THE DEMANDS FOR MOTOR GASOLINE AND HEATING OILS

DEPARTMENT OF ECONOMICS,
FACULTY OF GRADUATE STUDIES AND RESEARCH,
MCGILL UNIVERSITY,
MONTREAL, CANADA.

Submitted as a partial requirement for the degree of Master of Arts (Economics) by Donn K. Wilson, Bachelor of Commerce, summa cum laude, Loyola College, Montreal, Canada.

August 19, 1957.

TABLE OF CONTENTS

PART I

INTRODUCTION

CHAPTER 1 - PURPOSES AND METHODS

The objectives of this study are twofold - first, to examine the determinants and characteristics of the demands for two principal petroleum products, and second, to evaluate the impact of these demands on the nature of competition and the activities of suppliers in the two product markets.

By definition, this study of the petroleum industry is limited in many respects, and must be viewed as only a partial analysis of the pricing of petroleum products and the impact of this pricing on the economy.

This study is concerned with the demand for two refined petroleum products - motor gasoline and heating oils. A complete study of the pricing of petroleum products would involve the consideration of the demands for the many other refined petroleum products, as well as an examination of the many and varied supply factors within the industry.

The nature of competition and price determination will therefore be approached from the aspect of demand, supply being considered only in so far as it is conditioned by, or conditions demand.

Demand theories will be empirically tested, and the institutions, laws and policies, which are outside the framework of theoretical discussions, but which condition the nature of demand and the adaptation of supply to a great degree, will be examined. For example, both the price elasticity of demand and the effect of supplier policies will be herein reviewed.

Consumption trends and other pertinent statistical data will be drawn from government and industry reports on sales of refined petroleum products in the province of Quebec.

The writer would like to thank Dr. John T.Culliton of the Department of Economics at McGill University for his great assistance in the development of this study. Another word of thanks is due the writer's fellow employees in the Quebec Marketing Division of Imperial Oil Limited for their detailed advice and help, particularly Dr. J.S.Nadeau, Mr. J.C.DeGroote, Mr. A.H.D'Eschambeault and Mr. J.Keller.

CHAPTER 2 - RAW MATERIALS AND MANUFACTURING PROCESSES RELATED TO THE PRODUCTION OF REFINED PETROLEUM PRODUCTS

This second introductory chapter is a brief description of the nature and major sources of crude petroleum, and the basic refining processes involved in the manufacture of petroleum products.

THE NATURE OF CRUDE PETROLEUM

Crude petroleum as it comes from the ground is a mixture of thousands of different hydrocarbons which range from extremely light gases to semi-solid carbonaceous materials, such as asphalt.

These hydrocarbons are compounds which have vastly different characteristics from those of the hydrogen (a light, colorless, odorless gas) and the carbon (a black solid) which combine in various proportions to form the hydrocarbons. In addition, some types of crude petroleum contain sulphur, either uncombined or present as a part of certain hydrogen-carbon-sulphur compounds.

SOURCES OF CRUDE PETROLEUM

There are at present three main sources of crude petroleum in the free world - the Middle East, the United States

and Venezuela. The proven reserves [1] of these areas are:

Middle East	- 230	billion	barrels
U.S.	- 30.1	"	"
Venezuela	- 18	"	"

Canada is rapidly developing as a major producer of crude petroleum. Proven reserves which may be profitably exploited are at present approximately 3 billion barrels. In 1956, Canada was able to satisfy 65% of its own crude petroleum requirements, and exported 125,000 barrels per day to the USA and the Far-East. If Canadian exports were added to the domestic consumption of Canadian crude petroleum, the western oilfields satisfied 80% of domestic crude petroleum demand in 1956. When it is recalled that Canada produced only 9% of the considerably smaller crude petroleum demand at the end of World War II, the rapid progress made in the production of crude petroleum becomes very evident.

In addition, there are 300 billion barrels of known petroleum reserves lying in the Athabaska tar sands awaiting profitable development. At present, a number of companies are developing possible methods of profitably extracting the oil from the tar sands, and if these ventures prove successful, Canada could become the leading petroleum producer in the world. The USA is also making progress on methods to extract equally large petroleum reserves from shale rock

1. - Fortune - Vol. LIV No. 4, October, 1956, page 137 and following.

formations in the Colorado region. These development projects are, however, of a very long-term nature and the free world's crude petroleum supply will continue to be drawn from the present major sources for at least the next ten years, owing to the lower relative costs of drilling operations as against extraction processes.

Crude petroleum is, by nature, very susceptible to bulk transportation. At present, crude petroleum is transported by large tanker fleets from the relatively remote areas of the Middle East and Venezuela to major refining centres in Europe and Canada. [1]

THE BASIC PROBLEM OF REFINING

The end purpose of refining is to manufacture from each barrel of crude oil, gasoline, kerosene, furnace oils, diesel fuel, heavy fuel oils, asphalt, lubricating oil, chemical base stocks, etc., in a quantity and quality in proportion to demand.

This purpose is complicated by the fact that crude oil contains a very limited amount of the hydrocarbons which are suitable for immediate use as gasoline components. There-

1. - A small number of very large refineries, eg., Abadan and Aruba in the Middle East and the Caribbean, have been built to process the crude in close proximity to the major fields of both areas.

fore, refiners must select other types of hydrocarbons from the crude oil and convert them to types which are desirable in gasoline. Tremendous investments in refining equipment are required to separate the types of hydrocarbons needed and to alter their chemical composition. The following paragraphs will describe the evolution of major refining methods from the inception of demand with the motor vehicle shortly after the turn of the century to the present day.

DISTILLATION

The first process developed in one form or another to increase the volume of gasoline obtained from crude petroleum was thermal distillation. Distillation, as it exists to-day, involves the pumping of the crude oil into a tower at 700°-800°F. This tower typically consists of 20-30 trays arranged one above the other about two feet apart. The hot crude oil enters the tower six or seven trays from the bottom; a large proportion of the crude turns to vapor as soon as the pressure is relieved. The vapors then pass through small openings in each tray, rising higher and higher in the tower until finally a tray is reached where the temperature is low enough for a particular type of hydrocarbon to condense into liquid. The liquids are then drawn off at the various levels, light fractions are removed from heavier ones, and the products

are piped to storage. The portions of the crude oil which liquefy between 90°-400°F. become "straightrun" gasoline. This gasoline produced by simple distillation varies widely in its characteristics, depending upon the crude oil from which it is distilled. Apart from problems relative to the octane numbers of straightrun gasoline, the demand for gasoline far exceeded the amount of gasoline available from simple crude distillation (approximately 20% of a barrel in 1920-30.)

THERMAL AND CATALYTIC CRACKING

The only way more gasoline could be made from a barrel of crude oil was to convert heavy fuel oil into gasoline or to convert very light gases into liquid gasoline. Research led first to the development of thermal cracking.

In this process, the heavy hydrocarbons, above the boiling range of gasoline, are cracked by a combination of heat and pressure. The cracked materials are piped to a separator where the extremely heavy oils and tars are withdrawn and the remainder is pumped into the "bubble" or distillation tower, and the original process repeated. Through this method, approximately 44% of crude oil was being made into gasoline by 1937 in the USA. About 52% of the gasoline was straightrun and 48% was cracked. [1]

1. - The Story of Gasoline, (Ethyl Corporation, New York, 1956) p. 28.

World War II brought a tremendous demand for higher octane gasolines for military vehicles and aircraft. Neither simple distillation nor thermal cracking could provide enough high octane gasoline to satisfy the peak demand. The problem was solved by the intensive development of catalytic cracking equipment.

The big difference between thermal and catalytic cracking is the use of catalysts, chemicals which cause a desired chemical reaction to take place even though they do not necessarily take part in the reaction. Catalytic cracking, while involving considerable expense, is extremely useful owing to the various beneficial results obtained at the same time. For example, not only will catalytic cracking accomplish its basic purpose of converting heavy hydrocarbons into gasoline components, but the components so produced are superior with respect to anti-knock quality (ie., octane.) Moreover, catalytic cracking usually reduces the amount of sulphur in the finished product, increases the effectiveness of tetraethyl lead, the active ingredient of anti-knock compounds, and reduces the potential amount of engine corrosion which would result from the use of gasolines with a high sulphur content. Again, the catalytic cracker may be adjusted so that gasoline yields are reduced in favor of higher yields of light furnace fuel oil.

NEW PROCESSES

Many other superior methods have been developed over the years to increase the flexibility of refinery operations, particularly with respect to the production of high octane motor gasoline from crude petroleum. For example, thermal or catalytic reforming convert low-quality gasoline components into a slightly smaller amount of high-quality components. [1] Polymerization is the combining of two or more light hydrocarbons to form a liquid suitable as a high octane gasoline component. Other prominent processes are alkylation, isomerization, aromatization and hydrogenation; a discussion of these processes can be obtained in trade papers and are outside the range of this elementary review of refinery methods.

THE REFINERIES OF QUEBEC

The greatest refining country in the world is the USA, with a crude capacity of 8,629,000 barrels per day. [2] Canada's refining capacity is 707,500 barrels per day, with a cracking capacity of 342,625 barrels per day. [3]

1. - Reforming will be compared on a cost basis with the use of TEL (tetraethyl lead) which will produce the same results.
2. - National Petroleum News Factbook - 1954.
3. - Financial Post, January 5, 1957, page 30.

Since most examples of competition and trends will be drawn from the Province of Quebec, the capacities, both crude and cracking, of the five refineries in Quebec are listed below. All five refineries are located very close to one another in the Montreal East area. The parent company is shown in parenthesis below the refinery. [1]

	CRUDE Barrels Per Day	CRACKING Barrels Per Day
Imperial Oil (Standard Oil) (N.J.)	69,000	(17,500 Catalytic (16,200 Thermal
McColl-Frontenac (The Texas Company)	58,000	(23,000 Catalytic (14,000 Thermal
Shell Oil (Royal Dutch Shell)	55,000	(22,500 Catalytic (9,000 Thermal
British American Oil (Gulf Oil Corp.)	45,000	(18,000 Catalytic (3,500 Thermal
Canadian Petrofina (Fin. Belge des Petrôles)	20,000	16,000 Catalytic

The crude processing capacity of Montreal East will be increased by 30,000 barrels per day with the completion of the British Petroleum refinery in 1960. This latter company, formerly the Anglo-Iranian Oil Company, is a U.K. crown corporation.

The refinery capacity of Quebec, representing 35% of the Canadian total, is the largest in Canada. All crude run in this major refinery complex is imported, mainly from

1. - Financial Post, January 5, 1957, page 30.

Venezuela. The largest portion of the imported crude is transported through the jointly-owned Montreal Pipe Line from Portland, Maine. Canadian Petrofina, however, owing to its modern hydrogenation or desulphurization process, uses Middle East crude, which is relatively high in sulphur content.

The products manufactured at Montreal East are listed in Table No. 1 in order of distillation range. Domestic consumption totals are indicated in Table No. 2; these reflect the transfers of products to other provinces, imports and inventory changes.

CONCLUSION

In conclusion, the evolution of refinery methods has been conditioned by the growth in gasoline demand over the past five decades. Distillates, or heating oils, should then be considered a by-product in the production process. However, the high value of distillates makes them an integral part of any profitable refinery operation.

QUEBEC PRODUCTION

REFINED PETROLEUM PRODUCTS

1955

	Volume	%
Liquefied Petroleum Gas	373,104	.5
Chemical Feed Stocks	290,762	.4
Napthas	465,131	.6
Aviation Gasoline	87,011	.1
Motor Gasoline	27,396,355	37.0
Turbo Fuel	1,240,860	1.7
Kerosene and Stove Oil	5,106,466	6.9
Diesel Fuel Oil	4,343,802	5.9
Furnace Fuel Oil	11,189,798	15.2
Light Industrial Fuel	576,974	.8
Residuals	19,325,516	26.2
Asphalt	3,091,849	4.2
Petroleum Coke	216,972	.3
Lubr. Oils and Greases	133,297	.2
Total	73,837,897	100%

TABLE NO. 1

(All figures in barrels of 35 Imperial gallons)

Source - Dominion Bureau of Statistics - Refined Petroleum Products.

NOTE - Maritime production is included.

QUEBEC CONSUMPTION

REFINED PETROLEUM PRODUCTS

1955

	Volume	%
Liquefied Petroleum Gas	404,152	.8
Chemical Feed Stocks	308,894	.6
Napthas	287,895	.5
Aviation Gasoline	566,613	1.1
Motor Gasoline	14,659,349	27.8
Turbo Fuel	321,730	.6
Kerosene and Stove Oil	4,947,853	9.3
Diesel Fuel Oil	2,397,377	4.5
Furnace Fuel Oil	10,888,079	20.5
Light Industrial Fuel	514,349	1.0
Residuals	13,585,881	25.6
Asphalt	1,763,302	3.3
Petroleum Coke	1,646,463	3.1
Lubr. Oils and Greases	702,458	1.3
Total	52,994,395	100%

TABLE NO. 2

(All figures in barrels of 35 Imperial gallons)

Source - Dominion Bureau of Statistics - Refined Petroleum Products.

PART II

THE DEMAND FOR MOTOR GASOLINE

CHAPTER 3 - THE INDIVIDUAL MOTORIST'S DEMAND FOR MOTOR GASOLINE

INTRODUCTION TO PART II

The total industry demand for motor gasoline, 585 million gallons in 1956 in Quebec, is a composite of smaller demands which may be distinguished according to the type of consumer. The largest consumers as a group of motor gasoline are individual motorists; in addition, there exist considerable demands for this product from industrial and commercial consumers and from farmers.

This study of motor gasoline demand is therefore divided according to the type of consumer. The first two chapters of the second part deal with retail demand - the demand and consumption patterns of the individual motorist, and the demand for motor gasoline at the retail outlet. The third chapter studies other than retail motor gasoline demands at the consumer level, and finally, the fourth chapter deals with trends in the total industry demand for motor gasoline.

