Where to Cut, Where to Run: Prospects for U.S. South Softwood Timber Supplies and Prices

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Introduction

A review of market history shows that southern pine sawtimber stumpage prices have increased by over 150 percent in this decade (Timber Mart South). Concurrently, some (i.e. Cubbage and Abt (1996) Nilsson et al (1999)) have questioned the adequacy of southern timber supplies to meet projected demands, which are projected to increase by about 25 percent over the next two decades. Given what we know about inventories and growth rates, what are the prospects for supplies to meet the needs of the southern pine industry?

North American Timber Supply Curves

Market supplies and demands balance because the price mechanism works to stimulate or slacken offers and bids so that equilibrium is maintained. Thus, the more appropriate question is what are prospects for timber prices?

For an answer we first need some idea of a sector's supply structure. Timber supply in terms of a mathematical schedule is an unobservable abstraction, but we can approximate one from recorded harvest volumes and prices. To do this, we need a frame of reference to standardize harvests. In analysis of industries with fixed plants, the production capacity provides such a benchmark. For forestry, the ultimate measure of capacity is the available inventory of the timber itself. Therefore, calculating ratios of timber drain-to-timber inventory and contrasting them with prices across regions with similar resources might indicate the market's supply response.

Estimates of the bulk of timber drain in states and provinces can be obtained from log exports, pulpwood receipts and the production of softwood lumber and plywood. Products made from residues and not accounted for by pulpwood receipts, such as particleboard and MDF, are also counted as is the production of oriented strandboard where its furnish is primarily softwood (Spelter and McKeever, 1999).

As for timber inventory, such data are gathered periodically by the USDA Forest Service in their Forest Inventory and Analysis (FIA) program. FIA surveys are recognized internationally for their quality and depth and we used these data for the most recently published year (Smith et al, 1994).

Plotting the ratios of these numbers against 1997 delivered pine sawtimber prices for various eastern states results in the general relationship exhibited in figure 1. This relationship, formalized in an equation, forms the prism through which we translate projections of timber harvests and inventory into prices.

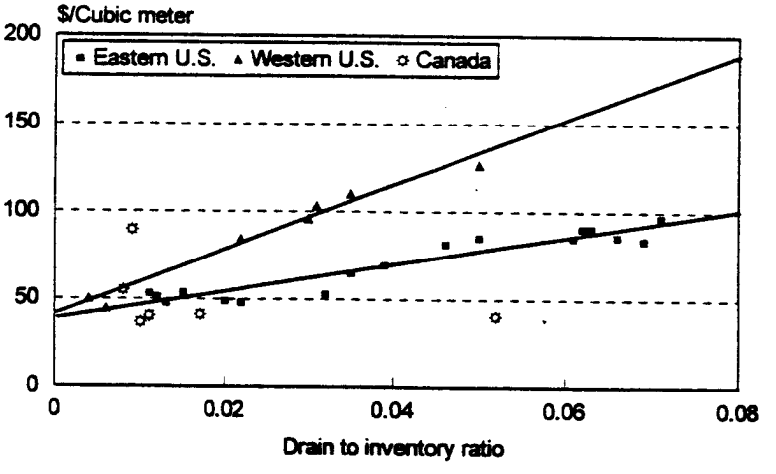

Figure 1.–Price (delivered) vs. drain-to-inventory ratio

As a point of interest, we also derived these data for the western U. S. states and the Canadian provinces using prices of softwood species that are prevalent in those regions. One difference between U. S. eastern and western calculations is the treatment of public timber. Because of the limits placed on harvests from western public forests, we omitted federal timber from the tabulation of available timber. The results for western U. S. states, displayed in figure 1, show a similarly strong correspondence between price and drain/inventory ratios, but the relationship is steeper than its eastern counterpart, yielding higher prices for a given level of resource use. There is no clear relationship evident for Canada. However, if we consign coastal British Columbia with the U. S. West and the other provinces, excluding the Maritimes, with the U. S. East, we find that the provincial prices (in U. S. $) are generally not out of line with those in states having similar resource types and utilization rates.

Southern timber supply

Turning now to the U. S. South, its total land area consists of about 216 million hectares of which 86 milion are forestland and 81 million are considered available for timber production. The area containing primarily softwoods is 36 million hectares of which about 29 millions are characterized as being in pine.

In 1992, one fifth of this area was classed as highly productive; a third as moderately productive while two fifths as average or lower (table 1). Ownerships were divided among the forest industry (30%) public agencies (11%) and non-industrial private interests (59%, table 2). A further point of interest is the breakdown by stand size. One third of all the softwood area (12 million hectares) was classed as seedling/sapling (less than 12.7 cm in diameter). This partly reflects the roughly 1 million hectares of farmland converted to timberland in the late 1980's under the Conservation Reserve Program (CRP).

