United States
Department of
Agriculture

Forest Service

Southeastern Forest
Experiment Station

General Technical
Report SE-56

Southern Appalachian Timber Study

J. E. de Steiguer, L. W. Hayden, D. L. Holley, Jr.,
W. G. Luppold, W. G. Martin, D. H. Newman, and
R. M. Sheffield

August 1989

Southeastern Forest Experiment Station
P.O. Box 2680
Asheville, North Carolina 28802

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J.E. de Steiguer, Project Leader
Southeastern Forest Experiment Station
Research Triangle Park, NC 27709

L.W. Hayden, Forester
National Forests in North Carolina
Asheville, NC 28802

D.L. Holley, Jr., Professor
North Carolina State University
Raleigh, NC 27695

W.G. Luppold, Project Leader
Northeastern Forest Experiment Station
Princeton, WV 24740

W.G. Martin, Forester
Region 8, Southern Region
Atlanta, GA 30367

D.H. Newman, Assistant Professor
University of Georgia
Athens, GA 30602

R.M. Sheffield, Resource Analyst
Southeastern Forest Experiment Station
Asheville, NC 28802

Preface

The team that conducted this study was comprised of the following USDA Forest Service and university personnel: Edward de Steiguer, USDA Forest Service, Southeastern Forest Experiment Station; Larry Hayden, USDA Forest Service, National Forests in North Carolina; Lester Holley, North Carolina State University, Department of Forestry; William Luppold, USDA Forest Service, Northeastern Forest Experiment Station; William Martin, USDA Forest Service, Region 8; David Newman, University of Georgia, School of Forest Resources; and Raymond Sheffield, USDA Forest Service, Southeastern Forest Experiment Station.

Holley and Martin prepared III.B. – Stumpage and Log Prices; Sheffield wrote III.C. – Harvest Trends; Luppold was responsible for III.D. – Factors Influencing Timber Demand; and Newman and Sheffield prepared III.E. – Factors Influencing Timber Supply. Sections III.F. – Summary Findings and IV. – Forecast of Future Market Conditions 1987-2000, were collaborative efforts involving the entire team. The remaining sections were written by de Steiguer.

The team wishes to thank the following for their technical reviews of this document: Clark Binkley, Yale University; Fred Cubbage, University of Georgia; William Hyde, Duke University; David Jackson, University of Montana; Jan Laarman, North Carolina State University; and Roger Sedjo, Resources for the Future, Inc. All errors and omissions, however, are the responsibility of the team.

J.E. de Steiguer, Team Leader
Research Triangle Park, NC
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Southern Appalachian Timber Study

EXECUTIVE SUMMARY

In May 1987, a team of USDA Forest Service and university personnel was assembled to conduct a study of the timber stumpage markets in the Southern Appalachian region. The study area is within a 100-mile radius of Asheville, NC, encompassing portions of North Carolina, South Carolina, Georgia, Tennessee, and Virginia.

The purpose of this investigation was to establish recent stumpage market trends and to project stumpage price trends to the year 2000. These projections were to verify the assumption of constant real stumpage prices used in the land management plans for the Southern Appalachian National Forests (i.e., the Nantahala, Pisgah, Cherokee, Chattahoochee, Jefferson, and Sumter).

Private timber harvests have increased rapidly over the past 2 to 4 years. Private stumpage prices, analyzed over the past 10 years, present a mixed picture. Real prices in North Carolina have been rising. None of the other States show this general strength. Hardwood veneer species, hardwood pulpwood, and, in some instances, oak sawtimber have generally been on the rise in all States.

The resurgent private stumpage markets in North Carolina seem to stem from expanded plywood, oriented strand board, and saw- and paper-milling capacity. The expansion in plant capacity, in turn, seems to stem from a strong consumption-oriented economy. Also, ownership fragmentation and increased nonfarm ownerships may be reducing the economic supply of private stumpage. However, this last point was difficult to verify.

Over the past 10 years, National Forest timber harvests have risen more rapidly than private harvests. During the same period, National Forest stumpage prices have, in most instances, decreased. This decrease seems to suggest slack competition for Federal timber, perhaps as a result of contractual difficulties and environmental constraints associated with National Forest timber harvests.

To the year 2000, the team foresees continued strong demand for hardwood veneer, hardwood pulpwood, and oak sawtimber due to the construction and modernization of mills and plants in the study area. Thus, the team expects private stumpage prices to rise slightly.

The environmental protection measures associated with harvest of Federal timber will continue in the future; therefore, it is difficult to envision a surge in the demand for Federal stumpage. However, increasing private prices should increase the competition slightly for Federal timber. This, coupled with only slight increases in harvesting on the Southern Appalachian National Forests, should moderate the declines in National Forest stumpage prices seen in the past 10 years. To the year 2000, the team predicts that Forest Service real stumpage prices will trend downward slightly or, perhaps, level off. These projections are quite similar to the ones currently used for land management planning on the Southern Appalachian National Forests.

KEYWORDS: Hardwood, stumpage markets, stumpage prices, National Forests.

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I. Introduction

I.A. Forest Planning

In 1979, Region 8 of the National Forest Systems (NFS) initiated the process for development of Land and Resource Management Plans (forest plans) for the National Forests in Southern Appalachia. The National Forests there are the Pisgah and Nantahala in North Carolina, the Cherokee in Tennessee, the Chattahoochee in Georgia, the Jefferson in Virginia, and a portion of the Sumter in South Carolina (fig. 1).

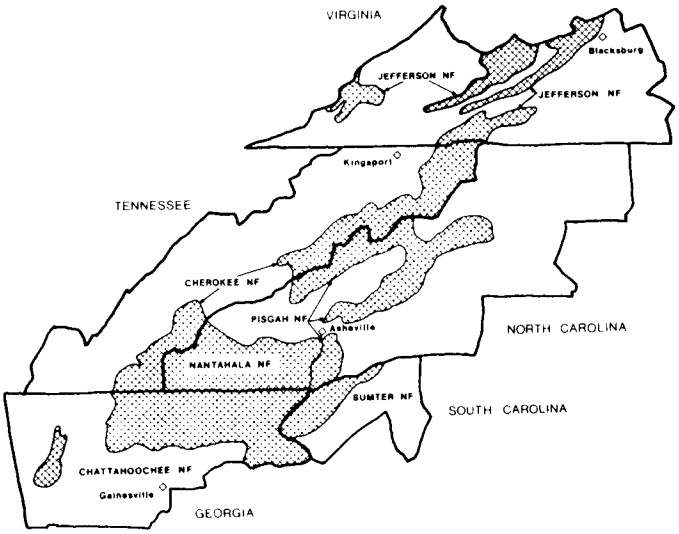


Figure 1. – Location map for the Pisgah, Nantahala, Cherokee, Chattahoochee, Jefferson, and Sumter National Forests.

Preparation of these forest plans was required by the Forest and Rangeland Renewable Resources Planning Act (RPA) as amended by the National Forest Management Act (NFMA). Along with the forest plans, an Environmental Impact Statement (EIS) was prepared in accordance with the National Environmental Policy Act (NEPA) and Council of Environmental Quality (CEQ) regulations.

The purpose of the forest plans is to provide management direction for the production of goods and services from the National Forests in a manner that maximizes long-term net public benefits. Once a forest plan is adopted, it guides forest management for 10 to 15 years (until about the year 2000 for the Southern Appalachian National Forests).

I.B. The Problem

The forest plans thus far released for the Southern Appalachian National Forests generally call for only slight increases in timber harvesting volumes to the year 2000. For example, average annual harvest volume for the Pisgah and Nantahala National Forests was 10.6 million cubic feet for the period 1981-85. The new forest plan calls for an average annual volume of 11.2 million cubic feet, a 6-percent increase.

Forest industries that draw upon timber supplies from these National Forests, and the surrounding private ownerships have taken issue with the low increases in timber harvest volumes. The essential criticism is that the forest plans were based on outdated timber market information. Forest industries maintain that, since the planning process began 9 years ago, the demand for Southern Appalachian timber has risen dramatically. Also, they fear that private ownerships are becoming an expensive and unreliable source of timber supplies. According to the timber-based industries, the Forest Service needs to reexamine the timber market information used in the forest plans and consider the possibility of plan revision to permit greater increases in timber harvests from the Southern Appalachian National Forests.

I.C. Purpose and Objectives

The purpose of this study is to estimate for forest planning future trends in Southern Appalachian timber markets. The focus is on hardwood stumpage markets because of their dominance in the regional timber industry. However, some stumpage price, harvest, and inventory information is presented for softwood markets.

The specific objectives of the study are:

1. To examine recent stumpage and log price trends for major hardwood species in the Southern Appalachian Region.

2. To examine recent timber harvest quantities.

3. To examine factors, such as final product prices, that have influenced the derived demand for timber.

4. To examine factors, such as changing ownership patterns, that have influenced timber supply.

5. To make an informed judgment about market trends through the year 2000, with emphasis on stumpage prices.

Section II of this report provides background information on the forest planning linear programming model (FORPLAN). An understanding of the manner in which FORPLAN uses market information is crucial because of the role the model plays in land management planning. Section III contains the analyses related to objectives 1 through 4. Section IV, the concluding section, describes our judgments about future hardwood market trends.

II. FORPLAN

II.A. Description

The FORPLAN is a linear programming (LP) model that assists forest planners in the evaluation of management alternatives. The LP model contributes to both the efficiency and objectivity of

forest planning, yet its processes are obscure to many people. This subsection explains the FORPLAN LP methodology. The following section describes the informational inputs to FORPLAN. The combined goal of the two subsections is to identify the FORPLAN data that must be examined, and perhaps modified, to address the concerns about timber harvest levels on the Southern Appalachian National Forests.

In the final EIS for the Nantahala and Pisgah National Forests, the basic purpose of the FORPLAN LP model is described: ". . . given an area of land, and several alternative ways of managing that land to produce goods and services, determine how much land should be managed in various ways so that public net benefits are maximized subject to certain biological, technical, and environmental constraints."

The workings of the LP model are best explained by the example in figure 2. Here, the true situation has been greatly simplified to consider the joint production of only two goods – timber and recreation. The objective is to determine how much land should be allocated to the production of each good in a manner that will maximize net public benefits. Acres of forest dedicated to timber production are represented on the horizontal axis, while recreation acreage is on the vertical axis.

The area under line segment AA' defines all the various combinations of timber and recreation that can be produced from the forest for a fixed level of expenditure. An increased budget or land base for forest management would cause the curve to shift outward away from the origin. The downward slope of AA' is determined by the technical production relationship between timber and recreation. In order to produce more timber, recreation opportunities must be foregone.

Constraints on the level of timber harvest are represented by the vertical line segments FF' (harvest floor) and CC' (harvest ceiling). These constraints ensure that harvest levels will not fall below F' nor above C' on the horizontal axis. Constraints may be imposed for such reasons as industry and community stability or to maintain recreation areas in the forest.

The area bounded by AA', FF', and CC' is referred to as the "feasible solution region." In other words, it would be possible to produce combinations of timber and recreation anywhere within the bounded area on the graph and still satisfy the constraints imposed by budgets, harvest limits, and technical production relationships. However, to maximize benefits, the optimal production solution will be somewhere along the line segment AA' at the outer edge of the feasible solution region.

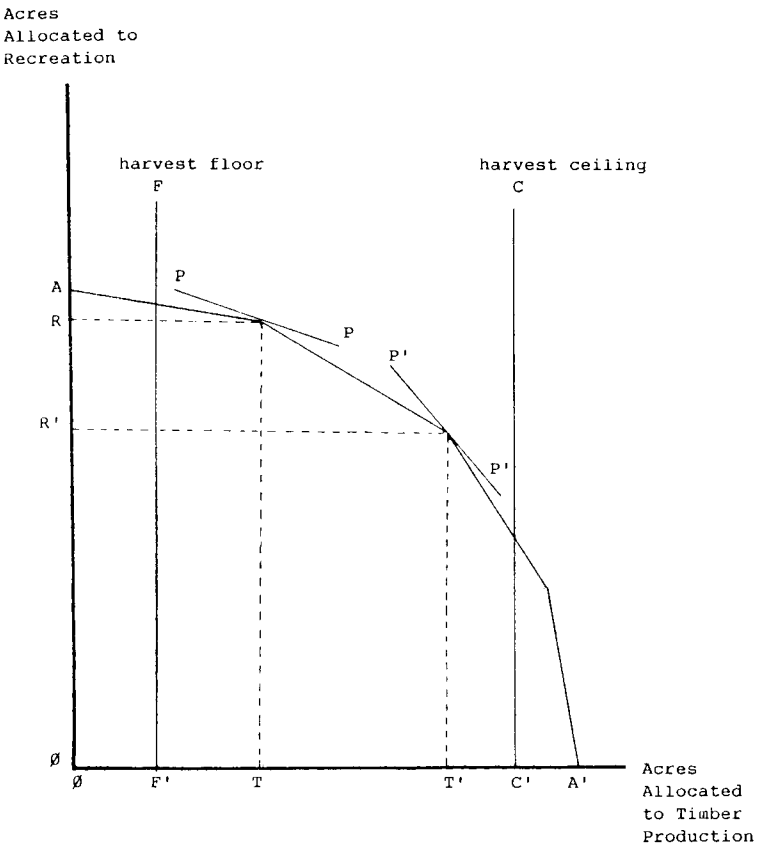


Figure 2. – Diagram of a FORPLAN-like solution for allocation of forest land to recreation and timber production.

In order to derive an optimal production solution, we also need information concerning the values of timber and recreation. These values are the prices that the user public is willing to pay for the resources. Timber prices can be derived from market information, while recreation values may be obtained from studies of "willingness to pay."

Line segment PP represents the summation of total recreation output times the unit value of recreation plus the total output of timber times the unit value of timber, or, otherwise stated, total dollar benefits of production. The slope of the line is equal to the negative ratio of timber price divided by recreation price. Hence, the relative values of the two resources determine the slope of this total benefits line.

The optimal level of joint production is found where PP is tangent to AA'. This point is said to maximize net public benefits and will result in R acres of recreation and T acres of timber. If, however, timber values were to increase relative to recreation values, the total benefits line will assume a steeper slope as illustrated by line segment P'P'

This relative price increase for timber generates a new point of tangency and, therefore, a new optimal solution with R' acres of recreation and T' acres of timber. The relative timber price increase results in the allocation of more land to timber production and less to recreation. The annual allowable sale quantity (ASQ) is derived from the acres of land allocated to timber production.

II.B. FORPLAN Timber Data

The previous subsection discussed the workings of a FORPLAN-like LP model and indicated three critical types of information needed to execute the model:

1. The technical production relationship between timber and other competing forest outputs.

2. The upper and lower timber harvest constraints.

3. The value of timber relative to the values of other competing goods and services.

Appendix B, "Description of Analysis Process," in the final EIS (USDA Forest Service 1987a) discusses the methods by which these data were developed for the Nantahala/Pisgah plan. Here, we will discuss only items 2 and 3 (above), the harvest constraints and timber values, because they are related to the present study of timber markets. The production relationships, while important, are beyond the scope of our study.

The timber harvest constraints used in the plan were derived from the RPA planning process. At the national level, RPA projects the aggregate annual consumption of NFS timber. These estimates represent the best guess as to the amount of NFS timber that will be purchased when offered at the prevailing market price. These RPA estimates are referred to, in RPA jargon, as "demand" estimates.

The national RPA consumption estimates are disaggregated to regions and, eventually, to individual National Forests. The upper and lower bounds on timber harvest are set at plus or minus 50 percent of the disaggregated RPA consumption estimate. The upper and lower bound estimates constitute the timber harvest constraints in the FORPLAN model. These bounds are, conceptually, equivalent to F' (harvest floor) and C' (harvest ceiling) as shown in figure 2. The LP model is allowed to "range" between these constraints in search of an optimal solution.

It is important to remember that the RPA consumption estimates and the timber harvest constraints do not dictate the exact level of NFS timber harvest, but only define the possible limits of the harvest. Increasing the upper bound of the timber harvest constraint will not necessarily increase the ASQ. The possible exception to this would occur if the LP solution were to "push against" and, thus, be limited by the upper bound constraint. In the case of most Southern Appalachian forest plans, this is, apparently, not a problem that has limited the ASQ.

Timber stumpage prices are the final data input to FORPLAN. From the previous discussion of the LP model, relative timber stumpage price, as reflected in the slope of the total benefits line, was the crucial variable in determining annual ASQ. An increase in timber prices, other things being equal, will likely generate an increased level of timber harvesting. The exact change in ASQ will depend on the amount of relative price change as well as the shape of the production surface.

Timber stumpage prices within FORPLAN are comprised of two components: (1) the beginning-year base prices that enter the model, and (2) the relative rates of price increase over time. Base prices for the FORPLAN analyses were developed by averaging Forest Service sale prices ($/unit volume), stated in constant 1978 dollars, from 1977 to 1980. This procedure yields a single price for valuation of timber that does not vary with respect to the quantity sold.

The rationale for computing a single, invarient timber price for FORPLAN stems from the assumption that the Southern Appalachian National Forests face a perfectly elastic (horizontal) demand curve within their constrained levels of possible timber harvests. The National Forests are assumed to have no market power and, therefore, can exert no measurable influence on aggregate supply or market price with their offerings.

This method of modeling demand for NFS timber is attractive because it avoids the complexities of deriving a downward-sloping demand curve and, thus, is easier to implement. Also, Connaughton and Haynes (1983) indicated that the horizontal demand approach may provide a reasonable approximation of the more conventional approach that utilizes a downward-sloping demand curve. This approach is perhaps true for Southern Appalachian National Forests because they account for a relatively small portion (about 10 percent) of the regional timber harvest.

The second component of stumpage prices, the relative rate of price increase over time, was obtained from RPA estimates via TAMM – the Timber Assessment Market Model (Adams and Haynes 1980). The TAMM model predicted future annual real (that is, net of inflation) price increases of about 4 percent for softwoods and 0 percent for hardwoods between 1978 and the year 2000.

III. Analysis of Southern Appalachian Timber Markets

III.A. Scope of the Analysis

Study Area

The data for the analysis of timber markets were collected for the Southern Appalachian region as depicted in figure 3. The counties within the region are:

North Carolina:

Alexander, Alleghany, Ashe, Avery, Buncombe, Burke, Caldwell, Catawba, Cherokee, Clay, Graham, Haywood, Henderson, Jackson, McDowell, Macon, Madison, Mitchell, Polk, Rutherford, Surry, Swain, Transylvania, Watauga, Wilkes, Yadkin, and Yancey

Tennessee:

Blount, Bradley, Carter, Cocke, Greene, Hamblen, Hamilton, Hawkins, Jefferson, Johnson, Knox, Loudon, McMinn, Monroe, Polk, Sevier, Sullivan, Unicoi, and Washington

Georgia :

Bartow, Catoosa, Chattooga, Cherokee, Dade, Dawson, Fannin, Floyd, Gilmer, Gordon, Habersham, Lumpkin, Murray, Pickens, Rabun, Stephens, Towns, Union, Walker, White, and Whitfield

Virginia:

Bland, Buchanan, Carroll, Dickenson, Floyd, Giles, Grayson, Lee, Montgomery, Patrick, Pulaski, Russell, Scott, Smyth, Tazewell, Washington, Wise, and Wythe

South Carolina:

Greenville, Oconee, and Pickens

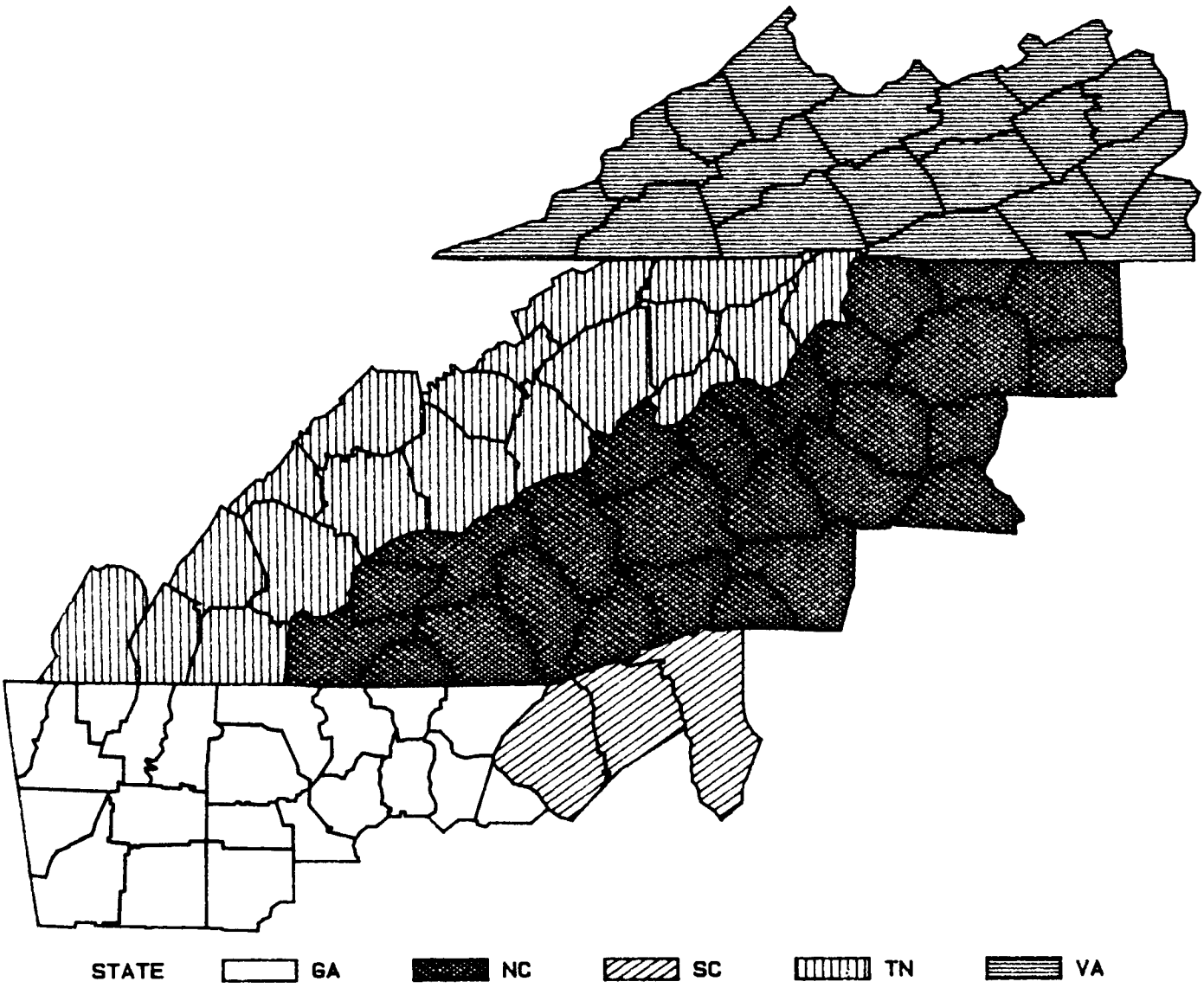


Figure 3. – The Southern Appalachian timber supply study area.

Data and Market Model

Data for the analysis of recent stumpage- and log-price trends were obtained from Timber-Mart South (TMS) and the National Forests from 1977 to the present. Regional price data for both public and private sales were available only for this period. Data on harvesting levels, ownership patterns, and factors influencing timber demand were available for longer time periods than were the stumpage prices.

