, afford to lose its Trinidad concessions, at least not without weakening its long-run growth prospects. Shell Trinidad, like B.P. Trinidad, was a marginal operation in the parent company's world-wide operations. It can meet its U.S. market demand for low sulphur fuels from Curaçao and Venezuela. The acquisition of Shell Trinidad, therefore, inflicted only minor hardships on Shell International's operations. It may be argued that it was in the long-run interest of the country for the government of Trinidad to purchase Shell Trinidad's assets; for the government can use these assets, as it did in the case of B.P., to learn more about the industry, strengthen its bargaining position and extend its influence into the country's oil economy. The acquisition of Shell's 100,000 barrels per day refinery makes Trinidad's national company an integrated operation and gives the government the second largest share of crude output in the country.

The discussion above highlighted the strengths of the Trinidad government and the weaknesses of the oil companies. Knowledge of these were pertinent to the formulation of government strategies in its bargaining with the oil companies over the distribution of rents earned in the industry (i.e., the application of its petroleum legislation), conservation and control of the country's hydrocarbon resources, the social obligations of the companies, and the role they should play in the structural transformation of the economy.

The companies' weaknesses were partly offset during the Second Five-Year Plan by the continued dependency of the economy on the petroleum sector. The government over the Second Five-Year Plan had limited success in bringing about a diversification of the economy through its programme of pioneer aid.[1] The share of the manufacturing sector in GDP grew relative to that of petroleum (Table 4.25): its value added to GDP grew at an average rate of 13 per cent per annum. Over the period of the Plan seventy-four pioneer and one hundred and eighty assisted plants were established with an investment of $178 million and a creation of 7,960 jobs.[2] However, although reasonable increases in output were achieved in textiles and garments, in industries assembling motor vehicles and household appliances, and in food processing, a substantial part of

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[1] Tax concessions and other incentives to new industries.

[2] The Third Five-Year Plan 1969-1973, p. 13.

this was due to the rapid expansion of production and exports of petrochemicals (Texaco Trinidad).[1] In general the policy of development through aid to pioneer industries failed to achieve a significant reduction in the level of unemployment (14 per cent of the labour force). Moreover, its direct stimulation of local industry was small, tax payments were very little, and outflow of profits, dividends and interest, relatively large.[2]

Declining national oil reserves, the overall stagnation of the economy and the general pervasive lack of technical and administrative knowledge about the oil industry caused the government to choose a conservative option with respect to the ownership of B.P. assets in Trinidad, i.e.,a joint venture as opposed to a fully owned government company. It also put Texaco at the beginning of the Third Five-Year Plan (1969-1973) in a relatively strong bargaining position. Texaco has access to U.S. and other markets for special products and fuel oils, it has access to ample supplies of crude oil, and of course, technology. The country could not afford to risk losing whatever benefits it derived from these assets. The government's continued cautiousness in dealing with Texaco reflects this. It nationalized Shell Trinidad Limited (1974), which had nothing to offer that the government with its greatly improved knowledge of petroleum affairs could not itself maintain; but it was only prepared at 1975 to

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[1] Ibid.

[2] Ibid.

propose a major participation in Texaco's operations,[1] for Texaco has much to offer and therefore much to withhold. In much the same way Trinidad's dependence on Amoco for the development of the east coast oil and gas reserves is very great. The country neither possesses the skills in marine drilling nor the capital necessary to undertake the risky venture of exploration in its offshore territories. The initial geological uncertainties are now reduced and Amoco's bargaining strength somewhat diminished. Amoco's dependence on these resources means that it has much to lose; but the government is still very dependent on Amoco's technology, and the vastly increased flow of funds from the export of crudes from these concessions to finance its multibillion-dollar development programmes.

One may conclude that geography, the existence of an established oil industry, and the government's commitment to the free enterprise market system and a parliamentary democracy together make Trinidad attractive to foreign oil companies seeking to avoid control by OPEC. Its attractiveness is further enhanced by the prospect of new discoveries of hydrocarbon resources. The great

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[1]The government has acquired all the service stations of Texaco Trinidad Limited for T.T. $20 million. The purchase date will take effect from April 11, 1975. The National Petroleum Company (NP) will provide an "intoplane" service at Piarco Airport on all the International Aviation contracts of Texaco (Trinidad) Limited and an "intoship" service on the terms agreed to between Texaco and Trinidad and Tobago Petroleum Marketing Company Limited. NP will enter into agreement with Texaco within two years for developing national brands of lubricants at the oil lube blending plant at Sea Lots, Port-of-Spain. Trinidad and Tobago Newsletter, Office of the High Commissioner for the Republic of Trinidad and Tobago, Ottawa, January 1977, pp.6, 7.

demand for these resources and the high rates of success in finding, when combined with the government's increasing knowledge of the industry, strengthens the country's bargaining position. The next chapter examines Trinidad's petroleum policies from 1956 to the present and assesses the government's effectiveness in maximizing the net benefits from the country's hydrocarbon resources.

CHAPTER 8

GOVERNMENT PETROLEUM POLICY AND RESOURCE BASE DEVELOPMENT

The major objective of the government with respect to the country's hydrocarbon resources is to optimize the flow of net benefits from these resources to its citizens. These net benefits accrue over time and depend on the extent to which growth in this sector generates growth in the rest of the economy. This means that the development of these resources must facilitate increased growth in other sectors of the economy either through backward and forward linkages or through both consumer expenditures from incomes earned in the sector and the current and capital expenditures of government financed by taxation of the industry. The question of how heavily government taxes the industry is, therefore, clearly related to national development strategies, especially in a small open petroleum economy. The share of petroleum output represented by value added and its distribution between wages, salaries, profits, and taxes is an important factor determining the nature and extent of the contribution of the sector to the economy; for, given the weak linkages with other sectors and leakages associated with imports of producer and consumer goods, it is government expenditures which in the small petroleum economy are a prime determinant of the pace and direction of economic change.

For the small open petroleum economy (no less than the large one) emerging from colonialism or a state of dependency on foreign technology and know-how the implementation of petroleum policies must be negotiated with the oil companies and/or their home governments. The nature and outcome of the bargaining process are determined by (1) the geological risks associated with finding oil in the country, (2) the existing level and the rate of increase in the country's technical knowledge of the industry, and (3) the effectiveness of nationalist forces in the country. (1) and (2) account for the conditions favouring a swing in power to the host country, but (3) creates the motive force. This chapter discusses the process leading up to the Trinidad government's implementation of its new petroleum policies in 1970, evaluates those policies and examines the government's use of the country's new petroleum (oil and gas) resources as a strategy for economic transformation as set out in the Second Five-Year Plan, i.e.,"the full utilization of our human and natural resources together with our capital resources so as to yield to the broadest segments of our society such levels of living as are commensurate with modern requirements of human dignity."[1]

As noted in Chapter 1 bargaining involving government and companies is a dynamic process in which each party accepts no more exercise of power against it than is necessary and exercises its power against ~~the~~ other to the maximum feasible. For the extractive

[1]Government of Trinidad and Tobago, Draft Second Five-Year Plan 1964-1968, p. 4.

industries the swing in the balance of power over time generally seems to favour the host countries, although there is nothing inevitable about this. In the previous chapter the analysis of the interdependence between the oil companies and the Trinidad government showed a steady shift in the balance of power towards the government after 1956. In examining that process, this chapter will attempt to determine whether the government has used that power to substantially increase net total benefits to the country within any given period of time, taking into consideration the various constraints operating against the small petroleum economy. Pertinent to this analysis, therefore, is the way in which government makes use of, or creates the opportunity for, exercising power in the interest of the country against the oil companies.

The analysis of the changing relationships between the Trinidad government and the oil companies is not as complex as in the case for oil in Venezuela, Iraq and Saudi Arabia, or copper in Chile, where there were many changes in ruling groups over the length of the process leading to nationalization of the natural resource in question. In Trinidad as there has been only one party in power since 1956 one can examine developments within the framework of a single approach to government and an unchanged economic ideology, i.e., capitalism (state or otherwise). Although the time span under study is characterized by political continuity it is useful to divide it into two periods for purposes of analysis: 1956-1968, which includes the period covering the First and Second Five-Year Plans, and 1969-1973, the period of the Third Five-Year Plan.

An Evaluation of the Government-Company Bargaining Process in Trinidad

From dependency to sovereignty: the initial strategies. Trinidad elected its first national government and named its first cabinet in 1956, with the People's National Movement (PNM) commanding the seat of government under Dr. Eric Williams. This historical fact created the preconditions for the initial stage of the transformation of the oil industry from colonial concessionaire status to one of national participation. The PNM government set about immediately to work toward full internal self-government within a West Indian Federation. By the end of 1961 Trinidad and Tobago had full internal self-government. During the five years between 1956 and 1961 the government was busy with constitutional reform (the restructuring of the old colonial system) and the general remodeling of the economy to meet the needs of the nation in its drive toward full sovereignty.

The new government chose a development strategy that was from the outstart dependent on foreign capital and technology. It made the false assumption that foreign companies could be expected to be good corporate citizens, and that by facilitating the maximizing of the profits of these companies through income tax exemptions and the provision of extensive infrastructural facilities, ipso facto, the utility of the nation would be maximized. The government accepted the Manchester School theory of development (W. Arthur Lewis) and the Westminster two party system of democracy. It solidly committed itself to the "free market system" and became entrenched in the western capitalist market economy. Indeed it is not clear whether it had any viable alternatives given the aggressive predisposition of the U.S.A. and its disregard for the sovereignty of weak countries.

As was inevitable the issue of control and ownership of natural resources came to the forefront. The confrontation centred around the "1941 Agreement" which gave the U.S. a ninety-nine year lease over certain territory in Trinidad for setting up military bases. The PNM government attacked the 1941 Agreement as unacceptable and not binding on the peoples of Trinidad and Tobago since they were not consulted on the matter by the then colonial government in Great Britain. The Prime Minister during the Chaguaramas debate wrote in "The Nation" on March 11, 1960:

> Thus it was left to the PNM to raise the crucial issue of independence - Chaguaramas. Chaguaramas means the reversal of a deal imposed on us by colonialism. Chaguaramas means reversion of our soil and resources. Chaguaramas means vindication of our governmental rights and prerogatives. Chaguaramas means independence in the sphere of foreign policy. Chaguaramas means capital before base. Chaguaramas represents for us an acid choice between the alternatives - an independent nation with a will of its own or a banana republic the satellite of a foreign power. Chaguaramas and Independence go hand in hand; the road to independence leads through Chaguaramas.[1]

The Chaguaramas crisis and the debate that centred around it represents a major confrontation with colonial and other foreign interests on the matter of privileges obtained under the system of colonial rule prior to 1956. The Chaguaramas debate had to do with

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[1]Dr. Eric Williams, Inward Hunger: The Education of a Prime Minister (London: André Deutsch, 1969), p. 224.

the establishment of a new order and a new system of internal and external relationships between the people of Trinidad and foreign interests. But the PNM concern over foreign control of Chaguaramas was tempered by its needs for foreign technology and capital. The government, therefore, for all its "hawkish" projections in the Chaguaramas issue was not prepared to risk an open military or limited violent confrontation with American interests in the island.[1] The compromise agreement reached between the governments of Trinidad and the United States on the Chaguaramas affair was indicative of the model that the PNM would adopt with respect to other American interests. The bargaining model the PNM adopted between 1956 and 1964 with the oil industry can best be described as resembling the strategy of the Shah of Iran in the Iranian experience rather than that of Mosadeq: persuasion became the key element in its policy for dealing with Texaco and Shell.

The new government immediately turned its attention to the oil industry as a source of revenue for financing its planned

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[1]The government finally agreed to allow the Americans to maintain a limited presence in Trinidad in return for specified kinds of aid. Its policy of conciliation and compromise in the Chaguaramas crisis was severely criticized by the more radical elements in the country as a betrayal of the people of Trinidad. The most vocal voices were the Oilfield Workers Trade Union (OWTU) in the person of its leader, George Weekes. Perhaps the most scholarly criticism of the government "compromise" on Chaguaramas is Lloyd Best's article "Chaguaramas to Slavery?" New World, vol. II, no. 1 (Mona, Jamaica: The New World Group Limited, 1965), pp. 43-70.

expenditure on building modern infrastructure.[1] To increase its share of profits substantially government needed more control over the industry. Its initial strategy was to systematically develop the necessary information base and knowledge essential to making decisions about the country's oil resources that were consistent with the best interest of the development of the nation. As early as 1958 Dr. Walter Levy[2] was asked to prepare a report on the Trinidad oil economy making recommendations with respect to government control of the country's oil resources and taxation of the industry. Following that, in November 1960, D. R. Craig, at the request of Dr. Williams, submitted a report to the Trinidad government on "Oil and Gas Conservation in Trinidad".[3] It was largely due to these recommendations, and the ominous signs of an imminent decline in the country's crude oil and natural gas reserves, that in August 1963 the Mostofi Commission was appointed with the mandate to (1) analyse the Trinidad oil industry in the context of the world oil industry, (2) recommend a legal framework that would safeguard the interests of the nation and stimulate growth in the industry, and (3) recommend policy that would stabilize employment in the industry as a whole.

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[1]In the First Five-Year Plan period (1958-1962) local sources financed 92 per cent of public sector outlays (T.T. $18.5 million). This was made possible by the rapid expansion of the petroleum sector and favourable oil prices. Second Five-Year Plan 1964-1968, p. 93.

[2]The Government of Trinidad and Tobago, The Trinidad Oil Economy (Government Printing Office, 1959).

[3]D. R. Craig, Oil and Gas Conservation in Trinidad (Calgary: November 1960), p. 1.

The government inherited a national economy dominated by a domestic oil industry which was an integral part of the world oil market, and almost totally dependent on the managerial skills of Shell and Texaco to produce and market its products in the world consumer oil markets. This fact, plus the total lack of any technical knowledge of the industry in government circles and indeed the absence of a centralized administration to deal with the petroleum industry, certainly suggested to many, but not to all, a strategy of gradualism rather than confrontation. Accordingly, the government embarked on a strategy of collaboration with the multinationals in the oil sector. William Demas (Economic Adviser to the Prime Minister) clearly indicated in discussion with this author in 1965 that while the government felt that it was not in a position to force the oil companies to act, it was obliged either to create a mechanism through which it could attempt to influence their actions, or at least be informed in advance of their investment plans. The government's position was further weakened by the fact that the known recoverable reserves of oil and gas were reported to be rapidly declining.[1] Consequently British Petroleum and Shell had planned drastic retrenchment in mining as a condition of their continued operation in the industry. This had serious social and political implications for the country and the government given its commitment to full employment and structural transformation.[2]

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[1]O. A. Capon.

[2]<u>Second Five-Year Plan 1964-1968</u>, p. 77.

In order to deal with these matters the government took two initiatives. First, it created the Tripartite Committee in 1964 consisting of representatives of government, labour (OWTU), and the oil industry, as an instrument through which it hoped to influence the employment and investment decisions of the oil companies. The committee met several times between 1964 and 1968 but functioned primarily as a forum for communication. Second, it passed the Industrial Stabilization Act in 1965 in the hope of creating an environment favourable to business and labour by stopping arbitrary retrenchment. The Stabilization Act earned the government the unpopularity of unionized labour and angered those who wanted more decisively nationalistic action. The Act simultaneously gave government the limited legal instrument needed to control retrenchment in the oil industry and offered industry the security it wanted against "illegal" strikes.

The policy of persuasion ("quiet diplomacy") produced a relationship between the Trinidad government and the oil companies which from 1965 to 1970 can be described as cordial and friendly. This was generally recognized by the more perceptive critics as an asset, even if "problematic". Lloyd Best writes "... these good relations may help the government to contend more easily with its economic problems while avoiding a policy of radical transformation."[1] The policy worked in a limited way. Texaco continued to invest in the development of its land and south west marine concessions, and to

[1]Best, p. 69. Lloyd Best teaches at the University of the West Indies, Trinidad.

add to the complexity of its refinery operations by expanding into the manufacture of lubricants and petrochemicals. However, the companies bluntly refused to become involved in the diversification or transformation of the Trinidad economy. During the mid and late sixties the government tried to persuade the oil companies to take an active part as good corporate citizens in the structural transformation of the economy as laid down in the Second and Third Five-Year Plans. But the oil companies' response was that oil was their business and that they would best serve the interest of Trinidad if they were left to do what they could do best, i.e. produce, refine, ship and market oil.[1]

Thus the government throughout the period of the First and Second Five-Year Plans was unable to get the oil companies to assume the role of captains of industrial development in Trinidad, or for that matter to make significant changes with respect to their hiring policies which continued the colonial policy of relegating Trinidad nationals to those jobs with the lowest status in terms of the managerial and decision-making process.

The government's initial acceptance of the oil companies' rationale for not identifying more closely with national objectives must partly be attributed to its own (or more particularly the Cabinet's) imperfect understanding of the process of development in the small enclave economy, and the misconception that the interests

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[1]Government of Trinidad and Tobago, Report of the Tripartite Committee on Retrenchment in the Oil Industry, Trinidad and Tobago, July 19, 25, 30, 1968 and August 2, 7, 9, 12, 15, 1968.

of multinational enterprises could be identical with those of the nation, so that the optimization of company profits would be consistent with the optimization of net social benefits.[1] The Trinidad government in the period 1958-1962, using the Arthur Lewis model of economic development as a guide to policy formation, therefore, limited its role to providing infrastructural inputs (cost reducing external economies) and fiscal incentives in the form of tax exemptions and depreciation allowances. Private enterprise was left virtually free to respond to output targets set in the Plan for the various sectors. The government hoped that through a process of "frank and fruitful co-operation" private firms would mold their actions to conform to "the social aspirations and objectives of the government representing the people of the country."[2]

The government's bargaining position was further weakened because under the old colonial regime the British government exploited Trinidad oil resources for its benefit and for that of the British oil companies, not that of the people of Trinidad and Tobago. When the PNM government came to power, therefore, there was no effective legal and administrative mechanism that it could use to control the companies. Instead, there were about fourteen ordinances administered by various civil service departments. In May 1963 the

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[1]The W. A. Lewis theory of economic development through foreign capital implies this. Lewis, "Economic Development with Unlimited Supplies of Labour," in The Economics of Underdevelopment, ed. A. N. Agarwala and S. P. Singh (New York: Oxford University Press, 1963).

[2]Second Five-Year Plan 1964-1968, p. vi.

Petroleum Department was placed under the Ministry of Industry and Commerce and given the responsibility for most of these ordinances; but a comprehensive petroleum policy pertinent to the long-term development of the country's petroleum resources was lacking throughout the first two Plans. Thus, as a vestige of this colonial situation, for the most part the Petroleum Department continued to collect output data which was unsuited for any serious economic, engineering, or geological analysis on the part of the government. In addition to these weaknesses the Petroleum Department lacked the skilled personnel and support staff necessary to manage the national oil resource and supervise the oil industry. The "Craig Report" described the situation as follows:

> The Petroleum Department is currently spending some 75 per cent of its time on royalty and leasing work. A considerable portion of the remaining time is spent on the recording of drilling and production data, the processing of routine drilling work-over and abandonment applications and other administrative tasks. There is virtually no time spent in the evaluation of the geological and engineering problems of the industry, and as a consequence only a qualitative comprehension of the technical problems of the industry prevails.[1]

The report made the general observation that petroleum production methods and conservation practices in Trinidad were maintained at a fairly satisfactory level, but that this occurred while "government's knowledge of the geological and engineering aspect of the oil industry had been minimal, and control of production and conservation practice had been exercised to a limited extent."[2]

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[1]Craig, p. 15.

[2]*Ibid.*, p. 3.

This state of affairs suggests that in the Nash sense of collaborative bargaining[1] the Trinidad government may have been unable to benefit appreciably from the growth in value added in the sector between 1956 and 1961. In the following sections this will be examined in the context of an evaluation of changes in petroleum policy between 1956 and 1976.

Trinidad petroleum legislation 1956-1976. The main elements of petroleum legislation in Trinidad at 1956 represented an extension of colonial policies and the ineptness of the government which lacked any technical knowledge of the oil industry. For instance, the mining leases had few of the safeguards that modern leases include to ensure good management of the resource and protection of the interests of the host country. In particular, a company holding an exploration lease had no obligation to carry out exploration in such concessions, and there was no limit on the number of such leases that a company could hold. Companies holding production leases had no drilling obligations stipulated in their lease nor were there clauses requiring that any part of the leased acreage be relinquished before renewal of the lease. The payments of dead rents, however, created some incentive to yield unpromising acreage. By 1961, however, a rapidly rising nationalism was beginning to challenge the practices of the multinational oil companies in the country.

