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# State and Local Government Activities

## *in the Tenth District*

IN THE AUGUST 1960 *Monthly Review*, some aspects of the significance of state and local governments in the national economy were considered. In addition, the level of general state and local government expenditures was compared among six states in the Tenth Federal Reserve District and the United States. State and local government outlays per person in District states were found generally to be high relative to the national average and to vary considerably among the states. Disparity in state per capita personal income levels was found to be associated in a general way with differences in per capita state and local expenditures, both in the Nation as a whole and within the District. However, income differences did not explain the higher-than-national average level of outlays in District states, nor did they account fully for discrepancies among the states.

In the present article, District per capita state and local government activities are viewed in terms of the major functions performed by such governments. This is done not only because information on these functions is of interest in its own right, but also because it permits a clearer identification of the factors associated with differing levels of activity among states and regions. While the experience of governments across the Nation is often looked to for factors which influence state and local government functions, the primary focus is upon six District states—Colorado, Kansas, Nebraska, New Mexico, Okla-

homa, and Wyoming.<sup>1</sup> Most of the basic data used in this article were obtained from the *U. S. Census of Governments: 1957*—the most comprehensive recent source of information on state and local government activities.

### Education

Across the Nation, education accounts for more variation in per capita state and local government expenditures than any other function, despite the fact that outlays for it are relatively less variable from state to state than those for most other major functions. This apparent anomaly results from the large absolute size of education expenditures. Nationally, they accounted for around 35 per cent of general state and local government outlays in 1957 — an amount equal to about 3 per cent of gross national product. Among the District states, education outlays were responsible for 34 to 39 per cent of the total. Despite this comparatively small variation in the proportion of general outlays devoted to education, differences in per capita dollar amounts were large. Only highway expenditures, among the other categories of outlays, showed about as large a range in the District. Indeed, the range of education expenditures was far greater than the total spent for any other function except highways and, in the case of two states, public welfare.

<sup>1</sup>While a significant share of the population of the Tenth District resides in Missouri, the largest influence upon state and local expenditures in that state is beyond the bounds of the District. Unfortunately, it is not possible to make meaningful comparisons of state and local activities in the District portion of Missouri with other District states. A number of conceptual and statistical problems involved in making inter-state comparison of state and local government expenditures are discussed in the August 1960 *Monthly Review* article.

Nationally, interstate differences in per capita education expenditures display considerable association with variation in per capita incomes. However, high per capita expenditures are not necessarily always associated with a proportionately larger amount of education services. Costs of such services differ from place to place and a large element in this disparity is variation in school salaries. Ordinarily well over half of local school expenditures are for payrolls, of which by far the largest portion goes for teacher salaries. These salaries are comparatively about as variable as outlays and relatively more variable than the salaries of all other public employees. Nationally — as might be expected — teacher salaries are closely correlated with per capita incomes. Therefore, the national relationship between per capita incomes and per capita expenditures for education is to some degree attributable to teacher salaries. Since such a large share of education outlays is for payrolls, school employment provides one measure—albeit a very crude one—of the actual level of services rendered.

#### **Per Person Education Activity High in District**

Whether measured in terms of employment or — with one exception — in terms of outlays, each District state purchases more education services per person than the national average. They do this despite the fact that their per capita incomes are generally below the national average. However, several factors can be identified which indicate that the “need” for education services in District states is unusually large. Possibly the most obvious of these is the high proportion of the population enrolled in elementary and secondary schools. In this regard, each state—except Nebraska—exceeds national experience by a substantial margin. This is in considerable measure attributable to an age pattern which in most instances contains an unusually great number of school age persons. An additional factor which tends to raise demands upon District

education systems is comparatively low density of population. While at least one recent study has indicated that economies of enlarged size are rather quickly exhausted in education plants, extremely low density probably does contribute somewhat to inefficient plant size. Furthermore, the cost of assembling the student body tends to be high in a sparsely settled area.

The high level of per capita education outlays in the District is partly accounted for by advanced (college and university) education upon which each state spends more than the national average. This is true of both total outlays and of operating expenditures. Indeed, in 1957, Colorado spent only slightly less per capita for higher education than the top state in the Nation and in the same year New Mexico incurred higher per capita current operating outlays than any other state. Each of the District states also employed more people in higher education relative to population than the United States average, with New Mexico ranking second in the Nation. While various reasons for this play a part in each of the states, at least one factor is common to all of them. In each case the percentage of the population enrolled in public institutions of higher education exceeds that in the Nation generally. This results both from high over-all advanced education enrollment and from the fact that a large percentage of it is in public institutions. In some states outside the District, where advanced education expenditures and employment are comparatively low, a large portion of enrollments is in private institutions. This is especially notable in several New England states. In some District states—Colorado is a striking example—higher education enrollments are inflated by unusually large numbers of non-resident students. In terms of financing requirements, large enrollments of such students are at least in part offset by the comparatively high nonresident fees they pay.

