

**The Petrobras Monopoly and the Regulation  
of Oil Prices in Brazil**

Fábio Brandão

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Oxford Institute for Energy Studies

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## Abbreviations

AIC	Average Import Cost
ANP	Agência Nacional de Petróleo (National Petroleum Agency)
ARA	Amsterdam-Rotterdam-Antwerp
ARP	Average ex-Refinery Price
bge/d	barrels of gasoline equivalent per day
boe	barrel of oil equivalent
CEDP	Centro de Estudos e Defesa do Petróleo (Centre of Studies and Protection of Petroleum)
CNP	Conselho Nacional do Petróleo (National Petroleum Council)
CNPE	Conselho Nacional de Política Energética (National Council For Energy Policy)
CPI	Consumer Price Index
DNC	Departamento Nacional de Combustíveis (National Department of Fuels)
DNPM	Departamento Nacional de Produção Mineral (National Department of Mineral Production)
FND	Fundo Nacional de Desenvolvimento (National Development Fund)
FRONAPE	Frota Nacional de Petroleiros (National Tanker Fleet)
FUP	Frete de Uniformização de Preços (Freight for Price Equalisation)
FUPA	Frete de Uniformização de Preços de Alcool (Freight for Alcohol Price Equalisation)
GPI	General Price Index
ICMS	Imposto sobre Circulação de Mercadorias e Sobre Prestação de Serviços de Transporte Interestadual e Intermunicipal (Circulation of Goods and Services Tax)
IOF	Imposto sobre Operações Financeiras (Financial Operation Tax)
IUCL	Imposto Único sobre Combustíveis Líquidos (Sole Tax on Liquid Fuels)

IVVC	Imposto sobre Vendas a Varejo de Combustíveis Líquidos e Gasosos (Retail Tax on Gas and Liquid Fuels)
LPG	Liquefied Petroleum Gas
NAP	National Alcohol Programme
PASEP	Programa de Formação do Patrimônio do Servidor Público (Public Employee Wealth Formation Programme)
PIS	Programa de Integração Social (Social Integration Programme)
SGMB	Serviço Geológico e Mineralógico do Brasil
toe	tonnes of oil equivalent
WPI	Wholesale Price Index

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## INTRODUCTION

### **Purpose and Outline of the Study**

The state oil monopoly in Brazil is exercised by the National Department of Fuels (Departamento Nacional de Combustíveis – DNC – which replaced the former Conselho Nacional do Petróleo – CNP) as the regulator and controller of all oil-related activities, and by Petrobras as the executor of the monopolised activities. The only activities not included in the state monopoly are the wholesaling, retailing and transport by road and rail of oil products. Petrobras is a vertically integrated oil company which has been the sole concessionary company executing the monopolised activities but has also operated in the competitive sector of the distribution activity through its subsidiary company, BR.

All oil product prices, including those practised by the competitive sectors, have been regulated: ex-refinery prices, distribution prices and retail prices. These prices have been structured in such a way that they have supported a complex set of subsidies, compensations and refundings which has helped the government to implement its oil products pricing policy. This policy has several objectives, sometimes in conflict with each other: to keep Petrobras solvent; to allow Petrobras to raise the funds it needs to carry out capital expenditure plans in keeping with economic development targets; to help the government reduce inflation and pursue the balance of payments; to foster the use of alternative sources of energy; to produce rent to the government; and to subsidise consumers.

The government has adopted a policy of keeping the funding sources of oil product subsidies within the oil business itself. This policy engendered a cross-subsidisation system involving the prices of the different oil products and later also the price of automotive alcohol. Cross-subsidising aimed at (a) improving the distribution of income thereby enabling poorer families to make use of more efficient and cleaner sources of energy; (b) helping to develop less industrialised parts of the country lying furthest away from production centres; and (c) fostering certain areas of industry.

The first oil price shock in 1973 inaugurated the start of an era of higher energy costs. Energy-importing countries in general, and particularly the developing countries, had to adjust their

energy matrix to reflect rising energy costs. Adjustments were made on both the demand side, by means of either increasing the efficiency of energy use or reorienting the development of economic activities, and the production side, by means of developing domestic energy resources, enhancing plant efficiencies and reducing distribution losses. Pricing plays a central role in the management of the energy sector as it induces the consumer, to a certain extent, to choose the cheapest fuels for a particular use. It also attempts to ensure the profitability of energy production.

The purpose of this study is to analyse oil products pricing in Brazil and its main impacts on consumption. The study starts with a brief history of the petroleum industry in Brazil and a description and analysis of oil product pricing and taxation regulations in the country. Next, we analyse the trends in oil products prices after the first oil shock, the cross-subsidisation among oil products and automotive alcohol and the trends in demand for these fuels.

In the historical section we describe the political and economic context of the creation of the state monopoly of oil and of Petrobras, the state-owned oil company in charge of carrying out the monopoly on the government's behalf. We also consider some aspects of Petrobras's development through its more than forty years of existence. In 1995, an amendment to the Constitution allowed the government to grant new concessions for the execution of monopolised oil activities. The original wording of the law that started the reform of oil regulations suggests that the opening up of the domestic oil sector to private investment was motivated by the country's need to increase the amount of investments in the development of oil and gas resources rather than by a government desire to promote competition in the domestic oil sector.

The analyses of oil product pricing regulations and of trends in their domestic and international prices were based on officially published information such as: texts of laws and subsidiary regulations; domestic prices and taxes as set and published by the regulator in official documents; statistical data as published by governmental institutes, Petrobras, international oil companies, Platt's and the IEA.

Chapter 2 concentrates on the analysis and description of oil products pricing and taxation regulations since the state oil monopoly was created in 1953. Regulations changed according to

the development stage of the domestic oil industry. Initially they ensured to Petrobras, the state-controlled sole concessionary company, the funds for its first capital expenditures by means of both allocating the company a share in oil product tax revenue and setting favourable ex-refinery prices. There was a 24-year long period of pricing transition in which ex-refinery prices developed from the level of opportunity costs, relatively high as Brazil is situated far away from the consuming and producing world oil markets, to a lower average level basically determined by domestic refining costs, when the country was already self-sufficient in oil product production. However, the opening up of the oil sector to private investments in a few years time will lead domestic ex-refinery prices upwards to their former higher levels, that is their opportunity costs.

Chapters 3, 4 and 5 are devoted to an analysis of trends in the domestic prices of petroleum products after the first oil shock. We examine the general level of oil product prices, i.e. the trends in the consumption-weighted average of oil product prices, so that we can assess the overall transfer of income among Petrobras, the government and consumers. Next, we analyse the prices of each product individually in order to look into the transfer of income among consumers of different products which takes place due to cross-subsidisation.

### **Methods and Results**

In the analysis of oil products average price we broke average consumer price into its component parts – i.e. ex-refinery prices, wholesaling and retailing gross margins, and taxes. Ex-refinery prices and margins have been set by the regulator based on a cost-plus policy. Petrobras's average ex-refinery net price is theoretically a function of the international oil price. According to regulations, one of the bases of calculations has been the average c.i.f. import cost of oil. However, very often the regulator has set this value, which we will name *structural average c.i.f. import cost of oil*, well below Petrobras's actual average cost of oil imports. The difference between the structural and the actual average import cost of oil generates a receivable from the Brazilian government on Petrobras's balance sheet. In December 1996 this debt amounted to US\$3.3 billion. We should stress here that this figure does not correspond to the present value of the actual debt; first, because the government does not pay interest and second because, until 1987, monthly government debts/credits were accumulated according to their historical value and were not subject to monetary adjustments, despite the high inflation rates experienced by the

Brazilian economy in the 1980s (average yearly inflation rate in the period 1983–87 was 230 per cent). In fact, Petrobras has been financing the government with funds the company borrowed from the financial market.

Basically, Petrobras's profitability has depended on government pricing policies. The consumption-weighted average of ex-refinery taxed prices has been typically higher than the import parity while average ex-refinery net of tax price has been typically below this level. This means that the government has taken, through oil product taxation, not only the rent from oil products but also part of what Petrobras could have obtained if its ex-refinery prices were set according to competitive market conditions. We estimated that, in the period 1973–93, oil products sales revenue produced a rent equivalent to US\$95.7 billion in constant money of January 1997. During this period the government levied US\$137.4 billion in oil product taxes, i.e. all the oil product rent plus US\$41.7 billion which implicitly represents Petrobras's lost revenue since it should be part of its sales revenue. In July 1997, average ex-refinery net price (US\$19.5/b) was still 15 per cent below import parity (US\$22.83/b) and 5 per cent below Rotterdam NWE/ARA quotation (US\$20.5/b). A 15 per cent discount to import parity in July 1997, when oil product daily consumption was 1.6 million b/d, represented a loss of sales revenue to the company equivalent to US\$160 million in that month.

Trends in the general level of taxes and in average ex-refinery prices showed asymmetrical behaviour on some occasions, so that the impact of world oil price fluctuations upon consumer prices was, to some extent, deadened. The general level of taxes levied on oil products fell, in real terms, when domestic prices increased sharply after 1979: taxes levied on a barrel of oil products fell by 55 per cent, in real terms, between 1978 and 1981, when average ex-refinery price increased by 81 per cent. However, when average ex-refinery price fell by 53 per cent in the 1986–93 period, taxes rose by 143 per cent in real terms.

In the studied period and until 1988, oil products taxation was earmarked for and bound to the development of the road transport sector and to the development of alternative energy sources. From 1977 onwards social contributions were also relevant, particularly in the 1984–86 period when they represented 60–78 per cent of total taxes on oil products. Up to 1979 the biggest share in oil product tax revenue was brought in by the Sole Tax, which was to be allocated to the

National Roadway Fund and to raising the capital of the National Railway Network. From 1973 and up to 1983, about US\$10.2 billion (at constant prices of January 1997) from oil product tax revenue were set apart for the development of alternative energy sources. In the years 1973–83 Petrobras also had a share in oil product fiscal revenue. This share was equivalent to US\$3.4 billion (at constant prices of January 1997), and was intended for funding offshore exploration. So Petrobras benefited twice from oil products tax revenue: directly by means of its explicit shares in fiscal revenue; and indirectly as the development of the domestic transport system boosted the demand for automotive fuels.

In most of the period studied and until 1991 oil products prices were equalised throughout the country. In this period automotive fuel and lubricant consumers paid, through a component part of the price of the products they were consuming, the equivalent of the total transport cost of all the oil products. These funds, managed on behalf of the government by Petrobras, would theoretically be sufficient to refund the distribution companies for the road and rail transport costs actually borne by them and Petrobras for the cost incurred in water and pipeline transport (solely executed by Petrobras as these activities are included in the state monopoly). The values of refundings were capped by the regulator responsible for monetary adjustments on these values. However, tariffs of monopolised transport modes were not as well adjusted to accumulated inflation rates as were the road and rail transport caps. As a result, in the 1985–90 period, transport cost refundings paid to distribution companies increased by 73 per cent while those paid to Petrobras fell by 74 per cent in real terms.

From 1992 onwards, consumers of gasoline, diesel and lubricants also subsidised automotive alcohol consumers since a mark-up of the component part of the prices of gasoline, diesel and lubricants intended to support the price equalisation regime also helped to cover the costs of the subsidies to the National Alcohol Programme with substantial funds (US\$1.1 billion in constant money of January 1997, in 1992–93).

The oil product price equalisation regime implied two kinds of subsidies among oil products consumers:

- Gasoline, diesel and lubricant consumers who lived close to the refineries subsidised consumers of these products who lived further away.

- Gasoline, diesel and lubricant consumers subsidised the transport costs of all other oil products.

On the one hand the price equalisation regime appears socially equitable as it fosters the economy of regions far away from the producing centres. On the other hand it poses problems which at the end of the day push up distribution costs: refunding of ghost (fraudulent) transport operations; overvalued caps for road and rail transport cost refunds; it encourages neither investments nor efficiency gains.

The profitability of Petrobras's investments in E&P and refining has depended on the value set by the government for the average ex-refinery prices, while the profitability of its investments on pipelines and tankers has depended on the value the government set for the transport tariffs. We show in Chapter 4 that the regulator was, at some point, more protective towards the distribution companies than towards the state oil company when the transport tariffs were fixed for them.

Oil products domestic pricing policy has included cross-subsidisation between different oil products and between automotive oil products and automotive alcohol. Positive externalities led to price reductions of (a) LPG in order to keep cooking costs low to poor people, (b) naphtha in order to foster the petrochemical industry, (c) fuel oil in order to protect the domestic industry against sudden oil price increases. The main funding source of these subsidies has been a markup of gasoline domestic prices. Furthermore, the high price of gasoline also helped to decrease the growth rate of oil consumption and to make possible the replacement of gasoline by alcohol as an automotive fuel.

Typically, gasoline and diesel sales have generated rents that have been shared by Petrobras and the government. Only Petrobras's shares of these rents have been used to cover the subsidies of other oil products. In other words, income transfers associated to cross-subsidisation took place only at the ex-refinery net price level and did not involve taxes. In the period 1974–93, gasoline sales accounted for between 53 and 100 per cent of total income transfers while diesel sales generated in a few years between 6 and 45 per cent of that total (in the other years diesel ex-refinery price was below opportunity cost).

Cross-subsidisation does not necessarily affect directly Petrobras's profitability as long as the average ex-refinery net price is equal to the import parity. Of course, consumers will adapt their needs to the relative prices of energy so that in the long term demand can be heavily affected by cross-subsidisation. The most striking example of the impact of cross-subsidies on demand is that of gasoline and alcohol. After the National Alcohol Programme (NAP) was established in 1975, gasoline demand fell by 120,000 b/d (or 47 per cent) between 1976 and 1985. This fall was partly offset by an increase of 112,000 bge/d (barrels of gasoline equivalent per day) in the consumption of alcohol. However, the less gasoline sold in the domestic market the higher its ex-refinery price should be in order to generate an adequate average ex-refinery price. The rise in the price of gasoline up to 1981 and the holding of its price (as well as that of alcohol which was indexed to the price of gasoline) at relatively high levels until 1983 decreased the consumption of Otto cycle fuels (gasoline and alcohol) by 7 per cent in the 1973-83 period.

Two kinds of automotive alcohol are sold in the Brazilian market - anhydrous alcohol and hydrated alcohol. Since 1975, anhydrous alcohol has been mixed with gasoline in a proportion of up to 20 per cent. The resulting mixture has been used in the former pure gasoline-fuelled cars. Pure hydrated alcohol has been fuelling cars with specially designed engines since 1979.

Several incentives were given to the NAP development including financing with negative real interest rates and fiscal incentives to buyers and owners of pure alcohol-fuelled cars. However, alcohol production costs were high and, despite the rises in the yields of both the agricultural and the industrial sectors, they are still relatively high. Sugar-cane has been grown in various climatically different parts of the country where agricultural yields are substantially different. Estimates of alcohol production costs depend very much on the yields employed in the calculations. One study, published in 1994, estimated that alcohol average production cost had dropped from US\$75/b to US\$45/b from the start of the NAP up to 1993.

In order to encourage consumers to buy cars fuelled with pure hydrated alcohol the government also capped the alcohol/gasoline final price ratio. Initially this cap (0.65) was such that owners of pure alcohol-fuelled cars could reduce their fuel costs by 20 per cent. The alcohol/gasoline price ratio cap continued to be raised until it reached 75 per cent in 1989.

*Anhydrous* alcohol was billed to distribution companies at a price equal to the ex-refinery price of gasoline, since they would be mixed and sold as 'gasohol'. This price was actually higher than the ex-distillery price of anhydrous alcohol and the surplus was meant to cover the *hydrated* alcohol subsidies. Petrobras, as the only buyer of anhydrous alcohol, managed this surplus on behalf of the government, using it to pay to the distribution companies the difference, always positive, between [actual hydrated alcohol supply cost] – [hydrated alcohol consumer price]. However, as the demand for *hydrated* alcohol rose, the demand for gasohol fell. Furthermore, after 1987 when the gasoline ex-refinery price fell, so did the *anhydrous* alcohol ex-distillery price. Both factors prevented the surplus generated by *anhydrous* alcohol sales to keep up with the growth of *hydrated* alcohol demand. Thus, from 1987 onwards there was an increasing deficit in the *hydrated* alcohol subsidy account (Alcohol Account). These deficits have been absorbed by Petrobras just like the deficits generated by oil imports (Oil Account). In December 1996 the Alcohol Account deficit amounted to US\$4.1 billion. We estimated that, in the period 1980–93, the cost of buying hydrated alcohol for pure alcohol-fuelled cars was greater by US\$20.7 billion, in constant money of January 1997, than the potential cost of importing equivalent quantities of gasoline.

The fall of the regulated ex-distillery price of *hydrated* alcohol and the end of subsidised financing for building new distilleries in 1985 provoked a halt in the growth of alcohol production while consumption continued to rise for some time. In 1989 there was already a shortage of *hydrated* alcohol that led the consumer to lose confidence in the NAP. Sales of alcohol-fuelled cars fell rapidly: their share in overall car sales decreased from 94 per cent in 1987 to 61 per cent in 1989, then to 13 per cent in 1990 and to a mere 0.5 per cent in 1996.

While gasoline final price was well above opportunity cost, diesel domestic final price has been set at levels considerably below those of the gasoline price. In the 1973–93 period, diesel/gasoline average relative price was 0.56. This policy led to the 'dieselisation' of the Brazilian truck fleet, i.e. the gradual replacement of gasoline-fuelled trucks by diesel-fuelled ones. In the period 1973–96 diesel demand grew faster (5.2 per cent per year) than the average growth rate of oil products (3.3 per cent per year) thus provoking an increased diesel share in the demand for oil products from 23.5 per cent to 35 per cent between 1973 and 1996.

Fuel oil was subsidised until the beginning of the second half of the 1980s, although subsidies were higher in the 1970s when fuel oil consumption grew at an average rate of 7.3 per cent per year. Fuel oil consumers received 4.93 per cent of the income transfers implied in cross-subsidisation. Fuel oil subsidies started to fall in 1980, after the second oil shock, when the government tried harder to replace imported energy by energy sources produced domestically. Major government efforts were concentrated on increasing domestic oil production and on substitution away from gasoline and fuel oil. The biggest shift in the industrial consumption of fuel oil (up to 1979 the industry sector share in fuel oil demand was, on an average basis, 81 per cent) was brought about by an increase in electricity consumption, although replacements by biomass (firewood, charcoal, and sugar-cane bagasse), coal and natural gas were also important. Relative prices of coal and industrial electricity were substantially reduced. The price of 1 boe of industrial electricity in 1978 was equivalent to seven times the price of 1 boe of fuel oil; in 1984 the [electricity/fuel oil] price ratio fell to less than 2. As regards the price of coal, the [coal/fuel oil] price ratio fell by 50 per cent in the same period. Fuel oil share in the industrial consumption of energy fell from 28 per cent to only 9 per cent between 1979 and 1985, when fuel oil consumption fell by 51 per cent.

LPG has been subsidised since 1973 and its consumption has been largely (88–93 per cent) for household cooking. LPG subsidies increased after 1980 when fuel oil subsidies fell. In the 1973–96 period LPG consumption rose at an average rate of 6.2 per cent per year, mainly due to increasing urbanisation and the greater penetration of LPG in rural parts of the country. In 1973 the LPG share in total *final* energy used for cooking was only 8 per cent and the remainder was due to biomass (firewood and charcoal). This figure rose to 50 per cent in 1996. The substitution of firewood by LPG takes place at a rate of 0.11 toe of LPG for every 1 toe of firewood due to the low efficiency of firewood stoves (5 per cent) as compared to that of LPG stoves (45 per cent).

Petrobras has had to change its refining structure in order to bring refinery output in line with the domestic demand for oil products. Specifications of diesel and fuel oil were changed: the releasing of diesel flash-point and raising temperature of 90 per cent of diesel evaporates enabled both heavy naphtha and vacuum light gas oils to be added to diesel stream, thus helping to increase yields of diesel; increasing fuel oil average viscosity saved middle distillates and

reduced fuel oil yields. Several other measures were taken to alter the refining structure aimed at reducing production of both gasoline and fuel oil and, at the same time, increasing diesel output: burning of vacuum residue instead of fuel oil for autoconsumption; cracking of vacuum residue; raising the temperature of vacuum gasoil cut; installing further coking and deasphalting plants to increase refinery conversion; rearranging streams of naphtha whose demand was increasing because of the development of the domestic petrochemical industry.

The programme of refining restructuring led to:

- an increase of diesel yield from 22 per cent in 1973 to 31 per cent in 1983, 33 per cent in 1990, and 35 per cent in 1996.
- A decrease of gasoline yield, after the start of the NAP, from 29 per cent in 1975 to 18 per cent in 1980, at which figure it practically remained until 1992. It was not possible to fully match refinery output to the falling demand of gasoline. So, from 1977 onwards, Brazilian refineries started to generate an increasing surplus of out-of-specification gasoline that was chiefly exported to the USA. Such exports reached a peak of 90,000 b/d in 1988.
- A reduction of fuel oil yield after the second oil shock: from 27 per cent in 1979 to 18 per cent in 1985 and 16 per cent in 1993 – which remained practically the same until 1996.

An important conclusion of this study is that while receiving a relatively low price for its products, as the weighted average of ex-refinery prices of petroleum products was lower than the import parity, Petrobras succeeded in increasing substantially Brazilian proven reserves of oil and gas, which rose from 1.5 billion boe in 1979 to 5.8 billion boe in 1996. In the same period, domestic production of oil rose from 166 thousand b/d to 784 thousand b/d. Furthermore, expected production of oil in the year 2000 is almost 1.5 million b/d.

# **1. A BRIEF HISTORY OF THE BRAZILIAN OIL INDUSTRY**

## **1.1 Introduction**

In this chapter, we present first a brief history of the development of the Brazilian oil industry before the creation of the state-owned oil company, Petrobras, in 1953. Since the 1930s, growing nationalism fostered the view that the state should establish strong control over the oil industry because of its pervasive role in the national economy. Foreign companies were looked at as a threat to national sovereignty. A long political battle between the liberals and the nationalists culminated with the passing of a law that created both the state monopoly over all oil activities (except oil product distribution) and Petrobras, the sole concessionary company that would exercise this monopoly on behalf of the government.

We describe next how the company was organised and how its initial investment programmes were largely funded either by oil product tax revenues or by the government's reinvestment of Petrobras dividends. We also briefly describe the development of planning in the company and the creation of a skilled labour force.

Finally, we present the main results of Petrobras's operations in refining and in the exploration and production of crude oil. In the period 1954–96, these operations helped the country to save foreign currency (US\$239 billion in 1996 prices) which otherwise would have been used to import the petroleum and oil products the country needed.

## **1.2 The Oil Industry before 1953**

### **1.2.1 The Imperial Period**

During the colonial phase in Brazil (before 1822), mines were owned by the King of Portugal. Mining concessions were given to private individuals against a payment of 20 per cent of the production (Victor 1991). The Brazilian imperial period started in 1822 when the country became independent from Portugal. The 1824 constitution stipulated that the state was the owner of the

subsoil. Private individuals could explore the subsoil searching for mineral deposits only through imperial authorisations. There was no subsidiary mining legislation.

Concession requests were initially induced by the presence in Brazil of bituminous shale, used to produce lighting fuels and lubricants, and coal. In 1864 (after the discovery of oil in a well in the USA in 1859), a mining concession which was the first to mention explicitly petroleum exploration, was granted to a British descendant, Thomas Denny Sargent. The decree that granted Sargent the concession also included further mining regulations. For instance, it provided tax exemption to imported capital goods and exports of turf and petroleum. It also stipulated a tax rate on net income from the production of minerals – 5 per cent in the case of precious metals and 1 per cent in the case of petroleum, turf and other minerals (Mattos Dias and Quaglino 1993).

A number of mining concessions mentioning petroleum exploration were granted after 1864 in the province of Bahia and in the former province of São Paulo. Some concessionaires succeeded in producing small volumes of lighting fuel from shale oil. However, the initial search for oil in Brazil was unsuccessful for several reasons: the difficult Brazilian geology offered neither superficial evidence which would make oil exploration cheaper nor accidental discoveries; there was insufficient knowledge about mineral deposit characteristics; and, of course, there was competition with imported products.

### **1.2.2 The Period of Liberal Legislation:1891–1930**

In 1889, a republic was proclaimed in Brazil. Article 72 of the republican constitution of 1891 transferred ownership of the subsoil from the state to the landowner. The principles established in that clause should have been complemented soon after by additional regulations. However, these regulations were only set in 1915. The private ownership of subsoil resources hindered oil exploration as landowners were inclined to prohibit access to their properties to would-be investors.

However, the first petroleum exploration venture in Brazil took place under that new legislation. In 1892, a small amount of oil was discovered in the state of São Paulo in a well 480m deep, drilled by a private person. Two barrels of oil were produced from this well! According to the

conclusions of a study ordered by the government in 1901, the obstacle to the development of general mining activities was the absence of subsidiary regulations to Article 72 of the constitution.

In 1907 the government created the Brazilian Geological and Mineralogical Service (Serviço Geológico e Mineralógico do Brasil – SGMB) in the Ministry of Agriculture. This ministry was responsible for undertaking geological studies in sites presenting favourable conditions to the existence of any minerals. The SGMB initiated studies on the probability of finding oil in some Brazilian states. The first exploratory well funded by the government was drilled only in 1919 by the SGMB.

By 1930, the SGMB had drilled 51 wells (Mattos Dias and Quaglino 1993). The results of oil exploration in Brazil were poor until then. On the one hand, the development of the Geological Service work was slow due to the small amount of money invested by the government. On the other hand, private companies exploring for oil suffered from a lack of both capital and skilled workers.

### **1.2.3 The Period of Increasing Nationalism: 1930–1953**

The revolution of 1930 led by Getulio Vargas started a dictatorship in Brazil and for fifteen years he was the strong man in the country. In 1933 the Brazilian people elected the Constitutional Convention which elaborated a new constitution which was promulgated in 1934. The Constitutional Convention also elected Getulio Vargas as president of Brazil; thus, the former dictator became a president.

The new constitution established that the ownership of mines and other natural resources in the subsoil was distinct from the ownership of the soil and the economic exploitation of mineral resources depended on government concessions that could only be granted to Brazilian citizens or to companies established in Brazil.

In 1934, the government created the National Department of Mineral Production (DNPM) that replaced the SGMB as part of a reorganisation of the Ministry of Agriculture. This Ministry

elaborated subsidiary laws regulating mining activity: the Código de Minas (Mining Code). This code established that mining concessions would be granted by the Ministry of Agriculture; mining activities should follow a programme previously approved by the government which would be advised on these matters by the DNPM; imports of machinery and material related to the exploration of mineral deposits would be exempted from tax.

There was still a lack of funds for oil exploration. The budget of DNPM remained small, and initially its exploration for oil was not successful. It was only in 1939 that oil was discovered in commercial proportions in Brazil by the DNPM in a locality called Lobato in the state of Bahia.

A new constitution was promulgated in 1937 as a consequence of an internal coup by Vargas – this was the beginning of his second period of dictatorship. Oil regulations included in the new constitution became exceedingly nationalistic. It was established that all mining companies' shareholders must be Brazilian.

In April 1938, just after the Mexican nationalisation of the oil industry in March, Decree 366 bestowed on the federal government the ownership of all existing oil and gas fields in the country. Later in the same month, Decree 395 established that the importation, exportation, transport (including pipeline building), distribution and trading of petroleum and oil products had to be authorised, regulated and controlled by the government. It also prohibited the participation of foreign capital in refineries operating in the country. At that time, the country had a refining capacity of 1,650 b/d owned by private companies, but the government had no participation in refining.

Decree 395 also created the National Petroleum Council (Conselho Nacional do Petróleo – CNP), which was directly responsible to Vargas. According to this decree, CNP would assist the government in formulating the terms and deciding on the allocation of oil and gas concessions. Secondly, it would perform, on behalf of the government, the exploration and production activities. Finally, as a regulator, CNP would control the imports and transportation of petroleum and oil products, and would grant permissions for the building of refineries.

The Brazilian army, convinced that oil was essential to the country's security, played an

important role in the formulation of the nationalistic petroleum policy. In February 1938, General Horta Barbosa, deputy of the army's Estado Maior, suggested to the Federal Council of International Trading (Conselho Federal de Comercio Exterior) that the oil industry should be either a state monopoly or nationalised. Decrees 366 and 395 were signed immediately after the conclusion of the Federal Council's studies on the army's proposal (Victor 1991).

General Horta Barbosa was nominated CNP's first chairman. He believed that refining could fund petroleum exploration and production activities and therefore planned to build a 10,000 b/d refinery in Rio de Janeiro to process imported oil.

In the 1930s, most Brazilian oil product supply (kerosene, fuel oil, gasoline and lubricants) depended on imports from four foreign companies: Standard Oil of New Jersey, Shell-Mex of Brazil, Texas Company, Atlantic Refining Company. Although they had no interest either in the upstream or in refining at the time of Decree 395, these companies fought the nationalistic legislation. In 1940, 1941, and 1942, Standard Oil unsuccessfully presented to the Brazilian government proposals to participate in exploration, production and refining activities in Brazil. These proposals were conditional on changes in the oil regulations. Following the advice of military advisers, dictator Vargas rejected these proposals.

After 1938, when the ownership of mineral deposits had been transferred to the government, the interest in forming companies to explore for oil decreased sharply and exploration was basically performed by individuals. In the period 1941–50, 44 concessions were granted to individuals while only one was granted to a company (Mattos Dias and Quaglino 1993). The lack of funds and technical skills was still an obstacle to exploration and it was apparent that only the government could overcome these difficulties.

After the creation of CNP, the government increased the pace of state exploration for oil. CNP had more funds than its predecessor (the DNPM). After the discovery of oil in Lobato in 1939, which had proved to be non-commercial, further exploration led to the discovery in 1941–42 of three commercial oilfields. Domestic oil production in 1943 was only 131 b/d, or less than 0.5 per cent of the national demand (as shown in Table 1.1).

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**Table 1.1: Brazilian Oil Product Consumption, 1940–53. Barrels per Day.**

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	<i>Aviation Gas.</i>	<i>Gasoline</i>	<i>Kerosene</i>	<i>Diesel</i>	<i>Fuel Oil</i>	<i>Others</i>	<i>Total</i>
1940	299	10,082	2,451	3,104	12,878	695	29,512
1945	1,193	9,303	1,947	3,513	14,204	991	31,154
1953	4,033	55,124	9,520	21,717	43,942	3,205	137,543

Source: Anuário Estatístico do Brasil – IBGE

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During the Second World War there were difficulties in the importation of rigs, machinery and equipments used in exploration and production as well as a shortage and rationing of oil products. Thus, the supply of oil products, mostly based on imports controlled by foreign oil companies, became a problem increasingly related to national security.

In 1940, the government followed suggestions made by CNP and centralised the levying of taxes on petroleum products through the creation of the Sole Tax on Liquid Fuels (*Imposto Único sobre Combustíveis Líquidos – IUCL*), a federal tax.<sup>1</sup> States and municipalities could no longer levy taxes on oil products. At the same time, the government stimulated domestic refining as it set a higher tax rate on imported oil products than on domestically refined ones. Part of the Sole Tax revenue was originally destined to fund the building of roads. From 1945 onward these funds constituted the National Road Fund.

Dictator Vargas was deposed in 1945 and a new constitution was promulgated the following year. This established, in Article 146, that oil concessions could be granted not only to Brazilian individuals, as stated in the 1937 constitution, but also to companies established in Brazil, including foreign ones. According to the nationalist press, that article was included in the Constitution as a result of direct pressure from a Standard Oil representative.

At the end of the Second World War, CNP opened a bid for refining concessions. No foreign capital would be admitted and preference would be given to candidates who would invest part of the profits made from refining in oil exploration. Two concessions were granted: the first, in 1946, to a 8,000 b/d refinery in Rio de Janeiro and the second, in 1947, to a 20,000 b/d one in São

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<sup>1</sup> Decree 2,615 of 21 September 1940.

Paulo. These two private refineries were not inaugurated until 1954. In 1946, the government decided to build a refinery in Bahia and authorised CNP to subscribe 50 per cent of the shares on behalf of the Union. The other 50 per cent would be offered to public subscription. The intention of the original plan was that for the first two years after its inauguration the refinery would be controlled by CNP, after which the state's shares would be sold in the stock market.

After the Vargas dictatorship General Dutra became president. During his government, CNP, under the new leadership of Colonel J. C. Barreto, tried to make oil regulations more flexible as far as foreign capital was concerned. In February 1948, the government sent to the National Congress a bill, the Estatuto do Petroleo (Petroleum Statute), which stated that foreign capital would be allowed to participate in all oil industry activities.

The Petroleum Statute tried, first, to ensure that domestic supply would be under national capital control. Secondly, it tried to attract foreign capital in refineries for the external markets. The Statute proposed that, in the upstream, foreign companies would not need to enter into any partnership with national capital. Companies might only export crude after national requirements had been satisfied for the next three years. In the downstream, foreign capital participation would be subject to a ceiling of 40 per cent until domestic demand of oil products was met.

The Petroleum Statute initiated, even before it was sent to the Congress, a national debate on petroleum policy. The main forum for the debates was the Military Club that promoted a number of conferences on the issue and reaffirmed the important role of the army in decision-making in oil matters. The supply problems during the Second World War had contributed to the characterisation of oil sector developments as a national security factor.

On one side of the debate, a group formed around General Juarez Tavora was defending the points of view of the statute. General Tavora believed that the nationalistic approach would be harmful as it could break the alliance between American and Brazilian capitalists initiated during the Second World War. He also believed that, due to the lack of funds and technical skills, the development of a national oil industry without the help of foreign capital would be very slow.

On the other side, a group led by General Horta Barbosa, the former president of CNP, believed

that the oil sector was of such vital importance in the national economy that it should be controlled by the government. This group thought that the state should build and control national refineries which would initially, process imported oil. Refining profits would then fund exploration for oil in Brazil. General Barbosa emphasised the plundering of the multinational oil companies and the intrinsically monopolistic character of the oil industry. He believed that when the government aimed to protect national capital it was in fact granting a virtual monopoly to the private sector. His view in fact, was that the oil sector should be a state monopoly, and he would not even allow a mixed company, with both private and government capital.

In 1948, after the Petroleum Statute had been sent to the Congress, the Student Commission of Petroleum Protection and the Centre of Studies and Protection of Petroleum (Centro de Estudos e Defesa do Petróleo – CEDP) were created. This was the beginning of a long public campaign – O Petróleo é Nosso (The Oil is Ours) – against the Statute of Petroleum. Both right- and left-wing politicians joined the campaign, which became a national popular movement. The CEDP brought together military, students, intellectuals, technical personnel and the nationalist press. The Centre was based in the state of Rio de Janeiro, the federal capital, but it organised conferences and promoted the founding of regional centres in other states. CEDP also exerted pressure on the Congress, trying to influence the discussions about the Statute. The task of CEDP was not easy. State governors frequently repressed public demonstrations and banned conferences, while military commanders arrested officers involved with the CEDP.

In 1948 the government submitted another bill to the Congress, the SALTE Plan (SALTE - initial letters of the Portuguese words for health, food, transport and energy), which proposed federal investments for the next five years. The plan included the following suggestions concerning oil: intensification of the exploration for oil; the building of a 45,000 b/d new refinery; enlargement of the refinery in Bahia to 5,000 b/d; purchase of tankers with a total capacity of 225,000 tons. In the bill sent to the Congress, the government made clear that private refineries, owned by national concessionary companies, would complement the 50,000 b/d capacity of the state-owned refineries controlled by CNP. The plan estimated that national oil demand was around 80,000 b/d.

In July 1949, CNP signed with French companies a contract for equipment and material supply

for the building of the new refinery in the state of São Paulo. At the end of the same year, the tankers proposed by the SALTE plan were bought and constituted the Frota Nacional de Petroleiros – FRONAPE – (National Tanker Fleet) which became subordinated to CNP.

In late 1949, it became clear that the original Petroleum Statute would not be approved by the Congress. In 1950 president Dutra's administration was almost at an end. Partly due to the strong popular mobilisation, the government gave up trying to turn the Petroleum Statute into law. The relative success of the movement against the Statute set oil policy as an important issue in the electoral campaign of 1950. Candidates for the presidency avoided expressing clearly their position concerning the oil policy. The campaign 'The Oil is Ours' entered the National Congress as members of CEDP were elected to the House of Deputies. Further, the campaign spread among army members when a nationalistic general and Horta Barbosa were elected respectively president and deputy of the Military Club. Finally, Getulio Vargas, the former president and dictator who had been responsible for the 1937 nationalistic oil regulations, was once again elected president of the country.

### **1.3 The Foundation of Petrobras**

In December 1951, Getulio Vargas sent Bill 1,516 to be voted by the Congress, proposing the founding of the company Petróleo Brasileiro S/A – PETROBRAS. The bill was prepared according to Vargas's nationalist views but in a way that could partly neutralise the opposition formerly favourable to the Petroleum Statute.

The main objective of the proposed company was to be the reduction of foreign currency spent on petroleum and oil product imports. Oil product consumption was growing fast. The average annual growth rate jumped from 1.1 per cent in the 1940–45 period to 20.4 per cent in the 1945–53 period. The impact of this growth on the commercial balance was substantial; oil imports increased from 7 per cent of total exports before the Second World War to about 18 per cent in 1952 (Petrobras 1993). In the short term, new domestic refineries would allow the country to save foreign currency by means of substituting crude oil imports for oil product imports. In 1955, in Brazil, a switch from one barrel of product imports to one barrel of crude represented a reduction of 45 per cent of f.o.b. import costs – in that year, the average f.o.b. import costs of

petroleum and oil products were respectively US\$2.1/b and US\$3.8/b (Petrobras 1994). However, only increases in domestic oil production could produce a substantial improvement in the trade balance. In the early 1950s Brazilian oil production, which was concentrated in Bahia, was very small, accounting for only 2.5 per cent of national consumption.

The original bill sent by Getulio Vargas to the Congress did not propose a state monopoly, but that the state would own at least 51 per cent of the new company's shares. The federal government would subscribe the total initial capital ( Cr\$ 4 billion ) and would be allowed, later on, to sell up to 49 per cent of these shares.

The bill provided some funding sources for the new company: 25 per cent of Sole Tax revenue (article 13); all fiscal revenue from taxes levied on imported cars (article 14); and compulsory contributions to research from concessionary private companies (article 48). For a limited period, car owners should buy special certificates in order to obtain their annual vehicle licences. Later on, these certificates would be converted into Petrobras shares (article 15).

The bill also proposed that Petrobras would be organised as a holding company, although the precise structure would be defined later, when the company's statutes were established. The formation of subsidiary companies would be quite flexible as the bill allowed Petrobras to organise all oil activities – exploration, production, refining and transport – in subsidiary companies. Many of CNP's responsibilities would be transferred to Petrobras: exploration for and production of petroleum; administration and operation of both government refineries and the national tanker fleet.

The presentation of Bill 1,516 to the Congress started a period of parliamentary debates lasting almost two years, and elicited negative reactions even from left-wing forces. Consequently, during the debates many amendments to the original bill were proposed. At the end of the day, negotiations drove the government to agree that a state monopoly would be established but, in exchange, the main points of the original project would not be modified. Vargas also had to agree not to nationalise oil product distribution companies, existing refineries and refineries that were under construction at the time. However, it was agreed that these refineries could no longer expand their processing capacities.

Finally, the amended bill became Law 2,004. It was signed by Vargas on 3 October 1953, on the anniversary of the 1930 revolution that had empowered him as the head of a provisional government. The state monopoly created by Law 2004 initially did not include crude oil and products imports, wholesale, retail and transport by road and railways. Later, in 1963, the monopoly was extended so that it also included the import of both oil and products.<sup>2</sup> Monopoly would be exercised firstly by CNP, as the regulator and controller, secondly by Petrobras and its subsidiaries, as executors.

Law 2004 created Petrobras as the sole concessionary oil company whose major shareholder was the state. Further, in contrast with the proposed bill 1,516, the composition of shareholders was restricted and it excluded foreign companies as well as Brazilians married to foreigners. The same restrictions were applied to all subsidiary companies.

Petrobras inherited assets and technical experience from CNP. These included: one operating refinery in Bahia (5,000 b/d) and another being constructed in São Paulo (45,000 b/d project capacity);<sup>3</sup> one fertiliser factory (being built); 22 tankers (total capacity of 224,000 tons); producing oilfields (total production of 2,600 b/d – less than 2 per cent of domestic demand); recoverable reserves of 15 million barrels; and assets from the Commission for Shale Industrialisation. Petrobras's initial capital was Cr\$ 4 million or US\$ 649 million, at January 1997 prices (Petrobras 1993 and author's calculations).

