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ing price data to assure validity of time comparisons of prices, or accuracy in measurement of price movements. Changes in commodity composition or product standards present a special difficulty in this connection. Our recommendations relative to increasing the precision and extending the scope of refined product classification in price reporting do, in our judgment, lay the indispensable groundwork for an eventual attack upon this vital problem. For the rest, we may conclude this part of our study with the observation that, particularly in a co-operative enterprise such as the development of adequate trade statistics unquestionably requires, to attempt relatively little initially does not foreclose the prospects of a fuller measure of ultimate accomplishment.

V

OBJECTIVES OF A PROGRAM OF PRICE-COST RESEARCH IN THE PETROLEUM INDUSTRY

RELATION OF PRICE, COST, AND EARNINGS MOVEMENTS TO SUPPLY AND TO THE COURSE OF INVESTMENT IN THE INDUSTRY

A PROGRAM of price research in the industry might appropriately be directed toward three broad objectives. Determination of (1) the forces upon which price and price movements depend; (2) price relationships among the several products of the industry; (3) the functions prices perform and their effectiveness.

of gasoline has varied with the passage of time. But it should be clear that this has an important bearing upon the comparability of retail gasoline prices, at least over extended periods and possibly over wide areas.

Because, however, of the relatively high degree of standardization of the products and raw materials of this industry at any given time, and particularly of its major product, motor fuel, it affords a promising field for analysis of the significance of product changes in the measurement of price movements. Moreover, on account of the complex relationship of various petroleum products, in some part as joint products, in some part as alternative products, and in some part as complementary products, and of the effects that quality changes may have upon these relationships, and *vice versa*, research in this direction should prove exceptionally fruitful. It will call for both economic perspicuity and statistical acumen and should have both theoretical and practical implications.

We direct immediate attention to the third objective. Prices in a competitive economy are presumed to be the devices by means of which equilibrium is maintained within an industry and a proper balance between an industry and the whole economy secured. This equilibrium both within the industry and between the industry and the whole economy is presumed to be established by the influence of prices in accelerating or retarding changes in supply and demand. The influence that price exerts upon each element in the supply-demand equation must therefore be analyzed to determine the role that prices and price movements play in establishing equilibrium. At this juncture we examine the problems involved in determining the influence of price on supply, leaving for a later section consideration of the problems involved in determining the influence of price on demand.

In general, the influence of price upon supply is first manifested by the withholding from or the offering on the market of the available stocks of the commodity in question. Sooner or later supply is presumed to be brought into equilibrium with demand by the influence that price exerts upon investment and production activity. Other influences remaining constant, high prices serve as an impelling force attracting capital into an industry and thereby increasing its productive capacity and ultimately its output. Low prices serve as a repelling force to the inflow of capital and afford a mechanism by means of which output may ultimately be brought into equilibrium with demand.

Crude Oil Production

In Chapter II the technical and economic characteristics of the several branches of the oil industry and of oil and its major products are analyzed briefly. There it is suggested that the speculative character of oil production, the migratory nature of the resource, the property laws governing its capture, the specialized and fixed character of the investment may serve to obstruct the force that price tends to exert in establishing an equilibrium between demand and

supply. Some students of the industry contend that these characteristics constitute such a serious obstacle to economy in the movement of capital into or out of the industry as to rob price of its effectiveness in establishing with reasonable dispatch equilibrium within the industry and between the industry and the whole economy while maintaining technical efficiency in recovery. It is upon such reasoning that the proration program rests. The thesis that unrestricted competition in oil production makes for waste and inefficiency has been frequently expounded in analyses and discussions of the economics of oil production.¹ In these analyses, however, the role that price plays as a regulator of demand and supply has not been scrutinized exhaustively. A thorough-going statistical and economic analysis of the relation between prices and costs on the one hand and production, stocks, and investments in productive capacity on the other seems to promise fruitful results. Such a research program is of major importance to the industry, concerned with the problem of profitably producing and marketing petroleum and its products; to the public, interested in a continuing supply of petroleum and its products at reasonable prices; and to economists, interested in testing price theory in its applicability to petroleum and its products.

An appropriate point of departure would seem to be an analysis of the changes in the current supply of crude oil and of their relation to changes in oil prices, and to changes in oil prices relative to general price levels. How promptly and consistently have changes in price been accompanied by changes in a similar direction in the amount of oil offered in the market? Over short periods has the 'elasticity' of

¹ The term 'unrestricted competition' is used here, not to denote a kind of *bellum omnia contra omnes*, with no quarter given, but only to indicate the absence of any special restrictions peculiar to the oil industry, i.e., of any restrictions upon competitive methods not generally enforced upon enterprisers in other fields. The thesis mentioned, as usually expounded, takes into consideration only the direct effects of competition upon, or within, the petroleum industry. For criticism of this thesis, from a viewpoint giving a broader perspective, see J. D. Gill, *The Economics of Overdevelopment*, a paper read at the annual meeting of the American Institute of Mining and Metallurgical Engineers, New York, February 16, 1939.

supply been equal to or greater than unity? If supply has been 'elastic', such 'elasticity' must have reflected itself in changes in the amount of either oil currently produced or crude oil in storage. Under unrestricted competitive operations with surface holdings in small blocks, the element of drainage limits the feasibility of 'closing in' individual wells in fields of flush production. How does this influence the efficacy of price as a regulator of current output? It apparently leaves the production from wells on artificial lift as the most flexible element in current output. However, in view both of the uncertain effect upon future production that the closing of a 'pumper' well is claimed to have and of the relatively small production of stripper wells under mechanical lift, it may be asked whether this source contributes any considerable 'elasticity' to current supply. To show the responsiveness of current output to price changes the Committee recommends an analysis of the relationship between price and well abandonments and the reopening of temporarily abandoned wells.

An analysis of the movement of inventories, other than purely seasonal variations, in their relation to price changes will further illuminate the general problem of the flexibility of supply in relation to price. Inventories, as we have said, presumably act somewhat as a 'governor' over demand-supply relationships in the short run. What influence do price changes have upon inventories and *vice versa*? Continued expansion of inventories obviously may involve an inflow of capital in relatively large amounts in the form of additions to storage and storage facilities. Here we may find an unexpected but, in an industry of this type especially, a perfectly 'normal' relation between price and the inflow of investment. Low prices may serve to expand rather than contract or check investments and they are the more likely to do so if, as in the case of petroleum, supply in the proximate future is highly problematical and in the long run certainly exhaustible. A further study of the relation between price changes and changes in oil inventories and capacity for storage seems indicated. Since excess refinery

capacity and the desire to keep refinery costs at a minimum by operating at full capacity may cause changes in inventories and storage facilities at the finished product stage of the industry, a study of the influence of price upon current supply should be extended to this stage. The analyst must be on his guard not to overlook the influence that prospective conditions may exert on movements of inventories, for example, the labor situation in the industry or expectations as to future prices. Nor should he misinterpret the significance of changes in stocks as reported because of failure to appraise the influence of stocks that are unreported.