DEFINITION OF RETAIL DEMAND

The term "retail demand" may be given to many distinct demands with equal applicability. "Retail demand" may mean the total amount of gasoline sold in the USA, in Canada,

or in Quebec. It may also mean the total amount of gasoline sold on the island of Montreal, or the total amount sold at any one of the 7189 retail outlets in the Province of Quebec. Finally, the term "retail demand" may mean the amount of gasoline that an average motorist buys on one day, in one week, or in one year.

It is obvious that all but the last of these definitions involve the addition of various amounts of these smallest of "retail demands," and are, therefore, in a certain sense, simply statistical summations.

INTRODUCTION TO THE INDIVIDUAL MOTORIST'S DEMAND FOR MOTOR GASOLINE

The typical retail consumer is a motorist who drives for pleasure, business, or a combination of both. The result to be obtained in examining and describing in detail this individual motorist's demand for motor gasoline is an understanding of his response to general price changes, to price changes at a particular retail outlet, and to changes in the level of his personal income.

Chapters 4 and 6 will deal with the consumer's response to particular price changes and to changes in his personal income. This section of Chapter 3 will deal with the price-elasticity of the individual motorist's demand for motor

gasoline. Moreover, since the industry demand for motor gasoline is an addition of an arbitrary amount of these smaller demands, this section is indirectly concerned with the elasticity of industry demand.

Initially, it is proposed to study gasoline as a single, simple product sold at only one quality level. This distinction has often been made in economic theses [1] in order to achieve unambiguous conclusions. In the following section, this unrealistic assumption will be eliminated, and demand for different grades of gasoline will be examined.

THE ELASTICITY OF INDIVIDUAL RETAIL DEMAND

Elasticity of a given demand is defined as "the ratio of proportionate change in quantity to a proportionate change in price at a point on a demand curve." [2] In order to initially analyse the elasticity of the individual demand curve for motor gasoline, it will be necessary to make the following assumptions.

1. - Motor gasoline is an homogeneous product - ie., no distinction is made between grades.

2. - A "general" price is the reference point - although many different prices do exist in fact throughout, owing to any fairly large geographical area transportation cost differentials.

1. - As for example, the elasticity of demand for automobiles, steak, etc., without reference to differences in quality among a broad product classification.
2. - Joe S.Bain, Pricing, Distribution and Employment, revised edition, (Henry Holt & Co., Inc., New York, 1953) p. 26.

These assumptions are necessary in order to discuss motor gasoline as a single product, as significant cross-elasticity exists between premium and regular grades. Moreover, when a general going price is referred to, it is only for the purpose of analyzing changes in the price or overall demand from an existing situation. When a price change is made, usually all companies advance by the same amount, maintaining existing differentials from firm to firm. The 1956 retail price increase, which allowed for higher shipping costs, illustrates this point. In every case, the increase was a half-cent per gallon.

> Imperial Oil Limited's premium gas will now sell for 47 cents a gallon and the regular grade for 45 cents. The second company Canadian Petrofina Limited will sell its premium gas for 46.9 cents a gallon and its regular grade for 44.9 cents.
> Montreal Gazette,
> July 11th, 1956.

> The new prices of Shell gasoline are 44.2 cents for regular grade and 47.2 cents for premium grade. The prices of Canadian Oil gasoline now are 44.9 cents for regular grade and 46.9 cents for premium.
> Montreal Gazette,
> July 12th, 1956.

> The price of BA gasoline was increased a half-cent a gallon to 44.5 cents for regular grade and 46.5 cents for premium grade.
> Montreal Gazette,
> July 13th, 1956.

> This (price increase) brings the price of McColl regular grade gasoline to 44.5 cents a gallon and the price of premium grade to 46.5 cents a gallon.
> Montreal Gazette,
> July 14th, 1956.

A perfectly inelastic demand curve at all points or prices would represent a group of products that are absolute necessities in exactly the quantities in which they are presently consumed [1] and for which there are no practical substitutes in the economy. Consumers faced by a price increase would, by definition, neither be able to alter their consumption of the product or buy a substitute. A perfectly elastic demand schedule would, on the other hand, be one for a product which is in no way considered a necessity, and for which there are substitutes readily available if the price should be increased above the going price. [2]

An individual motorist's demand curve for motor gasoline as a product, without reference to different brands, lies between these two extremes, but considerably closer to the former.

1. - When referring to elasticity over a certain period, such a curve could move either right or left, depending on growth in population, maintaining a 90° slope.

2. - An example of this exists in the oil industry in the case of the residual fuels sold to very large industrial accounts. If the price of bunkers exceed a certain amount, known as the break-even point, these accounts switch from oil to coal. Their equipment is made for such conversions and the cost of switching either to coal or oil is quite small. This in fact happened early in 1957, when the Aluminum Co. of Canada and Canadian International Paper converted to coal owing to pressures on Western Hemisphere bunker prices arising from the European shortage.

First, the motorist's demand for motor gasoline is derived from his demand for transportation in his car. Therefore, the only reason for which he will alter his consumption is that his demand for transportation increases or decreases. It is unlikely that, in most cases, his desire to take his car to work or to drive on Sunday will be affected by a decrease or increase of one cent in the general price of gasoline. [1]

Second, motor gasoline, practically speaking, is the only fuel that will allow him to effectively use his car for the purpose for which it was intended. A number of automobiles have been equipped recently with engines powered by diesel fuel oil. However, the cost of converting an engine to diesel fuel oil is prohibitive at present, ruling out this fuel as an effective substitute. It may be noted that the increasing amount of trucks and buses with diesel motors have the same relation to diesel fuel oil as the typical motorist has to motor gasoline. Therefore, if the price is reduced, there are no customers using a competitive fuel that would be drawn to motor gasoline; if the price is increased, there is no alternative purchase available. The choice is to buy gasoline or not to drive one's car.

1. - For example, a trip from Montreal to Quebec would cost the motorist only an additional dime. (200 miles at 20 miles per gallon.)

Third, the average motorist invests up to $5000. in his car. If no fuel is provided, the investment may be compared to burying money in the ground, apart from the satisfaction that accrues to some persons in owning an expensive car. Should the price of gasoline increase by 2 cents per gallon, the motorist would have to spend approximately an additional $14.00 per year for gasoline. Relative to the investment in his car, gasoline must be considered a necessity in reasonable price ranges, as a slight price adjustment would not be likely to change his demand for transportation, and indirectly, motor gasoline.

Fourth, gasoline has only one use - generating power in motor vehicles and some stationary engines. Thus, if the price fell, no consumers of close substitutes in other end-uses would purchase gasoline. No new buyers enter the market when downward price revisions are made.

Fifth, there is very little possibility of postponing purchases of motor gasoline, as it is against the law to store motor gasoline in other places than tanks in approved safety locations. To postpone a purchase in most cases involves the postponement of the demand for transportation.

Sixth, the elasticity of gasoline demand does not increase over time.

> This principle (that the demand for many products and service is more elastic when allowance is made for consumer adjustments to a changed price situation when only the immediate response to price change is considered) has little validity with respect to the generic demand for motor gasoline (unlike its application in connection with some products, eg., phonograph records). [1]

Owing to the necessity of motor gasoline, the lack of competition from close substitutes, and the other factors listed above, it is concluded that the average individual motorist's demand for motor gasoline is highly inelastic with respect to price changes within a reasonable range.

THE ELASTICITY OF INDUSTRY DEMAND FOR MOTOR GASOLINE AT THE RETAIL LEVEL

Since these individual demand curves, when totalled, form the industry demand in sub-markets, in provinces and nations, the general nature of the industry demand curves will likewise be highly inelastic with respect to reasonable price changes.

To quote Henry Schultz, the economist most noted for his development of demand elasticities in United States industries:

> A 10 per cent change in the average retail price would result in something like a 1.3 per cent change in the quantity taken by consumers. A price cut of around 30 per cent would be neces-

1. - Ralph J.Cassady & E.Jones, The Nature of Competition in Gasoline Distribution at the Retail Level, (University of California Press, Berkeley, California, 1950) p. 23.

> sary to stimulate an increase in the amount taken by consumers equivalent to the 4 per cent secular increase in gasoline consumption, which occurred between 1939 and 1940.

The industry curve will move to the right from its existing position as more individuals owning motor vehicles demand motor gasoline to power their cars.

A DISSENTING OPINION

A dissenting voice is Eugene V.Rostow in his book "A National Policy for the Oil Industry."

> But the large sellers of petroleum products generally believe that the demand for their products, and especially the demand for gasoline, is notably inelastic. This conviction is of course a typical article of faith among monopolistic sellers. It is an idea essential to the stability of a price system in which price competition is regarded as unethical, at best, and often vaguely criminal as well. The fact is that the market for petroleum products is decidely sensitive to price changes. As in other market contexts, elasticity of demand is not a simple or a continuous mathematical function. Market response to upward movements of price may be generally different than its response to price cuts. Gasoline is usually bought for prompt use, storage even for industrial consumers being expensive and limited. Thus forward buying by consumers in anticipation of price changes is of limited importance to the market. At different stages of the trade cycle, the quantity taken varies with price to different degrees, although petroleum products do not experience the extreme variations in consumption during the course of trade cycles which characterize capital goods like steel. The rate of exploration, and hence supply, is responsive to the level of prices.

> There is competition between petroleum products and other sources of energy, and between motor and other forms of transportation service, markedly influenced by relative prices..... While the elasticity of demand for petroleum products is in no sense a constant, applicable mechanically to all products or at all periods of a trade cycle, it is misleading to assume that price is immaterial to demand. 1

Some comments may be made on these statements by Mr. Rostow, a very severe critic of the oil industry.

1. - He states that elasticity of demand is not a simple or continuous function. However, it is unlikely that Professor Schultz's findings would shift so radically that a 10% decrease in prices would result in a 13% increase in quantity demanded. This would involve a 900% increase in demand elasticity.

2. - He points out that market response to upward movements of price may be generally different than its response to price cuts. It has been shown, however, that no new consumer will enter the market when a price cut is made, and that, in the face of a price increase, no products may be practically substituted by a car owner. Moreover, Mr. Rostow supplies no substantiation of his claim.

3. - The fact that gasoline cannot be stored does not increase elasticity. On the contrary, the fact that purchases may not be postponed increases the necessity of the product,

1. - Eugene V.Rostow, A National Policy for the Oil Industry, (Yale University Press, NewHaven, 1948) p. 13.

and hence its inelasticity, at a particular point in time.

4. - He mentions that the rate of exploration and drilling is responsive to the level of prices. There is a great difference between the elasticity of demand and the elasticity of supply, to which this statement refers. The writer fails to see how the fact that more wells are being drilled affects the amount of gasoline that Mr. X will buy when the price is reduced from 47½ cents to 46 cents per gallon.

5. - He points out that there is competition between motor transportation and other forms of transportation and that this competition is "markedly influenced by relative prices." This would attribute great knowledge to the average motorist, who, when the price increases from 47½ cents to 48 cents, decides that the time has come to take a bus or commute to work by train. Moreover, both trains and buses are powered by petroleum products. It is unlikely that the price of gasoline would radically change without adjustments in the prices of other petroleum products, particularly fuel oil.

It may, therefore, be safely concluded that the industry demand for motor gasoline, in practical price ranges, is highly inelastic.

THE INDIVIDUAL MOTORIST'S DEMAND FOR DIFFERENT GRADES OF MOTOR GASOLINE

The most significant difference between premium and regular grades of motor gasoline is their relative ability to prevent knocking, detonation or pinging. This ability is represented by the "octane numbers" of the two gasolines. Without entering into a technical discussion of the different methods of measurement, octane numbers reflect the relative components of the fuel isooctane, which is practically knockless in current automotive engines, and normal heptane, which knocks severely. Therefore, if a blend of 80% isooctane and 20% heptane is required to duplicate the knock intensity of the unknown gasoline, the gasoline would then be given an octane number of 80. [1]

> The octane requirement of a vehicle can be defined as the octane number of the reference fuel blend (usually isooctane and heptane) which produces barely audible knock during full throttle acceleration at standard ignition timing. [2]

The octane requirement of an individual motor vehicle is subject to many variables. Generally speaking, premium gasolines, which average 5 research octane numbers higher than regular grades, will satisfy 90% to 95% of all cars on the

1. - This is the Motor Method as distinguished from the Research Method, which gives an higher octane number. The difference between the two methods is called "Sensitivity," which depends on the type of hydrocarbon in the fuel.
2. - The Story of Gasoline, op. cit. p. 66.

road, whereas the average regular gasoline will provide enough road octane for only 65% to 75%. At one time, it was thought that commercial vehicles could use a low-grade gasoline in comparison to passenger cars. Recent octane requirement studies indicate that commercial vehicles have about the same average octane requirement as passenger cars of the same compression ratio.

The fuel value of high octane gasoline is obtained only when an engine is designed and adjusted to take advantage of it. For example, if a modern gasoline of 95 octane were used in an engine with a 4.5 compression ratio, the performance would be practically the same with 95 octane gasoline as it would be with 55 octane gasoline. Therefore, because the engine does not require more than 55 octane gasoline to suppress fuel knock, nothing is gained by using a better gasoline as far as knock is concerned. [1]

Engines can be made more powerful by increasing the size or number of cylinders, by improved carburetion, manifolding and valve design, or by increasing the compression ratio of the engine. A combination of all these methods has been used in recent years to increase the power of passenger car engines. An increase in compression ratio not only increases power but provides fuel economy.

1. - The Story of Gasoline, op. cit., page 71 and following.

The compression of an engine is increased by making the combustion chamber smaller in proportion to the total cylinder volume. Despite the fact that more work must be done to compress the mixture in the 9 to 1 compression ratio engine, there is a substantial net gain in efficiency and power due to the fact that less heat is rejected to the cooling system and more of the energy in the gasoline is put to useful work. Combustion temperatures are correspondingly higher in the high compression engine, and octane numbers must be increased for gasoline knocks when it is exposed to a combination of pressure and temperature too great for it to withstand. Otherwise, loss of power and eventual damage to engine parts would result.