The remainder of Section III contains an analysis of the Southern Appalachian timber markets. The following subsections contain analyses of stumpage and log prices, harvesting levels, factors influencing demand, and factors influencing supply. The final subsection summarizes recent timber market trends.

The logic behind our order of presentation (prices and quantities followed by demand and supply factors) is derived from basic components of the following generally accepted stumpage market structural model:

$$Q_d = f_1 (P,D) \quad (1)$$

$$Q_s = f_2 (P,S) \quad (2)$$

$$Q_d = Q_s = Q \quad (3)$$

In equation 1, the quantity of stumpage demanded (Q_d) is a function of stumpage price (P) and other demand-influencing factors (D). Equation 2 states that the quantity of stumpage supplied (Q_s) is a function of price as well as other supply-influencing factors (S). Equation 3 presents the equilibrium condition for the market-clearing quantity of stumpage (Q).

The reduced form of the structural model, developed by simultaneous solution, is:

$$P = g_1 (S,D) \quad (4)$$

$$Q = g_2 (S,D) \quad (5)$$

Two variables P and Q are examined in the first two subsections, while the two groups of variables D and S are examined in the next two subsections.

III.B. Stumpage and Log Prices

This section evaluates stumpage and log prices in the Southern Appalachian timber market from 1977 to 1987. It is assumed that timber markets in the region are reasonably competitive and that buyers and sellers have access to relevant information and are free to act. Under such conditions, prices actually paid and received reflect at least a momentary equilibrium between supply and demand forces. Many factors, however, affect the minimum price that sellers will accept and the maximum price that buyers are willing to pay, and these factors are constantly changing. Knowledge of movement in prices over time is crucial in any attempt to reach an informed judgment on supply and demand shifts occurring in a market.

Procedures

The focus of the analysis was on trends – on price changes from one period to the next – rather than on an assessment of absolute values being paid. Only two sources of timber price data were available for analysis: (1) average monthly prices reported for the study region by TMS, a private price reporting service operated by F.W. Norris, P. O. Box 1278, Highlands, NC 28741, and (2) average quarterly prices received for timber sold from National Forests in the study region. Both of these data sets were analyzed, and each is described in greater detail when presented.

The procedures followed in the analysis were simple and straightforward. The first step was to convert the price data from a nominal basis (the dollars actually paid and reported) to a real basis (computed numbers that reflect changes in purchasing power of dollars). Inflation was significant during the period 1977-87. It is assumed that inflation has driven up the price of timber along with the price of other goods and services in the economy. These inflationary increases, however, are independent of any underlying real shifts in the supply and demand for timber products; and the effects of real shifts are not apparent until the distortion of inflation is removed. This was accomplished by dividing the observed timber price in each period by the Producer Price Index for the period. The Producer Price Index, customarily used by researchers to deflate timber prices, increased at an average annual compound rate of 4.68 percent between January 1977 and August 1987. Only if nominal timber prices have increased at a greater rate can one conclude that there has been a real price increase caused by backward shifts in supply and/or outward shifts in demand.

The second step of the analysis was to plot real prices, period by period, starting at the beginning of 1977. By simply observing the resulting picture, it was possible to see direct evidence of underlying shifts in timber markets and to assess fairly accurately, without further analysis, the overall real price trends over the period.

A third step was carried out to assist in evaluating the Forest Service's planning assumption of constant real hardwood stumpage prices over time. The step involved fitting a regression line through the logarithm of the real price data points. Such a line represents the smoothed, best-fit, trend line of real prices. The line's slope reveals the average compound rate of increase or decrease in real prices over the period.

The mathematics of this third step can be demonstrated by the following equation:

$$P_t = P_o (1 + r)^t$$

where: P_t = ending year price, constant dollars

P_o = beginning year price, constant dollars

t = number of intervening years

r = compound annual rate of change

This equation is the familiar exponential (compound) growth rate model that uses discrete, rather than continuous, time intervals (Chiang 1974, p. 290). National Forest plans have assumed (from RPA analyses) that "r" will equal zero for hardwoods, which results in no real price increases ($P_t = P_o$). We wanted to calculate "r" for our various hardwood stumpage price series to see whether the constant real price assumption had been borne out over the period from 1977 to 1988.

From our time series data, there were two ways of calculating "r." The simplest would have been to take the beginning and ending year prices, along with the number of intervening years, and algebraically solve the above equation for "r." This method is simple, but disregards useful information contained in the stumpage prices of the intervening years. We used the regression method, which considers all observations of price over the period. By taking the logarithm of price, the above exponential growth equation is converted to the following log-linear form (Pindyck and Rubinfeld 1981, p. 475), which is estimated by means of least squares regression. The equation is of the following form:

$$\log P_t = \log P_o + (t)\ [\log(1 + r)]$$

The slope of the estimated regression line is the term "log(1 + r)," and the compound annual rate, "r," is extracted as follows:

$$r = \text{antilog}\ [\log(1 + r)] - 1$$

Standard statistical procedures were used to test whether or not the "r" produced by the above method is significantly different from zero.

Figure 4 uses average prices for mixed oak stumpage in the Southern Appalachian timber region to illustrate the above procedures. To simplify the exposition, monthly prices have been averaged by years before plotting. Nominal prices show an upward trend, averaging 2.7 percent per year as computed from the slope of the regression line plotted through the data points. With an inflation rate of 4.68 percent, however, it is evident that the actual purchasing power (real price) of one thousand board feet of oak timber decreased during the period. The lower set of data points for real prices shows this directly. The rate of real price change has been -1.9 percent per year. In the analysis that follows, real prices were computed with the Producer Price Index adjusted to a base year of 1977 = 100.

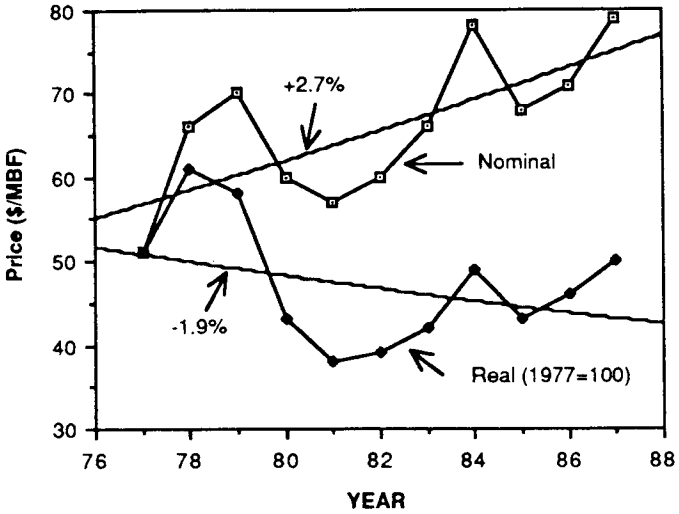


Figure 4. – Nominal vs. real stumpage price for oak in the Southern Appalachian region, 1977-87. Source: Timber Mart-South.

Figure 4 also illustrates the cyclic activity that has occurred in timber markets during the study period. Whereas oak prices fell drastically between 1978 and 1981, they have since been on an upward trend in response to outward demand shifts and/or backward supply shifts. Even with the upturn now taking place, real prices have not yet reached the levels of 10 years ago, and the trend line is negative for the period as a whole.

TMS Data

The TMS price reports have been issued monthly since December 1976 when the series began. High, low, and average prices are reported for 15 stumpage products (standing timber) and for 22 delivered timber products (log prices f.o.b. mill). Each of the 13 Southern States is subdivided into three regions, and prices are reported for all products in each substate area. The Southern Appalachian region under study corresponds closely to TMS's mountain areas in the States of Georgia, Tennessee, North Carolina, South Carolina, and Virginia.

The stumpage price data in TMS come primarily from consulting foresters who act as agents for private landowners in timber sales. Delivered prices are collected by sampling wood dealers, sawmills, and pulpmills. The TMS data collection and reporting procedures have been described in detail elsewhere (Gunter and Cubbage 1987).

The monthly average rather than the high or low prices reported by TMS were used in this analysis. Several of the products covered in the southwide TMS reports are not found in the Appalachian region, and other prices are reported intermittently because of spotty or thin markets. All products

showing prices in at least 50 months over the 128 month period from January 1977 to August 1987 were included in the analysis.

Southwide Timber Price Trends from TMS

Although the Southern Appalachian region is the focus of this study, one cannot ignore conditions in the larger market beyond this relatively small region. Conveniently, the southwide summary sheet that comes with the monthly TMS State reports provides timber prices averaged across all 13 Southern States. As a backdrop for judging price trends in the Southern Appalachian region, these southwide prices were analyzed from 1977 to 1987.

Figure 5 displays the southwide real price data for both stumpage and delivered products. The algebraic difference between delivered price and stumpage price represents the margin for logging and transportation costs. As anticipated, this margin is reasonably constant within a product category, and the two price lines tend to move up and down in unison.

The major conclusion from figure 5 is that timber markets have been in decline throughout the South during the study period. Prices for every product show a declining real price trend. A cycle is evident, especially in the hardwood products. Whereas prices fell sharply in 1979 and 1980, they turned upward after 1982, and they are still rising. Still, the overall trend for all real product prices in the South is negative for the 1977-87 period. Table 1 gives the average annual rates of decline in real prices during the period.

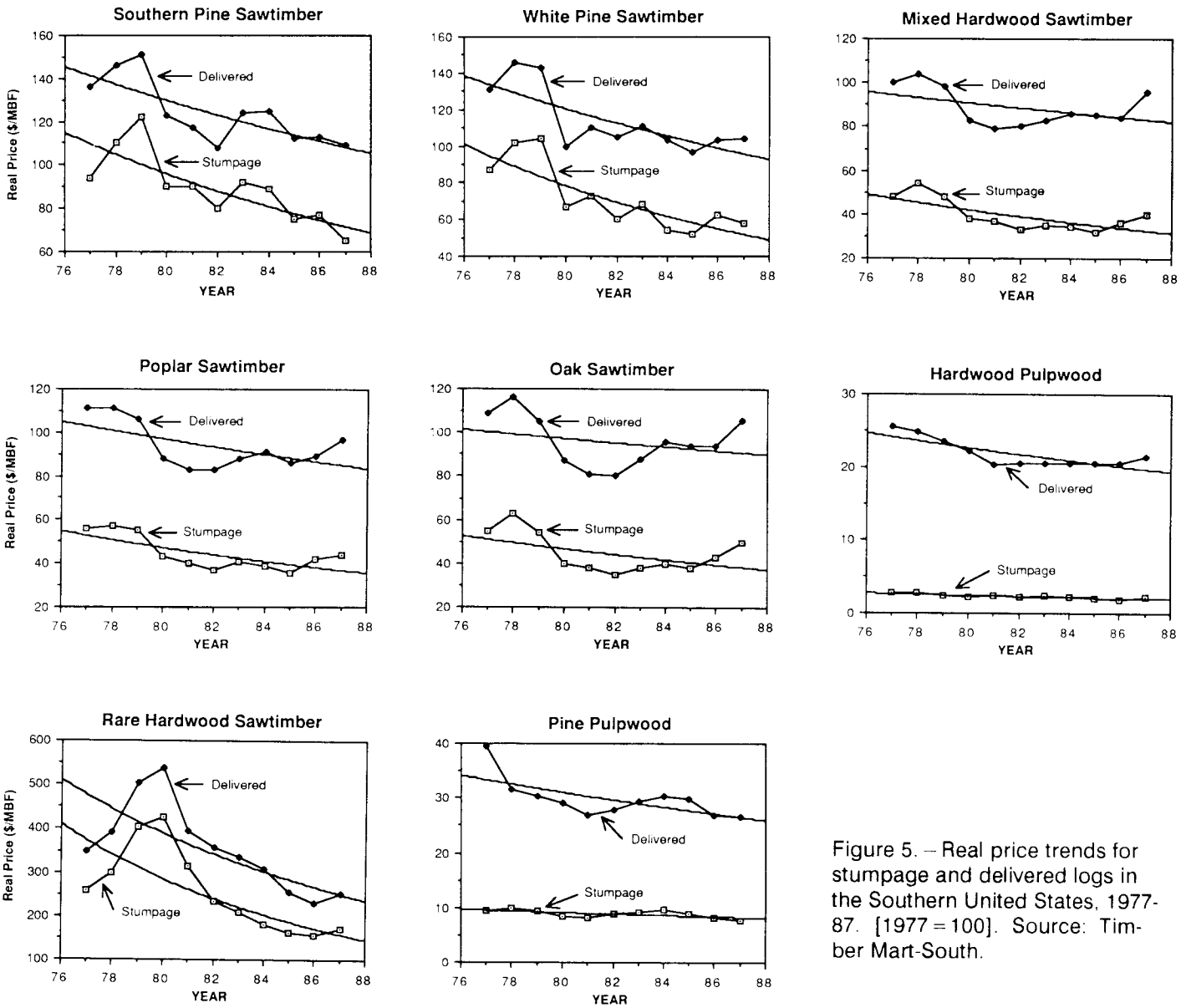


Figure 5. – Real price trends for stumpage and delivered logs in the Southern United States, 1977-87. [1977 = 100]. Source: Timber Mart-South.

Table 1.--Annual percentage rate of change in real timber prices averaged across the entire South, 1977-87

Product	Standing timber prices	Delivered timber prices
Southern pine sawtimber	-4.1	-2.6
White pine sawtimber	-6.3	-3.5
Yellow-poplar sawtimber	-3.8	-2.1
Oak sawtimber	-3.2	-1.2
Rare hardwood sawtimber	-8.7	-6.4
Mixed hardwood sawtimber	-4.0	-1.5
Pine pulpwood	-1.3	-1.3
Hardwood pulpwood	-2.9	-2.1

All rates are significantly different from zero at the 95-percent level.

Source: Timber Mart-South.

Southern Appalachian Timber Prices from TMS

TMS provides separate monthly reports for the Southern Appalachian portions of Georgia, Tennessee, North Carolina, South Carolina, and Virginia. This breakdown presents an opportunity to look separately at price trends in each State as well as to average prices across States for the trends in the Southern Appalachian timber region as a whole. Since TMS does not report the volumes associated with the prices reported, the average price for the entire region was computed as an unweighted arithmetic average of the subregions.

In figure 6, real prices are plotted for the Southern Appalachian region as a whole. As with southwide prices, the price trends are generally negative. Declines can be observed most clearly from the slopes of regression lines plotted through the data. Two products, yellow-poplar veneer stumpage and rare hardwood veneer logs, stand out as the only products with overall positive price trends between 1977 and 1987. The contrast between the rising prices for these products and negative trends for all others in both the Southern Appalachian region and the South as a whole are good evidence that atypical forces are at work on the demand and/or supply side of the market. Later sections of the report will analyze major factors on the demand and supply side that are possible explanations for the price movements observed here. Note that the down-and-up cycle, evident in the southwide price data, also appears in the Southern Appalachian price trends. During the last 2 or 3 years, markets in the region appear to have been especially strong. In most cases, real prices have risen above the regression lines plotted through each data set.

Stumpage price trends in individual States in the Southern Appalachian region are summarized in table 2. As the regional average column shows, price trends are predominately negative. Notable exceptions occur within several States. All pulpwood items have a positive trend in Tennessee, and all veneer items have a positive trend in South Carolina. The most striking exception to the general negative trend, however, is North Carolina. In North Carolina, all hardwood stumpage products have a positive price trend except rare hardwoods, which have relatively small markets. It appears that markets for hardwood stumpage have been atypically robust in North Carolina. Attempts to explain this phenomenon will occur in later sections.

Table 2.--Annual percentage rate of change in real stumpage prices within State areas that form the Southern Appalachian timber region, 1977-87

Product	GA	TN	NC	SC	VA	Aver.
Pine sawtimber	-0.7*	-0.5*	-2.6	-1.8	-3.1	-1.6
White pine	-6.1	-5.6	-6.1	-5.2	7.4	-6.0
Yellow-poplar sawtimber	-2.7	-3.3	1.6	-2.5	-3.1	-2.0
Oak sawtimber	-2.2	-4.1	2.3	-3.8	-2.2	-1.9
Mixed hardwood sawtimber	-4.5	-5.1	0.1*	-4.3	-6.0	-3.9
Rare hardwood sawtimber	-15.0	-10.5	-10.4	-7.9	-12.7	-11.7
Yellow-poplar veneer	2.1	-0.3*	3.2	3.6	0.7*	1.8
Mixed hardwood veneer	-0.1*	-8.1	0.7*	0.6*	-5.8	-3.2
Rare hardwood veneer	1.4*	-4.8	-0.6*	2.5*	0.3*	-0.5*
Pine pulpwood	-0.6	1.5*	-0.9	-1.6	-0.5*	-0.3*
Soft hardwood pulpwood	-1.7	1.0	2.9	-0.6*	0.1*	0.5
Pulp hardwood pulpwood	-2.2	2.3	1.7	-1.6	-4.8	-0.9

*Not significantly different from zero at the 95-percent level.

Source: Timber Mart-South.

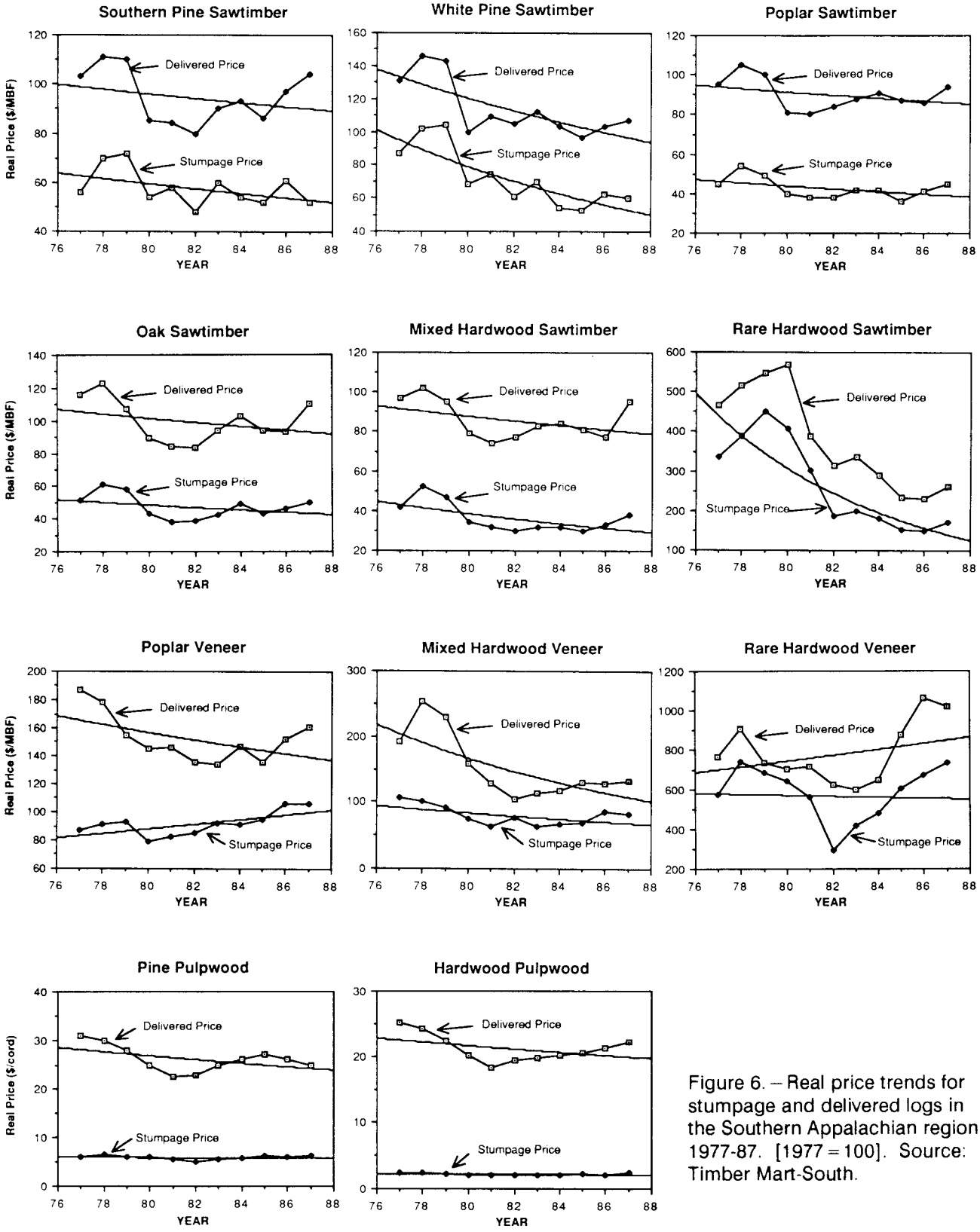


Figure 6. – Real price trends for stumpage and delivered logs in the Southern Appalachian region, 1977-87. [1977 = 100]. Source: Timber Mart-South.

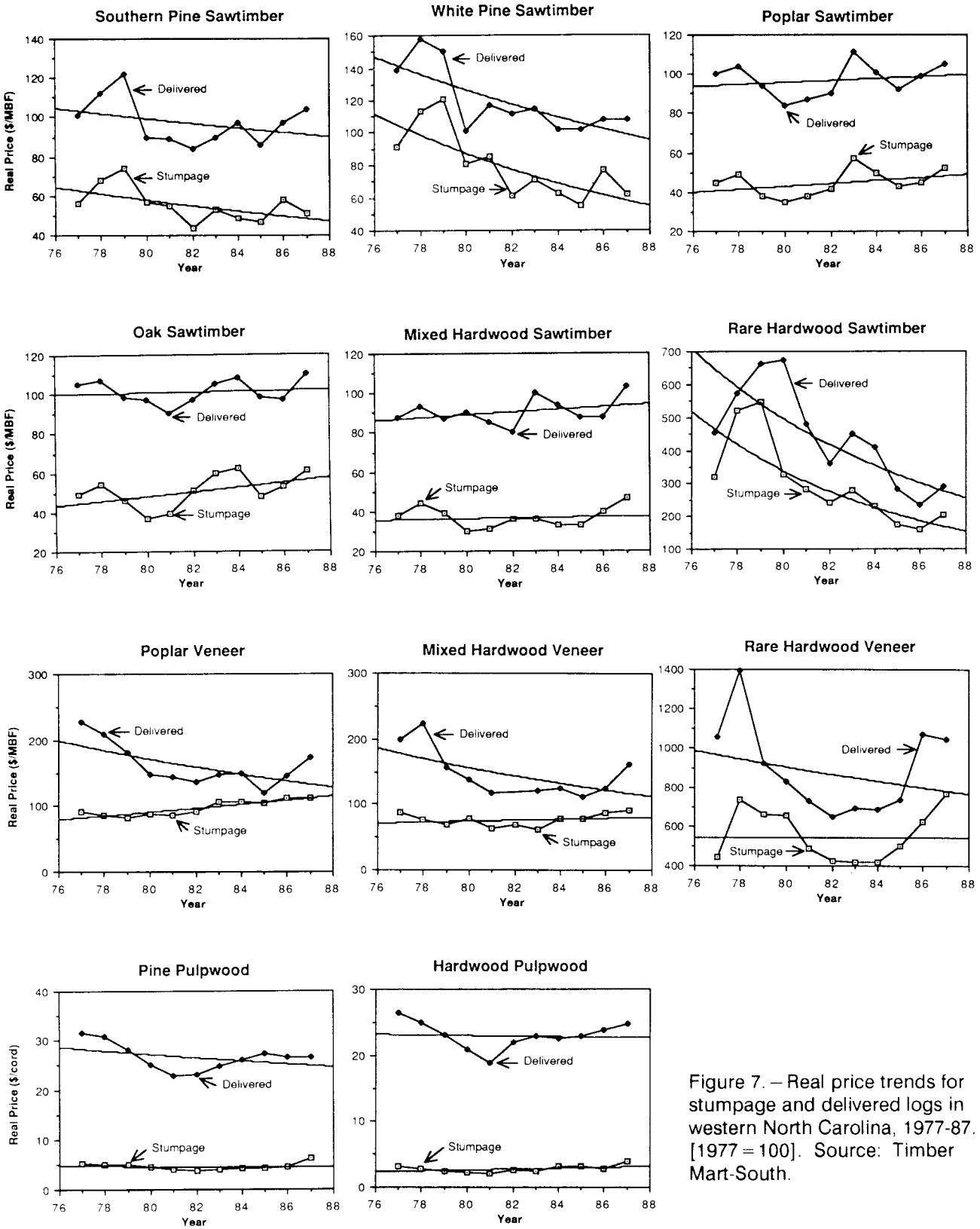


Figure 7. – Real price trends for stumpage and delivered logs in western North Carolina, 1977-87. [1977 = 100]. Source: Timber Mart-South.

