MONTHLY REVIEW

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FEDERAL RESERVE BANK OF MINNEAPOLIS

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Timber resources of the Ninth district West

The Ninth district's West contains some 16 million acres of forest—a big woodyard, indeed. Yet while the quantity of timber physically available for processing from this vast acreage is extremely large, much of it was by-passed as commercially unattractive during the early decades of this century, when the nation's lumber industry gradually shifted to the Pacific Northwest. In recent years the district's timber resource has taken on increased importance, as is documented by the industrial expansion that has occurred here. Factors underlying these recent changes indicate that further expansion possibilities exist. This article examines the region's forest resource and its capacity to support added industrial activity.

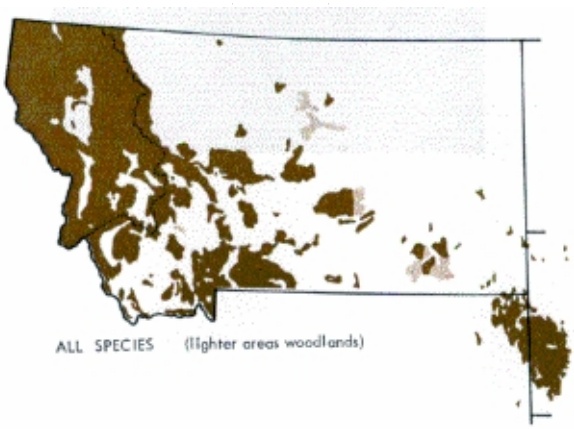
PHYSICAL DIMENSIONS OF THE TIMBER RESOURCE

Major species and their occurrence

The geographic distribution of commercial forest land in Montana and the Black Hills is portrayed in Chart 1. Within a general setting of semi-arid, treeless plains and foothills, the district's western forest land occurs on elevated, mountainous sites or in the moister valleys of the extreme west. The nearly 16 million acres is stocked almost entirely with western softwoods of five principal species: ponderosa pine, lodgepole pine, Douglas-fir, western larch and Engelmann spruce.

In total, stands of these softwoods in the western Ninth district contained an estimated 17 billion cubic feet of wood at the beginning of 1953. Over half the measured volume lies west of the Continental Divide in Montana, where, as Table 1 shows, Douglas-fir and larch are the leading species. Volume honors in eastern Montana go to lodgepole pine. The stock of ponderosa pine in the Black Hills is twice that in eastern Montana and about 80 per cent of that west of the Continental Divide in Montana. There also may be an additional 1 to 2 billion cubic feet of dead standing

Chart 1—Distribution of commercial forest land in Montana and the Black Hills



timber that could be salvaged for some uses, most of it in western Montana.

In terms of quality, the larger, more readily marketable volumes of timber are concentrated more heavily to the west than the data of Table 1 indicate. Some two-thirds of total sawtimber[1] volume is found in western Montana, while only slightly more than half the total timber volume occurs there. Not only average log size but also average log quality is greater in western Montana than in eastern Montana.

Growth and drain

While standing volumes of timber are one measure of the size of the timber resource, growth rates

[1] Estimated recoverable lumber volume in trees 11 inches and larger in diameter at breast height.

This article is the first of a series based on a forthcoming study published by the Federal Reserve Bank of Minneapolis. Two additional articles, the first describing timber industry trends and the second discussing timber industry prospects, will appear in later issues of the **Monthly Review.** Readers interested in obtaining copies of the original 64-page study, **The Timber Economy of the Ninth District West,** by Clarence W. Nelson, may secure them at $1.00 per copy by writing Publications Section, Research Department, Federal Reserve Bank, Minneapolis, Minnesota 55440.

and rates of cutting are perhaps more significant measures. Let us see what the magnitude of this forest "turnover" has been in recent years.

As shown in Table 1, the timber stock in the western Ninth district, consisting of more than half a billion live trees larger than 5 inches in diameter, currently stores an estimated 17 billion cubic feet of potentially merchantable wood. Some 316 million cubic feet were added by natural growth to our district's basic stock during the survey year 1952—a 2 per cent accumulation. At the same time, other natural factors have been and are eating away at the wood inventory continually. During 1952, mortality through natural forces claimed 126 million cubic feet, or something under 1 per cent.