With self-government (1961) the responsibility for shaping

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[1]See John F. Nash, Jr., "The Bargaining Problem," Econometrica, vol. 18, no. 26 (April 1950), pp. 155-162.

the administrative machinery for controlling the future operations of all oil companies passed on to the people's government. This required time and a systematic plan of action, which the PNM government set itself to accomplish. After 1956, what may seem to be ineptness or, as the Craig Report described it, a "hazardous" and "unusual expression of confidence in the altruism of the oil industry,"[1] may have been merely a reflection of a country in the initial stages of transition from colonialism to nationhood, lacking the managerial and technical skills to effectively monitor the operations of the oil companies and hence vulnerable to exploitation by them. However, the process of change was in motion, and the Craig Report represented one step in that process. The Report recommended a comprehensive consolidation of both the administration of mining legislation relating to exploration, production, and the disposition of oil and gas, and the laws pertaining to government management of the country's oil resources - leasing, taxation and royalties, and conservation.[2] On May 17, 1963 the government of Trinidad and Tobago appointed a Minister of Petroleum and Mines. This marked a major point of departure from pre-colonial practice and set the stage for centralizing within a single ministry all responsibilities for government control of the oil industry, and the review and formulation of oil policies.

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[1]Craig, p. 16.

[2]*Ibid.*, p. 11.

In 1964 the Mostofi Report re-emphasized the need for modernizing the administration of the petroleum industry and strengthening the petroleum division of the Ministry of Petroleum and Mines. The Report recommended the creation of a Central Petroleum Administration within the Ministry of Petroleum and Mines "to carry out a continuous review and reappraisal of the national oil policy, to ensure its implementation with sufficient flexibility and to exercise at the same time the indispensible vigilance necessary to safeguard the paramount national interest."[1] It also recommended that a special Petroleum Committee should be established within the Cabinet under the chairmanship of the Prime Minister to co-ordinate government policies and actions relating to the petroleum affairs of the country.

While the new government may have been initially too weak to significantly change the original terms of agreement under which the established oil companies operated, it was certainly not in as weak a position with respect to new companies. It is important to note, therefore, that the conditions of operation and obligations attaching to the licences granted Pan American and Dominion Submarine (January 10, 1961) on the Trinidad East Coast Continental Shelf were substantially different from those applying to earlier leases. Under the terms of the new leases the companies were obligated to spend mimimum annual amounts per acre on exploration.[2] Dominion was also

[1] Mostofi Report, p. 35.

[2] These expenditures ranged from $0.435 during the first year to $1.70 for each of the eleventh to the fifteenth year of the terms as extended.

required to commence drilling within twelve months after receipt of the licence and to continue drilling for at least 10,000 feet unless commercial production was encountered at a lesser depth.[1] The companies had to employ as far as possible qualified local personnel and to pay wages at a level equivalent to those paid by industries of the same type on the island. The companies were also required to submit each year a statement of expenses incurred to the Governor General. These leases were the precursors to the 1969 Petroleum Act.

The Petroleum Act 1969[2] consolidated and amended the laws relating to petroleum so as to make better provisions for exploration and for the development of known reserves. It also incorporated amended sections of the Income Tax ordinance and the Finance Act 1966 to give government a greater share of the rents of the industry. In January 1970 the Petroleum Regulations were published outlining the types of licences, the procedures for issuing those licences as well as the conditions under which they may be held. It described the operating rights, and the general technical and financial obligations of the companies. The Act and its Regulations gave Trinidad the legal framework within which it could exercise its sovereignty with respect to its hydrocarbon resources. It empowered the government to act to maximize the public revenues and social benefits derived from its petroleum resources over time.

The new laws established seven categories of licences for the purpose of taxation and control of petroleum operations: exploration,

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[1]Mostofi Report, pp. 116, 117.

[2]Government of Trinidad and Tobago, The Petroleum Act 1969 (Act no. 46 of 1969), December 30, 1969.

exploration and production, refining, liquifaction of gas, transportation, marketing, and manufacture of petrochemicals. The regulations pertaining to the mining operations treat exploration leases differently from exploration and production leases. In this respect they are similar to the old laws. However, the 1970 regulations firmly establish within the law public rights over the country's marine resources.

One of the most important departures of the 1969 Act is the requirement that the Minister grant licences on the basis of competitive bidding among the oil companies. This policy allows the government to "shop" for the company which is prepared to make the greatest concessions consistent with the country's "social aspirations and economic objectives". It is in principle an optimizing policy for the country, for it increases the government's capacity to maximize its share of the total possible rents accruing from all leases. Also this gives the government the flexibility under conditions of uncertainty affecting supply (output) to vary the negotiated terms (condition pressures) per licenced area for each company so that it minimizes the risk both to itself and the companies. To put it another way, by applying the petroleum legislation so that it places different "condition pressures" on licenced areas according to their capacity the government can create greater overall incentives for increased output than if it applied the legislation in a uniform way over all licenced areas.[1] In Trinidad the government can apply the regulations with some degree of flexibility allowing it to vary the tax burden from one licenced area to the other. For instance, the separation of concessions into land and offshore licences makes it possible when necessary to adjust for cost differences in the two types of areas.

The petroleum legislation may be broadly subdivided into clauses dealing with either the maximization of social benefits or the maximization of real cash flows. In general, the revenue maximizing clauses pertain to those sections of the Act which deal with conversion and relinquishment, those which are directed at controlling the level of production and refining, and those which alter the tax methods to the advantage of the country.

The social obligation provisions of the 1969 Act pertain to hiring practices, the preservation of property, maintenance of land surfaces, territorial waters and the environment in general, price discrimination in domestic markets and general domestic supply problems. In the context of the present analysis the most important clauses are those which eliminate the traditional training and employment practices, and those dealing with the domestic market demand-supply balances.

Under the concessionaire colonial system almost all managerial

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[1]This is similar to the problem of optimization under risk aversion. Dr. Dave K. Gandhi gives a mathematical proof in a paper entitled "Contract subdivision and risk reduction" which shows that in contract bidding a set of optimal sharing rates, one for each unit yields a higher certainty equivalent or risk adjusted value than a single stage ratio for the contract as a whole. Canadian Association of Administrative Sciences 1976 Conference, Université de Laval, Quebec, 1976.

and highly technical jobs were filled by foreign personnel. Despite the long history of the industry (1867) it was only from 1972, four years after the passing of the Work Permit law, that one notices any significant increase of Trinidad nationals in administrative and highly skilled positions in the oil industry (Appendix 8-B-1). This process has been speeded up by the nationalization of Shell, the joint-venture purchase of B.P.'s assets, as well as increased government efforts to tap the reservoir of skilled nationals living abroad. The 1970 Regulations, sections 42 (f) and (g), require that oil companies operating in Trinidad must:

> minimize the employment of foreign personnel, ensure that such employees are engaged only in positions for which the operator cannot after reasonable advertisement in at least one daily newspaper circulating in Trinidad and Tobago, find available nationals of Trinidad and Tobago having the necessary qualifications and experience; determine the rules of employment including salary scales in such manner as to ensure that all employees in the same category enjoy equal conditions irrespective of nationality;
>
> prepare, in consultation with the Minister programmes for industrial and technical education and training, including the grant of scholarships, and carry such programmes out diligently with a view to training nationals of Trinidad and Tobago to replace foreign personnel as soon as reasonably practicable and to affording nationals of Trinidad and Tobago every possible opportunity for occupying senior positions in the operations of the licencee.

In order to ensure that nationals are afforded the greatest opportunity to benefit from these new positions opened up by the legislation the government set up, in 1974, the Petroleum Institute Fund with an initial appropriation of T.T. $1 million, to which was added T.T. $2 million in 1975.[1] The Institute will train nationals for professional, technical and sub-professional jobs in the oil sector.[2]

Problems of domestic supply. The new legislation also protects the domestic consumer market against artificial domestic shortages and price discrimination. The 1970 Petroleum Regulations, sections 43 (u) and (v), state that:

> the Minister may require a Refining Licencee to undertake to deliver to the government at current wholesale prices such reasonable part of any particular product manufactured by him as may be required to supply such product in quantities exceeding ten per cent of the total quantity manufactured by him.

The 1969 Act also sets out regulations which guard against the practice of price discrimination by the companies in the domestic market, thus correcting a situation which the Mostofi Report disclosed in 1964. The Petroleum Regulations state that in the case of a marketing licence the companies shall sell in Trinidad and Tobago the petroleum products at prices no higher than maximum prices as the Minister of Petroleum and Mines shall fix and announce. Moreover, it authorizes the Minister to fix the maximum prices that may be charged by any company for the sale of petrochemicals within Trinidad and Tobago.

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[1]Government of Trinidad and Tobago, The Budget Speech 1976, December 12, 1975, p.19.

[2]Prior to the Petroleum Institute, the Management Development Centre was established (1964) to train management for and improve management skills in the industrial sector.

The world-wide energy crisis (winter 1973-1974), produced by OPEC's actions both to increase prices dramatically and to restrict supply, had an impact on Trinidad as well. Since the Trinidad refinery industry depends largely on imported crudes, product shortages were experienced in Trinidad as domestic demand for gasolene, kerosene competed with foreign demand for Trinidad petroleum products. The government, using its powers under the 1970 Regulations, decided to cushion the effect of higher prices on the economy by requiring the principal oil producing companies in the country to subsidize the price of gasolene, kerosene, gas and diesel oil on the domestic market effective January 1, 1974. The total subsidy represented a direct flow of benefits to the consumer. It was estimated at T.T. $52.3 million of which the companies were expected to pay T.T. $20.4 million and the government T.T. $31.9 million in the form of taxes foregone;[1] that is, the government's contribution was 3.6 per cent of the total revenues (T.T. $890.6 million) it actually received from the oil sector; and the companies' contribution represented 2.3 per cent.

Revenue maximization: conversion and relinquishment. Under the old laws a single company could hold large concession areas inactive indefinitely, a policy which might have been to its own advantage but which certainly was not in the 1950s and 1960s an optimum strategy for the country. Under the new laws an exploration licence cannot exceed three years but may be renewed from time to time for any one period not exceeding three years. Moreover, with respect

[1]Government of Trinidad and Tobago, Budget Speech 1974, pp. 40-41.

to exploration and production operations a major part of the original licenced area must revert to the government at the end of six years. This allows the government to offer the area again for competitive bidding (unless it is judged not to be in the public interest to do so), thus increasing the opportunity for maximizing revenues by charging additional signature bonuses.

In order to prevent companies from holding concession areas for the duration of the licence without carrying out any exploration, under the new leases the company is required to spend a minimum sum during the first three years. This sum must be guaranteed by bond and the company must show proof that the obligations are met. Moreover, the company must begin drilling at least one well within a specified maximum time after the granting of the licence. This is a dramatic change over the obligations of companies under the old mining legislation where no such requirements were demanded.

Under the present arrangements the Minister of Petroleum and Mines, with the assistance of a greatly enlarged staff of petroleum economists, geologists, chemical engineers, maintains a close review of all aspects of the industry, especially current levels of output and future potentials. The Ministry must also compare crude output levels to each company's refining obligations.

<u>Refining</u>. Trinidad's old petroleum legislation specified the relationship between a company's crude output and its refining obligations. Very simply, the old law required a company to refine a portion of its crude production in Trinidad at some given level of

output. The main benefit of this policy was the employment effect[1] and an increased netback price on domestic crude. The present legislation retains this obligation. Firms above either a minimum size output of crude per day or a minimum of aggregate daily reserves are required to operate under licence a refinery in Trinidad and Tobago with a throughput capacity of at least 50 per cent of the aggregate average daily production of the company. The major difference between the old and new regulations is that the present laws address themselves in precise terms to the question of whether Trinidad refineries should have priority in the use of Trinidad crude over refineries located elsewhere. The Minister of Petroleum and Mines can require the operator "to refine or have refined in Trinidad and Tobago up to one hundred per cent of the crude oil produced by him."[2] Given the good potential for growth in domestic crude and the present level of output from the east coast areas it would seem that Amoco should be required under Article 51 of the Petroleum Regulations 1970 to build a refinery to process its crude domestically; or that it should be required to sell crudes to Trintoc or Texaco to replace imports, Article 53(i). However, Amoco crudes are sweet crudes and

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[1]The debate between government, the oil companies, and the OWTU at the Tripartite Conferences held in July and August of 1968 revealed that the oil companies initially over-employed local labour in response to social and political pressures. This represented a flow of benefits to the labour-force in the fifties. However, this was reduced by the retrenchment programmes of the companies in the late sixties.

[2]Government of Trinidad and Tobago, The Petroleum Regulations 1970, Articles 50-54, p. 21. See also Article 48 of Exploration and Production (Public Petroleum Rights) Licence to Amoco Trinidad Oil Company, no. 1/57, p. 29.

the Trintoc and Texaco refineries have been constructed to process sour crudes. Moreover, the U.S. East Coast market for Trinidad refined products is one for residual fuel oils not gasolene and middle distillates. The Amoco crudes are light crudes of high quality and are best suited to production of higher value products, so, as stated earlier, it is more profitable at present high prices to sell crude for which there is a ready demand in Standard Oil's share of the U.S. market rather than sell it as residual fuels for which the prices are much lower. This no doubt explains why Amoco was allowed to export crude oil from Trinidad during the 1973-1974 oil crisis while domestic refineries operated at 50 per cent of capacity. To have done otherwise would have reduced government oil revenues

<u>Financial obligations of the companies under the Petroleum Tax Acts 1970, 1974, 1975 and 1976</u>. One of the central functions of any petroleum legislation is the maximization of the present value of public revenues over time. To achieve this requires minimizing tax avoidance practices and employing the most efficient system of tax levies. One important technique for attempting to prevent income tax avoidance is the separation of the various functions of production, refining, marketing, etc. for purposes of taxation, an approach introduced in Trinidad for the first time in the 1974 Income Tax Act. Prior to that the application of this accounting practice depended on the goodwill of the companies: up until 1973 Shell refused to separate its production activities from its refining and marketing activities. The government may also use bonuses, surface duties,

royalties, corporate income taxes, state participation or various combinations of these policy instruments to increase its share of the rents earned in the industry.

The Petroleum Tax Act of 1974 and subsequent Acts brought about "structural changes to the existing bases and methods of determining taxation of the oil companies" in order to ensure the maximum return to Trinidad's oil assets, i.e. production and downstream operations. The most important points are summarized below:

1. General

a. The introduction of a system of tax reference prices to determine tax liabilities for the production of crudes. Effective January 1, 1974 prices were set at U.S. $13.73 per barrel for Soldado crudes and U.S. $14.93 per barrel for Amoco East Coast Continental Shelf crudes. Thus income tax revenues are now partly insulated from price chiseling and price manipulation activities. These tax reference prices have increased by U.S. $2.50 since 1974.

b. The collection of oil taxes quarterly, based on an estimate of current year's liabilities. This has the effect of reducing government short term borrowing and debt charges. In fact it may even increase income through interest earned on surplus balances.

c. The separation of the production, refining and marketing functions for tax purposes in order to attempt to prevent losses in any one function of a company from being offset against profits in other functions.

2. Production

a. The classification of new and existing concessions into either land or marine tax zones and the use of a system of progressive production bonuses and unspecified sliding scale royalties[1] allows the laws to be applied in a more optimal fashion by distributing the burden of taxes according to what the projects can reasonably be expected to bear.

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[1]The Minister of Petroleum and Mines, with the permission of the Cabinet, may reduce royalties on certain leases if the company can produce evidence to support its request (Article 63 of Petroleum Act 1970).

b. The capitalization and amortization over a number of years of exploration and drilling costs.

c. The assessment of royalty rates on the basis of field storage value of crude oil as opposed to the value of a composite barrel of product produced from the particular crude, and the stipulation of those rates in the licences. These rates were changed from 12.5 per cent to 15 per cent in the new concessions (1975 and 1976).

d. The increasing of corporation profit tax applicable to oil production from 45 per cent in 1968 to 47.5 per cent in 1974 and to 50 per cent in 1975.[1]

3. Refining[2]

a. A throughput tax per barrel of oil processed will be levied on refining operations, regardless of the source of the oil. The rate of throughput tax will be fixed from time to time by the Minister of Finance in consultation with the Board of Inland Revenue and the Ministry of Petroleum and Mines with regard to the following:

(i) the need to assure government a reasonable flow of revenue from refining;

(ii) the need to maintain a competitive advantage for Trinidad in establishing new refining operations or expanding existing facilities;

(iii) the complexity of the refinery complex; for example, the Texaco refinery with its lubricating oil and petro-chemical paints will bear a higher throughput tax than the Shell refinery;

(iv) the changing conditions on the international oil market;

(v) other considerations which the Minister of Petroleum and Mines and the Board of Inland Revenue hold to be relevant to the circumstances of the domestic oil industry.

The Minister of Finance, with effect from 1st January, 1974, fixed the throughput tax at U.S. 10 cents per barrel for the Shell refinery and

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[1]Tax rates were changed from 42-1/2 per cent to 44 per cent in 1968.

[2]Government of Trinidad and Tobago, Budget Speech 1974, pp. 53, 54.

U.S. 15 cents for the Texaco refinery. In his budget speech he announced a U.S. one cent increase in the refinery throughput tax for Texaco effective January 1, 1975.

For new leases granted in 1975 the companies were required to pay approximately U.S. $4 million on signing the licence. In addition to this, during the first six years the companies must pay a minimum of U.S. 20 cents yearly for each acre within their exploration area, rising gradually from U.S. $1.00 in the seventh year to U.S. $5.00 an acre by the seventeenth and subsequent years. These payments may be deducted from royalties paid in the same year. Production bonuses are also charged as follows - approximately U.S. $1 million at such times when production reaches 25,000, 50,000 and 75,000 barrels of oil per day; U.S. $2 million at the rate of 100,000 barrels of oil per day; U.S. $3 million at the rate of 150,000 barrels of oil per day; U.S. $4 million at the rate of 200,000 barrels of oil per day; and for every increase of 50,000 barrels of oil per day an additional U.S. $1 million becomes payable.

The changes in corporate tax liabilities, royalties, refinery taxation, the substantial bonuses now levied on the signing of exploration and production licences, and production bonuses all combined to vastly increase government tax yields and narrow the companies' scope for tax evasion.

Institutional and administrative changes. 1974 marks the beginning of a new era in Trinidad petroleum administration. Mindful of the need for vigilance the Trinidad Cabinet gave formal approval in February 1974 for the establishment of an Energy Secretariat[1] deriving its power to act from the Cabinet. The Secretariat was to negotiate government participation in the oil industry with interested parties (i.e. foreign governments and companies), to monitor developments in the world oil economy, and to evaluate and/or formulate policy with respect to the oil industry as it affects the national interest. Some of these functions have, since November 1974, been integrated into either the Ministry of Petroleum and Mines, or a special Task Force consisting of highly trained nationals (chemical engineers, geologists, electrical engineers, economists).

Moreover, both the Ministry of Petroleum and Mines and the Ministry of Finance have been given a new vitality much needed to carry out their functions effectively. Their technical staff has been greatly expanded and upgraded between 1973 and 1975. The takeover of Shell also brought within the government's control a considerable number of managerial and technical personnel and information vital to its decision-making within the industry. It has also benefited by its easy access to the managerial and technical resources of Tesoro Petroleum Company. To ensure that conditions exist for competent, long-term, dynamic planning in the mining of hydrocarbons in marine territories, the government has approved the establishment of an Institute of Marine Affairs. The principal objectives of the Institute of Marine Affairs, according to the planning document supporting this venture, will be "to make available to the Government of Trinidad and Tobago a body of knowledge and expertise upon which it

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[1]Trinidad Guardian, "Government Set up Energy Secretariat," February 2, 1974.

can draw for information and advice on the economic, technological, environmental, social and legal aspects of marine affairs thus making available to the planners concepts and tools which are relevant to Trinidad and Tobago, and enabling the policy and decision makers to avoid the undesirable impacts of any proposed action."[1]

An evaluation of Trinidad's petroleum tax laws. Having described the petroleum laws and recent government initiatives it now remains for us to examine the effectiveness of these changes. It is very difficult to make a precise assessment of total benefits without using a very complex, dynamic type model. However, we can put some bounds on the problem to reduce its complexity to manageable proportions. We will attempt to measure the effectiveness of changes in the petroleum tax laws and government initiatives in terms of the increase in the government's share of surplus profits or rents earned in the industry relative to some theoretical optimum. For the purpose of the analysis petroleum policies pertaining to land operations will will be examined for the period 1951 to 1963 and 1964 to 1976. The offshore mining operations will be examined for the period 1973 to 1975.