Table 3.--Annual percentage rate of change in real delivered prices within State areas that form the Southern Appalachian timber region, 1977-87

Product	GA	TN	NC	SC	VA	Aver.
Pine sawtimber	-1.1	-0.6*	-1.4	-1.0	-1.6	-1.1
White pine sawtimber	-2.3	-4.7	-3.7	-2.6	-3.5	-3.4
Yellow-poplar sawtimber	-1.8	-2.1	0.5*	-1.0	-0.7	-1.0
Oak sawtimber	-1.3	-2.5	0.2*	-1.5	-2.0	-1.5
Mixed hardwood sawtimber	-2.0	-2.2	0.7	-1.2	-3.9	-1.7
Rare hardwood sawtimber	12.0	-10.7	-8.4	-9.0	-7.8	-9.4
Yellow-poplar veneer	-1.2	-1.4	-4.0	-1.0	-1.7	-1.9
Mixed hardwood veneer	-1.7	-11.4	-4.1	-3.3	-7.3	-6.6
Rare hardwood veneer	2.3	4.2	-2.1	-1.0*	1.7	1.8
Cross ties	-2.4	-2.4	-2.7	-2.4	-2.6	-2.6
Pine pulpwood	-1.2	-1.6	-1.4	-1.6	-3.0	-1.5
Mixed hardwood pulpwood	-2.6	0.3*	-0.4*	-3.2	-1.4	-1.4
Pine chips, clean	1.0	1.9	1.9	1.5	0.4	1.4
Hardwood chips, clean	1.4	2.0	2.5	1.4	1.2	1.3

*Not significantly different from zero at the 95-percent level.

Source: Timber Mart-South.

Table 3 presents the trend rates for delivered log prices in each State in the Southern Appalachian region. Several products in this table are not displayed in figure 6 because they have no comparable stumpage product. Two such products, clean pulp chips of hardwood and pine, show an increasing price trend in all States. North Carolina markets again stand out as having a positive price trend for yellow-poplar, oak, and mixed hardwood sawtimber—the three high-volume hardwood log categories. Figure 7 shows the data on which the North Carolina trends cited above are based.

Stumpage Prices from National Forest Timber Sales

At least one National Forest is located in the Appalachian portion of each State in the study area. An analysis of National Forest stumpage prices was carried out separately for the National Forest land in each State and for National Forest land in the region as a whole.

Most National Forest timber sales are formally advertised for 30 days and awarded to the highest bidder under a sealed bid procedure. The quality, size, and volume of the offered timber are determined from a detailed cruise and displayed in the advertisement. Volumes are shown as estimates only and in no way guarantee the purchaser's own volume recovery. Prior to sale advertisement, the timber volume is appraised to estimate fair market value. Most sales are appraised by a transaction evidence appraisal system that considers stumpage prices of recent sales as well as conditions on the current sale area. The appraised value is advertised as the minimum acceptable bid rate by species and product. Perspective purchasers must bid at least this minimum value for each species and product offered, and the sale is awarded to the highest total bid. Any permanent road building costs associated with a sale are appraised separately by the Forest Service. The timber buyer builds the road and is reimbursed at the appraised cost. Road building costs do not necessarily affect the bid price for stumpage. However, road building does impose risk and extra administrative costs on the timber buyer.

Unlike practices on some National Forests in the Western United States, there are no contract provisions for adjusting the winning bid price up or down based on market conditions at the time the timber is actually cut. Most timber sale contract terms in the Southern Region cover a 3-year period, which is shorter than contract periods in the West. Thus, for the National Forest price data used in this study, the original sale price is also the cut price.

The data for National Forest sales were available on a quarterly basis over a full 10-year period, 1977-86. Throughout a given quarter, each sale resulted in an independent observation of the amount being paid for each species in the sale. Since the species sale volume was known, it was used to weight each price in arriving at an average quarterly species price within a given State. Likewise, the total volume represented by each quarterly species price in a State was used in arriving at a weighted quarterly species price for the entire Southern Appalachian region. Sales with less than $2,000 in total initial appraised value were excluded from the analysis.

Table 4 displays the real price trend by stumpage product and State on National Forests in the study area. The average column represents the trend of weighted quarterly prices for all National Forest sales in the study area. This aggregate column reveals that National Forest stumpage prices have experienced a negative trend. This finding is similar to that obtained from the analysis of TMS data, which reports on stumpage prices received for timber sold from private land. In general, however, prices on National Forest land have been decreasing at a much higher rate than stumpage sold from private land.

Table 4.--Annual percentage rate of change in real stumpage price paid for National Forest timber within the Southern Appalachian region, 1977-86

Product	GA	TN	NC	SC	VA	Aver.
Yellow pine	-2.77	1.27*	-5.78*	-3.55*	6.98*	-1.80
White pine	-6.86	-1.30*	-13.19	-10.22*	-5.10*	-7.01
Yellow-poplar	-9.80	-3.60	-9.89	--	0.34*	-8.59
Mixed oak	-6.08*	-2.30*	-8.30	-5.80*	9.22	-5.35
White oak	-8.74	-7.04	-8.68	--	4.24*	-8.12
Northern red oak	-5.13	-8.72	-2.89*	--	-3.84	-4.11*
Mixed hardwood	-6.02*	-5.60*	-6.42*	-11.97	-7.73	-7.11*
Pine pulpwood	-6.70*	14.95	-10.43*	-15.67	3.14*	-0.67*
Hardwood pulpwood	-6.32*	8.89*	-17.24	-1.33*	-2.21*	-4.31*

*Rate not significantly different from zero at the 95-percent level.

Source: USDA Forest Service, Region 8.

The National Forest stumpage sales data provided an opportunity to look simultaneously at both price and volume over time. These data are plotted by product in figure 8 for the aggregate of all National Forest sales in the study region. From 1977 to 1986, the National Forests progressively increased the harvest volume of all stumpage products except softwood pulpwood. Real prices fell during the same period. In fact, the price lines are practically a mirror image of the volume lines.

Regarding price trends for National Forest sales from individual States, only the Cherokee (Tennessee) and Jefferson (Virginia) National Forests show any positive real price trends. It is somewhat puzzling that the National Forests in North Carolina do not show the same positive price trends for the major hardwood stumpage products that the TMS data show for private land. One possible explanation is that the spatial dimensions of stumpage markets are restricted by mountainous terrain so that the progressive harvests from National Forest land have driven prices down in close proximity to the forests but not in the larger Southern Appalachian region. Certain factors, however, suggest that stumpage prices on private land are really not directly comparable with National Forest prices. In somewhat overly simplified form, private sales have the following characteristics: (a) the land is generally accessible, so road building costs are low; (b) most harvesting involves partial cuts of valuable trees only; and (c) loggers have free rein to minimize extraction costs. These conditions give the private landowner what he wants most – the highest price for his timber. The Forest Service also seeks top prices but is willing to sacrifice income to meet certain administrative, silvicultural, and environmental constraints. Some of the conditions that may have contributed to falling National Forest timber prices during the study period are discussed below.

For silvicultural reasons, most Forest Service timber sale contracts require that timber operators perform clearcuts to remove all trees, including those with little or no value. In western North Carolina, small roundwood comprises approximately 50 percent of the volume on an average timber sale. Markets for such low-value products can fluctuate considerably in the short term. After timber operators log and deck the small roundwood, they may be unable to sell it. Since the appraised value of this small roundwood must be met in the bid, buyers probably compensate for uncertainty by bidding less than market value for the highly valued timber such as red oak sawtimber.

Stumpage prices on National Forests may also be depressed, compared to those on private land, by Forest Service site protection standards. Conventional logging techniques involving tractors or skidders are being prohibited on land with prevailing steep slopes. Instead, cable logging must be used, which involves a higher capital investment and higher operating costs than conventional logging. This extra cost results in a lower bid price for stumpage. It is significant that from 1962 to 1972, 25 percent of National Forest hardwood removals in western North Carolina took place on 50 percent or steeper slopes. From 1972 to 1982, 56 percent of removals came from 50 percent or steeper slopes. Other examples of provisions that lower the residual value of National Forest stumpage are placement of erosion control structures, maintaining roads, and seeding and fertilizing roadbeds and skid trails.

In a market with few bidders, it is also conceivable that Forest Service procedures for establishing minimum bids could result in a downward price trend. The Forest Service utilizes a stumpage appraisal method called "Transaction Evidence Appraisal" for computing the advertised minimum bid price for stumpage. This appraisal method smooths market fluctuations and keeps prices relatively stable. In arriving at the minimum bid price for a sale, the

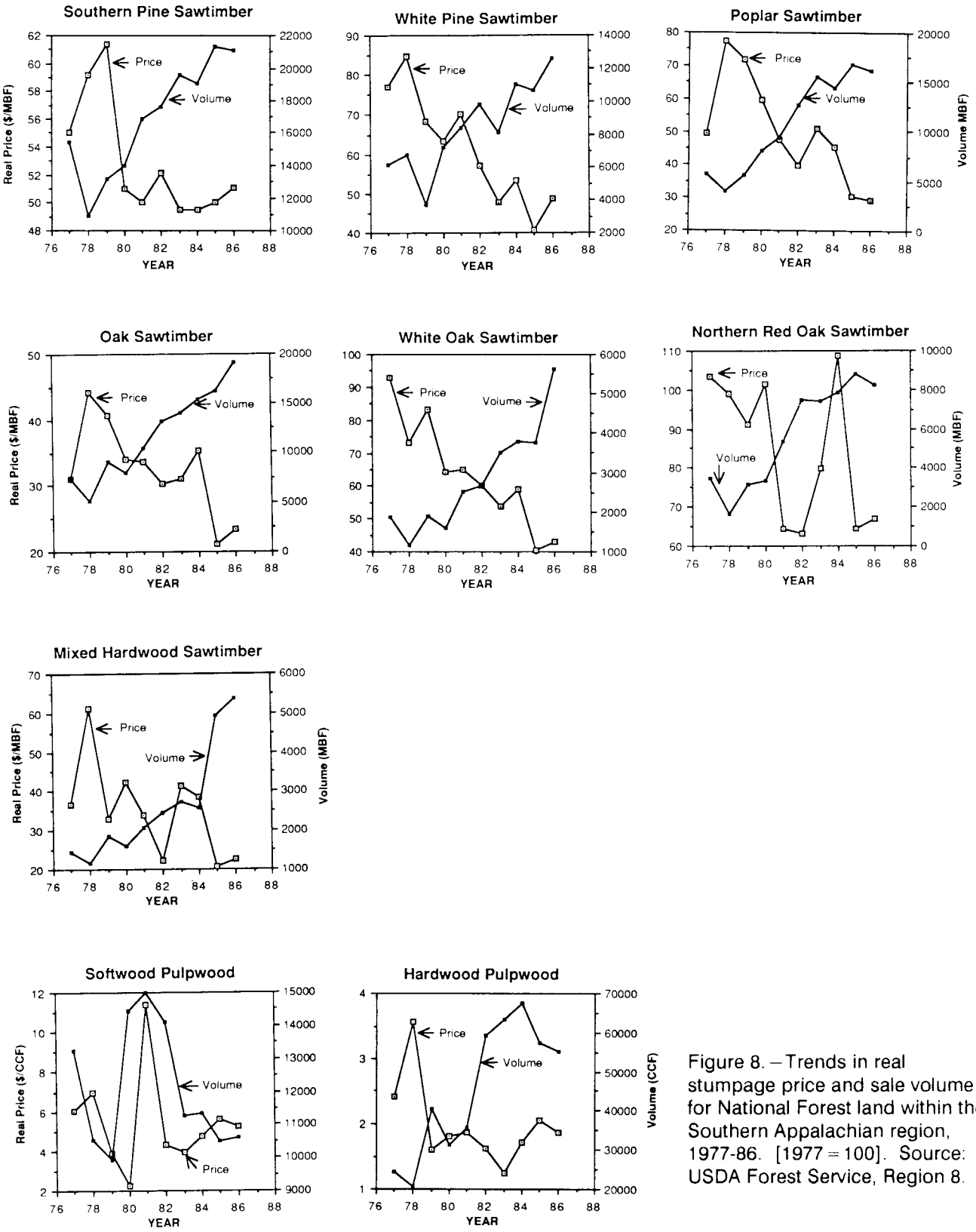


Figure 8.—Trends in real stumpage price and sale volume for National Forest land within the Southern Appalachian region, 1977-86. [1977 = 100]. Source: USDA Forest Service, Region 8.

weighted average of high bids from the previous quarter are reduced by 10 percent. When there is a lack of competition, timber is often sold for the minimum advertised rate. The advertised price would then decrease by 10 percent the following quarter. The appraisal system would allow this 10-percent decrease to compound through time, resulting in a downward stumpage price trend. During the past 10 years, the average number of bidders per National Forest sale in the Southern Appalachian study area was 2.3 bidders. Since 1982, however, that number has steadily decreased to an average of 1.8 bidders per sale.

Finally, prices for National Forest timber were altered from 1983 to 1985 by the introduction of new volume tables for sale volume determination. The new tables gave good estimates of volume; however, there was some misapplication of merchantability standards when tallying individual trees. This caused the advertised volume of sawtimber to be overstated. To compensate, bidders were known to lower their bid rates on sawtimber. The merchantability standards were revised in 1985 to give more accurate volume estimates. This problem with merchantability standards contributed to a decline in "computed" stumpage prices from 1983 to 1985. Total revenue to the Forest Service, however, was not necessarily affected.

Summary

For the period since 1977, real timber prices show an overall decline within the Southern Appalachian region and within the larger southern market beyond. Generally, real prices fell sharply from their levels at the beginning of the period and have been on an upward surge for the past several years. However, most prices have not yet reached the levels obtained early in the period.

The most notable exception to this overall trend is hardwood stumpage sold from private land in North Carolina (measured by TMS data). Private hardwood stumpage prices in North Carolina have moved upward since 1977. This suggests that some extraordinary market forces are at work in North Carolina, creating either a backward shift in stumpage supply, an outward shift in stumpage demand, or possibly a combination of both.

Finally, the contradiction between negative price trends for National Forest stumpage sales and positive price trends for private stumpage sales in a small geographic market such as western North Carolina is surprising. This result suggests tight spatial markets for National Forest timber. More importantly, it appears likely that "red tape" and numerous constraints on government timber sales significantly limit competition and lower the residual value of government stumpage.

III.C. Harvest Levels

This section examines changes in timber harvesting in the study area for two decades. Two independent sources of data were examined to establish trends in harvesting levels from timberland in the study area: (1) Forest Inventory and Analysis (FIA) estimates of total removals, and (2) industrial roundwood production data obtained from canvasses of primary wood products plants. Recent National Forest timber sale volumes are used to supplement the FIA data. FIA data provide estimates of total annual removals averaged across two broad periods of 8 to 10 years. The industrial roundwood production data are annual or for 2- to 3-year periods.

Timber Removal Estimates from FIA

FIA provides the only estimate of total volume of timber removed annually from forests in the study area. These estimates are based on the periodic remeasurement of nearly 3,000 permanent sample plots in the study area. These samples are distributed across all forest conditions and ownerships. FIA estimates of timber removals include volume removed and utilized for industrial timber products (sawlogs, veneer logs, pulpwood, etc.) and fuelwood. Merchantable volume removed but not actually utilized for timber products (logging residue and other removals) is also included. The unutilized portion typically accounts for about 15 percent of total softwood removals and about 25 percent of total hardwood removals.

A problem common to any multistate analysis that uses FIA data is that the inventories are usually conducted on different dates in each State. One has the option of updating statistics to a common date or accepting the resource statistics as reported and pooling the respective States to obtain a best estimate of statistics for the entire area at a specific point in time. In this document, all FIA data have been assembled without updating. Totals for the latest survey (inventory) in each State were summed to obtain study area totals for the most recent period. Likewise, data for the next most recent survey in each State were totaled to provide change information. Inventory dates for the latest surveys were from 1980 to 1986; those for the previous surveys were from 1971 to 1978 (fig. 9).

It should be emphasized that FIA timber removals are not point-in-time estimates for the year the inventory was conducted. Removal statistics from FIA data are average annual values developed from removals since the previous inventory in each State. Thus, annual removal values reflect rates of timber harvesting for a longer period than might be implied from the inventory dates alone. For instance, in figure 9, note that timber removals occurring as early as 1961 in Georgia and Tennessee can influence the average removal level for the previous

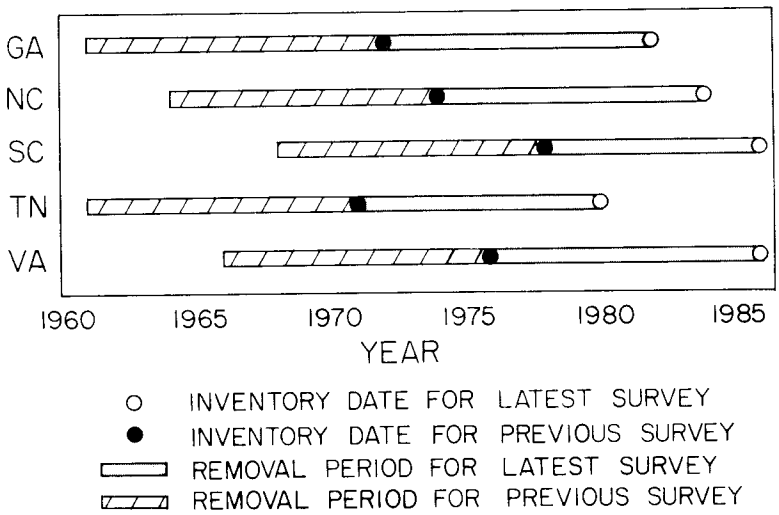


Figure 9. – Date of inventory and corresponding timber removal period for the two most recent inventories in the Southern Appalachian timber supply region, by State.

survey period. When separate State removal values are summed to obtain study area totals, these annual removals are not directly related to a fixed range of years because the remeasurement periods in each State are different. In general, annual removals for the previous survey period are characteristic of the mid-1960's to mid-1970's, whereas the latest period represents the level of removals for the period between the mid-1970's and the mid-1980's. Regardless of the years involved, the reader should recognize that year-by-year fluctuations and very recent changes in removals are effectively masked by the periodic nature of the data.

FIA data reveal a downward trend in annual timber removals in the study area from the removal periods of the previous surveys to the most recent periods (table 5). For all species combined, annual timber removals dropped from 315 million cubic feet to 291 million cubic feet, or by 8 percent. Trends for softwoods and hardwoods differ. Softwood removals increased by 6 percent, whereas hardwood removals declined by 18 percent during these two periods. Trends for sawtimber or board-foot volume are essentially the same as those for growing stock and, therefore, have been omitted from further discussion. Reductions in hardwood removals occurred for all timber-size categories (poletimber and sawtimber), whereas most of the increase in softwood removals was in the larger size categories.

Softwood species accounted for more than one-half of the growing-stock removals in the study area but comprised only 27 percent of the standing inventory. This imbalance is apparent in the statistics for

Table 5.--Average annual removals of softwood and hardwood growing stock in the Southern Appalachian timber supply region for the two most recent survey periods,[a] by ownership class

Ownership class	All species		Softwoods		Hardwoods	
	Previous surveys	Latest surveys	Previous surveys	Latest surveys	Previous surveys	Latest surveys
	Thousand cubic feet					
National forest	36,296	29,159	13,696	15,520	22,600	13,639
Other public	10,615	5,586	4,770	3,276	5,845	2,310
Forest industry	23,321	28,495	15,266	19,692	8,055	8,803
Farmer	107,433	74,197	43,495	36,553	63,938	37,644
Misc. private	137,341	153,438	63,709	73,685	73,632	79,753
All ownerships	315,006	290,875	140,936	148,726	174,070	142,149

[a]See figure 9 for survey dates.

the earlier period; the gap widened with the recent increases in the level of softwood removal.

The reduction in annual hardwood removals across the two periods occurred on farm woodlots, National Forests, and other public land. On National Forests, hardwood removals for the latest period averaged 40 percent lower than for the earlier period. The reduction was even more severe on other public land – 60 percent. These drops occurred on a relatively stable land base. A 41-percent drop in hardwood removals on farmer-owned timberland was accompanied by a 35-percent drop in acreage of timberland they owned. Increases in hardwood removals occurred on miscellaneous private and forest industry land, but the magnitude of these increases was not sufficient to offset the declines elsewhere.

Softwood removals increased on miscellaneous private, forest industry, and National Forest land. Declines in softwood removals on farms and on other public land were less severe than those for hardwood removals.