The state oil monopoly was further enforced by Article 177 of the 1988 Constitution, promulgated after the end of the military dictatorship. The original wording of this article maintained the scope of the monopoly and also forbade the state to grant other concessions for oil/gas exploitation than those already granted to Petrobras.

In 1995, amendment No. 9 to Article 177 of the Constitution allowed the government to 'contract with state-owned or with private enterprises' for the execution of the state monopoly with due regard for the conditions set forth by specific regulations. So, Petrobras will soon face

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<sup>2</sup> Decree 53,337 of 23 December 1963.

<sup>3</sup> In 1953, domestic refining capacity was 11,260 b/d or 8.2 per cent of the 137,000 b/d Brazilian product demand.

competition from other concessionary companies in Brazil. Subsidiary regulations will provide for a guarantee of oil products supply in the whole territory, define the conditions of contracting and the structure and duties of the regulator. In December 1995, Law 9,249 stipulated that, from 1996 onwards, the government would levy income tax on the results of those Petrobras activities arising from the execution of the state oil monopoly which had previously been exempted.

In July 1996, the government sent a bill on oil regulations to the Congress, and competing bills were also presented by Congress members. All these bills were taken into account by the relator in order to prepare a final text. On 6 August 1997, the Congress passed the final bill which became Law 9,478, the new petroleum regulation legislation, after receiving the sanction of the president. The legislation created the Conselho Nacional de Política Energética (CNPE) which will be responsible to the president and which will define Brazilian energy policy. DNC, the former regulator, will be replaced by the Agência Nacional de Petróleo (ANP) four months after the publication of the oil legislation. The duties of ANP will be to regulate, contract and control the economic activities of oil in the country. It will promote E & P concession rounds,<sup>4</sup> decide about granting concessions and control the concessionaires' activities. Decisions on the granting of concessions will be based on the general work programme, timetables, the proposed minimum investment and the contract signature bonus. The agency will also grant licences for refining, natural gas processing, imports and transport by pipelines and waterways of oil, its products and natural gas. Ports and *transport* pipelines<sup>5</sup> will be subjected to the open access regime. Access pricing will be regulated by ANP. The import of oil, its products and natural gas will be subjected to CNPE directives.

Law 9,478 gave Petrobras the right to keep the concessions in currently producing areas. During a transition period, i. e. three years from the date the law was sanctioned, and depending on the company's investment capability, Petrobras can also keep concessions in areas where it had made either commercial discoveries of oil/gas or investments in exploration. If Petrobras succeeds in producing oil/gas in these areas within the transition period, ANP will allow it to carry on with

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<sup>4</sup> The legislation established that E & P activities will be carried out under a concession regime.

<sup>5</sup> The legislation clarifies the distinction between *transfer* pipelines and *transport* pipelines. Transfer pipelines are those whose routes are considered as of 'specific and exclusive interest of the owner or exploiter of the facility' while transport pipelines are those whose routes are of 'general interest'.

the production activities. Six months after publication of the new legislation ANP must vest Petrobras with operating licences for the existing refineries and natural gas processing units owned by the company. Petrobras will be allowed to set up subsidiary companies and to enter into partnerships to operate in the domestic oil business. Further, Petrobras must create a transport subsidiary company that will operate its pipelines, ports and ships.

The law also established that the state must keep control of Petrobras by means of holding at least 50 per cent plus one share of the *ordinary voting shares*. After the publication of Law 9,478 the government announced that it will sell the remaining shares in excess of the minimum needed to retain control of the company.<sup>6</sup>

The fact that the law initially preserved vertical integration, assets ownership and the effective refining monopoly of Petrobras (currently Petrobras owns more than 98 per cent of domestic refining capacity), suggests that the opening of the domestic oil sector to private investment was motivated by the country's need to increase the amount of investment on development of oil/gas resources rather than by the government's desire to promote competition in the domestic oil sector.

## **1.4 The Development of Petrobras**

### **1.4.1 Organisation**

The decision by Congress to apply the same shareholder criterion to all Petrobras's subsidiaries – even those dedicated to non-core activities – hindered its ability to participate in these ventures. The 51 per cent ownership of the subsidiaries meant that funds had to be prioritised for core activities.

Despite the chronic lack of funds for exploration and the popular belief in the existence of huge reserves of oil in the Brazilian territory, there were some unsuccessful attempts to find oil in Bolivia. As a result, Law 2,004 outlawed further foreign ventures unless they were linked to government-to-government agreements.

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<sup>6</sup> Currently the state holds 81.7 per cent of the ordinary voting shares and 9.2 per cent of the preferred shares.

In fact, rather than the division of Petrobras into subsidiary companies with separate shareholders and accounts, initially two departments were responsible for the coordination of exploration and production (E&P) activities while other core business activities (refining, sea transport, petrochemicals, pipelines) were under the direct supervision of the board of directors, who were assisted by specialists on those matters. Non-core business activities were arranged into coordination committees and services (personnel, materials, juridical, and so on).

Policies were formulated by the Administrative Council, consisting of Petrobras's president (with veto power) and directors, all appointed by the president of Brazil; counsellors representing public organisations who owned Petrobras shares and counsellors representing private shareholders. The management of the company's resources was the responsibility of the Board of Directors which included the chairman and directors.

Political instability caused frequent changes in the leadership of Petrobras. In 1962, some high level officials published a manifesto in which they disapproved of the conduct of the company's president and asked for his dismissal. In reaction to this, he fired most of those who had signed the manifesto and tried to obtain the support of the leadership of the petroleum industry unions. The unions thus gained more autonomy and started to exercise increasing control on the Petrobras management. The political radicalisation of the early 1960s strengthened the unions' power in the country. In return for their support, the Petrobras president agreed to put pressure on the government to adopt measures that would favour Petrobras – such as including the import of oil and products in the state monopoly and the take-over of existing private refineries. The degeneration of the system of hierarchy occasioned the loss of skilled people and high level officials (Carvalho 1977). In 1964, a military coup installed a dictatorship which reinstated strict government control over Petrobras.

Since its foundation in 1953, Petrobras has expanded its activities in Brazil under the protection of the monopoly. This expansion and the need to reduce the impact of political instability on the company's management are the two reasons why the company was divided into departments and services in 1965. Departments not only acted as filters of information between operational units and the management but also isolated these units from the impact of changes in personnel in the top administration. Political interference at levels below the board of directors was not common,

but in the case of subsidiaries the President appointed directors for each activity. Four departments were created to manage the core business activities: (a) the former departments of exploration and production were merged into a single unit; (b) the industrial department managed the operation of refineries; (c) the transport department was responsible for the tanker fleet, pipelines and terminals; and (d) the commercial department for products supply and commercial operations. Other activities were performed by eight services: planning, organisation, finance, juridical, personnel, material, engineering and public relations. This organisational change also led to the creation of the Petrobras research centre.

In the late 1960s, in order both to overcome bureaucratic difficulties and to meet the need of decentralisation, large investments started to be managed by executive groups with leaders appointed and responsible to the board of directors. These groups were formed by technical personnel from different departments and services and benefited from great autonomy. Their lifetime was limited to the development period of the projects that had generated each executive group.

Also in the late 1960s, Petrobras started to expand into non-monopolistic activities. There was an urgent need for the creation of subsidiaries due to the diversification of the company's activities. A petrochemical subsidiary company (PETROQUISA) was created in 1967 and a distribution company (BR) in 1971. A subsidiary for overseas exploration (BRASPETRO) was created in 1972, for foreign trade (INTERBRAS) in 1976, fertilizers (PETROFERTIL) in 1976 and mining (PETROMISA) in 1977.

In 1993, driven by the idea that more efficient operations could be achieved by abolishing or selling some subsidiaries, the Brazilian Congress voted to abolish both INTERBRAS and PETROMISA and to privatise PETROQUISA.

#### **1.4.2 Funding Sources**

Until 1996, Petrobras investments were equivalent to US\$148.7 billion, at constant January 1997 prices (as shown in Figure 1.1). In the 1954–92 period, Petrobras invested US\$136 billion (at constant January 1997 prices) while in the same period the government contribution to

Petrobras's capital formation was equivalent to US\$16.6 billion (at constant January 1997 prices, see Table 1.2), or 12 per cent of the company's total investments in that period. The rest of Petrobras's investment was mainly funded by the company's operations complemented by some financing, as we will show in this section.

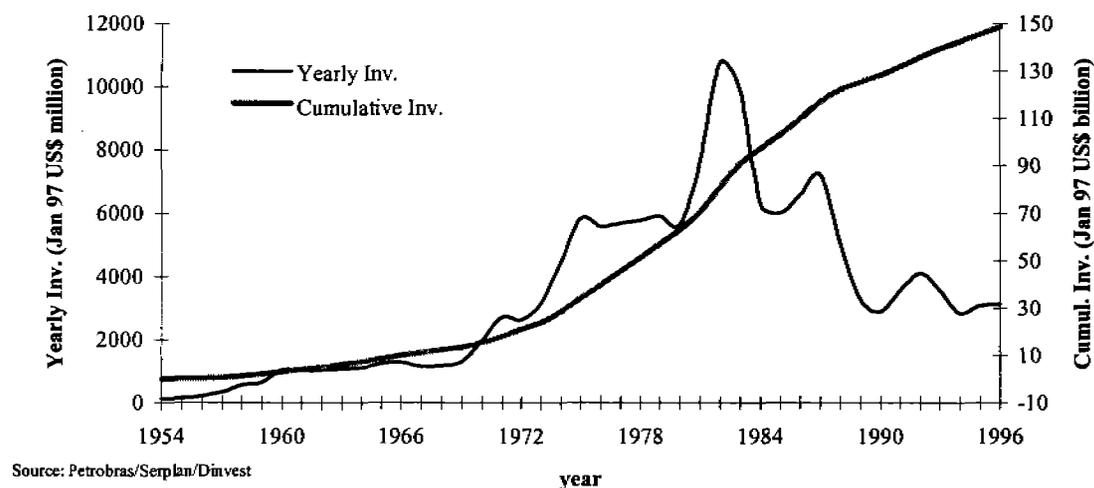


Figure 1.1: Petrobras' Investments, 1954-96.

Only 2 per cent of government contributions to Petrobras's capital formation was not generated by the oil sector, that is neither by dividends, nor taxes from oil product sales, nor tax exemptions. Together with inherited assets from CNP, these contributions were not related to the activities of Petrobras (6 per cent of government contributions). 54 per cent of government contributions were funded by oil product tax revenue (80 per cent of these contributions were from Sole Tax revenue). Tax exemption accounted for 22 per cent of total government contributions while dividends reinvested by the state accounted for 18 per cent.

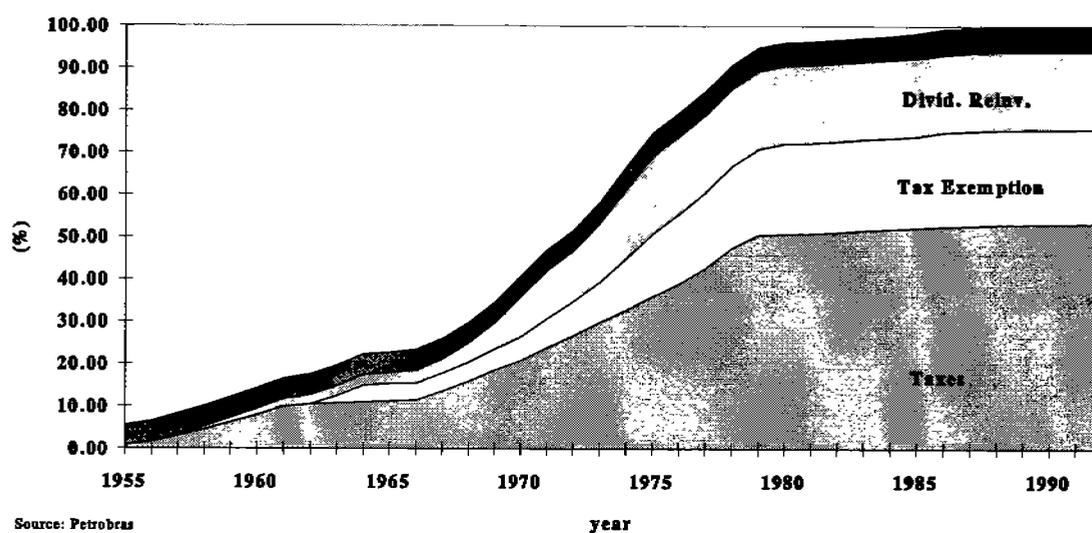
Figure 1.2 presents the government's cumulative contributions to the company's capital formation up to 1992. As is shown, in 1972 Petrobras had already received 51 per cent of those

investments. The 1973 oil shock led the government to increase the pace of investments in the oil sector: already in 1979, 95 per cent of government investments in Petrobras had been made.

**Table 1.2** Government Contributions to Petrobras's Capital Formation in the 1954–92 Period.

<i>Source</i>	<i>Jan 97 US\$ billion</i>
- Taxes	9.0
- Dividend reinvestment	3.0
- Tax exemption	3.7
- Incorporation of goods	0.7
- Cash	0.3

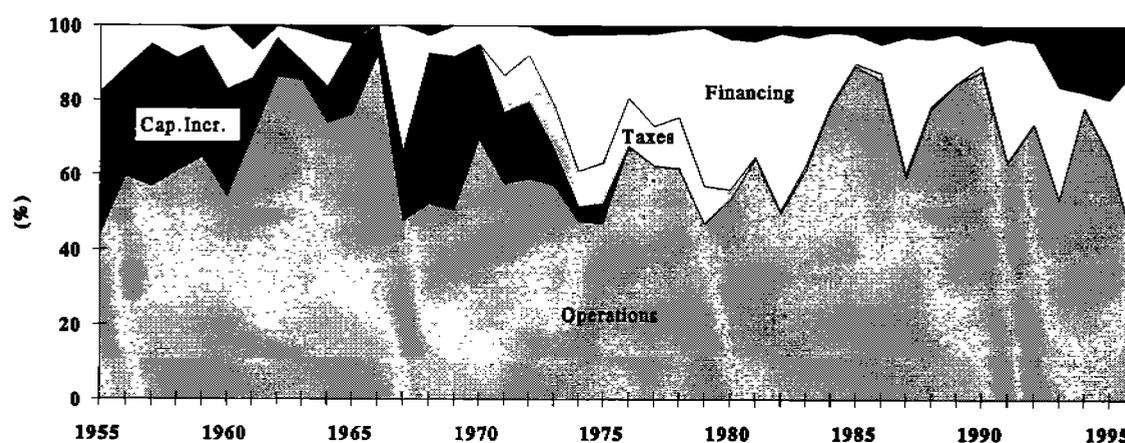
Source: Petrobras



**Figure 1.2:** Government Contributions to Petrobras's Capital Formation. 1955–92.

The need for government contributions after 1979 decreased because of the coming on stream of oilfield developments and the effect of high prices on revenues.

Figure 1.3 presents funding sources until 1996. Funds were mostly provided by company operations. The average share of this funding source in the period 1955–96 was 65 per cent.



Sources: Until 1979, Calabi et al.; 1980-96, from Petrobras' Annual Reports.

Figure 1.3: Petrobras' Funding Sources. 1955-96.

Until 1960, issued capital increases provided the company with between 29 and 38 per cent of yearly funds. In that period, almost all capital was subscribed by the government. Table 1.3 shows that these subscriptions were funded firstly by shares in fiscal revenues under Law 2,004 (see section 1.3) and secondly by government dividends that were reinvested. Private contributions were not significant in that period.

Table 1.3: Funding Sources of Issued Capital Increases. 1955-1975. Per Cent.

Year	Taxes	Government Dividends	Private	Year	Taxes	Government Dividends	Private
1955	100	0	0	1966	24	63	14
1956	100	0	0	1967	86	14	0
1957	81	19	0	1968	54	46	0
1958	79	20	1	1969	60	38	3
1959	81	18	1	1970	50	50	0
1960	80	18	1	1971	42	42	16
1961	85	13	3	1972	39	38	23
1962	59	38	3	1973	36	64	0
1963	51	47	2	1974	2	74	23
1964	83	13	4	1975	0	80	20
1965	95	5	0				

Source: Calabi et al 1983

In the early 1960s, the share of issued capital increases shown in Figure 1.3 was reduced as

Petrobras no longer had a share in Sole Tax revenues (see Table 1.4). This Sole Tax share was restored in 1967, decreased in subsequent years and was finally abolished in 1975. In 1976, the government ceased to invest in Petrobras, and dividends that had formerly been reinvested by the government, were absorbed by the National Development Fund created in 1974 in order to finance the National Development Plan II.

In the 1972–76 period, part of Petrobras's share in IUCL was specifically set apart for investment amortisation in oil exploration and research (see Table 1.4). From 1971 to 1984, fiscal revenues from earmarked taxes levied on oil products – alinea (i) and later alinea (D) (see section 2.4.2) – also funded amortisation of those investments. Both contributions to investment amortisation as well as funds from the National Merchant Marine Fund to finance shipbuilding, are included in the item 'Taxes' in Figure 1.3.

**Table 1.4:** Petrobras's Share in Sole Tax Revenues. 1953–1976. Per Cent.

<i>Year</i>	<i>Petrobras' Share</i>		<i>Year</i>	<i>Petrobras' Share</i>	
	<i>Capital Increase</i>			<i>Capital Increase</i>	<i>Investment Amortization</i>
1953	25		1965	0	
1954	25		1966	0	
1955	25		1967	14.4	
1956	25		1968	12.5	
1957	15		1969	12	
1958	15		1970	8	
1959	15		1971	8	
1960	15		1972	5	3
1961	15		1973	5	2
1962	0		1974	4	2.3
1963	0		1975	0	6.3
1964	0		1976	0	4.2

Source: Calabi et al 1983

Financing increased in the 1970s owing to the development of off-shore oil production. The need to import capital goods led to the use of supplier's credits and to debt increases. New loans were needed not only to finance increased investment in the exploration for oil, but also because Petrobras's operations demanded more working capital. There was a reduction of financing in the mid 1980s, after the Mexican moratorium in 1982, when the international financial market refused to lend more money to Latin American countries. The average share of loans in total

funds increased from 9 per cent in the period 1955–70 to 24 per cent in 1971–96.

The revenues from the 1993 sale of subsidiaries' interests were included in 'Others' in Figure 1.3.

### 1.4.3 Planning

*Petrobras Planning and National Planning.* Petrobras's development plans were always part of the national planning process. The early development of Petrobras depended heavily on government investments as we showed in the previous section. In 1956, President Kubitschek's government (1956–61) prepared the Plano de Metas (Plan of Goals). This included development programmes for a number of sectors. From the funds allocated to these programmes, 40 per cent were set apart for the energy sector (Carvalho 1977). During the implementation of Plano de Metas, Petrobras's investments increased from US\$106 million in 1956 to US\$346 million in 1958 and to US\$607 million in 1961. The government changed Sole Tax regulations (see Section 2.4.1) so that adequate funds could be transferred to Petrobras to help the company to achieve the targets of the government's petroleum programme: expansion of domestic oil production, refining capacity and the oil tanker fleet. In fact, the targets established by the Plano de Metas for the oil sector were based on a programme prepared by Petrobras's Assessoria Econômica (Economic Advisory Council).

The 1962 Plano Trienal (3-year Plan) set apart 35 per cent of government investment for the oil sector, but this was abandoned due to the political instability that preceded the 1964 military coup.

Petrobras's Planning Service (SERPLAN) was created by the 1965 administrative reform of the company. Until 1988, when a new constitution was promulgated, Petrobras plans, prepared by SERPLAN, were approved only by the executive branch of the government. After that, approval of the Congress was also required. Article 165 of the 1988 constitution established that all companies in which the state is the major shareholder must submit to the Congress a 5-year Investment Plan (Plano Plurianual de Investimentos – PPI), detailing the type of investments to be made. The PPI, together with the 5-year Operation Plan (Plano Plurianual de Operações – PPO) forms the 5-year Activity Plan (Plano Plurianual de Atividades – PPA). The PPA must be

compatible with Petrobras's Global Expenditure Plan (Plano de Dispendios Globais – PDG) which is a part of the government's PDG. The government's PDG is used by the IMF and the World Bank to evaluate the public deficit.

Plans are first sent by Petrobras to the Ministry of Mines and Energy, who submit them to the Planning Ministry. After approval of the plans, the Planning Ministry includes Petrobras's 5-year investment budget in the government's global budget. The Brazilian president sends this budget to the Congress, which may change it. After being voted on and passed, it is returned to the president to be sanctioned and either turned into law or vetoed.

*SERPLAN's Objectives.* The development of Petrobras's planning has been conditioned by the fulfilment of its mission – i. e. to meet the nation's demand for oil products at minimum costs. Thus, the prime goal of Petrobras is *not* to maximise its profits. The company could not choose the quantities of each oil product to be supplied in each region of the country. It must supply the entire domestic market of oil products at prices set by the government. For instance, it must supply the petrochemical sector with all its requirements in naphtha even if it would be more profitable to Petrobras to produce gasoline.

For Petrobras, a company which can neither choose its markets nor determine its own product prices, profit maximisation is equivalent to cost minimisation. If  $P$  is the company's profit,  $S$  the domestic sales revenue (that cannot be optimised by Petrobras),  $X$  the export revenues and  $C$  the total cost incurred by Petrobras to supply the *whole* domestic market, then SERPLAN must solve the following problem :

$$\text{Max}\{ P \} = \text{Max}\{ S + X - C \}$$

But  $S$  is given. Thus, all Petrobras can do is minimise  $C$  less  $X$ , i.e.:

$$\text{Max}\{ P \} = \text{Max}\{ S + X - C \} = \text{Max}\{ X - C \} = \text{Min}\{ C - X \}$$

*The Planning Process.* In the planning process, although emphasis has been given to social cost-benefit analysis of projects, the commercial analysis has also been taken into account. Social analysis evaluates the project's impact on the country's economy while commercial analysis evaluates the impact on the company's cash flow. In social cost-benefit analysis border prices

are used to value inputs and outputs, taxes and duties are excluded as they are transfers from the national point of view, and the exchange rate must reflect the relative purchasing power of domestic and foreign currencies. Furthermore, some intangible benefits, such as job creation and regional development, are also considered in the analysis. The commercial analysis considers the cashflow of a project including expenditures (with taxes), revenues, rebates and refunds established by regulations. Further, commercial analysis uses the actual exchange rate paid by the company.

The development of a project depends on its internal rate of return (social and commercial) being higher than 15 per cent, which is the internal rate of return guaranteed to downstream projects by specific regulations since 1966 (see Chapter 2).

The whole company is involved in the planning process, which is coordinated by SERPLAN. SERPLAN first estimates three scenarios of petroleum products demand over the next ten years, one optimistic, the second pessimistic and the third expected. Secondly, it plans the investments and the imports necessary to supply the expected demand, subject to a hypothesis of expected fund availability. At this stage, SERPLAN identifies the investment set related to the 'expected' demand scenario and to an expected scenario of fund availability. Further sensitivity analysis is conducted on the expected supply scenario to the full range of forecasts on both demand and funds. The sensitivity analysis enables SERPLAN to identify the investment set that is common to several scenarios, that is the set of *robust* investments. *Robust* investments are less likely to require further adjustments than other options.

In vertically integrated companies, such as Petrobras, investments are highly interdependent. For instance, the discovery and development of a new heavy oilfield may affect investments in the downstream: the capacity of conversion units, tankers, pipelines or terminals may need expansion in the near future as a result of the development of the new field. The investment analysis of integrated companies should be global, i. e. they should consider the complex net of interdependencies linking all projects.

The Investment Division of SERPLAN has used a linear programming model to perform an integrated analysis of the main projects of oil production and of the supply system. The model

works out the minimum cost solution for the supply of petroleum products to the domestic market for a 10-year period. The model has helped in the determination of the following: capacities, operation start-up dates and location of new process units; characteristics and capacities of the transport means needed; and operation start-up dates of oil and gas production projects.

Strategic planning, based on the scenario technique, was introduced in Petrobras's planning cycle in 1989. In order to cope with uncertainties inherent to the decision-making process, SERPLAN prepares both international and national scenarios describing different possible visions of the future. These broad scenarios constitute the framework in which specific scenarios for the oil industry are prepared. Naturally, the strategic plan provides the guidelines for PPA elaboration, since its boundary conditions are established by one of the scenarios generated by the strategic plan.

#### **1.4.4 Development of the Labour Force**

When Petrobras was created, there was a lack of skilled people required for work in the oil industry. Initially, most of the personnel came from CNP. Seismic and drilling activities were performed by contracted companies. CNP had already sent some people to be trained abroad and the Centro de Aperfeiçoamento e Pesquisa de Petróleo – CENAP (Centre of Improvement and Petroleum Research) which was created in 1950 had made covenants with universities to create courses on refining and petroleum geology.

Petrobras had to acquire and transfer know-how to its technicians in order to improve the ability of the company to explore for, produce and refine petroleum. The strategy for training skilled people to work in the upstream sector was based on hiring foreign geologists and geophysicists who would transfer know-how to Brazilian personnel. The company believed that, in the short term, this was the way to develop the national oil sector. At that time, Brazilians were optimistic about Petrobras's upstream results in the near future. So, the company hired a former geologist from Standard Oil Company of New Jersey, W. K. Link, as the head of the Exploration Department. Many other American geologists and geophysicists were also hired while Brazilian technicians were being trained.

After six years as head of the Exploration Department, the results achieved by Link were still very modest. The huge amount of geological and geophysical information collected allowed the department to produce, in 1960, an assessment of Brazilian sedimentary basin potential. That assessment, known as the Link Report, was quite pessimistic about most of the basins. The impact of this report on public opinion was very negative as it was contrary to the nationalistic view that Brazil was a country where petroleum was abundant. Link resigned in 1961, at the end of his contract, saddened by criticisms about his work, and was replaced by a Brazilian geologist.

Petrobras contracted foreign professors to teach in Brazil but later they were replaced by Brazilians who had been sent to study abroad. Training programmes were mainly carried out by Petrobras itself or by universities and other institutions linked to the company by special agreements.

#### **1.4.5 Petrobras's Contribution to the Development of the Capital Goods Industry**

As a company in a capital-intensive sector, Petrobras has played an important role in the development of the Brazilian capital goods industry. Since its establishment, Petrobras has stimulated the national industry to provide the capital goods it needed. A number of companies were created in the capital goods sector and expanded due to the growing volume of orders from Petrobras. They also had to invest in modern equipment to meet the specifications set by Petrobras.

The period from 1954 until the end of the 1970s was one of downstream consolidation. In 1954, 5 per cent of Petrobras's purchases of equipment and materials were supplied by the national industry; in 1960, the share of the national industry in these purchases was already more than 60 per cent and in 1979 it was around 80 per cent.

In the late 1970s Petrobras started to invest increasingly in offshore oil production. This activity demanded new kinds of equipment which the national industry could not supply immediately. Consequently, in 1980 the share of Brazilian manufactures in total supplies to Petrobras fell to 52 per cent. However, import restrictions generated by the debt crisis helped to raise that share to 83 per cent in 1982 and to 91 per cent in 1989.

From 1990 on, import restrictions were reduced by the Collor government whose main goal was the opening up of the Brazilian economy. The average import tax rate was reduced from 35 per cent (standard deviation = 20 per cent) in 1989 to 17.1 per cent (standard deviation = 10.7 per cent) in 1993 (Baer 1995) increasing the competition between national and foreign industries. The share of Brazilian industry in Petrobras's purchases fell but it was still kept higher than 80 per cent (Petrobras 1994).

## 1.5 Results of Petrobras's Operations

### 1.5.1 Refining

As already shown, when Petrobras was created in 1953, national refining capacity was 11,260 b/d of which a 5,000 b/d refinery was owned by Petrobras. Initially, the company decided to build refineries so that Brazil could import crude oil instead of oil products which, naturally, were more expensive than oil (see Section 1.3). By doing so, in the short term the country could save foreign currency and generate value-added.

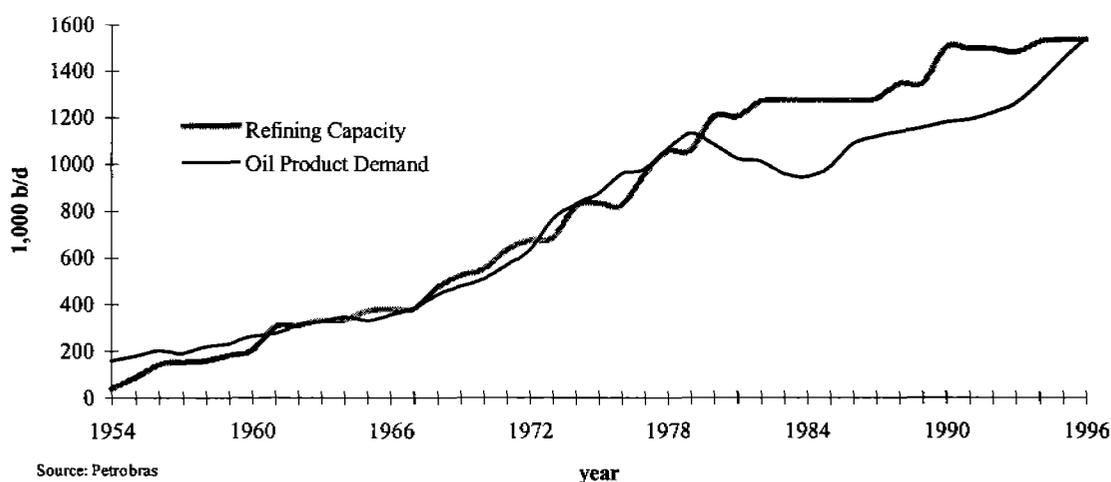


Figure 1.4: Petrobras's Refining Capacity. 1954-96.

Petrobras built nine refineries and incorporated two small private ones, with the aim of meeting domestic demand. In 1954–60, the average share of heavy fuel oil in Brazilian oil demand was at a maximum level of around 35 per cent. It declined in the following years. So, in order to maintain an adequate fuel oil yield, all the refineries were built with conversion units of heavy residues: atmospheric residues were processed in vacuum units; and vacuum gasoils were converted into lighter products in fluid catalytic cracking units. Later, some of the vacuum residues were processed in deasphalting and coke units.

In 1972 the country was already a net exporter of oil products. In that year, domestic refineries could process 675,000 b/d, and refining capacity increased further to 1.2 million b/d in 1980 and to 1.5 million b/d in the early 1990s (Figure 1.4).

### 1.5.2 Foreign Exchange Savings

The need to save foreign currency strongly influenced Petrobras’s decision to build refineries. Figure 1.5 presents these foreign currency savings. The values were calculated as the deflated difference between foreign exchange spent in two distinct situations of oil product supply to the domestic market: a hypothetical situation in which domestic demand for oil products would be entirely met by imports; and the actual situation. Differences were deflated using the American CPI.

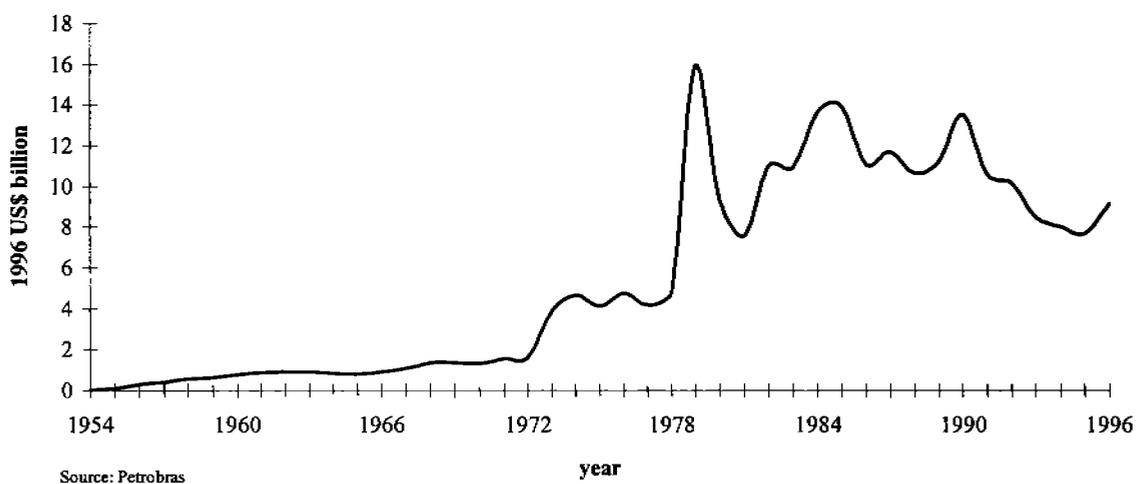


Figure 1.5: Foreign Currency Saved by Petrobras. 1954–96.

Foreign currency saved by Petrobras (FCS), in each year can be split into three components. One due to crude oil domestic production (PRODC), the second due to production of domestic refineries (REFC) the third due to the production of Perobras' tanker fleet (TC):

$$FCS = PRODC + REFC + TC$$

PRODC can be written as the opportunity cost of domestic production. REFC is equivalent to the difference of the opportunity cost of the domestic refineries' production and the opportunity cost of refinery feedstock. TC represents the opportunity cost of the long haul transport of crude oil less freight and foreign currency expenditures to pay repairs and maintenance of tankers and less an adjustment due to product exports.<sup>7</sup>

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<sup>7</sup> Consider that:

- PDP = (p<sub>1</sub>, p<sub>2</sub>, ..., p<sub>n</sub>) is the vector of product domestic production.
- PI = (i<sub>1</sub>, i<sub>2</sub>, ..., i<sub>n</sub>) is the vector of the imported volumes of the n oil products.
- PX = (x<sub>1</sub>, x<sub>2</sub>, ..., x<sub>n</sub>) is the vector of the exported volumes of the n oil products.
- PIC = (pi<sub>1</sub>, pi<sub>2</sub>, ..., pi<sub>n</sub>) is the vector of the oil products c.i.f. import costs.
- OI = volume of oil imports.
- <OP> = average f.o.b. price of oil imports.
- PXP = (px<sub>1</sub>, px<sub>2</sub>, ..., px<sub>n</sub>) is the vector of the oil products f.o.b. export prices.
- MAIN = abroad maintenance and repairs of tankers
- FREIGHT = all freights contracted by Petrobras.

Then we can write:

$$\begin{aligned} 'S &= [P\vec{D}P + \vec{P}I - P\vec{X}].P\vec{I}C - [OI.<OP> + \vec{P}I.P\vec{I}C - P\vec{X}.P\vec{X}P + MAIN + FREIGHT] \\ &= P\vec{D}P.P\vec{I}C - OI.<OP> + [-P\vec{X}.(P\vec{I}C - P\vec{X}P) - MAINT - FREIGHT] \end{aligned}$$

We will consider that the import source of products is the same as the exports destination. Then (PIC-PXP)=2PF, where PF = (f<sub>1</sub>, f<sub>2</sub>, ..., f<sub>n</sub>) is the vector of freights of the oil products on the route (import source)-Brazil. If <OIC> is the average c.i.f. import cost of oil then <OP> = <OIC> - <OF>. Then we can re-write FCS as following:

$$FCS = P\vec{D}P.P\vec{I}C - OI.<OIC> + TC$$

$$\text{where: } TC = OI.<OF> - 2P\vec{X}.F\vec{X} - MAINT - FREIGHT$$

If ODP is the amount of the domestic production of oil that was refined by Petrobras then:

PRODC increased with domestic oil production. In 1970, when domestic production of crude oil was equivalent to 36 per cent of refineries' feedstock, PRODC share in FCS was 37 per cent while the REFC share was 55 per cent (Petrobras 1997). Hard currency savings due to domestic refining were particularly enhanced during the oil price increases of 1973 and 1979, when the differentials between crude oil world prices and product international prices widened. In 1973 REFC share in FCS was 77 per cent and in 1979 was 81 per cent. Petrobras saved US\$8.6 billion in 1973–74 and US\$25.4 billion in 1979–80 (at constant 1996 prices). In 1980, REFC share in FCS fell to 51 per cent. In the 1981–85 period FCS increased but this was now due to the substitution of national oil for imported oil. In 1985, the PRODC share in FCS was 69 per cent. SERPLAN estimated that FCS in the period 1954–96 was equivalent to US\$239 billion, at constant 1996 prices.

### 1.5.3 Crude Oil Exploration and Production

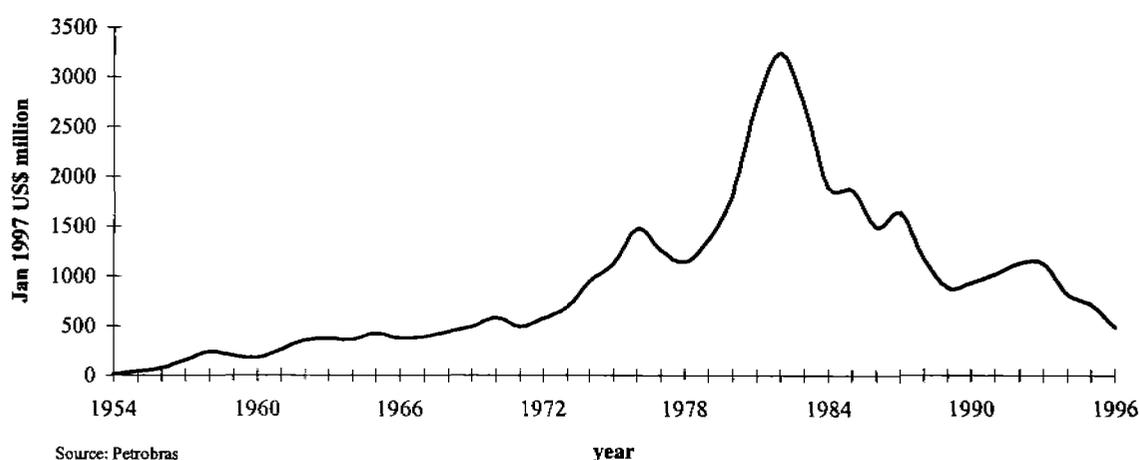
Until the early 1970s, onshore oil discoveries in Brazil yielded small reserves. At that time, there was no available technology for offshore oil production in deep waters – in the early 1980s, 200 metres was considered a great depth by the industry.

In 1973, domestic production of oil was 174,000 b/d, or 23 per cent of the oil processed in Petrobras's refineries. Most of the oil required by the country was imported. In 1975, after the first oil shock, net imports of petroleum and products were equivalent to 30 per cent of the country's total exports. In 1980, that figure rose to more than 46 per cent (MME 1994). It was desirable to substitute domestic production for imported oil in order to obtain further reductions of foreign currency expenditures in the oil sector, beyond those already achieved through refining.

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$$\begin{aligned}
 FCS &= ODP.<OIC> + [P\vec{D}P.P\vec{I}C - (ODP+OI).<OIC>] + TC = \\
 &= PRODC + REFC + TC
 \end{aligned}$$

$$\text{where: } PRODC = ODP.<OIC> \quad \text{and} \quad REFC = P\vec{D}P.P\vec{I}C - (ODP+OI).<OIC>$$



**Figure 1.6:** Trends in Petrobras Investment in Oil Exploration. 1954–96.

The impact of the oil shocks in 1973 and 1979 on the Brazilian commercial balance, induced an increase of exploratory activity by Petrobras as shown in Figure 1.6.

Better oil prospects were located in the continental shelf rather than onshore. After the development of offshore oil production technologies, it was possible for Petrobras to discover and develop large oil reserves in deep water. In 1968 the first Brazilian offshore oilfield was found in the state of Sergipe. In 1974, Petrobras discovered the first oilfield in the Campos Basin, which later became the largest petroleum province in the country – offshore Rio de Janeiro.

Offshore exploration for oil was intensified. In the period 1981–92, offshore exploratory wells recorded a success rate of 32 per cent, equal to that of the North Sea in the same period (Petrobras 1993b). In 1985, two giant fields were discovered in very deep waters in the Campos basin. In one of them – the Marlim field – Petrobras started to produce oil in the world’s deepest water wells: the Marlim pilot project began in March 1991 at a water depth of 405 metres; in April 1994, another well started to produce at a water depth of 1,027m. In 1996, Petrobras discovered another giant oilfield in the Campos Basin, the Roncador field, located at a depth of between 1,500 and 2,000 metres. Petrobras initially estimated Roncador’s proven reserves of oil at 1.4 billion barrels.

The 1973 oil shock suddenly increased the share of oil imports in total Brazilian imports from 12 per cent to 23 per cent in the 1972–74 period (IMF 1984). The need for the country to increase quickly domestic reserves and production of oil led the government, in 1975, to authorise Petrobras to sign risk contracts for oil exploration with other companies. These contracts were granted until 1988, when the new constitution prohibited the signature of new contracts. However, risk contracts that were granted before the constitution was promulgated remained effective.