Adjustments in the supply of crude oil in the short run will, then, be reflected in changes in either current output or in crude oil or refined product inventories, or in both. Underlying supply, in the long run, however, are the undeveloped and undiscovered oil reserves. In what manner and to what extent are their discovery and development influenced by price factors? Is the rate of the inflow of capital into oil 'production' governed by price (in relation to cost), and what relationship does the discovery of reserves bear to the rate of inflow of capital?

Where property holdings are small and competition unrestrained, operators have been under great pressure to complete a contemplated drilling program as rapidly as possible once an oil pool has been discovered and development begun. In truth, the very character of any particular program may have been shaped by that of competitors on adjoining tracts. The migratory character of oil and the property system governing its extraction necessitates a system of offset drilling as a protective measure. A multiplicity of factors may work toward the rapid development of a discovered reserve under competitive exploitation. Furthermore, under such standards of proration as are sometimes employed, the influence of a declining price upon drilling activity may be obscured, if not checkmated. These matters are well known, of course, to those familiar with oil. Their significance to the economist has never been adequately

appreciated. Indeed, the influence the price of crude oil exerts in encouraging or checking this tendency has not been adequately explored. Exploratory research in this direction has indicated, contrary to what some might have expected in the light of the geological and legal characteristics of oil production, that the number of producing oil wells completed annually bears a direct relation to the price of oil. Data on aggregate producing wells drilled do not distinguish between those drilled in wild-cat and in proven territory. It has been assumed, therefore, that producing wells constitute developmental rather than exploratory drilling. This assumption is probably not far from the facts. However, since such analyses as have been made of this relationship have not involved a breakdown of the data by producing regions, further analysis along these lines should be fruitful.

The drilling of dry holes may be taken as a rough measure of the intensity of search for new reserves. Exploratory economic research seems to indicate in general that rising prices tend to increase the number of dry holes drilled and falling prices to decrease the number. Such movements would presumably be influenced also by the state of the capital market and changes in the general price level. However, speculation, the hope of extraordinary gains, often seems to play a more important role than rational economic behavior (that is, calculation) in bringing undiscovered reserves into development. Although in the last decade and a half great progress has been made in the application of scientific methods to oil finding, the chance element in oil discovery has not been eliminated. If price is to be relied upon as a long-time regulator of supply, there should be not only a positive correlation between the number of dry holes drilled (since these reflect intensity of search) and the price of oil, but also a correlation between expenditures in search for oil and new fields discovered as well as expenditures on fields discovered and the potential production from them. What are the facts? Is there any measurable relationship between discovery response to wild-cattling

effort and the price of oil? The rate of discovery is the most important element in maintaining equilibrium. Does it lend itself to price control?

Has price resulted in the early development of readily 'accessible' and hence cheap supplies and have less 'accessible' and hence more costly supplies been 'tapped' only in response to the price factor? Have improvements in technology reduced the proportion of dry holes to producing wells? Does average initial production and ultimate recovery of wells bear any measurable relationship to price? How does price influence the application of new recovery techniques, for example, water flooding?

Price is, of course, merely the immediate factor influencing supply. The relation between price and costs (upon which earnings depend) is presumably the determining factor in establishing equilibrium between supply and demand in the long run. The inquiry should therefore, be pushed into this realm. While continuous cost data are not available and would be difficult to secure, the cost studies of the Tariff Commission and the Petroleum Administrative Board contain data covering six years, 1927-33, which should be sufficient to warrant tentative conclusions with respect to the relation between cost and price and its influence upon supply. Although it is recognized that these six years were rather abnormal, these data should be analyzed in detail for what they reveal concerning the questions raised in the foregoing discussion. Other data are available from public, and private but published, sources, on the course of earnings. It is not necessary for the purpose of such studies as are here suggested that authentic, complete and meticulously accurate data upon earnings in the industry should be available; representative figures, disclosing variation in earnings from period to period, are adequate. These too should be analyzed for the light they may shed upon elasticity of supply.

As the foregoing discussion indicates, there are those who believe that price has manifested a certain functional irresponsibility in the production branch of the oil industry.

This thesis needs further investigation, and affords an appropriate point of departure for further research. If the belief is well founded, then presumably the phenomenon is to be explained in terms of certain peculiarities of oil production to which attention has been called—the uncertain and localized occurrence of oil in place, the geological and physical circumstances under which it occurs, its migratory character, the nature of property rights in oil. Do these factors in reality serve to make price an unsatisfactory equilibrant of crude oil supply and demand? A research program directed toward a more convincing answer to this question is recommended.

Refinery Division

The refinery division of the industry is a manufacturing enterprise and as such is commonly supposed to be more responsive than the extractive division to those price influences which govern economic activity in general. Nevertheless, further inquiry into the extent to which equilibrium has been maintained in this branch of the industry, and between this and the other branches, into the factors that may have made for instability and into the role price has played, seems warranted. It is alleged that a more or less continuous excess of refinery capacity has existed in the industry and that at times this excess has been of large proportions. For example, in 1929, when a new peak in crude oil output was attained, the rated capacity of refineries in operation at the end of the year is reported to have been 32 per cent in excess of the rate of crude oil production during the year. Moreover, the rate of production of crude oil seems to have been considerably in excess of the demand for all oils during that year as evidenced by an increase in crude oil and products in storage. On the basis of the figures reported by the Bureau of Mines, overcapacity seems to have been more or less chronic. But an uncritical acceptance of such data may lead to unwarranted conclusions. Excess capacity in a dynamic industry and in a dynamic economy is not incompatible with economic progress. Moreover an

apparent excess capacity may be a reflection of obsolescence in either the physical equipment of refineries or their geographical location. In the absence of proration, the small scale non-cracking and incomplete type of plant apparently tends to locate in new fields where, temporarily at least, there is access to relatively cheap supplies of crude. By curtailing the available supply of flush-production crude eagerly seeking a market at whatever price it may bring has the introduction of proration resulted in any significant shifts in character or location of operating refinery facilities? Has it led to any withdrawal of capital from small refineries and an increase in the investment in larger scale units? If so, have these developments resulted in advancing the average efficiency of refining operations and been reflected in the prices of refined products? If overcapacity is established, how has it and construction of new refinery capacity varied with the prices of crude oil and of refined products, or with the difference between them, that is, the refiners' margin? Is it possible to measure the influence of changes in refining technique upon this margin?