Table 1. - Pine forest area by productivity class.

Productivity class (M^3 per ha. per yr.)	Area (Million hectares)	(Percent)
8.4 or more	6.2	21
5.0 to 8.4	9.1	31
3.5 to 5.0	11.8	40
1.4 to 3.5	2.3	8
Less than 1.41	0.0	0
Total	29.4	

Table 2. - Pine forest area by ownership class.

Ownership class	Area (million hectares)	(percent)
Forest Industry	8.9	30
Other private	17.3	59
Public	3.2	11
Total	29.4	

In addition to site productivity, the production potential of land depends on management intensity. Forest Service measurements of yields for various management levels range from the extensive involving minimal inputs, to active management involving site preparation, weed control and periodic fertilization. These alternatives (#6 through #10) are illustrated in figure 2. Management regimes embodied in options #6 and #7 have been typical of southern forestry and are still employed on many smaller non-industrial private holdings. Higher management intensities are becoming the norm on industrial and other professionally managed forests. But even the most intensive option depicted pales in comparison with results achieved from highly intensive cultivation including annual applications of fertilizer (i. e. option #11 in figure 1, Borders and Bailey (1999)). This indicates the extent of the untapped production potential that exists in forestry.

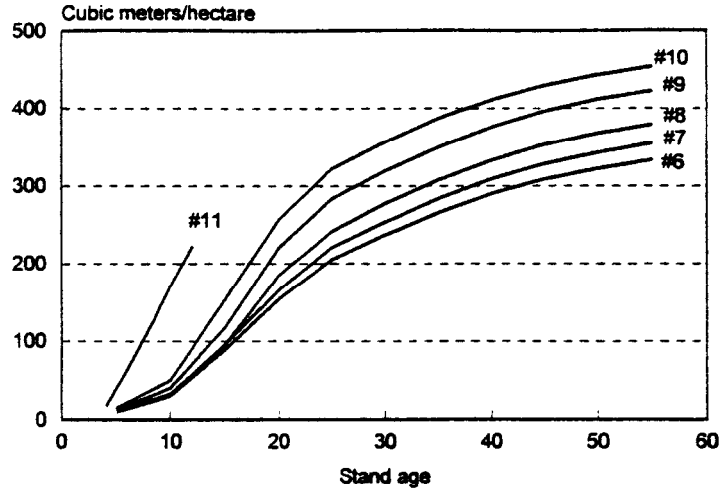

Figure 2.–Cumulative yield functions (unthinned stands)

I applied these yields to forestlands across ownerships, making adjustments for site fertility. I also assumed lower levels of management for non-industrial and public lands than for industrial forests. Further, I adjusted yields across the board to force the resulting 1992 aggregate inventory of pine roundwood (12.7 cm or greater diameter) to match the FIA inventory value of about 2,650 million m^3. Lastly, the management mixes were chosen so that they produced net growth of approximately 129 million m^3, net of non-pine' softwoods, matching the 1992 FIA estimate. The resulting aggregate yield curve for the starting period of the 25-year projection is depicted in figure 3. For perspective this is contrasted with the yield for the lowest management intensity (#6). The shortfall in the projected level reflects real world leakage from the idealized amounts caused by field conditions such as incomplete stocking, fire breaks, roads, lakes and intrusion of non-pine species.

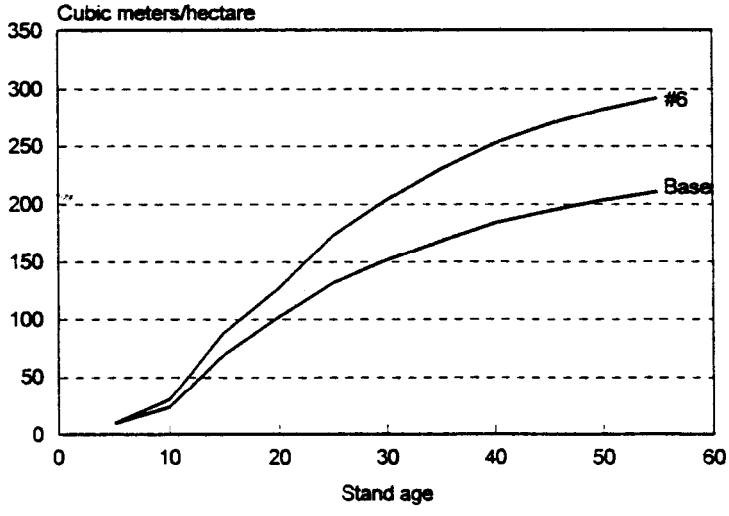

Figure 3.–Theoretical and realized cumulative yields
(thinned and unthinned)

To portray probable future growth, I gradually introduced higher management intensities over time from the spectrum of yields (up through #10) on harvested and replanted lands, but maintaining the same reduction factor used for the 1992 starting period. The resulting evolution of the aggregate yield function is illustrated in figure 4.