In the period 1975–88, almost all sedimentary basins were opened to risk contracts, including those offshore. However, international companies were not interested in deep water areas. 243 contracts were granted to 42 companies who invested US\$1.8 billion and discovered only five fields. Of those companies, 22 were operators. In 1994, risk contracts that were still in effect provided two companies with a production of only 7,220 b/d of oil.

Petrobras also carried out further oil exploration in the Amazon. In 1986 it found the first commercial oil and gas field in the rain forest, the Urucu field, followed the next year by the discovery of another field in the neighbourhood. Oil production in that region started in 1988.

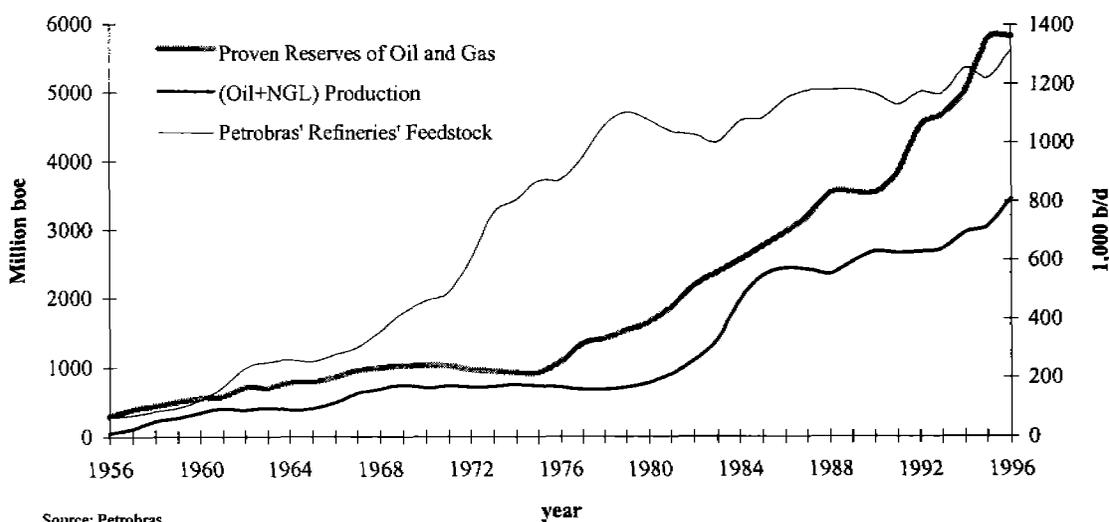


Figure 1.7: Trends in Brazilian Proven Reserves of Oil and Gas. 1956–1996.

As oil exploration was intensified in Brazil, oil and gas proven reserves increased from 0.9 billion boe in 1973 to 2.4 billion boe in 1983, 4.7 billion boe in 1993 and 5.8 billion in 1996, as can be

seen in Figure 1.7. Most of the new discoveries were in the continental shelf.

The development of the new oilfields raised oil and NGL production to 0.6 million b/d in 1985 and to 0.8 million b/d in 1996 (Petrobras 1997). Typically, all domestic oil production was processed in Petrobras's refineries. In 1996, oil production was enough to supply 61 per cent of the country's

needs. Petrobras estimates that its oil and NGL average production in the year 2000 will be around 1.5 million b/d.

#### **1.5.4 Principal Financial Indicators**

The discussion of Petrobras's financial and economic performance is not only beyond the scope of this study but also presents some difficulties. First, the accounting procedures vary considerably from international standards. These procedures were designed in a way to respond to the historically high inflation rates. Until 1987, monthly financial statements were accumulated according to their nominal value as stipulated by Brazilian corporate legislation. However monetary adjustments were made on permanent assets, stockholders' equity, CNP (and later DNC) accounts, advances and credits for capital increase, at official indexes. From 1988 onward, Petrobras also presented in its annual reports the financial statements expressed in the currency of constant purchasing power. Since then, the financial statements of previous months have been deflated to the date of the current month and expressed in US dollars at the current exchange rate. So, results have been subjected to monetary and exchange rate variations. Further, unlike most international oil companies, Petrobras's E&P investments are all expensed in the same year in which they occurred. We also emphasise that the cost of imported oil that has been included in the reported cost of goods sold is not the actual import cost incurred by Petrobras but an arbitrary figure used by the regulator to set the domestic prices of oil products – i.e. the structural c.i.f. cost of imported oil. These and other peculiarities of Petrobras's accounting procedures must be taken into account when developing any comparative analysis.

Secondly, we must bear in mind when analysing Petrobras's income statements that domestic prices of oil products have been set by the government in such a way that, very often, as we will show further in this study, the consumption-weighted average of ex-refinery net of tax prices was

**Table 1.5: Principal Financial Indicators of Petrobras. 1985-96**

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
(a) Net Operating Revenue (US\$ millions)	13,140	12,055	12,464	12,107	11,549	12,848	11,270	12,494	13,789	13,721	15,195	16,786
(b) Net Income (US\$ millions)	1,061	1,900	134	471	160	557	(237)	56	673	1,743	586	661
(c) Total Assets (US\$ millions)	11,659	12,338	13,400	13,083	13,333	12,953	14,813	18,667	19,794	28,023	30,504	32,281
(d) Stockholders' Equity (US\$ millions)	5,614	8,297	7,882	7,246	8,421	5,863	11,850	11,200	12,236	18,855	20,257	19,250
(e) Return on Sales (b/a)	8.1 %	15.8 %	1.1 %	3.9 %	1.4 %	4.3 %	-2.1 %	0.4 %	4.9 %	12.7 %	3.9 %	3.9 %
(f) Return on Investments (b/c)	9.1 %	15.4 %	1.0 %	3.6 %	1.2 %	4.3 %	-1.6 %	0.3 %	3.4 %	6.2 %	1.9 %	2.0 %
(g) Return on Stockholders' Equity (b/d)	18.9 %	22.9 %	1.7 %	6.5 %	1.9 %	9.5 %	-2.0 %	0.5 %	5.5 %	9.2 %	2.9 %	3.4 %
(h) Short-Term Debt Index												
[Current Liabilities] / [Total Assets]	32 %	26 %	32 %	32 %	32 %	40 %	26 %	29 %	25 %	22 %	23 %	27 %
(i) Debt Index												
[Total Liabilities] / [Total Assets]	52 %	39 %	44 %	43 %	41 %	49 %	35 %	38 %	38 %	33 %	35 %	40 %

Source: Petrobras.

not in phase with international prices. So, in some years, Petrobras's oil products net of tax sales revenue, which basically is its net operating revenue, could be substantially different from those of international major oil companies selling the same amount of the same products in other countries.

Table 1.5 presents Petrobras's principal financial indicators (subsidiaries' results are not included). US dollar figures have been calculated in the same way as in the company's annual reports, i.e. by applying the year-end exchange rate to the net income (loss) and to the stockholders' equity and the average exchange rate for the year to the net operating revenue.

Despite low rates of return on investment in most years in Table 1.5, Petrobras investments were substantial as suggested by the rise of stockholders' equity. In 1990, the stockholders' equity and permanent assets were underestimated as their monetary adjustments were far below inflation (Petrobras 1995). Consequently the rise of net income in that year, shown in Table 1.5, is a distorted result.

The 1991 loss, a solitary instance in the history of Petrobras, was provoked by the fall of net operating revenue together with monetary and exchange rate variations – the exchange rate increase was bigger than the monetary adjustment. In 1992, the inverse behaviour of both the net operating revenue (which increased) and the monetary and exchange variations, brought profits back to Petrobras's income statement. The 1994 appreciation of the real against the US dollar reduced the value in reals of the company's debt and helped to increase its net income.

After the Mexican moratorium in 1982 it became difficult for Latin American nations to contract new loans in the international market. Furthermore, in 1989 Brazilian legislation imposed severe limits to the medium- and long-term debts of companies. Thus, Petrobras had to avail itself of more short-term loans and of sales of bonds (medium- and long-term) and commercial papers (short-term) to finance both its working capital and investments. Petrobras's short-term debt index reached 40 per cent in 1990. From then on the debt profile improved as suggested by the fall of the short-term debt index that came down to 22 per cent in 1994 (see Table 1.5). The reduction of third-party capital used by Petrobras is represented by the reduction of the debt index from 52 per cent in 1985 to 40 per cent in 1996 (see Table 1.5). At the end of 1996 the debt

of Petrobras related to domestic and foreign loans and financing totalled US\$8.3 billion, whose short-term portion amounted to US\$3.1 billion.

We must stress here that, according to its annual reports, the total debt of Petrobras in 1996 (US\$8.3 billion) was almost equal to the balance receivable from the government at that time (US\$7.4 billion). Of this 97 per cent was from the National Department of Fuels (DNC which replaced the former CNP) due to lagged ex-refinery prices of oil products (Petroleum and Oil Product Accounts) and to insufficient refunds of Petrobras's expenses with the domestic supply of automotive alcohol (Alcohol Account).

## **2. OIL PRODUCT PRICING AND TAXATION POLICIES IN BRAZIL**

### **2.1 Introduction**

Since the creation of the state monopoly in 1953 oil products prices have been regulated by the government. The regulator (CNP and later DNC) has not only set ex-refinery prices but also gross distribution margins (wholesale and retail). Until 1988, taxes on oil products were levied by the federal government. Since 1988, oil products taxation has been decentralised so that each state of the federation sets its own tax rates.

Ex-refinery prices have been set at different stages of the development of the domestic oil industry in a way that reflected the average cost of oil products supply. Initially, when domestic refining capacity was small, most of the oil products consumed in Brazil were imported. At that time, ex-refinery prices were set in line with the opportunity costs of supply, i.e. the c.i.f. import costs. These costs were particularly high due to the long distances separating Brazil from the exporting countries. Later, when domestic refining capacity increased and the country had become self-sufficient in oil products, ex-refinery prices were set in line with domestic refining costs which were lower than the opportunity costs.

In this chapter, we describe the various oil products pricing regulations applied in Brazil since the oil monopoly was created. We describe how oil products pricing was used not only to remunerate the investments of both Petrobras and distribution companies, but also to fund the following: the initial development of Petrobras, other prior government investments, mainly in the development of alternative energy sources, and the regime of oil products price equalisation over the whole country. Sometimes actual products prices were different from those set by the regulations. We also describe how these price deviations were taken into account by the regulator to determine Petrobras's receivables in its balance sheet.

We grouped the component of oil products prices in three categories which are analysed separately in this chapter: ex-refinery net of tax prices (prices paid to Petrobras for refining); distribution gross margins (paid to both Petrobras and distribution companies); and taxes and

contributions (paid to the government).

## **2.2 Ex-refinery Net of Tax Prices**

Oil exploration, production, refining, and transportation as well as sea, river, lake and pipeline transport of oil products were monopolised by the Brazilian government in 1953. These activities have been carried out by a sole concessionary company, Petrobras.

Oil products pricing in Brazil was part of the broader regulations of the domestic oil industry. Net ex-refinery prices were set on the basis of regulations which tried to cover supply costs and an adequate profit margin for Petrobras.

Refining self-sufficiency has been an explicit goal of the Brazilian government since the end of the Second World War. Domestic refineries would allow the country to save foreign currency by means of the substitution of crude oil imports for products imports. The refining self-sufficiency goal determined Petrobras's initial development strategy as it decided to invest in domestic refining capacity. In the first years, crude oil was mostly imported as in the 1950s Brazil's proven reserves were still very small. Furthermore, it was expected that refining profits could fund future exploration ventures. In 1954, 98 per cent of the product demand was met by imports (Petrobras 1994). Therefore, the supply cost was almost exclusively determined by imports. This fact was reflected in the pricing regulations which established that ex-refinery net of tax prices of oil products should be equal to the c.i.f. import costs plus port expenses. Brazilian opportunity costs were relatively high as compared, for instance, to Europe, since Brazilian c.i.f. import costs included transport costs from distant supply sources (USA and Europe).

The domestic prices of oil products were sensitive to exchange rate movements, since opportunity costs were set in dollars by the international market. Domestic refining was favoured between 1957 and 1959 by the depreciation of the cruzeiro relative to the dollar,<sup>1</sup> as this inflated domestic prices of oil products. In the early 1960s, Petrobras's refining capacity already

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<sup>1</sup> In the 1957-59 period, the average inflation rate was 18.8 per cent p.a. while the average growth of the exchange rate (Cr\$/US\$) was 39.3 per cent p.a.

matched the domestic demand for oil (as shown in Figure 1.4<sup>2</sup>).

In 1962, the production of refined products by Petrobras was equivalent to more than 70 per cent of domestic demand in Brazil. Therefore, in the early 1960s, oil products supply costs depended more on domestic refining costs (including the oil cost) than on c.i.f. import costs.

The change in the main source of oil products supply led to a change of pricing regulations. In November 1964, Law 4,452 established that, from then on, ex-refinery prices should be set as fixed proportions of crude oil c.i.f. import costs. The proportionality rates initially set by the Law are presented in Table 2.1. Thus, according to the new regulations, domestic prices were not necessarily in line with international prices any more. Furthermore, Law 4,452 allowed the regulator (CNP) to increase (rate decreases were not allowed) the proportionality rates.

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**Table 2.1:** Ex-refinery Net of Tax Prices (RP) Relative to Oil c.i.f. Import Cost. Oil c.i.f. import cost = 1.0. 1965/66.

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	RP
LPG	2.30
Aviation Spirit	2.15
Gasoline	2.20
P r e m i u m	2.60
Gasoline	
Jet Fuel	1.80
Kerosene	2.30
Diesel	2.25
Fuel Oil	1.70
Lubricants	5.5 to 7.0

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In November 1966, Law 61<sup>3</sup> established new pricing regulations: the ex-refinery prices of products would be based on the price of gasoline, which was initially fixed at Cr\$ 53.44/litre

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<sup>2</sup> The total capacity in Figure 1.4 does not include 56,000 b/d of privately owned capacity.

<sup>3</sup> In fact, this law was a decree (Law-decree, or Decreto-lei in Portuguese), with the same effects as a law, that was promulgated by the Brazilian president during the military dictatorship when the executive branch abnormally absorbed some legislative functions. The military dictatorship frequently used this instrument as a way to by-pass the Congress in the government decisions.

(equivalent to US\$3.84/b<sup>4</sup>). Gasoline was already one of the most important petroleum products consumed in Brazil.<sup>5</sup>

The ex-refinery relative prices of major products were initially established by the Decree-Law 61 as shown in Table 2.2. These relative prices were different from the international ones which are also shown in the table.

**Table 2.2:** Oil Product Relative Prices Set by November 1966 Regulations and Rotterdam Spot Prices. Gasoline price = 100.

	<i>Petrobras Ex-refinery Price (Nov 1966)</i>	<i>Rotterdam Spot Prices (Jan 1967)</i>
LPG	105	-
Gasoline	100	100
Premium gasoline	118	134
Kerosene	135	-
Jet fuel	-	128
Diesel	100	111
Fuel Oil	72	64

Rotterdam prices from Jenkins 1989

Diesel (whose share in oil product demand was 22 per cent in 1996) was priced cheaply relative to gasoline in order to redeem public and goods transport; on the other hand, the relative price of fuel oil, whose share in products demand was 30 per cent, was higher than the spot market price. Relatively cheap premium gasoline, whose share in the products demand was less than 1 per cent, was supplied to car owners, mostly from high-income groups.

The regulator could set relative prices either according to international market conditions or the

<sup>4</sup> In January 1967 the Rotterdam spot price of gasoline was US\$2.61/b; if we assume that the gasoline freight cost from Rotterdam to São Paulo coast was around US\$1/b, we conclude that the gasoline ex-refinery price was relatively close to the c.i.f. import cost.

<sup>5</sup> In 1966 the gasoline share of total product demand was 30 per cent. Gasoline demand was growing fast (18.8 per cent p.a.) as compared to total product demand (15.5 per cent) due to the car industry development since the end of the 50s.

national economic situation. There were no specific rules for minor products pricing. However, if a minor product was imported and was not produced domestically at all, its price was set on the basis of its c.i.f. import cost.

Furthermore, Law 61 stated that ex-refinery prices should be related to refining average costs and that they should protect Petrobras's refining margins. This law categorised refining costs and margins in four groups as follows:

Group I	Value, in cruzeiros, of the crude oil refined by Petrobras: given oil c.i.f average import costs and exchange rates
Group II	Refining labour costs
Group III	Other refining variable costs
Group IV	Depreciation, amortisation and remuneration of the capital invested in refineries

The share of each group in total costs was also initially fixed ( Group 1 at 74.3 per cent; Group 2, 9.2 per cent; Group 3, 12.7 per cent; and Group 4, 3.8 per cent) and the rules for readjusting the value of each cost group were set. The interval between two consecutive readjustments should be longer than three months.

The 1966 regulations established an explicit link between ex-refinery net prices and domestic refining costs. Although there was no explicit relation between domestic and international prices of products, the gasoline ex-refinery price, the basis for the domestic pricing of other products, was still close to the c.i.f. import costs in November 1966. Domestic relative prices presented in Table 2.2 suggest that, from the refiner's point of view, the government was starting to establish a kind of cross-subsidy system, in which the excess of fuel oil sales revenue compensated, to some extent, for the deficit of diesel sales revenue.

The 1966 pricing regulations did not change until 1977. Trends in ex-refinery prices and opportunity costs in the 1973-77 period can be found in Chapter 3.

The period 1953-77 was one of transition for the Brazilian oil products pricing system: from

marginal cost pricing, in which ex-refinery prices were set at the level of the relatively high opportunity costs of supply – c.i.f. import costs – to another system in which relatively lower domestic refining costs determined the price of the composite barrel of oil products. Since 1972, when Brazil became a net exporter of refined products, products supply costs have been largely determined by domestic refining costs.

Had the marginal cost pricing principle been adhered to, the Brazilian government would have set products prices at the level of the marginal costs of supply – i.e. for products whose domestic supply was supplemented by imports, the domestic ex-refinery prices should be equal to the c.i.f. import costs, and products in surplus domestically and therefore exported should be priced ex-refinery at the level of f.o.b. export value.

In countries like Brazil, which are located far from the importing/exporting markets, the adoption of marginal cost pricing may lower the remuneration of refiners. Let  $x$  represent an exported Brazilian oil product;  $P_x$  the price of  $x$  in the destination market;  $i$  an imported product;  $P_i$  the price of  $i$  in the market of origin;  $F_x$  and  $F_i$  the freight costs of  $x$  and  $i$ . The marginal costs (MC) of  $x$  and  $y$  can be written as:

$$MC_x = P_x - F_x \quad \text{and} \quad MC_i = P_i + F_i$$

Consider further that the importing and exporting of products involve the same external market, for instance Rotterdam. In this case  $P_x$  and  $P_y$  are both spot market prices. Since these prices can be taken as an estimate of ex-refinery prices in NW Europe, the Brazilian marginal revenue from supply of exported products would be lower than ex-refinery prices in North West Europe. If  $s_k$  is the share of product  $k$  in Brazilian oil products demand, the consumption-weighted average of domestic ex-refinery prices ( $\langle P \rangle_{\text{Brazil}}$ ) could be written as follows:

$$\begin{aligned} \langle P \rangle_{\text{Brazil}} &= \sum_k (P_k s_k) + \sum_i (F_i s_i) - \sum_x (F_x s_x) = \\ &= \langle P \rangle_{\text{Rotterdam}} + \Delta \end{aligned}$$

where:

$$\langle P \rangle_{Rotterdam} = \sum_k (P_k s_k), \quad \text{and}$$

$$\Delta = \sum_i (F_i s_i) - \sum_x (F_x s_x)$$

Since transport costs between spot markets and Brazil are not insignificant the marginal cost pricing principle can lead to a loss of competitiveness for Brazilian refineries (when  $\Delta < 0$ , that is when volumes of exported products are larger than those of imported products).

On 30 December 1977, the government changed once more the oil products pricing regulations through Law 1,599.<sup>6</sup> The new regulation determined that CNP would set ex-refinery prices according to 'the international market conditions, the country's internal economic situation, and the characteristics of the national refineries whose profitability must be ensured'. It was stipulated that the consumption-weighted average of oil products ex-refinery prices (or simply the average ex-refinery price, ARP) should be equal to the value per litre of the sum of the four cost groups defined by Decree-Law 61 in 1966. So, if  $P_i$  and  $V_i$  are respectively the price of and the demand for product  $i$ , ARP can be written as:

$$ARP = \frac{\sum_i P_i V_i}{\sum_i V_i} = \frac{\text{Group I} + \text{Group II} + \text{Group III} + \text{Group IV}}{\sum_i V_i}$$

The new pricing system broke the indexation link between international prices and domestic prices of oil products. It also allowed the government to set oil products relative prices according to social, economic and political targets. Although Law 1,599 did not suggest the adoption of any direct subsidy, the new regulations allowed the creation of a cross-subsidy structure between oil products.

The law set the initial values for the ARP components in cruzeiros of 8 May 1977. These values converted in dollars were as follows:

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<sup>6</sup>This law was in fact another 'Decreto-lei' promulgated by the executive branch.

	US\$/b
Group I	15.64
Group II	0.8
Group III	1.07
Group IV	2.3
ARP	19.81

The law also established different readjustment rules for each group value. Group I value would change according to the behaviour of exchange rates and oil c.i.f. import costs; readjustments of Group II value would depend on the wage policy; readjustments of Groups III and IV would be driven by inflation. Furthermore, Law 1,599 also determined that basic values used for the calculation of capital depreciation and remuneration in group IV could only be revised every three years.

The 1977 regulations created a hybrid system which combined elements of both pricing principles, marginal and average cost pricing. Crude oil processed in Petrobras refineries was remunerated according to its marginal cost (petroleum c.i.f. average import costs) while other refining costs were taken on an average basis.

In 1977, crude oil costs were largely determined by the imported oil cost as national oil production was equivalent to only 17 per cent of all crude processed in Petrobras's refineries. According to the new regulations, both national and imported crude oil had the same value in the ARP. The regulated value of domestic crude oil did not depend on its quality – density, sulphur content, metal content, and so on – that is on the actual value of this type of oil in the international market. This causes a distortion. For example, if the oil produced in Brazil is heavy and the imported oil is light, the regulations upgraded the value of the domestic oil to the higher c.i.f. price of the more valuable light oil. In other words, the import price of crude oil was taken as a reference for domestic pricing without allowances for quality differentials between the imported and the local crudes.

Petrobras refineries were not free to produce the most profitable range of products since they had to supply the country with the oil products it demanded. However, any refining structure aiming at meeting domestic demand for oil products would theoretically have its costs covered by the ARP's Group II. Furthermore, Group IV guaranteed an internal rate of return of 15 per cent for

refining projects. Consequently, the 1977 regulations set refining profitability independently of the types of products sold by the refineries.

The basic regulations concerning petroleum product ex-refinery net of tax prices have not changed since 1977 and until Law 9,478 was promulgated in August 1997. During the transition period provided by Law 9,478 (see Chapter 1) ex-refinery net prices will be deregulated based on directives of the government but they still can involve cross-subsidising. However, after the transition period any subsidy to an ex-refinery price must be proposed by CNPE and must pass by the Congress.<sup>7</sup> As a matter of fact, the law did not determine the end of cross-subsidising among different oil products and among gasoline/diesel and automotive alcohol. It only stipulated that *ex-refinery prices* shall not engender cross-subsidising any more. So, in most instances ex-refinery prices will tend to be closer to opportunity costs. However, while Petrobras holds the effective refining monopoly one can still expect ex-refinery prices to remain subject to some regulation.

Cross-subsidising of oil products and alcohol has been developed in Brazil for such a long time that it will not be eliminated in the short term. The automotive alcohol industry survival has depended on subsidies funded, directly or indirectly, by gasoline mark-up (and from 1992 onwards also by diesel mark-up). A sudden fall of gasoline final price and the end of alcohol subsidies would provoke a collapse of hydrated alcohol demand and would cause serious damages to the alcohol industry. So, some cross-subsidising may be expected to occur even after the transition period, this time with subsidising costs supported by taxation rather than by ex-refinery overprices.

### **2.3 Distribution Costs, Margins, and Other Supply Costs Covered by Product Prices**

In the price of products charged by Petrobras to distributors there were (apart from an element for transport costs discussed further below) the following items defined in 'alíneas' of Article 13 of Law 4,452 of 1964:

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<sup>7</sup>We estimated that in July 1997 Petrobras's average ex-refinery price was still 15 per cent lower than import parity: average domestic ex-refinery net price in this month was equivalent to US\$19.42/b and the estimate of average cost of oil product import (from Rotterdam) was US\$22.83/b.

- Alinea (b) Price differences between alcohol and gasoline, as some alcohol was already mixed to the gasoline.
- Alinea (c) Difference between import and domestic product price.
- Alinea (d) Control, administration, and technical expenses incurred by the National Petroleum Council (CNP)
- Alinea (e) A premium for low pour point fuel oil.
- Alinea (f) Differences between the average oil transport costs actually incurred by Petrobras and the transport costs included in ARP's Group I.
- Alinea (g) Payments to the oil-producing states of 6 per cent of the value of the oil produced. The states should invest at least 80 per cent of these revenues building and paving roads. Since 1953, Law 2004 determined that these compensatory payments should be made to states and municipalities where oil was produced. These payments were not covered by any price component until alinea (g) was introduced.

Since 1938, one of the guide-lines of Brazilian pricing policy was to reduce, as much as possible, inter-regional differentials in oil products prices. From 1964 to 1977, the price components that covered distribution costs had been set in such a way as to yield oil products price equalisation at the wholesale level throughout the country. Inter-regional price differentials were only due to differences in transport costs from the supply tank farms (or simply supply bases) to the retail outlets.

The uniform supply price of a petroleum product  $i$  to the wholesale centre consists of the ex-refinery price plus a transport element  $t_i$ . If  $T$  is the total transport cost of all products to all regional wholesale centres we have  $T = \sum v_i \cdot \langle t_i \rangle = \sum v_i \cdot t_i$ , where  $\langle t_i \rangle$  is the average transport cost of product  $i$ .<sup>8</sup> Note that  $t_i$  may be different from  $\langle t_i \rangle$  which means that the burden of

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<sup>8</sup> The element  $\langle t_i \rangle$  is the actual average transport cost of product  $i$ . Let  $t_{i,od}$  and  $v_{i,od}$  be respectively the transport cost and the transported volume of product  $i$  from origin  $o$  to destination  $d$ . Then:

$$\langle t_i \rangle = \frac{\sum_{o,d} t_{i,od} \cdot v_{i,od}}{v_i}$$

transport cost can be placed more heavily on some products than on others.

The payment system is as follows. The distributor pays Petrobras the supply price which includes  $t_i$ . If he transports the products to a wholesale centre he claims back the costs incurred on presentation of the relevant invoice.

The transport costs were covered by alineas (a) and (h) as follows:

Alinea (a) Coastal freights and related expenses.

Alinea (h) Initially, this alinea was introduced to cover other supply costs that eventually become relevant. In 1969 CNP defined alinea (h)<sup>9</sup> to cover:

- rail and river transport costs of products to the supply bases as well as exceptional road transport costs.
- petroleum and product pipeline transport costs, included in the monopoly.
- errors in oil CIF import cost estimations due to exchange rate fluctuations.

Until 1977, when product prices were equalised regionally at the wholesale level, alinea (h) only covered distribution costs to the supply bases spread over the country. Since 1978, when the regulator equalised product prices in all locations throughout the country<sup>10</sup> (not only at the wholesale level), the objectives of alinea (h) were enlarged to cover also total transport costs from the supply bases to the consumption centres. From then on, all transport costs actually incurred by the distribution companies were refunded by the regulator.

Since the creation of the monopoly in 1953, distribution companies have operated chiefly between the supply bases and their retail outlets. They also transported products, by railways or roads, to some few inland supply bases (secondary bases). Only Petrobras transported products by means of pipelines or water vessels to primary supply bases, as these transport means were included in the state monopoly.

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<sup>9</sup> CNP Resolution 9/69 of 15 July 1969

<sup>10</sup> CNP Plenary Decision of the Ordinary Session No. 1766 of 17 October 1978.

In 1980, an amendment to Law 4,452 grouped 'alneas' from (a) to (h) in only two:

- Alinea (A) This was payable on all oil products. Basically it included all costs covered in old alneas (a), (b), (c), (f), (h). It also included:
- oil product road transport costs.
  - automotive alcohol transport, storage and trading expenses.
  - coal subsidy, transport, and domestic trade expenses.
- Alinea (B) Similar to old alinea (d); it was payable only on automotive fuels (0.2-0.3 per cent of product realisation price).

New alneas (A) and (B) did not have a long life. In January 1984, a constitutional amendment<sup>11</sup> shared among all states and municipalities the levies made under the 'alneas'. This amendment virtually prevented the use of the 'alneas' to cover supply costs. So, from January to November 1984 the government used funds from Financial Operation Tax revenue (Imposto sobre Operações Financeiras - IOF) as a temporary substitute for the alneas.

In November 1984, CNP created a new price component,<sup>12</sup> the Frete de Uniformização de Preços- FUP (Freight for Price Equalisation), in order both to cover the transport costs and fund the price equalisation regime throughout the country for gasoline, diesel, LPG, kerosene and jet fuel. FUP's levying would also compensate some cost differences not covered by other component parts of oil product prices. FUP was a component part included only in the prices of gasoline, diesel and lubricants. FUP has covered the following costs:

- Oil product transport costs: from the refineries to primary supply bases; between supply bases; from the supply bases to retail outlets;
- Differences between actual oil c.i.f. average import cost and the regulated value of ARP's Group I;
- Differences between oil product c.i.f. import costs and their respective domestic prices.

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<sup>11</sup> Constitutional Amendment 26 - Passos Porto Amendment.

<sup>12</sup> Resolution 16 of 27 November 1984; equalisation of automotive alcohol prices across the country was regulated by Resolution 18 of 11 December 1984.

Furthermore, the regulator stipulated that in case the primary funding source of the alcohol subsidy should be insufficient, part of the FUP's levying could be used to complement that funding.<sup>13</sup>

Wholesaling and retailing gross margins, were also set by the regulator as specific price component parts. Gross distribution (wholesale and retail) margins covered all general distribution related expenses and ensured a remuneration of the capital invested by the companies involved in the activity.

After the government sent the bill of new oil regulations to the Congress in 1996 (see Chapter 1), the regulator (DNC) announced that within a six-month period from the time oil regulations were set, distribution and retail prices would be gradually deregulated. Deregulation would be conditioned to regional diversity and to the competition features of the markets (Boletim de Preços, Petrobras/Decom/Diprer, March 1996).

After the partial de-equalisation of automotive fuel prices in November 1991, the government adopted the following measures towards deregulation of distribution/retail prices (Boletim de Preços, Petrobras/Abast-MKC, various issues):

- In February 1994 LPG prices were partially de-equalised so that prices were uniform only at the supply base level. Final prices were capped in each municipality. Distributors could pass on to the final price only those transport costs that were equivalent to up to 60 per cent of the final price cap (in the north region of Brazil this limit was 32 per cent). The excess to those limits was refunded to distributors using, as before, FUP revenues. As a result, LPG transport cost refunding was then restricted to transport in the North region and in some municipalities in the Midwest.
- In September 1995 distribution prices of gasoline and alcohol (and later, in April 1996 distribution prices of diesel) were further de-equalised<sup>14</sup> so that prices were uniform only at

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<sup>13</sup> Regulated by CNP's Resolution 18 of 11 December 1984.

<sup>14</sup> Portaria MME - 332 of 26 September 1995.

the *primary* supply base level. Final prices of these products were capped at each municipality according to the regulator's estimates of transport costs from the primary to the secondary bases and from secondary bases to the retail outlets. Distributors could only pass on to final prices transport costs that did not exceed certain ceilings. The part of transport costs that was in excess of these limits was refunded by Petrobras on behalf of the regulator to distribution companies using FUP resources (in April 1996 diesel was subjected to similar regulations). Thus, the government still granted some subsidy to costs of transport to remote areas of the country.

- In February 1996 jet fuel distribution gross margins were deregulated at most domestic airports.
- In April 1996 distribution/retail prices of gasoline and alcohol were fully deregulated in the south, southeast, northeastern coast, and in some supply bases in the Midwest of Brazil.
- In August 1996 LPG refunding of LPG transport costs was limited to the case of 109 municipalities in the northern region of the country<sup>15</sup> (about 2 per cent of the municipalities in the whole country and about 35 per cent of those in the northern region). In the rest of the country distribution/retail gross margins of LPG were limited by the final price caps for each municipality set by the regulator.
- In December 1996 the government abolished refunding of road and rail transport costs of gasoline and automotive alcohol. However part of river transport costs in the North were still subsidised with FUP funds.

## **2.4 Taxes**

### **2.4.1 The Sole Tax**

The Sole Tax on liquid fuels and lubricants was a federal excise tax introduced in 1940.

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<sup>15</sup> Portaria-MF - 195 and Portaria-DNC - 22 of 31 July 1996.

Monophase (sole) taxes, initially introduced in 1925, were substitutes for multiple taxation on all businesses. They were only levied at a certain point of the producing chain of a good, so that the fiscal burden did not increase with the number of operations involved in the production and commercialisation of that good.

Law 2,615<sup>16</sup> which introduced the Sole Tax, protected domestic refining as it set higher rates on imported than on domestically refined products (see Table 2.3). This law also stipulated the proportions of the tax levied on each product to be destined to a Road Fund shared by states and municipalities. These proportions varied between 13 per cent for fuel oil produced domestically and 38 per cent for imported diesel. The fund should only be used for road development or maintenance.

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**Table 2.3:** Sole Tax Excise Rates (1940–55)

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	<i>1940–52 (Reis/kg)</i>		<i>1953–55 (Cr\$/kg)</i>	
	<i>Imported</i>	<i>National Production</i>	<i>Imported</i>	<i>National Production</i>
LPG	-	-	1.2300	0.90
Gasoline	1.0154	0.620	1.7220	1.20
Kerosene	0.4677	0.285	0.4677	0.28
Diesel	0.1046	0.065	0.1720	0.07
Fuel Oil	0.08	0.050	0.1160	0.08
Lubricants	0.5784	0.035	1.4760	0.80

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In 1948, the government determined that all tax revenue on oil products would constitute the National Road Fund to be shared by the National Road Department (40 per cent) and by the states (60 per cent). These shares were changed again in 1952:<sup>17</sup> 75 per cent of the total revenue was destined to the National Road Fund and 25 per cent to the Oil Research Fund, a funding source for oil activities performed by the state. The same law also changed Sole Tax rates. However, tax rates on imported products were still higher than those on domestically refined

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<sup>16</sup> Actually a 'Decreto-Lei' promulgated by the dictator Vargas.

<sup>17</sup> Law 1,749 of 28 November 1952.

products: excise taxes on imported gasoline, diesel and fuel oil were respectively 44, 145 and 45 per cent higher than taxes on the same products produced in Brazil (see Table 2.3).

In 1953, Law 2004, which established both the state monopoly and Petrobras, determined that 25 per cent of Sole Tax revenue would fund increases of the company's capital until 1957 (later extended to 1961). Shares in Sole Tax revenue were important to Petrobras's initial development. In 1955, 38 per cent of Petrobras funds came from fiscal revenue, 84 per cent of which was its share in the Sole Tax. In the 1955–61 period, the average Sole Tax share in Petrobras's fiscal funding sources was 76 per cent (source: Petrobras/SEFIN and author's calculations).

Refining was initially the main source of profits for Petrobras. Substantial crude oil reserves were not discovered until the early 1980s in the Campos basin. The few refineries that Petrobras owned until 1955<sup>18</sup> generated small profits that were not enough to finance the investments included in the petroleum programme of the government's Plano de Metas (Goal Plan). Petrobras needed additional funding sources.

In November 1956, accumulated inflation since the last readjustment of Sole Tax excise rates, in October 1952, was 119 per cent. As the Sole Tax was an excise tax and its nominal value had not changed, its real value was effectively reduced by inflation by 54 per cent. Consequently, Petrobras's fiscal funding source was also reduced. Excise taxes must be regularly adjusted according to inflation rates because they represent absolute amounts.

In November 1956, Law 2,975 changed the Sole Tax from an excise to an *ad-valorem* tax. The tax base was the c.i.f. import cost of products. This change was meant to avoid the inflationary erosion of the real value of tax revenues.

Tax rates on imported oil products until 1964 are shown in Table 2.4. Tax rates on domestically refined oil products were equivalent to three-quarters (3/4) of those on imported products. This lower tax on domestic products naturally helped the company's expansion. Law 2975 also

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<sup>18</sup> One in Bahia and another in São Paulo with project capacities of respectively 2,500 b/d and 45,000 b/d.

**Table 2.4: Sole Tax Per Cent Rates. 1957-88**

	Tax Base: Product c.i.f. Import Cost		Tax Base: Ex-refinery price	Tax Base: Oil c.i.f. Import Cost										Tax Base: Final Price
	1957 <sup>(1)</sup>	1958 <sup>(1)</sup>		1959 <sup>(1)</sup>	1967 <sup>(3)</sup>	1970 <sup>(4)</sup>	1974 <sup>(5)</sup>	1975 <sup>(6)</sup>	1976 <sup>(7)</sup>	1977 <sup>(8)</sup>	1979 <sup>(9)</sup>	1980 <sup>(10)</sup>	1986-88 <sup>(11)</sup>	
LPG	80	80	80	87	80.3	28.9	15	20	16	10	4.0	2.1		
Av. gas.	65	75	85	323	298.1	107.3	60	120 <sup>(12)</sup>	0	62	0.0	0.0		
Gasoline	150	150	150	347	320.4	128.2	70	140	112	73	29.0	10.0		
Prem. Gas.	200	200	200	400	369.2	187.2	102	200	160	104	41.0	-		
Kerosene	80	90	100	144	132.9	47.8	26	35	28	18	6.5	2.8		
Jet Fuel	0	0	0	270	249.2	89.7	50	100 <sup>(12)</sup>	0	52	0.0	0.0		
Diesel	55	65	80	271	250.2	65.1	36	50	40	26	6.5	5.0 <sup>(13)</sup>		
Fuel Oil	50	60	70	8.5	0	0	0	0	0	0	0.0	0.0		
Lubricants	150	150	150	825 to 1,050	761.6 to 969.3	274.2 to 407.2	150 to 225	300 to 450	200 to 360	156 to 234	78 to 92	18.0		
Naphthas	-	-	-	-	-	1 to 128.2	1 to 70	1 to 140	0.8 to 112	1 to 73	1.5 <sup>(14)</sup>	2.9 <sup>(14)</sup>		
Crude oil	exempted	exempted	exempted	Imp: 20 cent; dom.: 6 cent	exempted									

(1) - Law 2,975 of 27-11-56  
 (2) - Law 4,452 of 05-11-64  
 (3) - Dec.-Lei 61 of 21-11-66  
 (4) - Dec.-Lei 1,091 of 12-03-70  
 (5) - Dec.-Lei 1,296 of 26-12-73  
 (6) - Dec.-Lei 1,340 of 22-08-74  
 (7) - Dec.-Lei 1,420 of 09-10-75

(8) - Decree 79,657 of 05-05-77  
 (9) - Dec.-Lei 1,691 of 02-08-79  
 (10) - Dec.-Lei 1,785 of 13-05-80  
 (11) - Law 7,451 of 26-12-85  
 (12) - In 30-11-76, Dec.-Lei 1,490 exempted aviation fuels from sole tax payment.  
 (13) - The rate on diesel sale price increased to 7.5 per cent in 1987 and to 10 per cent in 1988.  
 (14) - Naphtha used as petrochemical feedstock was exempted from sole tax payment.

extended to 1961 the time period during which Petrobras would have a share in Sole Tax fiscal revenue but decreased this share from 25 to 15 per cent. However, despite this share reduction, Law 2975 resulted, one year later, in an increase in real terms of 47 per cent of Petrobras's funds from Sole Tax revenue. Until 1961, the pricing system provided Petrobras with both fiscal protection (tax reduction) and a share in Sole Tax revenues. At that time, these mechanisms were criticised by some economists who considered them to be heterodox measures on the grounds that companies should expand through funds generated by their industrial operations (Leitão 1988).

In 1964, Law 4,452 determined that the ex-refinery price of oil products would be the new base of the Sole Tax. Further, it established that Sole Tax would also be levied on crude oil processed by Brazilian refineries (in this case, the average petroleum c.i.f. import cost was the tax base). The new tax rates are shown in Table 2.4 and were applied to oil products independently from their provenance.