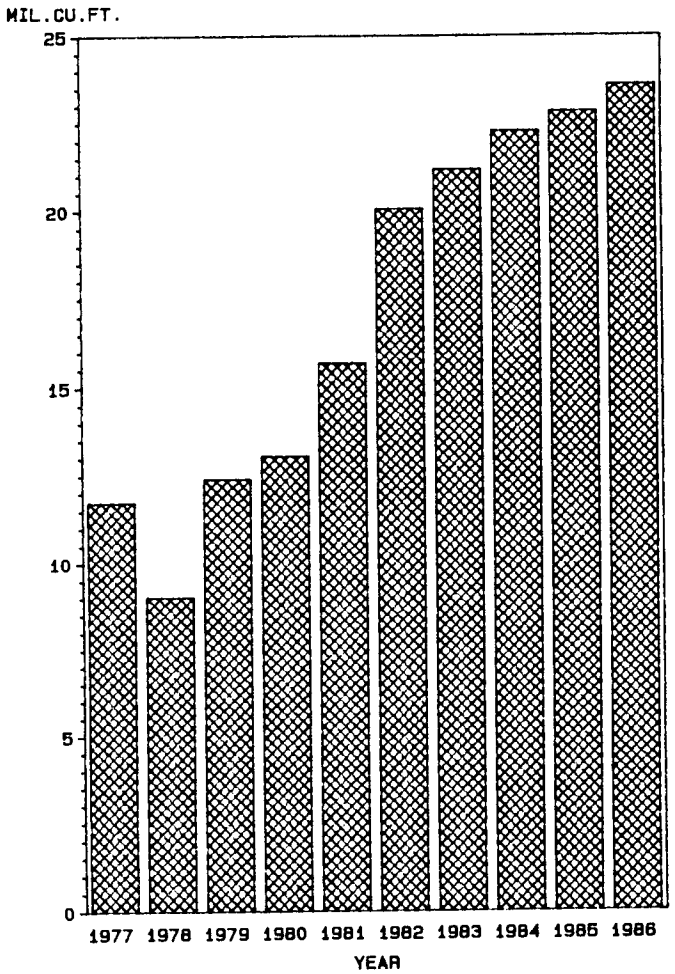


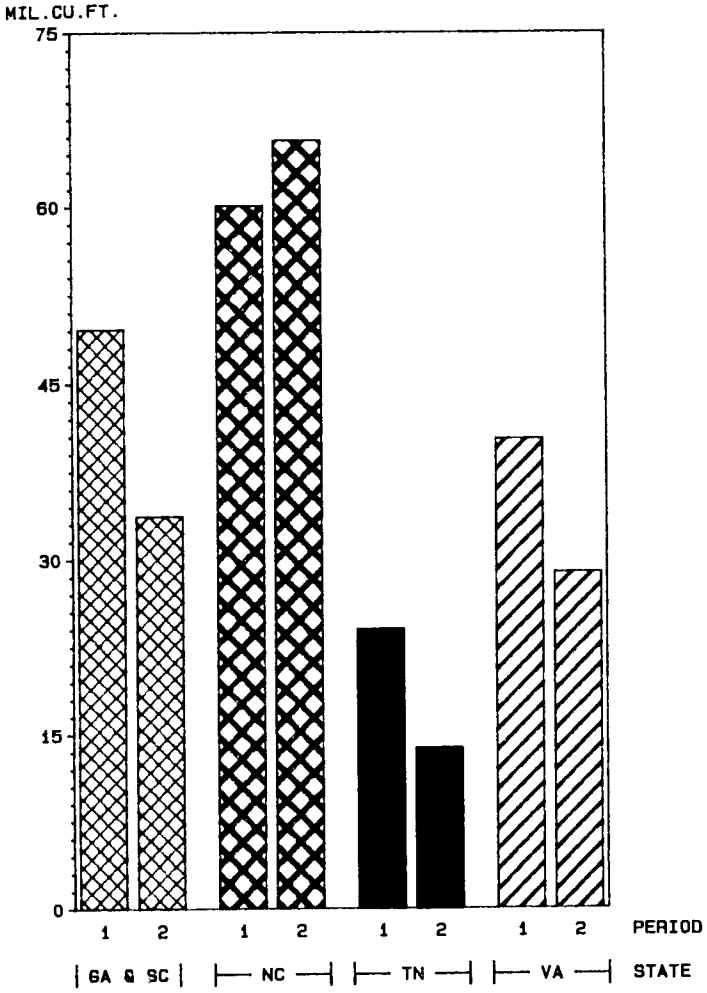
Figure 10. – Volume of timber sold on National forest timber sales in the Southern Appalachian timber supply region, 1977-86.

Volume of timber sold in large National Forest timber sales in the study area provides evidence of a recent upturn in harvest levels from National Forests (fig. 10). Volume sold on National Forests in the study area has increased from 11.7 million cubic feet in 1977 to 23.6 million cubic feet in 1986. This upward trend does not necessarily conflict with the declining levels of timber removals from National Forests as shown in the FIA data. FIA estimates of annual removals represent period averages that extend back into the early 1960's; the timber sales data are only from 1977 to 1986. National Forest removal levels were apparently at a low point during the mid-1970's. Figure 10 depicts a recovery of harvest levels from this period.

During the latest survey period, average timber sale volumes were lower for National Forests than FIA average annual removals. The FIA removal estimates represent the total volume removed from timberland on National Forests. They include volume removed from major timber sales (fig. 10); minor sales, such as fuelwood harvests; road construction; and other miscellaneous cutting. Part of the gap is also due to different merchantability standards and volume computation procedures used in FIA sampling versus timber sale volume computation.

The downward trend in hardwood removals across the two survey periods was evident in every State in the study area except North Carolina (fig. 11). In the North Carolina study counties, annual hardwood removals rose by 9 percent in the latest remeasurement period compared to the previous one. This increase in cut came entirely from private timberland and was mostly due to increased removals of soft-textured hardwood species such as yellow-poplar. Increases in softwood removals occurred in the study portions of Georgia, North Carolina, and Tennessee. Slight drops in softwood removals occurred in the mountain counties of South Carolina and Virginia. These two States make up a relatively minor component of all softwood removals in the study area.

FIA resource statistics for the study area have been separated into three species groups for softwoods and six for hardwoods. Softwood groups are yellow pine, eastern white pine, other softwoods; hardwood groups are select white oaks, select red oaks, other white oaks, other red oaks, yellow-poplar, and other hardwoods. Section III.E.2, Growing Stock Inventories, gives a description of the major species within each group. Removal trends for each of these species groups are presented in table 6. For softwoods, the most significant change occurred for eastern white pine. Annual removals of this species rose from 16 to 24 million cubic feet. Removals of yellow pine species were up slightly, and currently account for 82 percent of all softwood removals.



Period 1 = Previous Surveys; Period 2 = Latest Surveys

Figure 11.—Changes in annual hardwood removals for the past two survey periods in the Southern Appalachian timber supply region, by State.

Table 6.--Average annual removals of growing stock in the Southern Appalachian timber supply region for the two most recent survey periods,[a] by species

Species	Previous surveys	Latest surveys
	Thousand cubic feet (percent)	
Softwood		
Yellow pine	121,339 (86)	122,454 (82)
Eastern white pine	16,234 (12)	24,259 (16)
Other softwood	3,363 (2)	2,013 (2)
Total softwoods	140,936 (100)	148,726 (100)
Hardwoods		
Select white oak	25,070 (14)	15,684 (11)
Select red oak	14,816 (9)	10,652 (7)
Other white oak	18,027 (10)	13,748 (10)
Other red oak	41,988 (24)	33,888 (24)
Yellow-poplar	24,013 (14)	26,565 (19)
Other hardwoods	50,156 (29)	41,612 (29)
Total hardwoods	174,070 (100)	142,149 (100)

[a]See figure 9 for survey dates.

Annual removals across the two periods for five of the six hardwood species groups followed the downward trend for hardwoods as a whole. Yellow-poplar was the only major hardwood species to sustain an increase in annual removals, either in actual volume or in relative terms. An 11-percent increase in removals of yellow-poplar occurred between the two latest periods. The largest percentage reductions occurred were 37 percent for select white oak and 28 percent for select red oak. Together, these two species accounted for 18 percent of hardwood harvest, an amount proportionate to their makeup of the standing hardwood inventory.

The documented changes indicate that hardwood removals in the study area have gone down over the last two to three decades. Such findings are not inconsistent with those in many areas in the Eastern United States. Hardwood removals are either down or only modestly up according to the latest FIA surveys in Alabama (Rudis and others 1984), Kentucky (Kingsley and Powell 1978), Mississippi (Donner and Hines 1987), North Carolina (Sheffield and Knight 1986), Tennessee (Birdsey 1983), Virginia (Bechtold and others 1987), and West Virginia (Bones 1978). Again, these changes are long term and do not necessarily reflect annual fluctuations or very recent changes.

Increased demand for timber products can be met in ways other than increasing the quantity of timber removed from timberland. Improved utilization at the mill and in the woods help to stretch timber supplies. Because there have been improvements in utilization over time, the documented changes in removal levels may not reflect actual change in demand. In other words, annual removals may not indicate an equal relationship with actual consumption of timber products.

Timber Product Output

The second source of data revealing change in harvesting levels is the output of roundwood timber products from the forests in the study area. These data are much more sensitive to annual fluctuations in timber harvest levels than are the average annual FIA removals. All primary wood-using plants in the States of Georgia, North Carolina, South Carolina, Tennessee, and Virginia are canvassed periodically to determine levels of industrial timber products produced by county. In cooperation with FIA Research Work Units, State forestry agencies, and extension personnel conduct most of these canvasses. The Tennessee Valley Authority conducts similar canvasses in much of the study area and provided portions of the data that follow. Production

of major roundwood products harvested in the study area were summarized for each State and canvass year for softwoods and hardwoods (table 7). Canvass years are often different for each State and are available for a limited number of years in some.

Roundwood production data vary a great deal by State, species, and product. For softwoods, the trend is generally upward, with the output in the latest canvass years representing the highest values for the periods represented in most cases. Increases in the output of softwood sawlogs and pulpwood have occurred during the last 3 to 4 years.

Softwood sawlog and pulpwood output in the study counties in Georgia have increased consistently since the early 1970's. Softwood output in the North Carolina portion of the study area has changed more erratically; softwood output has increased in each of the four canvass years from 1976 through 1986. Except for 1973, output in 1983 and 1986 exceeded that for any of the industry canvasses conducted from 1964 through 1986. Significant increases have occurred in softwood-sawlog output in Virginia and in both sawlog and pulpwood output in Tennessee.

The greatest hardwood output for each of the States has occurred in the last 3 to 4 years. These recent increases have occurred for both sawlogs and pulpwood. Hardwood sawlog output has increased the most in North Carolina (1983 and 1986), Tennessee (1985) and Virginia (1984), and the least in Georgia. Hardwood pulpwood output was at its highest level in the most recent canvass year for each of the States, except for Georgia.

Table 7 shows changes in industrial roundwood output for the study area counties. Not included is an unknown but significant amount of roundwood harvested for domestic fuel. For the entire State of North Carolina, hardwood fuelwood use was estimated at 21 percent of annual hardwood growing-stock removals (Sheffield and Knight 1986). There is little doubt that the volume of wood used for fuel has increased during the last 10 to 15 years in the study area.

Table 7.--Industrial roundwood production in the Southern Appalachian timber supply region, by State, year, species group, and product

	Softwood					Hardwood				
Year	All products	Saw logs	Veneer logs	Pulpwood	Other	All products	Saw logs	Veneer logs	Pulpwood	Other
	Thousand cubic feet									
GEORGIA AND SOUTH CAROLINA										
1971	48,846	24,849	--	23,510	487	17,517	12,394	349	4,670	104
1974	49,106	21,660	--	27,163	283	18,593	10,601	416	7,486	90
1977	55,272	26,949	--	28,111	212	16,242	9,119	672	6,451	--
1980	65,356	32,697	871	31,709	79	17,448	12,047	518	4,883	--
1983	72,434	32,857	584	38,167	826	17,550	10,784	837	5,929	--
1986	82,277	34,660	1,546	45,557	514	20,105	12,610	414	7,081	--
NORTH CAROLINA										
1964	29,229	19,425	--	9,496	308	37,209	21,482	1,851	12,397	1,479
1967	31,468	18,196	46	13,037	189	35,487	19,128	2,279	13,718	362
1969	27,793	15,483	--	11,658	652	33,082	18,147	474	13,791	670
1973	36,763	23,059	--	13,617	87	41,271	25,868	3,167	12,099	137
1976	28,193	19,257	--	8,839	97	28,941	20,989	1,004	6,867	81
1979	28,937	19,088	301	9,402	146	37,523	25,953	993	10,577	--
1983	33,937	23,168	116	10,653	--	46,840	35,010	3,366	8,454	10
1986	35,682	20,368	10	14,818	486	46,651	29,024	3,247	14,244	136
TENNESSEE										
1970	13,468	6,360	9	6,946	153	14,736	5,576	316	5,536	3,308
1979	13,522	5,985	--	7,357	180	14,248	8,845	--	5,200	208
1985	23,259	7,836	--	15,404	19	16,615	10,517	112	5,780	206
VIRGINIA										
1976	5,414	5,044	2	343	25	22,732	18,200	683	3,720	129
1978	5,839	4,970	--	722	147	18,496	14,953	622	2,921	--
1980	6,355	6,018	2	322	13	21,011	17,264	100	3,600	47
1984	8,460	8,046	24	330	60	29,575	24,018	371	5,180	6

Summary

The determination of harvest trends in the study area is difficult because annual measures of timber harvest quantity are not uniformly available. Nevertheless, when FIA removal estimates and industrial timber product output data are examined, the following composite picture emerges:

FIA data indicate that the average annual harvest of all species declined by 8 percent between the previous decade (mid-1960's to mid-1970's) and the present decade (mid-1970's to mid-1980's). Between those periods, hardwood harvests fell 18 percent, while softwood harvests rose 6 percent. North Carolina was an exception, however. There, hardwood harvests rose by 9 percent.

Timber product output data are reported at more frequent intervals and provide additional resolution for recent harvest trends. These data clearly indicate a recent upturn in harvests of both hardwoods and softwoods in every State within the study area. Indeed, the harvests from 1983 to 1985 are higher than for any of the last 15 to 20 years. Recent data indicate that present markets are as strong as in any recent decade.

III.D. Factors Influencing Hardwood Product Demand

Products that are constructed wholly or partly from hardwood materials range from inexpensive paper products to highly expensive furniture. Diversity rather than similarities rules the hardwood timber and subsequent product markets. Hardwood forests tend to be mixed-species stands of uneven-aged timber. Hardwood sawmills produce numerous grade/species combinations and distribute lumber to a variety of secondary processors. Individual hardwood mills often produce unique plywood, pulp, or composite products. Furthermore, secondary hardwood processors tend to produce differentiated products, with each producer tending to exploit a market niche rather than producing generic commodities.

This section describes major primary and secondary hardwood product markets in the Southern Appalachian region of western North Carolina, southwestern Virginia, eastern Tennessee, northern Georgia, and northwestern South Carolina. Major economic and technical factors will be examined that affect demand and supply of primary and secondary hardwood products, with implication on hardwood roundwood demand. Before hardwood markets are described, a basic primer is presented on the economic theory periodically used in the discussion.

Primary Hardwood Products Markets

The major hardwood products of the Southern Appalachian study area are hardwood lumber, hardwood plywood, oriented strand board (OSB), hardboard, and paper. Hardwood lumber is normally produced from sawlogs, while hardwood plywood is produced from high grade sawlogs and/or veneer logs. Hardwood pulp (for paper making) and composite hardwood products (OSB and hardboard) are normally produced from low-grade sawlogs, small diameter roundwood (pulp logs), and sawmill residue. Low-grade saw and pulp logs tend to be low-value but high-volume byproducts of sawlog and veneer log harvesting activities. The hardwood lumber and veneer markets will be discussed in separate sections; the composite panel product and paper markets will be discussed together.

Hardwood Lumber. The hardwood industry is mainly composed of small, family-run operations, primarily located in the Eastern United States. Only a small amount (under 10 percent) of hardwood lumber being produced is by large publicly owned timber products corporations. There is no clear information on the size of firms in this industry because the U.S. Department of Commerce (1985a) lumps it with the softwood lumber industry in its Standard Industrial Classification category (SIC) 2421. However, average employment per establishment for SIC 2421 in the predominantly hardwood States of Kentucky, Ohio, Pennsylvania, Tennessee, and West Virginia range from 8.8 to 10.5 employees per firm.

Capacity of hardwood sawmills in the study region is hard to determine because of inconsistent reporting among States. Perhaps, the best source of capacity information is the TVA statistics for 1979 and 1985 (Tennessee Valley Authority 1979-86). However, these statistics exclude all South Carolina counties and 12 of the 27 counties of northeastern North Carolina in the study region. These statistics still provide some insight into changes in hardwood sawmilling capacity for the study area and are presented below in terms of thousand board feet. Actual hardwood lumber production for 1979 and 1985 for South Carolina counties was obtained from timber product output studies and is included below:

Year	GA	VA	TN	NC	SC
1979	40.6	110.7	74.0	136.2	45
1985	39.4	107.5	70.4	176.2	28

Although the statistics for South Carolina probably overstate a capacity drop, they do indicate that sawmill capacity decreased in the study region, except in North Carolina. However, the 30-percent increase in North Carolina more than made up for the decrease in the other States. The North Carolina counties not included in the TVA region had an additional production capacity of 66.5 million board feet when estimated from North Carolina sawmill directories.

As with employment and capacity statistics, accurate statistics on national hardwood lumber production are not available. Recent hardwood production statistics released by the U.S. Department of Commerce were much lower than estimates developed by Cardellichio and Binkley (1984), whose findings were confirmed by Luppold (1987) using different procedures and data bases. These two studies and periodic timber product output studies completed by the Forest Service for individual States indicate that production of hardwood lumber is 8 to 10 billion board feet annually in the United States. Hardwood lumber prices range from $0.12 to $1.85 per board foot (Barrett 1987), with a conservative average for all grades and species of $0.30. Using this conservative number, hardwood lumber is a $2.4 billion industry.

Although hardwood sawmills tend to be unique operations, most can be divided into three categories: grade mills, industrial product mills, and part-time mills. Grade lumber mills usually produce a minimum of 2 million board feet of lumber per year. The primary product of grade mills is relatively high quality 4/4 (1 inch) and 5/4 (1-1/4 inch) lumber that is usually graded either at the sawmill or by the purchaser. Industrial products mills may be small or large and may be found in combination with a grade lumber mill or as a separate operation. The primary products of industrial mills are railroad ties, mine timbers, or ungraded pallet lumber. A secondary product of these mills is ungraded, higher quality lumber. Part-time mills are small operations with low-capital investments. These mills start up whenever the market picks up and augment the supply of both high-grade and industrial lumber.

The major markets for hardwood lumber in 1982 are shown in Table 8. About 38 percent of hardwood lumber went into pallets and containers. The second largest user on a volume basis, and the most important user on a value basis, was the domestic furniture industry with 23 percent of the market. In addition, if dimension stock used in furniture is added, the proportion increases, probably to about 34 percent.

The lumber of each species has several different markets, depending primarily on grade. High-grade lumber [grade Firsts-and-Seconds (FAS) oak and ash] has been in increasing demand by European and Japanese furniture manufacturers. High-grade lumber of other species and medium-grade (grade 1C) of most species are demanded by domestic furniture, cabinet, and millwork manufacturers. Medium-grade red oak also is being demanded by Taiwanese furniture manufacturers.

Table 8.--U.S. hardwood lumber demand for 1982[a] and changes in employment[b] in these industries between 1982 and 1986

Industry	1982 lumber usage (million fbm)	Changes in employment (1982-86)
Pallets and containers	3,254	6.6
Furniture and cabinets	1,987	17.7
Dimension and flooring[c]	1,149	23.6
Millwork[d]	580	49.4
Railroad ties	834	4.8
Exports	357	40.1
Others	440	17.6

[a]Adapted from Luppold (1987).

[b]U.S. Department of Labor (1974-86).

[c]Dimension or rough furniture parts accounted for about 949 board feet.

[d]Millwork figures revised downward because of inconsistencies between values and volumes.

The railroad tie industry uses low- to medium-grade log centers of dense species, such as oak, hickory, hard maple, and sweetgum. The primary market for lower grade hardwood lumber is the pallet industry. One exception is low grade red oak, which is being utilized by the re-emerging oak strip-flooring industry.

Although nearly every species has been used by domestic furniture manufacturers at one time or another, red oak has been highly utilized as an appearance lumber for over a decade. U.S. red oak has been in greatest demand by European, Canadian, and Taiwanese furniture manufacturers (Luppold and Araman 1988). Oak also is preferred for the production of pallets and flooring. The impact of these demands for oak has been reflected in the price movement of oak over the last several years as shown in figure 12.

In figure 12, the movement of relative (inflation-adjusted) 1C red oak price is contrasted with the price movement of 1C yellow-poplar, No. 2 southern pine 2 by 4's, and overall hardwood lumber price. Although the price for southern pine increased in relative terms during the 1970's, the price for red oak remained high, showing only a cyclical movement due to economic expansion and contraction. The increase in overall hardwood lumber price is due mainly to increases in oak prices counteracting decreasing prices of most other hardwood species. In fact, the only hardwood species that have shown

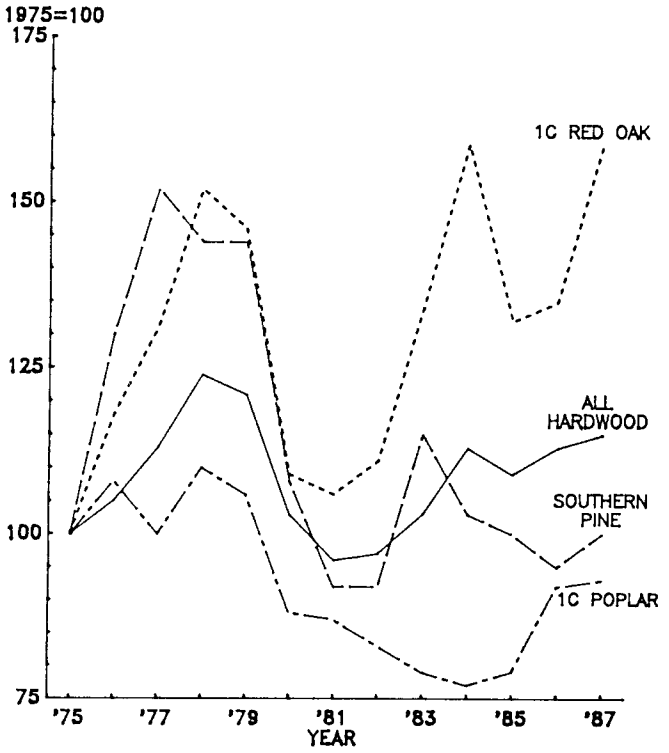


Figure 12. – Relative price movement of No. 1 common Appalachian red oak and yellow-poplar, southern pine construction 2 by 4, and all hardwood lumber, 1975-87. Source: Lemsky (1972-87), Richards and Wilcox (1985-87).

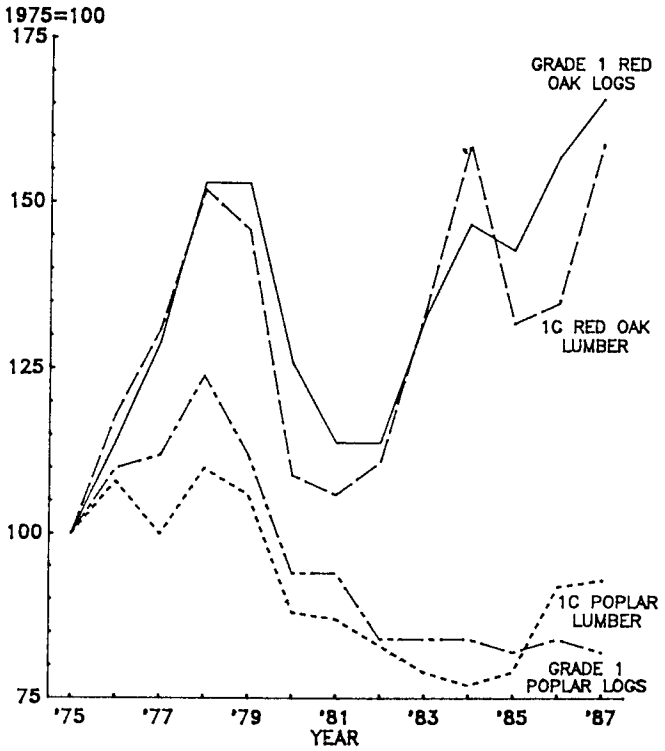


Figure 13. – Relative price movement of Appalachian No. 1 common red oak and yellow-poplar lumber and USFS grade 1 red oak and yellow-poplar logs in Ohio, 1975-87. Source: Lemsky (1972-87), Ohio Agricultural Statistics Service (1987).

relative increases are red oak, ash, and black cherry. Of these, only red oak is found in abundance in the Southern Appalachian area.