Table 1  
Education Activities In District States In 1957

	General Expenditures Per Capita All Functions	Rank	Education Expenditures Per Capita	Rank	Per Capita Expenditures for Local Schools	Rank	Per Capita Capital Outlays for Education	Rank	Enrollment in Local Schools Per Full-Time Education Employee
Wyoming	\$ 328	1	\$ 120	1	\$ 94	1	\$ 25	1-2	15
New Mexico	279	3	109	2	82	2	19	3-4	17
Colorado	280	2	102	3	76	3	25	1-2	16
Kansas	271	4	92	4	73	4	19	3-4	15
Oklahoma	248	5	88	5	67	5	18	5	17
Nebraska	202	6	78	6	61	6	14	6	15
U. S. Average	237		83		70		19		17

SOURCE: U. S. Census of Governments: 1957.

### Local School Expenditures in Individual States

The number of public elementary and secondary school students per education employee did not differ greatly from state to state in the District in 1957. Thus, in looking at differences in local education expenditures among the individual District states, an interesting question presents itself. Why do per capita education expenditures at the local level vary so much when the amount of educational services rendered per pupil—measured by the rough standard of employment—is for the most part not radically different? In each state a pattern can be discerned which probably goes a long way toward an answer.

Wyoming, which in 1957 ranked next to the highest in per capita local school expenditures nationally and highest in the District, did so largely as the consequence of a series of reinforcing factors. To begin with, the state has a high per capita income and the rate of pay for teachers is correspondingly high. In addition, a large percentage of the state's population is enrolled in local public schools and comparatively rapid growth in enrollment has given rise to large capital outlays. Furthermore, Wyoming is among the more sparsely populated states in the union. The latter fact may well help to account for a somewhat smaller number of pupils per employee than in other District states. In addition, low density tends to increase per pupil costs incurred outside the classroom.

Nebraska, at the other end of the expenditure spectrum, presents a more complicated picture. Its per capita income is around the average for the District but per capita expenditures for education in 1957 were well below even those in Oklahoma—the lowest income state. Partly accounting for this is the fact that enrollment of students in primary and secondary schools was substantially lower in regard to population than elsewhere in the District. Similarly, the median pay of teachers in Nebraska was well below that of any other District state. Reinforcing these factors was a comparatively low rate of increase in enrollment, with correspondingly small capital outlays per person. This combination of factors helped to produce low per person education expenditures despite a relatively high ratio of employees to students in elementary and secondary schools.

New Mexico also presents an interesting case. In 1957 its per capita income was near the lowest in the District and ranked 31st in the Nation. Despite this, more was spent per person for local schools than in any other District state except Wyoming and more than in all but six other states in the Nation. Important elements in the explanation for this situation were New Mexico's large student enrollment relative to population, which was greater than in any other District state, and the fact that it ranks next only to Wyoming in low density of population. However, an im-

portant additional aspect is the fact that the median pay of teachers in New Mexico was well above that of any other District state. This is rather puzzling in light of New Mexico's comparatively low per capita income. However, it may well be related to another factor which helps to explain the state's high expenditures per person, i.e., the rapid increase in school enrollment in recent years. This growth required the state to engage substantially in capital outlays and may have made it necessary, as well, to attract teachers from outside the state.

Colorado has a smaller percentage of its population enrolled in local schools and is more densely populated than New Mexico or Wyoming—the District states which exceeded it in per capita outlays. On the other hand, elementary and secondary school enrollment in Colorado has risen faster than in any other District state. This was reflected in unusually heavy capital outlays for local schools. The balance of these factors combined with somewhat lower teacher salaries than in New Mexico and Wyoming resulted in local school outlays below the level of the other Mountain States but above the remaining District states.

Kansas and Oklahoma—whose local school outlays fell well below those of Wyoming, New Mexico, and Colorado, but were above the national average—have several features in common. Both have a low density of population by national standards but considerably higher than any of the other District states. While school enrollment in Oklahoma has tended to decline somewhat in recent years and Kansas has shown some increase, the rise in the latter was far less than that experienced in the Mountain States. At least partly as a consequence, neither spent as much per capita for capital outlays in 1957 as did the Mountain States. In addition, Kansas and Oklahoma differed relatively little in median annual teacher salaries and were well below the Mountain States. In some respects, how-

ever, they were highly dissimilar. While Kansas was about equal to the District average in terms of per capita income in 1957, Oklahoma fell considerably below any of the other states. On the other hand, Oklahoma ranked comparatively high in enrollment relative to population while Kansas fell near the District low. Furthermore, Oklahoma had one of the highest ratios of students to full-time education employees in the District, while Kansas ranked much lower in terms of this measure. The various factors influencing education expenditures in the two states resulted in a slightly higher per capita outlay in Kansas than in Oklahoma.

#### Highways

Spending on highway construction and maintenance accounts for roughly 20 per cent of the general outlays of state and local governments in the United States and typically for a somewhat higher percentage in the District. In 1957, per capita highway expenditures ranged from \$25 in South Carolina to \$107 in Connecticut and they were relatively the most variable of the major categories of state and local outlays. A high degree of variability is not surprising, perhaps, since over two thirds of highway expenditures were for capital outlays and of these more than four fifths were for construction. Construction tends to be undertaken in large projects and, therefore, shows considerable variation, not only from state to state but also at different times in the same state. In 1957, variation in highway expenditures in District states, on balance, tended to reinforce the differences in per capita expenditures attributable to education. Consequently, by far the greatest portion of total variation in per capita outlays was due to those two functions.