> The value of high octane gasoline lies in its ability to burn smoothly without knock under high pressure and temperature, thereby permitting the high compression engine to give the extra power and economy for which it is designed. [1]

Since the compression ratios of cars vary, it is necessary to produce at least two grades of gasoline. Otherwise, high compression cars would knock or low compression cars would have to use unnecessary high octane gasoline.

Table No. 3 indicates that, although over the past five years sales of regular gasoline in Quebec have expanded by

1. - The Story of Gasoline, op. cit., p. 73.

8% more than premium grades, the trend in the last two years has been to grade No. 1 gasolines. This is due to two factors:

1. - The introduction of anti-stalling winter additives into Grade 1 gasoline in late 1954. This trend is presently being counteracted as similar additives were put in regular gasolines towards the end of 1956.

2. - Compression ratios on American-type motor vehicles have increased from 25% to 30% over the past three years. It is recommended at present in manufacturers' specifications that all cars from the Pontiac class up should use Grade 1 gasolines. This trend to higher compression ratios is likely to continue at a progressively lower rate.

PRICE DISCRIMINATION ON PREMIUM GRADES

Some analysts are prone to consider premium or more expensive quality products as leading examples of first-degree price discrimination. [1] Two conflicting opinions are given on this:

> Premium gasolines are usually 5 to 10 octane numbers higher in anti-knock quality than the corresponding regular grade gasolines. Although premium gasoline may average 6-10% more in cost per gallon, its cost per mile (per passenger mile, or ton-mile for commercial vehicles) may be lower if the vehicle's engine is designed or adjusted to utilize the additional octane numbers or to benefit from the extra additives of premium gasoline. [2]

The Ethyl Corporation is a strong supporter of the absence of consumer exploitation in the sale of premium gasolines.

1. - In many cases, justifiably so - a "deluxe" model refrigerator, which costs $5.00 more to produce due to additional chrome and special fixtures, often sells for $25.00 more than the standard line.
2. - The Story of Gasoline, op. cit. p. 73.

MOTOR GASOLINE SALES BY GRADE
(000 gallons)

PROVINCE OF QUEBEC - 1952 - 1956

	1952	1953	%	1954	%	1955	%	1956	%	1956/52
Premium Grade (No. 1)	196,317	202,131	3	222,828	10	243,507	9	279,059	15	42
Regular Grade (No. 2)	186,802	218,074	17	242,513	11	260,194	7	280,489	8	50
T O T A L	383,119	420,205	10	465,341	11	503,701	8	559,546	10	46

TABLE NO. 3

SOURCE: - Yearly Report of Gasoline Sales, Ethyl Anti-Knock Limited, Toronto, Ontario. 1956.

Mr. Rostow, [1] on the other hand, quotes Joe S.Bain, to the effect that additional TEL (tetraethyl lead, an additive that increases octane numbers significantly) costs only .37 cents a gallon, while premium grades usually retail for from 2 cents to 4 cents a gallon more than regular gasolines. Mr. Rostow may be overlooking the fact that more costs are involved in the production of premium motor gasoline than the addition of TEL. Additional refinery units for the production of lighter fractions, advertising of an additional grade, additional pumps and underground storage at retail outlets, and more refinery pipe-lines are supplementary costs.

It appears, therefore, that premium gasolines fill a desired requirement, and the additional cost of premium gasoline production approximates the higher price to the consumer.

THE CROSS-ELASTICITY OF DEMAND BETWEEN GRADES OF GASOLINE

As regards cross-elasticity of demand between the two products, regular gasoline is a poor substitute for the premium grade in a large part of the market. Cars above a certain compression ratio cannot use regular grades without loss of power and eventually damaging effects on their engines. Therefore, any shift of patronage due to the ex-

1. - A National Policy for the Oil Industry, op. cit., p. 13.

pansion or diminution of the price differential between regular and premium grades must be made by consumers owning cars with regular grade compression ratios.

In theory, any car which does not need premium gasoline, assuming no special additives are only in this grade, should use regular gasoline as long as the price is fractionally below premium grade gasoline. In practice, this conclusion is affected by the lack of consumer knowledge concerning the actual usefulness of premium gasoline. Table No. 4 indicates the answers dealers gave to the question: "What is the difference between the two grades of gasoline?"

The variety of answers from these dealers gives a good indication of the lack of knowledge on the part of buyers, who should be even more poorly informed. As a result, when the differential is narrowed, considerable cross-elasticity would exist as normal regular grade consumers would switch to the premium gasoline they don't need and can't benefit from. Conversely, when this differential is increased, many of those consuming premium would return to purchasing regular grade gasoline.

If consumers, in conclusion, were fully informed, no cross-elasticity would exist. Since this is not realistic, a considerable degree of cross-elasticity between grades

is present in the motor gasoline market relative to price changes, particularly advertised ones, from the existing price situation.

"What is the difference between the two grades of gasoline?"

Province of Quebec

Number of Cases	-	127	100%
No Answer	-	3	2.4
Number Answering	-	124	100%
Higher Octane Rating	-	60	48.4
Contains additive planned for high compression engines	-	5	4.0
Contains tetraethyl lead	-	8	6.4
Contains lead	-	1	0.8
Contains an anti-knock additive	-	1	0.8
Prevents carbon deposits	-	1	0.8
Contains TCP	-	14	11.3
Contains unspecified additive	-	5	4.0
Difference in colour	-	3	2.4
More highly refined	-	1	0.8
Has more power	-	39	31.5
Better starting	-	1	0.8
Better mileage	-	7	5.6
Faster Pick-up	-	1	0.8
Slower Burning	-	1	0.8
Better Performance	-	17	13.7
Hi-Test better grade	-	3	2.4
Other Differences	-	5	4.0
Don't know	-	2	1.6

TABLE NO. 4

Source - Survey of Gasoline Station Operators in Eastern Canada, (Ethyl Corporation, Toronto, 1956) p. 52.

p. 34 missg. error in pagination -35-

CHAPTER 4 - THE DEMAND FOR MOTOR GASOLINE AT THE RETAIL LEVEL

INTRODUCTION TO CHAPTER 4

In Chapter 3, the natures of the individual and industry retail demands for motor gasoline as a simple product and at various quality levels were discussed. In Chapter 4, the main topics are the adaptation of supply to demand in its full multi-dimensional character, the elasticity of firm demand, and the nature of retail competition as influenced by demand considerations.

It has been seen that all retail motor gasoline demands, whether at the local, provincial or national levels, are summations of the demands of individual motorists. These individual demands are obviously localized in varying intensities, dependent upon the concentration of population and the existing road network. Demand, in this geographical sense, can be visualized as large or small black dots and thick or thin black streaks on any road map corresponding to the location of population and the importance of existing roads.

THE MAXIMIZATION OF PROFIT OPPORTUNITIES

Any potential supplier will be attracted to the retail gasoline business only if he thinks that he will receive a relatively profitable return on his investment in this type of business. Ignoring cost considerations, profit opportunities will directly depend upon volume opportunities, and volume opportunities will depend upon the localization of demand.

In a monopolistic or communist economy, motor gasoline would be made available in cheap, unattractive outlets, located so that each one would operate at capacity. [1] The adaptation of supply to the concentration of demand in a competitive economy is decidedly different, owing to the principle that what is profitable to one will be profitable to another under conditions of free entry, and the assumption that the existing suppliers hold no exclusive control of profit opportunities.

If a person opened a retail outlet on an intensively travelled Montreal thoroughfare, he would maximize his profit by minimizing his costs of construction, equipment and operation, assuming he is the only supplier in the area. However, a potential competitor is able to enter the local-

1. - There are only 8 service stations in Moscow.

ized market profitably by providing slightly more attractive facilities, better service or a superior product.

Thus, the adaptation of supply to demand is conditioned by the multi-dimensional character of this demand as evidenced in the nature of competition within actual markets. This multi-dimensional character may be analyzed by reviewing the reasons individual motorists patronize one service station rather than another.

THE MULTI-DIMENSIONAL NATURE OF RETAIL MOTOR GASOLINE DEMAND

Any analysis of consumer buying habits in relation to motor gasoline purchases will include the following patronage motives.

1. - Convenient location
2. - Service
3. - Brand of gasoline
4. - Accessibility of the outlet
5. - Personality of the operators
6. - Possession of a credit card
7. - Appearance of a service station
8. - Low price

Analysis of this type is usually developed with each motive viewed as an entity, often overlooking the complex nature of choice which usually involves two or more of the listed patronage factors. Moreover, this type of analysis does not differentiate between the motives governing the

patronage of a particular station and those merely determining the general type of station patronized.

Ralph J.Cassady, in his "Nature of Competition in Gasoline Distribution at the Retail Level," [1] suggested the distinction between qualifying and selective motives.

> Patronage motives should be classified on a basis of (1) those governing the type of station which will be patronized (qualifying factors) and (2) those which govern the purchase at the particular station (selective factors). That is, certain basic factors, such as convenient location in relation to the home, might qualify the outlet for inclusion among those from which selection is made on the basis of some differentiating characteristic, such as attractive facilities.

The following table classifies the various patronage factors on this basis.

Qualifying Factors	Selective Factors
(1) Convenient location	A) Ease of entrance
(2) Reputation for efficient service	B) Extraordinary service
(3) Acceptable brand	C) Preference for a particular brand
(4) Generally acceptable price	D) Concessions from the market price
(5) Clean and attractive facilities	E) Personality of attendants
(6) Availability of credit	F) Possession of credit card by consumer
(7) General reputation of company represented	G) Urgent need for service

1. - The Nature of Competition in Gasoline Distribution at the Retail Level, op. cit. pp. 29-30.

As these patronage motives, both qualifying and selective, influence the nature of retail gasoline competition to a very significant degree, it might be useful to discuss briefly each of these factors to appreciate the varying importance each has in the all-important final choice by individual motorists.

QUALIFYING FACTORS

Convenient location is a function of the individual motorist's current activity and to a lesser extent of the level of the motorist's gasoline tank. For example, certain service stations are conveniently located when a motorist is driving to his place of business, the same ones or others when he is visiting friends, and usually entirely different service stations when he is driving on the highway. Moreover, if a consumer's gasoline tank is full, no station is conveniently located until he burns off an arbitrary amount of his most recent purchase. Thereafter, his purchase will depend to a large extent on habit - some motorists buy when their tank is half full, others when it is almost empty. In the latter case, the number of convenient locations is considerably reduced. Convenience of location, although a highly variable factor, is the primary qualifying motive - obviously, to buy gasoline at any retail outlet, the motorist must be in the general vicinity.

The following factors are not listed in a sampled order of importance, but are in total, reasonably complete.

The second qualifying factor, reputation for efficient service, is, by nature, a psychological rather than a purely logical motive. Biases are established from individual experience that determine what stations, usually classified by brand name, qualify for patronage in this respect.

The acceptability of particular brands will depend as much on the amount of quality advertising done by the brand suppliers as on the technical quality of the motor gasolines. Retailers of major brands will have a decided advantage in this respect, although independent retailers receive their supplies in most instances from the major refineries. Joe Bain notes:

> Intensive sales promotion has tended to set major brands in a quality class apart in the minds of buyers, whereas the minor brands occupy an inferior position in the public eye. [1]

The third qualifying factor, a generally acceptable price, is relative to the prices within the individual motorist's geographical range. If a motorist is accustomed to purchasing in an area where gasoline retails for 45 cents per gallon, he does not find this price unreasonable because the product sells for 30 cents per gallon in

1. - Joe S.Bain, Pacific Coast Petroleum Industry, Part I, (University of California Press, Berkeley and Los Angeles, 1944) p. 197.

California. This factor, however, is not particularly significant since all prices within an area are typically uniform at outlets of the same type.

Most motorists attach great importance to the fifth qualifying factor, clean and attractive facilities. A situation is frequently found where two stations are on the same intersection, one selling at 3 to 4 cents below the other, but with substantially less attractive facilities. The fact that the attractive station does not meet the other's lower price indicates that he is not losing significant volume to the price-cutter. In other words, motorists on the average place a value on clean and attractive facilities that may be measured in terms of cents per gallon.

Some motorists will also attribute a certain value to the availability of credit facilities at outlets marketing major brands of motor gasoline. The fact that credit is available does not mean that all consumers will take advantage of this convenience, as experience indicates that credit customers consume more on the average than those paying directly for their purchases. This trend, of course, is not particular to the purchase of motor gasoline, for it is always much less painful to sign one's name than to pay directly "out of the pocket."

The general reputation of the company represented at the retail level depends on two factors - the length of the period of establishment within a marketing area and the importance attached to public relations by the supplier company. As a general rule, major suppliers are most anxious to promote consumer goodwill, and spend large amounts of money to explain their technical progress, research and good intentions to the public. Again, this qualifying motive is not particular to the oil industry, for the only company that can afford to overlook public relations is one that monopolizes the marketing of an essential commodity. Even wholesalers, as are major refiners, must promote their franchise and the quality of their product with existing and potential retailers.

These seven motives, taken together or in part, with a particular weighting depending upon the individual, will qualify an arbitrary amount of service stations as outlets suitable for an individual motorist's patronage. The individual must still select one from among these qualified retail outlets, and certain other factors will influence this final choice.

SELECTIVE FACTORS

The first selective factor is ease of entrance. This is of particular importance to women drivers for obvious reasons, but also can be important to male drivers. For example, if a motorist must make a right-hand turn to go to work and can merge with the heavy traffic if a gasoline purchase is made at an outlet on the right-hand corner of the street, this could easily be enough to influence him in favor of that outlet. To patronize the stations across the street would involve two left turns into heavy traffic which could be easily avoided. Thus, at certain times, service stations on opposite sides of a busy street are in only indirect or remote competition.