Oil products taxation was clearly related to the development of the road sector. Law 4,452 determined that 89 per cent of funds from the shares of the federal government, states and municipalities in Sole Tax revenues (respectively 40, 48 and 12 per cent) should be set apart to the National Roadways Fund, while only 11 per cent of those funds should be used to increase the capital of the Federal Railway Network. Furthermore, article 6 of that law established that 11 per cent of the National Road Fund quota should be set apart for investments to replace some avowedly noneconomic railway lines by new roads. Road transport has been predominant in the Brazilian transport modal split. In 1971 the share of the road sector in transport energy demand was 85.4 per cent. In the period 1971–80 the average growth of energy consumption in the road sector was 6.3 per cent, much higher than in the rail sector (3.6 per cent).

In 1966, Law 61<sup>19</sup> changed again the Sole Tax base. The Sole Tax levied on each oil product would be calculated as a proportion of the average c.i.f. import cost of crude oil in the previous quarter. New Sole Tax rates are shown in Table 2.4. Law 61 also determined that 14.4 per cent

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<sup>19</sup> This law, as well as most of the oil regulations during the military dictatorship that lasted until 1985, was a 'Decreto-Lei', a decree promulgated by the executive branch.

of the Sole Tax revenues should again be set apart to increase Petrobras's capital. This share decreased year after year, according to specific regulations, until it definitely disappeared in 1977 (see Table 1.4). Petrobras's shares in Sole Tax revenues represented 43 per cent of the total contributions of the Brazilian government to the company's capital formation.

The Sole Tax base did not change until 1980 but rates were changed after 1961 by subsequent regulations (see Table 2.4). In 1970, the government exempted fuel oils from Sole Tax payment; aviation fuels were also exempted from that tax in 1977-78. In 1975, the government created<sup>20</sup> an additional tax equal to 12 per cent of Sole Tax. The new tax was levied as a Sole Tax supplement - 75 per cent of the revenues of this new tax were to be invested in urban transport and the rest in urban development.

The Brazilian government used the Sole Tax as a shock absorber for the world oil price increases of 1973 and 1979, so that they would not be entirely passed on to the consumer. In 1974 tax rates were reduced by 50 per cent (premium gasoline) to 74 per cent (diesel). In 1979 the tax rate reductions were around 35 per cent. In 1980 tax rates were further reduced: aviation fuels were exempted; rates on LPG, gasoline, and kerosene were around 25 per cent of their 1979 levels; the diesel rate was one-sixth of its 1979 equivalent.

In 1975, after the first oil shock, the government created the National Alcohol Programme. This aimed at reducing both oil imports and hard currency spending by means of the substitution of ethylic alcohol for gasoline in Otto-cycle vehicle engines. In 1978, the government stipulated<sup>21</sup> that the Sole Tax, as a tax levied on liquid fuels, should also be levied on automotive alcohol. However, automotive alcohol consumers would be exempted from Sole Tax payment until 1985 when the rate on alcohol final price would be 5 per cent.

In 1980 the government changed again the Sole Tax base:<sup>22</sup> from May 1980 it would be the oil

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<sup>20</sup> Law 6,261 of 14 November 1975.

<sup>21</sup> Dec.-Lei 1,631 of 2 August 1978.

<sup>22</sup> Dec.-Lei 1785 of 13 May 1980.

c.i.f. import cost at 31 January 1980.<sup>23</sup> Changes of this tax base value could only occur after a twelve-month interval and would be made according to the accumulated inflation rate since the last tax base readjustment. The new rates for each product are shown in Table 2.4.

The tax base was changed for the last time in 1985<sup>24</sup> when the Sole Tax became a rate imposed on final prices of products. New rates are shown in Table 2.4. The same law also extended the term of alcohol exemption from Sole Tax payment until 1990.

#### 2.4.2 Other Earmarked Taxes

From 1970 to 1979 amendments to Law 4,452 created five new earmarked taxes levied on oil products. They were included in the former 'alneas' list of Law 4,452. The new alneas were introduced in order to fund prior government investments, mainly in development programmes of alternative energy sources. The purpose of these new alneas, described below, clearly characterised their fiscal nature:

- Alinea (i) Introduced in 1970,<sup>25</sup> it was levied on ex-refinery prices of automotive fuels, kerosene and LPG (5 per cent in 1970/71, 2 per cent in 1972/77, and 5 per cent in 1978/79). The revenues of this alinea were initially destined to Petrobras as special contributions to investment amortisation in oil exploration. In 1979 Dec-Lei 1,681 changed the allocations:
- 25 per cent to Petrobras: amortisation of investment in offshore oil exploration and research;
  - 28 per cent to Eletrobras;
  - 44 per cent to Nuclebras;
  - 3 per cent to CNEN.

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<sup>23</sup> The oil c.i.f. import cost at 31 January 1980 was equivalent to Cr\$7.87/litre or US\$28.31/b.

<sup>24</sup> Law 7,451 of 26 December 1985.

<sup>25</sup> Dec-Lei 1091 of 12 March 1970 altered by Decs.-Leis 1221 of 15 May 1972, 1599 of 30 December 1977, and 1,681 of 7 May 1979.

- Alinea (j) Introduced in 1973;<sup>26</sup> it was levied on the ex-refinery price (1 per cent) of automotive fuels, kerosene and LPG in order to fund geological and technical research in minerals, mainly coal and shale.
- Alinea (l) Introduced in 1975;<sup>27</sup> it was payable on automotive fuels, kerosene and fuel oil in order to subsidise energy from national sources as an attempt to reduce the country's reliance on foreign energy supply.
- Alinea (m) Introduced in 1976;<sup>28</sup> it was payable on aviation fuels in order to provide financial resources to the Airway Fund.
- Alinea (n) Introduced in 1979;<sup>29</sup> it was levied on crude oil c.i.f. import cost (12.5 per cent) in order to fund energy mobilisation programmes: one-third to the National Alcohol Programme (PROALCOOL); one-third to the Alternative Transport Programme; and one-third to the Programme for Development of Coal and other alternative energy sources.

In 1980, the same amendment that grouped alineas (a) to (h) in two (see Section 2.3), abolished alineas (i) to (n) and created two new earmarked taxes, alineas (C) and (D) which, along with alineas (A) and (B), lasted until 1983 (see Section 2.3):

- (C) This was an amount equivalent to up to 10 per cent of aviation fuel ex-refinery price set apart to fund the National Airways Plan.
- (D) It was payable only on gasoline (35 per cent of the ex-refinery price). These funds were set apart to:
- Finance the Energy Mobilization Programme (81 per cent)
  - Invest in Petrobras's offshore oil exploration (4.1 per cent)
  - Eletrobras Investments in the electric sector's new technologies (4.5 per cent)
  - Nuclebras and National Nuclear Energy Commission (7.6 per cent)
  - National Mining Fund (1.4 per cent)

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<sup>26</sup> Dec.-Lei 1297 of 26 December 1973, rewritten by 1st art. of Dec.-Lei 1387 of 07 January 1975.

<sup>27</sup> 3rd Art. of Dec.-Lei 1420 of 9 October 1975.

<sup>28</sup> 1st Art. of Dec.-Lei 1490 of 30 November 1976.

<sup>29</sup> 3rd Art. of Dec.-Lei 1691 of 2 August 1979.

– Mineral Resources Research Company (1.4 per cent)

### 2.4.3 Oil Product Taxation after the 1988 Constitution

A new constitution was promulgated in 1988 after the end of the military dictatorship in 1985. This constitution decentralised oil product tax levying: Sole Tax, levied by the federal government, was replaced by two new taxes levied by the states and municipalities. One was a value added tax (Imposto sobre Circulação de Mercadorias e sobre Prestação de Serviços de Transporte Interestadual e Intermunicipal – ICMS) levied by the states at every stage of the production and trading chain. The other was a tax on retail of all gas and liquid fuels except diesel (Imposto sobre Vendas a Varejo de Combustíveis Líquidos e Gasosos) levied by the municipalities. Differently from the Sole Tax, the new taxes were not earmarked.

VAT rates can be different among states, and vary depending on the product and operation type (internal or interstate). VAT is not levied on interstate operations involving oil products. VAT rates adopted by the state of Rio de Janeiro between 1990 and 1996 are shown in Table 2.5.

**Table 2.5:** Oil Product ICMS Rates in the State of Rio de Janeiro, 1990–96. Per Cent.

	<i>1990–91</i>	<i>1992–95</i>	<i>1996</i>
LPG	12	12	12
Gasoline	17	25	25
Diesel	17	18	12
Kerosene	17	18	18
Jet fuel	17	25	25
Fuel oil	17	18	18
Others	17	18	18

Retail tax rates depend on local regulations and can reach 3 per cent.

#### 2.4.4 Other Taxes and Social Contributions

*Royalties.* In December 1985, the government allowed<sup>30</sup> the inclusion of a new component part in oil product prices in order to cover the financial compensations paid by Petrobras to states and municipalities affected by oil production activities *in the continental shelf*. Royalty payments were at 5 per cent of the value of oil production. Wellhead oil value was calculated by CNP as the difference between average oil c.i.f. import cost in ARP's Group I and the average transport costs of domestic oil from the production fields to loading terminals. The shares in royalty revenues were set as follows:

- Offshore – 1.5 per cent to states contiguous to producing areas;  
1.5 per cent to municipalities contiguous to producing areas;  
1 per cent to the Navy Ministry;  
1 per cent to a special fund to be shared by all states and municipalities (in 1991 Decree 1/91 decreased this share to 0.5 per cent and the other 0.5 per cent was allocated to municipalities where loading/unloading terminals operate).
- Onshore – 4 per cent to producing states (in 1991 Decree 1/91 decreased this share to 3.5 per cent and allocated 0.5 per cent to municipalities where loading/unloading terminals operate);  
1 per cent to producing municipalities.

*Import Tax on Crude Oil and Oil Products.* Brazilian import taxes are levied by the federal government and are not earmarked. Until July 1991, crude oil was exempted from import tax. From then on, an *ad valorem* tax rate of 11 per cent was imposed on imported oil on the basis of the c.i.f. price. Later, this rate was increased to 19 per cent in September 1991 and to 38 per cent in January 1993. Then the tax rate on oil imports was reduced to 33 per cent in August 1994, 20 per cent in September of the same year, 17 per cent in January 1995, 14 per cent in January 1996, and 11 per cent in January 1997.

Oil products had been exempted from import tax until July 1994. From August of that year

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<sup>30</sup> Law 7453 of 27 December 1985.

onwards, the same import tax rate on crude oil imports was imposed on oil products imports.

*Social Contributions.* In 1970 the government created social programmes (PIS/PASEP)<sup>31</sup> in order to provide public employees with a progressive savings scheme. Company contributions were based on a rate (0.65 per cent in 1997) on its gross operation revenue.

In 1977, contributions to the Social Security Institute<sup>32</sup> began to be paid on gasoline and diesel prices. This social security quota was an excise tax payable only on gasoline and diesel. Another contribution to the Social Security Institute (COFINS)<sup>33</sup> was introduced in 1991; it was based on a rate of 2 per cent of the company's gross operation revenue.

PIS/PASEP and COFINS contributions are accumulated at each stage of the oil product commercialisation chain. Thus, the effective rates on the final price are higher than the nominal rates imposed at each of those stages.

*Quota for the National Fund for Development.* The Brazilian government created in 1986 the National Development Fund (FND – Fundo Nacional de Desenvolvimento)<sup>34</sup> in order to help to finance the investments needed to accelerate national economic development. The initial assets of FND would include some government interests in state-controlled companies. Furthermore, the state would subscribe FND quotas using specific fiscal revenues; private institutions of social security maintained by state-owned companies should use 30 per cent of their technical reserves in order to acquire FND debentures. Finally, compulsory contributions to FND were imposed on both consumers of Otto cycle fuels (gasoline and automotive alcohol) and motorcar purchasers. The value of these were as follows:

- 28 per cent of the price (before this tax) of gasoline and alcohol;
- a rate on the acquisition price of cars.

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<sup>31</sup> PIS – Programa de Integração Social (Social Integration Programme); and PASEP – Programa de Formação do Patrimônio do Servidor Público (Public Employee Wealth Formation Programme).

<sup>32</sup> Contributions fed the Social Security Liquidity Fund.

<sup>33</sup> COFINS – Contribuição para Financiamento da Seguridade Social (Contribution for Social Security Financing).

<sup>34</sup> Dec.-Lei 2,288 of 23 July 1986.

Compulsory contributions on car acquisition and on gasoline or alcohol consumption ceased to be levied in 1987<sup>35</sup> and 1988<sup>36</sup> respectively. These were supposed to be refunded three years after they were levied. The refund value of contributions related to automotive fuel consumption would be calculated according to the average consumption per vehicle in the year when the loan was made, plus interests. So far, these refunds have not been paid.

## 2.5 Oil Product Prices in July 1997

Table 2.6 shows the components of oil products domestic prices and the respective import parities.<sup>37</sup> The first column presents the components of the price of the composite barrel of oil products. The value of the crude oil *structural* c.i.f. import cost included in the ARP was US\$14.92/b while the *actual* average crude oil c.i.f. import cost was US\$17.87/b. The average ex-refinery *taxed* price ([ARP plus taxes] = US\$33.75/b) was higher than the import parity (US\$22.83/b) which was higher than ARP (US\$19.42). So, the sale of each barrel of products generated rent (US\$10.92=US\$33.75/b-US\$22.83/b), that was entirely kept by the government, and a transfer of income from Petrobras to the government (US\$3.41/b=US\$22.83/b-US\$19.42/b).

The levying of the ICMS and the social contributions were equivalent to 70 per cent and 22 per cent of total oil product tax revenue respectively, as shown in Figure 2.1. The social contributions represented 78 per cent of the federal government stake in oil product tax revenue. The federal government retained 28 per cent of total oil product tax revenue (a share in the royalties plus import tax plus social contributions), the states 53 per cent (a share in the royalties and in the ICMS) and the municipalities 19 per cent<sup>38</sup> (a share in both royalties and ICMS).

In July 1997, diesel sales generated 64 per cent of FUP proceeds, gasoline 31 per cent and

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<sup>35</sup> Dec.-Lei 2,340 of 26 June 1987

<sup>36</sup> Portaria CNP-DIPRE-PD 180 of 17 October 1988

<sup>37</sup> Import parities were calculated considering Rotterdam as the market source of Brazilian imports. Freight rates were estimated using Worldscale spot rates published by Shipping Statistics and Economics.

<sup>38</sup> The retail tax on oil products (IVVC) was not considered in Table 2.6 because its rate varies among municipalities.

lubricants 5 per cent. Of these proceeds 31 per cent were allocated to cover part of the costs of automotive alcohol subsidies. Total FUP levying was shared between Petrobras (66 per cent) and distributors (34 per cent).

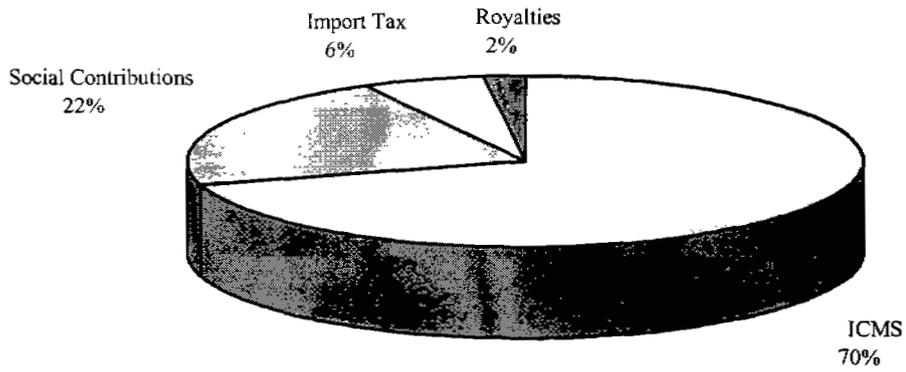
**Table 2.6:** Domestic Prices. July 1997. US\$/barrel.

	<i>Composite Barrel</i>	<i>LPG</i>	<i>Naphtha</i>	<i>Gasoline</i>	<i>Jet Fuel</i>	<i>Diesel</i>	<i>Fuel Oil</i>
Ex-refinery Net of Tax Price	19.42	7.64	16.46	32.90	23.88	18.17	14.37
FUP	6.61			13.39		13.05	
Gross Distribution Margin	12.73	40.69		29.10	3.66	14.90	1.75
Taxes	14.33	8.30	5.58	33.49	13.33	12.14	6.27
ICMS	10.11	6.80	3.97	27.22	10.22	6.99	4.03
Social Contributions	3.10	0.38	0.49	5.15	1.99	4.03	1.12
Import Tax	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Royalties	0.29	0.29	0.29	0.29	0.29	0.29	0.29
<b>Consumer Price<sup>1</sup></b>	<b>53.08</b>	<b>56.63</b>	<b>22.04</b>	<b>108.87</b>	<b>40.87</b>	<b>58.26</b>	<b>22.39</b>
Opportunity Cost	22.83	21.56	22.30	25.74	25.43	24.71	15.90

(1). LPG and diesel – the value shown is equal to the consumer price caps set by the regulator for Rio de Janeiro; gasoline and jet fuel – consumer price estimates in Rio de Janeiro.

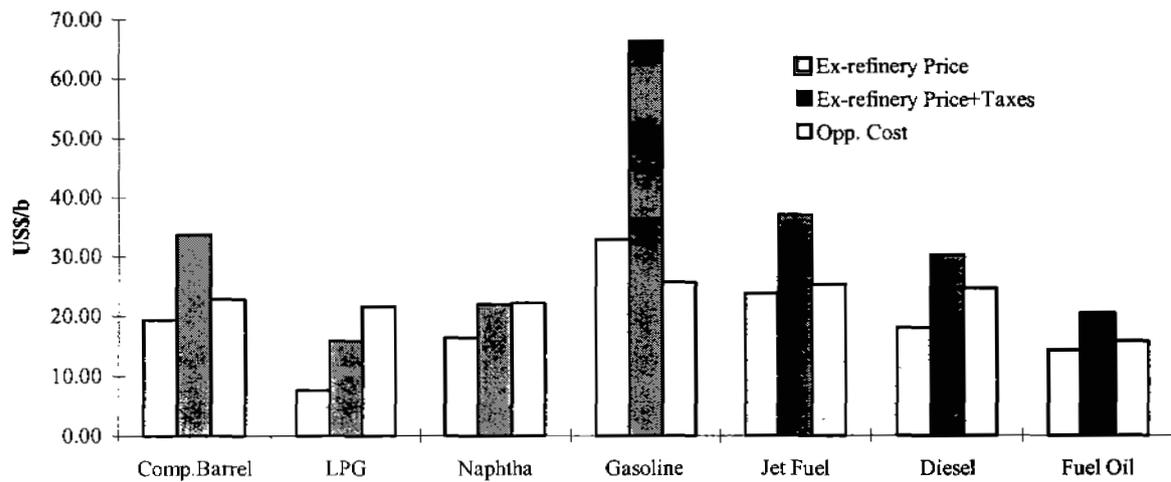
LPG consumers and the petrochemical industry which used naphtha as feedstock were subsidised since the ex-refinery taxed prices of these products were lower than the opportunity costs (see Figure 2.2). The costs of these subsidies were partly covered not by tax revenue but by a mark-up of the ex-refinery net price of gasoline (note that the ex-refinery net price of all other products is lower than the import parity). The mark-up of gasoline ex-refinery price, the higher ICMS rate on this fuel, and the low ex-refinery price of diesel brought about a very low domestic relative price of diesel: the consumer price of diesel was almost half the price of gasoline while the opportunity costs of both fuels differed by only 4 per cent.

Four types of subsidy were present in the oil product pricing in July 1997. First, the cross-subsidisation involving the consumers of gasoline, LPG and naphtha supported by the ex-refinery net prices. Second, the cross-subsidisation of transport costs between consumers of automotive fuels and the consumers of other oil products supported by the FUP levies. Third, the cross-



**Figure 2.1:** Share of Each Tax in Total Oil Product Tax Revenue. July 1997.

subsidisation between consumers of automotive fuels living close to the refineries and those living farther away. Fourth, the cross-subsidisation between consumers of gasoline and diesel and those of automotive alcohol, supported by part of the FUP levies.



**Figure 2.2:** Oil Products Ex-refinery Prices and Opportunity Costs. July 1997.

## 2.6 Cost Compensations between Petrobras and the Government

Some component parts of product prices that represent supply costs must be forecast by the regulator when setting oil product prices which will be valid for an undefined period. During this time, the actual supply costs can differ from the regulator forecasts. If actual supply costs are higher than the forecasts, then the regulator must compensate Petrobras for this loss. If, on the contrary, forecast costs are higher than actual costs, then the surplus is kept by the regulator in special bank accounts in order to pay for future Petrobras refundable costs.

The oil price is subjected to unexpected and sudden changes as it is dependent on the nervous international oil market. The average crude oil c.i.f. import cost, expressed in national currency, can vary for other reasons than world oil price fluctuations – such as changes of either exchange rates or import sources or freight costs.

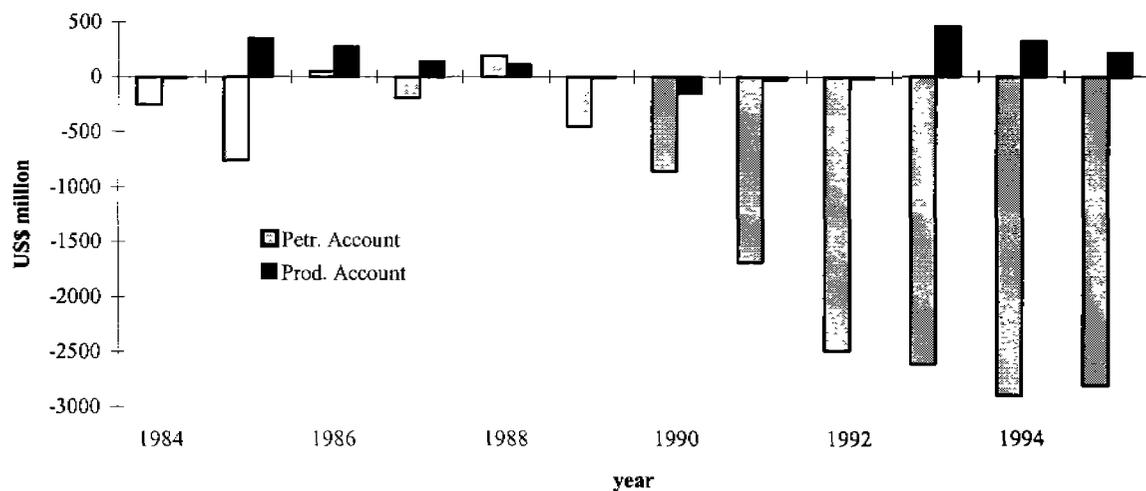
Since June 1983 the regulator has settled the difference, expressed in national currency, between actual oil c.i.f. import cost and the forecast import cost through a special bank account known as *Petroleum Account*. The difference between the actual cost of the oil imported by Petrobras to supply private refineries and the regulated value of this oil was also written in this account. The Petroleum Account balances at the end of each year from 1984 until 1995 are shown in Figure 2.3.<sup>39</sup>

Until December 1987, despite high inflation rates in Brazil – the yearly average inflation rate in the period 1983–87 was 230 per cent – monthly credits/debits of the Petroleum Account were accumulated according to their nominal value. Consequently, until 1987 the real value of the account's balances was eroded by the high inflation rates of that period. It was only after January 1988 that the regulator readjusted the Petroleum Account balances according to inflation rates.

The increases of Petrobras credits in the Petroleum Account from 1989 onward, are clear evidence that the ex-refinery average price set by the regulator was consistently out of tune with the regulations, i. e. ARP's Group 1 was not set according to the regulations. These credits are only related to the gap between actual oil import cost incurred by Petrobras and the value of

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<sup>39</sup> Values were expressed in dollars using exchange rates of the last day of each year.



**Figure 2.3:** Balances of Petroleum Account and Product Account. 1984–95.

crude oil in ARP's Group I set by the regulator in conflict with Law 1,599. The gap between the value of domestic oil set by the regulator and the should-be value of this oil, according to regulations, has not been taken into account in the Petroleum Account. In Section 3.5 we analyse the implications of this problem.

Since December 1984, the costs covered by FUP (Freight for Price Equalisation – see Section 2.3) have been refunded to Petrobras through another special account maintained by the regulator, the Oil Product Account. The FUP revenue is written in this account as a Petrobras debt while the following expenses are written as Petrobras credits:

- Petrobras's product transport costs;
- Payments to the distribution companies for their refundable product transport costs;
- Differences between product import costs and domestic prices (positive or negative);

Petrobras credits in the Oil Product Account did not increase at the same pace as those of the Petroleum Account, as can be seen in Figure 2.3.

The credit balance in both non-current accounts, Petroleum and Petroleum Products (this amounted to US\$3.3 billion in December 1996) has generated receivables from the Brazilian government on Petrobras's balance sheet. While the government has not paid interest on these funds owed to Petrobras, the company has borrowed money from the financial market to

supplement the resources generated by its operations in order to finance part of its investments and its working capital. Thus, Petrobras has not only financed the government, it has also been a source of free financial resources to it.

### **3. REGULATED EX-REFINERY PRICES OF PETROLEUM PRODUCTS AND INCOME TRANSFERS**

#### **3.1 Introduction**

As from the mid 1960s when Brazil became self-sufficient in the refining of crude and up to 1977, the prices of petroleum products though regulated individually were no longer explicitly indexed to respective world prices. In 1977 new regulations, still in effect, served primarily to lay down the system for computing ex-refinery average price (consumption-weighted average price of the various petroleum products) and no longer specified rules for pricing each kind of product. These regulations, if carried out to the letter, would have kept Petrobras running profitably. At the same time they led to product prices being used as a tool for government economic policy.

The fact that relative prices of petroleum products could be freely fixed under such regulations enabled the government to work out a system of cross-subsidisation whereby the artificially raised domestic price of certain products created enough further revenue to fund the financing of other products and hydrated alcohol. Such subsidising has brought about a series of transfers of income among consumers of different petroleum products. In Brazil such a transfer of income has not taken place through any kind of taxation but rather through the setting of ex-refinery prices which have in fact borne the brunt of cross-subsidisation. Hence artificially high or low ex-refinery prices are directly connected with high or low consumer prices, and vice-versa.

The use of fuel prices as tools in the carrying out of economic policy has met and continues to meet with strong opposition from the World Bank as regards the price policy methods which it recommends to the governments of developing countries. It is a simple policy, viz: 'In a developing country context, the highest priority structural initiative must be to let energy prices reflect the real costs of supply, including pollution abatement and damage costs' (World Bank 1993: 43). This policy has changed little since 1983 save for the suggestion that regard should be had for the cost of environmental protection in the setting of energy prices. In other words, the World Bank favours the complete abolition of fuel subsidies and feels that prices ought to cover

'long-term marginal costs'<sup>1</sup> plus costs of externalities connected with the environment.

The marginal production cost of a good may vary between its c.i.f. import cost and its f.o.b. export cost. The c.i.f. import cost of a given petroleum product is the *opportunity cost* thereof for the consumer, since it represents the alternative to cost of supply by its home refineries. The f.o.b. export cost represents the opportunity cost for the refiner, since it is the alternative to the price of that petroleum product in the home market.

The main Brazilian consumer centres lie far away from the large world petroleum product markets, such as Rotterdam, the Caribbean and Mediterranean markets. Therefore the cost of transportation between Brazil and the external markets is relatively high and affects both the cost of importing certain oil products needed to make up local supply and the prices of surplus products exported. For instance, in 1993 the freight rate<sup>2</sup> for light products from Rotterdam to southeast Brazil, (US\$1.90 per barrel<sup>3</sup>), was 2.24 times more expensive than the US\$0.85 per barrel charged between Rotterdam and countries in the northwest of Europe.<sup>4</sup>

It is not always easy to estimate correctly all the factors needed to devise a rational price policy. Often it is hard to determine accurately long-term production marginal costs for given petroleum products since this calls for sound estimates of oil reserves and demand. Even import costs can pose difficulties since there are ambiguities involved as regards import sources, long haul freight rates and, in a country the size of Brazil, points of entry.

A proper price policy should ensure that Petrobras, the state-owned company in charge of

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<sup>1</sup> The marginal production cost of goods is the rise in the overall costs of a company caused by producing one further unit of such goods. Long-term marginal cost is that of meeting future rises in consumption, whereupon capacity may have to be pushed up.

<sup>2</sup> There is an important difference between 'transport cost' and 'freight rate'. Transport cost is the overall cost of operating a vessel and depends on the particulars of the vessel – its capacity, fuel consumption, speed – price of bunkers, speed, time at sea, time idle, wages and harbour charges borne by owner. Costs of transportation between various ports in the world are estimated and published in 'New Worldscale Rates' (former 'Worldscale Rates'), based on a standard kind of vessel and standard chartering costs. Freight rates depend on the tanker market and are stated as proportions of Worldscale flat rates.

<sup>3</sup> Rate estimated by author, based on Worldscale world freight rates published by Shipping Statistics and Economics (December 1993)

<sup>4</sup> Rate estimated from difference between NW Europe c.i.f. price and f.o.b. price, ARA base, as published by Platt's.

carrying out the oil monopoly, is provided with the funds needed for the investments that have to be carried out and to make it a financially viable concern. In spite of the cross-subsidisation of products, overall sales therefore must generate revenues that would fulfil these objectives.

Revenues in line with competitive market conditions would be earned by Petrobras if the weighted average of ex-refinery net prices (ARP) is equal to the import parity (average c.i.f. import cost – AIC). Cross-subsidisation can be consistent with  $ARP = AIC$  even if ex-refinery relative prices are out of step with world prices. But if  $ARP < AIC$ , the government – by setting relatively low prices for one or more products – would bring about a transfer of income from oil to other sectors of the economy. Here it might be pointed out that one of the purposes of bringing Petrobras into being was to cut down on the cost of petroleum products supply at a time when most of those consumed in the country had to be imported. The cost to Brazil of importing petroleum products was and is relatively higher than that incurred by countries lying closer to external markets. To strictly abide by competitive market conditions would add heavily to the price of fuels to the domestic economy.

In this chapter we start by briefly describing the inflationary process of the Brazilian economy in the last forty years. Then we demonstrate the necessity to take inflation into account in order to calculate average prices for periods when inflation rates are high. Next we examine whether the trend in ARP corresponds to price regulations (based on a cost-plus policy) and to competitive market conditions (where marginal costs and revenues offset one another). We then estimate the economic rent obtained from oil products.

### **3.2. Some Aspects of Inflation in Brazil**

Inflation has been a significant feature of Brazilian economic development. Annual rates of inflation in Brazil for 1945–96 are shown in Table 3.1.

In the 1940s the average rate of inflation was 10 per cent; in the 1950s it was 19 per cent, in the 1960s nearly 45 per cent, in the 1970s 34 per cent. It then jumped to a steep 428 per cent in the 1980s, and reached its maximum of 2708 per cent in 1993.

**Table 3.1: Annual Rates of Inflation in Brazil, 1945–96. Per Cent.**

1945	10.1	1956	24.4	1967	24.3	1978	40.8	1989	1782.9
1946	22.6	1957	7.0	1968	25.4	1979	77.2	1990	1476.6
1947	2.7	1958	24.3	1969	20.3	1980	110.2	1991	480.2
1948	8.3	1959	39.5	1970	19.3	1981	95.2	1992	1157.9
1949	12.2	1960	30.6	1971	19.5	1982	99.7	1993	2708.6
1950	12.4	1961	47.7	1972	15.7	1983	211.0	1994	1093.8
1951	11.9	1962	51.3	1973	15.5	1984	223.8	1995	14.8
1952	12.9	1963	81.3	1974	34.5	1985	235.1	1996	9.3
1953	20.8	1964	91.9	1975	29.4	1986	65.0		
1954	25.6	1965	34.5	1976	46.3	1987	415.8		
1955	12.4	1966	38.8	1977	38.8	1988	1037.6		

Source: FGV-Conjuntura Econômica

Two schools of thought have tried to explain the Brazilian inflation in the 1950s. The structuralist school considered inflation to be due to inelastic supply within given sectors of the economy. Some sectors – particularly farming and activities heavily dependent on imports – were unable to keep up with demand. The structuralists regarded inflation in underdeveloped countries as a normal feature of economic development. The monetary school of thought, by contrast, put inflation down to the government's deficit which was being covered by increasing the money supply. It considered inflation to be harmful to economic development because of the distortions it caused (Bresser 1980).

Bresser showed that the rise in government current and investment expenditures from 1947 to 1960 had not been funded by taxation. The resulting deficit led to strong inflationary pressure. He argued that revenues from taxes, though adequate given the per capita income of the country, had not been enough. Bresser added that: 'moderate inflation is inherent in the economic development of developing countries. In Brazil inflation amounted to indirect taxation that enabled its government to solve problems connected with its ever-increasing involvement in the economy. Until it reached the extraordinary rates of the 1960s the inflation was a phenomenon both natural and necessary for the economic development of the country'(Bresser 1980: 65).

The inflation at the beginning of the 1960s was referred to by Inácio Rangel (Rangel 1963) as an inflation of costs and not of demand. Indeed, during that decade, demand lagged behind the

production capacity of industry. Such idle capacity led to a drop in the marginal efficiency of capital. The oligopolistic nature of markets enabled companies to react thereto by pushing up prices. At the same time companies were urging the government to increase both, credit – which banks were also urged to do – and its orders for goods and services from the private sector. The subsequent rise in government expenditure, since it had not been accompanied by any tax increases, led to a deficit in the government budget which had to be covered by currency issues. The cost inflation referred to by Rangel was later identified by Bresser as one of the medium-term causes of the Brazilian crisis of the 1960s, which lasted up to 1969 (Bresser 1980).

The oil price shock of 1973 (when 80 per cent of the oil used in Brazil had to be imported), caused the small surplus of the Brazilian balance of trade which stood at US\$7 million to become a deficit of US\$4.7 billion, or 59 per cent of the figure for overall exports in 1974. Since the government did not want to slow the economy down, it chose to keep rates of growth high. As a result, trade deficits after 1973 caused a significant increase in Brazilian foreign debt. Loans were entered into at varying interest rates at a time when the liquidity of world money markets was high and rates of interest relatively low.

Due to the widespread use of oil in the various sectors of the modern economy, the 1973 increase of world oil prices provoked a rise in costs of production in Brazil in many sectors. These upward movements in costs were passed on to consumers and helped therefore to feed the rising inflation.

The second oil shock in 1979 worsened the situation and aggravated trade balance deficits – in this year the proportion of net imports of crude oil and products was as high as 40.4 per cent of overall Brazilian exports. World interest rates also went up which made dearer any fresh borrowing needed to prop up economic growth. Furthermore, debt service, which previously took place at variable rates of interest, also grew. In 1979 and 1980 the rates of GDP growth were high despite the oil shock (6.4 per cent and 7.2 per cent respectively) but they were accompanied by increases in the inflation rate (see Table 3.1)

After the Mexico moratorium of 1982 the international market refused to continue financing the debts of Latin American nations. Following requirements imposed by the IMF, the Brazilian government started to run an adjustment programme that included measures such as devaluation,

a reduction in capital expenditures and in government and consumer spending. Despite these measures the rate of inflation remained steep until 1985 (see Table 3.1).

The many years that it had had to live with inflation had caused the Brazilian economy to work out an automatic price adjustment mechanism. This mechanism, which had become part of the indexed economy, gave rise to an *inertial component* of inflation. The indexation system led to distortions of relative prices in the first half of the 1980s, as pointed out by Antonio Castro (Castro 1985): wages, public service tariffs and the prices of crude oil products had been set below the inflation rate.

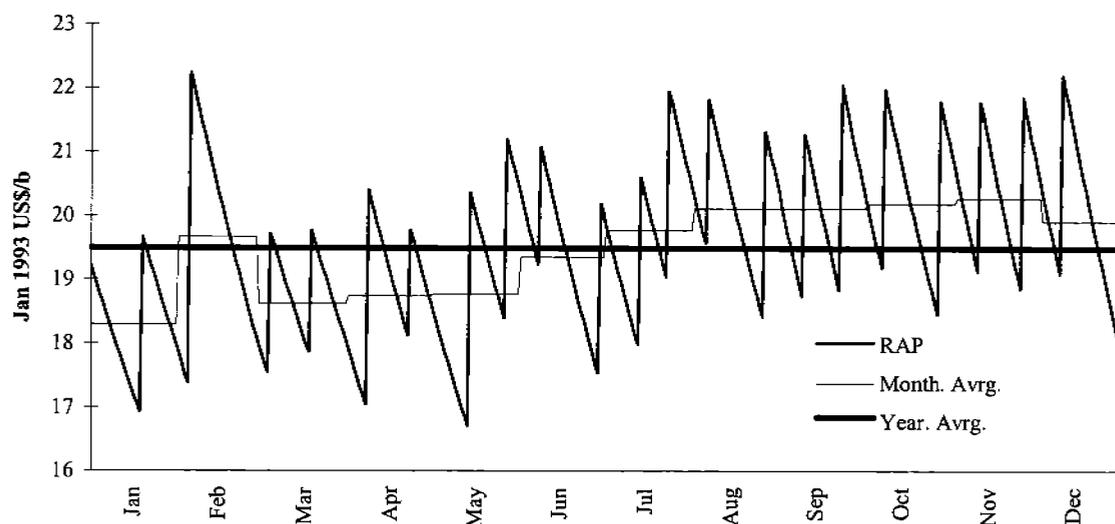
In 1986 the government embarked upon another stabilisation programme, known as the Cruzado Plan, which was intended to deal with the *inertial inflation* without regard for any structural factors. Basically, the government froze prices, wages, rents and mortgage payments in addition to forbidding any indexation of contracts for a term of less than one year. It began by bringing the 235 per cent inflation rate of 1985 down to 65 per cent in 1986, but soon there were problems. Distorted relative prices remained frozen for a long time – some public service tariffs and prices of fuels stayed at relatively low levels, which made the government deficit problem more acute; instead of allowing price adjustments to be made to certain basic products that were in short supply the government decided to import them, thereby diminishing its reserve of convertible foreign currencies. The state of such reserves became so bad that in February 1987 Brazil was obliged to declare a moratorium. Thereafter the government lost control over inflation which had risen to extraordinarily high rates – of even as much as 0.8 per cent per day.

A new liberal government took over in 1990 and launched an anti-inflationary programme which failed. In 1993 inflation had climbed to 2,708 per cent in one year. In July 1994 the government ran a new anti-inflationary programme, named Plano Real. Import tax rates were drastically reduced and domestic prices stabilised due to competition with imported products. The inflation rate was reduced to 1094 per cent in 1994 and to only 9 per cent in 1996.

### **3.3 Inflation and Petroleum Product Price Adjustments in Brazil**

When the rate of inflation was very high domestic nominal prices had to be adjusted frequently

in order to avoid any deep plunge in real prices. In 1993, when the inflation rate was at its highest, the prices of petroleum products had to be adjusted as often as 22 times (as can be seen in Figure 3.1, which presents the trends in the average of ex-refinery real prices). Each peak of the graph stands for a price adjustment.



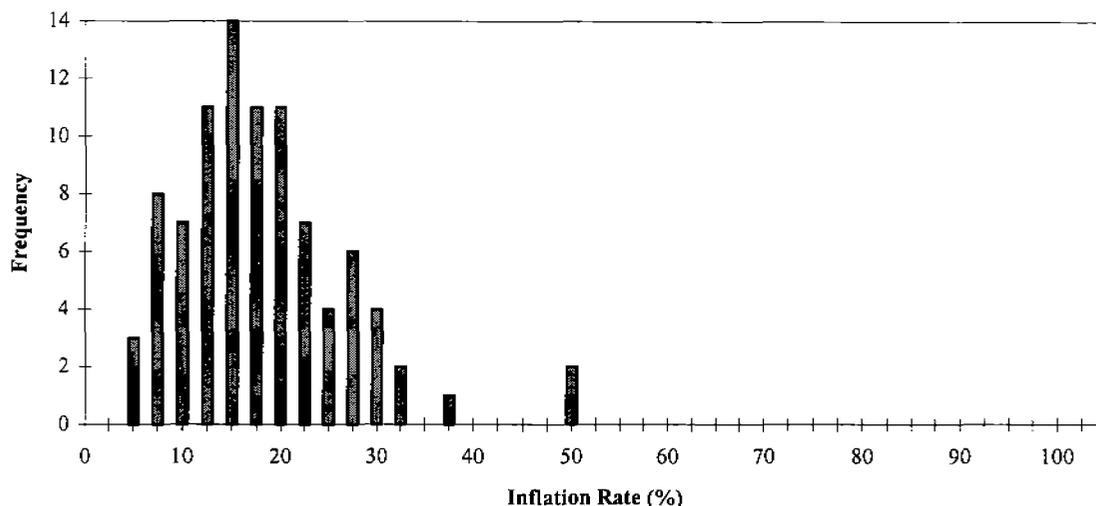
**Figure 3.1:** Trends in 1993 Petrobras Average Ex-refinery Price (ARP).