The change in prices for hardwood lumber is reflected in the sawlog market. Figure 13 indicates that as the price of red oak lumber increased, so did the price of higher grade red oak logs. Similarly, as the price for yellow-poplar lumber decreased, so did the price of higher grade yellow-poplar logs. Ohio log prices were used in this figure because they are the only historic price series for hardwood logs that divide species and grade. The grade distinction is vital for oak because the price for grade 1 red oak logs has increased by 66 percent over the last 13 years, while the price for grade 3 white oak logs has decreased by 7 percent. Since hardwood sawmills over broad areas receive similar prices for lumber and incur similar production costs, the use of Ohio prices to demonstrate the relationship between log and lumber prices is appropriate.

Exports of high-grade hardwood lumber in general and oak lumber in particular have become a major force in the domestic hardwood lumber market. The growth of U.S. exports is affected by rising prices for tropical, European, and Japanese hardwoods; increased consumer demand in Europe and Japan; and the development of the Asian furniture industry. The decline in the value of the dollar has stimulated European and Japanese demands; 1987 exports of U.S. oak surpassed 725 million board feet. Exports of red oak surpassed 330 million board feet, while exports of white oak surpassed 125 million board feet.

The increasing price of red oak lumber is caused by increased domestic and foreign demands for red oak lumber. This price increase has caused an increase in both red oak lumber supply and red oak log demand. Since other hardwood species decreased in relative value, stands with large amounts of red oak are likely to be in greater demand than stands with lesser amounts of red oak.

Hardwood Plywood and Veneer. Hardwood veneer and plywood operations, which average 58 employees per firm, tend to be larger than hardwood sawmills. In 1982, the industry was composed of 306 establishments in the United States that were manufacturing hardwood veneer and plywood – 65 were in North Carolina and 125 were in the five study area States. (U.S. Department of Commerce 1985a).

Although the hardwood veneer and plywood industry consumes far less timber volume than the hardwood lumber industry, value of veneer and plywood shipments was over $1.3 billion in 1982 (U.S. Department of Commerce 1985a) and has risen substantially since then. Part of the reason for the high value of shipments is that plywood is a finished or semifinished product, while rough lumber is a raw material. Double counting is also a problem in this industry. Over $277 million of hardwood veneer was used by firms classified in SIC 2435 (U.S. Department of Commerce 1985a). However, manufacturers of hardwood veneer were also placed in this group.

Although there may be double counting of this industry by the Bureau of the Census, it is clear that hardwood veneer and plywood are high-value products and that hardwood veneer logs are more valuable than sawlogs. For instance, the average cost of red oak sawtimber stumpage in Ohio in May 1987 was $205 per thousand board feet (Doyle scale), while the average cost of high-grade red oak veneer stumpage ranged from $463 for a 15-inch log to $645 for a 24-inch log. (Ohio Agricultural Statistics Service 1987).

Domestically produced hardwood veneer and plywood are used by producers of furniture, architectural products, cabinet-grade plywood, and wirebound boxes. Also, substantial volumes of veneer (nearly 1 billion square feet valued at $81 million in 1986) are exported to Europe, Taiwan, and Japan (U.S. Department of Commerce 1986a). Most of the inexpensive wall paneling sold for home construction is produced from imported lauan plywood or particleboard products.

The two main types of veneer are face veneer and core material. Face veneer is produced from species with attractive appearance, such as oak, walnut, and cherry, and is usually sliced to give the look of lumber. Core material is normally produced from less dense and less expensive species, such as yellow-poplar, sweetgum, or basswood, and is usually rotary cut to gain the most yield from the log. Face-grade veneer logs are rare but are found in combination with high-grade sawlogs. Such logs normally travel distances more than 100 miles from forest to mill and sometimes thousands of miles. Core-material logs are not as rare as face-grade material logs but still can travel longer distances from forest to mill than sawlogs.

Veneer demand is difficult to determine since no information is published on the veneer market other than international trade statistics. Veneer is not as standardized as hardwood lumber and veneer sellers and purchasers tend to negotiate price on a flitch-by-flitch basis (sliced log). However, exports of veneer have increased 24 percent since 1982, and the demand for red oak veneer by domestic furniture manufacturers appears strong. According to industry sources, domestic veneer slicers are operating at maximum production. Demand for yellow-poplar core stock is strong in the Southern Appalachian area because of the plywood mills, which consume around 20 million board feet of logs a year.

Pulp and Composite Products. Unlike the hardwood lumber industry, which is composed of mostly small family-run firms, the pulp and paper and composite products industries are controlled by large diversified forest products companies. In the study region, there are two pulpmills, two OSB plants, and one hardboard siding plant. Laws prohibit disclosure of sales and employment information on these individual plants, but the corporations involved employed over 134,000 people and had sales in excess of $16 billion in 1986 (Standard and Poor's Register 1986).

Although high-grade hardwood sawlogs tend to be higher priced than high-grade softwood sawlogs, hardwood pulpwood is less expensive than softwood pulpwood. Traditionally, the majority of paper and composite products were manufactured from either softwood roundwood or residue from softwood lumber and plywood manufacturing. Softwood continues to be the major fiber source for these industries, but hardwood usage has continued to increase as new technologies and markets have allowed manufacturers to use increased amounts of low-cost hardwood material.

Examples of such changes in the study area include increased demand for hardwood roundwood by one of the pulpmills and the recent construction of the two OSB plants. As a result of these changes, demand for hardwood by these industries has increased from 400,000 cords in 1984 to a projected 1987 usage of 562,000 cords.[1] Current expansion plans by these firms will result in a demand of 652,000 cords a year by 1990 and over 780,000 cords a year by 2000.

Although hardwood pulp is made from both dense and soft hardwood species, current technology dictates that OSB must be made from soft hardwoods. The major increase in hardwood demand since 1984 has been from the addition of OSB plants. Since the major growth in future demand will be made by these plants, the majority of the increased demand will be for soft hardwoods, such as yellow-poplar.

Secondary Hardwood Products Markets

The demand for hardwood lumber, veneer, and plywood and the resulting demand for hardwood timber are mainly a function of secondary hardwood product demand. These demands occur in four distinct markets: (1) consumer goods, (2) office

[1] Figures obtained from telephone survey of the five firms in the study region.

furniture and fixtures, (3) construction materials, and (4) industrial. Each of these markets will be discussed separately.

Consumer Goods. The main consumer goods produced from hardwood lumber, plywood, and veneer are wood household furniture, upholstered household furniture, and kitchen cabinets. Minor products include craftsmen supplies, sports equipment, and toys. The major consumer product made from hardwood pulp is magazine and bookpaper.

Wood household furniture includes case goods (dining and bedroom furniture and occasional tables), while upholstered furniture includes seating other than dining room and kitchen chairs. The wood household furniture industry was the single most important user of hardwood material, consuming $380 million[2] of hardwood lumber, $186 million of hardwood dimension, $100 million of hardwood veneer, and $63 million of hardwood plywood in 1982 (U.S. Department of Commerce 1985a). Since employment in this industry has increased over 7 percent since 1982, material uses have probably increased around 7 percent (U.S. Department of Labor, Bureau of Labor Statistics 1974-86). This industry is especially important to the Southern Appalachian area and North Carolina since 50 percent of the firms are in the five-State area and nearly 30 percent are in North Carolina (U.S. Department of Commerce 1985a).

The upholstered furniture industry used $80 million of hardwood lumber and an additional $180 million of hardwood dimension and frames (U.S. Department of Commerce 1985a). Since much of the lumber used in upholstered furniture is hidden from view, the vast majority of the lumber used is low grade but structurally sound or of a species not generally used in case-goods production. Wood use in this industry has probably increased since 1982 since employment by the industry increased nearly 11 percent (U.S. Department of Labor, BLS 1974-86).

In 1982, the kitchen cabinet industry consumed nearly $150 million of hardwood lumber, $37 million of hardwood plywood, and $15 million of hardwood veneer (U.S. Department of Commerce 1985a). This has been one of the most rapidly growing hardwood-using industries, growing 34 percent in relative value (inflation adjusted) of shipments between 1976 and 1982 (U.S. Department of Commerce 1985a). Since 1982, employment in this industry has increased 54 percent, indicating rapid growth in both production and hardwood material usage (U.S. Department of Labor, BLS 1974-86).

[2]All dollar values reported in this section were developed from the 1982 Census of Manufactures by taking reported values and adjusting to account for firms not giving detailed breakdowns of material use.

Household furniture and cabinet demand is affected by population, income, housing starts, family formation, lifestyle, and fashion. Figures 14 and 15 show the two main factors – population in the peak furniture buying age (24-45) and disposable family income (U.S. Department of Commerce 1985b). Although housing starts are often used to track wood product demands, housing starts are more a proxy for the combined effects of income and population growth.

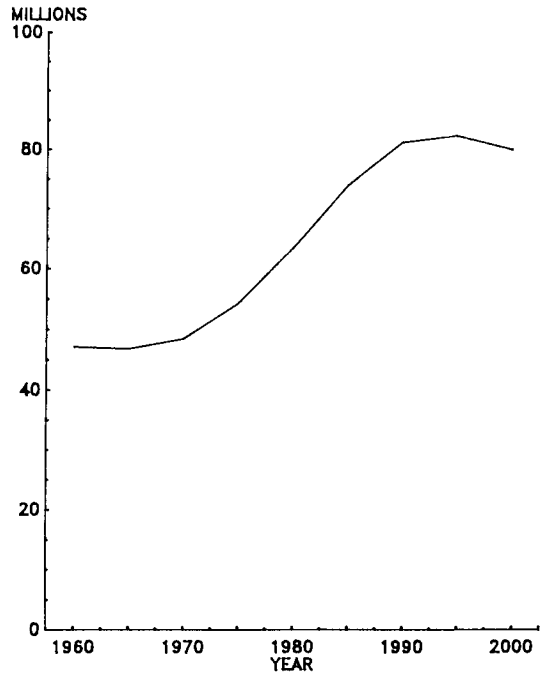


Figure 14. – Level of population between 25-45 years of age (actual and projected), 1960-2000.

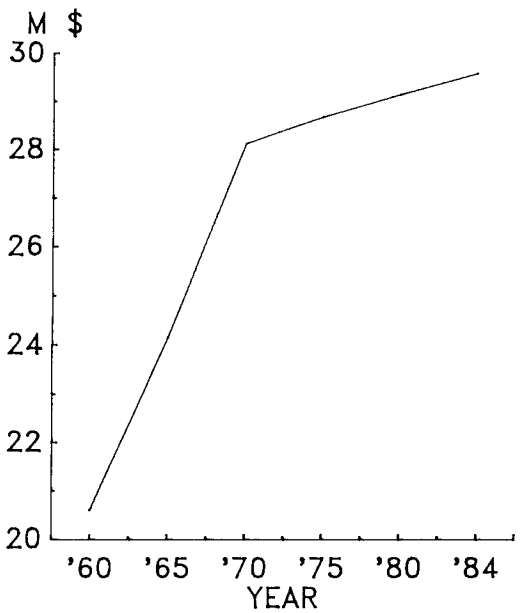


Figure 15. – Median family income, 1960-84, in constant 1984 dollars. Source: U.S. Department of Commerce (1986).

In recent years, the population of people of peak buying age has increased sharply (fig. 14). This figure indicates that this segment of the population will increase over the next few years, level off, and start to decrease at the turn of the century. Figure 15 indicates that inflation-adjusted family income is also increasing, even though its growth has slowed considerably during the 1980's. These concurrent trends suggest that demand for hardwood products will increase in the 1980's but start to decrease in the early part of the next century. Current trends discussed below do indicate an increase in demand for hardwood-based products.

Currently, wood furniture sales are at an all time high,[3] but domestic production is still below the level of the late 1970's because of the surge in furniture imports (Luppold 1988). However, the high level of imports has not necessarily decreased the use of U. S. produced lumber in furniture manufacturing. Nearly 40 percent of the imports originate from Asia, and a high proportion of these imports contain lumber produced in the United States (Luppold 1988). Furthermore, the amount of hardwood lumber used per piece of domestically produced furniture also has increased (Luppold 1988).

The surge in kitchen cabinet demand is influenced by increased population and per capita income and also by style and fashion. Large kitchens with wood, many times oak, cabinets are in style. Demand for wood kitchen cabinets not only originated from new home construction but also from a strong remodeling market. The large upsurge in kitchen cabinet demand has probably influenced the oak market the most.

The demand for paper produced from hardwood pulp seems to be increasing as limited circulation magazines and the shop-at-home catalog market expands. Future demands for paper products manufactured from hardwood pulp are difficult to forecast because of changing technology and markets. However, it is safe to assume that these demands will increase nationally and may increase in the study region.

Office Furniture and Fixtures. The office furniture and fixtures industry consumed $166.2 million in hardwood lumber, $76.5 million in hardwood plywood, and $65.1 million in hardwood veneer in 1982 (U.S. Department of Commerce 1985a). Since much of the material consumed by this industry has high value, the dollar figures are not directly comparable to the household industry dollar figures. For instance, Luppold (1988) estimated that while the wood household furniture and related dimension industry consumed 1,376 million board feet of hardwood lumber in 1982, the commercial industry only consumed 275 million board feet.

Although demands by commercial furniture manufacturers may be relatively small compared to the household industry, the commercial sector has seen tremendous growth over the last 15 years (Luppold 1988). This growth, coupled with the tendency of wood commercial furniture to require high-grade wood, has put added pressure on markets for premium-grade hardwood products. These manufacturers appear to be competing with European and possibly Japanese lumber and veneer buyers.

Construction Material. The main hardwood construction materials are hardwood millwork, hardwood flooring, OSB, and hardboard siding. While the millwork industry supplies products mainly for the construction of restaurants and offices, the hardwood flooring industry supplies products mainly for residential construction. OSB is a low-cost substitute for softwood plywood. Hardboard siding is a popular product for both home and commercial construction, but sales of this product have been slowed by increased use of vinyl products.

Assuming that the revised figures in Table 8 representing hardwood lumber use in millwork are correct, hardwood lumber use in this industry remained steady between 1972 and 1982. However, the 50-percent increase in millwork employment since 1982 nationwide and the 42-percent increase in employment in the predominantly hardwood States of the Midwest and Appalachia indicate that hardwood consumption by this industry was considerably higher in 1986 (U.S. Department of Labor, BLS 1974-86). There is no way to determine species mix from the available data; however, because of the appearance and nature of millwork and the predominance of oak in recently built restaurants and offices, it is likely that much of the increase in millwork demand has impacted the oak market.

The hardwood flooring industry went through a large decline between 1958, when lumber consumption was near 2 billion board feet, and 1982, when lumber consumption was around 200 million board feet (Martens, in press). Since 1982, the demand for oak strip floors has increased by 93 percent, and the demand for plank and parquet flooring has increased moderately, raising wood usage by the flooring industry to around 325 million board feet in 1986 (Martens, in press). Almost all the flooring produced in the United States today is oak, with 2C red oak being the primary material.

The increased demand for hardwood flooring and the apparent increased demand for hardwood millwork seem to be heavily influenced by style and fashion. Oak flooring demand declined during a

[3]Determined by adding domestic production as reported by the National Furniture Association plus exports as reported by the U.S. Department of Commerce, Bureau of the Census, in Report FT-246 and less exports as reported by the U.S. Department of Commerce, Bureau of the Census, in Report FT-410.

period of unprecedented housing starts in the 1960's and 1970's but increased during the moderate market of the mid-1980's. Hardwood millwork was seldom seen outside of boardrooms and bank lobbies until the early 1980's. Wood floors in at least one room are in vogue in custom-built houses, and new fast-food restaurants have large quantities of oak millwork. Since flooring and millwork demands are style related, it is difficult to know when demand for hardwood flooring and millwork will rise or fall.

Future sales of both OSB and hardboard siding will be affected by the same factors that influence the sales of residential and commercial furniture. If construction increases because of increased population in certain age groups, demand for these products will increase. As the population levels off, demand for these products will either stay constant or fall.

Industrial Demand. The main industrial hardwood products are pallets and railroad ties. Approximately one-third of the pallets are produced by firms associated with hardwood sawmills. These operations can utilize 100 percent of a sawmill's production if the sawmill is cutting low-grade timber (pulp quality), or just use the lower quality lumber produced from a mill cutting higher quality timber. Normally, the sawmill and pallet operations are in separate buildings and run as separate profit centers.

The pallet industry has doubled in size over the last 12 years (National Wooden Pallet and Container Association 1987). This growth is due to the substitution of capital-intensive materials handling systems, which substitute pallets for labor, and to increased yearly levels of domestic industrial production (Luppold and Anderson 1986). Although pallet markets are highly regionalized, with pallets normally traveling under 50 miles to the demanding customer, pallet lumber can travel distances of several hundred miles. Pallet-quality lumber produced in the Southern Appalachian area (other than red oak, which goes primarily to flooring plants in Tennessee) is ordinarily shipped to pallet firms located near major industrial plants or major metropolitan areas.

Timber usually is not purchased and cut for pallet material, and higher grade sawlogs usually are not bought for the pallet-quality lumber that the logs will produce. However, the pallet market is important because it provides an outlet for low-quality lumber and logs that otherwise would not be profitably utilized.

Railroad ties are cut into final form at hardwood sawmills and shipped to treating plants for final processing. The majority of ties are produced by small sawmills that tend to go in and out of business, depending on demand. Large sawmills can produce railroad ties, but the cyclical nature of the tie market, which is dependent not only on the economy but on railroad management, cannot be seen as a steady source of sales. The timber used to manufacture ties is low to medium quality. At small mills, which are the primary producers of ties, timber purchases are partly influenced by the tie market.

Concluding Comment

The demand for hardwood products appears to be strong, even after the stock market crash of 1987. "Hardwood Market Report" and "Weekly Hardwood Review" consistently report a strong and apparently growing demand for hardwood lumber. Discussions with manufacturers of hardwood veneer, plywood, furniture, pallets, and flooring indicate possibly the strongest market ever for their products. However, if a recession occurs, the current hot market will cool quickly.

A recession within the next few years will reduce hardwood product demand temporarily but will not reduce the potential long-term demand. Demand for hardwood products is a function of population level and age distribution. The population subgroup that consumes the major proportion of furniture, cabinets, and homes will remain high until the year 2000 (fig. 14).

Much of the strength of the current market is based on red oak. Since the beginning of 1986, red oak prices have increased 10 percent for FAS and 41 percent for 2C. However, an increase in the price of red oak is not new. Red oak prices have been above the level of overall inflation since 1973 (fig. 12).

Domestic furniture and kitchen cabinet manufacturers and European and Asian furniture manufacturers have increased demands for oak. The strong market for oak over the last 15 years has caused some sawmillers and processors of oak lumber to become concerned about long-term supplies. Currently, however, there is no easy way to validate these concerns.

Demand for yellow-poplar sawlogs and small-diameter roundwood will probably increase in the study region for many reasons. If continued strong demand keeps pushing oak prices higher, yellow-poplar will be one of the alternative species used to satisfy the ever-increasing demand for furniture. Although yellow-poplar is not perceived by manufacturers and the furniture-using public as oak is, oak was in a similar position 20 years ago. Since yellow-poplar is the second most abundant hardwood species, furniture manufacturers will probably learn to process and sell yellow-poplar as they learned to process and sell oak. Small-diameter roundwood demand will increase because of increased production of OSB by existing, and possibly additional, plants.

III.E. Factors Influencing Southern Appalachian Timber Supply

Theory of Timber Supply

The basic definition of timber supply is simply the aggregate quantity of timber that producers are willing to offer on the market during a specified time period for a given price. This market relationship derives from the influence prices have to induce individuals and firms to harvest timber and, implicitly, to grow timber. In harvesting timber, rising prices encourage more producers to enter the market and cause younger trees to be harvested as those producers already in the market increase their output. In growing timber, rising prices make timber growing a more profitable enterprise, motivating landowners to manage their land for timber as opposed to other land uses, such as agriculture or recreation.

This pure economic perspective of timber supply must be tempered by several constraints. A physical constraint on supply is the length of time necessary to grow timber of a desired size. Owners may be unable to respond to price changes promptly because the timber is either physically not available (e.g., incorrect species) or is too small (e.g., underage). In addition, timber production must compete for land with other productive uses that also respond to changing market conditions. Therefore, while rising prices may make timber production increasingly profitable, timber growing may still give lower returns than other land uses.

A social constraint on supply is the heterogeneous mix of forest ownership types. The presence of public ownerships – Federal, State, and county – imposes management constraints on potential supply. Managers of Federal land, and often State and county land, use allowable cut criteria to determine their annual harvests. Thus, their annual sales are not very responsive to short-term changes in price (Adams 1983; Buongiorno and others 1985). In addition, social and environmental concerns can raise the costs of production, and changing prices can alter the potential revenues derived from timber production. Thus, in the long run, public supply responds to changing market conditions by increasing or reducing the number of acres available for timber production, influencing the allowable cut and ultimate timber supply.

Private forest is held by forest industry and nonindustrial private forest (NIPF) owners. Forest industry can be expected to closely follow an economic supply specification in determining production levels (Hyde 1980; Jackson 1980). Thus, in the long run, industry should respond to rising prices with increased timber production and management inputs. However, in the short term, it is sometimes limited by the physical location of its timber relative to active timber markets or by the physical condition of its timber stands. In such a situation, industry may be unable to increase internally produced supplies in the face of rising demand.

The NIPF landowners are a diverse group with a variety of reasons for owning forested land. This diversity of behavior has been studied extensively (e.g., Binkley 1981; Boyd 1984; Clawson 1979; Hyberg 1986; Royer and Risbrudt 1983). Published studies show that, in addition to a response to changes in economic factors such as price, other factors such as size of landholding, outside income of the owner, and management objectives are directly related to the harvest decision, and separately related to the reforestation decision. Thus it is expected that actions which change the mix of NIPF ownerhsip types change the availability of timber.

As a result of these physical and social constraints, short-term timber supply responds slowly to changes in price (Adams and Haynes 1980b; Newman 1987). When changes in market conditions cause timber buyers to increase their demand, increases in the amount of timber available on the market are relatively small. In the longer term, this slight response may change as landowners respond to perceived changes in market conditions. However, these short-term effects cause apparent shortages in the timber market, and prices can rise substantially.

The rest of this section examines the supply factors distinct to the Southern Appalachian timber region. The initial focus is on changes in regional land use and the distribution of land between ownership types and the effect that these changes have had on timber supply. The discussion then examines changes in the forest inventory in the region and their significance for aggregate timber supply. The section closes with a summary of the analysis and a general discussion of future supply expectations for the region.

Determinants of Southern Appalachian Timber Supply

Inquiry and research into the forestry problems and potential of the Southern Appalachians have a long history. At the turn of the century, President Roosevelt called national attention to the depressed state of the region's environment and called for the creation of Federal reserves to help the area (U.S. Department of Agriculture 1902). Also at the turn of the century, the first organized forest management and education program began in the United States on the Biltmore Forest, which makes up the bulk of the present-day Pisgah National Forest (Schenck 1974). Later, a landmark study in the development of forest economics by William Duerr (1949) detailed the region's problems in forest production and marketing. Since that time, numerous other

researchers have surveyed and examined the characteristics of the area in general and its NIPF landowners in particular regarding the timber supply potential from them and the region or similar areas (Birch and Powell 1978a and 1978b; Boland and others 1979; Forrester 1980; Meredith 1976; Royer 1987; Wells 1977; Wells 1978; Wiggins 1977). These studies show common problems of rural areas across the country: changes in land ownership, changes in land management, and the consequences of these changes on timber production.