Van Meurs provides a set of criteria which allow us to examine the theoretical optimum share of project rents that can be taxed away, i.e., the "condition pressure" (CP) associated with any tax policy under given geological and economic conditions.[2] The government has a choice

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[1] Government of Trinidad and Tobago, Supplementary Notes on the Budget for 1976, December 12, 1975.

[2] Van Meurs, Chapter VI, pp. 145-149.

of not taxing the companies at all or applying any one or a combination of several tax elements. The range of its choice of a tax policy is on one extreme the situation in which no payments are required, and on the other extreme where the payments are, in a strict economic sense, burdensome. In the first case exploration and production conditions will be highly favourable (at least as far as legislation is concerned) and in the other case there will be no exploration or production because the companies find projects unattractive. In both cases no public cash benefits are derived. The optimum policy lies somewhere in between these two extremes.

In Van Meurs' model a key factor for assessing a tax policy is the manner in which companies react to proposed mining legislation; and this depends heavily on the cash flow of the project.[1] Since the impact on the expected-monetary value (EMV) of project rents after a change in the mining legislation is determined by both the cash flow of the tax element and the pre or post discovery character of the payments to government, the quantitiative influence of each change in mining legislation on the EMV can be predicted.

Van Meurs defines the condition pressure as follows:

$$CP = \frac{EMV - EMV^1}{EMV} \qquad 8.1$$

where EMV = expected monetary value of total rents that would be earned if no taxes were paid, or were earned before changes in the mining legislation;

[1]Ibid., Chapter V, p. 105. Van Meurs finds no evidence that payout time is affected significantly by various standard instruments of taxation.

and EMV^1 = expected monetary value of total rents earned after taxes are levied or after changes in the mining legislation.

According to equation 8.1 above CP is the percentage reduction in the theoretical maximum rents resulting from the introduction of petroleum legislation. CP varies between 0 and 1. If government introduces mining policies or makes changes in existing policy which imposes a CP = 1 on a company intending to invest in a project, and if the company accepts the terms of the contract, government will receive the maximum possible payments from the project, provided it is successful. Insufficient information about the geology of new areas on the part of government and companies alike makes the government unwilling to impose a CP = 1, and the companies very hesitant to accept such contracts. The existence of uncertainty makes it questionable as to whether the government is able to fulfil the conditions to reach a maximum revenue at all.[1] From equation 8.1 Van Meurs develops a model which shows the combined effect of geological risks and the influence of mining legislation on the response of a company to a project. The model derives the minimum number of dry holes that a company's share of expected project rents must cover for a given probability of finding (P) and a given CP before it undertakes the project. The formula for deriving minimum expected breakeven (quasi) rents for a project is as follows:

$$\text{Minimum breakeven project rents} = \left(\frac{1 - P}{P}\right) \times (\text{dry hole costs}) \qquad 8.2$$

[1] *Ibid.*, p. 107.

This is derived by putting P(company's part of project rent) - (1 - P) x (dry hole costs) = zero as a minimum requirement. It implies that dry hole or pre-discovery expenses must ultimately be paid out of the project rents. Of course in the case of multinationals this may not necessarily be the case; and in general one would expect a company to make its bonanzas carry a greater share of the burden of pre-discovery expenses incurred in all its concessions. When no payments are made to government (CP = 0) all the company requires in order to be attracted is to be assured that it will cover discounted quasi-rents as indicated by equation 8.2. However, when mining legislation is introduced and the company must make payments to government (CP > 0) a project must earn quasi rents plus the tax revenues required by the government. In this case the minimum rents in dry hole equivalents that must be earned by the project are:[1]

$$\frac{\text{Minimum expected project rents}}{\text{dry hole costs}} = \left(\frac{1 - P}{P}\right) \Big/ (1 - CP) \qquad 8.3$$

Multiplying the minimum expected project rents in dry hole equivalents by (1 - CP) gives the minimum breakeven project rents in dry hole equivalents, that is, the CP ratio represents the government share of expected rents. Values for equation 8.3 are derived in Table 8.1 for selected values of CP and P.

Van Meurs, after analyzing certain components of petroleum legislation under certainty and then in a more general sense under

[1]Derivation: P(expected part of project rent) - (1 - P) (dry hole costs) = 0 so that company's expected part of project rent = (1 - CP)(minimum expected project rent). Hence P(1 - CP)(minimum expected project rent) = (1 - P)(dry hole costs). This gives equation 8.3.

TABLE 8.1

ESTIMATES OF MINIMUM EXPECTED PROJECT RENTS EXPRESSED IN DRY HOLE EQUIVALENTS WITHIN THE RANGE OF 0-100 DRY HOLES

	Success ratio (P)	Condition Pressures (CP) 0	.5	.7	.8	.9	.95	.99
SECTION A ($0.01 \leq P \leq 0.1$)	0.01	99.0	-	-	-	-	-	-
	0.02	49.0	98.0	-	-	-	-	-
	0.03	32.3	64.7	-	-	-	-	-
	0.04	24.0	48.0	80.0	-	-	-	-
	0.05	19.0	38.0	63.3	95.0	-	-	-
	0.06	15.7	31.3	52.2	78.4	-	-	-
	0.07	13.3	26.6	44.3	57.5	-	-	-
	0.10	9.0	18.0	30.0	45.0	90.0	-	-
SECTION B ($0.1 < P \leq 0.25$)	0.13	6.7	13.4	22.3	33.5	66.9	-	-
	0.16	5.3	10.5	17.5	26.3	52.5	-	-
	0.17	4.9	9.8	16.3	24.4	48.8	97.6	-
	0.19	4.3	8.6	14.2	21.3	42.6	85.2	-
	0.20	4.0	8.0	13.3	20.0	40.0	80.0	-
	0.24	3.2	6.4	10.6	15.9	31.7	63.4	-
	0.25	3.0	6.0	10.0	15.0	30.0	60.0	-
SECTION C ($0.25 < P \leq 0.50$)	0.30	2.3	4.6	7.7	11.7	23.3	46.6	-
	0.40	1.5	3.0	5.0	7.5	15.0	30.0	-
	0.50	1.0	2.0	3.3	5.0	10.0	20.0	100.0
SECTION D ($0.60 \leq P \leq 0.80$)	0.60	0.7	1.4	2.3	3.3	7.0	14.0	70.0
	0.70	0.4	0.8	1.3	2.1	4.0	8.0	40.0
	0.80	0.3	0.6	1.0	1.3	3.0	6.0	30.0

Note: - represents values greater than 100 dry holes.

risks, reached the general conclusion that in order to achieve maximum public revenues petroleum laws must be highly selective and that the selectivity can be structured by:[1]

1. Applying different regulations in the petroleum law for oil and gas.

2. Providing for financial arrangements to cover exceptional cases: there may be instances in which high productivity fields are found in a low probability area or large fields found with low productivity.

3. Giving the most weight to elements such as corporate income tax, state participation and sliding scale royalties.[2]

4. Regulating the condition pressures according to the generally expected probability of success. The condition pressure should never exceed 1, and must account for the distinction between offshore and onshore areas, while the general economic setting must be included as well.

Van Meurs developed three cases as a guideline for assessing petroleum legislation in marine areas, and high cost land producers. However, the criteria are best suited to an analysis of conditions in the sixties when market prices were falling. After 1971, therefore, they must be adjusted upward to reflect the major increases in prices. The model assumes that low productivity fields are more likely to be found in areas with low probability success ratios, and vice-versa.[3]

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[1]Van Meurs, p. 145.

[2]According to Van Meurs, in general, royalties, corporate income taxes and government participation give higher yields to public revenues without discouraging investment in development and exploration. By contrast the burden (condition pressure) of bonuses and surface dues are such that they should only be applied to fields with a medium to high success ratio and where the likelihood of finding rich fields are relatively higher. In marginal fields with low success ratios where expected output is barely enough to cover dry-hole cost (minimum project rents) over the life of the project bonuses and surface dues should not be used. Van Meurs, pp. 119-127.

[3]See guideline 2 above.

However, small fields with high productivity and large fields with low productivity may occur in a random fashion throughout all areas so that one must be selective in applying the criteria. For instance, a high productivity field with a normal project life in an area with P = .10 would be able to support a CP = .90 if the project rents were expected to exceed a required minimum equal to the discounted cost of 90 dry holes.

In the analysis which follows it is assumed that the minimum requirement for investment in a project is that expected rents cover the cost of ten dry holes, and that in general fields which have the productive capacity to cover the cost of more than 100 dry holes are rare.

Case I - Low probability of success ratio ($0.01 \leq P \leq 0.1$)

Table 8.1, Section A, presents the situation where the probability of finding is very low. In such a situation even if the condition pressure (burden) is zero many projects will be found unsuitable because the region has a low expectation of meeting minimum project rents requirements. With a condition pressure of .9 very few projects are acceptable. It would seem that good government policy would require a condition pressure (CP) less than .5 for marine based operations and probably between .5 and .6 for land based. Van Meurs[1] suggests that in such a situation a rational procedure for implementation of this policy would be as follows: a 50 per cent corporate income tax with depletion allowance, a moderate sliding scale royalty not exceeding 10 per cent per barrel value.

[1]Van Meurs, p. 139.

Case II - Moderate probability of success ratio $(0.1<P\leq 0.25)$

Table 8.1, Section B, shows that perhaps the best policy would be one which raises condition pressures between .5 and .8: below .5 some projects, but not many, are expected to be abandoned. The mid-point for the range of expectations is about 55 with approximately a .15 chance of occurring. All the minimum rent requirements at CP = .5 and CP = .8 are less than 55. At CP = .9 however, some projects have minimum rent requirements in excess of 55 and seem to set an outer limit to tax rates. Condition pressures between .7 and .8 would seem appropriate. Van Meurs suggests the following components of mining legislation:

1. 50 per cent corporate income tax.
2. State participation only in rich discoveries.
3. Sliding scale royalties. The limits in this case to be dictated by the situation.

Case III - High probability of success ratio $(0.25<P\leq 0.50)$

Table 8.1, Section C, following the same line of analysis as in Case I and Case II above indicates that a policy with condition pressures between .8 and .9 leaves the projects highly attractive. Accordingly, the following mix of strategies is recommended:

1. 50 per cent corporate income tax.
2. 50 per cent state participation in a wider range of projects.
3. Sliding scale royalties up to 20 per cent of the per barrel value.

The absence of the use of bonuses and surface fees in Cases I, II and III does not preclude their being among the petroleum policy components. They have low priorities, however, in view of their adverse effect on marginal projects and the difficulty of using them selectively. They can be used effectively, especially in Case III, to ensure government of an early cash flow during the long lead time between initial exploration expenditures and production expenditures in the oil industry.

Case IV - Very high probability of success ratio ($0.60 \leq P \leq 0.80$)

Van Meurs does not develop a Case IV but it is suggested by the need for a model to evaluate the Trinidad east coast cost experience. In this case condition pressures (taxes on expected rents) as high as 95 to 99 per cent (Table 8.1, Section D) can be tolerated, especially if the productivity of the wells is in the high range known to exist in Venezuela and the Middle East, i.e. 1,000 to 5,000 barrels per well per day. At present world prices and reasonable cost this suggests:

1. Income tax of 80-85 per cent.
2. Major state participation.
3. Sliding scale royalties up to 25 per cent.
4. Surface fees, signature bonuses, and production bonuses.

In applying these criteria to Trinidad's oil industry it is assumed that total state ownership as a policy is inadvisable as long as the country remains heavily dependent on foreign companies. In such a case government participation can play a dual role by increasing public revenues from the oil industry and providing effective national control of the industry. Most oil producing countries seem to have followed the gradualistic approach to total state ownership. In the initial stages all countries have used mining legislation of the type outlined above to achieve national objectives rather than the more explosive outright policy of nationalization with the inherent possibility of the destruction of the benefits to the companies, governments and consumers.

Application of model. In order to use Van Meurs models one needs to have some qualitative or quantitative indicator of the geological conditions in the concession areas, and in particular one needs to know the probability of success pertaining to exploration on land and offshore areas. The latter can be approximated by the use of success ratios for exploration activities. Geologists consider Trinidad's geological conditions highly complex and unpredictable because of the large number of traps resulting from the frequent faulting experienced. The productivity and efficiency of the fields vary considerably between the old concession areas and the new offshore areas. In the old concessions the natural drive mechanism of the reservoirs is a very inefficient gas solution mechanism. However, in the East Coast Continental Shelf fields petroleum geologists believe the natural drive mechanism is a water base machanism, which is rated among the most efficient. This means that reservoirs in the new marine concessions have a higher expected recovery rate than that for the old land concessions. The recovery rate for water drive systems varies between 20 and 90 per cent as compared with 10 to 20 per cent for gas solution systems. The initial rates of output per well in the new marine areas are also very high by world standards, close to 5,000 barrels per day. Those for land and in the Soldado marine fields have been very much lower. In 1951 2,300 land wells produced an average daily production of 57,200 barrels, or 25 barrels per well.[1] By contrast, the Amoco wells produce an average of 2,000 barrels per well per day. The productivity of the wells in the land concessions remained considerably stable between 1951 and 1965 but declined rapidly between 1965 and 1975. In 1965, however, about 50 per cent of the land wells produced between 33 and 69 barrels per well per day, whereas in 1974 less than 20 per cent of the land wells produced between 7 and 44 barrels per well per day.[2] One notices, therefore, the drastic decline in productivity as opportunities for finding oil on the land are used up during the fifties. For this reason petroleum geologists at the Ministry of Petroleum and Mines (Trinidad and Tobago) suggest that the success ratio (P) in the fifties may have been about .25 assuming similar decline patterns as in the U.S.A. and about .10 or less in the late sixties and early seventies.[3] In the Soldado fields (TNA), however, P is probably higher ($.25 < P < .50$) given the new prospects in the Gulf of Paria and the south west marine areas. But the well productivity is much less than 2,000 barrels per day. In the East Continental Shelf area, however, the initial output per well is very high and $.60 < P < .80$.

The optimal policies. Using the Van Meurs criteria as a guide to good tax policies suggests that the Trinidad government should have

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[1] Trinidad's Oil, The Petroleum Association of Trinidad, 1952, p. 8.

[2] Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Monthly Bulletin, March 1965, July-December 1974.

[3] Results of an interview conducted with petroleum geologist at the Ministry of Petroleum and Mines, Port-of-Spain, Trinidad, April 15, 1976.

applied the policy instruments as follows:

1. Case II for land concessions in the decade 1951 to 1961. Case III would appear appropriate for the south west marine fields in the period 1956 and 1976, but taking into consideration the higher cost of finding in the marine areas the Case II model may have been a better choice.
2. Taking into consideration the decline in land reserves after 1964 it would have been advisable to shift from Case II to Case I as the guide for government policy in this period.
3. The policies most appropriate to the East Coast Continental Shelf fields would seem to be those suggested in Cases III and IV, taking due consideration of the effect of "sanding-in" on capacity, and rising cost in the future.

The following is an evaluation of the actual policies applied.

<u>The land and south west marine concessions</u>. An examination of Trinidad's mining legislation suggests that Trinidad did not optimize public revenues from its land concessions in the 1951-1961 period. Corporate tax rates were less than 50 per cent of net income (40 and 42.5 per cent) throughout the period, while royalties which averaged 10 per cent may have been too low. One must take into consideration, of course, that the effective rate may have been greater than 10 per cent because the value of crude for royalty purposes was based on the value (Caribbean) of a barrel of product derived from Trinidad crude. Royalties therefore varied directly with changes in prices as well as output. Surface duties were charged but they were usually offset against royalties. There was no government

participation. From Table 8.2 average product prices are estimated to be U.S. $2.90 in the period 1956-1961. This gives surplus profit of U.S. $1.25 per barrel of Trinidad crude, of which 51 per cent (U.S. $0.64) was taxes. With well capacities averaging 25 to 50 barrels per day in the less productive reservoirs and close to 500 in the rich fields, and prices between $2.00 to $2.90, the present value of surplus profits per barrel for r = .20 over a twenty-five year project (eight wells) is approximately double dry hole cost for low output and twenty times that cost for high output wells.[1] This suggests a tax policy similar to Case II with CP = 0.7 (i.e., 70 per cent tax take). Falling prices and output after 1961 increased condition pressures discouraging new drilling in land concessions, but in general the existing policies were sub-optimal.

In the Soldado fields the tax policies may have been even less optimal. The government, faced with a rapid decline in land reserves, was anxious to attract foreign capital for marine exploration and development. It was, therefore, prepared to provide major incentives. So that, in spite of the very favourable tax conditions implicit in the tax policies throughout the fifties the government still gave tax holidays to marine operators and made considerable tax concessions in the form of a 20 per cent depletion allowance. After 1961, however, these benefits were partly offset by falling crude and product prices.

The Peat, Marwick and Mitchell Accounting Study (1970) showed that prior to 1972 the companies also exploited the government's lack of knowledge in financial management and financial control that characterized typical good practice in the oil industry. For instance,

[1] Dry hole cost on land is estimated at U.S. $0.5 million.

TABLE 8.2

ESTIMATES OF CONDITION PRESSURES

IN TRINIDAD OIL INDUSTRY

(U.S. $ per barrel)

	1956	1957	1958	1959	1960	1961	1964-68
1. Average product prices	2.95	3.20	2.90	2.88	2.75	2.73	1.72
2. Refining and transportation cost	.65	.65	.65	.65	.62	.62	.62
3. Netback price	2.30	2.65	2.25	2.23	2.13	2.11	1.10
4. (Incremental) production cost	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5. Surplus profit	1.30	1.65	1.25	1.23	1.13	1.11	.10
6. Tax take	.57	.67	.77	.62	.62	.58	.62
7. Company share	.73	.98	.48	.61	.51	.53	-
8. CP (ratio)	.44	.41	.62	.50	.55	.52	1.00

Sources: Table 6.16; Figure 4.4.

Government of Trinidad and Tobago, Third Five-Year Plan, 1969-1973, Table III, p. 167.

Notes: (3) = (1)-(2); (5) = (3)-(4); (7) = (5)-(6); (8) = (6)÷(5).

up until 1973 the government allowed Shell and Texaco in the land and marine production activities to expense dry-hole costs in the year in which these costs were incurred rather than amortizing them over the life of the project. In addition to these the government levied taxes on the basis of prices reported by the companies thus leaving the companies considerable room for tax avoidance at production level.

The Mostofi Report (1964) commented on this abysmal lack of knowledge and recommended that "some of the existing accounting policies with respect to classification and treatment of items such as intangible drilling costs, dry-hole costs, casing cost, geological and geophysical expenses, depreciation, etc. as well as the rate of processing fees charged for foreign crude should be re-examined in order to safeguard the interests of the nation."[1] With regard to the assessment of taxable earnings in the oil industry it urged that an organization of chartered public accountants well versed in the oil industry be engaged to assist in the assessment of current income taxes, to aid the establishment of a uniform accounting system for the oil industry and to train Trinidadian citizens.[2] Subsequent to this the firm of Peat, Marwick and Mitchell was contracted to do an accounting study of the Trinidad oil industry. This study was conducted for the year 1970 and formed the basis for government negotiations with the oil companies over the period 1971-1973 and subsequent changes in the petroleum legislation discussed above. The

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[1] The Mostofi Report, p. 60.

[2] Ibid., p. 39.

negotiations added to the public coffers T.T. $25 million in retroactive taxes for 1972 and T.T. $17.6 million in 1973.[1] The recent changes in government petroleum policies have improved the situation considerably. The submarine well allowances have been revised downward from 20 per cent to 10 per cent; income taxes have been increased upward to 50 per cent, and tax reference prices have been established. Royalties for crude from the land concessions were increased to 12-1/2 per cent in the late sixties, and 15 per cent for the new marine concessions from January 1974. The government now has a two-thirds share of equity in the TNA marine fields and production participation contracts elsewhere. While making these adjustments the government had, however, to re-evaluate its assessment of the land potential taking into consideration its rapid decline since the mid-sixties. Within the present framework of the petroleum tax policies it decided to make a land production allowance as a percentage (about 10-15 per cent) of the tax reference price (U.S. 16.23 cents per barrel) to encourage the companies to maintain production levels on land. This is consistent with Van Meurs' recommendations for the low productivity case and it also represents a subsidization of labour. The wisdom of the policy depends on whether the social cost of retrenchment in the land projects is higher than the opportunity cost of the revenues lost. Given the high level of underemployment and unemployment in Trinidad (16 per cent of the labour force)[2] and the powerful position of the labour unions

[1]Government of Trinidad and Tobago, Budget Speech 1974, p. 52.