The reduction of regulated prices (in real terms) was a measure adopted by the government to try to restrain accelerating inflation. This was what actually happened in the 1980s when petroleum product prices as well as some public service tariffs and wages were adjusted below the inflation rate.

Several factors were taken into account in the adjustments of oil product domestic prices, such as: fluctuations in world oil prices, the accumulated rate of inflation, and fluctuations in foreign exchange rates and wages (which are largely the outcome of the accumulated inflation rate). Hence, whenever the government made an adjustment to the prices of petroleum products this was strongly influenced by the rate of inflation that had obtained since the previous adjustment. Indeed, we found that the accrued rate of inflation had triggered price adjustments when it rose beyond a certain figure.

Figure 3.2 shows the frequency distribution of the accrued inflation rates during the interval

between two consecutive oil product price adjustments<sup>5</sup> in 1988–93, when Brazilian inflation was extremely high. There were 92 price adjustments made during this period.



**Figure 3.2:** Frequency Distribution of Inflation Rates During the Interval Between Consecutive Oil Product Price Adjustments. 1988–93.

The average inflation rate in the frequency distribution in Figure 3.2 was 19.1 per cent and standard deviation was 12.5 per cent. The inflation rate in the interval between two consecutive adjustments varied within a wide range; however 89 per cent of the adjustments were made when inflation rates reached levels below 27.5 per cent.<sup>6</sup>

Steep inflation makes it difficult to construct a reliable series of domestic prices, whether real or nominal. When the inflation rate is very high, average prices over a time period, even a short one, can be very misleading. Prices should therefore be referred to a base date.

Every month Fundação Getúlio Vargas estimates and publishes a monthly inflation rate measured in terms of the General Price Index (GPI). The GPI is a weighted average drawn from

<sup>5</sup> Such rates of inflation between two consecutive price adjustments were drawn from the monthly inflation rates published by IBGE.

<sup>6</sup> Figure 3.2 shows that an adjustment was granted after inflation had risen to 105 per cent, which adjustment took place after petroleum products prices had been frozen from March to August of 1990, when the Gulf War began.

three other indices: the Wholesale Price Index (WPI), worked out in two versions, namely, the Overall Supply (OS) which includes exports, and Internal Availability (IA) which does not; the Consumer Price Index (CPI); and the National Construction Cost Index (NCCI). The GPI is said to be related to Overall Supply or to Internal Availability depending on the WPI used.

Let  $i = i(t) = e^{j\Delta t}$ , the average daily rate of inflation for a given month based on the monthly rate of inflation. Let the nominal price of a given good at a time  $t = t_0$  be  $P_0$  and consider that it does not vary with time. The price of this good at time  $t > t_0$ , expressed in constant money of  $t_0$  can be written as:

$$P(t/t_0) = P_0 e^{-j \Delta t}$$

where:

$$j = j(t) = \text{Ln}[1 + i(t)] \quad \text{and} \quad \Delta t = t - t_0$$

The average real price for the time period  $\Delta t$  is:

$$\langle P(\Delta t/t_0) \rangle = \frac{\int_{t_0}^t P_0 e^{-j\Delta t} dt}{\Delta t} = \frac{P_0}{j\Delta t} (1 - e^{-j\Delta t})$$

Let us, for example, consider that price  $P_0$  has not been adjusted during a month in which the average daily rate of inflation has been  $i(t) = 1$  per cent. The average real price in money of the first day of the month becomes:

$$\langle P(\Delta t/t_0) \rangle = 0.86 P_0$$

Let  $P(t)$  and  $I(t)$  be functions representing the nominal price of goods at time  $t$  and the inflation accrued from  $t_0 = 0$  up to  $t$ . Then the average real price for the period  $0 < t < T$ , in money of the base date  $t_0 = 0$  can be stated as:

$$\langle P(t/t_0) \rangle = \frac{\int_0^T P(t) e^{-j(t)} dt}{T} \quad (3.1)$$

Average annual prices for this study were computed in terms of equation (3.1), where the base date was 1 January of each year. In working out the ex-refinery average annual price of a barrel

of petroleum products produced and sold by Petrobras in the home market a single deflation factor, namely, the GPI-IA was used to deflate the prices of different products. Since this is a compound index, it is best suited to deflate prices of a range of products.

### **3.4 Petrobras Average Ex-Refinery Price**

The fixing of ex-refinery prices of individual petroleum products by CNP (later on replaced by the DNC) has depended, since 1977, on the average ex-refinery price (ARP)<sup>7</sup> of all products. Furthermore, the pricing system allows domestic relative prices to be fixed in terms of the 'internal state of the economy within the country and of the peculiarities of the home crude refining business, profitability of which must be assured'. The only explicit connection referred to in such prevailing regulations between home and world prices is that the cost of imported crude used to determine the ARP should be equal to its average c.i.f. import cost.

Brazilian energy pricing policy has been aimed at targets connected with the economic development of the country. After the first oil crisis, petroleum products price policy in Brazil was mainly intended to foster the use of alternative sources of energy, to improve the distribution of income thereby enabling poorer families to make use of more efficient and cleaner sources of energy, to help develop the less industrialised parts of the country which lie furthest away from production centres, to encourage development within areas of industry, to yield government revenue, and to help reduce inflation.

The use of petroleum product pricing as an instrument of broader economic policies led to the fixing of prices at levels different from those typical of a competitive market, namely, at levels reflecting their respective marginal costs. The huge length of the coast-line of Brazil, plus the small number of roads that cross its frontiers with neighbouring countries, helped to impede the smuggling of the cheaper petroleum products across such frontiers, thereby making it easier to keep the home prices of petroleum products at levels different from those on world markets.

Funds used to subsidise the consumption of some of the petroleum products were secured from

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<sup>7</sup> Law 1,599 of 1977 requires that the consumption-weighted average of ex-refinery prices of various products shall be equal to ARP.

extra revenue derived from surcharges levied on other products. These subsidies and surcharges were built in to ex-refinery prices so that there was no need to levy taxes to cover the cost of cross-subsidisation. Petrobras played the part of intermediary in all these transfers of income among consumers. Where cross-subsidisation takes place, the total funds needed to cover the subsidisation of some petroleum products must be equal to the revenue derived from surcharges laid upon other products.

Practically all of the revenue earned by Petrobras is derived from the sale of petroleum products to the home market plus some export earnings. This makes it particularly vulnerable under the government-regulated ARP. A suitable ARP should enable Petrobras to obtain the funds it needs to carry out capital expenditure plans in accordance with the economic development targets of the government and to ensure its own financial viability.

The cost-plus policy implicit in the regulations fixing the ARP involves two important consequences for the home oil business. First of all, the regulations mean that the internal transfer price of crude from upstream to the refineries of the company does not depend on the quality of the crude nor on the cost of producing and transporting it but instead on the kind and source of the imported crude. Thus, if the company produces considerable quantities of good quality crude – for example, light and sweet, which is highly priced on world markets – any additional crude imported, which should then be of poorer quality, would be relatively cheaper. Under the regulations, this would bring down the value of the good quality home crude and consequently the profitability of the company. If, on the contrary, domestic production was of low quality crudes this would involve importing dearer ones – therefore leading to pricing the domestic crude at a higher level than warranted by its quality.

Secondly, in this system refining margins do not depend on the type and quality of the petroleum products sold on the home market. The ARP is to be fixed in a way that ensures that refining investments would have an internal rate of return of 15 per cent. Refining margins are guaranteed by the government but the major aim of the Petrobras refineries is to supply the country with the petroleum products required given government energy policy. They cannot freely seek other sources of profit on world markets. Hence refining activities must always be geared to home demand.

However, it has not always been easy for Petrobras refineries to adapt to changes in demand. For instance, the fall in home demand for gasoline, brought about by the rise of alcohol as an automotive fuel, led to great quantities of surplus output which was exported, mainly to the USA.

Since Petrobras cannot choose its markets and since the ARP is fixed by the government according to Law 1,599, any increase in the profits of the company will not only depend on selling more and on cutting operating costs but also on three other major factors, namely:

- The replacing of imported crude by cheaper home crude since upstream profit is equal to the difference between oil c.i.f. import costs and home production costs;
- The increase in refinery capital expenditure;
- The fostering of opportunities for petroleum products exports.

In the next section of this chapter we shall analyse the behaviour of world crude prices, taken as proxies to f.o.b. price of oil imported by Petrobras, and of the ARP in the period 1973–93. This analysis is important because of the great weight of raw material costs in overall refining costs.

### **3.5 Petrobras Average Ex-Refinery Price and World Oil Prices**

The cost of crude oil is the most important component of average ex-refinery price. Refining costs may vary between US\$2 and US\$3 per barrel (*Energy Détente*, 31 July 1997) depending on the complexity of the refinery concerned, while the cost of benchmark crude has always remained above US\$12 per barrel since the second oil crisis. The 1977 regulations laid down an initial figure for that part of ARP which involves crude costs (Group I, basically equal to oil c.i.f. import cost) at 79 per cent of the ARP. Furthermore, it was ruled that this part should be adjusted 'in terms of fluctuations in the foreign exchange rate ... and the c.i.f. cost of crude' at time intervals 'of not less than three months and not more than six months'. This interval between any two consecutive price adjustments was reduced when the rate of inflation rose at the beginning of the 1980s. In 1988, when the rate of inflation had risen to above 1,000 per cent per year the ARP was being adjusted every month.

Bureaucracy and the hesitation of the government in swiftly passing on to consumers the rising costs of Petrobras brought about by climbing costs of imported crude and by inflation were factors that caused products prices frequently to fall out of step with Petrobras costs. A means had to be found to make up for Petrobras losses/gains caused by exchange shifts and price fluctuations in the extremely volatile world oil market which were occurring between two consecutive price adjustments.

Up to June 1983, in order to prevent losses caused by foreign exchange rate movements, the exchange rate used for importing crude oil and products was the same as that employed by the regulator to calculate, in local currency, the c.i.f. average cost for ARP Group I. From now on we shall refer to this rate as the *structural exchange rate*. Also, up to June 1983, any losses/gains due to crude oil price movements in the international market could be made up to Petrobras, by the CNP, with the use of funds raised from petroleum product prices under alinea (h) (see Chapter 2).

After the second oil shock, annual rates of inflation rose to about 100 per cent per year in 1980 and to 211 per cent per year in 1983 (see Table 3.1). The official exchange rate (Cr\$/US\$) went on climbing along with inflation while the *structural exchange rate* lagged considerably behind as shown in Table 3.2.

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**Table 3.2:** Official and Structural Average Exchange Rates, 1975–83. Cr\$/US\$.

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	<i>Structural Exchange Rate</i>	<i>Official Exchange Rate</i>
1975	7.83	8.13
1976	9.86	10.67
1977	12.82	14.14
1978	16.65	18.06
1979	23.32	26.87
1980	42.93	52.70
1981	81.23	93.01
1982	145.03	179.40
1983	524.31	576.20

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Source: Petrobras and Banco Central

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The use of the structural exchange rate for importing crude, implied that Petrobras paid a lower local currency price for its imported crude. These differences were debited to the CNP by the Central Bank. This debt could be covered with funds raised under alinea (h). Beginning June 1983, crude was being imported at the official rate of exchange. Losses/gains brought about by differences between the local currency cost of crude imports computed by the regulator for the ARP structure – hereinafter referred to simply as *structural c.i.f. cost* – and the true c.i.f. import cost of crude were thereupon taken up by Petrobras.<sup>8</sup> Such losses/gains are recoverable<sup>9</sup> and have so far been entered by CNP in the Oil Account, to which we referred in Chapter 2.

In short, up to 1983 the losses caused by exchange rates were debited to the CNP, no direct loss being suffered by Petrobras. Thereafter the losses caused by structural c.i.f. costs were taken up by Petrobras and entered as Petrobras credits in the CNP books.

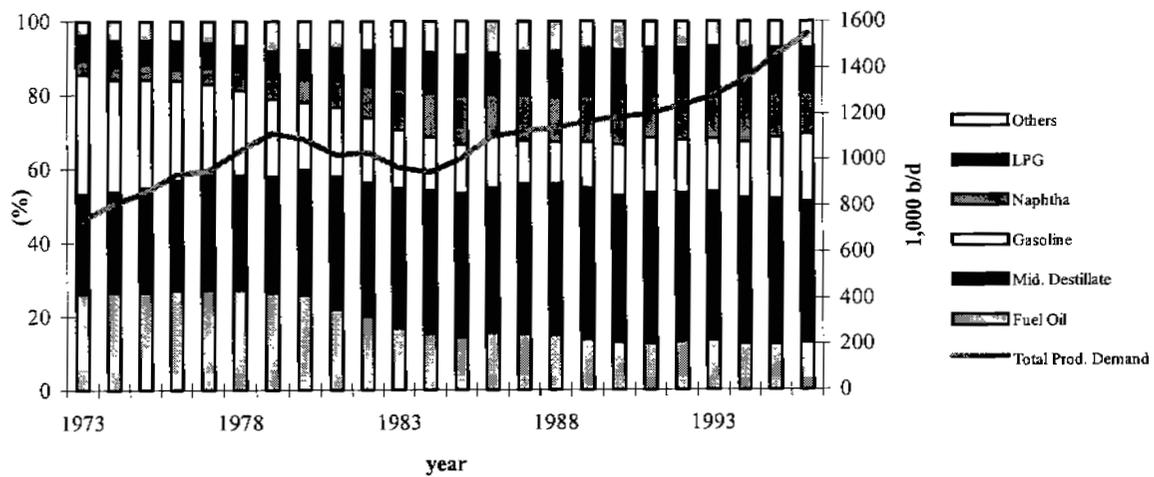
We shall now compare trends in the ARP with trends in spot price for Arabian Light, chosen as a proxy to the f.o.b. average price of the crudes imported by Petrobras. Arabian Light was chosen to represent world crude price because it was used as a reference crude, not only by OPEC itself but also in general world crude trading. Furthermore, Arabian Light is a crude that has figured substantially in the range of crudes imported by Petrobras.

Average annual domestic prices for the various products have been calculated according to equation (3.1), using GPI-IA as the deflator and taking 1 January of every year as the deflation base date. The average ex-refinery price (ARP) was worked out as the consumption-weighted average of ex-refinery net prices for seven products, namely: LPG, naphtha, gasoline, illuminating kerosene, jet fuel, diesel, and fuel oil. For the 1973–96 period, the seven products chosen represented from 91 to 96 per cent of the overall demand for petroleum products. Figure 3.3 shows Brazilian demand for petroleum products for the period 1973–96. Kerosene and diesel have been grouped under the heading of middle distillates.

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<sup>8</sup> Differences caused by variations in both exchange rates and crude c.i.f. import cost.

<sup>9</sup> Only mismatches of cost connected with the volume  $VI$  of crude imported to supply the home market with products could be recovered; if  $X$  was the volume of products exported and  $V$  the volume of crude imported, then  $VI = V-X$ .



Source: Balanço Energético Nacional (MME)

Figure 3.3: Brazilian Oil Product Demand, 1973–96.

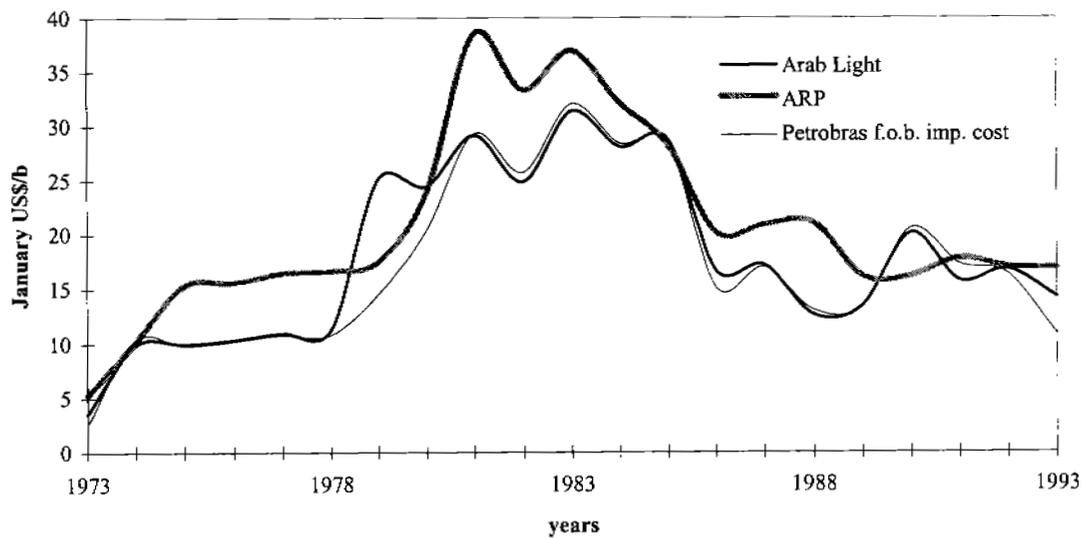


Figure 3.4: Trends in Average Ex-refinery Net Price (ARP) and Arabian Light Spot Price, 1973–93

The yearly average prices of Arabian Light were worked out in keeping with the ARP calculation, that is, the average monthly spot market prices were converted into local currency at the appropriate monthly average exchange rates. Up to June 1983 we used the structural exchange rates and thereafter the official ones. These prices, in local currency, were deflated using GPI-IA, with January as the base, and then averaged. Finally for every year both the ARP and the Arabian Light yearly average price were expressed in dollars at the January official exchange rate.

Figure 3.4 shows the trends in estimated ARP and Arabian Light crude spot market average prices.

The big share of crude oil costs in overall refinery costs explains the high correlation coefficient of 0.88 between the average ex-refinery and the benchmark crude prices. However, this correlation coefficient is relatively low compared with that between the spot prices for the major products – gasoline, diesel and fuel oil – and Arabian Light price, which turned out to be 0.96.

The rises in the world price of crude oil in 1974 and 1979 took some time to be fully passed on to Brazilian consumers. After the first oil crisis, the ratio of Arabian Light spot price to ARP rose from 67 per cent in 1973 to 97 per cent in 1974, and then fell back to 65 per cent in 1975. After the second oil crisis the ARP and the f.o.b. average price of crude imported by Petrobras were actually less out of step than suggested by the trends in ARP and Arabian Light prices shown in Figure 3.4. The Islamic revolution caused a sudden drop in the oil output of Iran, from 5.3 million barrels per day in 1978 to 3.2 million in 1979 and to 1.5 million in 1980 (Jenkins 1989). Prospects of a shortage, and even of a halt in the supply of crude, helped to increase the difference between spot market prices and the official prices quoted by the member countries of OPEC.<sup>10</sup> In December 1979 the official price for Arabian Light was US\$25.8 per barrel while the spot market price was US\$41 per barrel (Jenkins 1989). The difference between official and spot prices fell to US\$6.8 per barrel in 1980 and to just a few cents in July 1981.

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<sup>10</sup> From 1955 to 1973 the oil concessionaires operating in the Persian Gulf were obliged to publish posted prices. From 1974 onwards, after the OPEC countries had begun to acquire interest shares in the concessions under their jurisdictions, it was they who set the prices published, the government official prices.

At the time of the second oil crisis, most of the crude bought by Petrobras was obtained under long-term (1 year) agreements and at official prices. Table 3.3 shows Petrobras's yearly average f.o.b. import prices (worked out from the Monthly Report of Commercial Department/Petrobras) relative to Arabian Light prices.

**Table 3.3:** Average f.o.b. Price of Crudes Imported by Petrobras Relative to Arabian Light Spot Price. [Arabian Light Price]=100. 1973-93.

	<i>Average Oil f.o.b Import Price</i>		<i>Average Oil f.o.b Import Price</i>
1973	72.0	1984	101.2
1974	104.5	1985	99.0
1975	98.7	1986	90.8
1976	98.9	1987	98.8
1977	98.3	1988	103.4
1978	96.3	1989	100.0
1979	57.8	1990	102.3
1980	83.1	1991	109.6
1981	100.5	1992	97.5
1982	103.5	1993	76.3
1983	102.2		

Source: Petrobras, Neste and author's calculations

Drawing from Table 3.3 we estimate that the average f.o.b. price of crude oil imported by Petrobras in 1979 and 1980 represented respectively 83 and 85 per cent of the ARP for these years. Trends in the Petrobras average f.o.b. imported crude prices, estimated from Table 3.3, are shown in Figure 3.4. The correlation index between the ARP and the f.o.b. average price was 0.93.

As from 1983 Petrobras's losses or gains resulting from the gap between the structural and the actual oil import costs were entered in the Oil Account. However, the difference between the ARP and opportunity value of home crude oil is not entered in the Oil Account. In short, the difference between the average c.i.f. cost of imported crude ( $P_i$ ) and the structural c.i.f. cost ( $P_s$ ) only applies to the volumes of imported crudes. Considering the amounts entered as credits to

Petrobras in the Oil Account we have estimated the difference ( $P_s - P_i$ ) which can be carried forward. The results are shown in Table 3.4

**Table 3.4:** Estimated Gap between Structural and Actual c.i.f. Import Cost of Oil.

Year	Petrobras Refineries' Feedstock (1,000 b/d)		Petrobras Credits in Petroleum Account (Jan 93 US\$ million)	$[P_s - P_i]$ (Jan 93 US\$/b)	$[P_s - P_d]$ (Jan 93 US\$/b)
	Domestic	Imported			
1984	452	620	490.8	(2.17)	2.97
1985	549	534	968.3	(4.97)	4.83
1986	579	568	(1536.8)	7.41	(7.27)
1987	572	605	373.7	(1.69)	1.79
1988	556	623	(549.5)	2.42	(2.71)
1989	595	587	699.3	(3.26)	3.22
1990	637	528	441.4	(2.29)	1.90
1991	626	503	994.7	(5.42)	4.35
1992	635	536	675.6	(3.45)	2.91
1993	636	534	(172.5)	0.89	(0.74)

If  $P_s < P_i$  then the internal transfer price of the domestic oil ( $P_d$ ) was lower than  $P_s$  since the price of imported oil was actually paid by Petrobras. Let I and D be respectively the imported and domestic volumes of oil refined by Petrobras. Then, if  $\Delta P = P_s - P_i$ :

$$P_s(I + D) = P_i I + P_d D \quad \Rightarrow \quad [P_s - P_d] = - \frac{\Delta P \cdot I}{D}$$

$[P_s - P_d]$  estimates in the period 1984–93 are presented in Table 3.4. Up to 1988, these estimates and those of  $[P_s - P_i]$  are distorted, as the balances of Oil Account were not adjusted for inflation. The low internal transfer price of domestic oil (which in 1991, according to the Petroleum Account, was US\$9.77/b lower than its opportunity cost, that is the import parity), implies that income transfers have taken place from the upstream sector of Petrobras to other sectors of the Brazilian economy. We estimated that if the insufficiency of the internal transfer price of domestic oil had been allowed for, the credit of Petrobras in the Oil Account in December 1993 would be US\$5.6 billion, instead of US\$2.6 which was written in.

### 3.6 Petrobras Average Ex-Refinery Price and Average Import Price

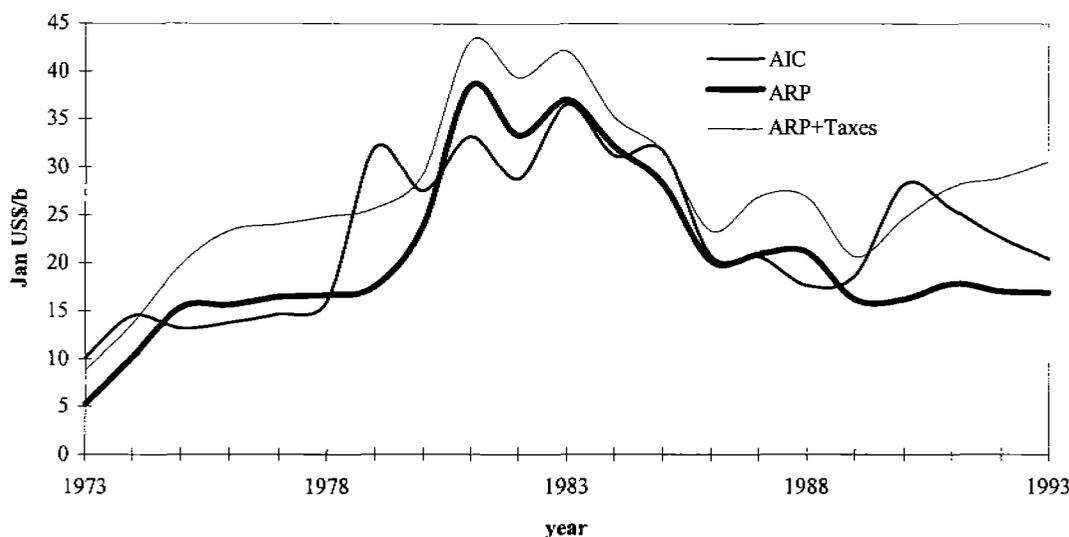
Often spot market prices adjusted for transport costs are used to estimate the opportunity cost of supply of petroleum products. For example, in northwest Europe ex-refinery prices are basically determined in terms of Rotterdam spot prices. In the region referred to as ARA (Amsterdam, Rotterdam and Antwerp) there are refineries and tank farms from which products are shipped out either in barges to the German and Benelux countries or in tankers to other countries. Traders and European refiners buy or sell petroleum products in Rotterdam to balance requirements on supply and demand in their refineries. We show in Appendix 1 how much Rotterdam spot market prices affect home prices in neighbouring countries.

In this study, for the purpose of estimating the opportunity costs of petroleum products supply in Brazil we have taken the Rotterdam spot market as the source of such imports. We assumed that the opportunity cost is equal to the import cost. In order to arrive at an estimated import cost for each product we just added to the Rotterdam spot prices – NWE/ARA quotations – our freight cost estimates for each product up to the port of São Sebastião, which is the nearest one to the largest consumer centre of the country. No other costs were taken into account [such as insurance, the Freight Surcharge Tax for Merchant Navy Renewal (Adicional de Frete para Renovação da Marinha Mercante – AFRMM)], or other harbour charges.<sup>11</sup>

Yearly averages of import costs in local currency were calculated for each product in the same way as that for the yearly average price of the Arabian Light crude in section 3.5. Finally the average import cost (AIC) of oil products, which we shall compare with the average ex-refinery price (ARP), was worked out as the consumption-weighted average of import costs of the various products. Figure 3.5 shows the trends in ARP and AIC for the 1973–93 period.

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<sup>11</sup> Monthly spot NWE/ARA prices up to 1975 were taken from the *Oil Economists' Handbook*; from 1975 to 1993 the data are those in annual editions of *Platt's Oilprice Handbook and Oilmanac*. LPG prices prior to 1985 were kindly provided by the Commercial Services Company Ltd. Monthly long haul freight rates for the products were computed from Worldscale rates published by Shipping Statistics and Economics. These monthly rates, which reflect the tanker market, are a proportion of the flat tariff (W=100) published every year by Worldscale for the Rotterdam–São Sebastião route.



**Figure 3.5:** Trends in Petrobras Average Ex-refinery Net Price (ARP) and Product Average Import Cost (AIC).

The Pearson correlation coefficient between ARP and AIC was 0.81, lower than that between ARP and Arabian Light spot price (correlation coefficient of 0.88 – see section 3.5) as regulations linked the calculation of ARP to the import cost of crude oil. We also calculated a correlation coefficient of 0.98 between AIC and Arabian Light spot price. This shows that international prices of oil products are more sensitive than Brazil's to fluctuations in world oil prices.

The difference between AIC and ARP indicates how much more (or less) Petrobras could have earned on the sale of a composite barrel of products. These differences for the period 1973–93 are shown in Table 3.5.

The heaviest losses sustained by Petrobras resulting from the gaps between average ex-refinery price and import parity took place in the years of the two oil crises and in the period 1990–92. These gaps may reflect some delay in the adjustment of home prices to the highly volatile international prices due to certain inertial factors.<sup>12</sup> In countries where prices are regulated such

<sup>12</sup>Domestic prices of products in some European countries also failed to follow spectacular rises in world prices in 1979. For example, in England price control exercised by the government from November 1972 to May 1979

gaps may also reflect hesitation on the part of the regulator in promptly following changes in world prices.

We estimate that in the period 1973–93 the gaps between average ex-refinery price and the import parity led to a loss of revenue for Petrobras of US\$41.7 billion, in constant money of January 1997. This loss of revenue may be regarded as a transfer of income from the oil to other sectors of the economy. During a given time period, the loss of revenue  $\Delta R$  due to the gap between ARP and the import parity may represent: (a) a transfer of income to the government and a subsidy to the consumer of petroleum products, if product tax revenue was lower than  $\Delta R$

represented an inertial factor in the home prices of products. Prices in England could rise only as the result of the increase in some costs. Among such costs – the allowable costs – stood those for materials, components, fuels and electricity, and part of labour costs (only 50 per cent of any rise in labour costs could be passed on to prices). Price rises had to be notified to the Price Commission 28 days before their implementation and companies had to submit evidence of the need for such hikes. The Price Commission was entitled to examine price increases and to recommend restrictions in such regard. From February to June 1979 the final net price (net of taxes but including gross distribution margins) of gasoline and diesel in the UK lay below the opportunity cost. Between January and June spot prices for gasoline and diesel rose by more than 80 per cent while net British prices of such products went up 48 per cent and 37 per cent respectively.

Table 3.6 shows net gasoline and diesel prices for four European countries during the 1978-80 period and in the quarters of 1990.

**Table 3.6 - Trends in Net Domestic Prices in Some European Countries and Spot Prices of Gasoline and Diesel**

Product	Year	NWE		France		Germany		Italy		UK	
		US\$/m <sup>3</sup>	Index								
Gasoline	1978	127.3	100.0	207.6	100.0	194.2	100.0	169.7	100.0	159.3	100.0
	1979	262.6	206.3	232.2	111.8	244.4	125.9	199.8	117.7	252.5	158.5
	1980	275.8	216.7	336.0	161.8	329.0	169.4	315.3	185.8	353.6	221.9
	Q1-90	165.0	100.0	214.6	100.0	245.4	100.0	267.8	100.0	250.3	100.0
	Q2-90	166.6	101.0	208.9	97.3	252.7	102.9	265.2	99.0	261.2	104.4
	Q3-90	256.8	155.7	277.1	129.1	324.5	132.2	309.2	115.4	338.8	135.4
	Q4-90	244.6	148.2	321.3	149.7	359.1	146.3	394.6	147.4	365.7	146.1
Diesel	1978	108.9	100.0	156.4	100.0	183.2	100.0	140.2	100.0	180.4	100.0
	1979	265.2	243.6	191.1	122.1	240.1	131.0	180.5	128.8	269.4	149.3
	1980	260.0	238.8	292.7	187.1	324.6	177.2	296.6	211.5	348.9	193.4
	Q1-90	151.0	100.0	231.9	100.0	244.3	100.0	258.2	100.0	255.3	100.0
	Q2-90	129.1	85.5	207.3	89.4	213.3	87.3	231.2	89.5	259.5	101.7
	Q3-90	194.7	129.0	252.6	109.0	260.4	106.6	245.5	95.0	297.9	116.7
	Q4-90	253.3	167.8	332.2	143.3	355.8	145.7	368.9	142.9	383.2	150.1

Source: Energy Prices and Taxes (IEA) and Platt's Oilprice Handbook and Oilmanac

For the 1978–80 period average net prices of gasoline and diesel shown in Table 3.6, except for the price of gasoline in the United Kingdom, grew proportionately less than spot prices for the period. Further, in 1979 domestic prices were lower than the opportunity costs save for the price of diesel in the United Kingdom. But in 1990, when world prices of crude and its products rose because of the invasion of Kuwait, the home prices for gasoline and diesel in the four countries referred to were less out of step with spot prices than during the 1979 crisis.

(in this case no economic rent on oil products was appropriated); (b) or merely a transfer of income to the government, if the government appropriates economic rent by levying more tax than  $\Delta R$ .

**Table 3.5:** Difference between Average Ex-Refinery Net Price (ARP) and Average Import Cost of Products (AIC). 1973–93. US\$/b

Year	[AIC - ARP]	Year	[AIC - ARP]
1973	4.86	1984	(0.99)
1974	4.27	1985	3.47
1975	(2.14)	1986	0.58
1976	(1.87)	1987	(0.25)
1977	(1.80)	1988	(3.48)
1978	(0.74)	1989	2.45
1979	14.49	1990	11.98
1980	3.66	1991	7.77
1981	(5.34)	1992	5.61
1982	(4.59)	1993	3.52
1983	(0.49)		

### 3.7 Taxes Levied on Petroleum Products

When the average ex-refinery price is lower than the import parity then at least part of the oil products tax revenue represents a transfer of income to the government. In order to estimate such transfers we have compared ex-refinery taxed prices<sup>13</sup> with the import parity. Both curves are shown in Figure 3.5.

An examination of Figure 3.5 leads to the conclusion that as regards opportunity costs the Brazilian consumer of petroleum products was subsidised in 1973, 1974, 1979, 1980, 1985 and

<sup>13</sup> Alineas playing the role of earmarked taxes were included: alineas (d),(g),(i),(j),(l),(m) and (n), up to 1979; alineas (B),(C) and (D) in the 1980–83 period. For 1980–83 part of the revenue collected under alinea (A) was meant to cover expenses incurred in the transportation and marketing of alcohol and coal subsidies. Unfortunately the data available did not allow us to break down the various allocations for funds collected under alinea (A), which was why we did not include that part of alinea A in the overall amount for taxes on petroleum products.

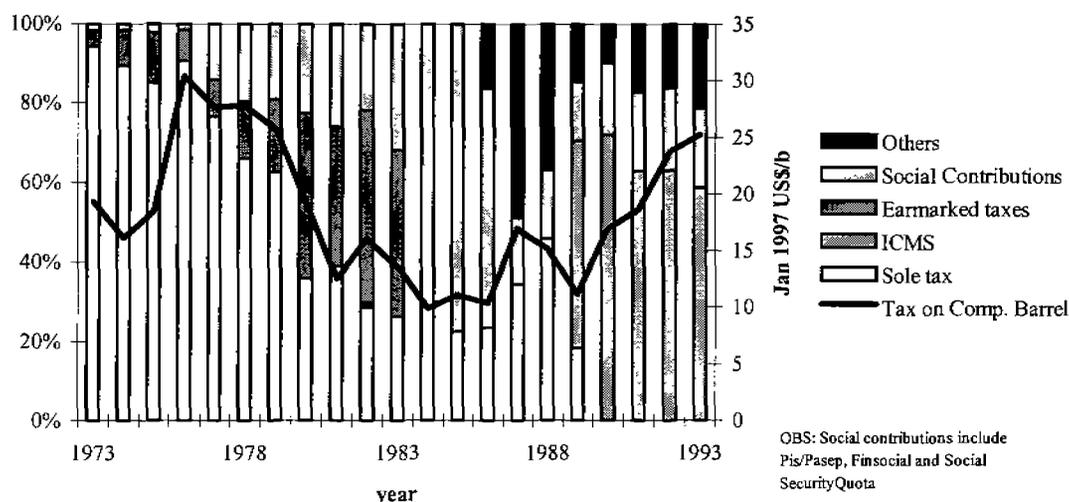


Figure 3.6: Taxes Levied on the Composite Barrel of Oil Products. 1973-93.

1990. We see that oil products taxes served to lessen considerably any benefits they might have gained from relatively low ex-refinery prices. We reckon that between 1973 and 1993 the amount of taxes paid by oil product consumers was equivalent to US\$137.4 billion, in constant money of January 1997. This means that the US\$41.7 billion which they underpaid to Petrobras on account of the distorted ex-refinery prices was totally swallowed up by the government through product taxation.

The share of taxes and contributions on petroleum products within overall government tax revenue has varied substantially. We have estimated that such share rose from 12.7 per cent in 1973 to 15.7 per cent in 1979, fell to 3.3 per cent in 1984, went up to 5.2 per cent in 1988 and to 8.7 per cent in 1993.<sup>14</sup>

Figure 3.5 shows that the ex-refinery price and the level of taxes levied upon a composite barrel of petroleum products sometimes involved asymmetrical behaviour. From 1979 to 1981, when the average ex-refinery price rose by 131 per cent, taxes fell by 42 per cent thus serving to

<sup>14</sup> In 1988 the Sole Tax charged on petroleum products and levied by the federal government was replaced by the ICMS (a value added tax) levied by the states of the federation. In order to arrive at the share of taxes levied upon petroleum products in the overall fiscal revenue, we therefore included ICMS revenue in the federal fiscal revenue. Information concerning such revenue was secured from the Central Bank Bulletin.

deaden the blow of the rise in ex-refinery prices upon final prices. However, in the years 1984–87, when the ex-refinery price went down by 35 per cent, this was not entirely passed on to consumers because the corresponding taxes increased by 100 per cent. In 1989–93 when ex-refinery prices were set well below the import parity taxes grew by more than 200 per cent.

Figure 3.6 shows the share of each kind of tax and contribution in the overall figure for taxes levied on a composite barrel of petroleum products

Up to 1979 the biggest share in oil product tax revenue was produced by the Sole Tax which was meant to be allocated to the National Roadway Fund and for raising the capital of the National Railway Network. Petrobras had a share in oil product tax revenue until 1983: up to 1976 the company had a share in the Sole Tax revenue (see Table 1.4), plus its share in revenues from alinea (i), up to 1980, and from alinea (D), up to 1983. Both were intended to be allocated to the funding of offshore exploration. Table 3.7 shows Petrobras's shares in overall tax in the composite barrel of petroleum products.<sup>15</sup> Up to 1978 these shares varied from 3.4 per cent to 11.2 per cent and from 1979 to 1983 fell to less than 2 per cent. We have estimated that Petrobras's share in overall tax revenue for the period of 1973 to 1983 was equivalent to US\$3.4 billion, in constant money of January 1997.

We can see from Figure 3.6 that after the big increases in the price of oil in 1979 there was a substantial rise in the share of earmarked taxes. These were mostly set apart for the development of alternative energy sources, principally automotive alcohol and coal. The increase of these taxes reflected the new emphasis within Brazilian energy policy towards the development of substitutes for crude oil. That part of taxes on petroleum products which was assigned to the development of alternative energy sources is also shown in Table 3.7. We have reckoned that for the 1974–83 period about US\$10.2 billion (in constant money of January 1997) from taxes collected on petroleum products was intended to finance the development of alternative energy sources.

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<sup>15</sup> Does not include that part of Sole Tax that was meant to fund the rise in capital of Petrobras (see Table 1.4).

**Table 3.7:** Part of Taxes on the Composite Barrel Intended for Development of the Energy Sector. 1973–83. Per Cent.

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Petrobras' Share in Tax Revenue	4.2	6.9	11.2	7.1	3.4	7.7	1.7	1.2	1.3	1.9	1.6
Development of alternative energy	-	2.4	5.7	2.6	3.8	5.5	9.4	31.5	30.4	45.5	36.8
sources											
- Alinea (j)	-	2.4	2.9	1.5	1.2	1.6	1.3	0.5	-	-	-
- Alinea (l)	-	-	2.7	1.1	2.7	3.9	8.1	3.9	-	-	-
- Alinea (n)	-	-	-	-	-	-	-	11.7	-	-	-
- Alinea (D)	-	-	-	-	-	-	-	15.4	30.4	45.5	36.8

Source: CNP Directives and author's calculations.



## **4.REGULATED PRICES OF OIL PRODUCTS DISTRIBUTION AND INCOME TRANSFERS**

### **4.1 Introduction**

The state oil monopoly in Brazil is vertically integrated with some liberalisation since wholesaling and retailing of oil products are excluded from it. However, the scope of the private wholesaler's activities has been limited since bulk transportation (by water vessels and pipelines) was included in the monopoly and, as such, has been performed exclusively by Petrobras.

All oil product prices have been regulated, even those prices in the relatively competitive market of oil product distribution. The regulator has set either the absolute value or the caps of prices at which Petrobras, wholesalers and retailers may sell oil products. Furthermore, final prices of major oil products have been more or less regionally equalised throughout the country as a consequence of the policy, initially formulated in 1938, of reducing, as much as possible, oil products prices inter-regional differentials. So, consumers living in remote areas of the country and those living close to the refinery gates have paid more or less the same prices for the oil products they needed.