Variability and the important role played by Federal financing tend to obscure whatever correspondence there may be between highway expenditures and some of the factors that

Table 2  
Per Capita State and Local Government Expenditures  
On Functions Other Than Education In 1957

	Highways	Rank	Public Welfare	Rank	Health and Hospitals	Rank	Urban Type Services	Rank	Other Outlays	Rank
Wyoming	\$ 93	1	\$ 17	5	\$ 25	1	\$ 17	4-5	\$ 58	1
Kansas	81	2	22	3	18	2	20	2-3	39	4
New Mexico	66	3	20	4	17	3-4	20	2-3	46	2
Colorado	54	4-5	44	2	17	3-4	25	1	39	3
Oklahoma	54	4-5	46	1	12	6	17	4-5	31	5
Nebraska	51	6	14	6	14	5	16	6	29	6
U. S. Average	46		20		19		30		40	

SOURCE: U. S. Census of Governments: 1957.

might be expected to influence them. For example, in 1957 there did not appear to be any straightforward relationship between per capita income and highway expenditures across the Nation other than near the low end of the state income distribution, where difficulties in obtaining matching funds may be particularly important.

The District states fell rather conveniently into three classes in regard to their per capita highway expenditures in 1957. Wyoming and Kansas were considerably above the other states and the national level. New Mexico fell somewhat lower but remained well above the national average. Colorado, Oklahoma, and Nebraska diverged little and were more moderately above the national average.

While individual state expenditure levels are associated with specific and often transitory factors, a generally higher-than-national level of highway activities per capita has been characteristic of District states in recent years. This is true whether activities are measured in terms of operating expenditures, capital outlays, or employment. To a large degree the high level of activity probably is associated with less-than-average density of population combined with a location athwart major east-west throughways. Thus, the number of persons per unit of surfaced road is much lower in each of the District states than in the Nation generally and the number of motor vehicles relative to population is appreciably higher. In addition, a significant portion of

the District's highways are in mountainous terrain where costs of maintenance and construction are high. All these factors were reflected in Wyoming's unusually great—next to the highest in the Nation—per capita highway expenditures in 1957. For the most part, similar factors are involved in accounting for New Mexico's high rate of expenditures. Furthermore, both New Mexico and Wyoming were among the early large participants in highway funds allotted under the Federal Aid Highway Act of 1956.

On the other hand, the high rate of spending in Kansas in 1957 cannot be accounted for in this manner. By District standards, Kansas is not particularly sparsely populated, Federal participation was not extraordinarily large, and the state's highways are not in unusually difficult terrain. The major reason for the state's high outlay was a heavy investment in the state-operated Kansas Turnpike in that year. Oklahoma also made a large toll road investment—in the Will Rogers Turnpike—but that in Kansas was larger, accounting for almost a third of total highway expenditures.

#### Other State and Local Government Activities

The functions already discussed, plus expenditures for public welfare and health and hospitals, account for about 70 per cent of all state and local government outlays. Outlays on the latter two categories are on the average of comparable size and considerably smaller than those for education and highways. The remaining expenditures are for provision of



a number of services associated with urban areas and for a variety of other purposes.

### **Public Welfare**

Public welfare expenditures show virtually no positive relationship to per capita income. This is illustrated by the fact that in 1957 per capita outlays for this function ranged from about \$7 per person in Virginia to about \$46 in Oklahoma, both of which stand quite low on the scale of per capita incomes. Lack of association with income is the joint consequence of a variety of factors. For one thing, the Federal Government participates unusually heavily in the welfare field. Nationally, almost half of state and local expenditures on welfare have been financed from Federal contributions in recent years. Second, at least in some of the highest expenditure states, liberal old-age assistance influences expenditures heavily and per capita outlays on this function show no positive relation to income. While old-age assistance is, of course, related to the age structure of the population, there is in addition wide variation from state to state across the Nation, not only in payments per beneficiary but also in the proportion of the population over 65 receiving assistance. This variation results from differences in laws, interpretation of laws, and the income status of the aged. Third, while high income is often associated with urbanization which, taken by itself, tends to increase welfare case loads, high income as such would probably tend to reduce them. Consequently, the lowest per capita public welfare costs might be expected in high income states with low urbanization, relatively youthful population, and low old-age assistance payments.

Thus Wyoming, which displays most of the features that might be expected to produce moderate levels of welfare payments, ranks near the District low in per capita outlays for the function. This is particularly impressive in light of the fact that the state has ranked highest in both of the other functions thus far

considered. On the other hand, the influence of old-age assistance payments on per capita welfare outlays is notable in Oklahoma, Colorado, and Kansas, but most striking in the former two. Oklahoma, which ranked lowest in per capita income among the District states and 36th in the United States, spent more per capita on public welfare in 1957 than any other state in the Nation. While aid to dependent children is quite a large welfare factor in the state, about three fourths of the total expenditure on welfare was for old-age assistance. Colorado, though spending less per capita on old-age assistance, used an even larger portion of its public welfare budget for the purpose. Colorado ranks comparatively high in the Nation, both in terms of benefits paid per recipient and case load relative to population. On the other hand, Oklahoma is somewhat less generous in awarding benefits but its case load is strikingly high both in regard to total population and in relation to the older members of the population. The other District states—Nebraska, New Mexico, and Wyoming—differed comparatively little in per capita old-age assistance payments in 1957 and were somewhat below the national mean.