[2]Government of Trinidad and Tobago, C.S.O., Labour Force, publication no. 30, 1976, table I.

among the oilfield workers the government may well be justified in considering the social cost of retrenchment too high to be acceptable.

The East Coast Continental Shelf concessions. Trinidad government petroleum geologists in making projections of expected output from the east coast marine area use a success ratio $P = 0.6$. They argue that this is a conservative estimate for the area, that recent data suggest a value of $P = 0.72$ with an upper limit of 0.8.[1] This high probability of finding crude and an even higher probability of gas, combines with high initial rates of crude output per well, to give credence to rather encouraging predictions of recoverable reserves (proven and probable) of oil and gas in the order of three billion barrels of crude and five trillion cubic feet of gas for the Amoco concession areas.[2] All these factors taken together strongly suggest that companies will tolerate very high condition pressures, even in excess of .95 (Table 8.1, Section D).

With a success ratio $P \geq .7$ and a $CP = .95$ the minimum expected rents for a project in the East Coast Continental Shelf will be approximately eight times dry hole cost. Dry hole cost for the area is about U.S. \$1.4 million to \$1.5 million.[3] The required rent (discounted), therefore, will be close to U.S. \$12.0 million. Assuming a price of U.S. \$12.00 per barrel (real terms) and r equal to 20 per cent, the present value of total revenues from a well producing

[1]Interview, Port-of-Spain, 15 April, 1976. See also Persad.

[2]Persad.

[3]See Chapter 4, page 86.

2,000 barrels per day over twenty years will be U.S. $46.8 million. Total cost (present value) at U.S. $1.50 per incremental daily barrel is estimated at U.S. $5.8 million, so that net profits will probably be U.S. $41.0 million, that is, 242 per cent greater than expected project rents. Even if incremental cost per daily barrel was put at U.S. $2.00, net profits would be more than sufficient to cover minimum expected project rents. This, therefore, suggests Trinidad should use a tax policy on the East Coast Continental Shelf similar to that discussed in Cast IV above, i.e., adopt a model closer to Venezuela's and the Middle East.

Under the new policies with respect to the East Coast Continental Shelf fields government has been collecting large premia payments on leases since 1970. These payments have increased from T.T. $2.6 million in 1970 to T.T. $79.8 million in 1974 (signature cash bonuses from production sharing arrangements)(Table 8.3). Royalties were raised in 1975 and while the government has no participation agreement with Amoco the largest producer on the East Coast Continental Shelf, it has joint-participation agreements with Tesoro Petroleum, and a 50 per cent share in a consortium between Trintoc, Tesoro and Texaco in an L-shaped concession south east of Point Galeota. On November 12, 1974 it signed four production contracts involving Tenneco, Deminex, Mobile Exploration Trinidad Limited, and Texaco Trinidad Incorporated, covering 1,241 thousand acres of marine territory located on the East Coast Continental Shelf and in the

TABLE 8.3

OIL SECTOR PAYMENTS TO GOVERNMENT OF TRINIDAD AND TOBAGO, 1964-1975

(T.T. $000)

	1964	1965	1966	1967	1968	1969
Royalties	21,870	25,706	26,678	25,711	34,930	24,847
Income tax & withholding tax	37,760	33,600	30,000	33,200	49,847*	38,963*
Customs and excise	5,331	6,105	6,469	6,900	10,248	11,050
Fuel throughput fees	-	96	146	151	179	216
Impost	126	232	420	766	848	736
Premia on oil leases	1	1	62	-	-	-
Seismographic survey						1,355
Other	15	44	30	37	48	33
Total	65,103	65,785	63,804	66,766	96,100**	77,200**
Tax take per barrel per day - U.S. $	.65	.67	.57	.50	.72	.67

TABLE 8.3 continued

OIL SECTOR PAYMENTS TO GOVERNMENT OF TRINIDAD AND TOBAGO, 1964-1975

(T.T. $000)

	1970	1971	1972	1973	1974	1975
Royalties	24,186	27,500	27,353	49,078	157,953	179,134
Income tax & withholding tax	33,500	30,000	30,000	39,678	640,000	991,185
Customs and excise	11,683	13,200	13,998	18,400	10,709	10,900
Fuel throughput fees	265	230	278	240	230	225
Impost	486	720	1,240	1,637	1,885	2,700
Premia on oil leases	2,581	7,600	-	-	79,800	30,267
Seismographic survey			606			
Other	95	46	72	45	43	56
Total	72,796*	79,296	73,547	109,078	890,620	1,214,467

Sources: Government of Trinidad and Tobago, Budget Speech 1970; Estimates of Revenue 1964-1976; Third Five-Year Plan, 1969-1973.

*Residual estimates.

**Totals reported by Minister of Petroleum and Mines, Trinidad and Tobago Debates of the House of Representatives, 1st session, vol. 15, no. 12, 3rd Parliament, Friday, 22 October, 1971.

Gulf of Paria.[1] At a tax reference price of U.S. $14.93 the Ministry of Petroleum and Mines indicates that in 1974 and 1975 taxes per barrel were in excess of U.S. $8 per barrel on the east coast or almost 60 per cent of the reference price. This gives Amoco a considerable margin over incremental cost (about U.S. $1.20) compared with experience elsewhere. Amoco is getting about U.S. $3.50 in addition to the 20 per cent return on capital included in the incremental barrel cost. In the words of the Minister of Finance, "The need is clear to take action to narrow the differential between the tax rate per barrel in Trinidad and Tobago and that prevailing elsewhere,"[2] that is, especially that on the East Coast Continental Shelf. In spite of this the Minister raised income tax rates a mere 2.5 per cent to 50 per cent. He also made adjustments in 1975 to the tax reference prices but this was in response to the price increases agreed to by OPEC countries (effective 1975). This had the effect of adding the full increase of U.S. $1.05 per barrel of crude agreed upon, while taking into account pro rata modifications based on quality crude. This notwithstanding, Trinidad royalty and tax rates are still low compared with the Middle East countries.

The Middle East producing countries increased royalties and income tax rates on three occasions in 1974. Royalties increased from 12-1/2 per cent in January 1974 to 20 per cent by November 1, 1974, while income taxes increased from 55 per cent to 85 per cent. This

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[1] Supplement to Trinidad and Tobago Gazette, vol. 14, no. 368, 15 December, 1975. Government notice 155, 156, 157, 158. The contracts involved Blocks 1, 3, 4 and 6 (Figure 3.2).

[2] Government of Trinidad and Tobago, Budget Speech 1975, p. 78.

puts the tax take on the Middle East crudes at approximately U.S. $9.82. This stands in contrast to the much lower take of about U.S. $8.00-$9.00 on Trinidad higher quality crudes (Amoco). Even when considering the higher cost in Trinidad, the Trinidad tax structure seems to leave a significantly larger share of the rents to the companies compared with the Middle East.

The impact of petroleum legislation on public revenues. Partly as a result of the significant changes in the Trinidad petroleum tax laws within the context of the dramatic increases in world crude prices over the last three years, and partly because of the dramatic increases in crude output from the East Coast Continental Shelf area after 1972, revenue accruing to the public sector from the oil industry has increased by impressive proportions. Additional taxes accruing to the government as a result of tighter financial controls on the industry have also been significant. As stated earlier, the retroactive taxes collected for 1972 and 1973 as a result of the new regulations amounted to a total of T.T. $42.6 million. According to the Accounting Study of 1970 total earnings before taxes in the oil industry were about T.T. $117.0 million (Table 6-D-1). At an income tax rate of 45 per cent the industry should have paid T.T. $53 million to the government in 1970, however, the Inland Revenue Department reports having received only T.T. 34 million in income taxes. The discrepancy of approximately T.T. $19 million is indicative of the degree of tax avoidance practised in the industry prior to 1974. A large proportion of the discrepancy was attributed to Shell Trinidad which boldly refused to report profits in its production activities separate from refining and in fact wrote-off production expenses against its refining operations. By replacing the refinery income tax by fixed throughput charges for Shell and Texaco revenues accruing on this basis at 1970 throughput (Table 4.7) would have been T.T. $46 million as opposed to T.T. $27 million (i.e., .45 of the total 1970 refinery earnings before taxes of T.T. $60 million; see Table 6-D-1). The tax formula not only simplified the task of determining profitability in a refinery that uses up most of its capacity in processing foreign crude but in all likelihood it has also increased the tax yield from the refining function and minimized the chances for tax avoidance of the kind typically practised by the industry.

Between 1964 and 1973 the annual average oil revenue accruing to the government from all tax levies was T.T. $70 million (Table 8.3). In contrast the average for the period 1974 to 1975 exceeded T.T. $1 billion, that is about fifteen times the annual average for the previous ten years. In 1974 alone total payments were T.T. $890.6 million, almost T.T. $200 million more than the total payments made in the ten years from 1964 to 1973 inclusive. This meteoric increase in payments to the government was partly due to growth in domestic crude production and partly to OPEC's major price increases (January 1974). But while world oil market prices increased by more than 300 per cent over 1973 levels and crude output in Trinidad increased by approximately 60 per cent between 1973 and 1975, government revenues from the oil industry registered much more dramatic increases; in fact, more than 1,000 per cent in the period 1973 to 1975. It would seem, therefore, that of the three contributing factors the government's new tax policies have been largely responsible for the greater share of the vast increase in public funds accounted for by the oil industry. This is further reflected by the increase in the ratio of total petroleum tax revenues to total value of petroleum exports (Table 4.27). The ratio declined from 13.9 per cent in 1962 to about 10 per cent over the period 1968 to 1973 and rose to 23.7 per cent in 1974 when the tax regulations came into full effect. It would seem, therefore, that the new petroleum tax policies have had the desirable effect of increasing public revenues without causing any slackening in the pace of development of the country's hydrocarbon resources. Notwithstanding this, there may be still considerable opportunity for the government to increase its share of the rents earned in the industry without jeopardizing development.

The next very important aspect of our analysis is to assess how effectively government uses its vastly increased oil revenues to create dynamic linkages between growth in the oil sector and growth in other sectors of the economy. The next section deals with government participation in the oil industry as a strategy for development.

Resource Base Development

Government participation as a development strategy. By 1968 the Trinidad government was faced with the grim prospect of oil mining being rapidly phased out from the land concessions and the oil industry becoming a fully service base refining operation. The unemployment problem that this posed was staggering given the already high level of unemployment and underemployment in the country (over 25 per cent). The strategy of development became more than ever one of making the country independent of the petroleum sector by transforming the other sectors of the economy.[1] Oil at this point was not to play a major role in this process. Public sector participation was essentially seen as participation in other sectors of the economy; agriculture, tourism, transportation, chemical manufacturing, etc. The government's policy then was essentially a conservationist policy aimed at buying "time to make the required adjustment to the changing economic situation."[2] Government involvement in the oil industry as a development strategy at 1969, while it was given an elaborate economic and philosophical justification by top ranking civil servants,[3] meant little more than intervention in the oil companies' decisions regarding retrenchment; the up-dating of petroleum legislation with respect to determining liability; and the acquisition of existing oil assets (alone or jointly) which could be rationalized and made sufficiently viable to maintain a satisfactory and, if possible, increased level of production and employment for the economy.

When Mr. Alleyne took the position that the government should "endeavour to develop those industries which are large scale

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[1]Government of Trinidad and Tobago, Third Five-Year Plan, p. 33.

[2]Government of Trinidad and Tobago, Second Five-Year Plan, p. 66.

[3]Doddridge H. N. Alleyne, The Permanent Secretary to the Minister of Petroleum and Mines, wrote in 1968: "It is the responsibility of government to ensure that both the physical resources and financial proceeds of the development of the Petroleum Industry are channelled into the economic development of the country." Alleyne, "The Spectrum of Government Involvement in the Administration of Petroleum Affairs," April 1968, p. 13. (Mimeographed.)

consumers of energy, thereby having a natural domestic base for the development of certain kinds of industry and the propagation of other allied industries"[1] it was largely a projection of possible directions of policy based on "controlled optimism" about the possibilities for finding substantial quantities of commercial gas and condensate on the East Coast Continental Shelf, and exploitable sources of oil in the north marine areas.[2] The idea of using the country's hydrocarbon resources as "poles de croissance" became a feasible strategy only in the second year (1970) of the Third Five-Year Plan when it was certified that oil and gas existed in substantial commercial quantities on the east coast. This increased hydrocarbon resource base represented on one hand a great potential source of capital for financing public sector investment and on the other the raw material base for economic diversification. It created a wider range of possibilities for structural transformation of the economy. In 1972, therefore, the government announced that top priority would be given to the establishment of energy base industries[3] (petrochemicals and electrochemicals) and the transformation of the petroleum sector so as to form "greater linkages with the rest of the economy."[4] In a sense

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[1] Ibid.

[2] Government of Trinidad and Tobago, Third Five-Year Plan, p. 11.

[3] Government of Trinidad and Tobago, White Paper on Public Participation in Industrial and Commercial Activities, Appendix I, White Paper no. 2, p. 14.

[4] Government of Trinidad and Tobago, Budget Speech 1976, p. 4.

government's decision to give priority attention to the winning and production of oil resulted in large increases in public revenues for financing the country's economic development and provided a base for establishing new industries requiring gas and oil as feedstock or using large doses of these hydrocarbons as fuel. The vastly increased oil revenues accruing to government after 1973 gave it the power to actualize an extended role as the prime mover in the national economy of economic growth and development, and as the principal force operating to increase the extent of local control over key industrial sectors and to ensure that private foreign investment makes its maximum contribution to overall national development.

Given these new and significant deposits of natural gas and oil the strategy that readily suggests itself is the development of petrochemical and electrochemical industries. If one diversifies along these lines, theoretically the possibilities for transformation of the petroleum sector are great. Figure 8.1 shows the full range of theoretically feasible complexes and the "spin off" possibilities for petrochemicals in Trinidad. However, a fully developed petrochemical industry is only feasible in a highly industrialized country (like the U.S.A. or U.S.S.R.) with a population of about 200 million.[1] The fact that Trinidad's population is only approximately one million puts severe constraints on the possibilities for industrial diversification through this approach. Moreover, the

[1]B. Mostofi, "Petroleum Based Industrial Complexes," Proceedings of World Petroleum Congress, 8th, vol. 6 (London: Applied Science Publishers Limited, 1971), p. 164.

composition of Trinidad's natural gas imposes additional constraints on its use as a raw material for the manufacture of petrochemicals. Because of its high methane content (94 per cent, volume) it would seem that its potential usage is greatest in the manufacture of amonia, methanol and acetylene and their respective derivatives,[1] i.e. nylon, plastics and fibres; raw materials for synthetic resins, pharmaceuticals and rubber, urea-formaldehyde, plywoods and other wood products, dinnerware, solvents, proteins, polyester and vinyl based products. One must, therefore, make selective choices of output slates depending on the demand in foreign markets.

U.S. markets offer good prospects for Trinidad exports of certain petrochemicals, especially amonia and methanol.[2] Since U.S. refineries are designed to maximize output of gasolene and jet fuel there is little incentive to divert light fractions to petrochemcials. As a result natural gas liquids have provided the bulk of petrochemical feedstocks. Therefore, the expected decline or levelling off in U.S. output of natural gas is bound to generate increased demand pressures for imports of LNG as well as petrochemicals. Trinidad is well placed in terms of resources and geography to benefit from this

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[1] Basharat Ali, "Prospects for Natural Gas Utilization in Trinidad and Tobago," Society of Petroleum Engineers of AIME, Trinidad and Tobago Section, papers presented at the Conference held on April 2-3, 1976, pp. 79-88. Analyses of gas being produced and samples of drill-stem tests in Trinidad indicate the following composition of gas, 94 per cent methane, 3 per cent ethane, one per cent propane, butane and higher acid gases, and one per cent inerts.

[2] Acetylene itself is not an exportable product because of its properties. Developments along this line will have to incorporate its usage in derivatives, i.e. polyvinyl chloride, polyvinyl acetate, polysoprene, neoprene, polyacrylates, etc. and the consumer products derived from these (Figure 8.1).

market situation.

At this point one is faced with some difficult choices. On one hand it is important to determine whether the export of LNG or petrochemicals is most likely to provide the greatest possibilities for the structural transformation of the Trinidad economy. On the other, one must decide whether the country's hydrocarbon resources would be better utilized as the nucleus of a major industrial sector. This, of course, would create a domestic demand for fuels as an energy product rather than a chemical product, and again one is faced with the decision as to what is the optimum allocation of a limited resource between alternative uses. Some computer studies put the possible optimum combinations in the range 30:70 per cent energy to chemical products on one extreme, and 70:30 per cent energy to chemical products on the other.[1] There are several possible options or choices of technology; and government planners must determine which design will optimize the net benefits to Trinidad. However, since about 90 per cent of Trinidad's output of refined products is fuels for energy usage; there is, in a strictly technical sense, justification for a policy to expand the output of petrochemicals relative to fuels. The exact proportions will depend on long-term market conditions, and more specifically the results of technical and engineering studies which are beyond the scope of this thesis. With these considerations in mind let us examine the Trinidad government's actual strategy for the development of its hydrocarbons.

[1]B. Dolkiewicz, Hydrocarbon Processing, "Integrate the HPI Interface" (Chemical Systems Inc., 1970) quoted in B. Mostofi, p. 164.

<u>The petroleum based and energy intensive "push"</u>.[1] The government development plan can best be rationalized by the Hirschman thesis of unbalanced growth, using a "big push" investment strategy. The main focus is on industries using hydrocarbons for feedstock and industries requiring large inputs of fuel for energy. The principal criteria for selecting a project are its contribution to employment, net value added, the foreign exchange savings expected, its level of utilization of local materials, and the marketability of the product. Unfortunately each project is evaluated on an independent basis with little more than a back of the envelope approach to examining whether the industries selected will collectively make the maximum contribution to the structural transformation of the economy over time. This is an area of major weakness in the government's planning.

At the beginning of 1976 the government had several petroleum-based and energy-intensive projects either under study or in progress. The total capital cost of these projects is expected to be T.T. $7.2 billion (Table 8.4). Even at the greatly increased flow of tax revenues from the oil industry government would not be able to meet the annual outlays required by all these projects and at the same time finance its other commitments.[2] As may have been expected, therefore, its "big push" approach to development created severe pressures

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[1]"Push" here means the "Big Push" in the unbalanced growth sense of the term. In that context the take-off to self-sustained growth can result from "one or a few big projects or from a large number of projects of varying size that dovetail with one another." Hirschman, p. 51.

[2]Recurring expenditures and development expenditures - see Appendix 8-A.

TABLE 8.4

CAPITAL COST OF PETROLEUM-BASE AND ENERGY-INTENSIVE PROJECTS BEING STUDIED OR IN PROGRESS AT 1976

In progress	T.T. $ mn
1. Fertilizer joint-venture with W. R. Grace (Tringen)	207
2. Iron and steel complex	653
3. Polyester fibre complex	85
4. Furfural plant	40
5. Fertilizer joint-venture with Amoco	759
6. Natural gas pipeline	85
	1,829
Under study	
7. Upgrading and expansion of Trintoc refinery	300
8. Olefins/Aromatics petrochemical complex	2,000
9. Aluminium smelter	662
10. LNG	2,310
11. Petrochemical joint-venture with Texaco	122
	7,223

Source: Government of Trinidad and Tobago, Budget Speech 1976, pp. 5-6.

for current cash flows that could weaken the government's bargaining position with the oil companies.