In this chapter we discuss the pricing of oil products distribution which has been based on a complicated system of refundings, compensations and cross-subsidisation involving the regulator, Petrobras, the distributors and the consumers of oil products and of automotive alcohol. This system was created by the government in order to support the regionally uniform price regime and started to be dismantled in the early 1990s when the government initiated the deregulation of oil products distribution prices.

### **4.2 The Distribution Network**

Petrobras has developed and run a system of integrated transportation as part of the distribution chain of petroleum products and automotive alcohol in Brazil. The pipeline and waterway transportation of crude, natural gas and petroleum products is carried out exclusively by

Petrobras, the sole concessionary company of the state oil monopoly. Road and rail transportation are however open to other distribution companies.

Part of the distribution system developed by Petrobras includes a tanker fleet, ocean terminals, and pipelines, as well as BR, a subsidiary engaged in the distribution of petroleum products, established in 1971. Petrobras's tanker fleet, the fifth largest in the world, consisted in 1995 of 74 ships which represented a deadweight capacity of 5.6 million tons: 53 crude and petroleum product carrying ships, six LPG, three chemical and twelve ore-oil vessels. The company has ten ocean terminals, some exclusively for the handling of crude; two terminals along the Amazon river and fifteen land-based terminals, of which five are alcohol collection centres. At these terminals Petrobras has 8.9 million m<sup>3</sup> of tankage (5.3 million for crude and the rest for products). Petrobras also makes use of six ocean, two lake and two river terminals owned by third parties.

Its crude and product pipeline network is in the process of being extended. In January 1995, 11 per cent of petroleum products throughout the country was carried by pipelines. Supply bases at which distribution companies have their tanks are spread around the country and consist of primary or secondary bases. Primary bases are either directly linked up to some home refinery by means of pipelines or lie along the huge Brazilian coast; they receive Petrobras products by means of pipelines or coastal transport. The secondary bases lie inland, far from any refinery or port, and products are carried thereto by road or rail by distribution companies. The distribution network for petroleum products in Brazil is made up of 22 primary and 44 secondary bases for light products. Most of them also handle dirty products (37) and LPG (46).

Distribution begins when products are transferred, either by pipeline or by tankers, from the refineries to the primary distribution bases. This initial stage has been carried out exclusively by Petrobras. The distribution companies start their work at the primary bases, from which they haul products by road to reselling outlets within nearby municipalities, or by road and rail to the secondary bases, from which the products are afterwards hauled to the reselling outlets. Sales of products have been carried out by just a few distributing companies, as shown in Table 4.1.

**Table 4.1:** Share of Distribution Companies in the Brazilian Market of Petroleum Products. Per Cent.

<i>Year</i>	<i>BR</i>	<i>Esso</i>	<i>Shell</i>	<i>Atlantic</i>	<i>Texaco</i>	<i>Ipiranga</i>	<i>Others</i>	<i>Five Majors' Share</i>	<i>Herfindahl Index</i>
1973	29.6	21.6	23.0	8.4	8.4	6.7	2.2	91.1	0.207
1974	32.6	19.0	22.9	8.3	8.2	6.8	2.2	91.0	0.214
1975	33.2	18.0	22.0	8.2	8.3	6.7	3.7	89.6	0.210
1976	34.0	17.7	21.9	8.1	8.2	6.8	3.2	89.9	0.214
1977	34.9	17.2	21.6	8.1	8.3	6.7	3.2	90.1	0.217
1978	35.2	16.7	21.1	8.1	8.4	6.7	3.8	89.6	0.216
1979	35.3	16.2	20.9	8.2	8.4	7.1	3.9	89.0	0.215
1980	35.7	16.2	20.8	8.1	8.4	7.4	3.6	89.1	0.217
1981	36.3	15.8	20.5	8.2	8.6	7.7	3.1	89.2	0.219
1982	35.9	15.5	20.4	8.4	8.8	8.0	3.1	88.9	0.216
1983	35.5	15.5	20.3	8.5	8.9	8.3	2.9	88.8	0.214
1984	35.9	15.0	19.9	8.8	9.0	8.5	3.0	88.5	0.215
1985	35.8	14.9	20.1	9.0	8.7	8.7	2.9	88.4	0.214
1986	37.2	14.2	19.7	9.0	8.4	8.6	2.9	88.7	0.221
1987	37.9	13.8	20.0	8.7	8.2	8.4	3.0	88.8	0.225
1988	38.3	12.2	20.7	8.4	8.4	8.4	3.6	88.1	0.227
1989	37.3	11.6	21.5	8.7	8.7	8.5	3.7	87.8	0.223
1990	36.4	11.6	21.2	9.0	9.0	8.8	4.1	87.1	0.216
1991	35.8	11.6	21.2	9.2	9.1	9.1	4.1	86.9	0.213
1992	36.4	11.3	21.0	8.5	9.4	9.2	4.3	87.2	0.215
1993	36.1	10.1	21.7	8.6	9.3	9.4	4.8	86.6	0.215
1994	35.9	9.4	21.7	8.1	9.7	9.0	6.2	85.7	0.213
1995	35.2	9.5	21.4		9.6	16.2	8.2	91.8	0.221
1996	34.3	9.2	20.8		9.9	16.2	9.6	90.5	0.215

Source: BR

The share of the five largest distribution companies in the overall domestic market for petroleum products – one of the indicators used to measure degree of sales concentration – varied in the 1973–96 period between 91.8 and 85.7 per cent, as shown in Table 4.1. This share has fallen little: from 91.1 per cent in 1973 to 90.5 in 1996. In 1994 the share was 85.7 per cent but it rose to 91.8 in 1995 when Atlantic left the country and sold its market share to Ipiranga.

The Herfindahl index (H), another indicator of the degree of sales concentration,<sup>1</sup> which takes

<sup>1</sup> The Herfindahl index is calculated as the sum of the squares of the market shares of each company. Theoretically it may vary between 0 for sales infinitely broken up, to 1 for sales highly concentrated in the hands of only one seller. The inverse of the Herfindahl index represents the number of hypothetical companies with identical market shares that would produce the same index value.

into account the share of each company but gives greater weight to those with larger shares, is also shown in Table 4.1. The inverse of the Herfindahl index represents the number (N) of hypothetical companies with identical market shares that would produce the same Herfindahl index of sales concentration. In the period 1973–96, N varied between 4.4 and 4.8 in the Brazilian oil product market, indicating that sales concentration did not change very much. In fact, in this period the Herfindahl index slightly increased (N fell from 4.8 to 4.7) due to an increase in BR's market share – which was the distribution company that sold the most products during the period examined.

### 4.3 The Regionally Equalised Price Regime

Up to 1977 the product prices at the supply bases were equalised while prices in each municipality were adjusted in terms of transport costs from their supply base. Thus consumers who lived close to refineries, concentrated in the southeast and south of the country, were in fact subsidising those who lived further away. The cost of transportation up to these bases, incurred by both Petrobras and distribution companies, were refunded by the regulating agent. These refunds were being made from funds raised from component parts of the price of products which were specifically meant to cover the average cost of transportation up to the distribution bases – this cost included the amortisation and remuneration of capital expenditure for the transportation system (pipelines, terminals, tanks, and so on).

From the end of 1978 up to 1991 product prices were equalised at all selling outlets in the whole country. The component parts of product prices meant to cover the average cost of transportation<sup>2</sup> now also included the average cost of transportation from bases to reselling outlets. In addition to transport costs, such component parts of the product prices could also cover the following: the cost of carrying, storing and marketing automotive alcohol and coal (alinea A); the coal subsidy (alinea A); the difference between the home price and c.i.f. import cost of petroleum products (alinea A and, later on, the FUP); the difference between the structural c.i.f. import cost of crude and its actual import cost (alinea h, later on, alinea A and, later on, the FUP – Freight for Price Equalisation); and part of the automotive alcohol subsidy (the FUP, after 1992).

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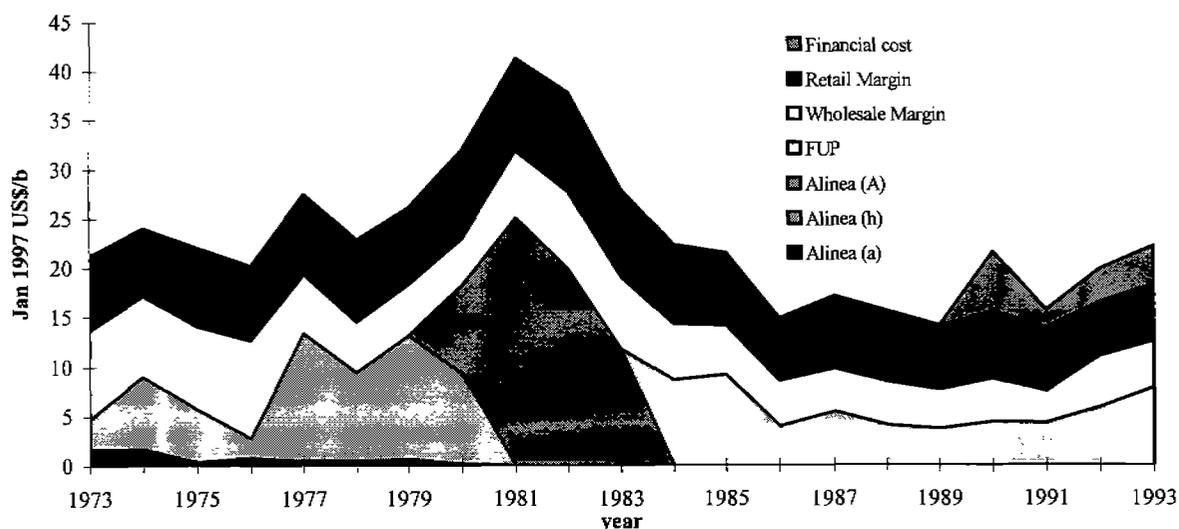
<sup>2</sup> Up to 1980 such parts included alíneas (a) and (h); from 1980 to 1984, alinea (A); and from 1984 onwards, the Freight for Price Equalisation (Frete para Unificação dos Preços FUP).

It should be noted that the FUP is a component part only of prices of automotive fuels and lubricants. Hence, since the FUP was created in December 1984 the consumers of such products have been paying for the transport costs of all petroleum products and not just for those they use.

On behalf of the regulator, Petrobras has administered the funds that enable the prices of products to be equalised. The alineas and, afterwards, the FUP, were part of the refinery billing prices and were collected by Petrobras. With the funds thus collected, Petrobras first refunded the distribution companies for the transport costs borne by them and passed on the parts thereof intended to subsidise alcohol. Then, what remained of those funds, if sufficient, was used to cover its own refundable costs. Any differences between the amount collected and the amount due to the various agents – distribution companies, alcohol plant owners, carriers and Petrobras itself – have been entered in the Oil Product Account (see Chapter 2), although it had been expected that there would be no difference.

#### 4.4 Trends in Distribution Components of Oil Product Prices

The component parts of the final price of the composite barrel (consumption-weighted average of final prices – AFP) intended to cover transport costs and gross distribution margins are shown in Figure 4.1.



**Figure 4.1:** Trends in Components of the Final Price of the Composite Barrel of Oil Products Intended to Cover Distribution Costs. 1973–93.

Parts of the AFP meant to cover transport costs (alinea (a),(h) and (A), and the FUP) varied substantially throughout the period mainly because they were also sources of funds for other purposes, as referred to above and in Chapter 2. Unfortunately the data available did not enable us to break down alinea (h) and (A) in terms of their purposes. The sharp rise under alinea (A) immediately after the 1979 oil crisis was due to the addition of parts for subsidising the hauling of coal and alcohol (in the 1978–81 period alcohol and coal production rose by 87 and 40 per cent respectively).

From January to November of 1984 the funds needed to cover costs of transporting oil products within the country were raised from the Tax Charged on Financial Transactions, that is, outside the petroleum products price structure. From 1984 onwards such funds were derived from the FUP, which became a part of the price components for gasoline, diesel and automotive lubricants. The FUP collected was mainly for the cost of transportation of all products supporting the regime of price equalisation. Thus, consumers of automotive fuels and lubricants were in fact subsidising consumers of other kinds of products, since they were paying for the cost of carrying the latter. Furthermore, the automotive fuel and lubricant consumers close to refineries were subsidising part of the cost of carrying such products to consumers in more distant places. The FUP collected could also cover:

- The difference between product import costs and ex-refinery regulated prices;
- The difference between the actual average import cost of crude and the structural oil import cost.

As from mid-1992 it has been the intention that a part of the revenue from FUP should complement the subsidies given to the Alcohol Programme, as set forth in regulations on the subject.<sup>3</sup>

#### **4.5 The FUP and Petrobras's Transport Costs**

The differences between total refundable costs and revenue collected under the FUP have been taken to the Oil Products Account. The balance at the end of each year in the 1984–95 period was shown in Figure 2.3. In Table 4.2, the credits of Petrobras as entered in the Product Account (i.e.

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<sup>3</sup> CNP resolution # 18/84 of 11 December 1994.

expenses refundable with FUP revenue) are shown for the period 1985–93.

**Table 4.2:** Expenses Refundable with FUP Revenue. 1985–93. January 1997 US\$ million.

	1985	1986	1987	1988	1989	1990	1991	1992	1993
Transport Costs									
- Distrib. Companies	943.4	1240.5	1326.3	1438.4	1336.4	1633.2	881.2	561.6	453.6
- Petrobras	281.7	227.9	174.7	167.5	108.0	73.3	73.3	243.3	321.3
Imp. Compensation	8.6	0.0	0.0	130.0	290.9	446.9	442.3	499.4	318.4
Alcohol Subsidy	0.0	0.0	0.0	0.0	0.0	0.0	0.0	455.2	647.5
Total	1233.7	1468.3	1501.0	1736.0	1735.3	2153.4	1396.8	1759.4	1740.7

Source: Petrobras

From 1985 to 1990 refundable transport costs of distribution companies rose from US\$943.4 million to US\$1.6 billion in January 1997 values, and represented between 76 and 88 per cent of overall expenses refundable with FUP funds. Refunds for road and rail transport costs were made according to freight rates drawn up and updated by the regulating agent. The repayable long distance road haulage freight rates were worked out in terms of a formula that considered the cost of the truck service and of storage.<sup>4</sup>

Rail freight rates were worked out as proportions (about 70 per cent) of alternative road rates.

From November 1991 onwards petroleum product prices began to be equalised only at the supply base stage. Transport costs from supply bases to municipalities were no longer refunded; only the

<sup>4</sup> where:

Cap = truck capacity

T = hours worked per day

Cv = variable costs

d<sub>0</sub> = average daily mileage

A = 0.8080

H = time loading/unloading

Cf = fixed costs

d = round trip distance

Sup = base supply cost per unit volume

M = 0.8580

$$Freight = \frac{1}{Cap} \left[ \frac{H}{T} \cdot Cf + Cv \cdot d + A \cdot Cf \cdot \left( \frac{d}{d_0} \right)^M \right] + Sup$$

cost of transportation from major bases to secondary bases was being refunded to the distribution companies. Consequently repayments to these fell substantially, down to US\$453.6 million in 1993, or 26 per cent of total refundable expenses (see Table 4.2).

The method of computing refundable costs to Petrobras by the regulator for the carriage of products from refineries to main bases (coastal, road, rail, lake and pipeline transport costs, harbour fees and losses) was quite different from that of refunds made to distribution companies. In 1985–91, at a time when inflation was very steep in Brazil (see Table 3.1), transport costs as entered in the Oil Products Account fell from US\$282 million to a mere US\$73 million, in constant prices of January 1997. Clearly the distribution companies were more skilled than Petrobras in securing adjustments.

Costs incurred by Petrobras by mode of transport, as entered in the Oil Products Account by the regulator for the 1985–93 period, are shown in Table 4.3.

**Table 4.3:** Refundable Transport Costs Incurred by Petrobras as Entered in the Oil Product Account. 1985–93. January 1997 US\$ million.

<i>Mode</i>	<i>1985</i>	<i>1986</i>	<i>1987</i>	<i>1988</i>	<i>1989</i>	<i>1990</i>	<i>1991</i>	<i>1992</i>	<i>1993</i>
Coastal	142.91	137.74	103.72	113.38	69.57	34.29	22.47	79.63	90.60
Pipelines	43.87	26.51	8.77	4.91	1.01	0.22	5.57	59.09	123.13
Others	95.03	63.52	62.22	49.29	37.41	38.80	45.26	104.55	107.58
Total	281.81	227.77	174.70	167.58	108.00	73.30	73.30	243.28	321.31

Source: Petrobras.

Pipeline and coastal transport costs were those incurred by Petrobras when using its own or chartered ships and its own pipelines. Book costs of coastal transport, which in 1985 represented 51 per cent of Petrobras's refundable and book transport costs, were basically a matter of the regulator setting two rates: one, in Cr\$ per ton mile, for the cost of ships at sea, and the other, in Cr\$ per ton, for the cost of ships while in port. The cost of pipeline transportation covered not only operational charges but also depreciation and remuneration of capital outlay made for the pipelines, where applicable.

Table 4.3 shows that for the period 1985–91 Petrobras coastal transportation costs entered in the Oil Products Account fell from US\$143 million to US\$23 million in 1991 (a drop of 84 per cent in real terms) although the coastal carriage of petroleum products by sea had not declined.<sup>5</sup> This fall in the amounts entered in the account took place because the monetary adjustment rates for coastal transport tariffs, set by the regulator for the period 1986–91, were lower than the extremely high inflation rates during this period. We estimate that the average freight tariff dropped from US\$4.03 per thousand ton miles in 1986 to US\$2.30 per thousand ton miles in 1989 and to a mere US\$0.52 per thousand ton miles in 1991.<sup>6</sup> In order to give an idea of how low the average tariff was in 1991, we present estimates in Table 4.4, based on Worldscale rates for 1991, of the cost per ton mile of transportation of petroleum products between some Brazilian ports. Obviously cost per ton mile is lower for long journeys than for short ones. The average distance travelled per ton of petroleum products carried coastwise by FRONAPE<sup>7</sup> (a department of Petrobras responsible for the tanker fleet) was 567 miles in 1991. The Paranaguá/Rio de Janeiro route (see Table 4.4) gives us an idea of the tariff based on the international standard for a travelled distance of 672 miles which is close to the average distance travelled by FRONAPE's vessels. The estimated transport cost for this route was US\$3.44 per thousand ton miles which was six times greater than the average tariff of US\$0.52 per thousand ton miles allowed by the regulator to cover Petrobras's average shipping costs.<sup>8</sup>

Pipeline transportation costs entered by the regulator, as shown in Table 4.3, fell steeply from 1985 to 1990 because tariff adjustments were below the extremely high inflation rates of that period.

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<sup>5</sup> FRONAPE coastal transport production figures (including crude) rose from 22 billion ton miles in 1985 to 27 billion ton miles in 1990.

<sup>6</sup> We estimated these average tariffs as the ratio of FRONAPE yearly revenue earned from coastal carriage and total yearly coastal transportation done (in ton miles) in the carriage of crude and oil products. Data provided in various editions of DETRAN's Monthly Activities Report.

<sup>7</sup> Average distance in miles was reckoned as the ratio of tanker fleet production (ton miles) to the load carried (tons). Figures taken from Fronape Statistics Bulletin (1991).

<sup>8</sup> Comparison of the average freight tariff, estimated from Petrobras's tanker fleet aggregated production with the ton/mile cost for one given route is a relatively limited comparison, since transportation cost by sea depends on many factors, such as deadweight capacity used, distance sailed, product carried, harbour charges, and so on. However, it at least serves to show how extremely low freight rates had become by 1991.

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**Table 4.4:** Estimated (Worldscale) Transport Costs between Various Brazilian Ports

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<i>Route</i>	<i>Distance (miles)</i>	<i>Cost (US\$/1,000 ton miles)</i>
Recife-Santos	2530	1.38
Recife- S. Sebastião	2416	1.47
Recife-Rio de Janeiro	2156	1.58
Salvador-São Sebastião	1758	1.75
Paranaguá-Rio de Janeiro	672	3.44
S. Sebastião- Rio de Janeiro	332	6.63

Source: Worldscale and author's calculations.

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From 1992 onwards there was a change in procedure for computing Petrobras's refundable transport costs and, as shown in Table 4.3, there was a rise in repayable amounts. In December 1991 a DNC directive<sup>9</sup> regulated not only the computation of refundable pipeline transport costs<sup>10</sup> but also determined that the adjustments of pipeline transport tariffs should take place at the same time as adjustments made to road haulage of fuel.

#### **4.6 Distribution Margins**

The gross margins of wholesalers and retailers are laid down by the regulator. Such margins cover overheads and include remuneration of capital outlay made by these concerns. The setting of distribution margins is based on information obtained from the major distribution companies operating in the country. Calculation of the retailers' gross margin is based on spot sampling of reselling outlets where sales volume is close to a standard volume.

Gross margins for wholesalers and for retailers on a composite barrel of petroleum products were shown in Figure 4.1 (in money of January 1997) for the period 1973–93. These margins dropped during this period as shown in Table 4.5.

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<sup>9</sup> DNC Directive 36 of 23 December 1991.

<sup>10</sup> Tariffs for pipeline transport would cover: direct and indirect operating and maintenance costs; capital amortisation over ten years; capital outlay remuneration (15 per cent p.a); and administration costs.

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**Table 4.5: Composite Barrel Average Distribution Margins. January 1997 US\$/b.**

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	1973–80	1980–89	1990–93
Wholesale	7.39	5.48	4.37
Retail	7.76	8.05	6.18

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Gross retail margins declined less over the whole period than wholesale margins (the standard deviation for retail and wholesale gross margins were US\$1.17 per barrel and US\$1.84 per barrel respectively, in constant money of January 1997). Average retail margins were always higher than wholesale margins.

#### **4.7 Conclusion**

The state oil monopoly and the presence of Petrobras, the only concessionary company executing this monopoly, made it easy for the government to implement the regime of oil products price equalisation. First, because the control of transport operations was easier since most of the ton miles involved in the transportation of oil products were produced by (the tankers and pipelines of) only one company, Petrobras, thus reducing the possibility of fraud. Second, because Petrobras also managed the refundings to the few distributors (five distributors have controlled between 86 and 92 per cent of the oil products domestic market) on behalf of the government as relevant price components were included in Petrobras's refineries billing price.

However, the eventual insufficiencies of the funds to cover the costs of the equalisation regime were borne by Petrobras. Part of its resulting deficit was due to income transferred to the government. It was relative to insufficiencies in regulated tariffs for monopolised transportation. Thus, in some years, the balances of the Petroleum Product Account were figures with no relation to reality since they were computed based on under-estimated sea and pipeline transport costs. Insufficient tariffs prejudiced, for instance, the growth of Petrobras's pipeline network and thus the efficiency of the distribution system of the country. The second part of the deficit was financed by Petrobras since it was recorded in the Petroleum Products Account and could be recovered later on.

The regime of price equalisation throughout the country is, on the one hand, a socially fair

regime, for it helps towards the economic development of regions far away from producing centres. On the other hand, it poses some problems which in the end push up distribution costs borne by the consumer: transportation never really carried out could be fraudulently charged for; caps for some refundable transport costs were over-estimated by the regulator; distribution companies were not encouraged to be more efficient nor to engage in further capital expenditure which might bring down their distribution costs since such costs would be refunded anyway.

The state oil monopoly and the presence of Petrobras also enabled the government to develop two cross-subsidisations. First, the cross-subsidisation of transport costs between consumers of oil products. Second, since 1992, consumers of gasoline and diesel also supplemented, through a mark-up in the transport component of oil product prices, part of the funds to cover the costs of the subsidy to the National Alcohol Programme. In 1992–93 this supplement was equivalent to US\$1.1 billion (in constant prices of January 1977). It was Petrobras who intermediated all the transfers of income involved in both cross-subsidisations.

## **5. CROSS-SUBSIDISATION OF PETROLEUM PRODUCTS AND AUTOMOTIVE ALCOHOL**

### **5.1 Introduction**

After the first oil crisis, petroleum product pricing policy in Brazil showed greater concern for the social and economic objectives. On the one hand, LPG was offered at a relatively cheaper price in order to keep cooking costs low for poor people; the government granted subsidies for naphtha in its wish to foster the petrochemical industry; the price of diesel was held low compared with that of gasoline in order to favour mass transport and so that the cost of road haulage might remain low (road haulage in Brazil by diesel trucks is predominant over other modes of transportation); prices of fuel oil were also kept relatively low to help local industry. On the other hand, the price of gasoline was set at high levels compared with those of other products. Thus, the burden of world oil price increases was borne mostly by private car owners from social groups with middle and high incomes. The raising of the domestic price of gasoline was first of all a means to provide funds for the subsidisation of other petroleum products. Secondly, it helped the Brazilian government to support its policy of replacing gasoline by alcohol as an automotive fuel.

In the period 1977–93 the domestic prices of petroleum products did not keep up with international prices, but were nonetheless linked to world oil prices through the oil import cost included in the regulated domestic price.

The analysis of the subsidisation of oil products can be done in two stages. The first stage focuses on the trends in average price of these products in order to assess the transfer of income between Petrobras, the government and consumers. This has already been done in Chapters 3 and 4. The second stage deals with the prices of each product individually in order to assess the transfer of income between consumers of different products. This is undertaken in the present Chapter.

## 5.2 Cross-subsidisation and Rent from Petroleum Products

Transfers of income between consumers of different products can take place even if the taxed average ex-refinery price (TARP) is set equal to the average import cost (AIC) because relatively highly priced products may generate funds used to subsidise other products. The taxed ex-refinery prices of LPG, fuel oil, petrochemical naphtha and jet fuel were, for a long time, lower than their respective opportunity costs, as shown in Figures 5.1 to 5.6.

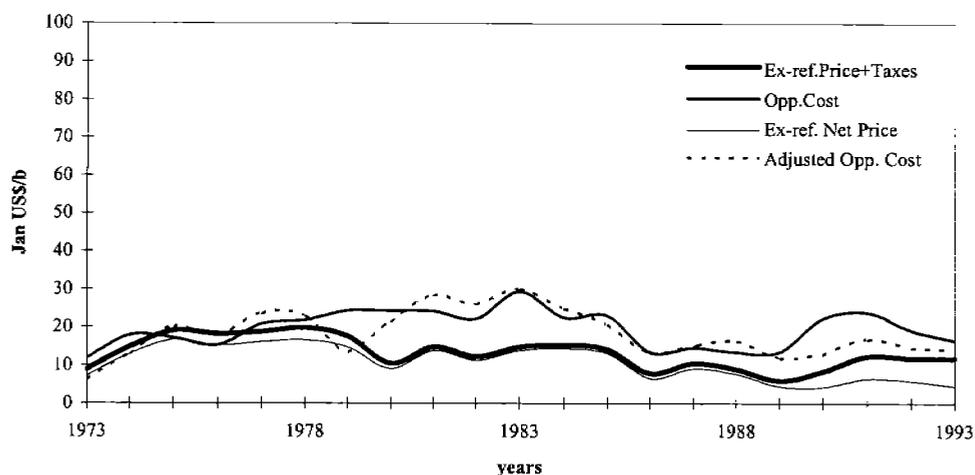


Figure 5.1: LPG Trends in Ex-refinery Prices and in Opportunity Costs

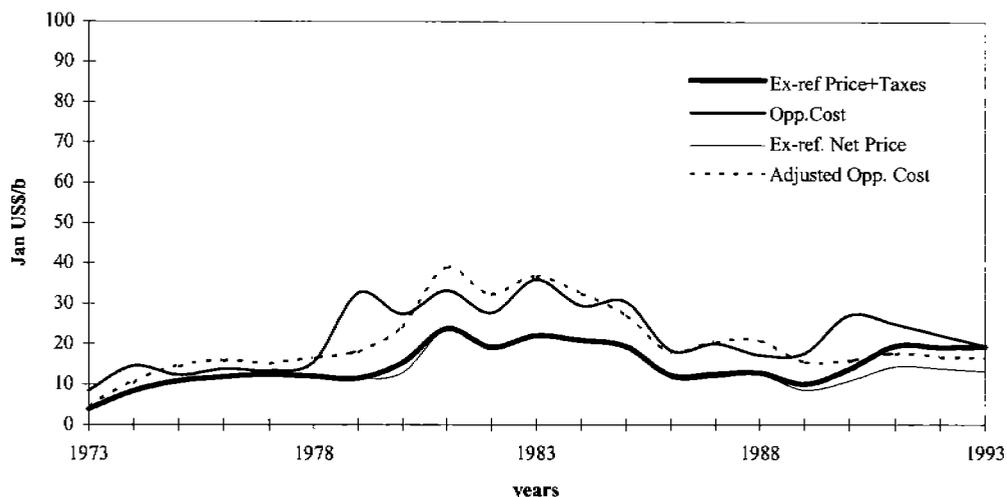


Figure 5.2: Naphtha Trends in Ex-refinery Prices and in Opportunity Costs

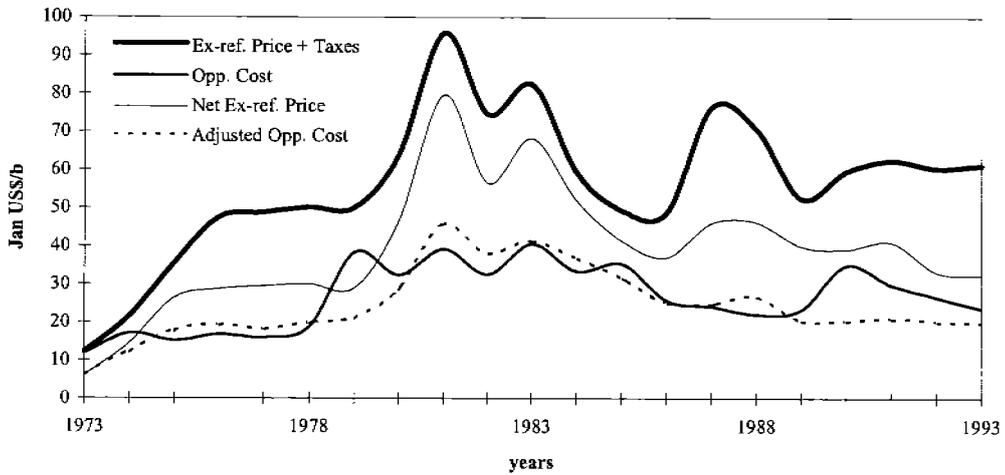


Figure 5.3: Gasoline Trends in Ex-refinery Prices and in Opportunity Costs

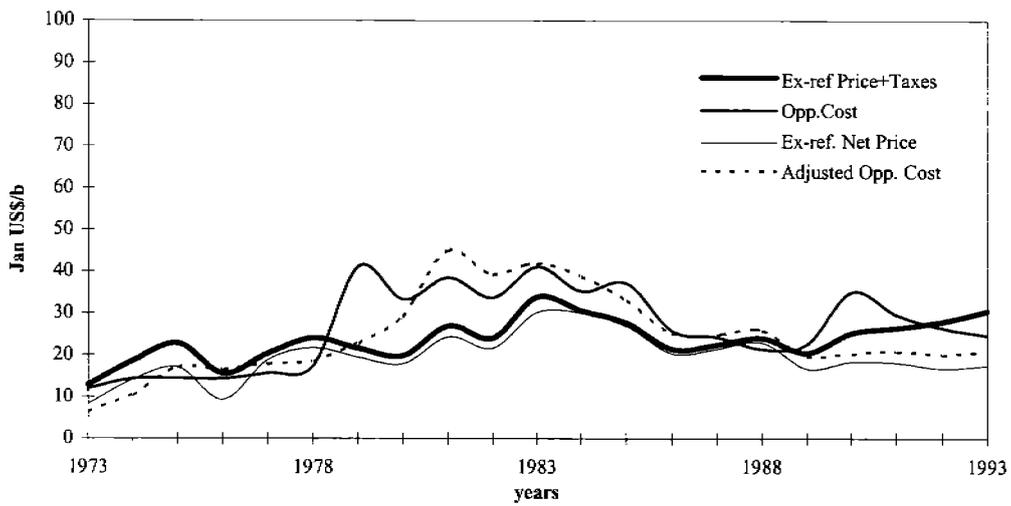


Figure 5.4: Jet Fuel Ex-refinery Prices and Opportunity Costs

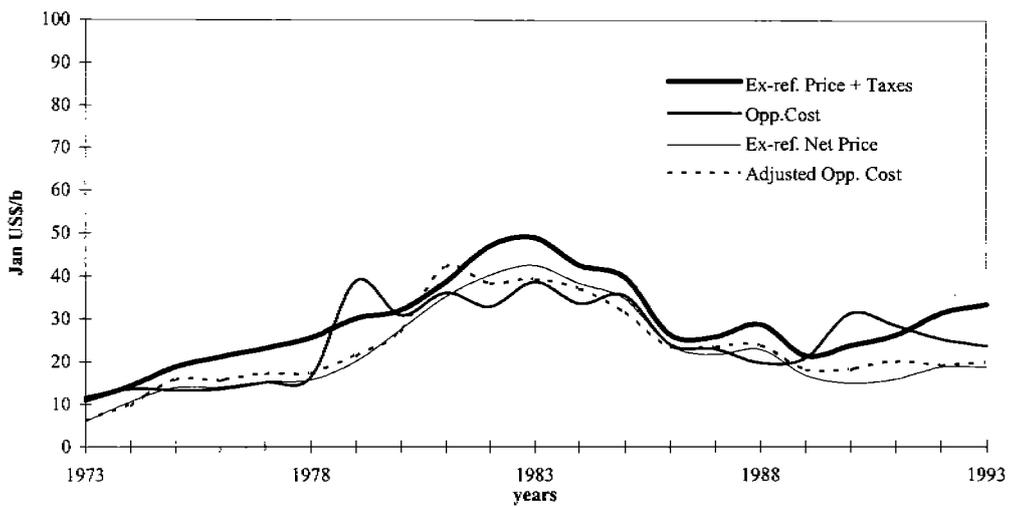
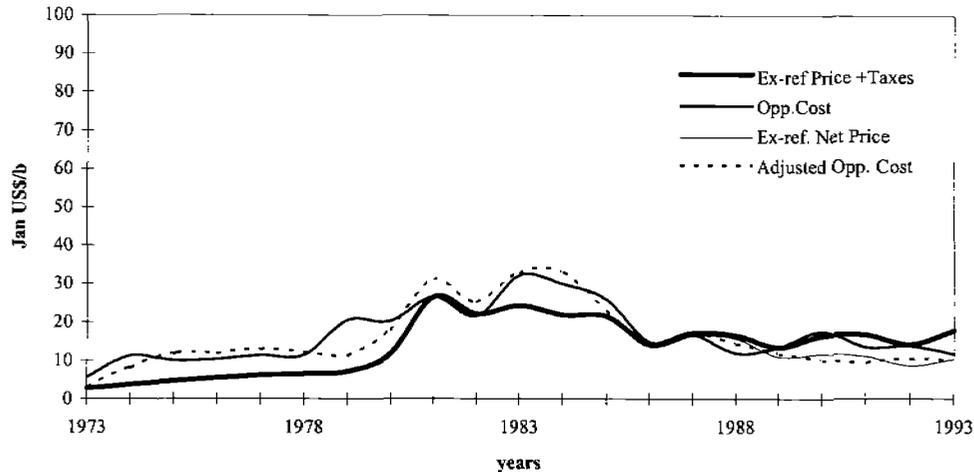


Figure 5.5: Diesel Ex-refinery Prices and Opportunity Costs.



**Figure 5.6:** Fuel Oil Ex-refinery Prices and Opportunity Costs.

Therefore in order to keep refining profitable, funds had to be transferred to the refineries to offset the relatively low revenue derived from the sale of these products. These funds were not drawn from tax revenue of the government but were instead generated by the refineries themselves from the sale of other products whose ex-refinery net prices were fixed at higher levels. In short, the cross-subsidisation of oil products took place exclusively at the refinery gate.

That part of the ex-refinery price (taxed) of certain products (principally gasoline) which exceeds opportunity cost, namely, the *rent* on such products, is split between the government and Petrobras – the government part is added to its tax revenue and the Petrobras part is intended to finance the subsidisation of other products. Rent from the composite barrel of products and the shares of each product in it are shown in Table 5.1. The share of each product depends on both the price distortion and its share in overall demand.

The rent from the composite barrel was negative in the years when average ex-refinery taxed price was lower than the import parity. Negative rents represented losses for Petrobras alone because the government continued to collect taxes in all situations.

**Table 5.1: Product Shares in the Rent of a Composite Barrel**

	US\$/Composite Barrel								Comp. barrel Rent	Demand (1,000 m <sup>3</sup> )	Total Rent (US\$ billion)
	LPG	NP(p)	NP(g)	GS	DS	KS	JF	F.Oil			
1973	(0.21)	(0.16)	(0.02)	0.10	(0.18)	(0.02)	0.02	(0.82)	(1.28)	41,259	-0.33
1974	(0.22)	(0.23)	(0.04)	1.42	0.18	0.04	0.14	(2.10)	(0.82)	44,578	-0.23
1975	0.13	(0.05)	(0.01)	6.26	1.37	0.08	0.27	(1.46)	6.59	47,199	1.96
1976	0.20	(0.07)	(0.01)	8.75	2.02	0.10	0.04	(1.40)	9.63	51,454	3.12
1977	(0.15)	(0.04)	0.00	8.55	2.27	0.11	0.16	(1.49)	9.40	52,050	3.08
1978	(0.14)	(0.18)	(0.02)	7.70	2.65	0.12	0.21	(1.43)	8.90	56,371	3.16
1979	(0.53)	(1.19)	(0.13)	2.68	(2.58)	(0.11)	(0.68)	(3.80)	(6.34)	59,488	-2.37
1980	(1.18)	(0.74)	(0.11)	6.23	0.37	0.07	(0.47)	(2.37)	1.80	58,214	0.66
1981	(0.89)	(0.69)	(0.16)	11.37	0.87	0.03	(0.48)	(0.00)	10.04	55,121	3.48
1982	(1.06)	(0.71)	(0.14)	7.99	4.81	(0.00)	(0.41)	0.14	10.62	55,092	3.68
1983	(1.72)	(1.60)	(0.13)	7.08	3.67	0.08	(0.32)	(1.44)	5.61	51,961	1.83
1984	(0.88)	(1.07)	(0.08)	4.09	3.38	0.10	(0.19)	(1.33)	4.02	50,266	1.27
1985	(1.11)	(1.52)	(0.09)	2.04	1.62	0.04	(0.38)	(0.69)	(0.09)	52,992	-0.03
1986	(0.69)	(0.76)	(0.04)	3.44	0.87	0.02	(0.18)	(0.07)	2.59	58,443	0.95
1987	(0.53)	(0.97)	(0.04)	6.65	1.10	0.04	(0.07)	0.06	6.25	59,896	2.35
1988	(0.62)	(0.55)	(0.03)	5.89	3.63	0.09	0.10	0.74	9.24	60,795	3.53
1989	(1.06)	(0.99)	(0.04)	3.88	0.21	0.04	(0.08)	0.01	1.99	62,733	0.79
1990	(2.02)	(1.73)	(0.05)	3.69	(2.93)	0.03	(0.35)	(0.16)	(3.52)	63,428	-1.41
1991	(1.63)	(0.65)	(0.03)	5.20	(0.92)	0.05	(0.12)	0.45	2.33	64,594	0.95
1992	(1.07)	(0.37)	(0.01)	5.18	2.39	0.04	0.05	0.06	6.27	66,676	2.63
1993	(0.67)	(0.02)	(0.01)	5.83	3.79	0.11	0.20	0.89	10.12	69,362	4.42

Abbreviations: LPG = Liquefied Petroleum Gas; NP<sub>(p)</sub> = naptha, petrochemical feedstock; NP<sub>(g)</sub> = naptha, gas works; GS = gasoline; DS = automotive diesel oil; KS = lighting kerosene; JF = jet fuel; F. Oil = fuel oil

### 5.3 Net Ex-Refinery Prices: Sources of Funds for Cross-subsidisation Purposes

The transfer of income involved in cross-subsidisation always took place at the level of ex-refinery net price and never involved tax revenue. Thus our analysis only considers ex-refinery prices and corresponding opportunity costs. As an aid to the analysis let us consider a hypothetical situation in which there is no cross-subsidisation among oil products: relative domestic ex-refinery prices are equal to relative import costs. The average ex-refinery net prices and the levels of oil product demand are the same in both actual and hypothetical situations. We shall refer to domestic ex-refinery prices in the hypothetical situation as ex-refinery prices adjusted to opportunity costs or simply adjusted ex-refinery prices.

Let  $A_i$  and  $I_i$  be the adjusted ex-refinery price and the c.i.f. import cost for product  $i$  respectively.