In regard to old-age assistance and education expenditures, it is interesting to note that an age distribution of the population which tends to require large expenditures for these purposes is also one which, other things being equal, tends to depress income. A recent study of state income differentials found that the proportion of the population above and below working age bears a significant negative relation to state per capita income. Thus, greater tax effort may be required in some states exhibiting these age characteristics not only because needs are greater but also because the ability to meet them is less.

### **Health and Hospitals**

Health and hospital expenditures are financed almost exclusively from state and local revenue sources, since Federal funds gener-



ally account for less than 5 per cent of the outlays for this function. At least partly as a consequence, per capita health and hospital expenditures are rather closely associated with income across the Nation.

At first glance, such an association does not appear to exist among the District states. While Wyoming—with the highest income—does spend distinctly the largest amount, and Oklahoma—the lowest income state—spends the least, outlays by the other District states do not show a discernible relationship to income. However, if current operating costs are considered separately, a more distinct association appears. For example, both Kansas and New Mexico, which stood higher than one would expect on the basis of income, undertook large per capita capital outlays in 1957, and Colorado, which ranked lower than would have been expected, undertook relatively little investment in that year.

#### **“Urban Type” Services**

A group of expenditures which can be rather conveniently considered together are for what might be termed “urban type” services. This category includes expenditures for police and local fire protection, sanitation, local parks and recreation, housing and community redevelopment, and local libraries. Since these are services ordinarily rendered within urban areas, it is not surprising to find them smaller in the District states than in the Nation generally. Per capita outlays for these purposes were less than the national average in each District state in 1957. Relative to other types of expenditures they were even more markedly below the national average. In the District, outlays for these items ran between 5 and 9 per cent of the total, whereas nationally they constituted over 12 per cent.

#### **Other Functions**

The remaining expenditures of state and local governments are for a miscellaneous group of functions which, in 1957, absorbed between 12 and 17 per cent of the total out-

lays of the District states. In most instances, per capita expenditures on these functions are comparatively small and, therefore, do not differ by substantial amounts from state to state. The most variable and perhaps the most interesting—from the point of view of the District—of the remaining outlays are those for natural resource activities. Each District state spends more per capita than the national average in the resources area, with the highest outlays occurring in states where natural resources assume a particularly important role.

#### **Concluding Statements**

The foregoing analysis of the factors which appear to be associated with differing levels of per capita state and local activities cannot, of course, claim to be complete. For example, specific institutional arrangements in the various states may play an important role in limiting or accentuating expenditures. Matters such as earmarked taxes, debt limits, and property tax limits may lag in adapting to changed circumstances. To a degree, conceptions of acceptable levels of services differ from state to state. These matters no doubt play a significant—but hard to quantify—role in determining activity levels. Nevertheless, the factors which have been cited in this study are ones which previous investigations and perusal of the 1957 Census suggest are significantly related to expenditure differences at a national level and in most instances they form a logical pattern in regard to the District states.

**TECHNICAL NOTE:** In several places in the text, reference is made to the relative variation displayed by particular variables. The measure used to indicate relative variation is a coefficient determined by computing the percentage which the semi-interquartile range is of the median. The coefficients for the major types of state and local government expenditures across the Nation are as follows: total education 17.6; highways 21.2; public welfare 15.0; health and hospitals 20.0; police and local fire protection 24.4; sanitation 30.6; and natural resources 49.1.

# Recent Adjustments

## in Petroleum Refining

CONSIDERABLE INTEREST has been centered recently on petroleum refining as a result of the dramatic turnabout of conditions in that industry. After enjoying unprecedented prosperity in late 1956 and early 1957, petroleum refineries have since operated under considerably less auspicious circumstances. While developments in the industry undoubtedly reflected the impact of the recession in 1958, there is some evidence that the problems facing the industry have persisted during the business recovery. For example, high levels of excess capacity and burdensome stocks of refined products still persist. This situation reflects comparatively small increases in demand for refined products and continued increases in total crude oil refining capacity.

With these factors in mind, this article has several objectives. First, developments in the demand for refined petroleum products and changes in refining capacity in recent years are described. Second, inducements to invest arising out of changes in the nature of demand for petroleum products and technological developments in the industry are discussed. Third, the current level of capacity utilization is analyzed in terms of more prosperous years in the petroleum industry. Finally, some explanation of the continuing expansion of refining facilities in light of the low rate of utilization of existing capacity is undertaken. While this discussion is of direct relevance to the petroleum industry, it may also have some implications for other industries where capacity is more than adequate. Recent low rates of utilization in some manufacturing industries have given added interest to analysis of

investment under conditions of excess capacity.