The second selective factor noted by Mr. Cassady is extraordinary service. This might mean cheap washings, greasing, discounts on tires, batteries or accessory items, 24-hour service, etc.; any one of a whole range of special services could be enough to swing the balance in favor of one of two equally well-located and accessible service stations.

Preference for a particular brand, as noted earlier, depends more upon the consumer than upon the technical quality of the various brands of motor gasoline. The

motorist is influenced by supplier advertising, both informative and persuasive. It is to the credit of gasoline retailers that claims of absolute superiority are minimized. A survey by the Ethyl Corporation indicates that approximately 50% of all motorists buy the same brand of gasoline on every occasion. A considerable portion of this 50% buy the same brand consistently because they feel it is the best on the market in respect to quality.

The fourth selective factor, price concessions, will be reviewed below in connection with the nature of retail competition.

The fifth and sixth selective motives, personality of attendants and the possession of a particular credit card, are very significant to the regular customers, that 50% of all motorists that buy the same brand all the time. The possession of a particular credit card is a result of other selective motives, rather than being a selective motive in itself. In other words, if a customer feels that Imperial Oil provides the best gasolines and service, he may request a credit card for the sake of convenience, having already decided to patronize Imperial outlets.

The last selective factor, urgent need for service, is most applicable to highway driving. While motoring in

the city, an alternative choice is usually available within a few blocks, and an outlet supplied by a particular major within a mile.

This reasonably complete listing of qualifying and selective motives indicates that the pattern of individual choice is quite complex; for example,

> there are individuals who demand a particular brand at a clean, conveniently located station; those who are indifferent to brand, but choose on a basis of price combined with a location convenient to home; those who desire full service and a well-known brand of gasoline at a station near work; those to whom location is not important, who have no brand loyalty, and who do not wish service, but who do buy on the basis of price. [1]

There are then different broad classes of consumers in any location - those susceptible to advertising, others to price, others to service, etc. Two stations may, therefore, not be in competition even though at the same intersection, because each appeals to a different class of consumer.

To conclude, the quantity demanded is not solely related to the price of gasoline at different retail outlets, despite the fact quality variations are, for practical purposes, negligible. Demand for motor gasoline is then truly multi-dimensional at the retail level.

1. - The Nature of Competition in Gasoline Distribution at the Retail Level, op. cit. p. 46 (footnote).

> The outstanding characteristic of the retail markets, however, is the differentiation of products in a large number of dimensions. [1]

In other words, a customer may pay more for one gasoline although other gasolines are equal in respect to technical quality, because the one he purchases is, in his mind, better in a certain sense of quality, which may be called non-technical.

> The product which the buyer receives is essentially the branded commodity in question plus some assortment of free services, the importance of which is not inconsiderable. [2]

THE ELASTICITY OF FIRM DEMAND - RETAIL MOTOR GASOLINE

The elasticity of firm demand must, by definition, have relation to the activities of two or more competitors, except in the case of a monopolistic seller, in which instance the industry and firm demand curves are one and the same. Hence, where there is an absence of monopoly, we are dealing with a market wherein two or more firms actively compete for sales.

> A "market" in the objective sense and as a sphere of economic relationships to be included in an empirical investigation of price behaviour, was defined above as some area which is reasonably homogeneous with respect to the principal forces of price determination. It thus includes a group of sellers

1. - Pacific Coast Petroleum Industry, Part I, op. cit. p. 197.
2. - Ibid. p. 197.

> (and their products) whose 'subjective markets' are largely coextensive, or, in other words, all of whom sell to a common group of buyers in a common territory. [1]

To analyse the elasticity of firm demand, the simplest of all retail markets may be imagined - the competitive relationship of two service stations, a duopoly, located at the same intersection, with equal accessibility to the main stream of passing traffic. This preliminary assumption is not unrealistic.

> Whereas the limits of the whole domestic market are defined from the point of view of the major refiners, the limits of a local distributive market may be defined from the standpoint of the individual distributive outlet, whether integrated or independent. [2]
>
> The market area of any individual service station therefore includes a very limited territory and a very limited number of immediate rival sellers - considerably less than would sell in a medium-sized or large city. [3]

Since the two stations to be analysed have 'subjective markets' which are coextensive, they are in direct competition and hence subject to the same price-determining forces.

A demand curve, whether industry or firm, will depend for its elastic or inelastic nature to a large extent on the availability of close substitutes. Two equally well-

1. - Pacific Coast Petroleum Industry, Part I, op. cit. p. 186.
2. - Ibid. p. 188.
3. - Ibid. p. 189.

known brands, offered at equally accessible and attractive outlets, are very close substitutes one for the other. Apart from the brand name which creates a degree of product differentiation, they are, in fact, perfect substitutes. It is concluded that the firm demand curve for retail motor gasoline, subject to certain considerations, which will be reviewed below, is highly elastic owing to the availability of close substitutes.

> The reason for the higher degree of demand elasticity for the product of the firm than for a product of the industry is that any change in the total amount taken by consumers which results from a change in price is a result of a change in the total amount purchased by consumers, while any change in the amount taken of the product of any one firm resulting from a change in the price by that one firm alone is, at least in part, a result of a shift in patronage from one supplier to another. More simply stated, when all firms drop the price any increase in amount taken may be moderate because the response is confined to those who have not previously purchased the product or perhaps have purchased but are now purchasing more of it; when one firm only reduces its price, the response will be made up not only of those who are buying for the first time or who are now buying more but also includes some who are shifting patronage from other suppliers to the price cutter. [1]

1. - Ralph J.Cassady, Price Making and Price Behaviour in the Petroleum Industry, (Yale University Press, 1954) p. 77.

COMPLICATIONS IN FIRM DEMAND ANALYSIS

This simple analysis of the elasticity of the typical retail outlet's demand is complicated by at least four considerations which are particular to a certain extent to the marketing of retail motor gasoline, although the demand for other products may be complicated by one or more of these factors.

1. - Buyer knowledge.

2. - The Presence of Brand Names.

3. - The Applicability of the Elasticity Concept to Demand Factors other than Price.

4. - The Influence of Dealer Margins.

Since price-elasticity measures the change in the quantity of the product demanded relative to the change in the price of the product, a price change must be recognized to be of any effect.

> As elasticity of demand is conditioned by response of consumer-buyers to price changes, it necessarily follows that the amount of information consumers have concerning price changes will affect elasticity. [1]

It follows that the degree of price-elasticity of a firm's demand, particularly in a downward price adjustment,

1. - The Nature of Competition in Gasoline Distribution at the Retail Level, op. cit., p. 24.

will depend to a large extent on the effectiveness of the advertisement of this cut.

> ..... display of price signs is important to the success of aggressive price competitors in the gasoline field, since they tend to intensify the response to the price cut. [1]

A second complicating consideration in an analysis of the elasticity of retail motor gasoline firm demand is not particular to this product - the differentiation of products through brand names. While motor gasolines are for all practical purposes of the same technical quality, they are not perfect substitutes as distinctions have been created in the public mind through advertising, particularly as between major and independent brands. The oil industry follows the neo-classical Chamberlinian model perfectly; suppliers desire to provide a product close to that of their competitors so as to be able to shift the patronage of their competitors' customers, and yet to differentiate their product within the broad framework of the industry as much as possible.

This discussion of brand names leads to the third consideration affecting elasticity of firm demand. Since elasticity is relative to price as well as quantity, it follows that, with demand of a particularly multi-dimensional nature in the case of motor gasoline, the elasticity concept

1. - The Nature of Competition in Gasoline Distribution at the Retail Level, op. cit. p. 25.

can be applied to other merchandising methods apart from price. To cut price is, in effect, to incur an extra "cost;" it is expected that the total profit will be larger through increased volumes, despite the decrease in per unit profit. Similarly, improved lighting, cheap car washes or more courteous service have a certain "elasticity" relative to their "cost." It may be noted that courtesy costs practically nothing, yet is one of the most effective tools in increasing sales at the retail level. While large price reductions are admittedly the sharpest of all competitive methods, sound policy dictates a look at the methods that are likely to be more advantageous in the long-run. Moreover, the value placed by consumers on non-price factors reduces the effect of a price-cut at an unattractive outlet marketing an unknown brand. The price-cutter's demand elasticity depends directly on how many customers he draws away from his rivals. Experience in the Los Angeles area indicates that major brand outlets will not lose significant volume if independent price cutters do not shade the majors' prices by more than 3 cents. In the language of economics, the independent outlet's demand curve does not flatten or increase its elasticity until a price x cents below the major outlet's posted price is reached. The whole shape of the independent demand curve is relative to the price at

the outlet selling a major brand. If the independent outlet posts the same pump price as the major outlet, its volume will decrease significantly from the volumes it would receive at posted and advertised discounts. [1] However, the elasticity of demand between major brand outlets is very high owing to the possibility of substitution of the major products in consumers' minds. Similarily, the elasticity of demand between independent, price-cutting outlets is even higher, because to their price-conscious customers, their products are perfect substitutes, excluding the attractiveness of outlets and other non-price factors which are usually equal at outlets of this type.

1. - It should be noted that refiners ordinarily do not control the pump price at their retail outlets except through education of the individual operator. Major outlets may be classed as:

1. - Company-owned and Operated Stations - a salaried employee operates the station on behalf of the major supplier who maintains complete control of pricing policies.

2. - Company-Owned Service Stations which are leased to independent businessmen for a rent. The Company, while not allowed to force the tenant in any matter, naturally retains the right to refuse the renewal of any lease upon its expiration.

3. - Financed Accounts - the major company finances an independent businessman in the establishment of a retail outlet. In return, the company receives an exclusive supply contract for a stipulated duration. Typically, these outlets are neither as large or attractive as Company-Owned Service Stations.

4. - Dealer accounts - The largest portion of retail outlets are in this category. The dealer enters into a supply contract with a refiner, and is in turn allowed to use the supplier's brand-name, loaned equipment, pumps and tanks. This secures the gallonage for the supplier to a certain extent.

Finally, the high elasticity of demand is conditioned as to its possible influence on competitive practices by dealer margins. When an operator is considering a price change, he must consider the effect of the contemplated price change on his profit, even ignoring the possible reactions of his competitors.

> To take an example: a retailer operating on a 4 cent margin sells 10,000 gallons of gasoline at 25 cents (per gallon.) Wishing to induce additional patronage, he drops the price to 24 cents (a 4 per cent reduction.) As a result, sales increase by 8 per cent (to 10,800 gallons.) His sales volume which was $2,500 before, now is $2,592; thus, whereas before the amount he was able to retain as gross margin was $400 (10,000 times 4 cents), it now is $324 (10,800 times 3 cents), a substantial reduction. Actually, the retailer would have to sell 13,334 gallons at the 3 cent margin in order to do as well as before, even assuming that operating costs were not enhanced by the increased volume, that is, the rate of elasticity would have to be 8-plus if the seller were to break even on a one-cent price-cut. [1]

This consideration, while not limiting the elasticity of demand in the technical sense, certainly limits the use of price-cutting as a competitive weapon in practice, even ignoring competitive reactions.

To conclude this section on the elasticity of the demand of firms marketing motor gasoline at the retail level, it has been seen that:

1. - The Nature of Competition in Gasoline Distribution at the Retail Level, op. cit. footnote, p. 31.

1. - Generally speaking, the elasticity of firm demand is very high, but that this is limited by:

2. - The lack of consumer knowledge,

3. - The differentiation of the product in many respects, which results in different rates of elasticity between major outlets, between majors and independents, and between independents.

4. - The effect of the dealer margin, which, ignoring rival reactions, limits the possibility of exploiting an highly elastic demand curve.

THE NATURE OF COMPETITION IN RETAIL MOTOR GASOLINE MARKETING

The preceding section discussed the elasticity of firm demand in isolation; in practice, this high elasticity conditions the whole nature of retail marketing, particularly the choice of competitive weapons. Gasoline retailers cannot ignore price-cutting owing to the oligopolistic nature of the immediate market. This statement is conditioned by the fact that, while major price-cuts cannot be ignored by any competitor, less well-known brand marketers may sell at a certain amount below the pump price at the outlets selling a major brand. When the price-cut exceeds the value that consumers place on the superior attractiveness and service at major outlets, these cuts likewise cannot be ignored, owing to the large decrease in sales that will result. The result of the price-cut is, with this exception, that

it must be met by defensive price adjustments. Nothing is to be gained owing to the highly elastic nature of the firm demand curve and inevitable rival reaction from cutting price, except in the very immediate short-run.

The neo-classical theory of the monopolistic competitive market, under which category retail gasoline firms would likely be placed, at least in large urban centres, holds that price-cutting is possible without reaction because each rival would lose an insignificant amount of business to the price-cutter. However, even in a large city, the urban market is nothing but a composite of smaller oligopolistic markets - the individual operator forms an oligopolistic market with the 3 to 4 competitive outlets on either side of him, and similarly for all operators within the metropolitan area. A price-cut by any of these immediate rivals, particularly if they are major brand marketers, must bring forth a defensive price adjustment.

The use of price as a competitive weapon is ruled out by common sense and the realization of long-run profit opportunities. Competition for volume must of necessity turn to other less sharp methods.

> This elasticity is likely to lead toward several interesting competitive results: 1) the existence of identical postings by all firms offering well and favorably known brands (since any open

> price differential would result in a drastic shifting of custom from one firm to another); 2) a heavy reliance on persuasive sales effort by such firms to provide sales; and most important, 3) the use of the posted price as a point of departure from which price rebates and discounts are granted to individual buyers (since such price competitive activities cannot easily be neutralized by other sellers. [1]

A DISSENTING OPINION

This logical outcome of a market characterized by very high intramural price elasticity is severely criticized by Mr. Rostow.