The intent of some of these studies (Boland and others 1979; Forrester 1980; Wells 1977) was to delineate the distinguishing characteristics of NIPF landowners in parts of the region, either to assess their potential to harvest timber, or relatedly, their potential to invest money for active management for timber production. These studies show NIPF landowners to be substantially older than the general population (70 to 80 percent are age 50 or older), but they have approximately the same education level as the surrounding population (28 to 38 percent have gone beyond a high school diploma) and the same income levels. Approximately 30 percent consider farming to be their primary occupation and 70 percent live on or within 10 miles of their forest land.

The primary factors related to timber availability, all other things being equal, for forest landowners in the region are: (1) residency of the owner, (2) size of the forest tract, (3) landowner objectives, and (4) landowner occupation (Wells 1977). Timberland owned by rural inhabitants is nearly twice as likely to receive harvest treatments as timberland owned by urban inhabitants. The size of the landholding also has a direct effect on the likelihood of timber availability; larger tracts are more likely to be harvested. Finally, farmers are more likely to sell timber than other owners.

Comparing the characteristics that increase the likelihood of timber harvesting with recent changes in the composition of forest landholdings in the region can give a better understanding of timber supply potential for the region (table 9). Over the past 25 years, total NIPF land decreased 2.2 percent from 10.9 million acres to 10.6 million acres. The percentage of acreage owned by farmers – the NIPF group thought to be the most likely to harvest timber – decreased nearly 43 percent from 5.46 million acres to 3.13 million acres. This decrease reflects changes in the farm economy that have forced many people to abandon farming as a career. Thus, much of the land that changed category may still be held by the same individuals, who now have different occupations. Much of the land dropped from the farm category is now held by owners in the miscellaneous category. This group includes corporations not engaged in farm products manufacture and individuals who do not farm. Holdings in this miscellaneous category increased 38.5 percent from 5.43 million acres to 7.53 million acres. Although these owners are somewhat more reluctant to sell timber than are farmers, this change in landholding alone may not signal a significant decrease in the availability of timber.

Table 9.--Area of timberland in the Southern Appalachian timber supply region, by ownership class and survey period[a]

Ownership class	1961-68	1971-78	1980-86
	Thousand acres (percent)		
National forest	2,517.9 (17)	2,631.2 (18)	2,620.0 (18)
Other public	266.0 (2)	283.0 (2)	322.6 (2)
Forest industry	1,067.6 (7)	630.5 (4)	624.3 (4)
Total	3,851.5 (26)	3,544.7 (24)	3,566.9 (24)
Nonindustrial private (NIPF):			
Farmer	5,468.0 (37)	4,828.8 (33)	3,132.2 (22)
Misc. private	5,434.6 (37)	6,235.3 (43)	7,525.5 (53)
Total	10,902.6 (74)	11,064.1 (76)	10,657.7 (75)
All ownerships	14,754.1 (100)	14,608.8 (100)	14,234.6 (100)

[a]The survey periods represent the three most recent FIA surveys for the respective States in the study area.

This conclusion may be illustrated by the changes in the distribution of timber removals from the region in the 1970's and 1980's (fig. 16). In the 1970's, farmers owned 33 percent of the timberland and accounted for 34 percent of the timber removals. The miscellaneous owners held almost 43 percent of the timberland and accounted for almost 44 percent of the removals. In the 1980's, farmers' share of timberland reduced to 22 percent and their removals dropped to 26 percent of the total cut. The miscellaneous owners' share of timberland increased to 53 percent and their share of total removals increased to over 50 percent. Thus, the relative shares of timber removals from all NIPF land stayed almost constant between the periods. In absolute terms though, NIPF removals declined by more than 30 million cubic feet as total removals dropped by almost 40 million cubic feet.

These changes in relative ownership and production levels reflect statements made by Clawson (1979) regarding the reliability of using surveys based on past management behavior alone in predicting the likelihood of timber production: "Such surveys will often show a considerable number of forest owners who have sold no timber in the recent past and who say they have no intention of selling timber in the future. Their replies to questions may be completely honest and yet the reality may be different, either because they change their minds or because the property is bought by a new owner with different objectives." Although the group that has been found to be the most likely to harvest timber, farmers, has declined in relative importance in the region, this change alone is not sufficient to predict that total timber supplies will decline.

Forest industry land also decreased substantially, from 1.07 million acres in the 1970's to 0.62 million acres in the 1980's. The rate of decrease slowed over the past survey period. North Carolina, South Carolina, and Virginia's forest industry acreage actually increased, but overall industry-owned forest land still decreased 1 percent. The tightening of timber supplies due to landowner changes seems to indicate that forest production may become more profitable in the future. That forest industry has not responded to this potential by increasing its landholdings suggests that it does not anticipate timber prices rising relative to the price and availability of suitable forest land.

Even as its land base has decreased, forest industry's production has increased and now provides 10 percent of the total timber removals in

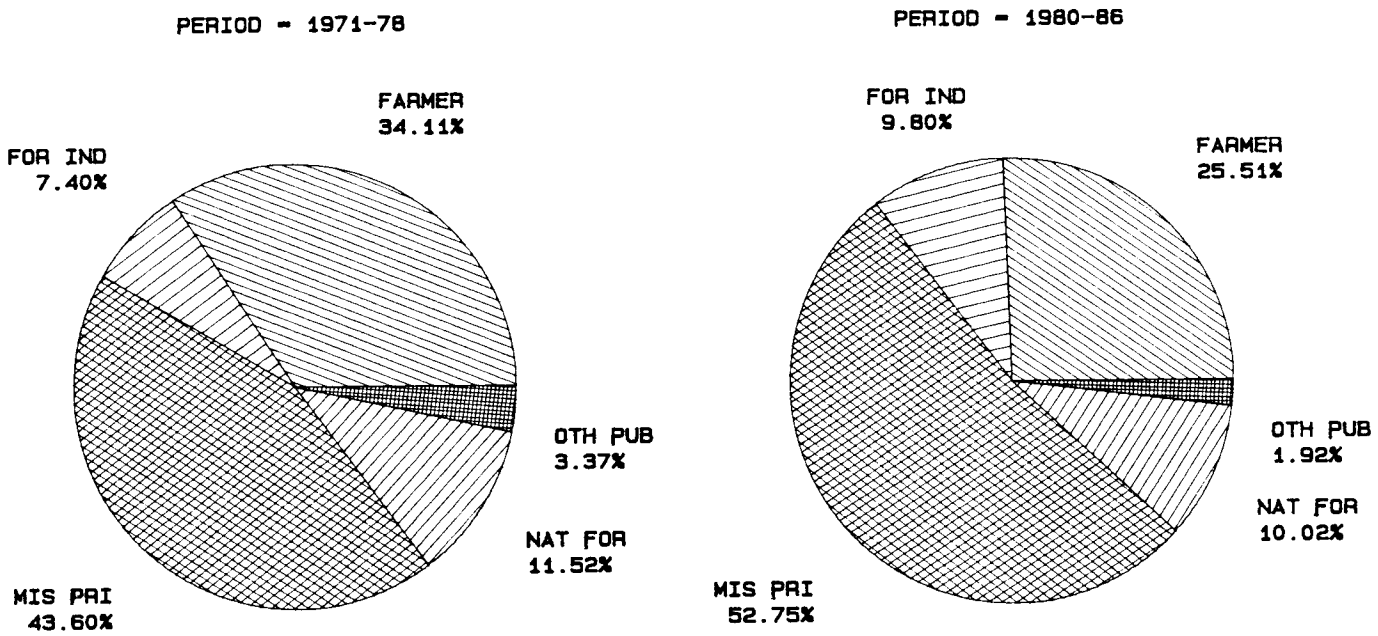


Figure 16. – Distribution of annual timber removals in the Southern Appalachian timber supply region for the two latest survey periods, by ownership class.

the region. It is the only group other than the miscellaneous individual group to show an absolute increase in total removals. Its removal level is also the closest to an even-flow situation as annual growth is only 1.5 times higher than removals (fig. 17). No other ownership category approaches this level of harvesting intensity. Even this level of removal leaves a substantial cushion for increased harvests. Farmers are the next closest with a growth/removals ratio near two. Thus, while forest industry could potentially increase its production, 50 percent from its existing timber base, physical or strategic reasons may prohibit it from doing so. In that case, unless it increases its landholdings or increases the productivity of its forest-land base, it is unlikely to increase its level of timber production. If total removals from all sources continue to decline, however, its share of total production will likely rise.

Land Availability

The availability of land for timber production is an extremely important key to this analysis. Since forestry is often seen as a residual land use, increases in land prices drive down the potential for advantageous timber production. In an assessment of forest-land market values, de Steiguer (1982) found real price rises greater than 5 percent throughout the 1970's in the Appalachian region. Some of the rise in price was attributed to rises in stumpage prices, but strong demand for recreational land and rural residences and rising interest rates in the region added to the upward pressure on forest land prices. These high prices for land deter long-term active forest management due to the long forest production cycle and ultimately reduce the future availability of timber.

Along with these general rises in land prices, de Steiguer found much higher sale prices for smaller tracts of land than for large tracts. Therefore, there is an incentive for land sellers to subdivide large tracts. The economic effects of this land fragmentation have been discussed extensively in the literature (Row 1978; Schallau 1975). The major impact of fragmentation is the creation of smaller timber production areas. This fragmentation causes cost inefficiencies from decreased timber accessibility and the inability to take advantage of scale economics in production. As a result, costs of timber management and harvesting practices are raised when the tract size falls below 5 to 30 acres (Cubbage 1982; Cubbage and Harris 1986). The impact of fragmentation tends to be greater for pine management than for hardwood management. When high-quality hardwood is desired, individual tree harvests are often performed, making parcel size less of an issue.

Meredith (1976) followed deed changes on 48 tracts of land, 500 acres and larger, in one Tennessee county over a 30-year period and found substantial land sales and fragmentation. Although no specific studies of this type have been done within the study area, the relatively short average land tenure found in past NIPF owner surveys (11-30 years) seems to verify that fragmentation is occurring. Conversely, holdings of farmland in the region and in the rest of the country have been consolidated extensively.

As a result of these changes in land value and tenure, the potential for active timber production has declined substantially over the past 30 years. Fragmented ownership drives up the cost of timber removals, making active management for timber production less likely. At the same time, increasing land prices make consolidation of forest holdings more difficult. Thus, potential profitability from timber production of much NIPF land has become

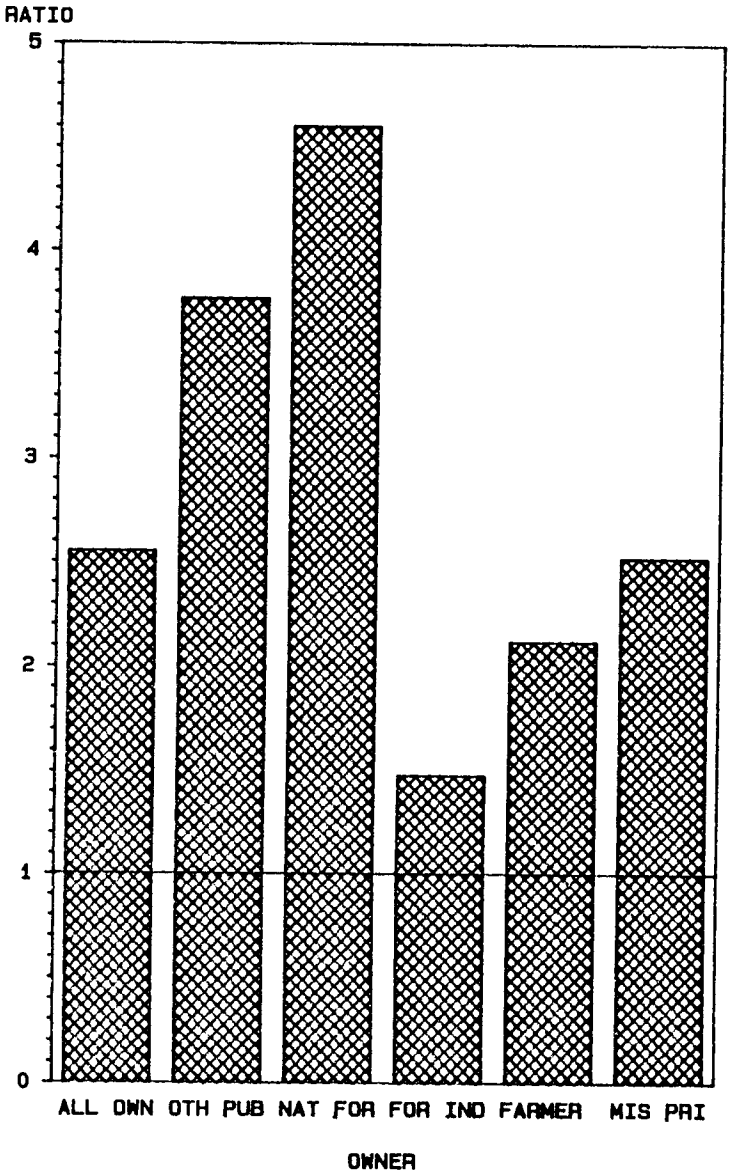


Figure 17. – Ratio of net annual growth to annual timber removals in the Southern Appalachian timber supply region, by ownership class.

marginal. Only with sharply rising stumpage prices will this land become available for active forest management.

Physical Accessibility Constraints

In addition to landowner attitudes and objectives, physical attributes of the resource significantly affect the supply of timber at a given time. Steep terrain and remote timberland are major supply problems in the area. These conditions drive up costs for roads to access the timber, and they create a need for specialized equipment to log the sites.

The potential impact of steep slopes and poor access on potential timber supply can be examined using FIA survey data collected in the North Carolina, South Carolina, and Virginia portions of the study area. Slope percentage and classes are presented in table 10. The measure of accessibility is the distance to an access road. Distances are grouped into three arbitrary classes to easily allow comparisons by ownership. Since the vast majority of the softwood inventory is on relatively gentle terrain and/or near roads, the remaining discussion focuses only on the hardwood inventory.

Slope and accessibility are important factors affecting the potential supply of hardwood timber. Across all ownerships, 54 percent of the hardwood inventory is more than 500 feet from an access road and more than two-thirds is on slopes of 31 percent or steeper. In order to assess possible impacts of terrain and accessibility factors, the extreme classes of slope (61 percent and steeper) and distance to access road (1,500 feet and greater) are assumed to be less likely to contribute to short-term timber supplies than the less extreme categories. The hardwood inventory existing on these timberlands was examined and compared for the major ownership classes.

For all ownerships, almost one-third of the hardwood inventory is on slopes of 61 percent or steeper or more than 1,500 feet from a road. Wide differences in this proportion were found for the major ownership classes. Less than 17 percent of the hardwood inventory on farmer-owned timberland exists on these more extreme conditions. In general, farm timberland is more gently sloping and much closer to a road than either miscellaneous private or National Forest land. About 30 percent of the hardwoods on miscellaneous private land are on slopes of 61 percent or greater or on sites more than 1,500 feet from a road. In contrast to these major sources of private hardwood supply, a much higher proportion of the hardwoods on National Forest land is found on these sites. More than 46 percent of the hardwood inventory on National Forest land is characterized by these extreme conditions.

Select red oak is highly concentrated in remote areas or on sites that pose operability problems. The proportion of red oak on slopes of 61 percent and steeper and/or more than 1,500 feet from a road averages 43 percent and ranges from 22 percent on farm ownerships to 54 percent on National Forests.

These data indicate strong physical constraints on hardwood timber inventories. As a result, less hardwood timber is economically available in the region than might be expected after looking at the current inventory figures alone. Changes in other factors will have to occur to bring these marginal sites into active production.

Technical Change

A final factor affecting timber supply in the region is technical change in the production of timber. Since most of the hardwood growth in the region is in natural stands, the way that timber is produced has changed little. In fact, there is some evidence that productivity in the region for all types of forest production, from all sources, has decreased during the most recent survey period (Sheffield and others 1985; Wallace and Newman 1986).

Cable logging systems have been introduced to harvest steep slopes. In many cases, these systems raise the cost of harvesting, but they reduce site damage and other external effects caused by tractor logging. In addition, they may make logging practical on some slopes that were once inaccessible. The overall effect of this type of change on total supply is uncertain because direct accounting costs of production are raised, while total economic costs may well be lowered. The extent to which NIPF landowners respond to the potential of less damaging harvesting operations, or to the potential to operate on previously unusable sites, will determine the ultimate supply effect. Generally, the effect of technical changes in production such as this is to increase and extend total available supply.

Table 10.--Percentage distribution[a] of hardwood growing stock, by slope class and distance to access road, for three ownership classes and all owners

Slope class (percent)	Total	Distance to access road (ft)		
		0-500	501-1500	1500+
		NATIONAL FOREST		
0-30	29.0	8.7	10.1	10.2
31-60	55.2	16.5	17.3	21.4
61+	15.8	1.0	6.0	8.8
Total	100.0	26.2	33.4	40.4
		FARMER		
0-30	38.2	25.5	11.7	1.0
31-60	53.1	25.9	20.3	6.9
61+	8.7	2.9	3.0	2.8
Total	100.0	54.3	35.0	10.7
		MISCELLANEOUS PRIVATE		
0-30	29.5	18.7	8.1	2.7
31-60	54.4	24.3	18.6	11.5
61+	16.1	6.7	5.7	3.7
Total	100.0	49.7	32.4	17.9
		ALL OWNERS		
0-30	31.6	18.1	9.5	4.0
31-60	54.4	23.1	18.3	13.0
61+	14.0	4.5	5.1	4.4
Total	100.0	45.7	32.9	21.4

[a]Based on latest FIA survey data for North Carolina, South Carolina, and Virginia counties in study area.

Growing-Stock Inventories

Physical factors that affect potential timber supply are the volume of standing inventory, the direction of change in that inventory (expanding or shrinking), and the extent to which the inventory is already being utilized. These factors can also be examined within the framework of the previously defined ownership categories.

Growing-stock inventory in the study area currently totals 21.6 billion cubic feet, the equivalent of 1,519 cubic feet per acre of timberland (table 11). Hardwoods make up nearly three-fourths of the inventory of growing stock. Yellow pine species, eastern white pine, and hemlock comprise the bulk of the softwood total. Virginia pine, shortleaf pine, and loblolly pine are the major yellow pine species. The hardwood resource is divided among a much larger number of species. Collectively, oak species account for almost one-half of the hardwood inventory. Because of important differences in suitability for high-value wood products, statistics for the oak resource are divided into four categories: select white oak, select red oak, other white oak, and other red oak. The select white oak group is predominantly white oak, whereas the select red oak group is almost entirely northern red oak. Chestnut oak makes up the major portion of the other white oak group. Scarlet oak and black oak are the most abundant oaks in the other red oak group. The select white and red oak categories total 1.5 and 1.4 billion cubic feet of growing stock volume, respectively, or about 9 percent of the hardwood total for each.

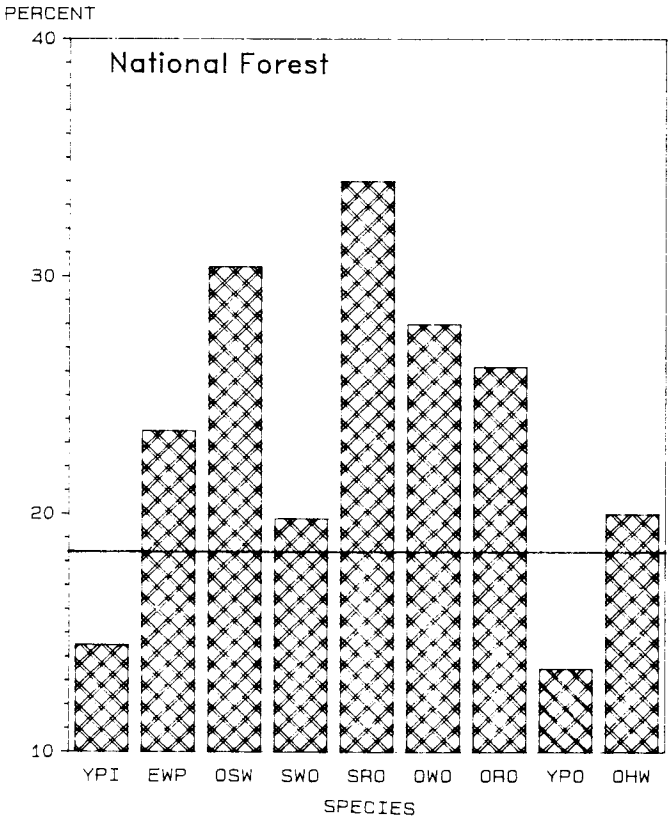
Most hardwood species occurring in the study area are lumped into the category of "other hardwoods." Major hardwoods included in this category are the maples, hickories, birches, beech, black locust, and basswood. The inventory volume of these and many other less abundant species totals nearly 5.3 billion cubic feet, or one-third of all hardwood growing stock. Yellow-poplar is the most abundant single species in this mountainous area, making up 17 percent of the hardwood resource with 2.7 billion cubic feet of inventory.

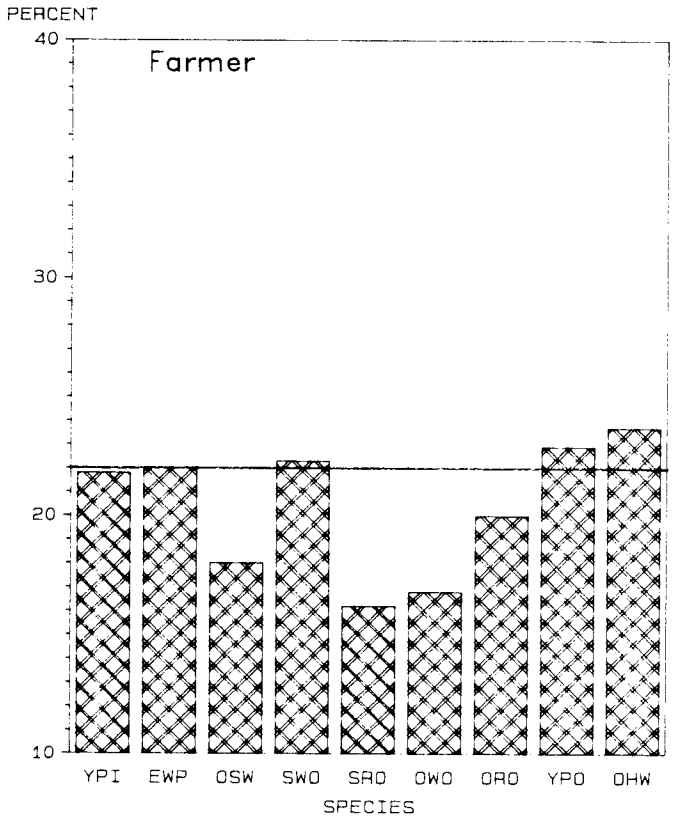
Other public and forest industry holdings account for less than 10 percent of the softwood growing stock inventory and for only 6 percent of the hardwoods. They contain 7 percent of the timberland acreage in the area.