While oil production, refinery throughput of crude oil, and refinery capacity have all tended sharply upward during the last three decades, the output of gasoline has increased much more rapidly chiefly because of the widespread introduction of the cracking process. Is there any discernible relation between changes in the margin between the prices of crude oil and refined products and the rate of introduction of the cracking process? What is the relation between the installation of cracking and reforming processes and funds available within the industry for capital expansion or replacement? How have the more recently adopted polymerization and catalytic processes in commercial use influenced prices and margins, and *vice versa*? A consideration of these several questions may afford at least a partial answer to the broader question: To what extent has refinery capacity been responsive to price and price margins?

Marketing Division

As capital has continued to flow into oil production, as stocks have mounted, as refining capacity has increased, facilities for the retail marketing of gasoline have expanded persistently during certain periods, more rapidly than sales. This expansion was accompanied by a marked decline in the retail price of gasoline during 1920-35, and by a slight but rather persistent downward trend in the margin between the wholesale price of regular grade gasoline in Oklahoma and the average retail price in 50 representative cities of the United States. It has likewise been accompanied by a decrease in average sales per retail outlet and presumably by an increase in the average marketing cost per gallon of gasoline marketed. While available data on costs, prices, margins, and gallonage are far from what might be desired, even they have not been analyzed as systematically and thoroughly as the importance of the problem warrants. Supplemented and improved in the directions indicated in Chapter IV, their analysis should lead to more positive conclusions concerning the influence prices and margins have had on the growth of retail marketing facilities in this industry. The opinion is widespread in the industry and among its students that prices and marketing margins have not effectively performed their basic function in the retail distribution branch of the industry. But this view has been challenged by responsible analysts who have explored the field. The issues raised certainly merit further and more painstaking study.

To operate a retail station apparently requires no special type of business or technical training. Likewise one filling station makes relatively slight demand upon a community's capital resources. Gasoline retailing is essentially and characteristically a field of small scale enterprise as judged by capital investment. Consequently, entrance to the business has been relatively easy. Exit of a 'plant' once established is not so simple. The plant structure, such as it is, represents a highly specialized type of investment. Once a 'plant'

is in operation the only cost items, other than the cost of goods sold, directly limiting price competition are such operating expenses as wages and interest on borrowed capital. When the enterpriser is at once operator and proprietor even the latter items may be foregone over considerable periods.

Under these conditions have retail price adjustments followed cost differences and variations closely? Have inward and outward movements of investment in this branch of the industry been steadily responsive to price inducements and price warnings? These questions are manifestly of prime significance not only to a host of actual and potential small enterprisers and an even larger host of motorist customers, but also to those with more substantial and extensive business interests in the industry. For in no small measure the 'temper', or plane, of the competitive process in the industry at large is set by the degree to which price performs its basic function in this terminal phase of the industry. Here are focused the accumulated forces of supply and the ultimate forces of demand and upon the mode of their adjustment at this point depends, to a considerable extent, for better or for worse, the fortunes of a far-flung industry and of the vast public it serves.

In periods of sustained 'overproduction' of crude oil, such as occurred in the late 'twenties and early years of the present decade, pressure was thereby brought to bear upon integrated and partly integrated companies to expand marketing facilities, either directly or indirectly. In this manner an assured outlet for their refined products might be provided and their strategic position in the market fortified or strengthened. So far as the impetus to this expansion of marketing facilities had its roots in an overabundance of crude oil under a regime of unregulated production the influence of an uneconomic element in the increasing scale of service station investment might be considered to have waned latterly; for the spread of proration, with its proven efficacy, at least for the time being, to hold back a large potential production of crude oil has reduced the direct

and immediate pressure of surplus supplies seeking a market outlet.

On the other hand, the suggestion has been made that proration, though removing the immediate pressure of crude oil surplus, has indirectly exerted much the same influence upon the scale and organization of the market structure. Proration has done this, it is contended, through accentuating the advantage to an integrated unit of a slight increase in *its* crude output, pipeline runs, refinery throughput, and distributed gallonage. In the first three of these four successive processes of the industry especially, the incremental costs associated with a given marginal increase in the operating scale are relatively small. In production areas still under natural flow the costs of producing oil are largely either 'sunk' costs or costs of superintendence, which do not vary greatly in aggregate amount with fluctuations in the rate of production. The situation is similar in pipeline transportation wherever unutilized capacity exists, and, within limits, holds true even when the addition to 'runs' involves an increase in pipe-line capacity, since right of way, maintenance, superintendence, communication facilities and in some part even pumping facilities do not require expansion in proportion to increase in capacity. In the refinery branch of the industry, likewise, in view of a substantial margin of capacity beyond peak load requirements, an increase in throughput is usually possible without a proportionate increase in total costs. Since, then, incremental costs are likely to be much less than average costs all along the line, their cumulative force makes extra gasoline gallonage in the retail markets seem unusually attractive to the management of a fully integrated concern.

Under proration, it has been suggested, this expansive pressure may be appreciably greater even than it would otherwise have been, and in particular that the pressure from the production branch of the business tends to be enhanced since the discrepancy there between incremental costs and average costs is bound to be magnified. The contention has been advanced that this expansive force makes

itself felt through a circuit of enlarged market facilities, of mounting gallonage and finally of bids for additional crude oil allowable. And since prorating agencies usually canvass the field in determining allowables, these possibly inflated 'nominations' may result in 'letting down the bars' of curtailment somewhat at least in particular fields, with temporary advantage to certain interested concerns. This increased allowable thereupon may become the signal for another cycle of expansion of market facilities, added gallonage, and so on.

Whether, under proration, the expansion of market facilities has continued to be, even if it were assumed theretofore to have been, 'stimulated' by forces generated in the initial, or raw material, branch of the industry is by no means certain. Only an intensive study of all aspects of the movement of capital into the retailing branch of the industry can supply a convincing answer. Other factors besides those discussed above may well have had an important bearing upon the outcome, that is, concretely and primarily, upon the trend of service station investment; e.g., certain types of tax legislation, particularly chain store taxes. Whether the net outcome of developments, during the past decade especially, in the direction of expanding service station facilities represented a prudent and farsighted adjustment in the sense of providing a superior accommodation for motorists which they would in the long run stand ready to support, through their demand for petroleum products, or instead, an imprudent and shortsighted response (in part) to the dictates of competitive strategy, is uncertain ² and needs further study.