The year 1952, however, was a particularly bad year for insect loss. Normal mortality would be closer to 55 million cubic feet annually, or less than one-third of 1 per cent. Since this deduction from timber inventory varies from year to year, the balance between what is added by growth and what is trimmed away by natural forces may vary also; in 1952, the estimated net addition was 190 million cubic feet.

Man, of course, takes his timber supply from the forest, and as he does so, he necessarily alters the natural balance—not only the stock and the drain, but also the growth. In 1952, some 125 million cubic feet of wood were cut from the forests of the district.

During that year, then, given all the factors adding to and depleting the stock, our total inventory of live wood showed a net gain of about 65 million cubic feet, or less than one-half of 1 per cent.

Sustainable yield possibilities today

Current growth rates, however, are not necessarily a valid measure of the rate of timber harvest that can be kept up indefinitely—that is, the "sustainable yield." An overmature forest, for example, may have a very low annual growth of new wood, but its growth possibilities with a better balance of tree sizes might be quite high. Sustainable yield is thus dependent on the inherent productivity of the forest land and the efforts applied in managing the forest.

TABLE 1—DISTRIBUTION OF SOFTWOOD TIMBER VOLUMES ON LIVE TREES FIVE INCHES AND LARGER IN DIAMETER BY SPECIES AND SUBREGION, JANUARY 1, 1953.

	Volumes in million cubic feet			
Species	Western Montana	Eastern Montana	Black Hills	Total
Ponderosa pine	1,581	650	1,260	3,491
Lodgepole pine	997	3,080		4,077
Douglas-fir	2,589	2,095		4,684
Western larch	2,390			2,390
Engelmann spruce	819	565	27	1,411
Other softwoods	969	433		1,129
Total All Species	9,072	6,823	1,287	17,182

Source: Forest Service.

Estimates for this district's sustainable annual yield of wood, based on Forest Service studies, are given in Table 2. Sustainable cut for the district totals 456 million cubic feet annually, slightly more than 40 per cent of which is being taken currently. However, most of the proportion *not* taken is in the smaller size category; in sawtimber, current usage is running about 77 per cent of 'capacity,'

TABLE 2—ESTIMATED SUSTAINABLE ANNUAL PRODUCTION IN CUBIC FOOT EQUIVALENTS
(million cubic feet)

	Western Montana	Eastern Montana	Black Hills
Trees 11 inches and larger in diameter	145	65	14
Trees 5 inches to 11 inches in diameter	123	101	8
All timber 5 inches and larger in diameter	268	166	22

Source: Forest Service.

TABLE 3 — ANNUAL CUT OF TIMBER IN CUBIC FOOT EQUIVALENTS, 1957, BY SUBREGION AND SIZE CATEGORY (million cubic feet)

	Western Montana	Eastern Montana	Black Hills
Trees 11 inches and larger in diameter	141	22	9
Trees 5 to 11 inches in diameter	8	9	1
All timber 5 inches and larger in diameter	149	31	10

Source: Forest Service.

while in poletimber[2] it runs to only about 8 per cent.

Current drain expressed as a percentage of sustainable cut also varies sharply by subregion, as follows: western Montana, 56 per cent; Black Hills, 41 per cent; and eastern Montana, 19 per cent. Current drain is summarized, by size category and subregion for comparison purposes, in Table 3. You will note the great range in potential expansion; in some areas and sizes, expansion may be several fold, while in western Montana sawtimber sizes are being used nearly to the full extent of the sustainable annual cut.

The estimates of levels of timber removal that could be perpetually sustained from the forests of the region show that, in terms of sheer cubic volume, *at least* twice as much timber could be taken as is currently taken. This headroom for expansion of drain, then, serves as a measure of potential.

[2] Trees 5 to 11 inches in diameter at breast height.

It is significant that the bulk of unused capacity lies in the smaller sizes of trees.

Supply possibility picture summarized

The general scope of the physical supply potential is summarized in Chart 2. The data, presented in aggregate cubic foot volumes, mask a variety of quality, size, and species differences.