Bottlenecks in capital, material, and skilled manpower made it impossible to implement all the proposed projects within the 1975 to 1979 planning period. The government has, therefore, established the following project priorities for that period: (1) Tringen, (2) the iron and steel complex, (3) the polyester fibre complex, (4) a furfural plant, (5) fertilizer joint-venture with Amoco, (6) natural gas pipeline, (7) cement expansion. In addition to these projects there are service and utility facilities required to complement these industries: (1) power generation expansion, (2) Point Lisas estate development - roads, and (3) Caroni-Arena and designs for North Oropouche water development. With respect to the other projects such as aluminium, Trintoc's refinery expansion, the olefins/aromatic petrochemical complex, and LNG, further analysis and evaluation as well as engineering studies are being undertaken before final decisions are made. Our analysis in Chapter 5 suggests that the government should not expand refining capacity any further along traditional lines. However, there is need for rationalizing the use of existing refinery capacity in order to optimize output slates. With respect to the production of olefins or aromatics, Ali points out that the deficiency of higher hydrocarbons in Trinidad natural gas precludes the use of the gas as a raw material for olefins manufacture. He argues that should a large-scale LNG plant be established ethane-plus fractions may be used as a supplemental feedstock for olefins production. However, the quantities of this hydrocarbon that can be obtained from the Trinidad natural gas are very limited.[1]

Table 8.5 below shows total annual expenditure on projects which were given priority during 1976. The total estimated expenditure for the period 1975-1979 is T.T. $2,522 million, a formidable package by any standard. What are some of the benefits to be derived from these capital expenditures? It is expected that the total number of new jobs created over the period 1976-1979 will be in the order of 9,000 of which 3,000 will be permanent.[2] The direct employment benefits seem quite small relative to the large capital outlay. It, therefore, raises some questions as to the effectiveness of the policy. One must, however, take into consideration that it may take surplus skilled labour off the old land concessions thus reducing private and social costs: at present the government pays a production subsidy to the oil companies of about U.S. $2.00 per barrel of crude in order to maintain the employment levels in inland crude production. Also the induced employment multiplier effect associated with these large capital investments may be fairly significant, probably two to three times the direct permanent employment.[3] The group of industries is expected to provide a major stimulus to the domestic gas industry and to create new sectors within the economy such as spinoffs from the petrochemical industries and the iron and steel complex. The long-

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[1]Ali, p. 81.

[2]Government of Trinidad and Tobago, Budget Speech 1976, pp. 22-23.

[3]See Kari Levitt, Input-Output Study of the Atlantic Provinces, 1965, vol. 1 (Ottawa: Statistics Canada, June 1975), Table 4.34, p. 235. Estimates above based on employment multipliers for the steel and metal manufacturing, and non-metallic minerals sectors in Nova Scotia.

TABLE 8.5

FORECAST OF EXPENDITURES ON PETROLEUM-BASE AND ENERGY-INTENSIVE PROJECTS, 1975-1979

	Forecast expenditures T.T. $ million
1975	92
1976	455
1977	649
1978	801
1979	525
Total	2,522

Source: Government of Trinidad and Tobago, Budget Speech 1976, pp. 4-8.

term multiplier effect may, therefore, be greater than suggested above.

Because of the demand that this long-term policy of development makes on the known gas reserves[1] the government suspended its decision with respect to the signing of a long-term contract to supply the U.S. with gas in the form of LNG pending "a more extensive identification of supplies."[2] To quote Prime Minister Eric Williams, it is "not merely the question of producing ... gasolene or aviation fuel, where in the very nature of things we would have to export the largest part of what we produce,"[3] but emphasizing it is first for Trinidad's petroleum-base and energy-intensive industries. This

[1]In 1974 the known reserves were reported to be able to produce 500,000 MCFD for twenty-five years. The industrial energy and petroleum base enterprise being developed is estimated to need 446,000 MCFD per day by 1983 (see Chapter 5, p. 136).

[2]Trinidad Guardian, "White Paper on Oil Coming," March 10, 1974, p. 18.

[3]Ibid.

brings us back to a consideration of a question raised earlier, namely, whether the export of natural gas and crude as unprocessed resources is more consistent with an optimal strategy of development than the use of these resources as the nucleus of a domestic industrial complex for further processing. It is usual to invoke the powerful value added criterion to support the case for further domestic processing of primary products. A formidable counter-argument, however, is that inefficiencies in the underdeveloped country or the inefficiency of government bureaucracy (in the case of government ownership) may reduce the benefits of the second option below those which may have occurred if the raw resource were exported without processing and the rents collected and invested elsewhere in the economy. The solution to the problem of inefficiency in underdeveloped economies is to explicitly plan for improvements in labour and managerial skills as a part of the development process. Since Trinidad government investments in human capital have been very substantial and carefully planned, the labour force is very flexible and adaptable to new technology. There is no reason that the same labour force cannot become as efficient in the downstream operations as in the upstream operations. Moreover, a government enterprise in competitive world markets will have to adopt management styles which are flexible and efficient if it is to stay in business. It is in the domestic market where such a company may have a monopoly, that waste and inefficiency may be tolerated because of political expediency.

A joint-venture company involving government, domestic and/or foreign enterprise can provide a variety of managerial structures capable of eliminating the inefficiencies and weaknesses inherent in government-owned monopolies. The joint-venture enterprise in which government has the majority share gives government the potential for control over policies relating to transfer prices and interaffiliate charges. At the same time it can make available the technical and managerial "know-how" that is essential to the efficient operation of the company. In the case of Trinidad Tesoro Petroleum Company Limited the government chooses the Chairman of the Board, and the rest of the Board is split evenly. The Managing Director is an expatriate but all the other senior staff and personnel are Trinidadians. Management makes the day-to-day decisions; and conflict about policy at this level is resolved at the Board level. Government is, therefore, in a position to prevent unwarrented transfers of earnings abroad.

A major cause for concern is that government participation may enhance the position of foreign investors in the country when public bodies are associated in a minority position with foreign firms and these firms expand without a corresponding shift in control. Even when government holds majority interests certain safeguards are required with respect to the control of equity at all times. The Trinidad government in its White Paper[1] on public sector participation in industry recognizes the need for government to create the mechanisms necessary to achieve an orderly transfer of assets to nationals, to study the state of the market in respect of divestment by private

[1]Government of Trinidad and Tobago, White Paper on Public Participation in Industrial and Commercial Activities, p. 13.

companies, to control sales of shares to the public to prevent excessive sales to foreigners and to ensure that shares are not distributed in such a way that the minority foreign interest effectively controls the company. A strategy of government participation with 51 per cent or greater equity minimizes the dangers of foreign control, providing the national interest is expertly represented and skillfully exercised. Thus the Trinidad government's policy of participation, while it is a mixed strategy of full, majority and minority ownership in certain key industries in the economy, places major emphasis on full ownership and joint-venture arrangements in which it has a majority shareholding of existing shares. At 1975 seventy per cent of government equity holdings in commercial enterprises represented fully owned interest (Table 8.6) and 18 per cent represented majority participation in joint ventures. The hydrocarbon resource base industries represent 57 per cent of government equity in these enterprises. Most of this (48 percentage points) was accounted for by the fully owned Trinidad and Tobago National Petroleum Marketing Company and Trintoc; and the rest (9 percentage points) by its majority participation in Trinidad-Tesoro, Tringen, Furfural Company Limited, Iron and Steel Company, and its minority participation in the gas pipeline.

The total net direct and indirect benefits derived from government taxation of oil and expenditure of oil revenues must be assessed not only in terms of its capital expenditures but its recurrent expenditures as well. However, a complete assessment of present strategies must await the future when the new projects out-

TABLE 8.6

GOVERNMENT EQUITY INTERESTS IN COMMERCIAL ENTERPRISES

BY SECTOR AND TYPE OF PARTICIPATION

Sector	Participation			Total	Value of shares held
	Full	Majority	Minority		Percentage
1. Sugar	1	1	-	2	8
2. Manufacturing (other than sugar)	2	4	2	8	3
3. Communication	3	-	-	3	14
4. Hydrocarbon resource-base industries	2	4	1	7	57
5. Transport, storage, fisheries	2	2	1	5	4
6. Finances	2	3	4	9	7
7. Hotels, tourism, offices	-	1	1	2	7
	12	15	9	36	100
Percentage total shares held	70	18	12	100	

Source: Government of Trinidad and Tobago, Review of the Economy 1975, Appendix 15, pp. 64, 65.

lined above (Table 8.4) begin to operate and data become available in the 1980s. Notwithstanding this, some notion of the benefits derived from total government expenditures, which increased by 244 per cent from T.T. $581.2 million in 1972 to T.T. $2.0 billion in 1976,[1] can be gleaned by an examination of government's role in creating jobs within the economy, and the profitability of enterprises in which it has become involved. In the developing petroleum economy a sort of "wage fund" is created and maintained by government taxation of the petroleum industry. Since employment in the high productivity petroleum sector is very small relative to the capital invested there, then the level of employment depends on the rate of growth in petroleum exports, the movements in the price of oil and the level of local wage rates and salaries, and the rate of taxation. When oil prices decline the wage fund is reduced so that unemployment increases. When wages and salaries increase faster than the rate of increase in petroleum exports at given level of cost and prices, then fewer people can be employed. One would expect, therefore, that one of the immediate benefits to be derived from increasing output and/or prices is the reduction in unemployment. If the wage fund theory holds true for Trinidad then we should be able to get a rough idea of some of the direct benefits that accrue from the government taxation of the oil sector by examining the changes in government revenues from the oil sector in relationship to the change in employment in the government services. In Trinidad, government services accounted for

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[1]See Appendix 8-A.

12.3 per cent of all persons with jobs in 1956, 15 per cent in 1969, and almost 16 per cent in 1971. Between 1956 and 1967 the increase in the number of persons employed in Trinidad was approximately 60,000 of which government accounted for 16,000 or 26.7 per cent (Table 8.7). In the period 1967 to 1971 approximately 9.2 thousand were added to employment while the labour force increased by only 4.1 thousand; that is, unemployment was reduced by about 3,000-4,000. The increase in government employment (8,100) accounted for almost all net employment in this period.

In the period 1956-1967 the economy grew rapidly up to 1961. It declined between 1962 and 1969. The decline was due to a slow down in the oil sector as well as the manufacturing sector. However, government revenues from the oil sector increased at a rate of 8.3 per cent per annum throughout 1956-1967 (Table 8.7) as compared with a rate of 15.6 per cent from other sources. By contrast, during the period 1967-1971 government revenues from the oil sector increased at only 3 per cent while revenues from households and other sectors increased at a rate of 20.3 per cent. Corporate (non oil) and personal income taxes increased at a rate of 24.2 per cent per annum during this period, in part reflecting the fact that the pioneer industries, established in the mid-1950s and early sixties, were now paying taxes. One can conclude on the basis of the above discussion that while government expenditures out of the "wage fund" in the mid-fifties and early sixties did have a significant impact on the improvement of the quality of life through their direct contribution to employment, oil was not the only major contributor. However, the growth in government tax

TABLE 8.7

RELATIONSHIP BETWEEN CHANGES IN EMPLOYMENT AND

GOVERNMENT REVENUES 1956-1967, 1967-1971

	1956-1967	1967-1971
1. Change in labour force (000s)	96.6	4.1
2. Increase in persons employed (000s)	60.0	9.2
3. Increase in government employment (000s)	16.0	8.1
a. Manual	-	2.5
b. Administrative, technical and other	-	5.6
4. (3) as a percentage of (2)	26.7	88.1
5. Annual rate of change in government revenue (%)	15.9	14.5
a. Rate of change in oil sector contribution (%)	8.3	3.1
b. Rate of change in households' and other sectors' contributions (%)	15.6	20.3

Sources: Government of Trinidad and Tobago, C.S.O., Labour Force, Publication nos. 1, 2, 4, 20 and 30.

Government of Trinidad and Tobago, Economic Survey of Trinidad and Tobago 1953-1958 (Economic Planning Division and C.S.O.), December 1959, pp. 84-87, 110-117.

Government of Trinidad and Tobago, C.S.O., Annual Statistic Digest, 1963, 1971, 1972.

Government of Trinidad and Tobago, Third Five-Year Plan 1969-1973.

Table 8.3.

revenues from the early (1956-1961) expansion in the oil industry made it possible to provide the initial necessary infrastructure and make tax concessions, which attracted a considerable number of new manufacturing enterprises during the mid-fifties and early sixties. The rapid decline in the rate of growth in oil taxes was therefore compensated for by increases in tax revenues from households and these pioneer industries in the following period. Thus it was possible for government, in spite of the stagnation of the private sector between 1964 and 1968, to build up a "wage fund" which it used to decrease the absolute level of unemployment between 1967 and 1971, thus keeping the rate of unemployment at about 10 per cent.

Perhaps one of the most significant achievements of the government after 1967 derives from its aggressive implementation of its Work Permit policy which advocates the promoting of Trinidadians to higher levels of decision making in key sectors of the economy. It accomplished this partly through a policy of public participation in the private sector and through the close monitoring of foreign companies. In the oil sector the upward advance of Trinidadians into the higher echelons of the oil companies has been very significant in all functional areas since 1968. Comprehesnive data on employment in the Trinidad oil industry by activity, job classification, and nationality are not available prior to 1970; however, Table 8.8 shows the steady decline in importance of expatriates in technical, professional and administrative jobs, in all activities. This is particularly noticeable in marketing and refining. For refining the employment of expatriates in those positions declined from 4.5 per

TABLE 8.8

EMPLOYMENT IN THE TRINIDAD OIL INDUSTRY

BY JOB CLASSIFICATION, NATIONALITY AND ACTIVITY

Year and nationality	Production Technical, professional, administrative	Refining Technical, professional, administrative	Marketing Technical, professional, administrative	General Administrative	Total
1970					
Nationals	92.5	95.5	96.8	97.3	98.1
Expatriates	7.5	4.5	3.2	2.7	1.9
Total	100.0	100.0	100.0	100.0	100.0
1973					
Nationals	93.1	97.4	96.1	97.7	98.1
Expatriates	6.9	2.6	3.9	2.3	1.9
Total	100.0	100.0	100.0	100.0	100.0
1975					
Nationals	93.5	98.3	100.0	98.5	98.7
Expatriates	6.5	1.7	-	1.5	1.3
Total	100.0	100.0	100.0	100.0	100.0

Source: Appendix 8-B.

cent in 1970 to 1.7 per cent in 1975, as compared with production where it declined from 7.5 per cent to 6.5 per cent. The rapid decline of expatriates in marketing and refining reflect the government's takeover of Shell and almost all domestic marketing of petroleum products.

After 1970 the percentage share of oil revenues in total government revenues rose from 24 per cent to 68.7 per cent in 1975 (Appendix 8-A). From the large current account surplus that built up government created a capital fund for long-term projects aimed at the structural transformation of the economy. Net additions to this fund were T.T. $244.4 million in 1974 and T.T. $830.1 million in 1976. Appropriations from these funds were used for the purchase of existing industries from foreigners (Shell, Texaco service stations, B.W.I.A., etc.), the development of energy base industries and the financing of major institutional and structural changes in the economy, i.e., the establishment of the Institute of Marine Affairs, The Petroleum Institute, and the development of industrial sites and services. This brings us back to the point of looking into the future with all its uncertainties: will the long-run options chosen optimize the net benefits to the country over time? As stated earlier, a complete answer will have to await the availability of more information. However, one can assess the government's strategy of nationalizing some existing industries or purchasing controlling shares in them. While the level of profits may not be the only measure of success, it gives some idea of the effectiveness of the policy, for ultimately government will have to re-evaluate any strategy for maintaining employment levels in these industries in terms of the net cost to the society.

Three of the companies in which government held full and majority participation earned an after-tax profit of T.T. $110.1 million for the financial year ending nearest to 1975.[1] Seven of the fully owned companies together made aggregate after-tax profits of T.T. $21.2 million while four made losses amounting to T.T. $17.5 million. Trintoc accounted for over 88 per cent of the aggregate after-tax profits and British West Indian Airways for 91 per cent of total losses. The book value of government's equity in these wholly owned companies amounted to T.T. $156.6 million at the end of 1975. No dividends accrued to government from these companies.[2]

In 1975 seven of the companies in which government held majority interest made a total after-tax profit amounting to T.T. $97.9 million while three made losses amounting to T.T. $0.4 million. Trinidad Tesoro Petroleum Company Limited accounted for 95 per cent, or T.T. $93.2 million, of the total after-tax profits and this company paid a dividend of T.T. $7.6 million to government. Government's equity holdings under this category amounted to T.T. $36.1 million. No other company under this heading paid dividends to government.[3]

It is not possible, given the state of the arts and the available data base, to use a more rigorous and fully dynamic mathematical model to select the optimal government strategies.

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[1]Government of Trinidad and Tobago, Review of the Economy 1975, Appendix 15, pp. 64-65.

[2]Ibid., p. 30.

[3]Ibid.

Nevertheless the analytic approach in this chapter provides a basis for evaluating existing policies. It suggests that prior to 1970 Trinidad government policies with respect to the control and taxation of the petroleum sector were clearly sub-optimal. Changes in petroleum legislation and government administration of the petroleum affairs in the early seventies have improved this situation but in general government has not taken full advantage of the swing in power towards it. This may be due to the high demand for cash flows to finance its industrial "push". However, considering the problems of transforming the economic and social structures of a small petroleum economy it would seem that a government policy of industrial diversification and the taxing away of the surpluses earned in the hydrocarbon sector to develop the rest of the economy does in part conform to an economic logic which recognizes the long-term problems of growth in such an economy. It is also difficult to see, given the revealed preferences in the society for a greater degree of sovereignty and hence control of the economy by the citizens, how the government could avoid direct participation, at least as an initial step towards effecting the transfer of control of the national resources from foreign to local hands.[1] The participation of the government in key industries covering a wide cross section of the economy (Table 8.6) and the imposition of carefully monitored constraints on foreign investment can bring about a significant transformation of the neo-colonial structures imposed on the economy by foreign capital. In the oil sector the government seems to be making

[1]The general social unrest and riots in Trinidad during 1970 were clearly directed against foreign capital and interests.

significant progress. Finally, in such a tiny open economy a successful "big push" strategy, in which the hydrocarbon resources represent the major poles of growth, will require a more systematic approach to planning than exists at the moment if unnecessary waste due to poor implementation and timing of projects is to be avoided.

CHAPTER 9

SUMMARY AND CONCLUSIONS

Prior to 1956 the Trinidad oil industry was operated as an extension of the commercial and military interest of the British metropole. The country was granted internal self-government in 1956; and a nominal independence in 1960: the responsibility for governing was now vested in the local government, but the power to control the major national resource on which the nation depended remained with foreign interests - Shell International, B.P. International and Texaco International.

On the eve of independence the British sold major oil assets in Trinidad to the Texas Oil Company without involving the local government (PNM). This, plus the 1941 Agreement authorizing the U.S.A. to maintain military bases in Trinidad, led Eric Williams to say "Chaguaramas means reversion of our soil and resources". This set the political background against which the oil industry was to develop. The government chose to fight the "war" with the Americans over land rights, but carefully developed a cordial relationship with the oil companies. There are several reasons for this. (1) It could not risk disrupting the flow of oil revenues which it needed to finance the cost of running the country. (2) It lacked the knowledge, expertise, and access to foreign markets essential for the viability of the oil industry. (3) It feared retaliation from the American government if it moved against American interests. (4) The government was committed to a capitalist form of economic development financed by foreign investment. It, therefore, saw its role as providing the infrastructure, and general social and political atmosphere that created the greatest incentive to foreign capital, especially in the oil sector.

The government's abysmal lack of knowledge about the oil industry was a reflection of the dualism in the Trinidad economy resulting from the disproportionate dependence on the petroleum sector and its total control from London. Several reports advised the government to hasten to improve its knowledge and control of the industry. Between 1956 and 1970 it took a series of initiatives which led to the introduction of new petroleum regulations. In general, however, the oil companies during the period 1956-1968 conducted their business with little or no direct control from the government. In the late sixties the Trinidad government still obedient to the classical concepts of the market, but mindful of the need for intervention, preferred to use the instrument of persuasion to cause the oil companies to adjust their investment plans to the development needs of the country, but the companies responded directly to the orders from their headquarters located in England and the U.S.A. These directives were mostly intended to facilitate the maximization of the global profits of the parent company and not necessarily the net social benefits of Trinidad. The government consequently switched to a conflict model for bargaining with the companies and took a more direct role in the redirecting of surpluses earned in the petroleum sector into the development of the rest of the economy.