Whatever may be the outcome of a thorough investigation of this major issue, however, two things seem clear. First, expansion of the scale of retail marketing facilities has made no genuine contribution toward solution of the basic problem of surplus capacity in the crude production branch of the industry. It has served primarily simply to

² As indeed, also, it is uncertain whether the actual course of development may not have represented neither of these extremes, but rather some intermediate adjustment, with perhaps oscillations alternately first in one direction, then the other.

transfer the pressure of overproduction, or threatened overproduction (mounting potentials), of crude oil to a later stage in the integrated operations of the industry. Second, so far as the expansion of marketing facilities has been spurred by advancing integration, in one form or another, it has impaired rather than improved the situation of those refiners having no direct ties with the expanding market facilities. For such refiners the problem of finding a steady and dependable outlet for their products has become increasingly acute, despite the growth in both aggregate retail sales volume and in number of retail outlets. The spot market for gasoline in tank car lots has become steadily 'thinner,' but in the circumstances this seems not to have retarded the expansion of investment in the retailing branch of the industry.

Closely connected with the major question whether the expansion of marketing facilities has surpassed the limits that sound economic considerations³ would indicate is the matter of sales promotion activities. How far, if at all, do the intensified national advertising campaigns conducted by integrated companies in recent years represent an effort to find relief from the pressure of a possible overinvestment in marketing facilities induced by other factors? On the other hand, how far, if at all, may these sales promotion efforts have actually increased, both absolutely and relatively, the demand for the types of products (branded) they publicize, thereby at once making expedient an increase in the number of retail outlets where they are conveniently available and offsetting in some degree the burden of overcapacity in the production and refining branches of the industry? It may not be possible to answer these questions with certainty, but it should be evident that inquiry along

³ We use this phrase here in the conventional sense. It imports simply such an allocation of resources among various alternative uses that, at the margin, the rate of pecuniary returns yielded by each of the several categories thereof in each of its several uses is as much as, and no more than, these factors might yield if elsewhere employed. There are, of course, other possible standards of 'sound economy', but for the purposes of this report we put them aside.

this line will bring out important considerations bearing upon the main question.

Whether price has afforded an adequate check upon the capital devoted to the retailing of gasoline should be examined further. The fragmentary character of available statistical data may prevent definitive conclusions, but adequate analysis of existing data will undoubtedly remove some of the existing obscurity. Distribution census reports provide information regarding changes in the number of service stations and in unit costs of retail marketing, as do also reports of the Petroleum Administrative Board. The problem is complicated by the fact that retail outlets frequently (in truth, usually) handle other commodities than petroleum products. Because of the tremendous importance of this subject to the oil companies themselves, co-operation in the assembly of representative data on investment, costs, gallonage, and margins might well be secured. The rewards promise to justify the efforts.

The foregoing discussion is designed to indicate some of the ways in which the efficacy of prices as guides to business commitments in the oil industry may at some points have fallen below a tolerable standard. Indeed, as has been suggested, price may have manifested a degree of functional irresponsibility in this sphere, considered as a whole. This is an hypothesis to be tested, not a settled conclusion. It affords a point of departure for inquiry and suggests the essential character of price research in the oil industry designed to determine the role price has played in maintaining equilibrium and the effectiveness with which this function has been performed. The interests of the professional economist, the business man and the public in this problem are so vital and of such magnitude that comprehensive research in this field seems justified.

ELASTICITY OF DEMAND FOR PRINCIPAL REFINED PRODUCTS

One of the crucial questions concerning price is its relation to consumption. As many interests are concerned with the consumption of petroleum products, research that may

illuminate the subject can be of great value. The relationship of price variations to the consumption of petroleum products is not to be determined easily. Numerous important factors influence changes in the amount of gasoline used that are not directly related to price changes or price differences; for example, from season to season or in one district relative to other areas. A simple illustration is the effect upon gasoline consumption of the dating of automobile license fee collection. Up to a few years ago in most states the calendar year was the period covered by automobile licenses. Various observers noted, however, that gasoline consumption in the first month or two of the year seemed to decrease as compared with the preceding December to a degree greater than could reasonably be explained by weather changes. A study of automobile registration data showed that many car owners were not buying licenses until the second quarter, thereby saving themselves both the operating cost of the car and a part of the annual license fee. Eventually a few states experimented in postponing the registration date until March 1 or April 1. Now a large number of states have adopted this policy and gasoline consumption has increased noticeably in the early months of any calendar year relative to the preceding December—a fact of importance to the petroleum, automotive, and other industries, as well as to the states.

Among other non-price or indirect factors having a similar incidence upon motor fuel consumption and thereby upon demand for gasoline and lubricants are the (a) efficiency of automotive power plants; (b) condition of highways; (c) relative cost and facility of alternative forms of transportation; (d) national income. Similar factors manifestly affect the demand for fuel oil and kerosene. But the vital question in connection with the bearing of all these conditioning factors upon the demand for petroleum products is the degree or measure of their influence. Is it quantitatively determinable? The Committee believes that studies thus far made in these directions have not conclusively demonstrated the possibility of precise quantitative meas-

urement but it suggests that there is reasonable prospect of obtaining significant results from intensive efforts to segregate and measure these various indirect factors affecting demand elasticity.

For instance, certain automotive authorities have contended that progress in automobile engine and vehicle design has outrun improvement in roads, so that the latter has become the more important limiting factor upon the growth of automotive transportation. This contention suggests several questions susceptible of fruitful research. Given a certain standard of technical performance in automotive vehicles, do road improvements tend to have their most marked effect in augmenting the number of vehicles used or in increasing the use of equipment already operating? Given, on the other hand, a certain standard of road improvement, do advances in the technical efficiency of automotive vehicles tend to reduce gasoline demand by curtailing the requirements of motor fuel for a given volume of automotive transportation or to expand gasoline demand by inducing more people to become motorists and most motorists to drive more, that is, to operate equipment more intensively? By comparing standards of road improvement, motor vehicle registrations, gasoline sales, and types of automotive design for registered vehicles in various state jurisdictions during carefully selected periods it should be possible to disentangle, to some extent, these several indirect factors that influence gasoline demand and weigh their relative importance. The collateral significance of such studies should not be overlooked. For example, they should furnish a useful index of the relative advantages of highway improvement outlays upon various classes of roads, such as hard-surfacing of secondary roads as against widening, straightening, and leveling arterial highways.

Much of the gasoline sold today is used by commercial vehicles competing with other forms of transportation, especially railroads. The relative cost and facility of alternative forms of transportation has an indirect effect upon elasticity of demand for gasoline and lubricants. Study of this effect

should contribute significantly to the resolution of important issues of public policy. To what extent is automotive transportation, and therewith the demand for gasoline, affected by the relative levels of railroad rates or changes therein?

Taxes may be regarded, according partly to the point of view and partly to the nature of the tax, as either an indirect or a direct factor affecting demand. So far as the tax is incorporated in the price of a product, its effect upon demand is indistinguishable from any other element, such as the cost of a direct factor of production. On the other hand, from the business standpoint in the formulation of price policy an excise tax, like the ordinary motor fuel impost, represents a rigid, predetermined, and extraneous element limiting the discretionary factor in price adjustment. In whichever light regarded the elasticity of demand is indubitably an important consideration in determining tax policy, since the revenue-yielding power of the gasoline sales tax is conditioned by it. It is equally incontestable that the levying of such a tax imposes limits upon the pricing policy of business, since the degree of elasticity of demand at the tax-included price level is almost certainly not the same as a tax-free price level. From the public standpoint as well as from the business standpoint, therefore, the determination of elasticity of demand for gasoline is among the extremely significant, if not one of the most urgent, problems of price research in this branch of the industry.