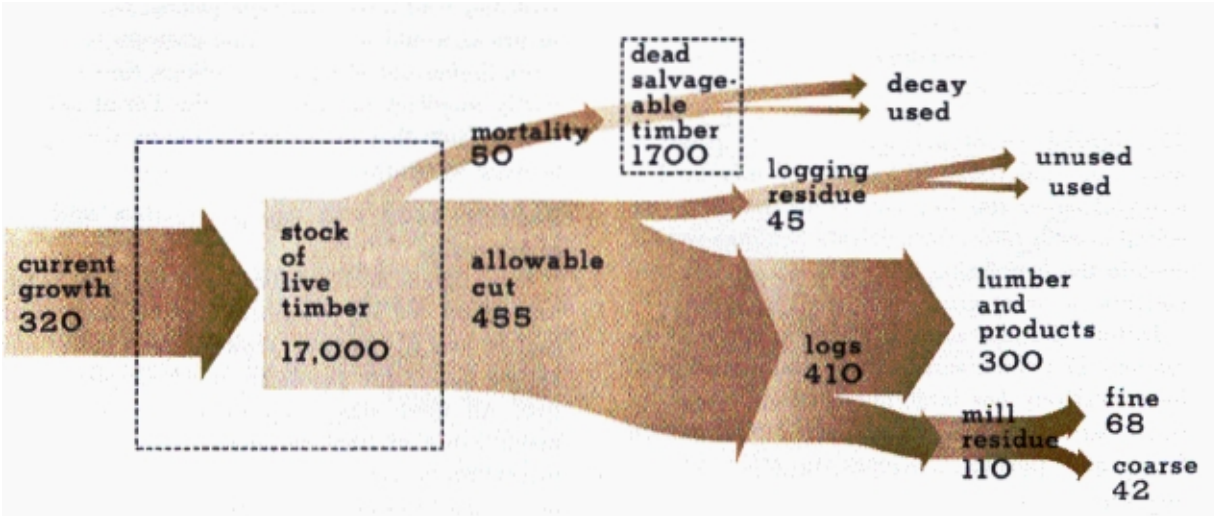
An allowable cut of 455 million cubic feet annually as shown is adapted from the Forest Service figures as a provisional measure of the outside size of feasible timber drain from the forests in our region. Under sufficiently intense market pressure, actual drain could conceivably rise to exceed the allowable cut with the full weight of the excess cut presumably occurring on private holdings. Hence the 455 million cubic feet shown as cutting potential represents not the maximum supply that could be made physically available but only a maximum feasible yield based on currently attainable forest management practices.

The fact that the allowable cut shown exceeds current growth simply emphasizes that this sustainable cut is based on a *potential*, not necessarily an existing, growth rate.

If we now trace out the flow of wood material, assuming live timber is cut at the allowable 455-million-cubic-foot-per-year level, we can see some additional raw material possibilities: These are represented by (1) the residues left in the forest after logging operations and (2) the residues resulting at the mill from manufacturing lumber and veneer. Given an annual cut of 455 million cubic feet, more than 45 million cubic feet of logging residues would be produced in the forest and more than 110 million cubic feet at the mills. Fuller use of these residues could increase substantially the physical volume of product output.

A fraction of both logging residues and mill residues does find its way into current uses now: the residues may either be sold by the plant as a byproduct, or recycled to displace inputs that might otherwise have to be purchased from out-

Chart 2—Physical supply possibility diagram, western Ninth district (figures in millions of cubic feet annually)



side. Given sufficient technological advance, these uses could be expanded greatly.

Another substantial source of raw wood for processing is the stock of dead but salvageable timber physically available in large quantities and suitable for many uses. Economic considerations are paramount here as in the case of residue use; and with sufficiently high prices for products and higher prices of conventional live input material, this type of timber could become attractive for industrial use. The stock of dead timber is added to, at an average annual rate of 50 million cubic feet; how fast it is reduced beyond salvage by decay, fire, etc. is unknown. Some years may witness increases of timber mortality in epidemic proportions among particular species and locations, creating special supply situations for short periods. We will present an example of this kind of market disruption in a future article.

ECONOMIC DIMENSIONS

Price as a determiner

The district's timber industry can be broken down into four main stages: *tree growing, logging, log processing,* and *wood processing* (including wood fiber processing). Each stage has one or more production processes, and the stages are tied together by virtue of the fact that wood outputs of earlier stages are inputs of subsequent stages.