Although the factors responsible for the problems facing the petroleum industry have become more evident in the past few years, some of them appear to have been developing for a considerable period. The influence of these factors was delayed and obscured by the occurrence of extraordinary circumstances, such as the Korean War, the oil shutdown in Iran, and the closing of the Suez Canal. For the purpose of describing the turnabout of conditions in the petroleum industry, developments from 1946 to 1956 have been contrasted with those from 1956 through 1959. In the decade following the end of World War II, demand for refined products grew at a relatively rapid rate. Since then, the industry has had to cope with a number of influences — some short run and others reflecting longer-term factors — which have tended to depress demand growth. The increase in overall demand declined from an average annual rate of 6 per cent in the postwar decade to an average rate of less than 2 per cent in the past 3 years.

### Changes in the Rate of Increase and Structure of Demand

Several factors have caused demand for refined products to grow at a slower rate in the past 3 years than in the previous decade. The sharp dip in business activity which reached a low in 1958 undoubtedly had an adverse effect on demand. Total energy consumption in the United States—measured in BTU equivalents of coal, petroleum, natural

gas, and water power—declined in both 1957 and 1958. This was the first time in the post-war period that energy consumption had declined 2 consecutive years. In the decade after World War II, growth of this measure of aggregate energy consumption proceeded at an average rate of 3.4 per cent annually. While information for 1959 is not available, energy consumption undoubtedly increased to some degree, as previous movements in this series have conformed roughly to movements in gross national product.

Factors other than short-run business conditions in the United States were responsible, at least in part, for the slower rate of growth of demand for refined products since 1956. Certainly one of the most widely fluctuating influences on total demand was exports of refined products. After increasing at an average annual rate of 3.4 per cent from 1946 to 1956, exports registered an annual decline of 9.5 per cent on the average from 1956 to 1959. Exports of refined products in 1959 were at the lowest point since 1950. Thus, by 1959 foreign demand had sustained a sharp decline from the 1957 peak as the abnormal conditions responsible for the stimulation of demand during the Suez crisis swiftly moderated.

On the other hand, longer-term developments in domestic demand also have been significant, although somewhat less striking than the reversal in exports. During the period from 1946 to 1956, consumption of petroleum products—excluding natural gas—increased at a rate of 6 per cent annually in contrast to a 3.4 per cent annual increase in total energy consumption. As a result, consumption of petroleum products accounted for 44 per cent of the energy market in 1956 as opposed to 34 per cent 10 years earlier. While there was no reason to conclude that the portion of the energy market which petroleum had captured by 1956 was the maximum penetration it would ever achieve, there was some reason to believe future gains at

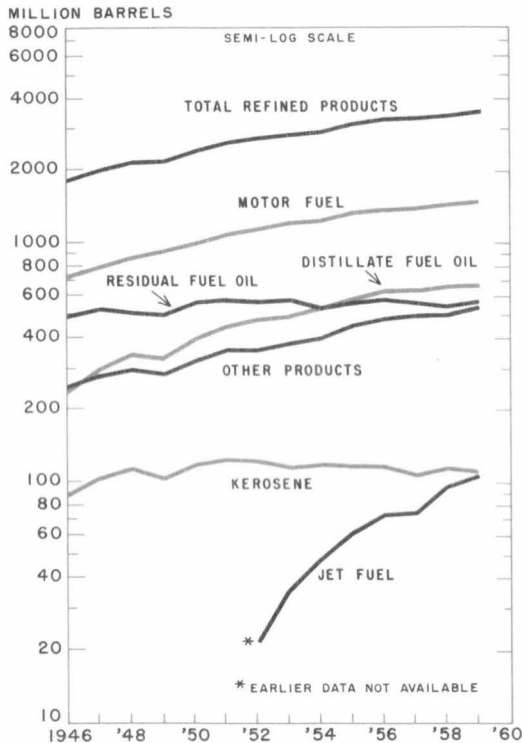
the expense of other fuels might be at a moderated rate. It does not appear likely that refined petroleum products will ever completely displace other energy sources, and indications are that the process of substituting petroleum products for coal in household heating and as railroad fuel have been largely completed.

In addition, the consumption of natural gas has shown particularly impressive gains in recent years and these gains have been, at least in part, at the expense of refined products. While increasing at an annual rate of more than 9 per cent from 1946 to 1956, natural gas consumption increased its share of the total energy market from 13 to 23 per cent. Further gains of nearly 6 per cent in the consumption of this fuel were recorded in both 1957 and 1958, increasing the market penetration of natural gas to nearly 27 per cent. In part, this may have reflected the lesser sensitivity of natural gas to business cycles, but the large gains during recession years were quite impressive. In contrast, the rate of increase in domestic demand for refined petroleum products in the 3 years after 1956 averaged less than 2½ per cent.

#### **Components of Domestic Demand**

Understanding of changes in aggregate domestic demand for refined petroleum products is aided by an examination of trends in its various components. Over the entire post-war period the demand for gasoline has increased roughly in line with total domestic demand for refined petroleum products. In 1946, gasoline consumption accounted for 41 per cent of domestic demand, while in 1959 it constituted 43 per cent of the total. The average rate of increase in consumption of this fuel has slowed considerably, however. A 6.5 per cent annual rate in the 1946-56 period slipped to a rate of 2.5 per cent in the past 3 years. During the entire period, on the other hand, there has been a continuing increase in octane ratings of gasoline for automobile use.