Considerable study has already been devoted to gasoline taxes in this connection. A review of the material available on the subject was recently published by the American Petroleum Industries Committee.⁴ The studies hitherto

⁴ See memorandum, *The Effect of Gasoline Tax Increase on Motor Fuel Consumption and Revenues*. Studies mentioned include one made in 1930 by R. G. Blakey; a joint study by J. W. Martin and Marshall Harris covering tax increases from 1925 through 1929; a study entitled *Gasoline Taxation and Its Effect on Consumption* by S. A. Swensrud (American Petroleum Institute, Proceedings, May 1933); a study by C. F. Roos of the effect of tax increase in Virginia in 1926, published in *Dynamic Economics* (Bloomington, Indiana, 1934), pp. 24-44.

made are concededly exploratory; they suggest, however, that there is a measurable inverse relation between the tax rate and consumption. The whole mass of data on the relation of changes in rates of consumption to changes in tax rates in various state and local jurisdictions should be assembled and analyzed.

There remains for consideration the main question of the elasticity of demand for gasoline and other petroleum products relative to the prices at which suppliers offer them for retail sale. In the case of motor fuel there is much discussion among motorists of 'mileage per gallon'. Does this indicate a degree of concern about the cost of gasoline that would mean sharp elasticity of demand relative to price? Very little published material seems to be available on this question.⁵ The subject is intricate because of the difficulty of isolating the influence of price among all the various factors operating upon demand.

The numerous and wide variations in price, both in place and in time, of this widely sold commodity should facilitate the study of its demand elasticity. On the other hand, the long range problem of determining to what extent the growth of automobile use has been fostered by declining gasoline prices is especially difficult. It is true that since the War there has been a secular downward trend in gasoline prices, especially marked after 1929, although up to 1920 gasoline prices had been rising. Is there any evidence that the sharply advancing price in the first period, that is up to 1920, which coincided with the shift of gasoline from a byproduct to a major product status retarded the growth in the use of automobiles? Conversely, has the sharp decline, coincident with outstanding improvements in the geophysical technique of oil discovery and the introduction of the cracking process in oil refining, appreciably accelerated the expansion of demand since 1920?

⁵ See, however, the pioneer studies of A. J. Nichol, *Partial Monopoly and Price Leadership* (Philadelphia, 1930), and C. F. Roos, *Dynamic Economics*. The latter study in particular evinces some ingenuity in the elaboration of mathematical formulae upon a rather narrow statistical base in attempting a solution of the problem.

It might appear that investigation of depressed prices in particular areas resulting from so-called price wars might provide material for studying the short-run elasticity of demand. By comparing gasoline sales data for such areas with similar data for adjacent areas where prices had remained steady, at higher levels, some indication might be afforded of consumer response to price inducements. Two qualifying factors would have to be considered, however. First, the shift of gasoline purchases from other areas into the low price area would have to be taken into account in assessing the significance of the gallonage increase accompanying the price decline. This probably occurs on a larger scale than might commonly be supposed. The effect of a severe price depression in Detroit some years ago was plainly discernible on the gasoline sales at service stations in Toledo, some fifty miles distant on the through routes to Michigan. It would be necessary, therefore, to try to determine quantitatively the extent of this diversion of demand from the territory surrounding the 'low price zone', in order to arrive at the increase in gallonage sold to customers normally buying within the low price zone, attributable to the reduced prices. A second qualifying factor is the tendency of dealers to 'stock-up' during short periods of cut prices and the published gasoline tax data are usually based on shipments to resellers rather than on actual consumption.

The significance of these qualifications upon the apparent effect of price reductions upon consumer demand would be relatively less, however, as the area of cut prices was larger and the duration of the price cut longer. It may well be that some of the acute and prolonged periods of severe price competition in southern California would afford a sufficient basis for fruitful study of the elasticity of gasoline consumption relative to price. It seems probable, too, that the price and consumption data for some foreign countries should prove helpful, for owing to various causes—scarcity, taxes, government or private monopolies—much higher prices and much greater variation in prices from time to time have prevailed abroad.

Such studies of the relation between consumption demand and price, whether in the domestic field or abroad, should, of course, have among their objectives the determination of the relative effect of price changes upon different classes of consumers. It is reasonable to suppose, for example, that the response to variations in price would be much greater on the part of passenger car owners in lower income brackets than of those in the higher income brackets or as compared with the response of industrial or commercial operators of trucks. Analysis of available data on sales to consumers taking delivery by different methods and under different contractual forms would be helpful. Further information might be obtained by an intensive survey of family budgets in representative local areas.

For petroleum products other than gasoline the relation between price and demand seems susceptible of more definite determination. In the case, particularly, of fuel oils used for commercial, domestic and industrial heating, the factor of substitution is much more conspicuous, exerting a powerful and unremitting influence upon fuel oil demand. Petroleum fuels come directly into competition with other sources of heat and power, including coal, coke, natural and manufactured gas, wood, and water power, and the extent of their use, still more the extent of their adoption, is to a substantial degree contingent, plainly, upon close cost reckoning. Factors other than price are, of course, influential in determining the kind and amount of fuel used. One is the portability and weight of both the fuel and the equipment required to use it, as in the case of vehicles, boats, and trains. The cost of equipment and other items involved in changing from one fuel to another and the technical characteristics of the fuel are other factors. For certain special industrial processes these technical features may be decisive. Significant conclusions as to the importance of these various factors could be reached, we believe, through a study of changes in the consumption of petroleum fuels in various uses in relation to their prices, the prices of their substitutes, and the rate of business

activity. The United States Bureau of Mines has published for several years a breakdown of the consumption of fuel oils by uses which should provide useful data for studies of this type.

In considering the heavy industrial fuel oils the by-product aspect would have to be weighed. Many refiners probably consider heavy fuel oils as a byproduct to be sold for what it will bring. Under this conception, its price would seem to depend more upon variations in the demand than upon the cost factors. This suggests the probability that in times of industrial depression prices of such oils would tend to fall drastically with declining demand, since the supply, based primarily upon running crude oil for gasoline, for which demand is relatively steady, would not be greatly decreased. The case is also complicated by the possibility of converting some of the residual parts of the crude, such as heavy fuel oils, into other products, such as coke, asphalt, and road oil. For the latter products, in their fuel and road building and maintenance uses, there are again; in turn, various substitutes—for asphalt and road oil, cement, coal tar, and other materials. In these circumstances, the determination of demand elasticity has obvious practical significance for the shaping of business policy.