The change in the attitude of the Trinidad government from a passive to an aggressive bargaining strategy was facilitated by the general world-wide swing in power from the oil companies to oil producing countries; the discovery in Trinidad of new hydrocarbon resources with which it could bargain, and the growth of technical expertise in the country. In 1960 OPEC was created to counteract the power of the international oil companies and maximize its members' share of the surplus profits earned in the world oil market. In 1971 the Tehran Agreements set the stage for the full transfer of the control of the oil resources back to the host countries. Trinidad, while not a member of OPEC and despite its small size, benefited from OPEC's leadership. It, therefore, found itself in a position to make similar claims against the oil companies operating in its territories, subject, of course, to the peculiar conditions pertaining to its oil industry.

The discovery of new hydrocarbon resources in Trinidad in the 1970s made Trinidad very attractive to the oil companies as an oil and gas exporting country. Prior to these discoveries it could not easily rearrange the terms of the old agreements with the established oil companies; but by introducing competitive bidding amoung the companies it increased its power and was thus able to establish new conditions more favourable to the country. The Petroleum Act 1969 set out these conditions. It reflected the highly improved bargaining position of the government, and greatly improved the net cash flows from the oil industry in Trinidad.

In the period 1956-1961 the Trinidad oil companies, despite their claims to the contrary, made a good return on their capital and also earned surplus profits. On the other hand, government's share of the total rents earned by the sale of Trinidad's hydrocarbon resources was estimated at 51 per cent, well below a possible tolerable limit of 70 per cent (CP). Between 1970 and 1976, however, the net cash benefits accruing to the country improved considerably, reflecting the application of the new petroleum legislation and more astute and aggressive government bargaining. The improvement in the government bargaining owes much to advantages of geography and the political stability of the country. For instance, Trinidad's social stability and political commitment to the free enterprise market system make it a very low risk area. The ~~advantages~~ that its political stability affords may be minimized by the small size of its oil resource base relative to Venezuela and the Middle East countries, but its closeness to the U.S. East Coast market for refined products gives it a comparative advantage in transportation over European and Middle East refiners. It is largely because of its stability, its easy access to large supplies of crude in Venezuela and Colombia, and its comparative transportation advantage, that in the late fifties and early sixties both Shell and Texaco shifted major refining operations from the Middle East (a high risk area) to Trinidad where taxes were more favourable and the likelihood of being nationalized (at the time) was considerably less. The companies derive other benefits from locating in Trinidad. The refining operations benefit from the existence of local supplies of crude oil and very significant natural gas deposits, as well as external economies resulting from government infrastructural expenditures, and the existence of utilities such as the manufacture of hydrogen, and adequate supplies of cheap power.

These comparative advantages serve, as it were, to create dependencies by the oil companies on Trinidad, which in the existing conflict bargaining situation expose them to the government's exercise of power. For instance, while it is true that Trinidad could not easily find alternative markets for Texaco's output if it were to nationalize Texaco, yet Trinidad is very important to Texaco's marketing strategies in the Western Hemisphere. That company has expanded its operations in Trinidad to the point that the opportunity cost of locating elsewhere would be very great both in terms of the capital replacement cost and the lack of alternative locations in the Caribbean with comparable cost saving economies and complementaries (in the broadest sense of the term).[1] In addition to refining, Texaco's production operations in Trinidad are an important part of the Texaco global network of production facilities. The nationalization of the oil industry in Venezuela and the Middle East countries makes Texaco's exploration and production operations in Trinidad even more important to the parent company, and hence makes the company more vulnerable to government action.

Until recently Shell Trinidad was a defensive market operation in the western market for the parent company. It made good profits and was not willing to go out of business in Trinidad. The

[1]Hirschman, pp. 67-68.

growth in the Trinidad government's competence and power made the nationalization of Shell a relatively easy operation and in a sense underlined its weakness in the economy of Trinidad. Even Amoco, for all the reverence with which Trinidad citizens regard it, has its major weaknesses which are exploitable by even a small country like Trinidad. With oil and gas reserves which are estimated to have a life of one hundred years at present rates of output (125,000 barrels of crude per day and a potential output of 500 million cubic feet of gas per day), Trinidad, in Standard Oil's (Indiana) global situation, is a bonanza which it cannot easily ignore.

While, therefore, in the fifties and sixties the Trinidad "majors" had great power and the backing of the powerful metropolitan governments, by 1970 this power was whittled down by an aggressive decolonialization process, the growth of knowledge about the industry (accumulation of human capital stock), and the exploitation on an individual basis of the weaknesses and gaps in the network of the global operations of the multinationals. By 1970 Trinidad could successfully confront the oil companies and force them to observe new petroleum legislation that gave the government much greater flexibility in (1) increasing the net cash benefits from the country's hydrocarbon resources, (2) greater control of and participation of nationals in the development of these resources, and (3) maximum use of these resources for the transformation of the economy. Our analysis of petroleum policies between 1956 and 1976 seems to support the position that prior to 1970 the old policies led to considerable sub-optimization of the net social benefits from the oil industry; but that this has been considerably improved with the introduction of new policies after

1970. Notwithstanding this, the author feels that the analysis in Chapter 8 strongly suggests a more vigorous policy of taxation of the marine oil resources than now exists; however, the present system of tax legislation and mining policies has been largely responsible for the dramatic increases in public funds since 1974. Moreover, this legislation and the government's public sector participation policy has brought about a major shift in control of the industry to local hands. It is perhaps the latter policy and the huge capital that government must find to implement it that is responsible for the continued caution exercised in dealing with the oil companies.

By the beginning of the Third Five-Year Plan (1969-1973) the government had acquired a better grasp of the policy implications of the new economics of the small open petroleum economy. It now knew that in such an economy one could not depend either on the industrialists or the households to save and invest their savings in the country. Past experience had shown that growth in the petroleum sector did not transmit itself automatically to other sectors of the economy and that surplus earnings in the oil sector uncommitted to projects in Trinidad's oil industry were not invested in other sectors but were shifted from oil in Trinidad to oil or something else in, say, Nigeria. Moreover, increases in wages paid in the sector were used up for imports of foreign goods. It was, therefore, essential that government take the initiative to redirect this vast amount of potential savings into projects that would trigger a process that would ultimately lead to self-sustained growth. One of the objectives of the government policy of public sector participation is to use direct participation in a select number of enterprises to create the "big push". It hopes that this will not only transform the petroleum sector but will also create greater linkages with the rest of the economy and transmit growth from the petroleum sector throughout the economy. There can be little doubt that given the economic constraints on the small petroleum economy this strategy provides a feasible solution to the problems of economic development. But the question is whether it is optimal. The question of optimality goes beyond the scope and analytical framework of this thesis, but our analysis allows us to make some critical comment.

The present scale of government entry into commercial enterprise requires a very highly centralized planning unit to co-ordinate the operations and evaluate the contributions to the overall objectives. State capitalism which tries to give the impression of a free enterprise market system by fragmenting the planning process will lead to confusion, conflict between ministries, and between ministers and high ranking civil servants placed in the multiplicity of directorships. The end result is poor planning and inefficiency. To facilitate a more co-ordinated or systematic government approach one needs a continuous series of national income statistics derived from the type of input/output model that through the disaggregation of the input/output multipliers permits an examination of the (negative) influence of foreign trade on the degree of interdependence as well as the contribution to inderdependence of various industries.[1] Beyond

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[1]See Kari Levitt, Input-Output Study of the Atlantic Provinces, 1965.

this there is the need for a more dynamic and comprehensive planning model which would allow an assessment of the improvement in structural interdependence that can be expected from the addition of various enterprises in certain sectors, or structural changes in a particular sector. For instance, it would permit an examination, under different assumptions with respect to availability and level of skills, of what the total change in the inter-industry system would be if structural changes in the petroleum sector were such that there was a reduction in export of gas and petroleum in favour of domestic demand for its use as feedstock for further processing or in energy intensive industries. It would permit a stage by stage analysis of the degree of transformation that could be expected from the implementation of projects of the government participation programme, and perhaps give new insights into the problem of economic planning in the small petroleum economy.

In the absence of such a model, however, one can still reach general conclusions based on the brief theoretical discussion presented in Chapter 3. The logic of the argument presented there leads one to conclude that while it is difficult without the comprehensive dynamic model suggested above to say which one of a large number of possible industries one should choose in practice to accelerate the process of industrial transformation, or indeed whether this can be fully achieved, it is clear that surplus earnings from the petroleum sector must be taxed according to some optimal system and used to create new poles of growth and ultimately the highest degree of sustained growth possible given the openness of the economy. In this sense the creation of industries which are linked to the hydrocarbon sectors is desirable. Expansion along the petrochemical interface offers a number of possibilities for further industrial development. There are also a considerable number of spin-off activities associated with the iron industry. However, the domestic markets are too small to support a full fledge petrochemical and iron products industrial complex. Such industry will have to depend on foreign markets. Competition in the world markets will require a high degree of efficiency and levels of productivity in these industries. Government investment of oil revenues in the creation of managerial and entrepreneural skills, and technological research is, therefore, consistent with the future demands that this development strategy will make upon the labour force and society.

World petroleum market conditions also support the strategy of expanding along the petrochemical interface. There is a growing demand for petrochemicals in the world and in particular in the U.S.A. where natural gas is in short supply. Also U.S. commercial policies and developments in other refined products markets suggest that the expansion of the refinery industry in Trinidad in terms of energy products is very limited. The strategy of transforming the sector so that it reflects a higher percentage of chemical products as opposed to energy products, not only creates greater linkages in the economy but makes a greater contribution to GNP and conforms to market realities.

Government participation within the petroleum industry brings under its control a significant segment of the petroleum resources of the country. It now owns considerable quantities of oil and gas for which it must find a market. A market for gas exists in the U.S.A. but failing that, under its "big push" policy domestic demand is expected to account for a large part (50 per cent) of the potential daily output. In this respect one can already see the government's policy of economic transformation taking shape as dependence on external market factors are reduced.

The nature of gas is such that the system of collection and diffusion of the product is highly centralized in order to minimize waste. On the other hand, government crude oil comes from three sources, Trinidad-Tesoro Petroleum, Trintoc, and its offtake in TNA. Marketing of this crude is not centralized. There seems to be good economic justification for greater co-ordination and synchronization of the production and refining operations, not just between Trintoc and Trinidad-Tesoro, but between these two and Texaco. This would have the clear advantage of rationalizing government's petroleum assets, strengthening the country's control of its petroleum resources and improving the market position of the government oil and petro-chemical enterprises by creating a better balance between its production and refining operations. It would also maximize the benefits to the country by internalizing the economies in scarce marketing "know-how" controlled by Texaco International.

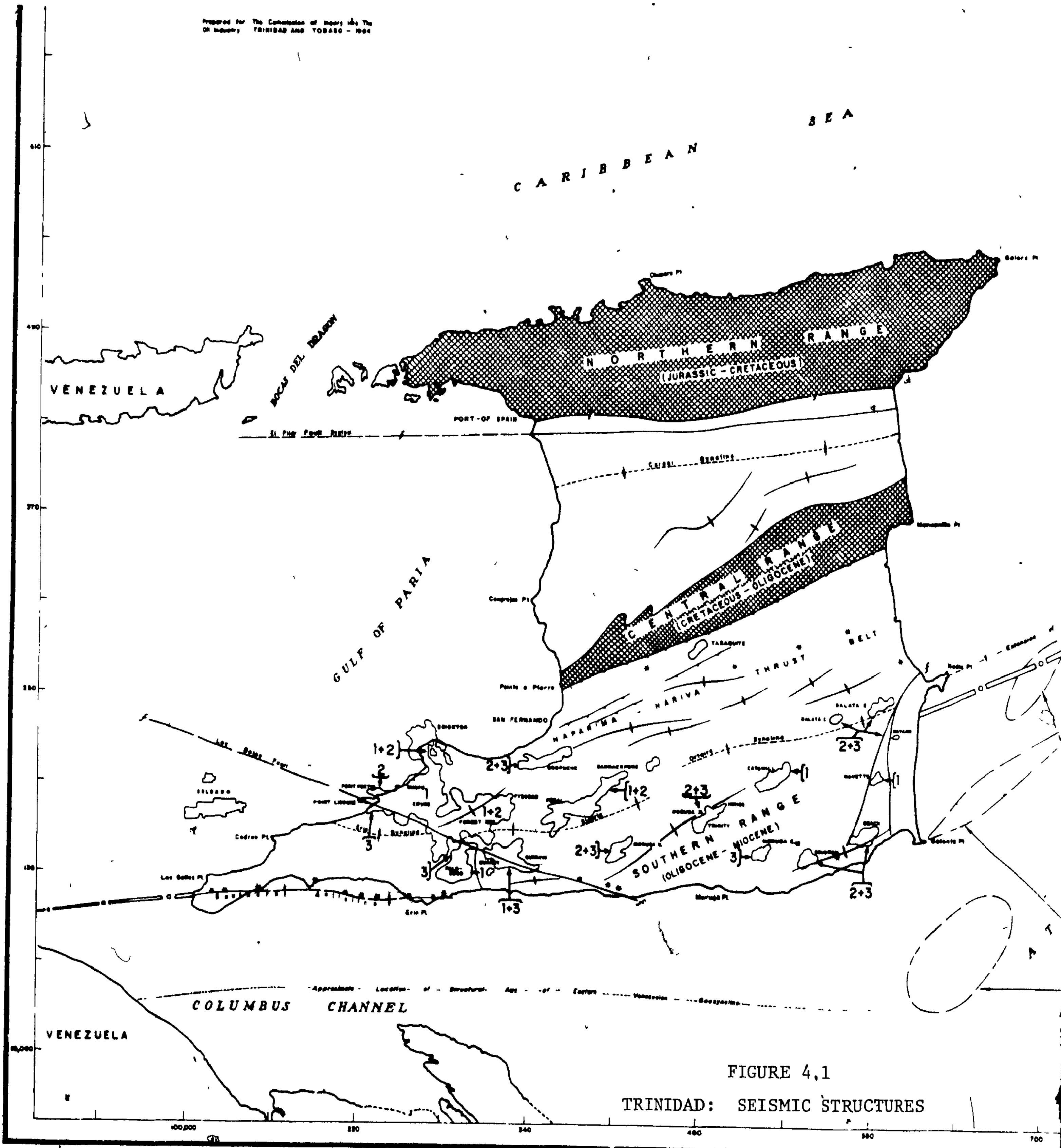


FIGURE 4.1

TRINIDAD: SEISMIC STRUCTURES

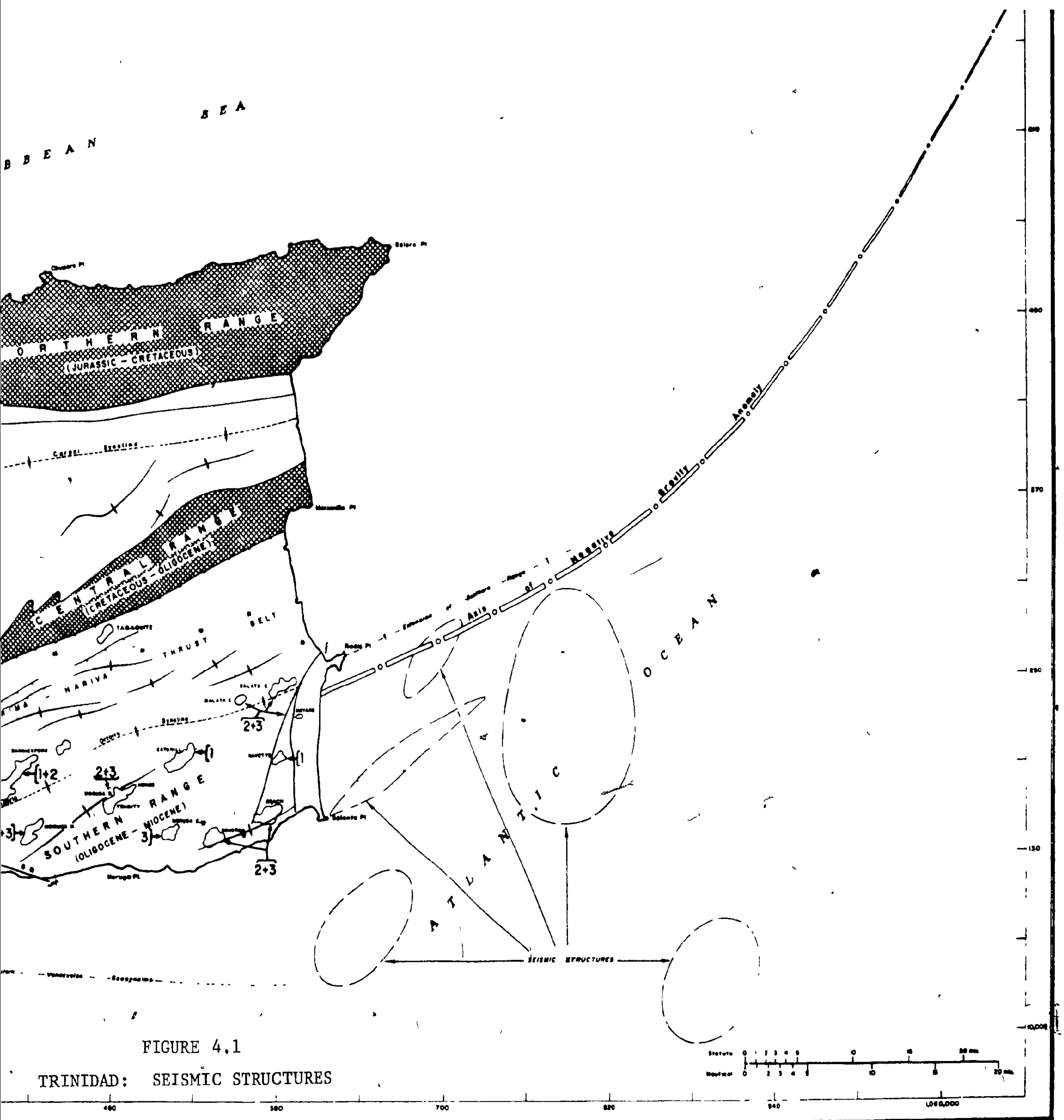
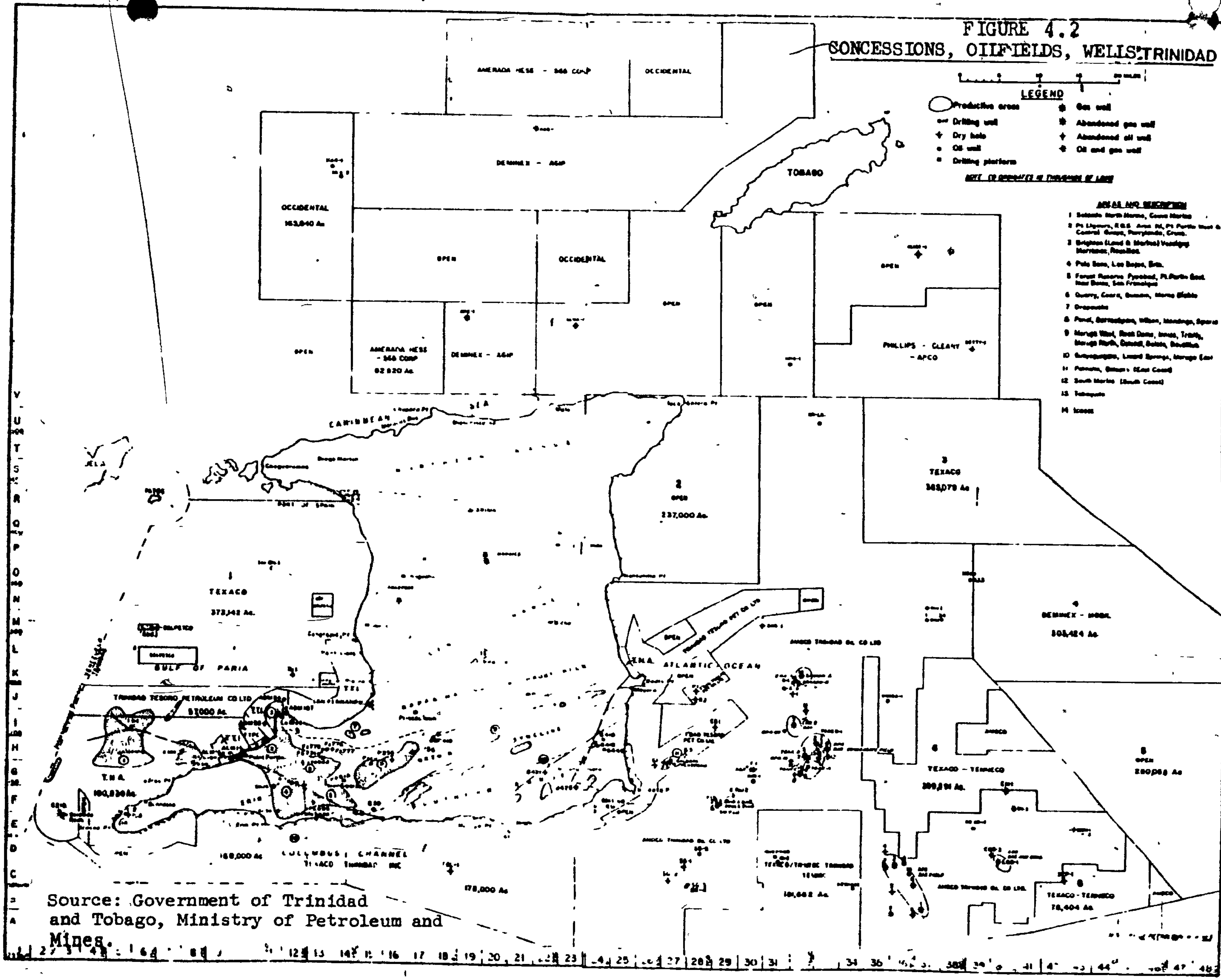


FIGURE 4.1

TRINIDAD: SEISMIC STRUCTURES

FIGURE 4.2
CONCESSIONS, OILFIELDS, WELLS: TRINIDAD



Source: Government of Trinidad and Tobago, Ministry of Petroleum and Mines.