In general, decisions about what timber products to produce and how much to produce are made by a large number of private, profit-seeking firms. Essentially all production, all trade, and all movement of material from the logging stage onward are conducted by these private firms. Even within our geographically restricted region of study, their numbers are relatively large, their sizes relatively small, and their markets competitive. Expectations of profit chiefly determine the kind and the amount of timber ultimately produced.

The tree-growing stage differs in two important respects from all later stages in the timber industry: (1) a large segment of the productive capacity is owned and operated by government, and (2) the profit motive is secondary in decisions—chiefly governmental—affecting a large part of the industry. In this region, the acreages held by the

three main classes of owners are distributed as follows:

Government ownerships	11.5 million acres
Large private ownerships	2.5 million acres
Small private ownerships	3.0 million acres

This breakdown of acreages does not precisely mirror the importance of holdings as measured in terms of either standing volume of timber or potential growth rates, since private holdings usually contain the better sites and, if not greater actual volumes, at least greater potential growth.

In total perhaps some 2.5 million acres of the region's 17 million acres of forest land are owned by a relatively few large corporations. About an equal acreage total — mostly small holdings on farms and ranches — belongs to other private owners.

Of the 11-plus million acres owned by governmental units, less than one million acres represent state and county forests and the remainder are federal holdings. In our district, as in most parts of the West, the federal Forest Service is *the* major timber grower and consequently the major source of supply of standing timber.

These major groups of landholders who make the district's decisions about tree growing each follow a characteristically different approach. The Forest Service, in general, directs its management program basically toward attaining predetermined physical production goals; large private owners, though also aiming at perpetual yield, set the level of their management programs in accordance with profit prospects; while small private holders tend to look upon their timber more as a fixed stock than as a perpetual flow of wood and give little heed to the capacity of their land for future timber growth.

While each of these groups may choose its course of action independently, the separate decisions interact in many ways. Some of the reactions take place through the market system, in which effects often offset each other. For example, a Forest Service action that reduced the amount of its *stumpage* (cutting rights to standing trees) available to the market today would tend to raise current and near-term stumpage prices. This change in prices would induce private growers to supply more timber out of current holdings, thus tending partly to offset the effects of the Forest Service action. Note that *prices* here serve as the signals through which the actions are effected.

Decision factors in log production and processing

Later stages in the timber industry, such as log production and log processing, receive the flow of timber sold by the tree grower. The motivations behind these later phases are much simpler to define. All these stages, up to and including the manufacture of final consumer products, involve private profit-seeking firms. In general, the timber processing firms are numerous and not individually dominant in the markets in which they sell. And since their products (principally lumber and veneer) are fairly standardized, their markets display a nearly classical competitiveness. Prices are all-important, and they are outside the control of the individual profit-seeking firm. The firm buys inputs and sells outputs. If in the course of this effort it earns an adequate return, it remains in business. If not, it fails. It is almost as simple as that.

In short, the essential decision criterion in determining the size of the flow of wood through each plant is *profitability*, and price is the means by which information about profit prospects is transmitted to the decision maker. Thus, poor profit prospects on the unused materials help explain why much of our region's timber resource has gone untouched — why in our region only 190 million cubic feet of timber have been cut annually, rather than the estimated 455 million cubic feet sustainable cut that could be taken each year.

Relationship of the regional industry to national markets

The general level of lumber and wood product prices is determined at a national level. Prices of

lumber from different geographic origins cannot get far out of line for comparable product class at any particular point of destination. Hence, allowing for differences in transportation costs, no one mill in our district can do much more than accept a market-dictated price for lumber products it wishes to sell at any given time. It has only the limited option of holding some kinds of stock off the market in hopes of getting a better price later.

Our district's timber ouput contributes a relatively small share to the national supply, and, except in restricted areas, its market influence is therefore slight. The major geographic source of softwood sawtimber for the United States markets is the Pacific Northwest (see Table 4). Gross changes in the supply of timber available from the Pacific Northwest *do* have a definite impact on national price levels.