From the standpoint of the interrelation of price and demand these byproduct aspects of certain petroleum products raise interesting questions, because to the extent that products are truly byproducts their supply is primarily determined not by the cost-price relationship but by the production of other, the primary, products. As has been indicated, however, almost no petroleum product is strictly a byproduct. In most cases there is a considerable range within which various product assortments may be made from the crude being run to stills.⁶ Indeed, the hydro-

⁶ Cf. A. J. Kraemer, A Report on the Effect of Technologic Factors on Supply of and Demand for Petroleum Products (Petroleum Investigation, Hearings on House Resolution 441, before the Interstate and Foreign Commerce Committee, House of Representatives, 75th Cong. recess, Washington, 1934), Part II, pp. 1310-90.

generation process makes it possible to convert the entire barrel of crude into gasoline. The relation between price, cost, supply, and demand in respect of these products are, therefore, very intricate, to say the least. Nevertheless, large investments are made from time to time, by both the petroleum industry and the users of these various products, on certain assumptions of price and availability. If, however, crude oil over the years rises in price as a result of declining production, or for any other reason, it presumably would mean that prices for the so-called byproducts would rise rather sharply. In view of the large capital investment by the users of such products, as well as by the manufacturers of the equipment in which they are used, it should be of distinct value to learn more about the price relationships between crude oil, gasoline, and the semi-byproducts of petroleum refining, and in particular about the factors that regulate demand for the semi-byproducts.

The consumption of petroleum distillates in agricultural uses, primarily for tractors, provides data of unusual interest for the study of price-making factors. Many tractors can burn either gasoline or heavier fuels, and since even the tractor farmer usually retains some horses the extent of tractor use as well as the kind of fuel used may be varied considerably. In contrast to the passenger car, for the tractor the cost of fuel is a relatively important item. Here then are a host of factors affecting the consumption of tractor fuels—the cost or price of gasoline, of other tractor distillates, of tractors, of horses and horse feed, of farm labor, and the price of farm products.

A thorough study of elasticity of demand for gasoline and other petroleum products should consider certain closely related problems. One is seasonal elasticity, that is, the variation in demand that may result from different weather conditions at different times of the year and in different geographic regions. The mere measurement of such seasonal variations is one problem. It should include consideration of the changes in seasonal variations. This is not a new field of research, but new studies need to be made frequently in

order to ascertain what changes, if any, are taking place. The other problem is to determine what lies behind the seasonal or geographical variations as such. Is it merely the weather per se? Or is it rather the effect of the weather upon driving conditions? Of course, it is a matter of common observation that it is largely the latter and that closed cars, heaters, easier starting, better roads, and better clearing of roads have increased winter consumption of gasoline relative to that of summer, but more knowledge about the relative importance of these different factors would be useful. Ways in which demand could in some measure be further stabilized might be revealed. Another and even more significant objective of such a study would be to determine to what extent supply is economically adjusted to variations in demand, not only from season to season and from region to region, but also among different classes of consumers and different types and modes of use.

EFFECT OF PRORATION OR CONCERTED CURTAILMENT UPON THE COST AND PRICE OF CRUDE PETROLEUM

Since 1927 the method of crude oil production has been altered fundamentally. Prior to 1927 the owner of a producing well, generally speaking, was at liberty to operate it as he saw fit, so long as he carried out his contractual obligations to the lessor on whose land the well was sunk. As a result, when new wells were brought in, production, as a rule, was very large at the outset, because the great pressure on the oil underground tended to force it to the surface. When in a few months, however, this pressure, through the open flowing of the well, had largely exhausted itself, production declined rapidly; and then, under pumping conditions, tapered off gradually over a period of years. This condition still prevails in greater or less degree in certain areas where no state control over production exists, as in Kentucky, Michigan, and Illinois. In California there is no state control, but a certain amount of self-imposed restriction by the industry itself has existed in recent years. In the mid-continent area, however, especially in Texas,

Oklahoma and Kansas, state control is thoroughgoing. Production in all oil pools of any consequence is limited by regulation and total production from each pool is 'prorated' among the participating wells. As a result, new wells in new pools are often limited in output to a small fraction, in some cases less than 1 per cent, of their 'potential', that is, of the quantity they could produce at that time if unrestrained.⁷ Under these conditions of restricted production the period which must elapse between the bringing in of the well and the time when enough crude oil is produced from it to pay for the cost of the well, is greatly prolonged, assuming the price to be the same in either case.

A great many questions stem from this new type of production control and about them there is today much speculation and controversy but little that is finally conclusive. What effect, for example, does this process of delayed recovery have on the cost per barrel of crude oil produced over a long period, or over the life of the well? Are there gains in the way of greater ultimate recovery through the more deliberate extraction of the oil likely to result under proration? Is a larger proportion of the recovered oil brought to the surface by natural pressure, rather than by pumping, under these conditions? If these advantages accrue, what is their magnitude in terms of cost per barrel? How far are these gains offset by added carrying costs on the capital investment resulting from the longer period required to retrieve the original investment?

There is also the question of the effect of proration upon the average price over a long period. Would such average price be higher or lower were production unregulated? And whichever is the case, will it be because costs are greater or less or because of modification in the impact of the supply factor upon the market? Some believe that the restriction of production per well results initially in a

⁷ The 'capacity' established for a well by a 'potential' test is often misleading, however. Such tests are commonly of short duration, especially if they be 'open-flow' tests; and it is very doubtful that the rate shown during the test could be sustained for any considerable period under conditions of unregulated production.

higher price but that this tends to stimulate the drilling of many more wells than are necessary, or than would be drilled were production not restricted, thus having the two-fold effect of tending to keep down the price (because of the constantly overhanging potential supply) and increase the per barrel cost. Under free conditions, it is claimed, prices would tend to decline or remain low until production from existing wells had begun to decline; then, as prices mounted, exploratory drilling would begin to increase again, new production would be brought in, and the cycle recommence. It is pointed out that, contrary to belief in some quarters, the number of wells drilled from time to time shows a remarkable correlation with the price of crude oil.⁸

Is there, then, a vicious spiral in the proposition that with restricted allowables prices must be kept higher in order to cover the added costs of operating surplus wells? This seems to be implicit in the contention of many producers from time to time that higher prices are needed.⁹ If, however, these higher prices attract still more wells, necessitating still further reductions in allowables, again requiring higher prices which induce still more wells, with a repetition of the cycle of smaller allowables, higher prices, more wells, *ad infinitum*, the device of proration would seem to have fallen somewhat short of effecting an economical adjustment of the supply of oil to demand. It has been suggested that as a consequence of the curtailment of flowing wells and the stimulus to drilling, an ever mounting potential of immediately produceable oil tends to be brought about below ground which has somewhat the same

⁸ See the Report of the Petroleum Code Survey Committee to the Honorable Harold L. Ickes, Petroleum Administrator, March 28, 1935 (reprinted in *National Petroleum News*, March 27, 1935, p. 23); also our discussion in the first section of this Chapter.