> The pricing practices which prevail in such a market of a few sellers are naturally those of price leadership and limited competition. In most areas the prevailing price is at or near the price posted by one or another of the big sellers. The fact implicit in the structure of the market, that any price can and will be met by other large sellers, is a sufficient force to deter frequent or aggressive price competition. Under the circumstances, price competition seems to promise no major seller additional profit, since all sellers tend to underestimate the elasticity of demand for their product ..... The major sellers attempt to change their share of the market largely through advertising, multiplication of selling outlets, and the development of consumers' preferences. Selling costs of this type are incurred as an alternative to price competition. In the oil industry they have developed to grotesque extremes, both as advertising expenditures, and in the building of offset filling stations at every conceivable corner where traffic might pass in sufficient volume. The manifest wastes of such behaviour raise the question whether in many cases monopolistic competition may not be more costly to society than monopoly itself. [2]

1. - Price Making and Price Behaviour in the Petroleum Industry, op. cit. p. 78.
2. - A National Policy for the Oil Industry, op. cit., p. 76.

Certain comments may be made on Mr. Rostow's statement.

1. - The major company is strictly a wholesaler, and the pump price is set by the individual operator. The prices are identical (it is impossible not to compete on price) because the dealers realize that it is to their benefit not to "cut each others' throats." The major supplier will certainly educate the dealer as to the benefits of maintaining price, so as to insure the dealer a living wage.

2. - Volume is a necessity to efficient refinery operations. When a new competitor enters the retail market, established marketers' volumes and hence profits are in danger if the market itself is not in a period of rapid growth. Mr. Rostow does not realize that it is absence of collusion that results in the "offset stations;" otherwise the market could be divided arbitrarily and profits maximized for the industry to the detriment of the consuming public.

3. - To eliminate major brand names would only result in the same number of outlets, each of which would remain in a local oligopolistic market, with an even higher elasticity of firm demand. Competition would still turn to non-price weapons.

4. - To eliminate the large refineries would result in the loss of the economies of large scale production which are indigenous to the petroleum industry at the manufacturing level.

5. - The retail market is not a monopolistic competitive one, but a composite of local oligopolies, wherein rival reactions can never be ignored.

> ..... a metropolitan area is a series of overlapping groups of "markets" bound together more or less like the links of a chain mail. The products of the farthest separated stations in the area are distant substitutes, but are connected by an intervening succession of stations, the products of each of which is a close substitute for those of adjacent stations on either side. [1]
>
> While the choice of suppliers by gasoline consumers is largely local, service-stations market areas are not mutually exclusive but may be pictured as a group of overlapping circles; hence each customer's market is affected to some degree by the policies of the others. This effect might extend for a considerable distance by wavelike transmission from vendor to vendor until the effect is dissipated. Indeed, in time, effects might be transmitted by this peripheral rivalry so as to extend finally over a whole metropolitan area ..... [2]

6. - The consumer has not suffered nearly as much as Mr. Rostow believes. The gasoline prices, excluding taxes, of one of the major companies in Quebec have increased by only 7.1 cents for Grade 2 motor gasoline since 1931, and by 6.6 cents for Grade 1. These increases are very significantly below the growth of the wholesale price index over the same period.

1. - Pacific Coast Petroleum Industry, Part I, op. cit., p. 188.
2. - The Nature of Competition in Gasoline Distribution at the Retail Level, op. cit., p. 27.

The petroleum industry in Quebec has provided an improved product with higher octanes and anti-stalling additives to the retail consumer at prices that have increased only slightly in the past twenty-five years.

CHAPTER 5 - OTHER DEMANDS FOR MOTOR GASOLINE AS A CONSUMER GOOD

INTRODUCTION

Although retail sales comprise the bulk of total motor gasoline sales in Quebec and other parts of Canada, the other demands for motor gasoline as a consumer good are particularly significant with respect to overall motor gasoline manufacturing and marketing policies. These non-retail demands represent approximately 25% of the total motor gasoline market.

There are many industries with individual demands for motor gasoline. The end-use remains the same as in the retail market - to provide power for motor vehicles. Under the broad non-retail category are included bus companies, for example the Montreal Transportation Commission and the Provincial Transport Company, some taxicab chains, [1] large truck transport companies, the federal, provincial and municipal governments, all forms of industry and the farmers of the province.

This chapter analyses the differences between these non-retail demands and the retail demands at the industry and firm levels reviewed in the foregoing chapters. The

1. - Others buy at retail outlets.

first section of Chapter 5 deals with the elasticity of the demands from non-retail consumers, the second section deals with non-retail firm demand, and finally, the third section deals with the existing nature of competition in these particular sub-markets for motor gasoline as influenced by demand considerations.

THE INDUSTRY DEMAND FOR GASOLINE AT THE NON-RETAIL LEVEL

The elasticity of the industry demand for any product or service depends on the intensity of the desire for the product or service, the existence or absence of acceptable substitutes for the item, and the practicability of postponing purchases. It was concluded that the industry retail demand for motor gasoline was highly inelastic owing to the absolute necessity of motor gasoline to the owner of a conventional motor vehicle, the complete absence of substitutes in the short-run, and the practical impossibility of storing the product after its purchase by the ultimate retail consumer.

Very little change in this conclusion is found when the same measures are applied to non-retail demand.

In the short-run, a bus company that has a fleet with motors that may be powered solely by motor gasoline has no

choice but to purchase motor gasoline at the lowest available price. In the long-run, however, a possible switch to diesel-powered motor vehicles will increase the elasticity of the long-run industry non-retail demand curve.

> The nature of substitution in the petroleum while not unique is different from that found in some other industries (for example, foodstuffs). For one thing, to a rather substantial degree substitutes for petroleum products are provided by the same industry which provides the original product ..... Likewise, diesel fuel and liquefied petroleum gas have made inroads on gasoline-motored trucks and buses. [1]

Motor gasoline is even more necessary to the typical non-retail consumer than to the retail consumer. To a hauling company owning a fleet of ~~either~~ trucks or a bus company with vehicles powered by engines using motor gasoline, gasoline is an absolute necessity. To the retail consumer, gasoline is only an absolute necessity if he wants to use his car. The fleet owner has no choice - he must use his trucks or go out of business. Most accounts owning delivery trucks will also find themselves in the same position. If this factor were the only consideration in evaluating the elasticity of industry demand, it would be concluded that non-retail demand is typically even more inelastic than retail demand.

1. - Price Making and Price Behaviour in the Petroleum Industry, op. cit., p. 17.

The possibility of postponing purchases is increased only to the extent that the typical industrial or agricultural consumer will have a certain amount of product in his storage tank. When the stored product runs out, motor gasoline again becomes an absolute necessity. [1]

In conclusion, the industry non-retail demand curve does not vary significantly from that of the retail demand curve, and in all probability, is slightly more inelastic.

THE FIRM DEMAND FOR GASOLINE AT THE NON-RETAIL LEVEL

The most significant difference between the non-retail and the retail buyer, relative to the product of a particular wholesaler, is that the non-retail buyer is more informed as to product quality and prices.

> Generally speaking, the type of buyer of a commodity has a considerable influence in price-making. Consumer buyers (retail) are, for example, not as well informed and are apt to be more emotional in their purchasing than industrial buyers. [2]

As a result, the effect of product differentiation on a brand name basis is considerably reduced. Competitive products are more perfect substitutes than in the retail market.

1. - However, some contracts are signed based on the delivery of certain volumes at a fixed price over the contract period.
2. - Price Making and Price Behaviour in the Petroleum Industry, op. cit., p. 18.

The effect of persuasive sales efforts is likewise reduced. The majority of advertising material directed at industrial accounts stresses the technical service available through signing a contract with a particular supplier.

The elasticity of firm demand is considerably increased owing to the availability of more perfect substitutes in the minds of the non-retail consumers. Of course, the larger the account, the larger will be the expense involved and the likelihood of more perfect knowledge increased. "In technical terms, the market for industrial items tends to be considerably more 'perfect' than the market for consumer (retail) items." [1]

THE NATURE OF COMPETITION IN GASOLINE MARKETING AT THE NON-RETAIL LEVEL

The earlier analysis of the nature of the competition in the retail market produced the conclusion that, since the firm demand curve is highly elastic and there are only a few sellers in the immediate or most local market, the use of price as a competitive weapon was ruled out and volume was sought by the means of advertising, service station construction and the provision of better service. It was recognized, however, that certain selective or "under-the-canopy" discounts were made to some retail customers.

1. - Price Making and Price Behaviour in the Petroleum Industry, op. cit., p. 18.

It would appear logical, therefore, to conclude that, since non-retail firm demand is even more elastic than retail demand, the nature of competition in the non-retail market would parallel that of the retail market. The need for volume is still present.

> Production of petroleum products is a type of process which calls for continuous full-capacity operation in order to keep costs at the lowest possible point and to utilize contract crude. [1]

Competition through advertising of product quality is less effective because of improved consumer knowledge in the non-retail market. Moreover, by definition, the acquisition of increased volumes through construction of new service stations is ruled out. In other words, non-retail demand does not have as many dimensions as in the retail market. Mr. Cassady states that competitive activity is concentrated in the use of certain methods:

> 2. - Competitive activities in sales to farmers: The attempt by a supplier to take over farm accounts by the offer of more favourable prices or terms. This may be done on a basis of a discount from the posted price to an individual or to a farm group, or on the basis of providing special facilities or equipment.
>
> 4. - Competitive activities at the commercial level.
>
> a) - On the basis of price. The offer of a discount from the posted price to accounts (such as taxicab companies) which purchase petroleum products for their own use.

1. - Price Making and Price Behaviour in the Petroleum Industry, op. cit., p. 43.

b) - On a basis other than price. Solicitation on commercial user accounts on a basis of providing facilities and equipment. [1]

It is evident from actual experience that price is frequently used as a competitive weapon in the solicitation of non-retail accounts. There exist a number of reasons why experience in this instance varies from that of the retail market. Generally speaking, the problem resolves itself around the possibility of rival reactions. In the retail market, a cut by a major must be met since the volume lost by an individual outlet, if his neighbour sells below him, represents a large percentage of his total sales, and hence his profit, which is calculated on a per-unit basis. In the non-retail market, it is possible in some instances to cut price to an industrial, commercial or fleet consumer without fear of reaction.

1. - The account is lost by a major supplier or wholesaler and, if the volume is moderate, represents only a very small percentage of the total sales of that supplier; hence, in the majority of cases, the loss of an isolated account would not bring forth a general reaction on the part of the company who lost the account.

2. - Moreover, refiners find themselves in varying long and short supply conditions at the same time. A refinery that

1. - Price Making and Price Behaviour in the Petroleum Industry, op. cit., pp. 93-94.

is long in gasoline may solicit an account presently held by a company that is short on gasoline without fear of reaction, again depending on the size of the account solicited.

3. - If a new firm enters the non-retail market, it may actively seek accounts on a price basis without fear of reaction in the short-run, for the reason that, once the contract is signed, there is no possibility of reaction.

4. - Some refiners do not solicit very large industrial and fleet accounts with discounts considerably below the posted price owing to the insecurity of this type of business. The loss of a large account would involve costly refinery production cutbacks.

5. - Possible rival reactions may be influenced by the fact that the competitor may be receiving sufficient volume for efficient operations from the retail market, and is not severely affected by the loss of one account, even a large one.

6. - "In the petroleum industry, however, much of the selling at this level (industrial) is the result of individual negotiation (and hence is quasi-secret) with the result that price cuts can be made with advantage to the initiator." [1] Some large companies, however, publish bids in the newspaper.

1. - Price Making and Price Behaviour in the Petroleum Industry, op. cit., p. 18.

Demand in the retail market, therefore, is the conditioning factor with each outlet being able to supply increasing volumes at the going price on a profitable basis. The only supply consideration that will affect the individual operator is that he may have to order three tank-wagons instead of two each week. If, however, his sales fall off owing to price-cutting activity in the immediate vicinity, he cannot ignore the decrease in his profit. In the non-retail market, on the other hand, supply considerations are much more significant as the efficiency of a refiner's operations is involved to a certain extent. " ..... it is in this market (industrial) that a sloppy supply situation generally has a direct effect on prices." [1]

1. - Price Making and Price Behaviour in the Petroleum Industry, op. cit., p. 158.

CHAPTER 6 - TRENDS IN THE CONSUMPTION OF MOTOR GASOLINE

INTRODUCTION TO CHAPTER 6

Any analysis of motor gasoline demand would be incomplete without a look at the behaviour of consumption over time - the relation of demand to long-term, cyclical and seasonal periods.

A demand curve for total motor gasoline would, by definition, show the relation of total gasoline quantities to price variations, holding constant the quality of the products that make up the industry, advertising and other selling costs, the purchasing power of the common group of buyers, consumption patterns, secular growth, the price output relation of all other goods in the economy, and other demand variables. The statistical impossibility involved in isolating these variables, as well as the necessity of experimentation to discover consumer reaction at other than the going price, has naturally resulted in the unavailability of such a demand curve in the technical sense.