Table 11.--Volume of growing stock in the Southern Appalachian timber supply region based on the latest forest surveys,[a] by species and ownership class

Species	All ownerships	National forest	Other public	Forest industry	Farmer	Misc. private
			Million cubic feet			
Softwood						
Yellow pine (YPI)	4,195.7	609.3	134.3	326.8	916.9	2,208.4
Eastern white pine (EWP)	1,268.9	298.3	23.0	70.7	280.0	596.9
Other softwood (OSW)	410.3	125.0	0.7	5.8	74.0	204.8
All softwoods	5,874.9	1,032.6	158.0	403.3	1,270.9	3,010.1
Hardwood						
Select white oak (SWO)	1,464.2	291.3	45.3	54.0	327.9	745.7
Select red oak (SRO)	1,400.0	477.2	49.1	38.7	227.0	608.0
Other white oak (OWO)	2,456.9	689.9	76.9	97.1	415.1	1,177.9
Other red oak (ORO)	2,436.9	639.3	64.3	74.1	489.1	1,170.1
Yellow-poplar (YPO)	2,741.5	371.2	34.7	95.6	630.2	1,609.8
Other hardwood (OHW)	5,251.0	1,055.1	168.8	143.3	1,247.1	2,636.7
All hardwoods	15,750.5	3,524.0	439.1	502.8	3,336.4	7,948.2
All Totals	21,625.4	4,556.6	597.1	906.1	4,607.3	10,958.3

[a]FIA surveys completed in the period 1980 to 1986.





The bulk of the inventory of every major species group is found on miscellaneous private, farmer, and National Forest land. There are noticeable differences in the proportion of each species group found on each of these three ownerships (fig. 18). National Forests control 18 percent of the timberland in the study area (the horizontal reference line in each of the charts in figure 18 represents the timberland proportion for that ownership group). In comparison, the proportion of the inventory of each species group found on National Forest land varies widely. Inventory proportions for yellow pine and yellow-poplar fall below the timberland proportion, whereas the proportion of growing stock inventory for white pine, other softwood (mostly hemlock), select red oaks, and the other oak group is well above the timberland proportion. The highest concentration on the National Forests is for select red oaks – about 34 percent of the high quality material of this species is on National Forest land.

Farmers control 22 percent of the timberland in the study area, with the inventory of many of the species groups similarly distributed. Except for select white oak, farmers control a disproportionately small quantity of the oak inventory. Only 16 percent of the select red oak inventory is on timberland owned by farmers.

Miscellaneous private owners hold 53 percent of the timberland. Proportionally, they control lesser amounts of growing-stock inventory for every species except yellow-poplar. Again, the greatest deviation from the area proportion is for select red oak.

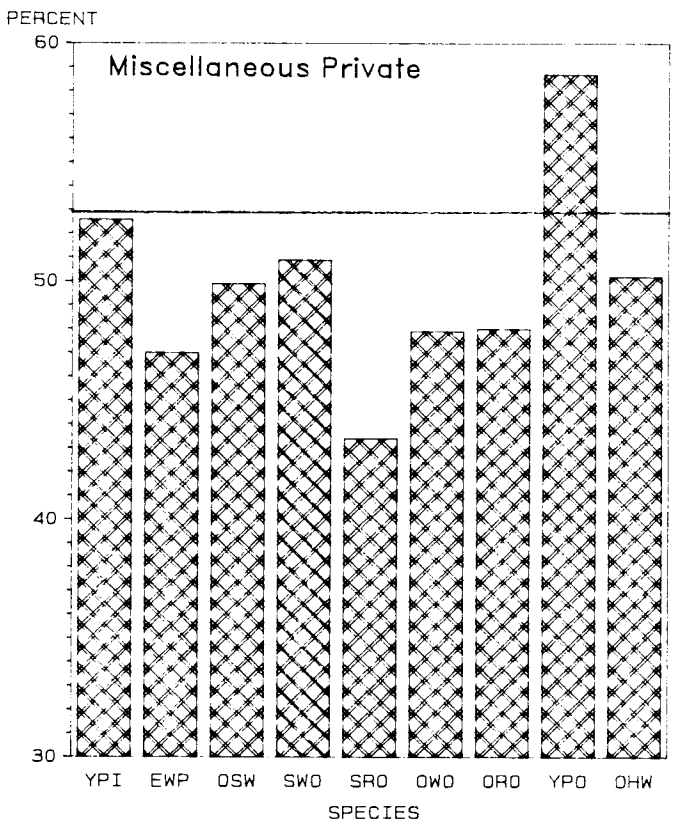


Figure 18. – Inventory distributions for major species groups and three major ownerships in the Southern Appalachian timber supply region. (Horizontal reference lines represent the timberland proportion.) See Table 11 for species acronymns.

Geographically, there are many differences in the distribution of the species across the study area (fig. 19). Yellow pine, for instance, is not common in the heart of the Southern Appalachians but is heavily concentrated in study area counties in Georgia, southeastern Tennessee, and South Carolina, and in the easternmost North Carolina counties in the study area. In fact, most of the species show noticeable concentrations in some portion of the study area. Species such as eastern white pine, select red oak, and yellow-poplar are clustered along the heart of the Appalachian chain. Other species, such as other white and red oak, are more uniformly distributed across the entire study area.

Inventory Change

The inventory of growing stock in the study area has expanded over the past several decades. The average change in inventory from the 1970's to the 1980's is displayed in figure 20. Increases occurred for all species groups during this period and in each of the States in the area. The most significant gains were for yellow-poplar, eastern white pine, and the group of miscellaneous hardwoods. Yellow pine inventory rose the least – 12 percent. The inventories of select white oaks and select red oaks went up by 18 and 29 percent, respectively.

Inventory Utilization

Net increases in growing stock inventory over the past one to two decades show that net growth exceeds removals for each of the species. Net annual growth during the latest remeasurement cycle for the study area exceeded the level of average annual timber removals by 62 percent for softwoods and by more than 250 percent for hardwoods. Growth surpassed removals for virtually all combinations of species and ownership classes.

Another index of relative timber resource use is an annual removal/inventory ratio. This ratio is simply the percentage of the standing inventory of a species that is removed each year. These values are presented to compare intensities of utilization by species and ownership. The removal/inventory values for the three major ownership groups are shown in figure 21.

For softwoods, this index averages 2.5 percent and ranges from 1.5 percent on National Forests to 2.9 percent on farmer-owned timberland. Yellow pines have the highest removal rate relative to inventory; eastern white pine values are intermediate, and those for other softwoods are low.

Less than 1 percent (0.90) of the standing hardwood inventory is removed each year in the study area. By ownership, this percentage ranges from 0.39 percent for National Forests to 1.13 percent for farmers. Removal/inventory percentages for each of the hardwood species groups are consistently lower on National Forests than on farms and miscellaneous private land. The rate of hardwood timber removal for farm timberland is somewhat higher than for miscellaneous private land. However, the removal/inventory relationship shown here suggests no major differences between the two groups in relative contributions to hardwood timber supplies.

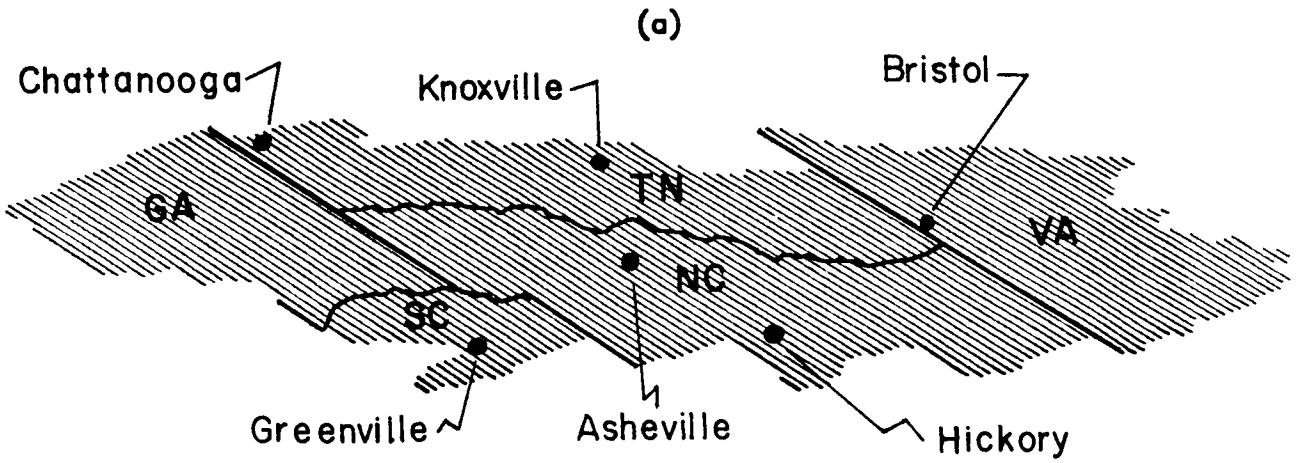
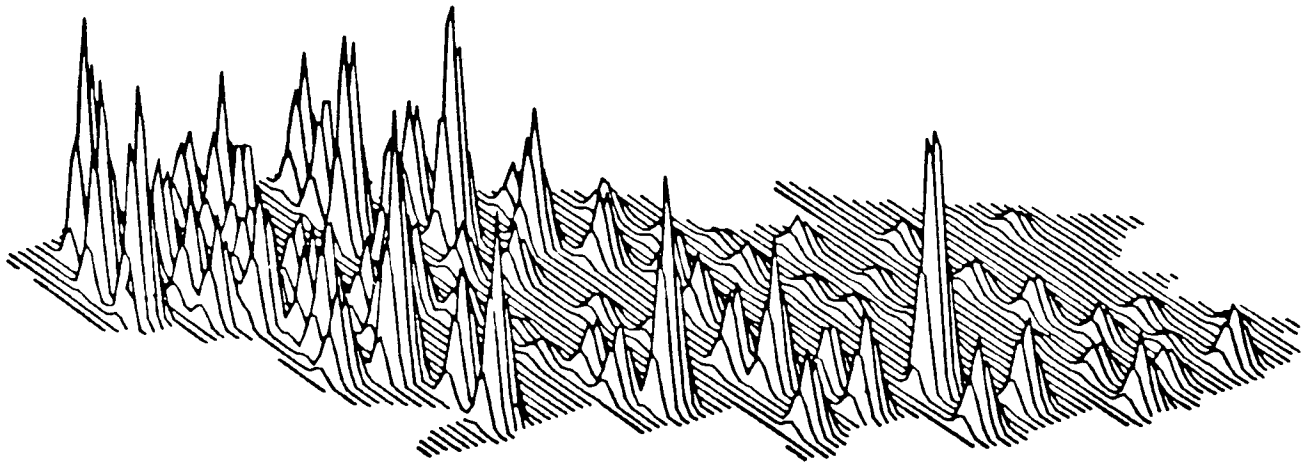


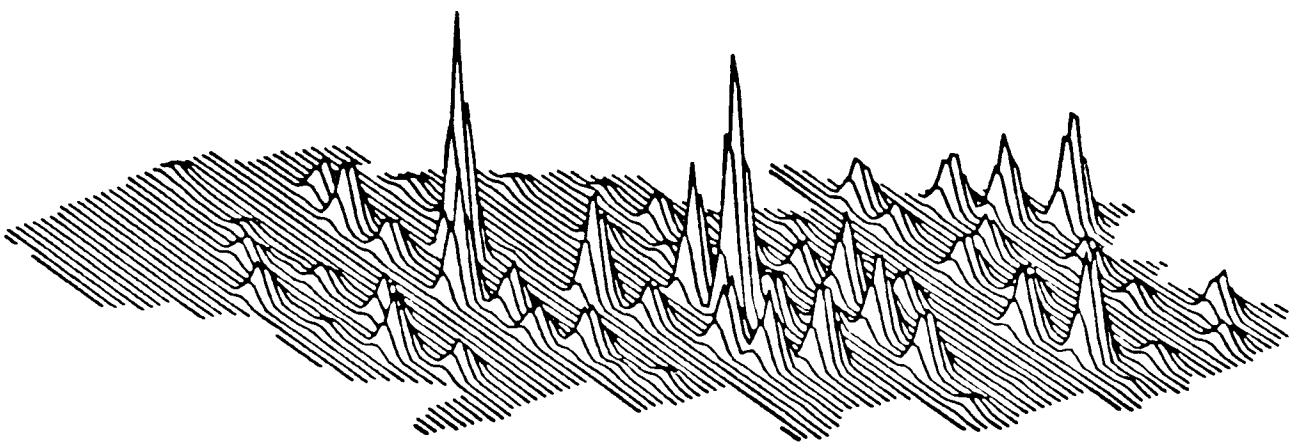
Figure 19. – Oblique views of the Southern Appalachian timber supply region showing the distribution of inventory volume for each species group. A spike rises from each county having volume for that species. For each species the height of a spike is proportionate to that county's volume relative to other counties. The map is for geographic orientation only.

Yellow Pine Inventory

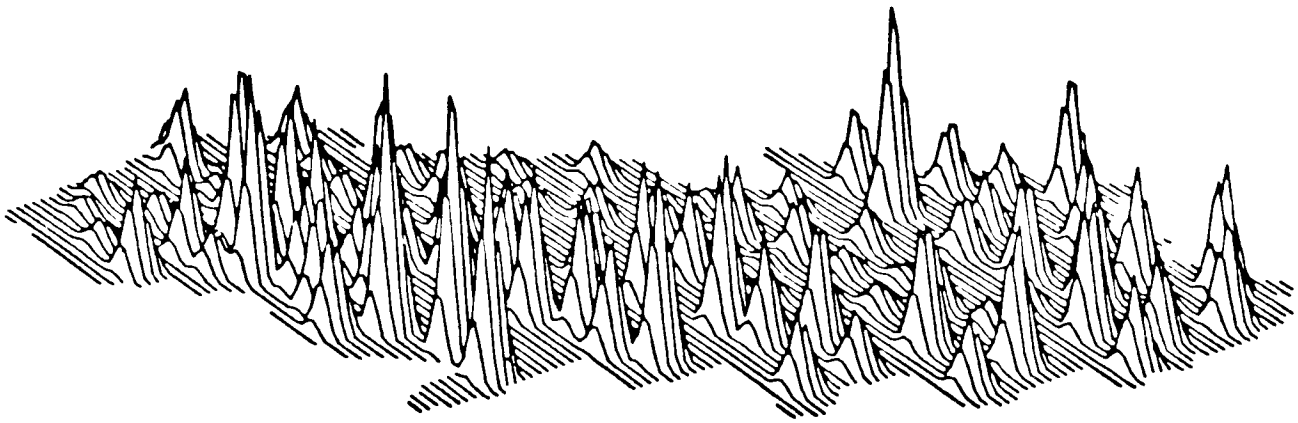


Eastern White Pine Inventory

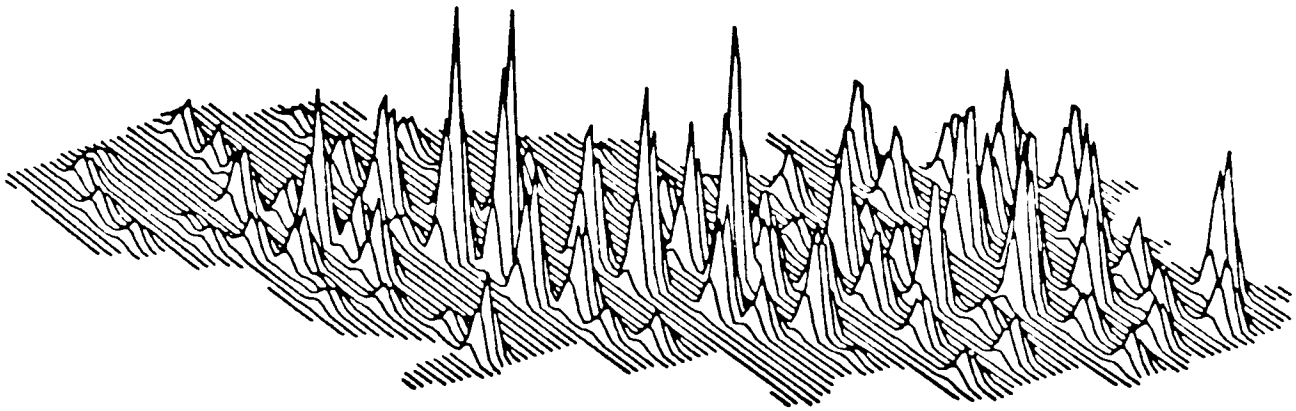
Other Softwood Inventory



Select White Oak Inventory



Select Red Oak Inventory



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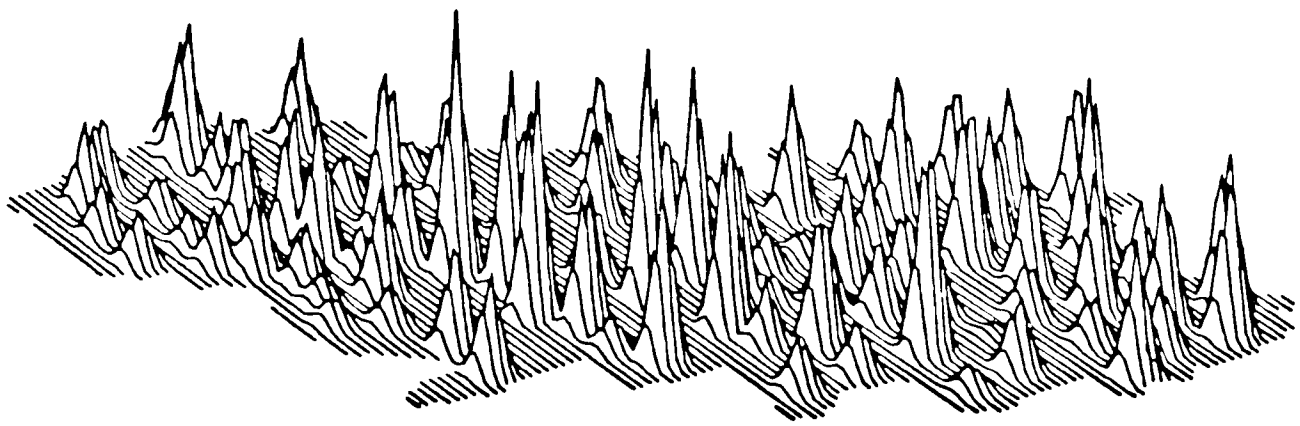

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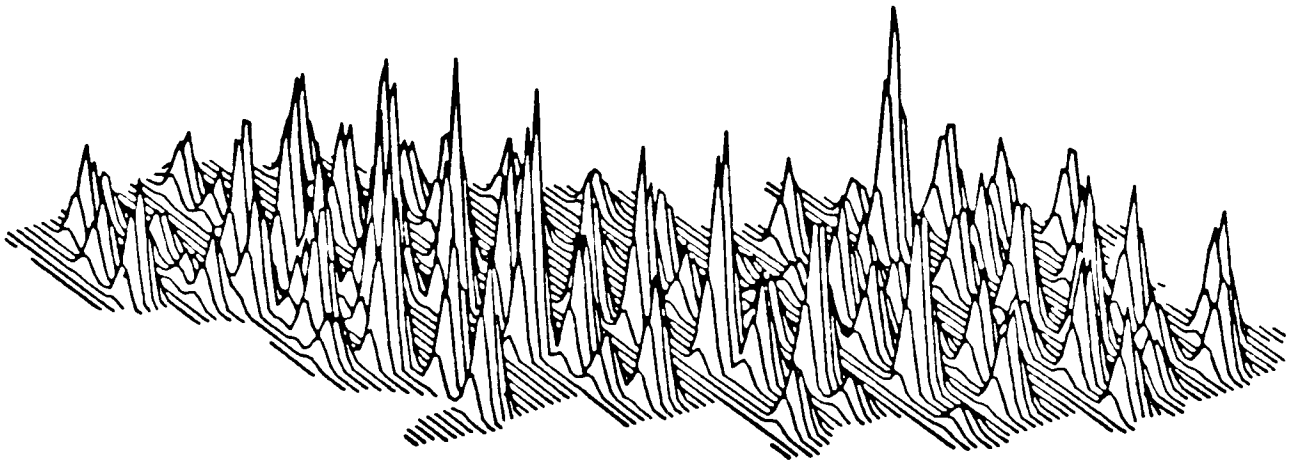
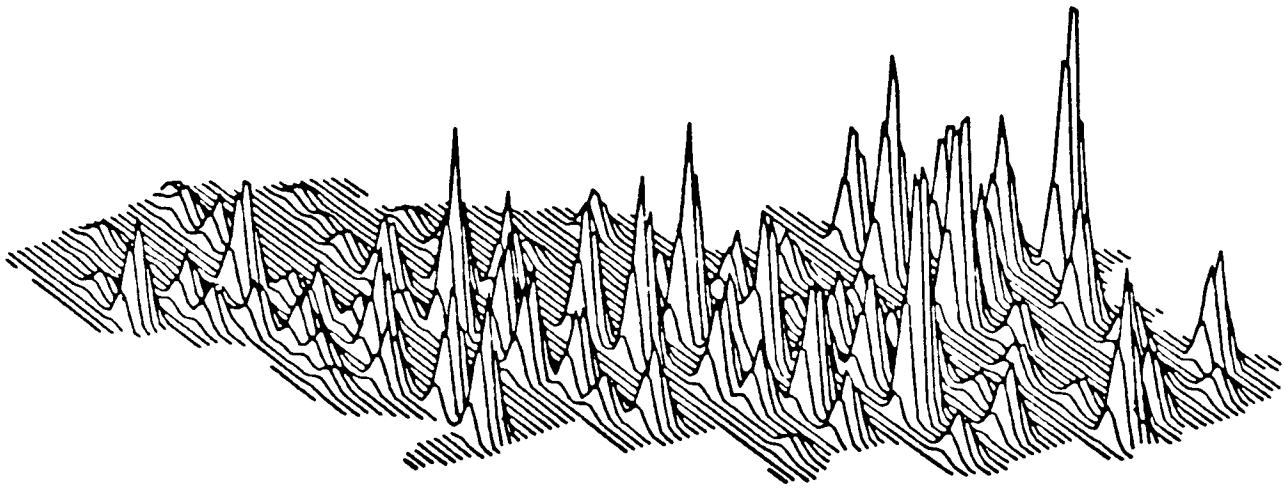
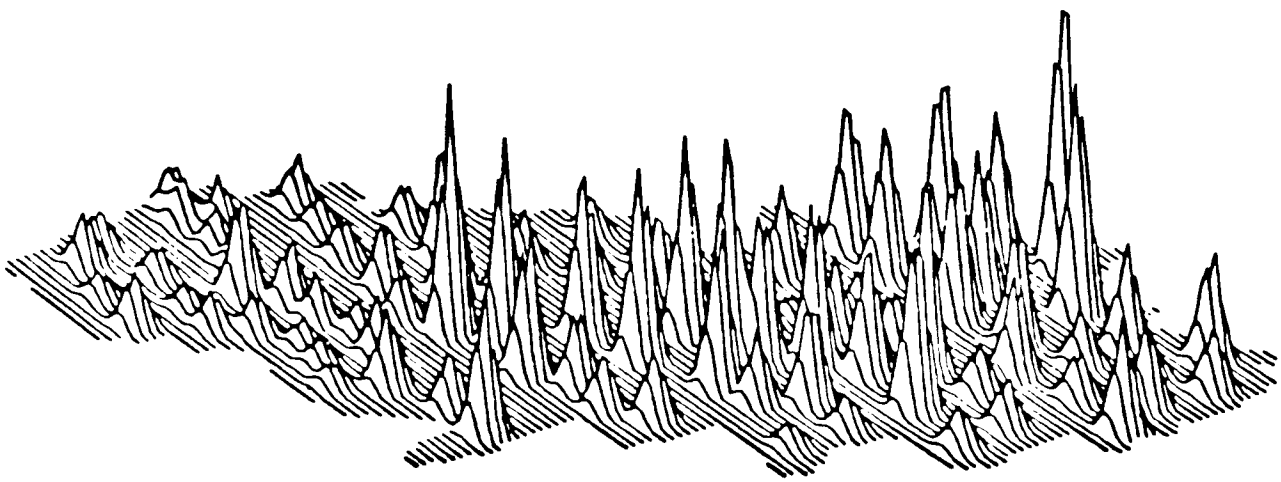


Yellow—Poplar Inventory



Other Hardwood Inventory



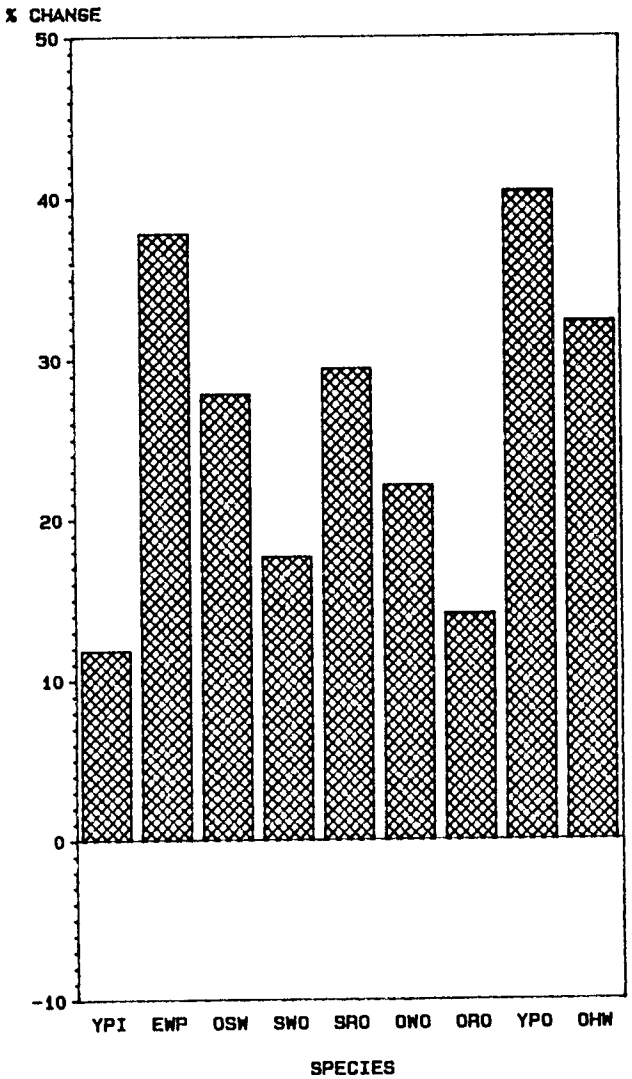


Figure 20. – Average change in growing-stock inventory in the Southern Appalachian timber supply region during the latest survey period by species group. See Table 11 for species acronymns.