## Demand For Refined Petroleum Products



NOTE: On a semi-logarithmic chart, equal slopes indicate equal rates of change.

SOURCE: U. S. Bureau of Mines.

Similarly, distillate fuel experienced a reduction in the rate of growth in demand from an annual rate of 10 per cent in the postwar decade to a 2.3 per cent rate from 1956 to 1959. Consumption of this fuel, which is used in diesel engines of trucks, buses, and railway locomotives and for heating private homes, was accelerated by the displacement of steam locomotives and the sharp increase in the number of diesel trucks on U. S. highways after 1946. Since these transitions have been largely completed, future gains may be more moderate than the 1946-56 average. In 1946 no information was available on jet fuel consumption. Since that information became available in 1952, however, consumption has

increased by more than four times. While kerosene is an important component of jet fuel and has experienced increased demand as a result of gains in consumption of that fuel, other demands for kerosene have remained generally stable in the postwar period.

In contrast to these relatively rapid rates of growth, demand for residual fuel oil increased at an average annual rate of only 1.3 per cent since 1946. A major reason for the relatively slow rate of increase in consumption of residual fuel oil was the intense competition this fuel faced from natural gas, since natural gas is probably a better substitute for residual fuel oil than for other refined petroleum products.

In broad perspective, the major change in the composition of demand since 1946 has been the rapid rise in importance of the lighter end products. These high-value products which include gasoline, kerosene, distillate fuel oil, and jet fuel have assumed a greater relative importance during this period as their share of domestic demand for refined products has increased from 60 per cent in 1946 to 68 per cent in 1959. This shift in the composition of demand has had an important impact on existing refineries and on new plants in the industry.

### Capital Expenditures and Additions to Refining Capacity

#### Investment in the Petroleum Industry

In the light of changes in the structure and growth of demand for refined products, it is interesting to trace the capital expenditures which have given rise to the present surplus of refining capacity. After World War II, plant and equipment expenditures for manufacturers of petroleum and coal products increased, reaching a peak in 1948 and subsequently declining for 2 years. Shortly after the beginning of the Korean War in 1950, plant and equipment expenditures were stimulated by high demand and the program of

the Defense Production Administration which allowed accelerated amortization of new facilities. Expenditures for plant and equipment continued to increase after the end of the conflict and reached a peak in 1957. Expenditures in 1958 were down sharply from the year-earlier level and, although moderate increases occurred in 1959 and the first two quarters of 1960, anticipated expenditures for 1960 were still one fourth below the 1957 level. Nevertheless, recent levels of investment have been sufficiently large to support continuing additions to basic refining capacity.

While increases in refining capacity are certainly related to plant and equipment expenditures in the petroleum industry, the relationship is by no means simple or fixed. A portion of investment outlays—the magnitude of which may vary from time to time and is not precisely known—goes for replacement. In addition, capital expenditures by petroleum companies are partly channeled into exploration, crude production, or distribution. In fact, as a result of the high level of excess capacity in the past few years, companies have indicated they are concentrating relatively more of total capital expenditures on distribution. Moreover, investment in new equipment motivated by efforts to reduce costs does not necessarily result in capacity expansion.

In addition, the recent trend toward increased octane ratings for gasoline and higher yields of light end products has required extensive investment aimed at increasing the quality and yield of certain products but not necessarily resulting in greater throughput capacity. The basic distillation process involved in refining allows no opportunity for varying the proportions in which the components of a given crude are divided, although different crudes yield different proportions of the various products. By means of cracking, however, the yield of the various components of crude oil can be modified to con-

form more closely to demand. Cracking is a means of increasing the yield and quality of light fuels by breaking large molecules into smaller ones. This accounts for the fact that catalytic cracking capacity increased nearly three times from 1946 to 1957 and reforming capacity increased more than 2½ times from 1954 to 1959. In contrast, thermal cracking capacity has declined slowly since 1946 as certain obsolete thermal processes have been scrapped.

The modification, replacement, and expansion of capacity has, in recent years, taken place at existing plants. As a result, most refineries consist of a conglomeration of old and new equipment. In this light, it is interesting to note that, while total capacity was expanded by almost 90 per cent during the postwar period, the number of refineries in operation declined by 20 per cent.

#### **Additions to Capacity**

It is apparent that inducements to invest in refining plant and equipment have arisen from the need to modernize plants, to develop capacity for increasing the percentage yield of light end products, and to replace aging equipment. Nevertheless, as mentioned earlier, part of the investment by petroleum companies in the last several years has taken the form of increases in basic crude oil refining capacity.

Basic crude oil refining capacity is defined by the U. S. Bureau of Mines as the maximum average throughput attainable with allowance for normal downtime for repairs and routine maintenance. Total capacity is divided into both operating and shutdown components. Since operating capacity is more sensitive to relatively short-term developments than total capacity, it is more suitable for the purposes of the article. Hence, subsequent references to capacity will pertain to operating capacity.