⁹ See e.g., statement by President Moran of Continental Oil Company, in announcing an increase in crude oil prices, that the situation required "either an increase in the allowables or an increase in the price" (*Oil and Gas Journal*, December 10, 1936).

effect upon prices as though the oil were on hand in above-ground storage tanks.¹⁰

A contrasting view of the significance of proration is that the extra capital cost of partly idle wells caused by delayed recovery is a small loss compared with the great physical waste of oil when it is allowed to come to the surface under unrestricted flow and with the losses attending chaotic marketing conditions prices are made on a catch-as-catch-can basis. The adherents of this view maintain that proration is well justified, from an economic standpoint, by the greater physical recovery and the more stable relation between supply and demand which, it is their contention, it tends to promote. The large reserves of potential production developed as a result of the stimulus to drilling can be kept under control by proration, they assert, and the oil allowed to flow to market only in proportion to current requirements. In short, the argument runs to the effect that proration tends to minimize the difference between the conditions of production of petroleum and those of the production of solid minerals, simply invoking administrative discretion as a lieutenant of ordinary business prudence in a field in which otherwise the latter is largely inhibited.

The discovered reserves of oil held in their natural reservoir are considered a highly desirable stabilizing factor, assuring supply for a long period and thus safeguarding heavy investments of capital in the oil, automotive, and other industries depending on petroleum, as well as constituting a valuable element of national defense.

The novelty and administrative imperfections of proration, the lack of uniformity in its exercise among the various oil producing states, the extraordinary influence of the East Texas pool, and the disruptive tendencies generated by the long continued depression have all combined to make it difficult to reach convincing conclusions concerning the questions and problems outlined above. The

¹⁰ See study by J. E. Pogue, *Economics of Crude Oil Potentials in the United States*, Transactions of American Institute of Mining and Metallurgical Engineers, Petroleum Development and Technology, 1931, p. 633.

issues raised by proration are of such profound and pervasive concern to the public interest, however, as well as of such vital importance to the petroleum industry that in the Committee's view thorough, objective, and comprehensive analyses of the economic effects of proration, both potential and actual, are highly desirable. Consumers wish to be assured that proration is not a device that might result in high or monopolistic prices. The government is interested in the maximum ultimate recovery, within economic limits, of a natural resource vital not only to national defense but also to the general welfare and to the stability of numerous peace time industries. The oil states are concerned from the standpoint not only of the effects of proration upon tax revenues but also of the equitable determination of proper allowables for various pools and producers. Different groups within the industry or affected by it have diverse interests in the questions at issue. Producers, of course, want higher crude oil prices; independent refiners are opposed to higher crude oil prices unless they can be certain of getting correspondingly higher refined product prices. Consumers are interested in continuing low prices. Finally, there is the fundamental question whether the proration authorities, in setting allowables based upon some estimate of demand or consumption requirements, may not, through their determination of the supply factor, be in fact actually regulating demand and prices.

In recent years, since the advent of proration, considerable controversy has arisen within the industry as to whether the division of the industry's total revenue among the several branches, to wit, production, pipeline transportation, refining and marketing, is not frequently distorted as a result of proration and various political and other factors. Some believe these to have made the posted price of crude oil unresponsive to the normal forces of supply and demand while the latter continue, nevertheless, to operate in the market for the refined products. Thus it is claimed that the refining branch of the industry, and particularly independent refiners not having their own crude

production, frequently suffer a severe squeeze between artificially high posted crude oil prices and realistically low refined product prices. The independent marketers, on the other hand, maintain that the integrated oil companies despoil marketing as a profitable field of enterprise by utilizing it not as a means of making marketing profits as such, but merely as a means of enlarging the volume of business on which production, pipeline, and refinery profits can be made. Unbiased analyses should be made of the relative proportions of the industry's total revenue that have gone to the various branches from time to time and under varying conditions and degrees of production control or proration, and of the forces making for this distribution.

Probably of no aspect of the oil business, therefore, can impartial study of price and cost relationships be productive of more valuable results than with respect to these questions concerning crude oil production and its regulation. With the experience already at hand an adequate factual basis for such studies is, we believe, available.

PRODUCTION COSTS AND COST-PRICE RELATIONS

The possible influence of various production control procedures on petroleum costs has been mentioned. In view of the prevalent tendency toward efforts to rationalize prices in one way or another, especially the proposals made from time to time to fix crude oil prices on the basis of production costs, research into the production costs of petroleum is in itself important. But what is the cost of crude oil production? What, indeed, is cost; what should be included in it? And if prices were to be fixed on the basis of costs, what would be the influence, if any, of the prices themselves upon the 'costs' as computed?

As previously indicated, some governmental studies have already been made of the costs of crude oil production. The first, by the Tariff Commission covering 1927-31, were extended through 1933 by the Petroleum Administrative Board of the Department of the Interior during the NRA

code period. In these governmental studies, as outlined in the description of methods used, the share of oil or other compensation going to the land or royalty owner or to previous lessees in the form of 'overrides' was treated as a cost of production and so also, through the mechanism of amortization charges, was the price paid for oil in the ground (that is, the amount paid over and above the value of wells and other equipment) by one producer to another for a developed production property. From the standpoint of the producer such items clearly would seem to be properly included in cost, because for any individual producer they are very real costs indeed. From the overall standpoint, however, some question may exist as to whether amounts representing payments for oil rights or profits on the sale of oil properties should be treated as costs in the economic sense. If, for example, the land owner gets one-eighth of the oil produced, what is *his* cost of production? In most cases, of course, it is nothing (except the possible reduction in revenue from the surface uses of the land on which the wells, tanks, etc., are located). Should overall costs, therefore, include this free or practically free royalty oil? Or again, if an oil right is sold by a lessee who gets a bonus or an 'override' equal to a certain share of oil subsequently produced, what is the cost of that operation?

Some suggest that if royalty oil and bonuses or overrides paid for leases or producing properties are treated as costs, then the price of oil itself tends to influence cost in the same direction in which the price has been tending. Furthermore, when the price of crude oil increases more wells tend to be drilled, as already shown, and under proration it is suggested that this means a diminution in the allowable production per well and higher costs per barrel. Thus, it is claimed, an increase in the price tends to bring about an increase in cost in both these ways.