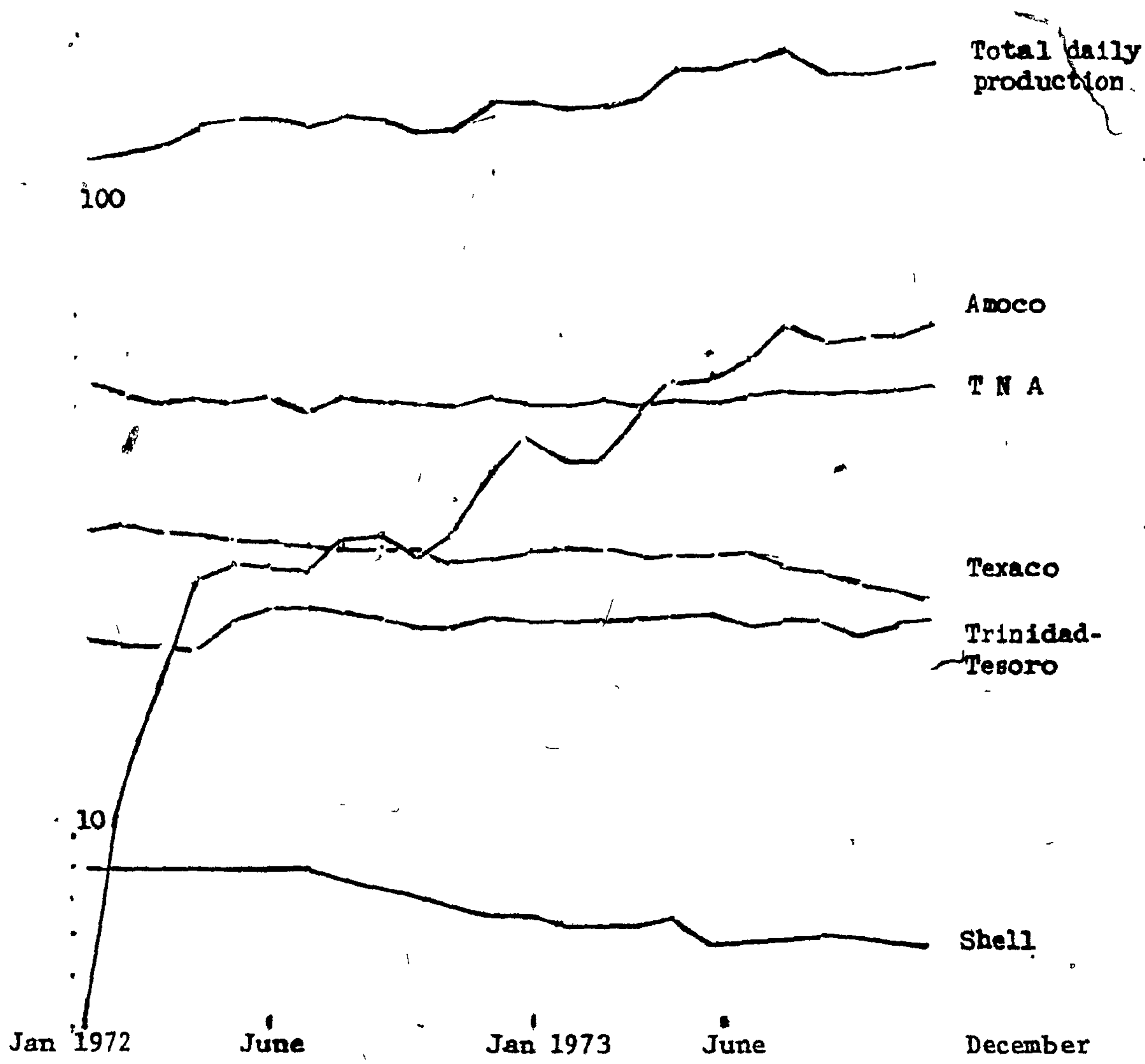


FIGURE 4.3

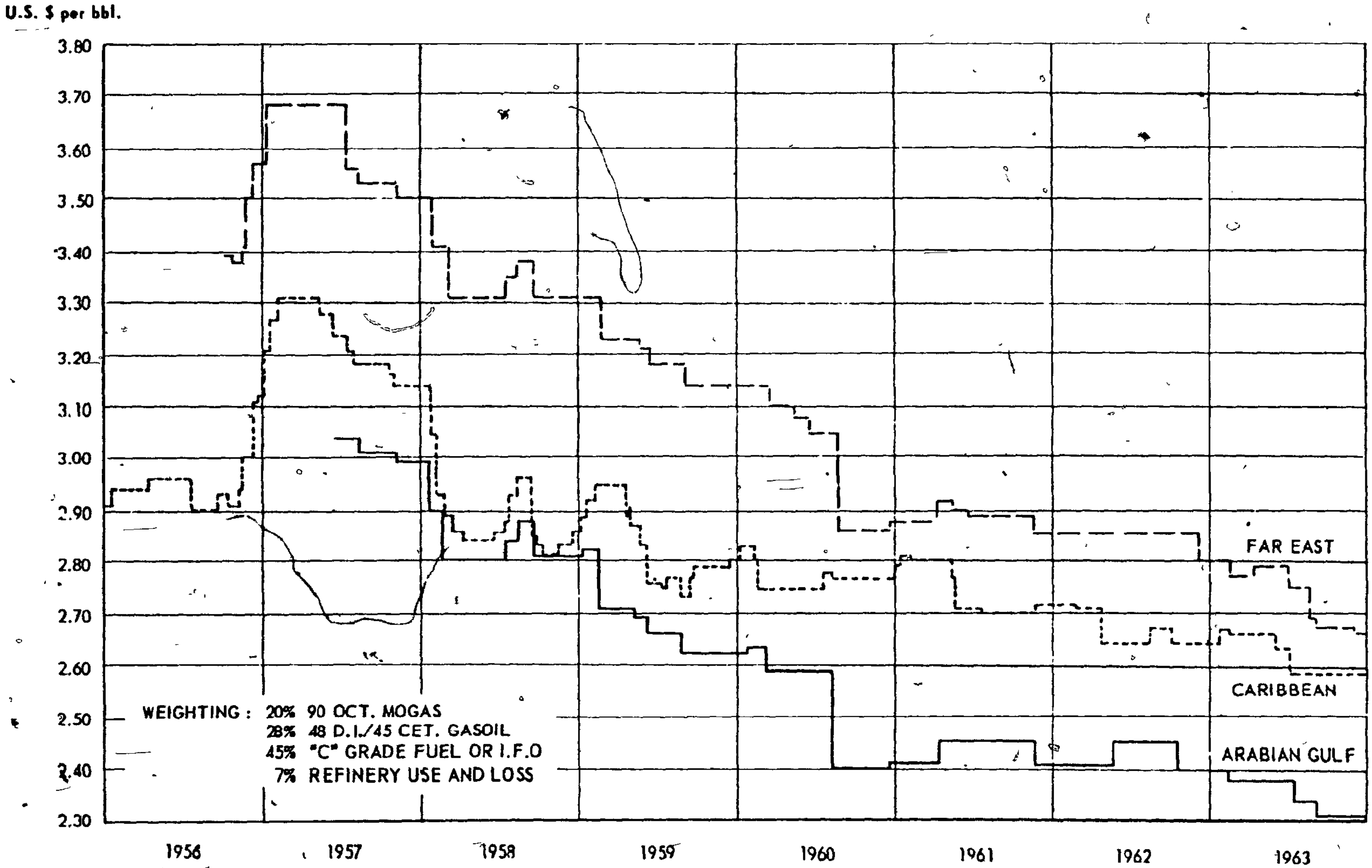
DAILY CRUDE PRODUCTION MAJOR COMPANIES

TRINIDAD - OOO BARRELS

SEMI-LOG 3-CYCLE.

FIGURE 4.4

WEIGHTED AVERAGE PRODUCT POSTED PRICE TRENDS 1956-1963

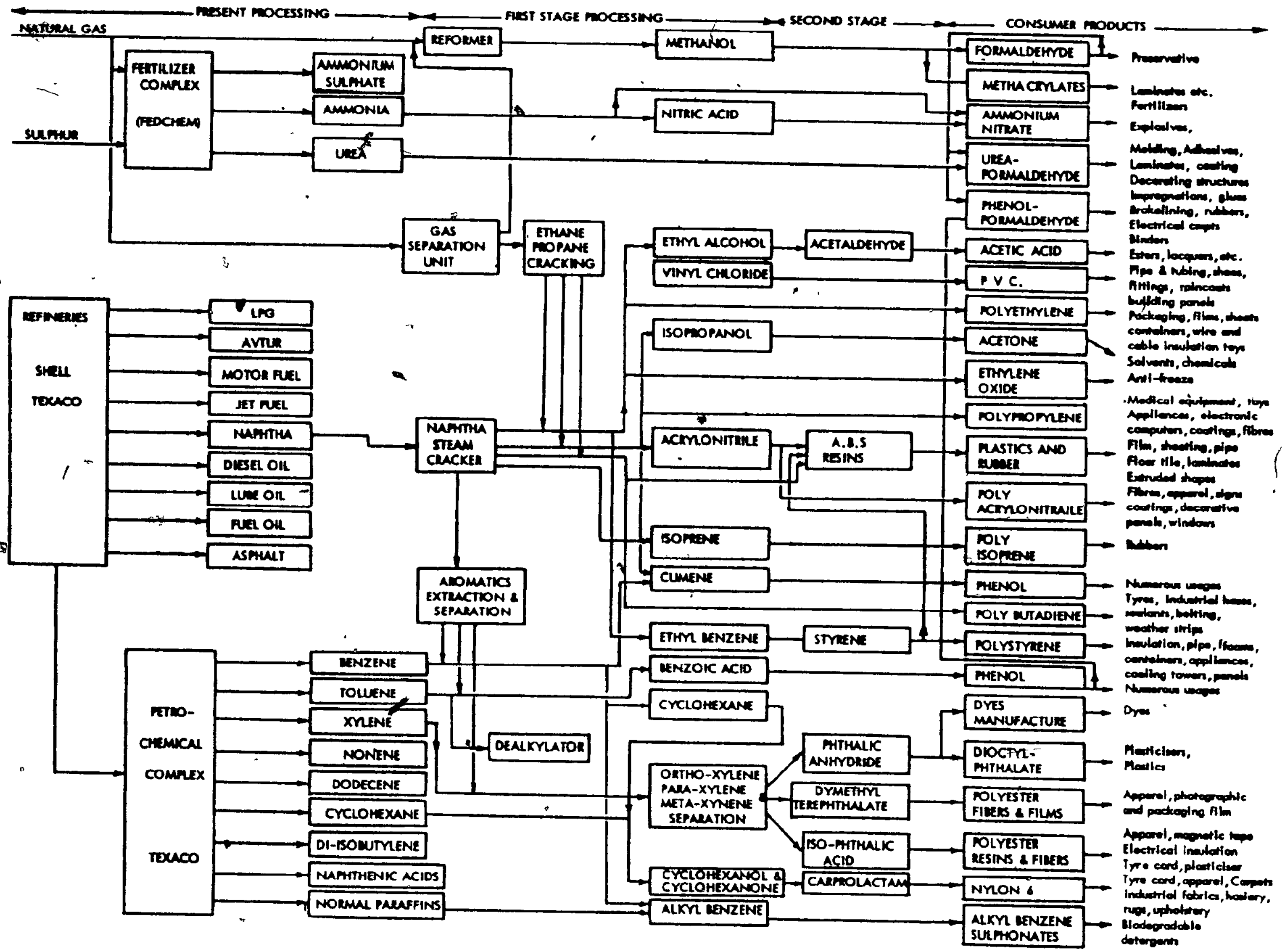


Source: SHELL INTERNATIONAL PETROLEUM CO. LTD.

FIGURE 8.1

PETROCHEMICALS PRODUCTION FLOW CHART

PETROCHEMICALS FULL RANGE OF POSSIBLE COMPLEXES



SOURCE: Government of Trinidad and Tobago, Ministry of Finance and The Industrial Development Corporation.

APPENDIX 4-A

CRUDE OIL PRODUCTION, TRINIDAD

TABLE 4-A-1

ANNUAL PRODUCTION OF CRUDE PETROLEUM BY COMPANY TRINIDAD AND TOBAGO 1951-1971

(mm bbls)

	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
1. Texaco Trinidad Inc.	(7.4)	(7.4)	(7.9)	(8.3)	(8.6)	(10.8)	13.3	16.0	17.7	17.2
2. Trinidad Leaseholds Ltd.[1]	6.1	6.1	6.1	6.4	6.4	6.8				
3. Antilles Petroleum Co. (T'dad) Ltd.[2]	0.6	0.7	1.2	1.3	1.3	2.4				
4. Sipana (T'dad) Oilfields Ltd.[3]	0.7	0.6	0.6	0.6	0.9	1.6				
5. Shell Trinidad Ltd.[4]	5.4	5.3	5.4	5.9	6.5	7.3	9.0	8.0	7.4	7.2
6. British Petroleum (T'dad) Ltd. (Tesoro 1969)[5]	(6.7)	(7.1)	(7.2)	(7.3)	(7.5)	(8.2)	8.5	9.3	10.1	10.0
7. Apex (T'dad) Oilfields Ltd.	3.1	3.1	3.0	3.0	3.0	3.0	(3.0)	(3.1)	(2.9)	(2.8)
8. Kern (T'dad) Oilfields Ltd.	0.7	0.8	1.0	1.0	1.0	1.1	(1.1)	(1.1)	(1.1)	(1.0)
9. Trinidad Petroleum Development Co. Ltd.	2.9	3.2	3.2	3.3	3.5	4.1	(4.4)	(5.1)	(6.1)	(6.3)
10. Trinidad Northern Areas Ltd.[6]	-	-	-	0.1	0.4	0.6	1.0	2.0	3.8	6.0
11. Trinidad Canadian Oilfields Ltd.	1.1	1.1	1.5	1.6	1.5	1.6	1.8	1.6	1.5	1.3
12. Premier Consolidated Oilfields Ltd. and Belpetco	0.4	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4
13. Dominion Oil Ltd.	-	-	-	-	-	-	-	-	-	0.2
Total all companies[7]	21.0	21.3	22.3	23.6	24.9	28.9	34.0	37.3	40.9	42.3

APPENDIX 4-A

CRUDE OIL PRODUCTION, TRINIDAD

TABLE 4-A-1 continued

ANNUAL PRODUCTION OF CRUDE PETROLEUM BY COMPANY TRINIDAD AND TOBAGO 1951-1971

(mn bbls)

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
1. Texaco Trinidad Inc.	17.9	18.4	18.4	17.4	17.6	22.8	30.0	29.7	20.6	16.2	13.8
2. Trinidad Leaseholds Ltd.[1]											
3. Antilles Petroleum Co. (T'dad) Ltd.[2]											
4. Sipana (T'dad) Oilfields Ltd.[3]											
5. Shell Trinidad Ltd.[4]	6.4	5.6	5.1	4.9	4.8	4.7	4.3	3.6	3.3	3.0	3.3
6. British Petroleum (T'dad) Ltd. (Tesoro 1969)[5]	10.5	10.3	8.4	9.5	9.7	9.7	9.7	8.4	(7.4)	(7.2)	(7.5)
7. Apex (T'dad) Oilfields Ltd.	(3.2)	(3.2)	(2.5)	(2.7)	(2.6)						
8. Kern (T'dad) Oilfields Ltd.	(1.0)	(0.9)	(0.7)	(0.8)	(0.8)						
9. Trinidad Petroleum Development Co. Ltd.	(6.3)	(6.2)	(5.2)	(6.0)	(6.3)						
10. Trinidad Northern Areas Ltd.[6]	9.4	13.1	15.3	16.6	15.7	17.4	20.4	24.2	25.3	24.1	22.0
11. Trinidad Canadian Oilfields Ltd.	1.2	1.2	1.0	0.9	0.8	0.7	0.7	0.6	0.5	0.4	0.4
12. Premier Consolidated Oilfields Ltd. and Belpetco	0.3	0.3	0.4	0.4	0.3	0.3	0.4	0.3	0.2	0.2	0.2
13. Dominion Oil Ltd.	0.1	0.02	0.03	0.06							
Total all companies[7]	45.8	48.9	48.7	49.7	48.9	55.6	65.0	66.9	57.4	51.1	47.1

APPENDIX 4-A

NOTES TO TABLE 4-A-1

1. Trinidad Leaseholds Ltd. had its name changed to the Trinidad Oil Company Ltd. in 1956, immediately after which it was purchased by the Texas Oil Company of the U.S. The company was renamed Texaco Trinidad Incorporated in 1958.

2. & 3. These companies were acquired by Texaco Trinidad Incorporated (then T.O.C.) in 1956.

4. The name of this company was changed from the United British Oilfields of Trinidad Ltd. to Shell Trinidad Ltd. in 1956.

5. The British Petroleum Company Limited purchased the remaining 50 per cent of the T.P.D. stock in 1956-1957. The B.P. Group comprised Apex (T'dad) Oilfields Ltd., and Trinidad Petroleum Development Company Ltd. B.P. Group was purchased by the Trinidad government and Tesoro Petroleum Company (1969) and a joint-venture company set up (May 1969), Trinidad-Tesoro. The Trinidad government owns 50.1 per cent of the shares.

6. This company is jointly owned by Texaco Trinidad Inc., Shell Trinidad Inc., and B.P. (T'dad) Ltd. (Tesoro, July 1969) as equal partners.

7. Includes Jones/Jad Ltd., production from which is negligible.

Sources: A. Harewood, "The Caribbean Mineral Economy: A Case Study of Trinidad" (Master's Thesis, McGill University, 1969).

Government of Trinidad and Tobago, C.S.O., Administration Reports of the Department of Petroleum.

Norman Girvan, "The Petroleum Industry of Trinidad" (Centre for Developing Area Studies, McGill University, 1969. Mimeographed.)

Work Sheets from the Ministry of Petroleum and Mines, Trinidad and Tobago.

Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Monthly Bulletin, 1964-1971; Annual Report, 1969-1971.

APPENDIX 4-A

TABLE 4-A-2

DAILY AVERAGE CRUDE OIL PRODUCTION BY COMPANY 1972

TRINIDAD AND TOBAGO

(000 bbls)

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Amoco Trinidad Oil Company	5.1	10.9	18.0	26.8	27.8	27.6	27.1	30.8	30.8	28.3	31.3	39.2
Premier Consolidated Oilfields Ltd.	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shell Trinidad Ltd.	9.2	9.1	9.1	9.1	9.1	8.9	9.0	8.8	8.6	8.4	7.5	7.6
Trinidad Northern Areas Ltd.	54.1	52.2	51.2	51.7	51.0	51.5	49.1	52.0	51.1	50.7	50.2	52.5
Trinidad-Tesoro Petroleum Co. Ltd.	21.0	20.9	20.8	20.2	22.8	23.5	23.3	23.0	22.6	22.0	22.0	22.8
Texaco Trinidad Inc.	33.9	34.1	33.3	31.9	30.9	31.3	30.4	30.0	29.6	28.5	28.0	28.6
Tricentrol Ltd.	1.0	1.0	1.0	1.1	1.0	1.0	1.0	0.9	0.9	0.9	0.8	1.0
Total	124.8	128.8	133.9	141.3	143.2	144.2	140.4	145.9	144.0	139.2	140.7	153.1

Source: Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Monthly Bulletin, January-December 1972.