VARIATION IN DEMAND OVER TIME

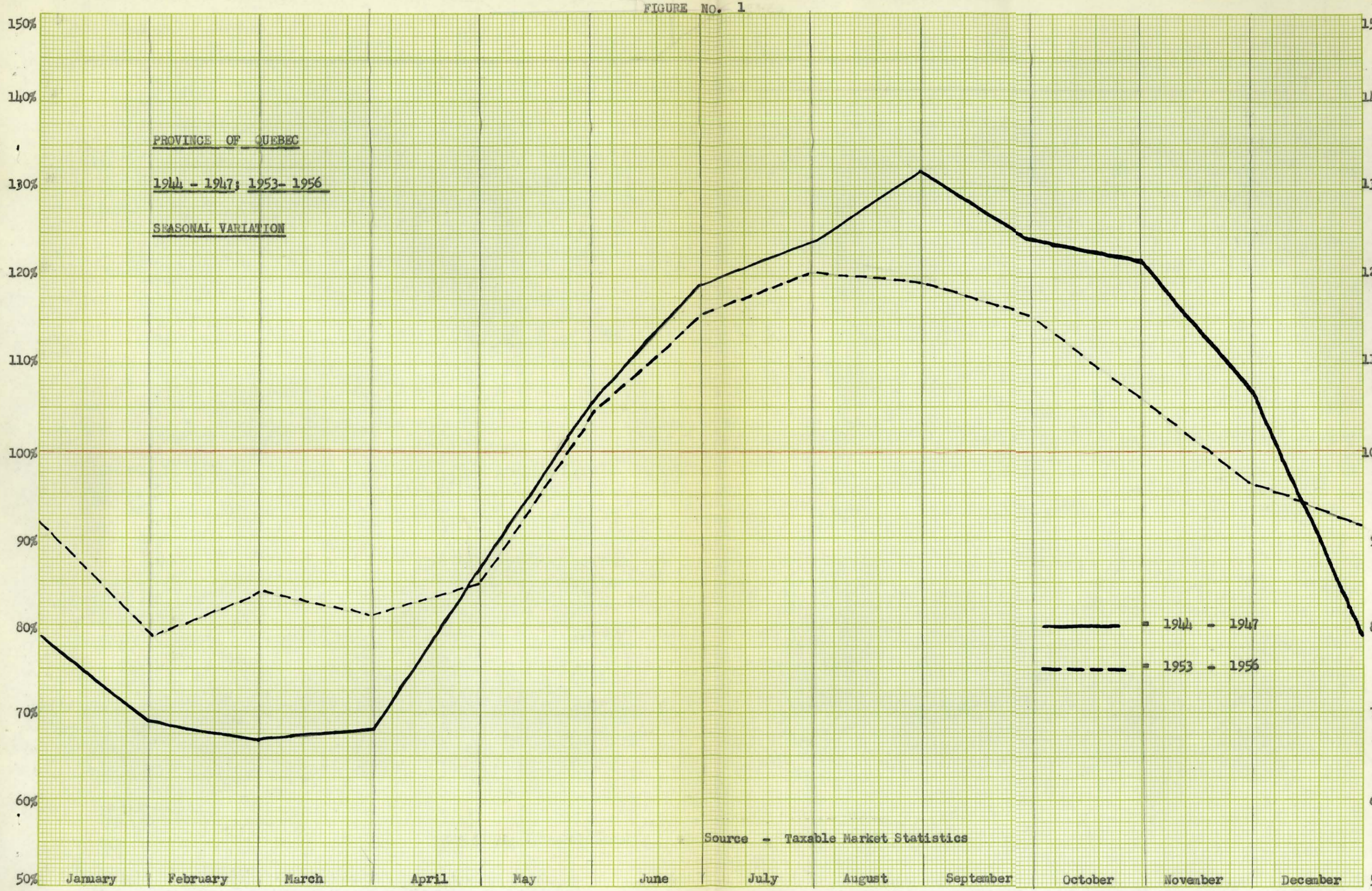
Taxable market figures have been compiled over the past twenty-five years by the Province of Quebec. These statistics indicate the total amount of gasoline that was purchased in a particular year. These totals may be used as well as a fairly accurate indication of the retail gasoline market, which comprises between two-thirds and three-quarters of the gasoline sold in a particular year.

Variation of gasoline over time can be divided into three distinct categories - seasonal, cyclical and secular variations. Of necessity, the last must be limited by the availability of market volumes (25 years).

a) - Seasonal Variations

As evidenced in Figure No. 1, the sale of motor gasoline has wide seasonal fluctuations in the Province of Quebec. Figure No. 1 refers to the seasonal trend for two periods, 1953-1956 and 1944-1947. The comparison of these two trends is of real significance, as each local climate will naturally have a seasonal variation influenced by the weather, and one year is of no real significance in isolation.

FIGURE NO. 1



Source - Taxable Market Statistics

There are two leading factors in the seasonal variation of gasoline sales, the weather and tourist trade. As regards the latter, it is felt that this is of negligible importance on a net basis, as tourist statistics reveal that the number of natives of Quebec entering the United States is two and a half times greater than traffic in the opposite direction. However, American travelers, as real tourists, usually remain in Quebec for a relatively longer time. [1] In effect, the tourist increase in demand is offset by the decrease due to Canadians travelling in the United States. The gallonage involved, moreover, is relatively small - approximately 20 million gallons in a market of 585 million gallons.

The weather, on the other hand, accounts for a disparity in the index of 1953-56 gasoline sales (derived from a 12 month moving average, adjusted for variations in the days in each month) of 42.8% between the high of August and the low of January. This is more than double the 20% disparity of sales in California.

As mentioned previously, what is of real significance is that, over the past ten years, the range of disparity has been reduced by 22.6%. This rapid increase in relative winter driving results especially from two factors:

1. - Travel between Canada and US - DBS - 1956.

1. - Technical improvements in gasolines, in snow tires, the introduction of 5W winter motor oil, cold-weather gear oils, chemical additives, and many other advances of the petroleum and related industries.

2. - Considerably improved road maintenance at both the provincial and municipal levels.

As a result of these factors, gasoline demand in 1956, compared to 1945, has increased in the months of December, January, February and March by 276%, as against an increase of 205% in the other eight months. If 205% is assumed to be the trend increase, then winter driving over the past ten years has contributed 30 million gallons to market growth. The impact of this evolution in consumer patterns is brought into bold relief when it is considered that it will be some time before Fina, an aggressive and well-financed marketer, which has been in the Quebec market on a large scale for three years, will achieve this volume. In conclusion, seasonal variations are of great significance in the sales of motor gasoline.

PROVINCE OF QUEBEC

ECONOMIC TRENDS

1931-1956

YEAR	POPULATION	PERSONAL INCOME MILLIONS OF DOLLARS	PER CAPITA PERSONAL INCOME
1931	2,874,662	973	$ 338
1932	2,925	799	273
1933	2,972	739	249
1934	3,016	816	271
1935	3,057	860	281
1936	3,099	933	301
1937	3,141	1034	329
1938	3,183	1038	326
1939	3,230	1083	335
1940	3,278	1222	373
1941	3,331,882	1475	443
1942	3,390	1766	521
1943	3,457	2015	583
1944	3,500	2114	604
1945	3,560	2200	618
1946	3,629	2388	658
1947	3,710	2608	703
1948	3,788	2930	773
1949	3,882	3106	800
1950	3,969	3295	830
1951	4,055,681	3772	830
1952	4,174	4153	995
1953	4,269	4469	1047
1954	4,388	4638	1057
1955	4,520	4963	1098
1956	4,628,378	5484	1185
Percentage Increase 1956/1931	61%	464%	495%

TABLE NO. 5

Source - DBS & Quebec Taxable Market Statistics.

PROVINCE OF QUEBEC

ECONOMIC TRENDS

1931-1956

YEAR	MV REG.	POP. PER CAR	TOTAL MOTOR GASOLINE SALES THOUSANDS OF GALLONS
1931	177,485	16.2	98,350
1932	165,730	17.6	92,333
1933	160,012	18.6	87,076
1934	165,526	18.2	93,311
1935	170,644	17.9	101,947
1936	181,628	17.1	109,863
1937	197,917	15.9	127,980
1938	205,463	15.5	136,120
1939	213,148	15.2	139,501
1940	225,152	14.6	148,575
1941	232,149	14.4	165,687
1942	222,622	15.2	155,853
1943	222,676	15.5	152,606
1944	224,042	15.6	169,566
1945	228,681	15.6	181,847
1946	255,172	16.1	204,490
1947	296,547	12.5	233,689
1948	335,953	11.3	267,431
1949	384,733	10.1	287,401
1950	433,701	9.2	324,325
1951	500,729	8.1	360,182
1952	574,974	7.3	397,517
1953	617,651	6.9	438,880
1954	674,144	6.5	467,722
1955	743,682	6.1	523,062
1956	835,000	5.5	584,724
Percentage Increase 1956/1931	370%		495%

TABLE NO. 6

Source - DBS & Quebec Taxable Market Statistics.

b) - Cyclical Variations

Any relation of cyclical fluctuations to gasoline sales will be reflected in average consumption per motor vehicle. If Figure No. 2 is referred to, the following trends will be noticed as regards average consumption per motor vehicle.

1. - Consumption per motor vehicle rose steadily from 1931 to 1939 with but two exceptions, 1933 and 1939.
2. - A decline from 713.7 gallons per motor vehicle in 1941 to 685.3 gallons in 1943.
3. - A steady increase from 1943 to 1946.
4. - An equally steady decline from 1946 to 1952.
5. - A gradual levelling out from 1952 to 1956.

Over the same period, the following cyclical variations took place in national and provincial production totals, as reflected in personal income statistics.

1. - The Great Depression, which commenced in 1929, with per capita personal income regaining the 1931 level only in 1940.
2. - A steady growth from 1940 to the present day, interrupted by moderate increases in 1946, 1950, and especially 1954, which were years of reaction either to record war-time prosperity or to inventory accumulation.

FIGURE NO. 2

PROVINCE OF QUEBEC

1931 - 1956

TRENDS IN CONSUMPTION PER MOTOR VEHCILE

& PER CAPITA PERSONAL INCOME

Source - D.B.S. & Taxable Market Statistics

When the two trends are compared, very little, if any, positive relation can be found, for consumption per motor vehicle increased during the period 1931-39, was diminished during the war boom, and has fallen off or remained steady during the period of prosperity from 1947 to the present day. Correlation may be imagined in the following instances:

1. - The increase in consumption per motor vehicle during the immediate post-war period.
2. - The decrease in consumption during the recession year of 1954.

In the first instance, increasing consumption was due more to a psychological reaction to war-time rationing and to the extensive utilization of existing motor vehicles during a shortage of new cars, trucks and buses. In the second instance, the decline in 1954 is more attributable to adverse weather conditions than to the very slight increase in per capita personal income.

As consumption per motor vehicle is one of the two variables, together with motor vehicle registration, which determine total gasoline sales, it would seem advisable to comment on trends in this variable over the past twenty-five years.

1. - The steady growth in the 1930's was due to road construction, and the advent of winter driving.

2. - The decline in the war years resulted from gasoline rationing.

3. - This was followed by a sharp increase from 1944 into the immediate post-war period, as consumption per motor vehicle returned to the trend position. A considerable reaction to rationing and the shortage of new cars, cannot be overlooked.

4. - The decline in motor vehicle average consumption to 1952 was occasioned by the alleviation of the new car shortage, a shift in consumer driving habits, as the first signs of highway congestion and car pools were noted, and the shift of some large average consumers, for example, trucks and buses, to diesel engines.

5. - The gradual levelling off to the present day results from offsetting trends - the continuing congestion and parking difficulties more than offset the increase in winter driving. The trend to diesel motors was continued with the conversion of some MTC buses to this type of engine.

Average consumption per motor vehicle, over the long-term, indicates little relation to cyclical fluctuations. [1] The conclusion that gasoline is considered a necessity could be safely drawn from the apparent lack of correlation between consumption and per capita income series. It has been shifts in consumer driving habits, rationing, motor vehicle shortages and winter driving which have produced the trends reviewed. The results, therefore, are negative as regards a definite correlation between cyclical variations and gasoline sales.

C) - Secular variations

	Increase of 1956 over 1931
Motor gasoline sales	- 495%
Motor Vehicle Registration	- 370%
Personal Income	- 464%
Population	- 61%
Consumption per MV	- 26%

The above figures indicate trend values for significant variables over the past twenty-five years - as indicated in Figure No. 3, there is a definite correlation between the growth of personal income and the increase in total motor gasoline sales over the past twenty-five years.

Since motor gasoline sales are a direct function of motor vehicle registration and consumption per motor vehicle,

1. - It would appear that the trend to non-personal ownership of motor vehicles would increase the lack of relation of gasoline demand to cyclical changes by definition, for personal incomes are not involved in purchases.

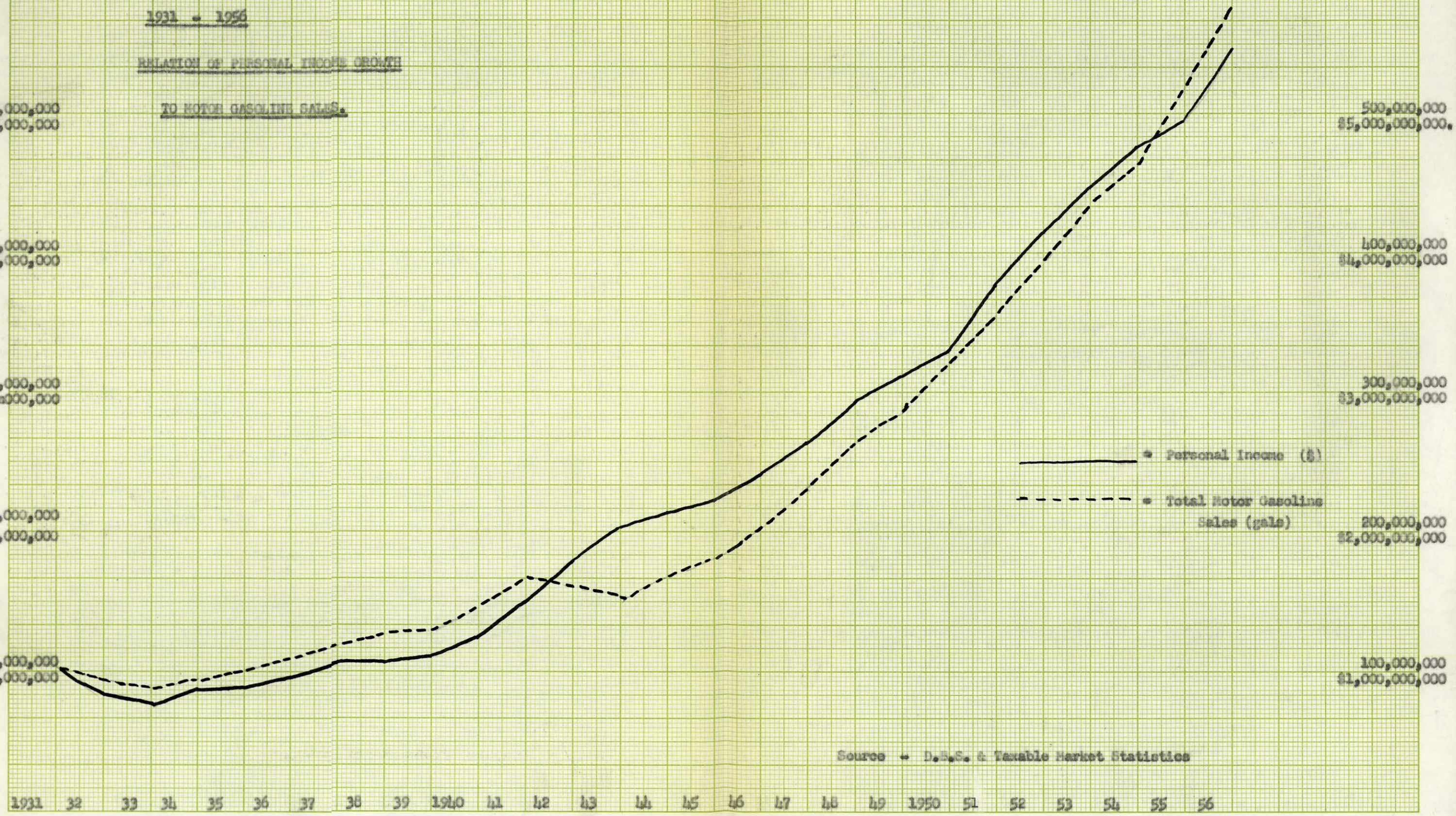
FIGURE NO. 3

PROVINCE OF QUEBEC

1931 - 1956

RELATION OF PERSONAL INCOME GROWTH

TO MOTOR GASOLINE SALES.