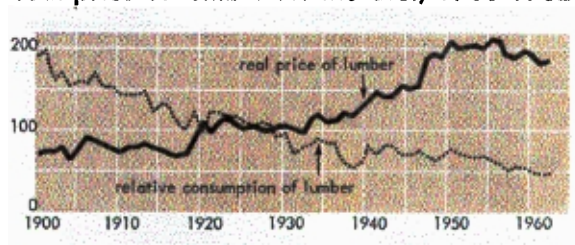
TABLE 4—TIMBER PRODUCTS OUTPUT, MAJOR REGIONS OF THE UNITED STATES, 1952.

	Softwood sawlogs for lumber (million board feet)
NORTH	1,946
SOUTH	9,610
WEST	19,877
Pacific Northwest	12,455
California	4,902
Ninth District	731
Other West	1,789
TOTAL UNITED STATES	31,433

Source: Forest Service.

All areas have experienced gradual removal of the more accessible higher quality old growth stocks, particularly during the last 25 years. This attrition has increasingly necessitated a shift into the less accessible, higher cost sources of stumpage, often with a loss of log quality. As a result of increasing delivered log costs and handling costs, the selling price necessary for competitive return has risen. (The historical improvements in technology and methods have only partly offset changes in unit costs.) Higher prices have in turn helped bring about a relative drop in lumber consumption over the past half century as users have either shifted to substitute materials or cut back the quantities of wood used in their products. The long-term trend in this direction is indicated in Chart 3.

Chart 3—Index of relative consumption and real price of lumber for the U.S., 1900-1962

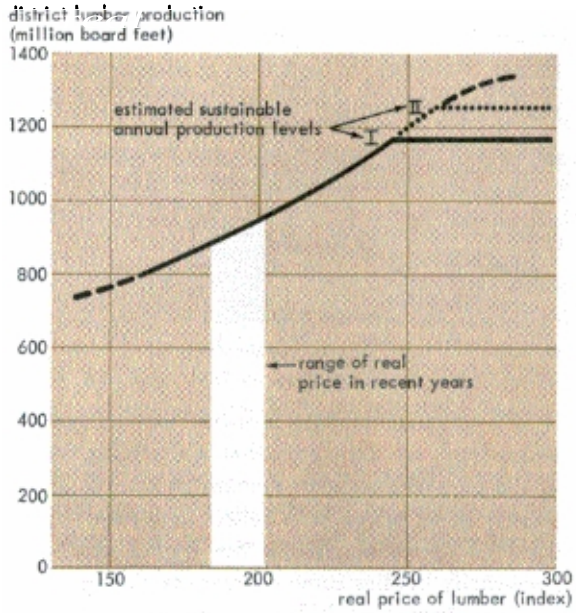


If we ignore for the moment any changes in technology, we may note that a declining supply in the face of persistent demand results in higher prices; these prices both reflect and allow higher costs of operation. While the higher real price necessarily implies some decrease in the aggregate quantity demanded, it does not necessarily imply a decline in production *from any one region.* In fact, areas of extensive forest resources which would formerly have been regarded as submarginal may actually profit from the transition as increasing quantities of their timber supplies become usable with the rising product prices.

Given this relationship, our region may have more to gain as the nation moves further into the margin of its timber supplies, because we have a greater amount of submarginal timber relative to our existing base. As prices go up, many higher cost operations in our region may become profitable.

We can represent a price-output relation appropriate to parts of our district as in Chart 4. This estimated relationship is based on a Forest Service study of an eastern Idaho-western Wyoming area adjoining our region and having many forest characteristics in common with eastern Montana. If this hypothetical relationship is correct, then an increasing real price for lumber would increase

Chart 4—Conjectural relationship between the region's lumber production and real price of lumber



The estimated sustainable levels of production shown in Chart 4 are based on Forest Service studies. Level I allows for allocating a definite portion of the available larger trees to other uses than lumber (e.g., veneer and poles) while level II simply allocates to lumber production all of the potential expansion in larger trees. If the Forest Service had effective control over the stumpage supply, then we might picture the region's current supply curve to be that shown by the solid line. More probably the curve would follow the broken line extension upward, because rationing of Forest Service stumpage would presumably drive prices higher on private timber and lead to increased drain on non-public stands, even beyond maximum sustainable levels. Of course, this representation of the price-output relationship is highly oversimplified. Our principal purpose is only to emphasize the key functional role of price in the allocation of resources in the timber industry.

lumber production from our region despite a concomitant decline in national output.