APPENDIX 4-A

TABLE 4-A-3

DAILY AVERAGE CRUDE OIL PRODUCTION BY COMPANY 1973

TRINIDAD AND TOBAGO

(000 bbls)

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Amoco Trinidad Oil Company	44.0	41.8	41.0	48.7	55.6	56.0	59.4	67.5	63.5	64.2	64.9	67.9
Premier Consolidated Oilfields Ltd.	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Shell Trinidad Ltd.	7.6	7.3	7.3	7.3	7.5	6.8	6.9	6.9	7.0	6.8	6.6	6.7
Trinidad Northern Areas Ltd.	50.8	50.0	51.0	50.4	51.0	50.8	52.4	52.9	52.5	51.6	51.9	52.7
Trinidad-Tesoro Petroleum Co. Ltd.	22.6	22.6	22.8	22.7	22.9	23.1	22.1	22.5	22.3	21.3	22.2	22.5
Texaco Trinidad Inc.	28.0	28.6	28.5	27.8	28.1	28.1	28.1	27.7	26.9	26.2	25.7	24.9
Tricentrol Ltd.	0.9	0.9	0.8	0.8	0.9	0.4	0.8	0.7	0.7	0.8	0.8	0.7
Total	154.3	151.6	151.8	158.1	166.3	166.1	170.2	178.7	172.3	171.4	172.5	175.9

Source: Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Monthly Bulletin, January-December 1973.

APPENDIX 4-A

TABLE 4-A-4

TRINIDAD AND TOBAGO ANNUAL CRUDE OIL PRODUCTION

1908-1971

(000 bbls)

Year	Marine production	Marine deviated	Land production	Total production
1908			.004	.004
1909			47.3	47.3
1910			105.1	105.1
1911			221.3	221.3
1912			485.9	485.9
1913			585.2	585.2
1914			993.2	993.2
1915			904.7	904.7
1916			927.9	927.9
1917			1,602.3	1,602.3
1918			2,081.9	2,081.9
1919			1,841.0	1,841.0
1920			2,083.1	2,083.1
1921			2,354.2	2,354.2
1922			2,444.7	2,444.7
1923			3,050.8	3,050.8
1924			4,058.1	4,058.1
1925			4,386.5	4,386.5
1926			4,971.5	4,971.5
1927			5,380.8	5,380.8
1928			7,684.6	7,684.6
1929			8,715.8	8,715.8
1930			9,419.0	9,419.0
1931			9,743.5	9,743.5
1932			10,126.1	10,126.1
1933			9,561.4	9,561.4
1934			10,894.4	10,894.4
1935			11,671.2	11,671.2
1936			13,237.0	13,237.0
1937			15,503.0	15,503.0
1938			17,737.2	17,737.2
1939			19,741.6	19,741.6
1940			22,226.9	22,226.9
1941			20,506.0	20,506.0
1942			22,069.2	22,069.2
1943			21,385.2	21,385.2
1944			21,635.0	21,635.0

APPENDIX 4-A

TABLE 4-A-4 continued

TRINIDAD AND TOBAGO ANNUAL CRUDE OIL PRODUCTION

1908-1971

(000 bbls)

Year	Marine production	Marine deviated	Land production	Total production
1945			21,092.6	21,092.6
1946			20,232.6	20,232.6
1947			20,520.6	20,520.6
1948			20,110.9	20,110.9
1949			20,616.7	20,616.7
1950			20,632.4	20,632.4
1951		30.8	20,811.9	20,842.7
1952		253.6	21,004.1	21,257.7
1953		804.8	21,541.1	22,345.9
1954		1,069.9	22,559.5	23,626.3
1955	36.0	1,399.1	23,461.7	24,895.8
1956	237.4	1,990.0	26,701.5	28,928.8
1957	495.2	2,242.4	31,326.4	34,063.9
1958	2,088.0	2,101.7	33,165.4	37,355.1
1959	4,272.9	2,148.8	34,497.0	40,918.8
1960	7,554.8	1,825.5	32,977.1	42,357.3
1961	11,113.1	1,871.9	32,782.8	45,767.8
1962	14,551.7	1,721.3	32,603.1	48,876.1
1963	17,328.3	1,496.5	29,853.5	48,678.3
1964	18,981.1	1,317.0	29,432.9	49,731.0
1965	18,091.2	1,274.7	29,493.0	48,858.9
1966	20,184.9	1,265.2	34,153.4	55,603.5
1967	24,082.0	1,177.9	39,734.7	64,994.6
1968	28,089.2	950.1	37,864.6	66,903.9
1969	27,702.5	724.2	28,991.8	57,418.5
1970	25,673.3	739.7	24,634.8	51,046.9
1971	22,933.5	850.2	23,364.1	47,147.7

Sources: Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Administration Report, 1969; Annual Report, 1970; Monthly Bulletin, January 1972.

APPENDIX 4-B

CARIBBEAN REFINERY CAPACITY

TABLE 4-B-1

REFINERY CAPACITY IN THE CARIBBEAN

(EXCLUDING VENEZUELA, COLOMBIA AND CENTRAL AMERICA SOUTH OF MEXICO)

Country	Company	Existing capacity 1969 000 b/d	%	Mid-1971 000 b/d	Planned capacity at end 1973 New 000 b/d	Expansion 000 b/d	Planned capacity at end 1973 000 b/d	%
Trinidad	Shell Trinidad	60	3.9	80		20	100	4.1
	Texaco Trinidad	340	22.4	400			400	16.5
Total Trinidad		400	26.3	480			500	20.6
Netherlands (Antilles)	Lago Oil and Transport	460	30.3	460			460	19.0
	Shell Curaçao	300	19.7	355		75	430	17.8
Puerto Rico (US)	Caribbean Refinery	40	2.6	40			40	1.7
	Commonwealth Oil Refinery	115	7.6	115		60	175	7.2
Puerto Rico	Sun Oil				65		65	2.7
Virgin Is. (US)	Hess Oil	70	4.6	70			70	2.9
Barbados	Barbados Union Oil	3	-	3			3	-
Antigua	West Indies Oil	11	0.7	11			11	0.4
Jamaica	Esso West Indies	28	1.8	28			28	1.2

APPENDIX 4-B

CARIBBEAN REFINERY CAPACITY

TABLE 4-B-1 continued

REFINERY CAPACITY IN THE CARIBBEAN

(EXCLUDING VENEZUELA, COLOMBIA AND CENTRAL AMERICA SOUTH OF MEXICO

Country	Company	Existing capacity 1969 000 b/d	Existing capacity %	Existing capacity Mid-1971 000 b/d	Planned capacity at end 1973 New 000 b/d	Planned capacity at end 1973 Expansion 000 b/d	Planned capacity at end 1973 000 b/d	Planned capacity at end 1973 %
Martinque	CFP/USP/Esso/ Shell/Texaco			10			10	0.4
Bahamas	New England Pet. SoCal			250		200	450	18.6
Dominican Republic	Various			25	60		85	3.5
Cuba	Shell de Cuba	27	1.8	93			93	3.8
	Cuban Petroleum Institute (Havana)	46	3.0					
	Cuban Petroleum Institute (Santiago)	20	1.3					
Totals*		1,520	100.0	1,940	125	355	2,430	100.0

Source: Petroleum Press Service, January 1969, pp. 14-16; September 1971, pp. 334-336.

*Percentages may not always add due to rounding.

APPENDIX 6-A

PRESENT VALUE TABLES

TABLE 6-A-1

PRESENT-BARREL-EQUIVALENT (PBE) FACTORS

Discount factor (a + r)	PBE factors when life of project is: 20 years	25 years	∞
10%	8.93	9.52	10.40
11	8.39	8.88	9.53
12	7.91	8.30	8.79
13	7.47	7.80	8.16
14	7.08	7.34	7.62
15	6.72	6.94	7.15
16	6.39	6.57	6.73
17	6.09	6.24	6.37
18	5.82	5.94	6.04
19	5.57	5.67	5.75
20	5.34	5.43	5.48
21	5.13	5.20	5.25
22	4.93	4.99	5.03
23	4.75	4.80	4.83
24	4.58	4.63	4.65
25	4.43	4.46	4.48
26	4.28	4.31	4.33
27	4.15	4.17	4.18
28	4.02	4.04	4.05
29	3.90	3.92	3.93
30	3.79	3.81	3.81
32	3.59	3.60	3.60
34	3.41	3.41	3.41
36	3.24	3.24	3.25
38	3.10	3.10	3.10
40	2.97	2.97	2.97

Source: Jerome Bracken and Charles J. Christenson, Tables for Use in Analyzing Business Decisions (Irwin, 1965), table 1, quoted in M. A. Adelman, The World Petroleum Market (Baltimore: The Johns Hopkins University Press, 1972), p. 51.

APPENDIX 6-B

DRILLING ACTIVITIES AND OUTPUT

TABLE 6-B-1

DRILLING STATISTICS AND WELL PERFORMANCE

TRINIDAD OIL INDUSTRY 1963-1971

Year	Total footage drilled (000s)	Daily average footage drilled	Number of rig months	Number of completions	Percentage of producing wells by artificial flow	Average daily production artificial lift (barrels)
1963	1,246	3,405	233.3	232	68	18.5
1964	1,056	2,886	180.6	194	68	19.4
1965	1,059	2,898	190.5	224	72	22.6
1966	1,188	3,253	183.2	275	72	25.6
1967	928	2,543	113.2	221	74	28.9
1968	943	2,583	99.4	176	76	28.5
1969	691	1,893	84.2	130	78	26.9
1970	664	1,819	83.7	135	80	26.0
1971	939	2,572	146.7	219	82	n/a

Source: Government of Trinidad and Tobago, Ministry of Petroleum and Mines, Monthly Bulletin, December 1963, December 1971.

APPENDIX 6-C

COSTS IN BRITISH PETROLEUM TRINIDAD CONCESSIONS

TABLE 6-C-1

COST PER BARREL OF CRUDE OIL FOR BRITISH PETROLEUM

LAND OPERATIONS TRINIDAD 1956-1965 - W.I. $

Year	Total	Drilling	Production	Administration	Depreciation
1956	3.31	1.36	1.22	.28	.45
1957	3.47	1.54	1.15	.27	.51
1958	3.25	1.40	1.11	.26	.48
1959	3.08	1.08	1.22	.32	.47
1960	3.27	1.08	1.31	.38	.50
1961	3.38	1.05	1.24	.64	.45
1962	2.93	.91	1.27	.40	.35
1963	3.36	.71	1.45	.75	.45
1964	3.12	.70	1.49	.55	.38
1965	3.16	.60	1.64	.48	.44

Source: "Oil in Turmoil", Vanguard Publishing Co. Limited. This was prepared by British Petroleum in its dispute over retrenchment with the Oilfield Workers Trade Union (OWTU) of Trinidad and Tobago. It was published by George Weekes, President of the OWTU in The Vanguard of April 1 and 15, 1967 and reprinted in a pamphlet "Oil in Conflict" along with an OWTU memorandum on the formation of a national oil company. Copy on file at Library of Economic Planning Unit, Trinidad.

APPENDIX 6-D

EARNINGS IN TRINIDAD OIL INDUSTRY

TABLE 6-D-1

SALES, REVENUES, NET INCOME, TRINIDAD OIL INDUSTRY 1970

	Producing	Refining	Marketing	Combined
Texaco Inc.*				
Total sales and processing fees	97,987,643	183,455,620	See below	184,858,377
Net income before taxes	15,121,227	50,607,970	See below	65,729,197
Operating margin percentage on sales	15.4%	27.6%	-	35.5%
Texaco Trinidad Ltd.				
Total sales and processing fees	-	-	16,019,579	-
Net income before taxes	-	-	1,775,667	-
Operating margin percentage on sales			10.6%	
Shell Trinidad Ltd.**				
Total sales and processing fees	43,822,029	73,945,113	38,919,416	102,127,129
Net income before taxes	22,504,656	9,549,678	(812,683)	31,241,651
Operating margin percentage on sales	51.3%	12.8%	-	30.5%
Trinidad-Tesoro				
Total sales	56,575,059	-	-	56,575,059
Net income before taxes	20,083,116	-	-	20,083,116
Operating margin percentage on sales	35.4%	-	-	35.4%

Source: Trevor Michael A. Farrell, "The Multinational Corporations, The Petroleum Industry and Economic Underdevelopment in Trinidad and Tobago (Ph.D. dissertation, Cornell University, Ithaca, N.Y., January 1974.) Data taken from Peat, Marwick & Mitchell Accounting Study, 1970.

*Combined total from Texaco Trinidad Inc. refers to the producing and refining divisions. Marketing is located in Texaco Trinidad Ltd.

**Shell reports no value in its books for crude transferred to the refinery. The accounting study assigns a value to the crude transferred based on Venezuelan prices for comparable crudes less a discount of 20 per cent.

APPENDIX 7-A

TEXACO WORLD-WIDE PRODUCTION OF CRUDE OIL AND NATURAL GAS

TABLE 7-A-1

TEXACO INC. WORLD-WIDE GROSS PRODUCTION OF CRUDE OIL

AND NATURAL GAS LIQUIDS*

(000 b/d)

	1966	1967	1968	1969	1970	1971
Trinidad	80	101	104	81	67	59
Colombia	45	45	41	62	67	67
Venezuela	225	211	205	192	169	142
Middle East	878	1,035	1,133	1,164	1,294	1,638
Saudi Arabia	722	846	931	949	1,039	1,333
Iran	125	154	164	177	209	255
Bahrain	31	35	38	38	38	37
Dubai	-	-	-	-	8	13
Indonesia	153	165	215	300	369	360
Africa	41	64	122	185	163	136
Libya	41	64	122	185	162	131
Nigeria	-	-	-	-	1	5
Germany	13	32	34	35	34	36
Australia	-	4	8	10	13	13
Other	-	1	1	2	1	1
Total world (excl. N. America and Communist countries)	1,435	1,658	1,863	2,031	2,177	2,452
U.S.A.	766	854	854	866	939	940
Canada	62	70	79	90	112	124
Total world-wide	3,263	2,582	2,796	2,987	3,228	3,516

Source: Moody's Industrial Manual, Moody's Investors Service, N.Y.

*Including liftings in Saudi Arabia and Indonesia and equity in other non-subsidiary companies.

APPENDIX 7-B

TEXACO WORLD-WIDE REFINERY RUNS

TABLE 7-B-1

TEXACO INC. WORLD-WIDE REFINERY RUNS -

CRUDE, NATURAL GAS LIQUIDS, DISTILLATES*

(000b/d)

	1966	1967	1968	1969	1970	1971
U.S.A.	801	860	901	929	948	995
Canada	114	125	133	135	140	145
North America	915	985	1,034	1,064	1,088	1,140
Trinidad	342	326	357	353	354	331
Latin America	68	70	68	61	79	101
West Germany	40	130	160	170	169	182
United Kingdom	102	100	122	124	124	139
Other Western European	112	98	148	259	286	322
Africa	12	21	24	25	25	31
Middle East	236	261	273	286	266	271
Far East	145	163	188	215	324	361
Other**	-	1	3	3	4	5
Total world-wide	1,972	2,155	2,377	2,560	2,719	2,883

Source: Moody's Industrial Manual, Moody's Investors Service, N.Y.

*Including interest in non-subsidiary companies.

**Unclassified.

APPENDIX 8-A

GOVERNMENT FINANCIAL STATEMENT

TABLE 8-A-1

TRINIDAD AND TOBAGO GOVERNMENT REVENUES AND EXPENDITURES

1972, 1974, 1975, 1976

(Millions T.T. $)

		1972		1974		1975		1976
Current revenue		398.3		1,196.7		1,686.5		2,020.4
Current expenditure		393.6		587.3		745.1		874.8
Current account surplus		4.7		609.4		941.4		1,145.6
Capital receipts		155.3		170.0		82.5		83.4
Capital expenditures:								
Capital repayments & sinking funds	20.1		89.9		50.8		38.6	
Long-term project funds	-		244.4		701.6		830.1	
Loans to statutory authorities	16.3		31.8		56.1		64.9	
Development program	123.6		133.9		202.7		263.4	
Public sector participation	22.9	182.9	10.0	510.0	12.5	1,023.7	32.0	1,229.0
Capital account deficit/surplus		-27.5		-340.0		-941.2		-1,145.6
Total deficit/surplus		-22.9		+269.4		+0.2		-

Source: Government of Trinidad and Tobago, Estimates of Revenue, 1972-1976.

APPENDIX 8-B

MANPOWER, TRINIDAD OIL INDUSTRY

TABLE 8-B-1

EMPLOYMENT IN THE TRINIDAD OIL INDUSTRY BY JOB CLASSIFICATION, NATIONALITY AND ACTIVITY - 1970-1975

	Production		Refining		Marketing		General Administrative	Total
	Tech., Prof., Admin.	Operating	Tech., Prof., Admin.	Operating	Tech., Prof., Admin.	Operating		
1970								
Nationals	929	3,214	1,521	2,572	241	141	1,734	10,352
Expatriates	75	-	72	-	8	-	49	204
Total	1,004	3,214	1,593	2,572	249	141	1,783	10,556
1971								
Nationals	962	3,532	1,586	2,551	195	165	2,008	10,999
Expatriates	74	17	72	-	9	-	44	216
Total	1,036	3,549	1,658	2,551	204	165	2,052	11,215
1972								
Nationals	947	3,654	1,906	2,689	204	162	2,050	11,612
Expatriates	71	25	68	-	10	-	45	219
Total	1,018	3,679	1,974	2,689	214	162	2,095	11,831
1973								
Nationals	958	3,628	1,882	2,731	221	157	1,917	11,494
Expatriates	71	28	50	-	9	-	45	203
Total	1,029	3,656	1,932	2,731	230	157	1,962	11,697

APPENDIX 8-B

MANPOWER, TRINIDAD OIL INDUSTRY

TABLE 8-B-1 continued

EMPLOYMENT IN THE TRINIDAD OIL INDUSTRY BY JOB CLASSIFICATION,

NATIONALITY AND ACTIVITY - 1970-1975

	Production		Refining		Marketing		General Administrative	Total
	Tech., Prof., Admin.	Operating	Tech., Prof., Admin.	Operating	Tech., Prof., Admin.	Operating		
1974								
Nationals	2,179	2,553	1,877	2,829	221	151	2,049	11,859
Expatriates	70	20	42	-	4	-	48	184
Total	2,249	2,573	1,919	2,829	225	151	2,097	12,043
1975								
Nationals	960	3,401	1,861	2,896	194	159	1,804	11,275
Expatriates	67	23	33	-	2	-	28	153
Total	1,027	3,424	1,894	2,896	196	159	1,832	11,428

Source: Government of Trinidad and Tobago, Ministry of Petroleum and Mines.

GLOSSARY

Oil-in-place: when exploration establishes the existence of oil in a region this is considered oil-in-place.

Reserves: that part of oil-in-place which development expenditures have converted to a ready inventory of oil stocks.

LIST OF ABBREVIATIONS

b/d: barrels per day

BWIA: British West Indian Airways

IPAA: Independent Petroleum Administration of America

LNG: Liquified natural gas

MEFC: Maximum Economic Finding Cost is the predictable increase in development cost. When this begins to exceed the cost of finding new oil-in-place then capital shifts to exploration from development.

Mn: millions

n/a: not available or not applicable

PAD: Petroleum Administration for Defense: the United States is divided up into five districts for the purpose of administering supply logistics of fuel for defense purposes during a major crisis. These districts are also used for the administration of the country's petroleum policies.

PNM Party: People's National Movement Party, Trinidad

scf: standard cubic feet

TNA: Trinidad Northern Areas; marine fields west of Soldado fields (Figure 4.2)

T.T.: Trinidad and Tobago

UPA: Under Processing Agreement--arrangement whereby parent company contracts the services of refineries of affiliates or other companies to process (partially or fully) its crude oil for a fee.

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