Source - D.B.S. & Taxable Market Statistics

it will be necessary to connect total personal income or purchasing power growth to these two factors.

1. - It has been concluded above that consumption per car varies more with the availability of good roads, winter driving and temporary influences than with cyclical fluctuations in personal income. This was due to the classification of motor gasoline as a "necessity."

2. - Motor vehicle registrations may be considered a direct variable of personal income. The logical consistency of this needs no further amplification. Moreover, motor vehicle registrations are very significant as regards market growth, for this variable increased by 370% over the past twenty-five years as against only a 26% growth in average consumption. Since consumption per motor vehicle has levelled out noticeably over the past five years, motor vehicle registrations, and indirectly, personal income, will assume a role of ever increasing significance as the prime determinant of motor gasoline sales.

It may be concluded, therefore, that, over an extended period, total motor gasoline sales vary directly with motor vehicle registrations and indirectly with personal income growth. This will be more true in the future than in the past, due to the levelling off in average consumption per motor vehicle. [1]

1. - This relation may be expressed algebraically, where $xy = f(x,y.)$ xy is total motor gasoline sales, x is total motor vehicle registration, and y is average gasoline consumption per motor vehicle.

PART III

THE DEMAND FOR HEATING OILS

CHAPTER 7 - THE INDUSTRY DEMAND FOR HEATING OILS

INTRODUCTION

Light furnace fuel oil and stove oil are the two main heating oils in domestic uses. Light industrial fuel oil and residual fuel oil are used in some instances in place of stove oil and furnace fuel oil at industrial accounts. In this chapter, only the industry demand for heating oils in domestic uses will be discussed. The firm demand for heating oils will be discussed in the following chapter.

Total furnace fuel oil and stove oil sales in the Province of Quebec were approximately 570 million gallons in 1956, only slightly less than the total motor gasoline sales of 585 million gallons. Furnace fuel oil sales accounted for 370 million gallons of this total.

The most noticeable difference between the heating oil and gasoline markets on an industry basis is that non-petroleum substitutes exist which may satisfy the demand for warmth from which the demand for heating oils is derived. It has been noted earlier that the most important determining factor in the inelasticity of the industry demand curve for motor gasoline was that no substitute existed in the short-run for motor gasoline in its sole use,

providing power for motor vehicles. In the long-run, the demand curve is more elastic owing to the possibility of shifts to vehicles with engines powered by diesel fuel oil. Wood, coal, manufactured and natural gas are, however, capable of satisfying the ultimate desire for warmth as well as furnace fuel oil or stove oil.

Table No. 7 indicates the importance of these various heating fuels in domestic uses in the Province of Quebec at the end of 1954. The different fuels have been converted to a common heat measure - British Thermal Units. A glance at these statistics reveals that the use of oil in domestic heating has been steadily increasing over the past ten years at the expense of coal, and to a much smaller extent, at the expense of wood. The use of manufactured gas has, on a percentage basis, indicated very little change over the period. Natural gas has not been available over the ten year period in Quebec.

THE USE OF ENERGY FOR DOMESTIC PURPOSES

PROVINCE OF QUEBEC

	COAL & COKE		OIL		MANUFACTURED GAS		WOOD	
	M Tons	% of Total Fuel	M Bbls.	% of Total Fuel	MM CF	% of Total Fuel	M Cords	% of Total Fuel
1945	2,383	43.1	1,652	6.5	5,150	1.8%	3,500	48.6
1946	2,281	38.4	4,106	15.2	5,523	1.8	3,480	44.6
1947	2,174	34.4	6,366	22.3	5,668	1.7	3,460	41.6
1948	2,215	34.8	6,336	22.0	6,119	1.8	3,480	41.4
1949	1,868	30.9	6,362	23.2	6,225	2.0	3,500	43.9
1950	1,828	28.1	8,212	27.7	6,464	1.9	3,630	42.3
1951	1,679	25.6	9,155	30.8	6,875	2.0	3,573	41.6
1952	1,572	24.4	10,233	34.8	7,038	2.1	3,300	38.7
1953	1,351	21.4	11,138	38.7	6,901	2.1	3,160	37.8
1954	1,259	19.1	12,695	42.1	7,008	2.0	3,210	36.8

TABLE NO. 7

SOURCE - C.L. O'Brian - "Energy in Eastern Canada" (Dominion Coal Board)

As in the case of motor gasoline, the industry total of 570 million gallons of heating oils represents nothing but the consumption of a number of smaller units - in this case, the 453,000 households (1954) that have oil heating units. The analysis of the relative value of different fuels will be considered in this light, recognizing the ultimate importance of the individual consumer, and analyzing the factors that make the individual choose oil rather than coal or wood or any other available fuel.

FACTORS INFLUENCING THE CHOICE OF A HEATING FUEL OIL

As in the case of the firm demand for motor gasoline, other factors than price influence the choice of one fuel rather than another. The five fuels that are considered to be in competition are wood, coal, oil, manufactured and natural gas. More particularly, six products may be considered, for there is a definite distinction between stove oil and furnace fuel oil.

Five factors influence the choice of a heating fuel:

A) - Price
B) - Cleanliness
C) - Automatic Heat
D) - Cost of Heating Equipment
E) - Service Requirements

In the future, the most intense competition in the domestic heat market will be between natural gas and heating oils. Although natural gas has been used as a fuel in some parts of Canada for more than half a century, particularly in Alberta and Saskatchewan, its relative importance in the total heating energy picture has been small, due initially to inadequate reserves and more recently to the difficulties involved in transporting the fuel over great distances to the large eastern markets of Canada. The more serious difficulties have now been overcome and the natural gas industry stands on the threshold of a period of great expansion with the completion of the Trans-Canada pipeline in late 1958 or early 1959. This analysis of heating oils, will, therefore, be concentrated on natural gas and the presently predominant fuel, heating oil.

A) - Relative Prices

If wood is considered, it is indicated that this source of heat energy is used primarily in remote areas. The only cost involved in obtaining the wood is chopping down a tree and cutting it up into cordwood. As this is not a direct cost, in the sense that no money is paid out, the cost of wood is likely to be minimized by the ultimate consumer. Oil in these remote areas of Quebec is relatively expensive

owing to the high cost of transportation from Montreal East. Coal, laid down at St. Lawrence ports, also must be shipped a considerable distance to the ultimate consumer. On a price basis, oil and coal are not competitive with wood in the typical wood-using areas.

If Montreal is considered, a possible price arrangement might be as follows, assuming the price of natural gas is competitive with oil.

	Price cents per therm	
Furnace Oil	13.0 cents	
Anthracite Coal	14.0 cents	
	max.	min.
Manufactured Gas	23.0 cents	23.0 cents
Natural Gas	15.0 cents	13.0 cents

TABLE NO. 8

Furnace fuel oil and natural gas would be highly competitive, particularly where new housing projects are being developed.

The price disadvantage of coal accounts to a large extent for the continuing decline in the use of this fuel. Unless drastic changes are made in methods of production

and transportation, this trend will continue. Finally, the use of manufactured gas will be ruled out owing to the considerable price disadvantage relative to the natural product and the possibilities of easy replacement.

B) - Cleanliness

The competitive fuels may be classified as follows in order of cleanliness:

1) - Gas (Natural gas in particular)
2) - Furnace Fuel Oil
3) - Stove Oil
4) - Wood
5) - Coal

Natural gas is particularly "clean." A burner is required in the basement which is supplied with fuel from a line under the street. The advantage over furnace fuel oil is that no storage tank or outside fill pipes are required. The inconvenience of trucks in the driveway, broken fences, outside spills, run-overs, etc., is eliminated.

The typical stove oil installation consists of a centrally-located space-heater (with an inverted bottle) filled by hand from a tank in the backyard or on the back gallery. This type of installation is particularly predominant in the city of Montreal which, with a potential of 100 million gallons, is the largest stove oil market in the world.

This market is very susceptible to the impact of natural gas owing to the ugliness of the typical installation and the very high cleanliness of natural gas.

Both coal and wood require large storage areas and disposal of the burned fuel residue. In the case of coal, "putting out the ashes" is a very obnoxious feature accompanying the use of this heating fuel. Moreover, it is almost impossible to construct a playroom in the basement of a home heated by coal owing to the presence of coal-bins, coal dust and the ash residue.

C) - Automatic Heat

Only natural gas and furnace fuel oil provide fully automatic heat. A large part of the increase in oil's share of the heating market of 35.6% since 1945 is a result of this competitive advantage over other fuels.

The impact of natural gas will give further impetus to the trend to automatic heat, and should increase sales of furnace fuel oil in the areas not served by the natural gas distribution system.

In conclusion, natural gas will have no advantage over furnace fuel oil in this respect, as both systems are thermostatically controlled. The advantage of natural gas and

furnace oil over stove oil serves to increase the attractiveness of these fuels to the Quebec stove oil consumer.

D) - Cost of Heating Equipment

It is in this respect that natural gas holds a distinct edge over furnace fuel oil. An estimate of comparative equipment costs places a conversion burner or furnace at $700. as against $75. for the natural gas installation.

A sample survey in the USA indicated that 43% of the consumers that switched from furnace oil to natural gas did so as a result of the lower equipment cost of natural gas. This percentage is much higher than the 28% that switched owing to the lower price of natural gas.

E) - Service Requirements

Natural gas distributing companies generally provide free emergency service consisting of repairing leaks and adjusting the flame or pilot light. The Toronto gas utility advertises free annual furnace clean-out, free burner cleaning and adjustment of all gas appliances and free labour for repairs. Parts needed for repairs are charged at cost and emergency service is provided on a 24 hour basis. This level of service is perhaps higher than the average and may be reduced in scope as the market for gas

develops. There has been a slight trend in the service policy of a very few gas companies in the United States to eliminate free emergency services. Due to the necessity for prompt emergency service arising out of the hazardous conditions created by possible gas leaks, and due to the fact that gas equipment requires very little servicing, the gas companies enjoy a favourable reputation with their customers.

Oil burner service is almost invariably rendered on a charge basis. These charges in the Toronto area approximate $5.00 for a general service call and do not include parts. An annual furnace clean-out costs around $10.00. Contracts can be purchased for an average of just over $20.00 per annum to include all emergency services, yearly clean, check and adjustments. Annual contracts including replacement of parts can be purchased for about $10.00 more.

Gas burners are very simple mechanically and are fairly uniform in design. They are produced by fewer manufacturers than oil burners. The mechanical simplicity of the gas burner, which has basically no moving parts, gives the unit a substantially longer life than an oil burner and allows its users to get by, year after year, with no service expense.

Natural gas, therefore, has a wide edge over furnace fuel oil in this respect.

THE ELASTICITY OF INDUSTRY DEMAND FOR HEATING OILS

In reviewing the second section of this chapter, the conclusion may be drawn at a first glance that the demand for heating oils is elastic, particularly with respect to natural gas in upward price adjustments and coal in downward price adjustments.

There are, however, certain refinements to the elasticity theory that will apply in the case of heating oils.

1. - The distinction between long and short-run elasticity, or the increase in the elasticity of a demand curve as time passes.
2. - The relativity of elasticity to the existing cost structure and hence price structure of the competing fuels.
3. - The multi-dimensional nature of the demand for heat.

In the very short-run, the demand for heating oils is likely to be highly inelastic, owing to the necessity of converting existing equipment to a type suited for the utilization of a competitive fuel.

> For another thing, substitutes in this (petroleum) industry are largely not immediately interchangeable with what are considered to be competing products. To take an example: anthracite coal is a substitute for No. 2 fuel oil (furnace) but generally a householder cannot switch from one to another at will. Actually, he must wait until he wishes to purchase new

> furnace facilities, at which time he again makes a semipermanent decision in favor of the one or the other.
>
> But if price or convenience favors either one, shifts will take place among a) new homeowners and b) those who are about to replace equipment. [1]
>
> It should be clear from the foregoing that a wider price differential among fuels has come about largely since World War II. It is the result mainly of a sharp rise in the price of petroleum products and coal with little change in the price of natural gas. It should be further emphasized that if such differentials were to continue over a period of time tremendous inroads by natural gas companies might be expected in the heating oil business of petroleum firms since the long-run elasticity of demand for heating fuels is likely to be high, assuming the existence of adequate supplies of competing fuels. This is particularly true in the case of natural gas, which even has certain non-price advantages over fuel oil. [2]

The conversion from coal to oil is not too expensive as the existing coal furnace may be converted to oil. A storage tank and a "firer" must be installed, but the initial expense is not wasted as does occur in the case of a conversion from furnace fuel oil to natural gas.