From January 1, 1946, to January 1, 1957, crude oil charging capacity increased at an

annual rate of 5.2 per cent. In the subsequent 3 years—despite low rates of utilization—capacity continued to increase at an annual rate of 2.8 per cent. Thus, additions to excess capacity have resulted from the sharply reduced rate of demand growth since 1956 combined with continuing additions to basic capacity.

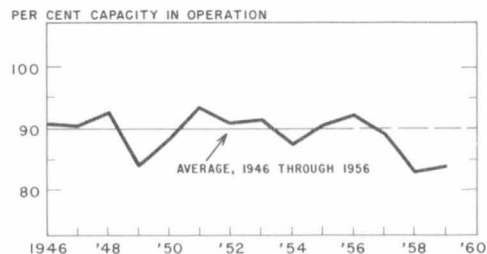
### Excess Capacity in Petroleum Refining

While refining capacity has clearly been large relative to output in the last several years, excess refinery capacity has existed virtually throughout the history of the industry. It has been common for expansion in capacity to be undertaken, although existing capacity was not being fully utilized. It is necessary to have a cushion of excess capacity in industries such as petroleum refining in order that short-run expansions in output may be undertaken. In this way, petroleum refineries are similar to steel mills. Plants in both industries are operated on a continuous 3-shift basis. As a result, it is not possible to expand capacity by working overtime or putting on another shift. The two types of plants are further similar in regard to the specialized equipment required. Both require more capital per worker than the average manufacturing industry. Capital invested in petroleum—including extraction and pipeline transportation—was a large multiple of the average for manufacturing as a whole in 1957. In both cases, existing capacity represents a rather fixed ceiling to production which cannot be raised in the short run by the substitution of other productive factors. This is in contrast to the manufacture of products which require little specialized equipment, or where bottlenecks can be avoided by the substitution of other factors for capital equipment. In addition to a cushion being required to meet possible short-run demand surges, anticipation of continuing demand growth would likely lead to some degree of current excess capacity.

While the need for a cushion of extra capacity appears clear enough, it may well be asked what the normal or desirable magnitude of this cushion is likely to be. For the first 11 years after World War II, crude petroleum inputs amounted to about 90 per cent of operating capacity. During this period the per cent of capacity in operation fell below the 11-year average three times—in 1949, 1950, and 1954, all years of reduced business activity. If the average level of capacity utilization from 1946 to 1956 were considered to be the goal of petroleum refineries as an aggregate, utilization exceeding this level for a period of time would stimulate refiners to expand capacity. On the other hand, if utilization fell below this level for a significant period, additions to capacity would be discouraged.

If, then, the normal rate of capacity utilization is taken to be around 90 per cent, recent rates have been below normal. In 1957, capacity utilization was 89 per cent of the potential and indications were that this level was considerably higher than demand justified, as refined stocks piled up and at the end of the year were 9 per cent higher than the year-earlier level. In 1958, U. S. refineries operated at 83 per cent of capacity. While this was a year of recession, this rate of capacity utilization was a low for the period since

**Per Cent of Refining Capacity in Operation**  
Crude Oil Runs to Stills as a Per Cent of Operating Capacity\*



\*Capacity is calculated as of July 1 by averaging capacity at the beginning and end of each year.

SOURCE: U. S. Bureau of Mines.



World War II—below even the rate of previous postwar recession years. The following year the rate of capacity utilization showed little improvement. In spite of the significantly increased level of excess capacity, further increases in capacity were made during this 3-year period. In fact, while crude runs to stills increased less than 1 per cent from 1956 to 1959, crude oil refining capacity increased more than 8 per cent from January 1, 1957, to January 1, 1960. These developments are, at least at first glance, contrary to what might be expected. However, a variety of factors may help to account for the seemingly incongruous developments of the past several years.

An influence which would contribute to increases in the industry's operating capacity is the decision of an individual refinery to expand capacity in an attempt to capture a larger share of the market. Although it can be concluded that the increase in total demand has not kept pace with recent additions in operating capacity for the industry as a whole, individual companies may have realized increases in their market share in line with the capacity expansion undertaken. In addition, the geographical distribution of new crude discoveries combined with population shifts have resulted in the construction of some facilities to take advantage of proximity to developing population centers and convenient access to crude supplies. Also, modifications are often necessary in refineries before crude from a new source can be refined. This is a result of the unique properties of various crudes and would of course tend to raise investment if not capacity.