It is suggested, too, that the maintenance of a high crude oil price tends also to promote drilling in areas of high cost production, where, at lower prices, drilling would not be likely to take place—at least to any material extent—until

a greater scarcity of oil developed. Once wells in such high cost areas have come into existence, however, their high costs become a part of the average costs for the industry as a whole and this, it is contended, is another illustration of the way in which a high price tends to result in increased costs.

An even more direct example of the influence of price upon costs is in connection with the payments for mineral rights. Under ordinary conditions where land is leased ahead of development the producer pays the surface land owner (who originally owns the mineral rights also) merely a nominal amount in cash and agrees to give him one-eighth of the oil when and if produced. Under such conditions the producer would regard his unit cost as being the total cost of the operation divided by seven-eighths of the oil. Thus the value of the mineral rights as such creeps into ordinary cost figures to a limited extent, although many economic authorities would contend that the value of the mineral rights or the amount paid for them, whether in cash or in royalty oil, is not a production cost in the proper sense of that term; it is merely a measure of the market value of the oil that presumably can be produced, less the estimated cost of getting the oil to the surface. If the fee owner who originally possessed the mineral rights drilled his own wells, his accounting records would not normally include among costs any amount representing the price paid for, or the market value of, the mineral rights;¹¹ his cost would be merely the actual costs of production divided by all the oil produced. In any oil producing area, however, especially after various properties have been traded with the passage of time, many of the producers are almost certain to have paid substantial amounts for mineral rights. A farmer may not sell his mineral rights until after development has proceeded to a point where oil is known with reasonable cer-

¹¹ On this point, reference being solely to accounting records of persons presumably not ordinarily highly skilled in the arts of business management, almost everyone would probably agree. The following clause is more debatable. Its acceptance depends on one's view of the validity and scope of the 'alternative cost' doctrine.

tainty to underlie his land; he then sometimes gets a very high price for his mineral rights; or the original lessor, who may have paid only a nominal amount for the oil rights prior to development, may later resell his lease to a producer at a substantial price; or one producer may sell his producing properties (that is, his mineral rights and his wells) to another producer at a price that reflects a large profit for the oil underground or, in other words, for the location value of the lease. Such profit, not a part of the original producer's cost—either actual or accounting-wise—nevertheless becomes a part of the new producer's investment cost to be charged up to his future production, usually under the heading of depletion or amortization.

The amounts paid for mineral rights fluctuate, of course, directly with the price of oil. A lease which, if oil were selling at 50 cents a barrel, might have a very low market value, might sell at many thousands or even hundreds of thousands of dollars if the price of crude oil were \$1.25 or \$1.50 a barrel, because obviously the value of the lease depends directly upon the expected realization for the oil that can be produced over and above the cost of getting it to the surface and into marketable condition. There is always a strong tendency to assume the continuation of current prices in valuing production even though the total oil can be got out only over a period of years. As already suggested, the cost of such mineral rights to the producer who buys them are often a substantial part of his total outlays, even though, as some economists contend, they may not be price-determining 'costs' of crude oil production.

The problem of determining crude oil production costs is, therefore, more complicated than may appear on the surface or than may be indicated by the experience of an individual producer according to his particular set of books. Some suggest that a vicious spiral would be involved in any program that undertook to fix crude oil prices on the basis of production costs which were themselves influenced by price. Inquiry into what constitutes a sound definition of cost in this case and into the influence, if any, of price upon

costs would seem, therefore, to be of considerable interest and possible significance.

SUPPLEMENTARY OBJECTIVES

Amplifying somewhat the introductory statement to the basic research project recommended, the Committee believes that a comprehensive program of study of the operation of the price system in a particular sphere, such as the oil industry, should have three major objectives. For clarity, these may be schematically presented as follows:

- 1) How do prices move and how do price relationships change?
- 2) What makes prices move as they do and price relationships alter?
- 3) What effects do price movements and price relationships have?

Illustrative of the appropriate questions arising under (1) are: (a) movements from year to year, month to month, or day to day; (b) movements in one geographic region relative to another; (c) movements in the given industry relative to movements of prices generally. With respect to the manner in which price relationships change, appropriate questions arising in the oil industry would be the relations of: (a) crude, wholesale, and retail price changes; (b) gasoline, fuel oil, kerosene, and other refined product price movements.

In connection with the second line of inquiry, research might well be concerned with the role in price determination of (a) costs; (b) demand; (c) administrative policy. But an exhaustive analysis could hardly fail to take account of: (a) the influence of technological advance; (b) the factors of competitive rivalry and business emulation; (c) the whole range of inhibitory forces stemming from traditional public policy and crystalized legal precedents.

A wide range of questions suggest themselves under the third heading, of which the following are representative. At the prices realized, what are the rates of return upon investment, and how is the flow of investment funds affected not only in the industry as a whole but also in (a) its four

vertical divisions, (b) the principal geographical areas, (c) enterprise units of various size and scope of integration? Does the rate of utilization of capacity in the several branches of the industry consistently vary directly with price changes and is there evidence from which could be deduced what constitute cost-indemnifying prices at various levels of curtailed operations? How are the returns to labor engaged in the industry affected by the course of prices? Do the prices realized and price relationships in any degree promote or hinder the conservation of petroleum or have repercussions upon the conservation of other natural resources and if so, in what measure? What are the effects upon consumption, and upon the social and economic interests of consumers, of the course of prices for each of the principal refined products?

From the foregoing survey it may be seen that this Committee has chosen to recommend as the initial and basic project for an articulated research program an inquiry falling within the broad bounds of the third basic objective. Supplementary to this basic project we have outlined two additional lines of inquiry relating more especially to the second major objective as above distinguished. In placing special emphasis upon the first of these projects and in limiting our recommendations to the three research problems outlined, the Committee does not thereby reject either as impracticable of execution or as wanting in vital significance research projects bearing upon other issues and having other objectives. But we are convinced that the basic project set out above, dealing with the efficacy of prices as regulators of the flow of investment and the rate of operations, is a suitable one upon which to concentrate for immediate development. This judgment rests upon three grounds: (1) that the project first above recommended is of fundamental and general significance; (2) that it is of paramount urgency; (3) that it is entirely feasible. To a large and, we believe, a sufficient extent, though by no means exhaustively, the factors that have in our minds given weight to these grounds have already been indicated. We shall not repeat them.

In submitting this limited research program, the Committee on Price Research in the Petroleum Industry would like to emphasize that it conceives of it as in the nature of a report *ad interim*. It represents simply what we have been able, in the time available, to agree upon in substance and in form for unanimous recommendation. Upon the basis of what may be accomplished by concentration upon these limited objectives, through the experience thereby gained, and from the exchange of opinion, criticism and suggestion, the Committee hopes and expects that a basis will be laid for eventual recommendation of additional research projects worthy of the support and encouragement of the Conference on Price Research.