Some historical evidence supports this relationship. If we compare over a long period of years the *real price of lumber* (average price adjusted for inflationary bias) with the *relative consumption of lumber* (a ratio which represents lumber's share among the general class of goods with which it competes) we would find that as the price of lumber has increased historically, the relative use of lumber has declined in total. Both the declining share and the higher price reflect the long-term national trend toward removing the best, most accessible timber and moving deeper into more remote stands formerly regarded as submarginal.

But for Montana the relationship has been different. Since 1930, the relative consumption of Montana lumber has gradually *risen* as real price of lumber has increased. The explanation for this lies in Montana's relatively large endowment of less accessible smaller timber. These rather gross relationships do not account for all that has happened. Changes in technology and in market acceptance have also been part of the story.

Economic supply of the resource

While the physical dimension of our region's timber can be estimated reasonably well, the economic dimension is more difficult to assess, for it depends on the prevailing system of decision making. While considerable room for administrative discretion exists at the tree-growing stage, our decision-making machinery for timber production is principally a market and price system.

We might consider the economic measure of potential lumber output to be not some single quantity but rather a *schedule* of profitable quantities corresponding to various potential prices. Such a schedule is given in Chart 4. This relationship, while labeled in terms consistent with current values of output and price, is primarily intended to be illustrative. At best it would apply approxi-

(Continued on page 11)

Current conditions . . .

The third quarter data which have just become available indicate that the national economy continues to expand; the rate of expansion, however, continues to be disappointingly moderate.

Gross national product rose by $9.1 billion in the third quarter. The magnitude of this increase, when contrasted to the first and second quarter changes, suggests that economic growth may be accelerating.

Consumption and government spending account for most of the third quarter increase. Personal consumption expenditures increased by $4.5 billion, as compared to their second quarter increase of $3.0 billion. It is interesting that this expansion of total consumer expenditures took place despite a concomitant $200 million decline in durable goods spending. This is the first time in the current expansion that this category of final demand has shown an absolute decline. The third quarter increase of government expenditures reflected solely an increased rate of spending by state and local government; federal spending, in fact, declined by some $100 million.

Gross private domestic investment continued to expand during the third quarter, reaching $83.7 billion—a $3 billion increase over the second quarter. Increased construction expenditures accounted for 70 per cent of this $3 billion increase.

The available economic indicators for October suggest a continued expansion. Thus during October the industrial production index rose by 0.7 points to 126.6, the unemployment rate declined from 5.6 to 5.5 per cent, retail sales increased by 2.4 per cent, and personal income rose by $3.0 billion. Current estimates for the fourth quarter put the gross national product at approximately $596 billion. This figure is in line with expectations based on the national economy's moderate performance this year.

The following selected topics describe particular aspects of the district's current economic scene:

1964 NATIONAL FARM INCOME OUTLOOK

Higher production expenses coupled with a probable drop in realized gross farm incomes spell a reduction in realized net farm income in 1964, according to estimates made at the Annual Outlook Conference of the U. S. Department of Agriculture. This decline in net income, estimated at 5 per cent or more below the level of 1963, would also mean a drop in realized per farm net income despite a continued decline in farm numbers.

An anticipated drop in cash receipts from wheat marketings is expected to be the prime cause for

lower crop receipts in 1964. This projection assumes a continuation of current wheat legislation. Some gains are expected in other cash crops, especially soybeans, but these would not offset the decline in wheat income. Slightly higher receipts are also expected from livestock and livestock products, with the most important increases likely to occur in cash receipts from hog marketings. Cattle prices as well as dairy and poultry prices are expected to approximate 1963 levels, while marketings are expected to be slightly higher. On balance, total cash receipts from farm marketings are likely to be down somewhat from 1963 levels.

Some reduction is also expected in direct government payments to farmers in 1964. Offsetting an increase in feed grain program payment will be a reduction in soil bank payment and the elimination of payment made under the Wheat Stabilization Program of 1962 and 1963.

Farm production expenses are expected to increase by as much as or more than the $600 billion gain shown in 1963: Production expenses for such items as fertilizer, seed, and repairs are likely to increase markedly, while depreciation, taxes, and interest charges will experience their persistent gradual increase.