Then:

$$\frac{I_i}{I_j} = \frac{A_i}{A_j}, \text{ for all } i \text{ and } j \Rightarrow \frac{A_i}{I_i} = \frac{A_j}{I_j} = \text{const.}, \text{ for all } i \text{ and } j$$

Also let  $s_i$  be the share of product  $i$  in the overall petroleum product demand and let  $ARP$  and  $AIC$  respectively be average ex-refinery net price and average c.i.f. import cost of products. When  $ARP = AIC$  then  $A_i$  is equal to the opportunity supply cost of product  $i$ . When  $ARP \neq AIC$  one can regard  $A_i$  as the normalised opportunity cost relative to the average home ex-refinery price. If  $RP_i$  is the ex-refinery price of product  $i$ , one can also write:

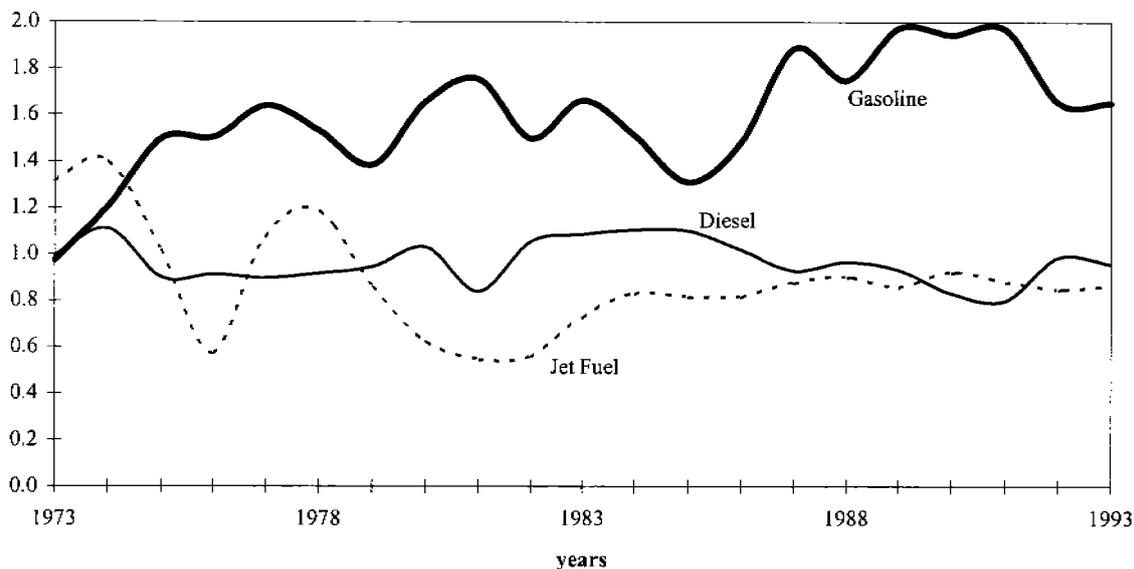
$$ARP = \sum_i RP_i \cdot s_i = \sum_i A_i \cdot s_i \quad \Rightarrow \quad \sum_i SUBSD_i \cdot s_i = 0$$

where:  $SUBSD_i = A_i - RP_i$

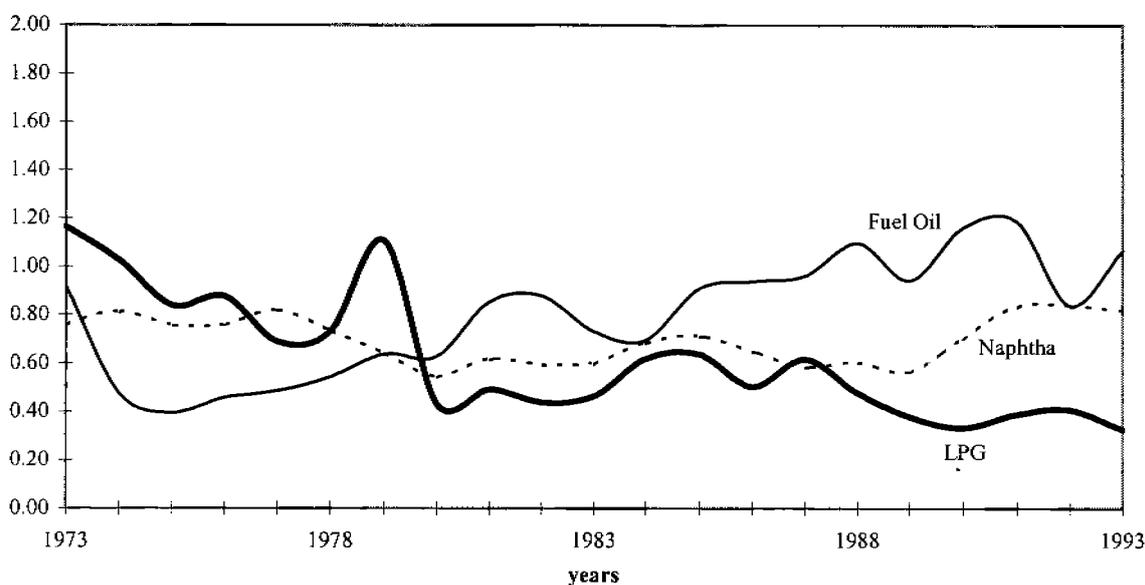
$SUBSD_i$  is the contribution (positive or negative) of the consumers of product  $i$  towards the cost of cross-subsidisation among oil products. If domestic and international *relative* prices are equal,  $SUBSD_i = 0$ , even if  $ARP \neq AIC$ . The revenue from the sale of products with  $SUBSD_i < 0$  leads to a surplus intended to cover any lack of revenue from products with  $SUBSD_i > 0$ , so that the sum of positive and negative subsidies cancel themselves out.

Figures 5.1 to 5.6 show the trends of ex-refinery net prices and adjusted opportunity costs for the major products. In order to make it easier to compare them, the trends in the ratio for each product are shown in Figures 5.7 and 5.8.

We see from Figure 5.7 that, save for 1973, the negative subsidy for gasoline was the largest. Between 1973 and 1993 the ex-refinery price of gasoline was, on average, 60 per cent greater than its adjusted opportunity cost. For the same period ex-refinery prices of LPG, petrochemical naphtha and fuel oil were, on an average basis, equivalent to respectively 62 per cent, 70 per cent and 80 per cent of adjusted opportunity costs. The ex-refinery diesel price was close to its adjusted opportunity cost: it was equivalent, on average, to 97 per cent of the adjusted opportunity cost.



**Figure 5.7:** Opportunity Cost of Gasoline, Diesel and Jet Fuel



**Figure 5.8:** Trends in the Ratios Between Ex-refinery Price and Adjusted Opportunity Cost of LPG, Fuel Oil and Naphtha.

Table 5.2 shows the shares, positive and negative, of sales of each product in the generation of funds transferred under cross-subsidisation.

Table 5.2 shows that, except in 1973, most of the revenue transferred by cross-subsidisation was by gasoline sales. For the 1973–93 period total revenue transferred among consumers every year as shown in Table 5.2 represented, on an average basis, 7.5 per cent of gasoline ex-refinery net price

**Table 5.2:** Share of Sales of Each Oil Product in Revenue Transferred through Cross-subsidisation

	<i>( per cent)</i>								<i>Total Transf.</i>
	<i>LPG</i>	<i>NP(p)</i>	<i>NP(g)</i>	<i>GS</i>	<i>DS</i>	<i>KS</i>	<i>JF</i>	<i>F.Oil</i>	<i>US\$/Comp. b.</i>
1973	43.6	(22.9)	1.7	(33.3)	(3.5)	20.0	34.6	(40.3)	0.16
1974	1.8	(5.7)	(1.1)	63.2	20.3	4.6	10.1	(93.2)	1.26
1975	(8.2)	(4.6)	(0.9)	99.5	(14.4)	0.1	0.4	(71.9)	2.72
1976	(5.4)	(5.4)	(0.9)	99.9	(13.2)	0.1	(8.5)	(66.6)	2.75
1977	(17.3)	(3.7)	(0.4)	97.9	(16.4)	0.8	1.3	(62.2)	3.05
1978	(16.8)	(8.0)	(1.0)	94.4	(14.9)	1.7	4.0	(59.2)	2.71
1979	5.5	(18.0)	(1.7)	90.8	(17.0)	3.7	(5.3)	(58.0)	2.02
1980	(25.6)	(16.9)	(2.3)	91.3	6.4	2.4	(9.5)	(45.8)	4.01
1981	(19.8)	(15.9)	(3.0)	100.0	(32.7)	(0.8)	(12.3)	(15.5)	6.84
1982	(35.9)	(25.6)	(4.2)	83.5	16.5	(1.9)	(17.2)	(15.3)	4.28
1983	(32.4)	(29.0)	(2.3)	78.7	20.5	0.8	(8.8)	(27.5)	5.83
1984	(25.6)	(29.2)	(2.0)	65.9	32.6	1.5	(6.1)	(37.2)	4.19
1985	(34.6)	(40.9)	(2.9)	53.0	45.0	2.0	(9.3)	(12.2)	2.69
1986	(40.5)	(39.9)	(2.3)	91.2	8.3	0.5	(9.6)	(7.7)	1.96
1987	(26.7)	(39.6)	(1.6)	99.2	(23.6)	0.8	(4.5)	(3.9)	2.77
1988	(43.2)	(39.4)	(1.9)	90.1	(11.8)	1.5	(3.7)	8.5	2.68
1989	(38.7)	(33.2)	(1.2)	99.1	(18.9)	0.9	(4.2)	(3.8)	2.64
1990	(39.8)	(19.8)	(0.6)	91.2	(37.9)	1.4	(1.9)	7.4	3.12
1991	(41.4)	(10.1)	(0.7)	92.2	(45.2)	0.9	(2.7)	6.9	3.48
1992	(60.8)	(16.6)	(0.5)	98.4	(5.0)	1.6	(5.2)	(11.7)	2.04
1993	(61.3)	(17.8)	(0.5)	93.2	(15.6)	2.3	(4.8)	4.4	2.12

Abbreviations: LPG = Liquefied Petroleum Gas; NP<sub>(p)</sub> = naphtha, petrochemical feedstock; NP<sub>(g)</sub> = naphtha, gas works; GS = gasoline; DS = automotive diesel oil; KS = lighting kerosene; JF = jet fuel; F. Oil = fuel oil

Until to 1980, fuel oil consumers – who are largely from the industry sector – benefited most from cross-subsidisation. In 1980 total revenue transferred between consumers of products almost doubled and remained high until 1984. In the years 1980–84 the cross-subsidisation of fuel oil fell noticeably while that for LPG and petrochemical naphtha rose. During this time diesel oil began to be a subsidiser. Increases in the domestic prices of gasoline, diesel oil and fuel oil reflected the government's objective of bringing down crude oil consumption in Brazil after the second oil crisis. Gasoline and fuel oil were the products mostly aimed at by the fuel substitution policy: part of the gasoline consumption was taken over by alcohol, part of the fuel oil consumption was taken over by electricity, biomass (charcoal, firewood and sugar-cane bagasse) and by coal, the transport cost of which was subsidised.

After the decline of world crude prices in 1985, total funds transferred between consumers of

petroleum products also fell (see Table 5.2). After 1985 cross-subsidisation favoured LPG, naphtha and diesel oil consumers mainly, the latter as from 1987. Fuel oil subsidisation continued to decline and by 1988 it had become negative.

#### 5.4 Cross-subsidisation of Transport Costs of Petroleum Products

Although the price equalisation of petroleum products in Brazil is a factor that has been included in oil product pricing policy ever since 1938,<sup>1</sup> it was only fully applied between 1978 and 1991. At the end of 1991 the first steps towards deregulating the oil business were taken. Gasoline and diesel oil prices were equalised at secondary supply bases while lighting kerosene prices were fixed only at the refinery gate.

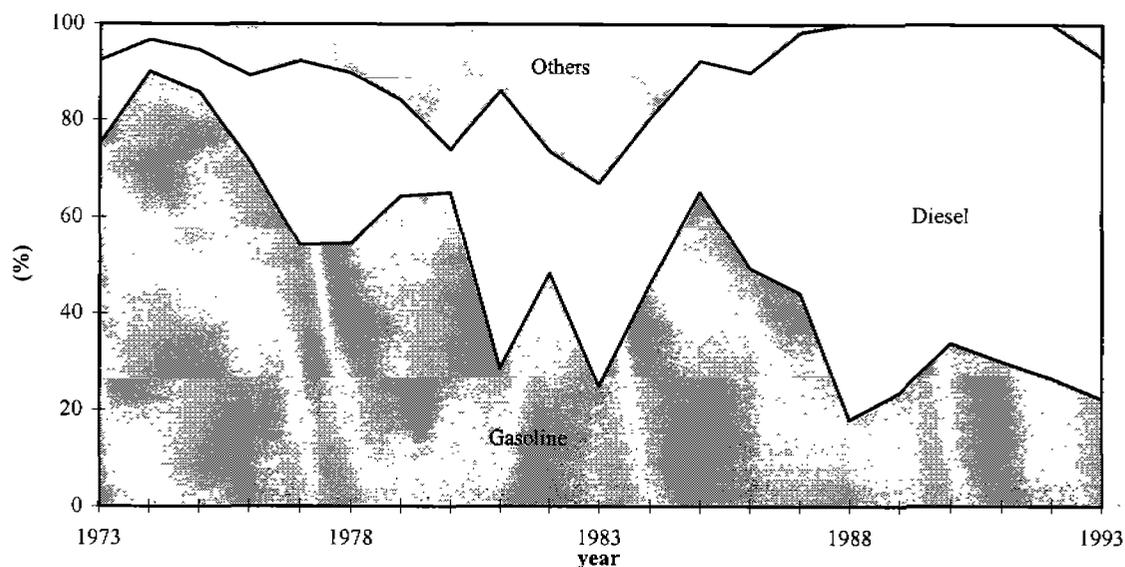
As was stated in section 4.3 the transport costs ( $TC$ ) of all products (volume  $V = \sum V_i$ ) up to the supply points where prices are equalised were covered through the collection of a component ( $F_i$ ) included in the price of the various products. The proceeds were used to refund the distribution companies and Petrobras for the relevant products transport costs.

It was expected that transport costs would be covered by collecting  $F_i$ , that is,  $TC = \sum F_i V_i$ . In terms of the composite barrel, the average transportation cost ( $\langle C \rangle = TC/V$ ) would be covered by  $\langle F \rangle = (\sum F_i V_i)/V$ . In other words, the average transportation cost of products was apportioned between them. However, the apportionment was done in ways that  $F_i$  did not reflect the actual average transport cost of product  $i$ . Throughout the period examined the  $F_i$  of gasoline and diesel oil prices covered most of the transport costs of all oil products. Figure 5.9 shows the share of gasoline and diesel oil in funds meant to cover transport costs.

Although the share of automotive fuels in the overall demand for petroleum products was not greater than 57 per cent, these two fuels provided, on an average basis, 91 per cent of the funds for the price equalising process in the 1973–93 period.

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<sup>1</sup> Decree-Law 538 of 7 July 1938, under which the National Petroleum Council (CNP) was organised, laid down one of the tasks of this regulating agent, which was to cap petroleum product prices, 'wherever possible with a view to the uniformity thereof throughout the territory of the Republic'.



**Figure 5.9:** Trends in the Raising of Funds Intended to Cover Transport Costs of All Oil Products

The price equalisation regime for products led automotive fuel and lubricant consumers to subsidise the transport costs of other petroleum products, and automotive fuel and lubricant consumers close to refineries to subsidise the transport cost of these products to consumers in distant locations.

### 5.5 The National Alcohol Programme and Cross-subsidies

Gasoline pricing in Brazil has been conditioned strongly by the development of a domestic market for automotive alcohol. The first oil crisis led the government to introduce the National Alcohol Programme (NAP) in 1975<sup>2</sup> acting upon suggestions of the Economic Development Council which clearly expressed what the goals of such a programme were to be. These were to save foreign exchange through crude oil import substitution; to expand the production of capital goods for distilleries; to reduce regional income disparities, since sugar-cane, the raw material needed, could be provided in most parts of the country; to reduce income disparities between individuals, since job opportunities would arise in the agricultural sector given that sugar-cane production is a labour-intensive activity.

<sup>2</sup> Decree 76,593 of 14 November 1975.

In the first stage of the NAP, which began in 1975, absolute (anhydrous) alcohol was mixed with gasoline. A production goal of 2.5 million m<sup>3</sup> was set for 1979, four times as high as the output in 1975. The country-wide proportion of alcohol put into gasoline rose from 1 per cent in 1976 to 14 per cent in 1979.

The second stage of this programme was embarked upon in 1979, induced by the disequilibrium of the balance of payments caused by both the rise in world interest rates which increased the service of the country's foreign debt and the rise in world oil prices. In this second stage a further objective was to make and sell cars fuelled by pure hydrated alcohol. The government set an alcohol production target of 10.7 million m<sup>3</sup> for 1985.

Several incentives were provided towards the development of the NAP, among which we emphasise the following:

- *Industrial Sector Financing.* Initially all capital expenditures could be financed by the government. From 1976 to 1978 the interest rate for such financing was only 17 per cent p.a (and 15 per cent p.a . in the less developed parts of the country) while the inflation rate stood at 40 per cent per year; from 1979 to 1980 the interest rate was set at 40 per cent of the inflation rate plus 5 per cent; in 1981 up to 90 per cent of capital expenditure could be financed at an annual rate of interest set at 70 per cent of the inflation rate plus 5 per cent, with a cap of between 45 per cent and 55 per cent p.a .; in 1985 the official credit terms stood close to market terms with real rates of interest at about 5 per cent p.a . (Serra and Moreira 1985). In short, up to 1985 capital expenditures for industrial alcohol production were being subsidised since real rates of interest were negative.
- *Agricultural Sector Financing.* Financing terms here were also very favourable. Capital expenditure could be financed at an annual rate of interest of only 7 per cent. Terms gradually became more severe until the real interest rate was set at 5 per cent p.a . in 1985.
- *Fiscal Incentives.* Both the Federal Sales Tax and annual licensing fees for alcohol-fuelled cars were set at lower rates than for gasoline-fuelled ones. Furthermore, the government in 1982 and 1983 abolished all charges for alcohol-fuelled cars used as licensed taxicabs.

The production goal set for the first stage of the programme was easily achieved: alcohol output in 1979 was 2.9 million m<sup>3</sup>. In order to encourage consumers to buy cars fuelled with pure hydrated alcohol the government, in the second stage of the NAP, not only continued to offer fiscal incentives to buy and license such cars, but also capped hydrated alcohol final price at 65 per cent of the gasoline final price. Then, even though the calorific value of alcohol is equivalent to 59 per cent of that of gasoline, alcohol-driven motors use up about 23 per cent more fuel than gasoline-fuelled ones.<sup>3</sup> Initially, consumers who had chosen to buy alcohol-driven cars spent 20 per cent less on fuel. In 1982 the alcohol/gasoline price ratio cap was put at 59 per cent; in June 1984 it was raised to 65 per cent; in May 1988 it went up to 69 per cent; and in January of 1989 it was set at 75 per cent. Ever since the beginning of the second stage of NAP and up to the end of the period examined in this study the fuel cost for owners of alcohol-fuelled cars was lower than for gasoline-fuelled cars. In the first half of the 1980s the Alcohol Programme was well received by consumers and by producers, who outstripped the alcohol production target for 1985 with an output of 11.6 million m<sup>3</sup> for the year.

Alcohol production costs declined after the commencement of the NAP because distilleries became more efficient and sugar-cane yields grew. Sugar-cane was grown in various climatically different parts of the country. Consequently there were sharp differences between yields in one area and another, as shown in Table 5.3.

Table 5.3 also shows that between the harvests of 1977–78 and 1985–86 there were, on a nationwide basis, 16 per cent and 23 per cent rises in the agricultural and industrial yields of alcohol respectively.

Estimates of alcohol costs of production depend largely on the yield figures employed. In 1987 the National Energy Committee (Comissão Nacional de Energia) estimated, on the strength of a country-wide average agricultural yield of 68.25 tons per harvested hectare<sup>4</sup> and an industrial

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<sup>3</sup>The low calorific value of alcohol (6,650 kcal/kg) as compared with that of gasoline (11,220 kcal/kg) is partially offset, as regards engine efficiency, by its anti-knocking power (octane number) which enables alcohol-fuelled engines to work at greater compression rates.

<sup>4</sup> Not all of the sugar-cane planted out is harvested at once; Table 5.3 shows the agricultural yield for all of the area planted out.

yield of 68.6 litres of alcohol per ton, that the average cost of production in the country was US\$42 per barrel (CNE 1987). Another study estimated that the cost of production of alcohol had dropped from US\$75 per barrel to US\$45 per barrel from the start of the NAP up to 1993 (Borges 1994).

**Table 5.3:** Industrial and Agricultural Alcohol Production Yields

	1977-78		1985-86	
	Agric. (t/ha)*	Indust. (l/t)**	Agric. (t/ha)	Indust. (l/t)
Northeast	44.4	50.6	47.0	63.7
Centre-west	28.5	53.7	46.7	69.5
Southeast	48.4	61.6	57.3	73.8
South	38.5	55.1	63.0	69.3
Brazil	46.4	57.4	53.9	70.7

\* Tens per hectare

\*\* Litres per hectare

Source: Comissão Nacional de Energia

The setting of alcohol prices paid to producers was based on the price of refined sugar sold on the home market. A parity factor of the prices of alcohol with sugar was officially established, having been intended initially to remunerate equally the use of sugar-cane for the production of alcohol and of sugar. So, alcohol pricing regulations implicitly assumed that the cost of producing alcohol and sugar were the same and this provided a further incentive to the sugar producer in the first stage of the NAP to set up an alcohol distillery next to his sugar mill.

Initially the parity factor was set so that 37.67 litres of alcohol were considered equivalent to 50 kg of sugar, which presupposed that alcohol would be produced by a highly efficient distillery. Later on this parity factor was reduced to 35 litres per 50 kg bag and then again to 31.67 litres. Since industrial yields had risen (see Table 5.3) the trends in the parity factor suggest that there had been a drop in the price of sugar-cane for alcohol producers compared to sugar producers.

Changes in the consumer price and the ex-distillery price of automotive alcohol in Brazil were driven by different factors: the first was indexed to the price of gasoline and the second was indexed to the price of sugar. The second stage of the NAP began when the price of crude oil

underwent a steep increase which led to a rise in the domestic price of gasoline. The success of the programme depended on holding the home price of gasoline sufficiently high to render consumer prices of hydrated alcohol less incompatible with its ex-distillery price. In June 1979 the ex-distillery price of hydrated alcohol was still 11 per cent higher than its consumer price; in 1980 the domestic price of gasoline and therefore of hydrated alcohol rose substantially (see Figure 5.3), so much so that by June of that year the ex-distillery price of hydrated alcohol had already become equivalent to 82 per cent of the consumer price; in 1981 the consumer prices of gasoline and hydrated alcohol continued to grow so that, by June of that year, the ex-distillery price to consumer price ratio had become 72 per cent (Serra and Moreira 1985).

As has already been explained in Chapters 2 and 4 part of the costs of transporting and storing alcohol were being covered under alinea (A) – a component part of the price of petroleum products and automotive alcohol. This means that up to that year the NAP was being subsidised by petroleum product consumers.

We go on to describe the price structure of the two types of alcohol, as from 1985, with the help of the 31 December 1992 price structure, shown as an example in Table 5.4.

**Table 5.4:** Price Structure of Gasoline and Anhydrous and Hydrated Alcohol on 31 December 1992. US\$ per barrel.

	<i>Gasoline</i>	<i>Anhydrous</i>	<i>Hydrated</i>
Ex-refinery price net of VAT	44.92	-	-
Average ex-distillery price, net of VAT	-	40.11	37.20
Transport cost adjustments (mills to mixing centres)	-	0.19	-
FUPA	-	4.62	-
Price billed to distribution companies	44.92	44.92	37.20
Freight mill-supply base	-	-	1.85
Distribution margin	6.88	6.88	6.70
Taxes, contributions, financial cost	26.25	26.25	19.38
FUPA	-	-	(4.90)
Consumer Price	78.04	78.04	60.23

Source: Petrobras

The anhydrous alcohol is bought by Petrobras and resold to distributors at the same billing price

as that of gasoline, as shown in Table 5.4. This table shows that the price of anhydrous alcohol billed to distributors at the mixing centres is US\$4.62 per barrel dearer than its ex-distillery price adjusted for transport costs. The positive difference between these two prices corresponds to an item known as Freight for Alcohol Price Equalisation (Frete de Uniformização de Preços de Alcool – FUPA). This component of the prices of anhydrous and hydrated alcohol was introduced in 1984 by the regulator<sup>5</sup> for the following purposes:

- To help to cover the subsidies (positive or negative) for anhydrous and hydrated alcohol;
- To cover the transport cost of automotive alcohol in such a way as to render alcohol final prices equal throughout the country;
- To cover Petrobras alcohol storage costs.

Table 5.4 shows that hydrated alcohol end price, which is indexed to gasoline price, was not enough to cover its supply costs. Under this price structure the ex-distillery price (with VAT of 25 per cent) was equal to 82 per cent of the consumer price. The negative difference of US\$4.90 per barrel between price and cost is the FUPA part of the hydrated alcohol price. Some of the anhydrous alcohol FUPA collected is meant to cover the negative hydrated alcohol FUPA, which is a method of cross-subsidising the hydrated alcohol consumers by the gasoline/anhydrous-alcohol blend consumers.

The regulation that introduced the FUPA in 1984 expected that if the anhydrous alcohol FUPA collected were not enough to cover the subsidisation of hydrated alcohol, part of the FUPA collected from petroleum products might also be used to offset the deficit.

In 1981 a special account was created – the Alcohol Account – kept by Petrobras and the regulator (CNP, afterwards DNC) to enter revenue related to cross-subsidisation, and expenses in connection with the subsidisation of hydrated alcohol and transportation and storage costs for both types of automotive alcohol. It was the FUPA collected that funded the automotive alcohol price equalising system. Balances in the Alcohol Account as at 31 December each year are shown in Table 5.5 below.

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<sup>5</sup>CNP Resolution # 18/84 of 11 December 1984.

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**Table 5.5:** Alcohol Account Balance as at 31 December each Year. US\$ Million

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<i>Year</i>	<i>Balance</i>	<i>Year</i>	<i>Balance</i>
1981	(57.0)	1989	(314.5)
1982	(35.2)	1990	(213.2)
1983	(52.5)	1991	(479.1)
1984	38.8	1992	(743.0)
1985	(199.1)	1993	(700.0)
1986	45.5	1994	(1,484.0)
1987	(85.7)	1995	(3,241.0)
1988	(249.0)	1996	(4,081.0)

Source: Petrobras

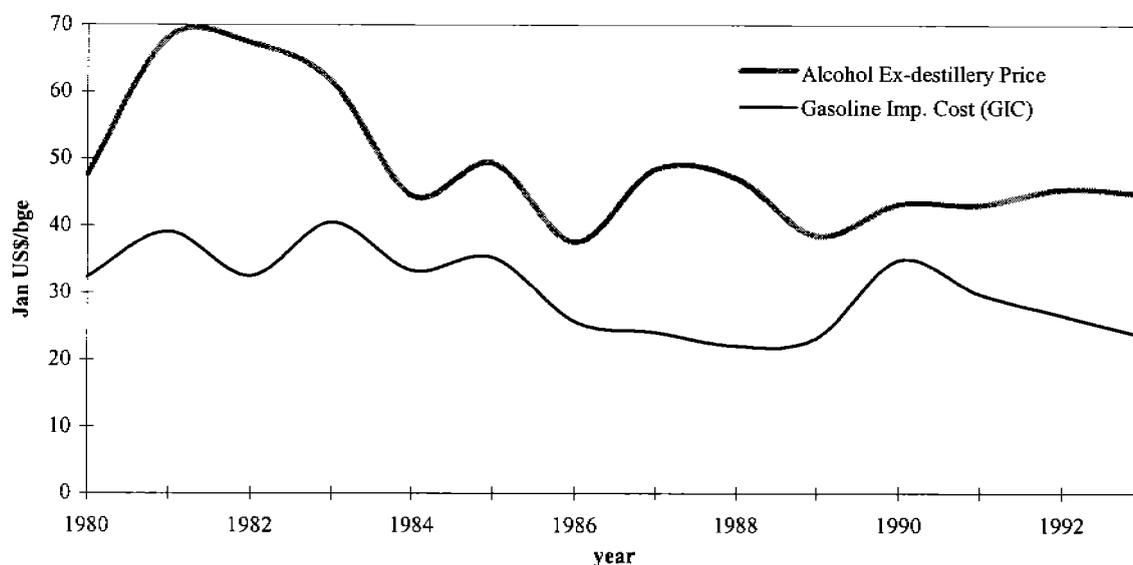
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FUPA and FUP are collected by Petrobras which uses these funds (as well as other revenue entered in the Alcohol Account) to pay the distribution companies, on behalf of the regulating agent, the difference between the consumer price and the real cost of supply of hydrated alcohol. Any Alcohol Account deficits are absorbed by Petrobras, as well as any deficit from the Crude Oil and the Petroleum Products Account.

The growing Alcohol Account deficits are mainly due to two things. First, the relatively low home price of gasoline, after 1988, when ARP was fixed well below import parity, which led to a reduction in FUPA in the anhydrous alcohol price. Secondly, the opposite trends of anhydrous and hydrated alcohol markets: growth of the hydrated alcohol market took place at the expense of the gasoline/anhydrous-alcohol mixture market. Together, these two factors – price and consumption decreases of the gasoline/alcohol blend – meant that anhydrous alcohol FUPA did not grow in proportion with the hydrated alcohol market. In April 1992 anhydrous alcohol FUPA collected was less than 1 per cent of total revenue entered in the Alcohol Account. As from July 1992, in view of the chronic increase in the Alcohol Account deficits, part of the FUP in the price of petroleum products was set apart to cover part of the shortage of revenue in the Alcohol Account (see Table 4.2). From July 1992 to December 1993 the share of the FUPA in the overall revenue entered in the Alcohol Account varied between 1 per cent and 8 per cent, while FUP funds used to subsidise alcohol for the same period were more than 40 per cent of the overall revenue.

Figure 5.10 shows trends in the yearly average ex-distillery price of hydrated alcohol expressed

in barrels of gasoline equivalent (bge)<sup>6</sup> and in the import cost of gasoline.



**Figure 5.10:** Trends in Ex-distillery Net Price of Hydrated Alcohol and in Gasoline Import Cost.

Figure 5.10 shows that the price paid to the producer for 1 bge of hydrated alcohol has always been higher than the import cost of 1 barrel of gasoline. Based on Figure 5.10 we estimate that the cost of buying hydrated alcohol to meet Brazilian demand in the quantities shown in Section 6.3 of this study, was greater by US\$20.7 billion, at constant money of January 1997, than the potential cost of importing equal quantities of gasoline.

After the drop in the first half of the 1980s, the ex-refinery domestic price of gasoline was kept relatively low for the rest of the analysed period (see Figure 5.3). As a consequence, the ex-distillery price of hydrated alcohol also fell as can be seen in Table 5.6 which shows ex-distillery real prices for the period of 1980–93 (nominal prices were deflated in terms of GPI- IA).

According to Table 5.6, the average ex-distillery hydrated alcohol price in 1986 was, in real terms, less than 73 per cent of its level in 1980 when the second stage of the NAP began (demand for hydrated alcohol at that time was still almost insignificant). From 1990 onwards the price for the producer was about half that of 1980.

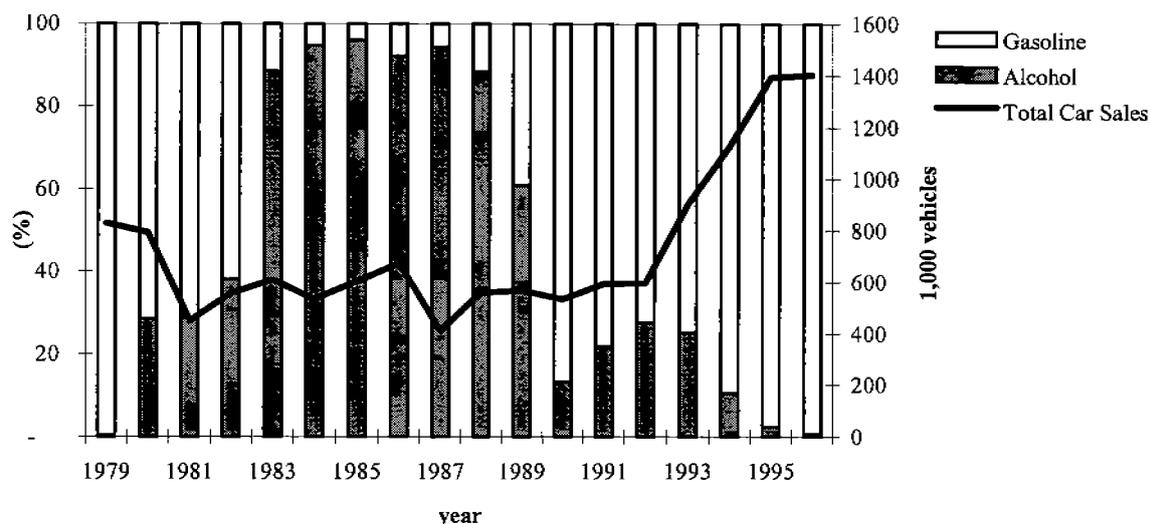
<sup>6</sup> 1 barrel of hydrated alcohol is equivalent to 0.81 of a barrel of gasoline.

**Table 5.6:** Hydrated Alcohol Ex-distillery Real Price in São Paulo, 1980–93

<i>Year</i>	<i>Price</i>	<i>Year</i>	<i>Price</i>
1980	100.00	1987	80.98
1981	107.46	1988	73.46
1982	106.02	1989	57.39
1983	96.34	1990	51.30
1984	86.53	1991	47.13
1985	96.08	1992	53.56
1986	72.82	1993	49.07

Source: Petrobras

These unattractive prices, along with the end of subsidised finance to new distilleries, brought about a halt in the growth of the production of alcohol. The average growth rate of Brazilian production of alcohol for the period 1976–85 was 3.8 per cent p.a., while production in 1993 was 1.5 per cent less than in 1985 (MME 1994). The quantity of sugar-cane milled in the years 1985–6 and 1989–90 was almost the same, that is about 224 million ton (IBGE).

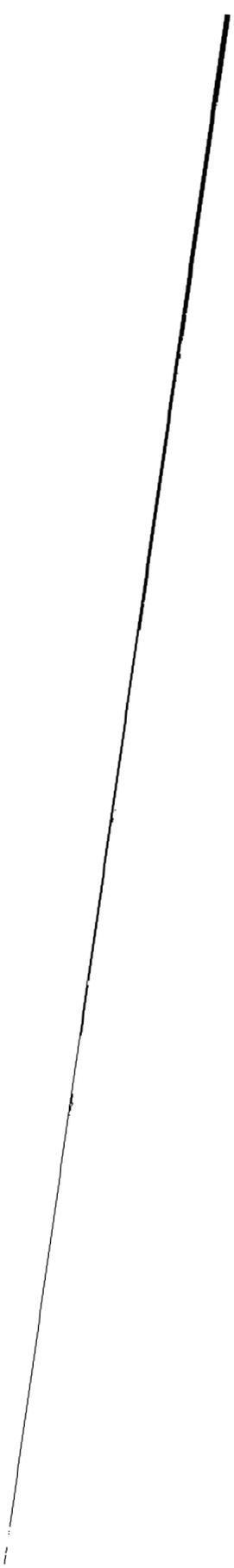


**Figure 5.11:** Car Sales by Kind of Fuel Employed.

In spite of the stagnation of alcohol production after 1985, demand continued to rise for some years because the home consumer continued to buy cars with engines fuelled by pure hydrated alcohol. In 1989 there was a shortage of hydrated alcohol at automotive fuel retail outlets, which caused Brazil to import methanol and ethanol. These alcohol supply problems led the Brazilian

consumer to lose confidence in the NAP, which caused a drop in the sale of alcohol-fuelled cars, as shown in Figure 5.11.

The share of alcohol-fuelled cars in overall car sales was about 88 per cent in 1983–89, having reached its peak in 1985. In 1990 this share fell suddenly to a mere 13 per cent and in 1996 to only 0.5 per cent.



## 6. TRENDS IN THE DEMAND FOR PETROLEUM PRODUCTS

### 6.1 Introduction

The policy of fuel substitution away from oil products, concentrated on gasoline and fuel oil, provoked dramatic reductions in the demands for both fuels. Demand for gasoline fell at an average rate of 7 per cent per year in the period 1976–85 and fuel oil demand by 10 per cent per year in 1979–85. On the other hand, the low relative price of diesel and LPG helped the demand for these fuels to increase at annual average rates of 5.2 and 6.2 per cent per year respectively in 1973–96.

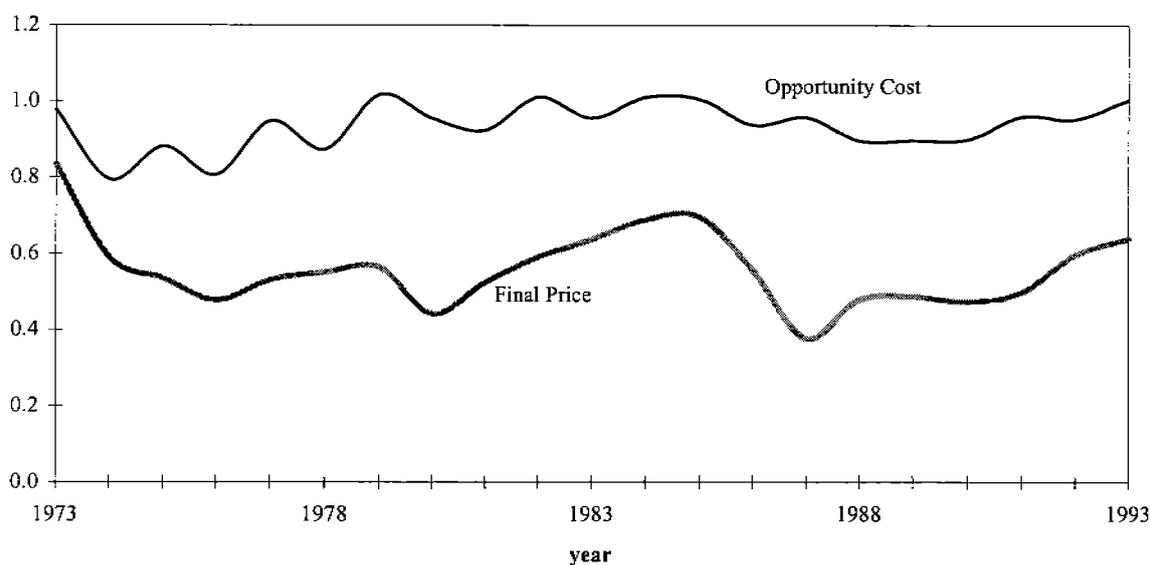
In this chapter we present and analyse the trends in the demands for gasoline, alcohol, diesel, fuel oil and LPG. We also discuss briefly the impact of the changes in the demand for these fuels in Petrobras refining.

### 6.2 Diesel Oil

Figure 6.1 shows the trends in diesel oil prices (consumer prices) and diesel opportunity cost relative to gasoline in the years 1973–93. Throughout this period the average relative price of diesel was 0.56 (at gasoline =1) while the average opportunity cost of diesel relative to gasoline was 0.94.

The low final price of diesel relative to gasoline was the result of setting both the ex-refinery price of, and the taxes on, diesel, at levels below those set for gasoline. Consequently the rent derived from the sales of gasoline was much higher than from diesel as shown in Figures 5.3 and 5.5, in Table 5.1 and Table 6.1. Over many years the rent from diesel was even negative.

The share of gasoline rent in final price rose from 1.6 per cent to 45 per cent from 1973 to 1975. In the 1973–93 period rent from gasoline and diesel was, on an average basis, equal to 39 per cent and 9 per cent of respective final prices.