The elasticity of industry demand for heating oils relative to competitive fuel advantages will depend to a certain extent on the age of the existing equipment. Some furnaces, either coal or oil, will be wearing out all the time. Total industry demand for heating oil, assuming

1. - Price Making and Price Behaviour in the Petroleum Industry, op. cit., p. 17.
2. - Ibid. p. 324.

natural gas has price and certain non-price advantages, will decrease, limited by the average replacement age of existing furnace installations. By the same reasoning, new developments are highly susceptible to this cheap, clean and efficient fuel.

Moreover, the industry demand for heating oils is particular to each locality, since price structures, dependent on costs of transportation, distribution systems, etc., are particular to each locality. In Montreal, natural gas may hold a certain price advantage over furnace fuel; in Washington, D.C., the exact opposite is the case.

> No price advantage for any fuel is necessarily permanent. A price comparison currently favoring natural gas may be reversed at any time. This could come about as the result of a rise in the price of natural gas, a decline in the price of oil, or a combination of the two. [1]

Given the existing price structure, an analysis of price elasticity is simplified. On the basis of cents per therm, a reference to Table No. 8 indicates that the industry demand for coal will show very little elasticity until a price competitive with oil and natural gas is reached. The choice between natural gas and oil must be resolved by non-price factors (or price factors related to equipment and service.)

1. - Price Making and Price Behaviour in the Petroleum Industry, op. cit., p. 324.

Although it would appear that a slight shading by either the natural gas or fuel oil companies would result in a swing to the lower-priced fuel, assuming that non-price factors are equal, actual experience indicates that more than a fractional price advantage is necessary to make fuel oil customers switch to natural gas or vice versa. The natural gas share of the domestic market ranged from almost nothing to just under 10% in a survey of twenty-seven United States cities in 1950 where gas was priced at 20% or more above oil. Where gas was priced at between 50% and 70% of the furnace oil equivalent, the natural gas share of the market ranged from 25% to almost 100%. Natural gas acquired only an additional 10% of the spaceheating market by lowering prices from a level 20% above oil-gas parity to a level 20% below the equivalent price of oil. As natural gas prices drop below the equivalent price of oil, the percentage of all households using natural gas tends to increase at an accelerating rate.

It is concluded that it may not be economical for oil companies to meet natural gas competition by price action, where gas sells for up to 20% less than oil, in view of the small increase in spaceheating achieved by natural gas as a result of this difference. To allow the price of natural gas to fall much more than 20% below the equivalent oil price

could result in the rapid loss of a sizeable portion of the market to natural gas.

The problem of determining the elasticity of industry demand for heating oils relative to competitive fuels is complicated by other price and non-price factors. If the price of furnace oil and natural gas are equivalent for the same amount of heat, it appears reasonable to purchase natural gas owing to the cheaper cost of the related equipment, lower service expenses and the slight advantage in cleanliness. Consumers will put a value on these features, but the extent of this valuation will vary from one householder to another, and may only be measured as a guide to policy by past experience in large markets.

In conclusion, the elasticity of industry demand for heating oils would appear to be relative to the type and age of existing heating equipment, the relative prices of the products in a particular location subject to the reservations noted above, and other non-price factors which favor natural gas, furnace oil, stove oil and coal in that order. The usefulness of the elasticity of industry demand in positive policy is limited by these considerations to a most significant degree.

CHAPTER 8 - THE FIRM DEMAND FOR HEATING OILS

THE ELASTICITY OF FIRM DEMAND FOR HEATING OILS

In the preceding chapter, it was concluded that the elasticity of industry demand for heating oils was dependent on the comparative costs of competitive fuels, the average replacement age of existing heating equipment, and a number of non-price or indirect price factors.

It is necessary to analyse the firm demand for heating oils in relation to a certain industry situation. It will be assumed that oil enjoys a price advantage over coal, as is the case at present in Montreal. Any other situation could be hypothetically introduced, as, for example, natural gas selling for less than both coal and fuel oil. The differences in the possible sets of assumptions will only alter the analysis to the extent that competition between firms has different aspects in a declining market than it has in a growing heating oil market.

As in the case of retail and non-retail motor gasoline markets, a number of firms supply products that are extremely close substitutes on a quality basis. A high degree of interdependence is created between the relative prices at which these competitors sell their products and the

volumes each is likely to receive. Because many customers may be drawn from the other sellers in the market, the response to a price-cut, that is not met by competition, is likely to be quite high. The ceteris paribus demand curve is highly elastic.

As in the case of retail and non-retail firm demand curves, this statement is not unqualified. Certain practical considerations must be taken into account which limit the response to a price-cut that is not immediately met.

First, nearly all domestic heat business is under contract, usually of a year's duration. Moreover, suppliers attempt to make these contracts automatically renewable. The result is that a publicized price-cut will have little effect in the very short-run as existing business is tied down by these contracts.

The long-run effect of a price-cut is limited by the necessity of extensive individual solicitation on the part of the price-cutter. The nature of the domestic heat business is such that customers do not take the initiative in the signing of contracts. Very often, it is the well-known company that first solicits the new business that obtains the contract.

Finally, the effect of brand-names exists, but to a considerably reduced extent when compared to the retail motor gasoline market. In Montreal, Canadian Import, Vipond-Tolhurst and Sacco are as well-known in the domestic heat business as the refiners who supply their product. In fact, Canadian Import sells more furnace fuel oil than any major supplier. The small jobber remains in a less advantageous position, but the number of potential price-cutters that can compete effectively on this basis is increased relative to the retail motor gasoline market.

In conclusion, the elasticity of firm demand is high, limited by contractual agreements, the necessity of individual solicitation and, to a reduced extent, the presence of well-known brand name suppliers.

THE NATURE OF COMPETITION IN THE DOMESTIC HEAT MARKET

The elasticity of firm demand, as indicated in the preceding study of the retail and non-retail motor gasoline markets, has a very significant influence on the nature of competition in an industry.

In the case of motor gasoline marketing at the retail level, the high elasticity of firm demand, *ceteris paribus*, ruled out to the publicized use of price as a competitive weapon to a large degree owing to the almost certain response

of competitors to a price-cut by a retail outlet in the immediate vicinity marketing a major brand. In the marketing of motor gasoline at the non-retail level, price competition was evident despite the even higher elasticity of firm demand. Price shading could be done with profit to the initiator owing to the nature of the market, particularly with respect to the diminished likelihood of rival reactions.

In the marketing of heating oils, it has been concluded that the elasticity of firm demand is likewise high, subject to certain considerations. The question immediately arises as to the use of price as a competitive weapon within this market. It is evident from the above that, given the conditioning facts of high firm demand elasticity, the solution is resolved around the possibility of rival reactions.

> Price is the chief incentive for attracting custom but quality of product and amount and reliability of the service are also factors. Contracts for burner service and repairs are usually of great importance and frequently the price of these items is the determining factor as to who gets the business. [1]

It is evident from experience that, within the relative price structure of competitive fuels, price is used to a considerable extent as a means of gaining volume.

1. - Price Making and Price Behaviour in the Petroleum Industry, op. cit. p. 242.

> One should not underestimate the importance of price competition in the sale of heating oils. Discounts in this field may take any one of the following forms: 1) price concessions from the majors' posted price generally offered to the whole trade; 2) price concessions given to individual accounts (possibly to meet the better offers of rivals); and 3) discounts from the regular price for oil burners, oil burner service, etc. [1]

It would appear that rival reactions can be overlooked to a certain extent; this implication drawn from experience is a reasonable one owing to certain factors inherent in the heating oil market structure.

As in the case of the non-retail gasoline market, the quotation of a special price to a particular consumer involves the loss of a very small percentage of the previous supplier's total sales and is not sufficient to call forth a price reduction.

A publicized price reduction by an important competitor will not result in an immediate loss of a significant percentage of any other competitor's total sales as the vast majority of their consumers are secured by existing contracts. When these contracts expire, a price adjustment may be made at that time on individual or general bases dependent on sound profit policy. For example, the supplier may stand to lose 5% of its business to the price-cutter.

1. - Price Making and Price Behaviour in the Petroleum Industry, op. cit., p. 243.

This 5% decrease in total sales may reduce costs more than proportionately at the refinery level for one reason or another, or price adjustments to individual accounts may be unwise from the point of view of public relations. The increase in elasticity over time, however, relative to different contractual durations must be an important consideration in the policy decisions of any supplier.

The amount of business each competitor is likely to lose to a price-cutter will depend on the aggressiveness of the latter's solicitation of individual accounts. This conditioning factor will vary from one company to the other.

> One extremely interesting aspect of competition in the heating oil business is the fact that the number of users of heating oil is constantly increasing and (therefore) marketers may concentrate on the resulting new business rather than on accounts being served by other suppliers. Insofar as this is true, competition is less intensive in the sale of heating oil than in the sale of gasoline, where to a large extent the business acquired by one firm must be taken from rival sellers. [1]

As mentioned above, the nature of competition will vary depending upon whether the heating oil market is growing or declining. If declining, the reaction by rivals to a price-cut is more imminent. Moreover, if other petroleum product markets are in expansionary stages, the likelihood of long supply conditions at the refineries is increased.

1. - Price Making and Price Behaviour in the Petroleum Industry, op. cit., p. 243.

Note - This is also true of the total motor gasoline market in Quebec.

Any business secured by a refinery jobber is never totally lost by the supplier. On the basis of interdepartmental values, only a percentage of the total company profit on an individual sale is lost. This market characteristic will, when transfers between all jobbers are considered in total, reduce the probability of reaction on the part of the direct marketing divisions of the major companies.

Finally, refiners may be in various supply positions with respect to heating oils or middle distillates at the same time. A supplier in a long supply position may take some of the volume of a competitor in short supply through price competition with a minimum fear of reaction.

It is concluded that price competition by a major supplier or large jobber is a sharp competitive weapon. However, the existence of certain market characteristics and supply considerations reviewed above allow the use of this weapon in the domestic heating oil market, despite the high elasticity of firm demand owing to the limitations these factors impose on rival reactions.

PART IV

CONCLUSION

In the preceding chapters, an attempt has been made to fulfill the objectives set forth in the first introductory chapter - to examine the determinants and characteristics of the demands for motor gasoline and heating oils and to evaluate the impact of these demands on the nature of competition and the activities of suppliers in the two product markets.

The industry demand for motor gasoline was considered as a composite of the demands of individual motorists and non-retail consumers. It was concluded that the industry demand for motor gasoline was highly inelastic, owing to the necessity of the product in its sole use and the absence of close substitutes. Considerable cross-elasticity was found between the different grades of gasoline at the retail level despite the restricted technical usefulness of higher octane gasolines in lower-priced cars.

At the level of firm retail demand, it was concluded that the relationship between price and quantity demanded was of an highly elastic nature. Having established the local retail market in the oligopolistic category, it was further concluded that the possibility of rival reactions and the multi-dimensional nature of retail demand are the

causes of the reduced use of aggressive price competition. Substantially the same conclusions were reached concerning the nature of non-retail gasoline demand; however, the diminished likelihood of rival reactions results in the wider use of aggressive competition. The variation of gasoline consumption over long-term, cyclical and seasonal periods was examined.

The industry demand for heating oils was felt to be inelastic in the short-run. In the long-run, the price relationship of competitive fuels such as coal and natural gas might change and existing heating equipment would have to be replaced, increasing the elasticity of the industry demand curve. Once again, other factors as well as price had to be considered to achieve an understanding of the full competitive relationship of heating oils, coal, natural gas and wood.

The conclusion was reached that the firm demand for heating oil tended to be highly elastic, although limited in particular by contractual agreements and the necessity of active customer solicitation. Aggressive price competition is evident in the heating oil market, again a result of the reduced likelihood of rival reactions.

The nature of the above conclusions reflects the importance of characteristics that are to a certain degree particular to the demands for motor gasoline and heating oils. Any study of this type will depend for its usefulness on the extent to which the practical considerations involved in the marketing of a particular product are linked with micro-economic theories to form a complete analysis.

REFERENCES

Bain, Joe S., Pacific Coast Petroleum Industry, Part I, (University of California Press, Berkeley & Los Angeles, 1944)

Bain, Joe S., Pricing, Distribution and Employment, revised edition, (Henry Holt & Co., Inc., New York, 1953)

Cassady, Ralph J., Price Making and Price Behaviour in the Petroleum Industry, (Yale University Press, 1954)

Cassady, Ralph J., & Jones, E., The Nature of Competition in Gasoline Distribution at the Retail Level, (University of California Press, Berkeley, California, 1950)

Dominion Bureau of Statistics, National Accounts - Income and Expenditure - 1931-1956.

Dominion Bureau of Statistics, Refined Petroleum Products - 1950-1956.

Dominion Bureau of Statistics, Travel between Canada and the United States - 1956.

Ethyl Corporation, The Story of Gasoline, (Ethyl Corporation, New York, 1956)

Ethyl Corporation, Survey of Gasoline Station Operators in Eastern Canada, (Ethyl Corporation, Toronto, 1956)

Rostow, Eugene V., A National Policy for the Oil Industry, (Yale University Press, New Haven, 1948)

Schackne, Stewart & Drake, N.D'Arcy, Oil for the World, (Harper & Brothers, New York, 1950)

Taxable Market Statistics, Revenue Branch of the Provincial Government - 1931-1956.