DISTRICT BUSINESS EXPANDS

Economic developments in the district this fall have paralleled those in the nation. Total personal income, on a seasonally adjusted basis, rose by $154 million, or 1.2 per cent, from September to October, to an annual rate of $12,782 million, which is 3.9 per cent higher than the rate computed in October 1962. (These increases for the nation as a whole were 0.6 per cent for the month and 5.0 per cent for the year.) The growth in district income was traced mainly to larger payments made by manufacturers, mining companies, firms in the communication field and larger governmental payrolls.

Another measure of the general business activity is the amount of debits reported by commercial banks. Debits for the most part are checks drawn against depositors' accounts and thus represent payments made for goods, services, debts, etc. Debits in this district were high in October—not as high as in September, but higher than in any of the first eight months of this year on a seasonally adjusted basis. The volume of debits for October increased 11 per cent from the figure for October, 1962. Larger amounts were reported from banks located in all size classes of urban centers, indicating a general expansion in business transactions.

The seasonally adjusted volume of construction put-in-place in the district has been rising, as indicated by the increase in the number of workers employed on projects. In addition to a growing demand for additional facilities, favorable fall weather has postponed the closing down of operations for the winter. The number of dwelling units authorized by building permit in October was up sharply, paralleling the national rise in housing starts. The aggregate valuation on building permits issued was also up, indicating that a high level of nonresidential construction may be maintained for some time.

Current information on district retail sales is not sufficient to permit inferences about aggregate volume. Department store sales in October did not recover from the September slump; in fact, sales, seasonally adjusted, slid a little further. Weekly sales at the beginning of November strengthened in the four district cities of Minneapolis, St. Paul, Duluth and Superior. The tragedy of the President's assassination reduced consumer buying, but only for a short period. Most Twin Cities retailers were looking forward to a high volume of sales after Thanksgiving. New car registrations show that the sale of new cars has been high in district states as in the nation. In rural areas, they have continued high even though the farm crop harvest was smaller than that of a year ago.

BANKING DEVELOPMENTS

After a substantial increase of $33 million in September, loans at district city banks dropped $6

million in October, a normal change for the month. The latest available data show that city bank loans resumed their advance during the first two weeks in November, rising $26 million—a better-than-average gain for the period

At district country banks the September loan increase of $24 million was the third largest for the month in the postwar period, and the October increase of $27 million was the second largest for any October in postwar years. In the first two weeks of November, loans at country banks rose by an additional $12 million, an above average increase for the period. This gain indicates a continuation of the moderately strong loan demand evidenced at country banks during both September and October. END

(Timber resources of the Ninth district West: Continued from page 8)

mately only for the present and for the near future. Over any longer period various adjustments would begin to take place. Improvements in technology that favor our region would shift the curve upward by making it profitable to produce more at any given market price. There is some evidence that this has in fact been happening in our district: output has increased despite steady or even declining lumber prices of very recent years.

The foregoing discussion has been based on an *aggregate* district output. But a great many individual timber product categories are independent of or in competition with one another. Actually, then, there are many products, not just one; and there are many markets, not just one. Each must strike its own balance. Some species may be cut faster than sustainable cut rates at most existing price levels, while others are cut at far below their physical availability even at zero stumpage prices. Moreover, as we shall see in a future article, changes take place over time with respect to commercial standing and competitiveness of particular species. In general, the inherent differences between species that appeared important to users many years ago have come to play a less important part in consumer demand in recent years.

In summary, we can see that the physical basis for industry—the sheer quantity of wood available—is substantially greater than the quantity currently being used. Whether much or relatively little of this amount is used in the near future depends on a variety of basic economic factors: technological development, prices of products as determined by the market, and prices of inputs the mills must buy. In a sense, then, the maximum sustainable harvest could be stretched to at least twice the present figure, given appropriate technology and suitable profit incentive. But the practical economic potential of the region's industry depends on several factors that will be shaped largely outside our region; most of these are economic variables that will be determined through the interaction of the market with a multitude of other sectors in our national economy. Recent trends, to be discussed in the second article in this series, document the fact that we are making ever-increasing use of our district's timber potential.

—CLARENCE W. NELSON

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