**Figure 6.1:** Trends in Domestic Final Price and Opportunity Cost of Diesel Relative to those of Gasoline (Price and Opportunity Cost of Gasoline = 1)

**Table 6.1:** Share of Rent in the Final Price of Gasoline and Diesel. 1973-93. Per Cent.

<i>Year</i>	<i>Gasoline</i>	<i>Diesel</i>	<i>Year</i>	<i>Gasoline</i>	<i>Diesel</i>
1973	1.6	-4.9	1984	42.8	21.8
1974	14.0	3.9	1985	20.8	9.1
1975	45.0	22.4	1986	40.0	7.1
1976	54.4	27.9	1987	58.3	8.2
1977	52.7	24.1	1988	61.1	23.8
1978	50.3	27.0	1989	47.8	1.8
1979	17.3	-22.7	1990	30.8	-20.0
1980	36.1	2.9	1991	42.6	-6.1
1981	47.5	4.1	1992	43.9	13.3
1982	40.4	23.0	1993	46.8	18.9
1983	42.7	16.5			

In the European countries rent from gasoline and diesel were not so different as in Brazil. Table 6.2 shows the average share of taxes in the final prices of gasoline and diesel for the period 1980–93 in certain European countries. In these countries, since the ex-refinery price was assumed to be equal to the opportunity cost, the estimated rent was equal to taxes and duties

levied upon petroleum products.

**Table 6.2:** Average Share of Taxes in Final Price of Automotive Fuels in Certain European Countries. 1980–93. Per Cent.

	<i>Belgium</i>	<i>France</i>	<i>Germany</i>	<i>Italy</i>	<i>Netherlands</i>	<i>UK</i>
Gasoline	60.8	66.5	58.0	70.8	62.5	60.1
Diesel	48.7	53.4	53.8	47.4	43.8	56.3

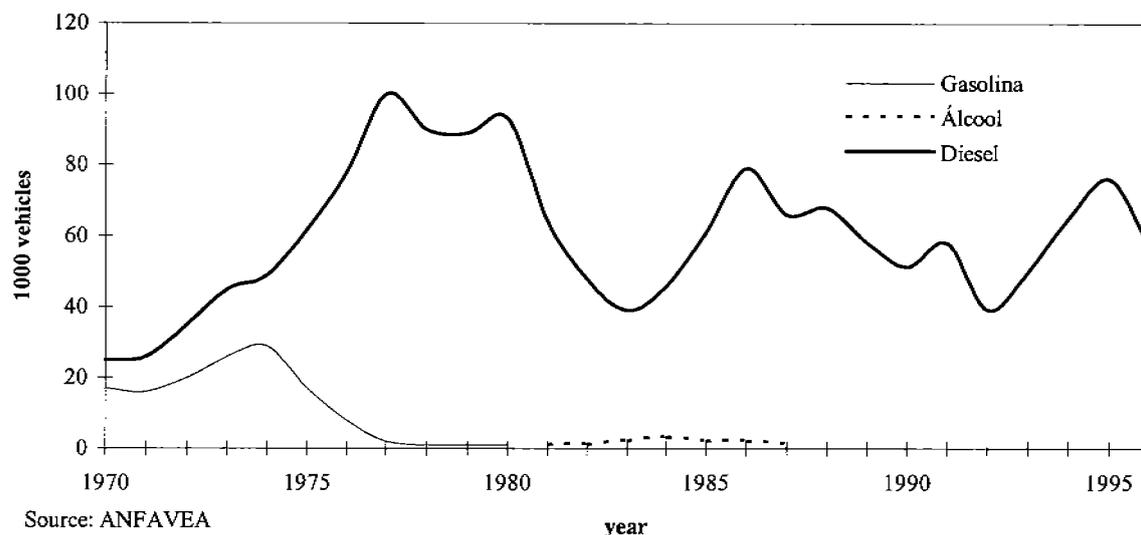
Source: OPAL and author's calculations.

Table 6.2 shows that in the countries referred to, the share of rent in the gasoline price was higher than in diesel, but the difference between these shares was not as high as in Brazil.

If taxes are regarded merely as a source of revenue, the government will be inclined to charge the heaviest rates on products whose demands present low price elasticities, since any increase in these rates will bring about a proportionally smaller drop in demand. Among petroleum products the automotive fuels are those which display the lowest price elasticity and they have been the ones most taxed by governments. In Brazil, the price elasticity of demand for Otto cycle fuels (automotive gasoline plus alcohol) was -0.25 in the short term and -0.43 in the long term (Correia 1995); for diesel, this elasticity was -0.05 in the short term and -0.13 in the long term (Petrobras Planning Service).

The policy of keeping the relative prices of diesel low led to the gradual replacement of Otto cycle trucks by diesel cycle ones (which was dubbed the 'dieselisation' of the Brazilian truck fleet). The same thing did not happen to cars, for diesel engine cars have never been built in Brazil. The dieselisation of heavy trucks is apparent in Figure 6.2 which shows sales of heavy commercial vehicles (buses and trucks) by type of fuel employed.

The sales of heavy gasoline-fuelled vehicles consisted mainly of light and medium weight trucks while the sales of heavy diesel-fuelled vehicles consisted of buses and heavy and extra heavy trucks. The sales of gasoline-fuelled heavy vehicles reached their peak in 1974 (equal to 60 per cent of sales of diesel-fuelled vehicles), and from this year fell rapidly arriving at practically zero in 1981. According to SERPLAN estimates the fleet of heavy gasoline-fuelled vehicles in Brazil



**Figure 6.2:** Sales of Trucks and Buses by Kind of Fuel Employed.

fell from about 200,000 vehicles in 1973 (when they were almost half of the entire fleet of heavy vehicles) down to virtually none in 1988.

Figure 6.3 shows the trends in diesel consumption in Brazil. The average growth rate between 1973 and 1996 was 5.2 per cent per year, a relatively high rate if compared with the average growth rate of demand for petroleum products as a whole, namely 3.3 per cent per year. Such growth in demand for diesel raised its share in the demand for crude, from 23.5 per cent in 1973 to 35.6 in 1983. At the same time the share of gasoline fell from 33.3 to 16.9 per cent and that of fuel oil from 27.2 to 18.2 per cent. In 1993 the share of diesel in oil demand was almost 37 per cent but it fell to 35 per cent in 1996.

Petrobras had to change its refining structure in order to bring the refinery output into line with the domestic demand for petroleum products. Some diesel specifications were altered<sup>1</sup> in order to broaden the diesel distillation range: release of diesel flash-point (except for diesel used in marine engines) enabled heavy naphtha to be added to diesel streams; raising the temperature of 90 per cent of evaporates enabled vacuum light gas oils to be added to diesel streams.<sup>2</sup> Some

<sup>1</sup> CNP Resolution # 7/80 of 22 January 1980.

<sup>2</sup> Specification for the distillation of diesel had been 90 per cent of evaporates at 360°C; from January 1980 onwards this became 85 per cent of evaporates at 370°C.

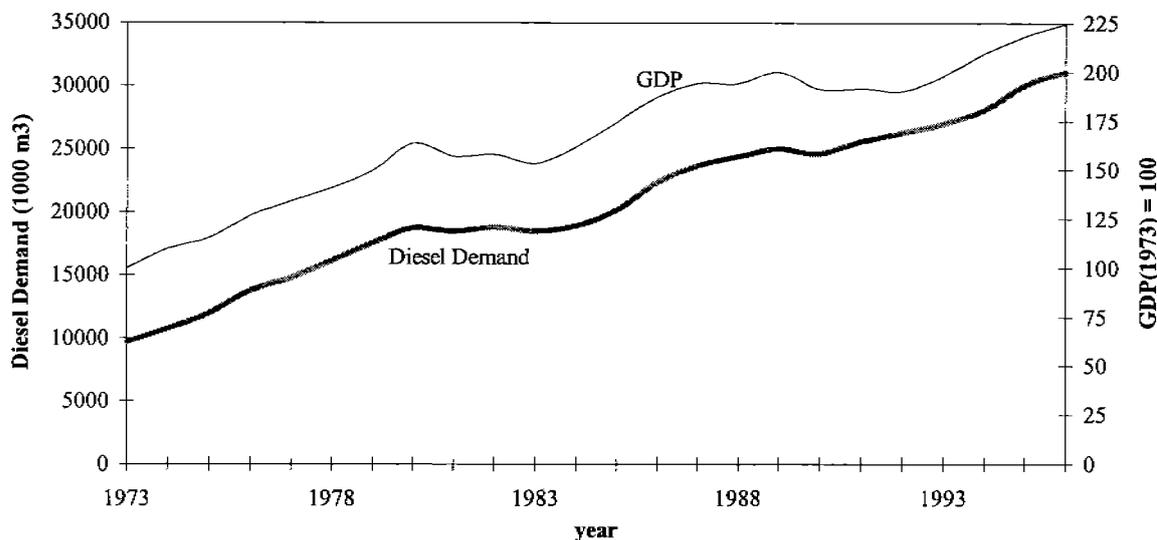


Figure 6.3: Trends in Diesel Demand in Brazil.

other measures taken to alter the refining structure while at the same time reducing the fuel oil production increased the diesel output. These measures were: increase of fuel oil viscosity by reducing the diluents<sup>3</sup> added to vacuum residue; burning of vacuum residue instead of fuel oil in order to meet refinery demand for heat (autoconsumption); cracking of heavy feedstock (vacuum residue); raising of temperature of vacuum gasoil cut; installing of further coking plants to convert vacuum residues into light petroleum products.

As a result of the changes in oil refining, the diesel share in refinery throughput increased from 22.4 to 31.2 per cent in the 1973–83 period. In the early 1990s this share was 33 per cent, less than the diesel share in total oil product demand. In 1989 Brazil became a net importer of diesel: imports increased from 5 to 78 thousand barrels per day (or from 1 to 14 per cent of diesel demand) in the 1989–96 period. Diesel imports increased not only because refinery yield did not keep up with demand but also because further refining capacity was needed.<sup>4</sup>

<sup>3</sup> Desired fuel oil viscosity is arrived at by mixing vacuum residues with suitable quantities of diluents, which are middle distillate products; generally the diluent employed is light cycle oil (LCO), an intermediate product from catalytic cracking plants. Quantities of LCO not used as diluent are first of all hydrotreated (mainly to bring down sulphur content) and then added to the diesel pool.

<sup>4</sup> Brazil became a net importer of oil products in 1991: oil products imports rose from 10 to 105 thousand barrels per day (or from 1 to 7 per cent of product demand) in the 1991–96 period.

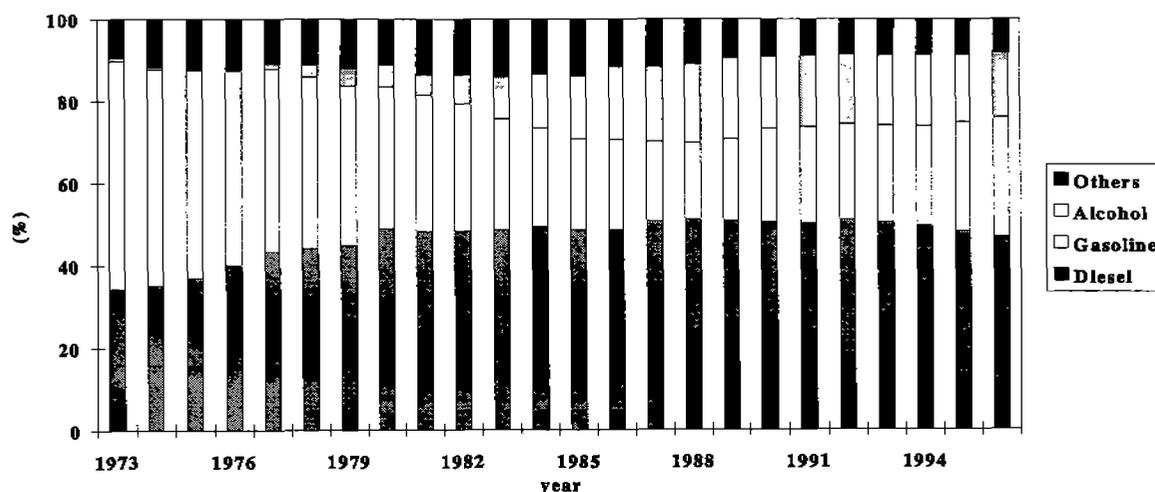
Some factors helped to keep diesel demand growth high. Firstly, the large share held by road transport in the carrying of goods and passengers throughout the country and the dieselisation of the fleet of heavy vehicles which led to a high correlation coefficient (0.99 for the 1973–93 period) between diesel demand and GDP (GDP for the period examined grew at an average rate of 3.6 per cent per year). Secondly, a lack of any technically and economically suitable alternative fuel for diesel cycle engines.

The predominance of roads within the Brazilian transport system can be seen in Table 6.3 which gives the shares of the various modes of transportation in the carriage of goods and passengers in 1993. 96 per cent of passengers and 56 per cent of goods were transported by road in that year.

**Table 6.3:** Share of Transport Modals in the Carriage of Goods and Passengers in 1993. Per Cent.

	<i>Goods</i>	<i>Passengers</i>
Air	0.3	1.8
Pipeline	3.8	-
Rail	20.6	2.0
Water	19.4	-
Road	55.9	96.2

Source: Anuário de Transportes – MT



**Figure 6.4:** Secondary Energy Consumption in the transport sector.

Figure 6.4 shows percentage consumption of other energy providing sources in the field of transportation.

On an average basis over the 1973–96 period, roads consumed 85 per cent of all energy used by the transport sector: all the gasoline, all the alcohol and 92 per cent of diesel used for transportation purposes.

### 6.3 Otto Cycle Automotive Fuels

Figure 6.5 shows the trends in demand for gasoline and both types of automotive alcohol – quantities are expressed in barrels of gasoline equivalent (1 barrel of alcohol is equal to 0.81 barrel of gasoline). The average growth of Otto cycle fuel demand for the period examined was 2.0 per cent per year.

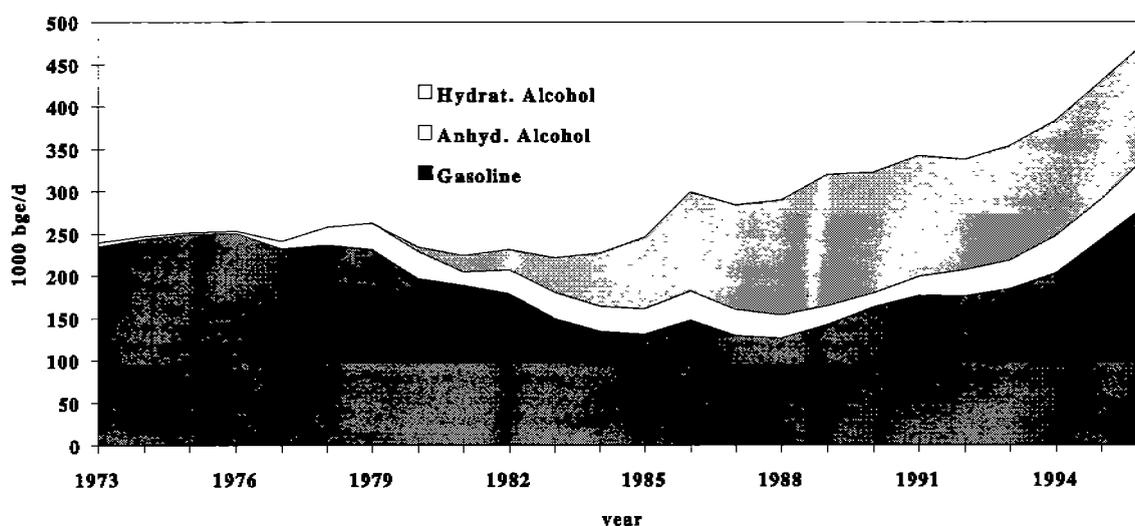


Figure 6.5: Trends in Gasoline and Alcohol Demand.

The rise in the price of gasoline up to 1981 and the holding of such price (and of the prices of the two types of automotive alcohol that were indexed to that of gasoline) at relatively high figures, up to 1983 (see Figure 5.3) constrained the growth in consumption of Otto cycle fuels. From 1973 to 1983 the overall demand for these fuels fell by 7%. Decline in the price of domestic gasoline, which began in 1984, heralded the start of a growth in the overall consumption of Otto cycle fuels, which rose at an average rate of 6.4% p.a. up to 1996.

After the Alcohol Program had been introduced most of the drop in the consumption of gasoline was due to its replacement by alcohol. The 120,000 b/d fall in gasoline consumption between 1976 and 1985 was partly offset by an increase of 112,000 bge/d in the consumption of automotive alcohol.

The decrease in domestic consumption of gasoline did not lead to a proportional reduction in the quantity of crude processed by refineries, for refineries cannot reduce their output of gasoline at the pace induced by the NAP and at the same time meet the growing demand for diesel and petrochemical naphtha. Brazilian refineries' yield of gasoline was reduced from 29% in 1975 to 18% in 1980, a yield which practically remained constant up to 1992 (MME, 1994). Gasoline yield reduction was achieved principally by rearranging the streams of straight run naphtha<sup>5</sup>.

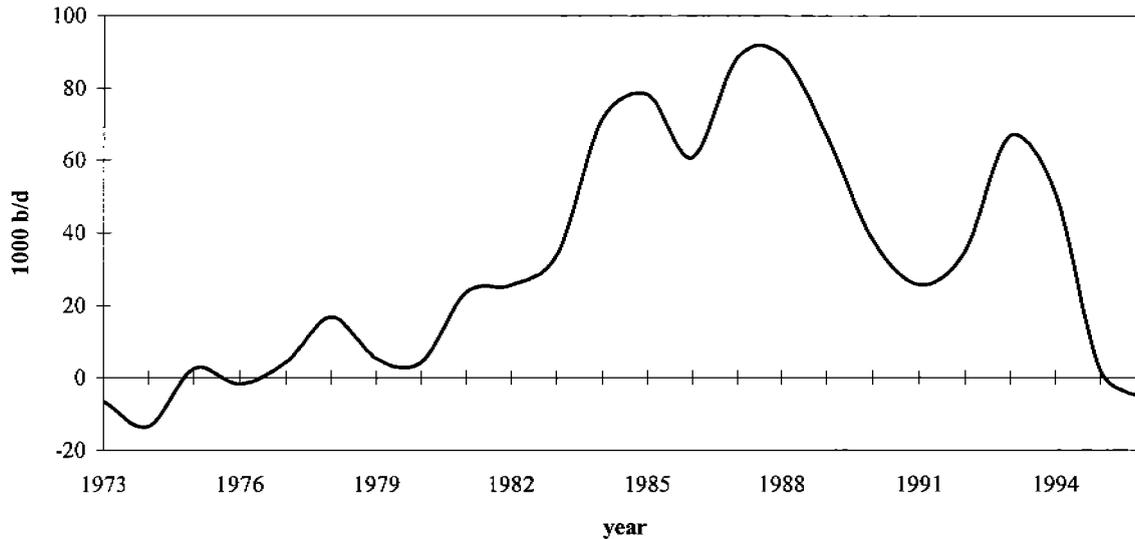
As Petrobras went on reducing the gasoline output of its refineries, the predominance of light cracking products began to rise (the octane number of these products is relatively high) in the refinery gasoline pool. The increase in the octane number of gasoline offered by refineries and the addition of anhydrous alcohol, which further improves the anti-knocking power of gasoline, did away with the need to use tetraethyl lead, which is an undesirable and poisonous substance, as a gasoline octane booster (in 1979 the regulator laid down a minimum motor octane number specification, MON, of 80).

As it was impossible fully to match the refinery output to the demand for gasoline, a surplus of gasoline, mainly made up of light cracking products, appeared. It was exported chiefly to the USA to be used as a component for a higher octane gasoline mix. Figure 6.6 shows the development of Brazilian gasoline exports. These exports reached a maximum figure of almost 90,000 b/d in 1988.

The stagnation of hydrated alcohol consumption which started in 1990 induced an increase of gasoline consumption that grew at an average rate of 10 per cent in 1990–96. Consequently in 1996 Brazil was a net importer of gasoline (see Figure 6.6).

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<sup>5</sup> Straight run naphtha, or naphtha from the atmospheric distillation unit, is a low octane component of end gasoline; usually it is processed in catalytic reforming plants in order to obtain a reformed high octane product suitable for the manufacture of good quality gasolines.



**Figure 6.6:** Trends in Brazilian Gasoline Net Exports.

The Alcohol Programme helped the country to save foreign currency as it brought about both a drop in the quantity of crude processed by Petrobras and an increase of gasoline exports.

#### **6.4 Fuel Oil**

The consumption of fuel oil within the major sectors of the Brazilian economy, other than that of energy,<sup>6</sup> is shown in Figure 6.7. Most fuel oil was consumed by the industrial sector – in 1973–96 fuel oil consumption in this sector was equivalent to between 62 and 84 per cent of its overall consumption (energy sector excluded). Up to 1979 the average share of this sector in overall consumption of fuel oil was 81 per cent. At that time when the consumer price was equivalent to only 40–68 per cent of the opportunity cost, the consumption of fuel oil grew at an average rate of 7.3 per cent per year, driven by an industrial growth rate of 7.5 per cent per year.

During the recession in the first half of the 1980s, Brazilian industrial output decreased at a rate of 0.3 per cent p.a. The drop in the consumption of fuel oil in the period 1980–85, as shown in Figure 6.7, took place however at a rate of 12.5 per cent p.a., which shows that such a fall was not solely due to the drop in industrial activity.

<sup>6</sup> Fuel oil consumption in the energy sector in the period 1973–96 was 10–16 per cent of overall home consumption of this fuel.

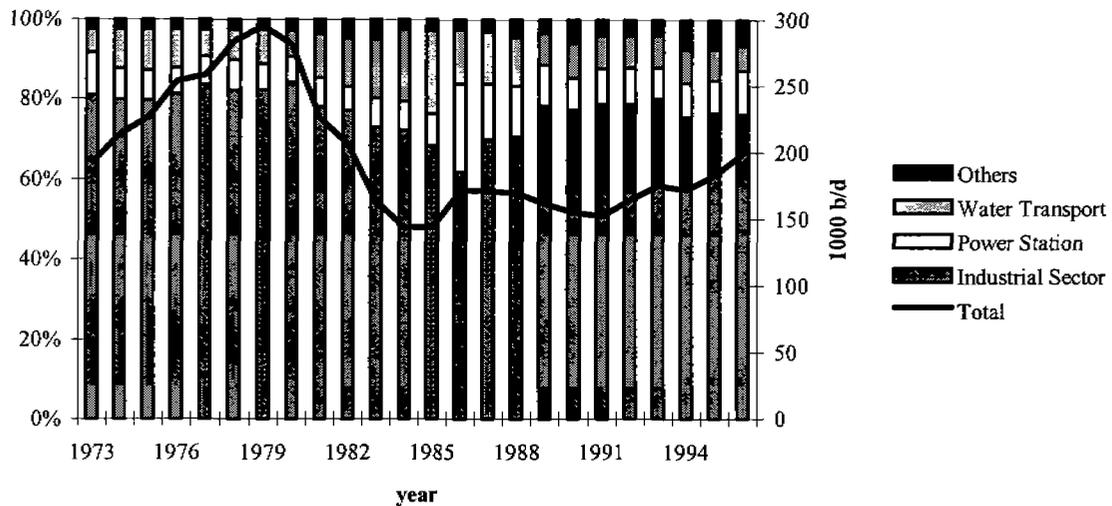


Figure 6.7: Trends in Fuel Oil Consumption.

After the second oil crisis the government thrived on replacing imported energy by alternative energy sources produced within the country. Major government efforts were concentrated on substitution away from gasoline and fuel oil. Gasoline, as we have already seen, was substantially replaced by ethyl alcohol. The biggest shift in the industrial consumption of fuel oil was brought about by an increase in hydro-electricity. Other important replacements of fuel oil in the industrial sector were by biomass (firewood, charcoal and sugar-cane bagasse), and by coal and natural gas. In addition to these efforts to replace fuel oil by other sources of energy, the government also tried to limit its consumption by laying down quotas for the major industrial consumers.

After the second oil crisis the price of fuel oil went up so that in 1981 rent earned from the sale of fuel oil climbed from negative figures to zero (see Table 5.1) and the consumer price became 12 per cent higher than its opportunity cost. This rise in the price of fuel oil brought about an increase in competitiveness of other sources of energy as shown in Table 6.4.

The price of 1boe of electricity in 1978 for industrial purposes was equal to almost seven times the price of 1 boe of fuel oil; in 1980, the ratio of electricity to fuel oil prices fell to almost 3 and in 1984 to less than 2. In Brazil the prices of electricity and petroleum products are practically independent from one another because hydroelectric power stations produce almost all domestic electricity: in 1979, 95 per cent of energy used to generate public electricity in Brazil was derived from water power; in 1993 this proportion had risen to 97 per cent and in 1996 it was 96 per cent

(MME 1997).

**Table 6.4:** Prices of 1 boe of Coal and of Electricity for Industrial Uses Relative to Fuel Oil. [Price of 1boe of Fuel Oil] = 100.

Year	Coal	Industrial Electricity	Year	Coal	Industrial Electricity
1973	62.9	992.4	1985	28.8	219.0
1974	52.0	825.2	1986	36.5	307.5
1975	51.4	871.0	1987	34.6	398.9
1976	45.2	719.5	1988	43.2	367.2
1977	57.9	685.6	1989	33.6	333.4
1978	58.6	695.3	1990	37.4	390.7
1979	51.9	540.3	1991	37.2	345.7
1980	32.5	296.1	1992	46.4	401.1
1981	33.8	268.0	1993	45.5	333.0
1982	48.4	284.3	1994	61.2	369.1
1983	36.0	216.9	1995	68.4	416.6
1984	29.4	197.5	1996	67.1	406.6

Source: Balanço Energético Nacional - MME

The relative price of coal/fuel oil fell practically by 50 per cent between 1978 and 1984 (see Table 6.4). Furthermore from 1980 to 1984 the hauling of coal was subsidised by taxation of petroleum products.

The shares of the various energy sources in the industrial consumption of energy are shown in Figure 6.8. The rise in the share of electricity in total consumption of energy for industrial purposes was due not only to its penetration into the fuel oil market but also to changes in the structure of Brazilian industry. This was due to the growth of industries that consume large quantities of electricity, such as the non-ferrous metal industries like aluminium, whose production rose from 299.3 thousand tons to 871.4 thousand tons (an increase of 191 per cent) between 1982 and 1988 (UN 1990). In this period the aluminium industry increased its share in the industrial consumption of electricity from 15 to 21 per cent.

Figure 6.8 shows that from 1979 to 1985 the share of fuel oil in the industrial consumption of energy fell from 28 to only 9 per cent. Almost 70 per cent of this drop was due to the penetration of electricity into industries other than aluminium (39 per cent) and biomass (31 per cent). The substitution of fuel oil in the principal sectors of Brazilian industry is shown in Table 6.5 below.

Table 6.5 shows that between 1979 and 1985 substantial parts of fuel oil consumption were replaced by the consumption of other sources of energy in all the industries covered. The most striking change in the consumption pattern occurred in the cement industry – which substituted practically all the fuel oil it was using by coal and charcoal. The substitution of fuel oil in the paper and pulp industries principally by firewood brought down the share of fuel oil used therein

**Table 6.5:** Shares of the Various Energy Sources in the Consumption of Energy by the Major Sectors of the Brazilian Industry. Per Cent.

<i>Sector</i>	<i>1979 Shares</i>				<i>1985 Shares</i>			
	<i>Fuel Oil</i>	<i>Electricity</i>	<i>Coal</i>	<i>Biomass</i>	<i>Fuel Oil</i>	<i>Electricity</i>	<i>Coal</i>	<i>Biomass</i>
Mining	57.0	38.4	1.0	-	23.2	67.0	-	3.3 <sup>(1)</sup>
Chemicals	43.5	46.0	0.1	2.3 <sup>(1)</sup>	22.9	56.7	2.5	5.5 <sup>(2)</sup>
Textile	35.4	59.8	-	3.4 <sup>(3)</sup>	13.1	75.0	-	10.5 <sup>(3)</sup>
Cement	70.5	23.2	4.0	-	3.2	27.8	38.4	27.7 <sup>(4)</sup>
Food and beverages	17.5	17.9	0.1	63.1 <sup>(5)</sup>	5.4	26.6	1.0	66.2 <sup>(5)</sup>
Paper and pulp	33.4	39.7	1.8	5.7 <sup>(3)</sup>	7.9	42.9	2.9	21.7 <sup>(3)</sup>
Ceramics	31.3	16.3	-	49.3 <sup>(3)</sup>	12.8	19.3	-	62.2 <sup>(3)</sup>
Iron and steel	11.9	24.3	30.1 <sup>(6)</sup>	26.0 <sup>(4)</sup>	3.4	26.2	35.1 <sup>(6)</sup>	27.2 <sup>(4)</sup>

(1) - Charcoal and firewood

(2) - Charcoal, firewood and sugar-cane bagasse

(3) - Firewood

(4) - Charcoal

(5) - Firewood and cane-thrash

(6) - Coke

Source: Balanço Energético Nacional-MME

by three-quarters. Substitutions of fuel oil in the iron and steel and food and beverage industries were also important, for such industries are the ones that consume most energy in the country: together in 1985 they consumed 40 per cent of all energy within industry.

The drop in industrial output at a rate of 0.3 per cent p.a in the first half of the 1980s, along with

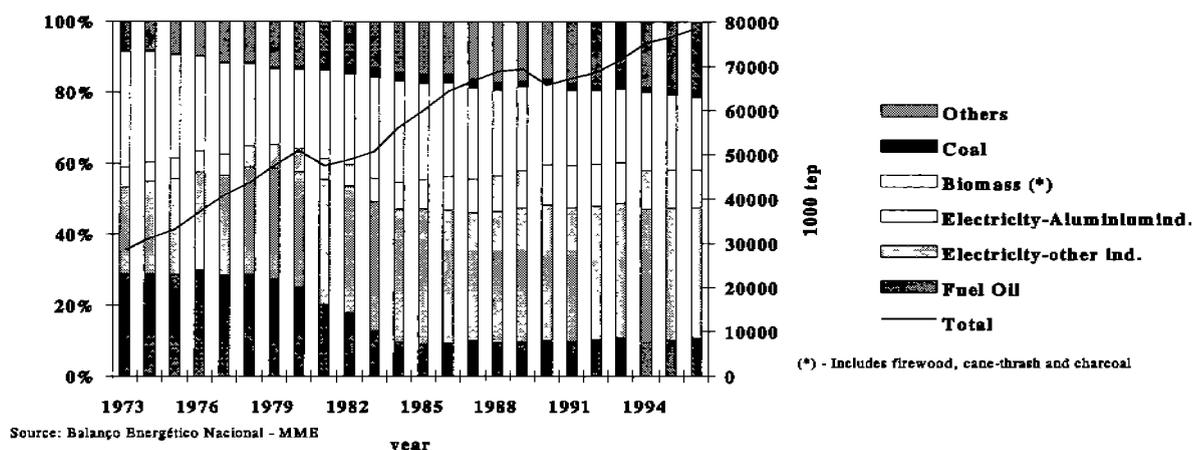


Figure 6.8: Shares of Various Energy Sources in Industrial Energy Consumption

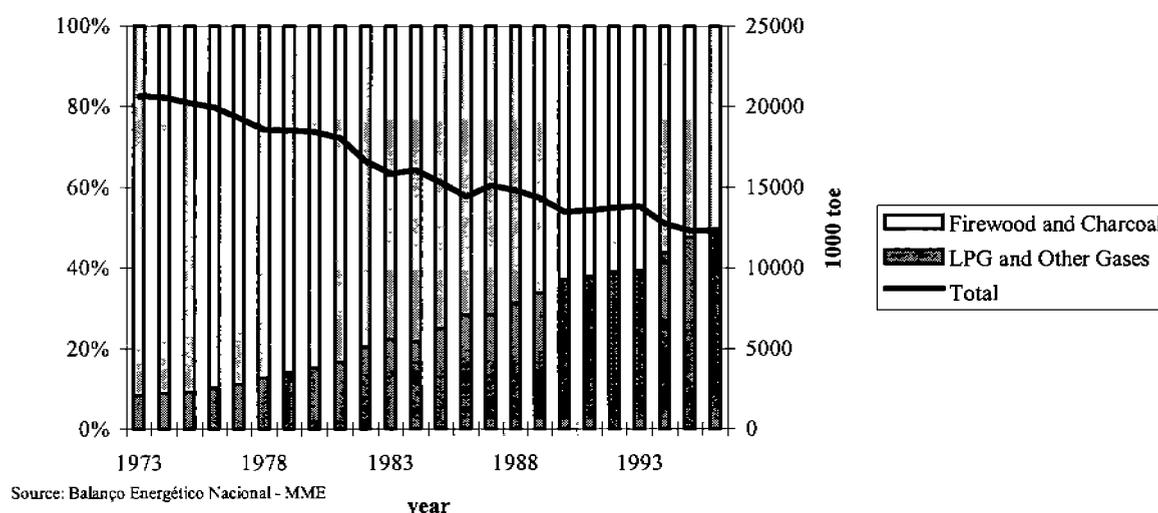
the rise in consumption of energy, are evidence of the fall in energy efficiency within this sector. Energy intensity in industry rose from 0.497toe/(1,000 US\$) to 0.612toe/(1,000US\$) between 1979 and 1985 (MME 1994). This rise was due not only to structural changes within the sector but also to a return to more inefficient kinds and uses of energy.

The drop in the consumption of fuel oil after the second oil crisis led to a fall in its share in the overall demand for petroleum products in Brazil (see Figure 3.3): its share of 26.4 per cent in 1979 fell to 14.4 per cent in 1985 and to 12.9 in 1996. Petrobras undertook several changes in refinery processes in order to increase conversion of the so-called bottom of the barrel. Such changes were referred to in Section 6.2 of this chapter. The Petrobras ‘bottom of the barrel’ programmes were successful: the share of fuel oil in the overall production of Petrobras petroleum products fell from 27 per cent in 1979 to 18 per cent in 1985 and to 16 per cent in 1996.

## 6.5 LPG

Consumption of LPG in Brazil in the period 1973–96 rose at an average rate of 6.2 per cent p.a. from 50.7 thousand barrels per day in 1973 to 191.2 thousand barrels per day in 1996. Most of this consumption has been caused by the use of LPG for household cooking purposes, which from 1973 to 1996 accounted for 88–93 per cent of overall consumption of LPG.

In 1973, 92 per cent of *final energy* used for household cooking purposes was obtained from the burning of firewood and charcoal, as can be seen from Figure 6.9. In terms of *final energy*, the share of biomass in total energy used for cooking had fallen gradually until it reached 50 per cent in 1996.



**Figure 6.9:** Final Energy Used for Cooking in the Residential Sector.

Substitution of firewood by LPG took place at a rate of 0.11 toe of LPG for every 1 toe of firewood. This was worked out in terms of the average efficiency of wood and LPG stove. We considered average efficiency for the use of firewood, LPG, gas from naphtha and charcoal for cooking 5 per cent, 45 per cent, 50 per cent and 10 per cent, respectively (Pinguelli et. al. 1984). Substitution of biomass by LPG led to a fall of 40 per cent in final consumption of energy for household cooking purposes in the period 1973–96, as shown in Figure 6.9. In terms of *useful energy*, the share of LPG used for cooking was 42 per cent in 1973, which rose gradually to 87 per cent in 1996. Overall *useful energy* consumed for cooking purposes rose by 75 per cent in this period (or 2.2 per cent per year).

The increase in the use of LPG may be put down to the growth of the Brazilian urbanisation rate<sup>7</sup> and to the greater penetration of LPG in rural parts of the country. The urbanisation rate in Brazil, reckoned from data taken from IBGE censuses, rose from 31.2 per cent in 1940 to 36.2

<sup>7</sup> The urbanisation rate is the proportion of the population living in urban areas.

in 1950, 44.70 per cent in 1960, 55.9 per cent in 1970, 67.6 per cent in 1980 and to 75.6 per cent in 1991.

In urban areas of the country electricity is the most suitable alternative to LPG. However, it was not used for cooking because the cost of electricity for household use was too high, even after the second oil crisis. In 1973 its cost was four times that of LPG (in barrels of oil equivalent); from 1974 onwards, the relative price of electricity gradually fell until it was equivalent to 2.1 times that of LPG in 1984: from 1985 it rose again until it was equivalent to four times the price of LPG in 1991 (MME, 1994).



## Appendix 1

### Rotterdam Spot Prices and Domestic Prices in NW Europe

Independent wholesalers in northwest Europe can obtain petroleum products under contracts with home refiners or by spot buying in the Rotterdam market. This has enabled independent importers to compete against home refiners. Such competition links domestic price fluctuations to the spot market. It should be noted that harbour, storage and internal transport costs for these products naturally raise the opportunity cost of the independent wholesaler. Therefore, home refineries located close to consumer markets and provided with their own means of transport and storage can get higher prices at home than on the spot market. Sales made by these refiners to the spot market may be regarded as merely marginal. Yet, for refiners the spot market has become the most important alternative market for petroleum products in the northwest of Europe. The importance of the Rotterdam market for refineries is such that spot prices have been used by the oil majors as internal transfer prices between their refining and distribution sectors.

Spot market prices greatly affect home prices in neighbouring countries. We examined monthly consumer net of tax prices for the period 1980–93 for the major products in six European countries, namely, Belgium, France, Germany, Italy, Holland and Great Britain. We arrived at the conclusion that although home prices are highly correlated to spot prices, the former might vary considerably from country to country.

Table A1.1 shows the correlation coefficient between net domestic prices in these countries and Rotterdam prices.

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**Table A1.1:** - Correlation Coefficient between Home Prices in European Countries and Spot Prices. 1980–93.

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	<i>Belgium</i>	<i>France</i>	<i>Germany</i>	<i>Italy</i>	<i>Holland</i>	<i>UK</i>
Premium Gasoline	0.80	0.93	0.92	0.81	0.87	0.87
Diesel	0.81	0.88	0.93	0.88	0.87	0.87
Fuel Oil	0.97	0.96	0.95	0.96	0.91	0.94

Source: OPAL and author's calculations

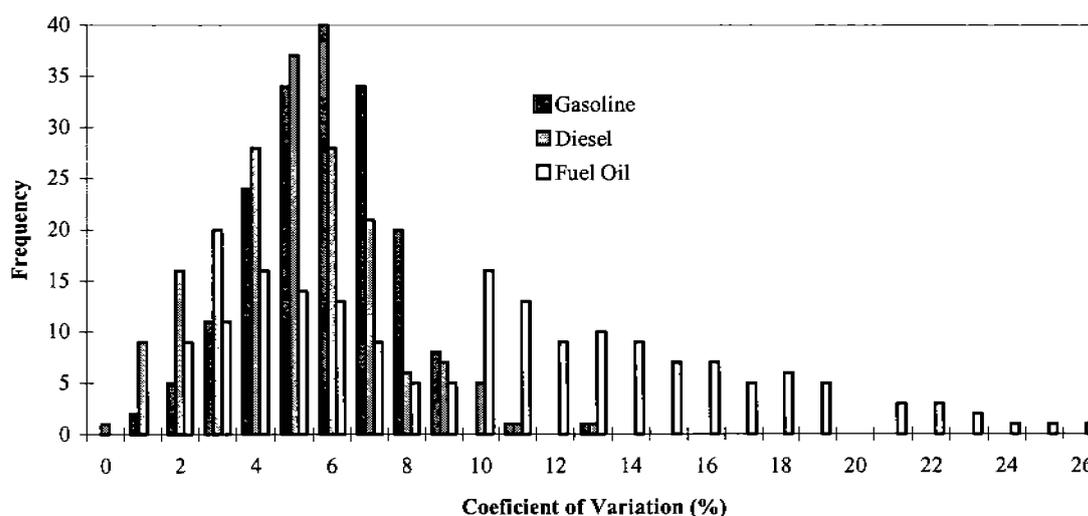
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End prices include not only the ex-refinery price but also gross distribution margins (wholesale and retail) which of course vary from country to country. Since the distribution costs of fuel oil do not include the retail segment, the number of factors bearing upon changes in its end price is less than in the case of gasoline and diesel. This may have raised the value of the correlation coefficient between the domestic and spot prices of fuel oil. Save for Holland, about 95 per cent of fuel price fluctuations could be explained by spot price shifts. The correlation coefficient for gasoline and diesel prices was around 90 per cent, except in Belgium and Italy.

To estimate the variability of prices of the three major products in those European countries in Table A1.1 we worked out the *coefficient of variation (CV)*, as shown below, in each of the 168 months of the 1980–93 period:

$$CV = \frac{\text{Standard Deviation}}{\text{Average}} \cdot 100$$

Frequency distributions of CV figures for each product are shown in Figure A1.1.



**Figure A1.1:** Frequency Distribution of Coefficient of Variation of Home Prices in six European Countries

In 95 per cent of instances the CV of gasoline and diesel prices lay between 2 and 10 per cent. For fuel oil, however, prices fluctuated relatively more from country to country: in 95 per cent of instances the CV lay between 2.5 and 22 per cent.

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