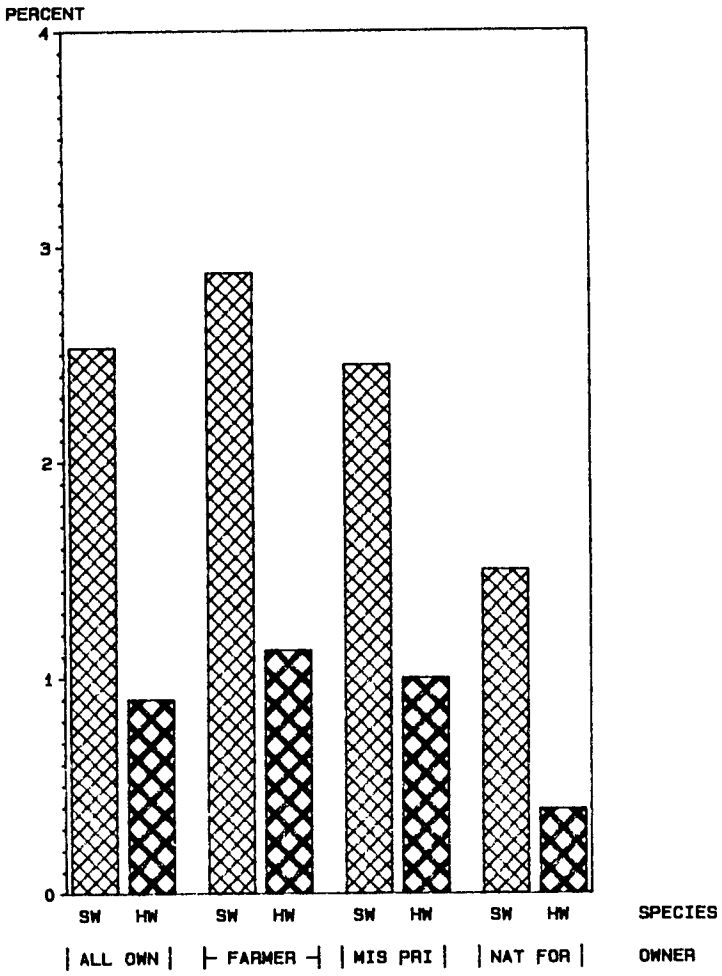


Figure 21. – Annual removal/inventory percentages for softwoods (SW) and hardwoods (HW) and major ownership classes in the Southern Appalachian timber supply region.

Summary

The ultimate supply effect from all the changes that have occurred in the study area over the past 25 years is difficult to ascertain. Among social constraints, the biggest threat to overall timber supply from NIPF sources is the fragmentation of landholdings. Specific research is needed to identify the degree to which fragmentation is occurring and how much of the available timber supply will be withdrawn because of it. The decline of the farmer/timber producer may be less of a problem than previous survey analyses have indicated. Only if this land is subdivided and sold will there likely be permanent declines in timber production. The other economic factors affecting timber supply from NIPF sources are important determinants but should remain fairly constant in the future.

Physical inventories in the region are abundant and growing. They are controlled primarily by NIPF owners but variations in relative proportions are important for some key species, such as select red oak. Overall, the hardwood resource is underutilized. That is, the proportions of total inventories harvested each year are low for all species group-ownership combinations. Utilization is especially low on National Forests.

During the next 10 to 15 years, no serious depletion of the timber inventory is foreseen. On the other hand, the combined effects of slower growth, increased mortality, and removals will reduce inventory increases.

III.F. Summary Findings

This subsection summarizes recent stumpage price and harvest trends in the study area and explains some of these trends. We rely primarily on the data and analyses presented in the previous four subsections of this report but occasionally introduce some new information to explain market trends. We begin with a summary of non-Forest Service trends and follow it with a summary of Forest Service trends.

Non-National Forest (NFS) Harvest and Price Trends

Trends in timber harvesting in the study area vary by time and species. Softwood harvests have risen fairly steadily in the long and short terms. Hardwood harvests have declined over the last two to three decades. Average annual removals for the latter half of this period are about 18 percent lower than for the first half of the period. Yet, within the last 2 to 4 years, hardwood timber removals have increased at a rapid pace. According to industrial timber product output data, harvests are at their highest levels of the past 15 to 20 years.

Within the study area, the TMS real stumpage price trends, representing non-NFS sales, are mixed. For some product categories, such as yellow pine, white pine, and rare hardwood sawtimber, real price trends are downward. For others, such as yellow-poplar veneer, rare hardwood veneer, and hardwood pulpwood, real prices have increased over the past 10 years. Among the States that comprise the study area, North Carolina exhibits the strongest recent stumpage markets, with 7 of the 12 product markets showing increases. Notably strong product categories for North Carolina are oak sawtimber, yellow-poplar veneer, and soft hardwood pulpwood. Tennessee shows increases for pulpwood stumpage, while Georgia, South Carolina, and Virginia show rises for veneer stumpage.

Examination of certain demand-influencing factors is helpful in explaining these recent harvest and price trends. The percentage of change in gross national product (GNP) shown in figure 22 in constant 1982 dollars characterizes the recent overall health of the American economy. The year 1974 was a recession year with a 1.3 percent contraction in GNP. The subsequent economic recovery was well underway by 1976, when GNP expanded by 4.7 percent. An economic downturn began in 1979 and led to the 1981-82 recession when GNP growth declined 2.5 percent. A period of rapid recovery and expansion in GNP growth began in 1983 and continued through the present. Changes in personal consumption expenditures, also presented in figure 22, move with GNP changes, although some dampened effect is evident.

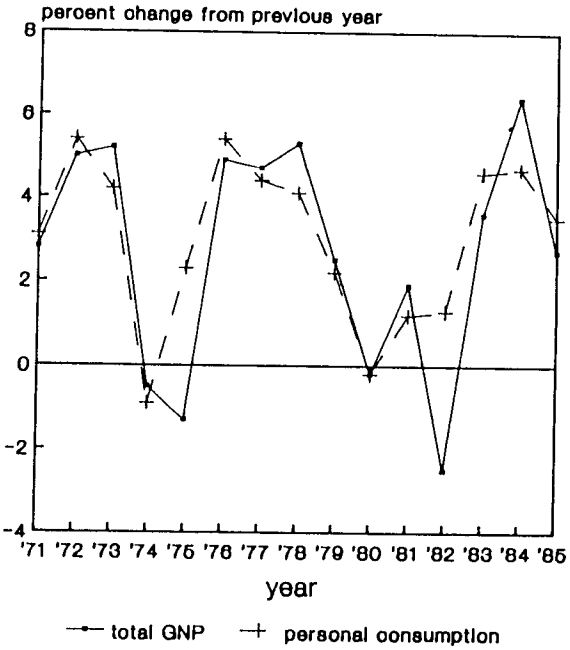


Figure 22. – Percentage of changes in gross national product (GNP) and personal consumption expenditures from 1971 to 1985, in constant 1982 dollars.

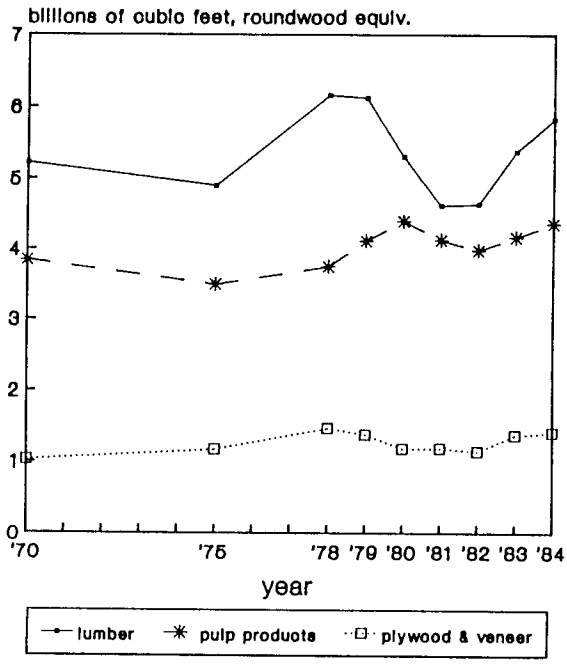


Figure 23. – Total annual U.S. production of forest products, 1970-84.

Forest products manufacturing, evidently, has simply responded to these changes in the national economy. Figure 23 presents total recent United States production of lumber, plywood and veneer, and pulp products in billions of cubic feet, roundwood equivalents. The general pattern of wood products production tracks closely the business cycle data presented in figure 22. Production

was down in 1974-75, rebounded in the late 1970's, took a severe downturn in 1981-82, but began a very strong recovery after 1982. National demand for forest products continued upward through the present. The excellent recent health of the forest products industry was noted in the November 9, 1987, issue of the Wall Street Journal (p. 22). Third-quarter 1987 earnings were up 54 percent over third-quarter 1986 earnings, making forest products one of the star performers among all U.S. industries.

The strong economic upturn of the past 5 years has, of course, affected the Southern Appalachian timber industry. Rising from the trough of the 1981-82 recession, forest products firms in the study area expanded output and, in some instances, production facilities as well. The following paragraphs trace this increase in production activity through the mills to the forest in an attempt to explain stumpage price movements.

Consumer demand has increased for furniture and wood flooring, both of which require sawn wood as a production input. Nearly 50 percent of the Nation's furniture manufacturers are located within the five States of the study area. Sawmill capacity in North Carolina has undergone recent expansion and modernization. Red oak's current popularity as a furniture and flooring wood explains rising oak sawtimber prices seen in North Carolina.

Demand has also increased for hardwood plywood products. Since nearly one-half of all the U.S. hardwood plywood and veneer operations are in the States that comprise the study area, a heavy demand has been placed on forests to supply the yellow-poplar veneer core stock and appearance veneers used to manufacture plywood. Too, there has been some recent capital expansion in the hardwood plywood industry in North Carolina. These factors seem to explain rising wood veneer prices.

The increases in prices for hard-hardwood pulpwood seem to result from an increased demand for slick paper used for magazines, catalogs, and mail brochures. One large paper mill located in western North Carolina currently meets 40 percent of its wood needs from hardwood forests.

The increases in prices for soft-hardwood pulpwood are a result of the increased demand for OSB, which has become a well-accepted, low-cost substitute for softwood plywood. Two OSB plants were constructed recently in the study area, one in Virginia and the other in North Carolina.

Thus, the rising stumpage prices observed for certain hardwood species in certain States are traceable to final consumer preferences through capital expansion of manufacturing facilities.

Stumpage price trends also seem to be influenced by supply factors. Recent trends in the study area show an increase in growing stock inventory that would suggest a negative impact on prices. However, there has been a strong offsetting trend on the supply side resulting from two factors. First, there has been a large decline in farmer-owned timberland. The new owners in the miscellaneous private category appear to have a lower propensity to sell timber than do farmers. Second, there seems to be a trend toward tract subdivision, which, due to economies of scale, also serves to decrease economic supply. The net impact of these factors on economic timber supply is not firmly established, but, the current thinking is that economic supply has contracted, placing some upward pressure on prices.

In summary, the analyses of non-Forest Service timber markets suggest an increasing economic scarcity of certain hardwood tree species whose real stumpage prices have risen. These rising prices have been triggered, in all likelihood, by strong demand for final products and the accompanying expansion of manufacturing facilities. Timber harvesting has increased in response to rising prices; however, it appears that demand for certain species is outpacing supply, especially in western North Carolina.

National Forest Harvest and Price Trends

Within the study area, National Forest timber harvest volumes have increased significantly in recent years. Indeed, the annual harvest volume for 1986 was 162 percent higher than the annual volume cut in 1978. The trend from 1978 to 1982 was one of accelerated annual increases in the volume harvested. From 1982 to 1986, the pattern was one of small yet steadily increasing NFS harvesting levels.

The NFS real stumpage prices in the study area have, generally, shown a rather strong downward trend between 1977 and 1986. The pulpwood markets in Tennessee and some of the sawtimber and pulpwood markets in Virginia show upward price trends, but these are exceptions. The overall picture is one of rather stark price declines. Particularly noteworthy are the stumpage price trends for the North Carolina National Forests (the Nantahala and Pisgah). Real prices there have declined precipitously even for the product-species markets that appeared strong in the TMS price analyses. For example, North Carolina NFS hardwood pulpwood prices fell 17 percent annually over the past 10 years, yellow-poplar prices declined 10 percent per year, and oak prices fell by more than 8 percent each year.

These declining real stumpage price trends, when examined in conjunction with the rising harvest levels, lead to the conclusion that the demand (willingness to pay) for NFS stumpage has not kept pace with the rate at which timber has been supplied. Whether demand has, in fact, remained static, decreased or even increased somewhat is unknown. All that can be said with certainty is that demand has not kept pace with supply. In light of the available evidence, this is an inescapable conclusion. Bear in mind, however, that the term "demand" as used here does not refer to such notions as the need or desire for some good. Instead, it is used in a strict economic sense to mean the willingness to pay for the commodity in question.

This apparent lagging demand for NFS stumpage is curious when the economic upswing of the past 5 years and its strengthening effect on certain segments of the study area private stumpage markets are considered. At this time, the study team can only offer the following hypothesis: The Forest Service has, over the past 10 years, added logging restrictions and contractual requirements that have raised the true cost of obtaining timber (stumpage bid price plus other contract compliance costs), making NFS purchases relatively unattractive. For industry, the apparent rising total cost of obtaining NFS timber has had the likely effect of stifling vigorous competition for NFS timber.

In conclusion, the study team has observed recent increases in harvesting levels and some non-National Forest stumpage prices in the study area, particularly in North Carolina. Also, the team believes that the rising real prices for non-NFS timber are due to a vibrant forest products market and the construction of new forest product production facilities. The rising prices have brought more wood on the market, but, in some instances, not at a pace commensurate with the increases in demand. The increases in Forest Service timber harvests, coupled with strong declines in Forest Service stumpage prices, lead us to conclude that the demand for Forest Service timber is not keeping pace with the increases in Forest Service supply.

IV. Forecast of Future Market Conditions 1987-2000

This final section forecasts future timber markets in the Southern Appalachian region. Our forecast focus is on stumpage price trends through the year 2000. As indicated in Section II of this report, these price trends play a key role in Forest Service land management planning via the FORPLAN LP model. Our forecasts are based on recent price trends (from Section III) and our judgment about future market conditions.

The analysis of stumpage price trends presented in Subsection III.B. was facilitated by fitting a least squares regression line through approximately 10 years of observed stumpage price data adjusted for inflation (1977 through mid-1987 for the TMS prices and 1977 through 1986 for the Forest Service price data). These regression results yielded, in effect, the average annual rate of change in real prices for the 10-year period. These rates of change were computed for the various product-species groups in the portions of the five States in the study area.

It is important to realize that the 10-year period used in these analyses apparently spans the major part of one complete business cycle. Thus, in computing the regression results, we have not looked just at a market upturn or downturn. Rather, we analyzed prices across one entire business cycle – peak to trough to peak.

Because the regression analyses span a complete business cycle, the team is willing to say, with reasonable confidence, that the price changes computed in Subsection III.B. provide an appropriate baseline of current conditions in timber markets. In the remainder of this section, we discuss future economic and market conditions that might cause future markets to deviate from current stumpage price trends.

First, a word about anticipated aggregate economic conditions between now and the year 2000. Because of the mounting Federal budget and trade deficits, the United States must look at its economic future with an understandable degree of uncertainty. However, since World War II, the United States has experienced seven business cycles with an average duration of 5 years and a range of 3 to 9 years (Glahe 1977). Following this pattern, we should see two or three complete business cycles by the year 2000, with anticipated long-term economic growth.

Regarding timber supplies from private ownerships, the recently published "South's Fourth Forest" (USDA Forest Service 1988), predicts a 9 percent increase in hardwood growing stock inventory for North Carolina, Virginia, and Tennessee by the year 2000. A larger inventory should lead to the

increasing economic availability of timber. However, we believe that this increase will be offset by the continued subdivision of forested tracts and the shift from farm to nonfarm ownerships. Thus, we anticipate a slight tightening of private timber supplies over the next 12 years in the study area.

The demand for private hardwood stumpage should remain strong for yellow-poplar and appearance veneers, soft-hardwood pulpwood, and, perhaps, oak sawtimber. Each of these separate product-species will be discussed in the next few paragraphs.

The yellow-poplar and appearance veneers are in demand for the manufacture of hardwood plywood. This has been a growing industry, particularly in North Carolina where plywood manufacturing facilities have been constructed within recent years. Since these plywood mills represent substantial capital investments, we anticipate continued pressure on the region's forests to supply yellow-poplar and fine veneers to keep these mills operating.

OSB has proved to be a well-accepted, low-cost substitute for softwood plywood. This product already has taken market shares from softwood plywood, and this trend is projected to increase in the future. Two OSB plants were constructed in the study area (one in Virginia, one in North Carolina) within the past 5 years. Also, the study team is aware that other companies are examining the region for new OSB plant locations. Because soft-hardwood pulpwood is used for the manufacture of OSB, we anticipate its demand will remain strong.

Oak sawtimber has been in demand in North Carolina for the manufacture of furniture, millwork, and flooring. Traditionally, the hardwood sawmilling industry has been viewed as somewhat more flexible than, say, the paper, structural board, or plywood industries. Because sawmills were often smaller and less capital intensive, they were able to shutdown during adverse economic times. However, in recent years in western North Carolina, there has been a rapid expansion of more permanent and sophisticated sawmills with innovations like computerized headrigs. Thus, we anticipate the demand, especially for oak sawtimber, to remain reasonably strong over the next 12 years, especially in North Carolina.

The demand for hard-hardwood pulp has been strong in recent years due mainly to one large paper mill located in Canton, NC. This paper mill, the single largest consumer of pulpwood in the region, uses hard-hardwood pulp to manufacture slick paper stock. Very recently, however, the paper mill's owners have announced that the facility's production will have to be reduced to meet the Environmental Protection Agency water quality standards. The fate of the mill is currently uncertain, but its closing would substantially reduce the demand for hard-hardwood pulp.

To summarize, we foresee some tightening in private timber supplies over the next 12 years, with increased demand for yellow-poplar and appearance veneers, softwood pulpwood, and oak sawtimber. Thus, we anticipate slight increases in the annual rate of price changes presented in Subsection III.B. for these stumpage product species.

Regarding the National Forest situation, it should be recalled that harvesting levels for the Southern Appalachian National Forests have increased over the past 10 years, while stumpage prices have fallen dramatically. This price decline is due, we feel, to weak competition for Forest Service timber stemming from the added costs associated with the complexities and complications inherent in Forest Service timber purchasing procedures. Because these complexities and complications are unlikely to be alleviated in the near future, it is difficult to envision a sudden surge in the price for Forest Service timber. However, because we are predicting a slight rise in non-Forest Service stumpage prices, it is possible to foresee a marginal increase in the demand for Federal stumpage. Therefore, the team predicts a slight increase in the demand for Forest Service stumpage over the next 12 years.

Timber harvest volumes from Southern Appalachian National Forests will increase only slightly between now and the year 2000. The Nantahala/Pisgah plan, for example, calls for a 6 percent increase in harvest volume. These slight harvest increases, coupled with what we see as slight increases in demand, should lead to some moderation of the rapid declines recently witnessed in Forest Service stumpage prices. Thus, the team predicts real stumpage prices for Forest Service timber in the Southern Appalachians will decline only slightly and may level off over the next 12 years.

In Section II, we discussed the timber price projections used in the National Forest land management planning process. Price projections, obtained from the RPA process, suggested that hardwood timber prices would increase at a zero real rate over the next several decades. The present study, although conducted independently from the RPA effort, essentially supports those findings. Between now and the year 2000, we foresee no real increases in hardwood stumpage prices on National Forests in the Southern Appalachians.

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This study investigated recent hardwood stumpage market trends in Southern Appalachia and projected National Forest stumpage prices to the year 2000. Over the past 10 years, hardwood timber harvest volumes from private lands have increased 38 percent with much of this increase coming in the last 2 to 4 years. Private hardwood stumpage prices have decreased across much of Southern Appalachia except for western North Carolina where prices have increased. During the same period, National Forest hardwood timber harvest volumes have increased about 162 percent. National Forest stumpage prices have declined within the region over the past 10 years. A judgmental forecast predicts no increase in National Forest real hardwood stumpage prices until the year 2000.

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