Decisions to expand operating capacity during 1957, 1958, and 1959 also may have in

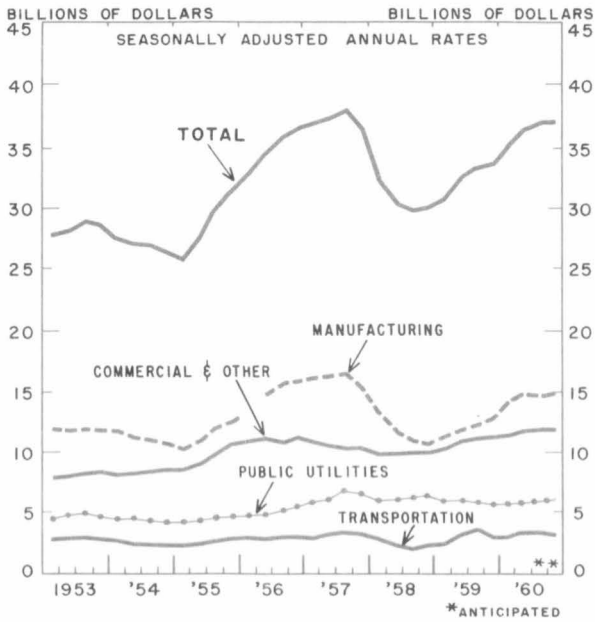
part resulted from the difficulties in gauging the extent to which increases in demand since 1950 were a consequence of the Korean War and the Suez crisis. These two influences served to obscure changes in long-run trends in demand for refined petroleum products. The process of separating and identifying short- and longer-term factors was further complicated by the recession which followed upon the stimulation of Korea and Suez.

Another factor which may be significant in explaining the continued increases in capacity is the fact that actual expansion in capacity is usually not realized for some time after the decision to expand is made. This lag may be of substantial length in the petroleum industry where equipment is elaborate and produced to custom order. It is conceivable that at least some capacity increases planned in late 1956 and early 1957 might not have been completed until 1958 or 1959.

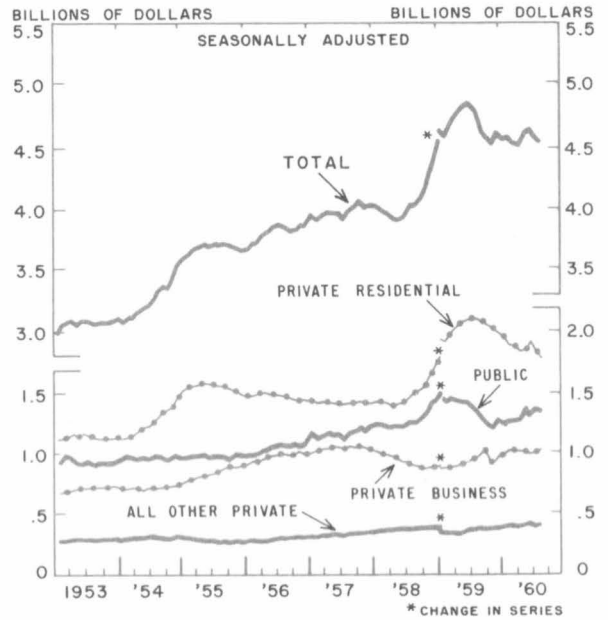
The latter two explanations for the continued increases in capacity in 1957, 1958, and 1959 lead to the conclusion that a certain period of time may be required for the industry to adjust to changing patterns in demand. The most recent survey of refinery capacity taken by the Bureau of Mines on January 1, 1960, indicates adjustments to excessive capacity may be under way. This is suggested by the fact that refinery capacity under construction as of January 1, 1960, was at the lowest level since 1945. Although the magnitude of capacity building on January 1 has not been a particularly reliable indication of the annual increase in operating capacity in the past few years, the low level of capacity construction supports the hypothesis that the 1960 increment to refining capacity will be small.



## Plant and Equipment Outlays



## New Construction



## BANKING IN THE TENTH DISTRICT

District and States	Loans				Deposits			
	Reserve City Member Banks		Country Member Banks		Reserve City Member Banks		Country Member Banks	
	July 1960	Aug. 1959	July 1960	Aug. 1959	July 1960	Aug. 1959	July 1960	Aug. 1959
Tenth F. R. Dist.	+1	+4	+2	+12	-1	-2	†	+2
Colorado	†	+7	+4	+13	+1	-1	+4	+3
Kansas	+3	†	+3	+17	-2	†	+1	+5
Missouri*	+1	+3	-1	+6	-3	†	-1	-1
Nebraska	+1	-3	+3	+9	+1	-1	+2	†
New Mexico*	**	**	+2	+10	**	**	-7	+3
Oklahoma*	†	+7	+3	+16	-2	-5	-1	+3
Wyoming	**	**	-1	+8	**	**	†	+2

\*Tenth District portion only.  
†Less than 0.5 per cent.

\*\*No reserve cities in this state.

## PRICE INDEXES, UNITED STATES

Index	Aug. 1960	July 1960	Aug. 1959
Consumer Price Index (1947-49=100)	126.6	126.6	124.8
Wholesale Price Index (1947-49=100)	119.2	119.7	119.1
Prices Rec'd by Farmers (1910-14=100)	234	238	239
Prices Paid by Farmers (1910-14=100)	298	298	297

## TENTH DISTRICT BUSINESS INDICATORS

District and Principal Metropolitan Areas	Value of Check Payments		Value of Department Store Sales	
	Percentage change—1960 from 1959			
	Aug.	Year to date	Aug.	Year to date
Tenth F. R. District	+12	+3	+3	0
Denver	+18	+8	+4	+2
Wichita	-4	-5	-11	-13
Kansas City	+11	+2	+7	+2
Omaha	+18	+2	+8	+3
Oklahoma City	+13	+3	0	0
Tulsa	+5	0	-1	-4