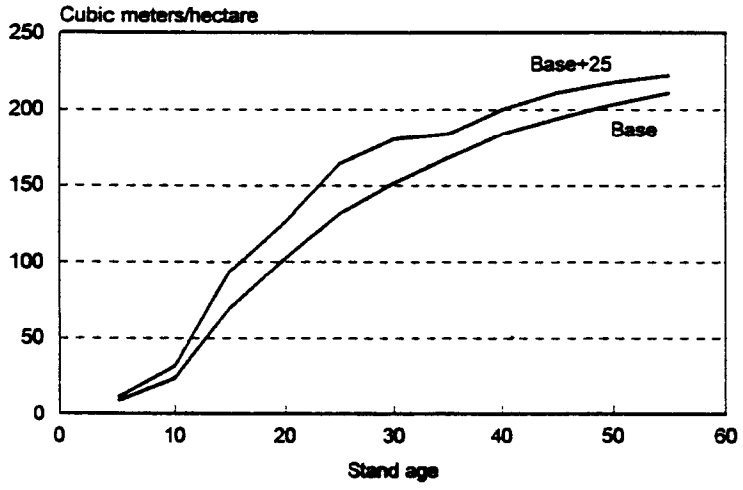

Figure 4.—Starting and ending cumulative yields

Harvest schedules were set to achieve an increase in cuts of 30 percent relative to the 1992 starting point (figure 5). Their evolution is illustrated in figure 6.

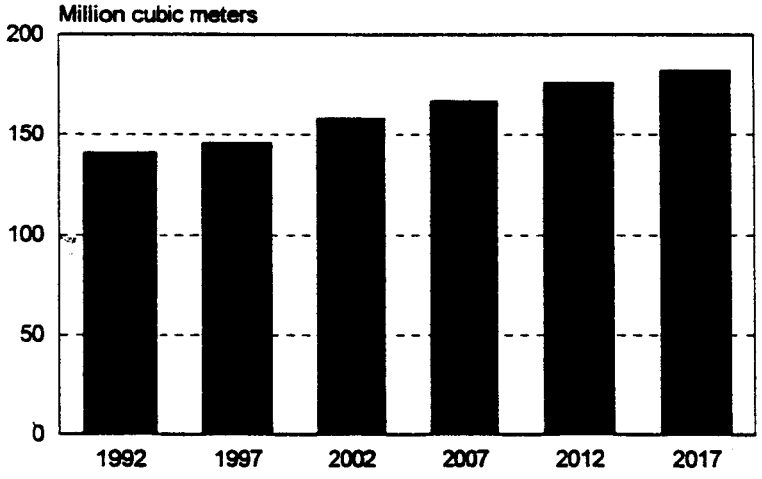

Figure 5.—Southern pine harvest assumptions

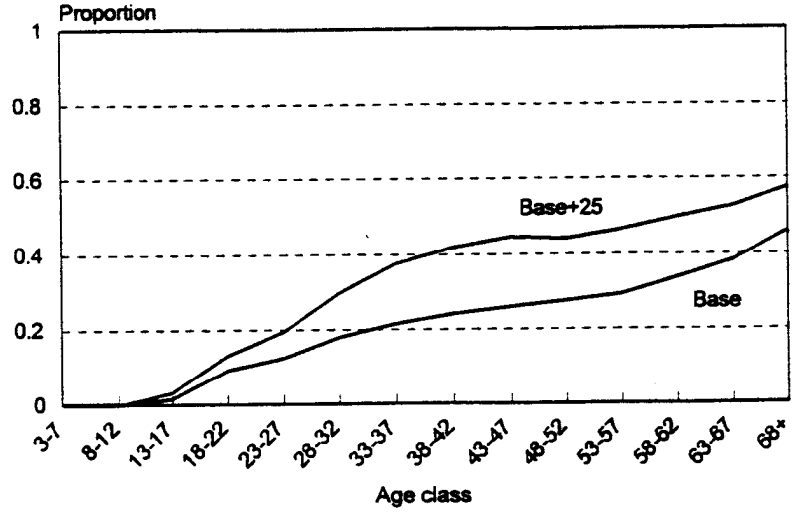

Figure 6.–Areas harvested by age class over 5-year periods at start and end of projection

Timber use rate and prices

Despite the modest improvements assumed in yields, as reflected in moderate stocking increases of 25 to 35 percent in the younger age classes and less than 10 percent in the older groups, growth increases by 42 percent. This is due to the rejuvenated age structure of the stand (figure 7). To meet demands, which initially exceed growth, stands in older age classes must be liquidated. This boosts the proportion of the younger age classes, which grow more vigorously enhancing growth. The downside, of course, is that older, bigger trees become scarcer.

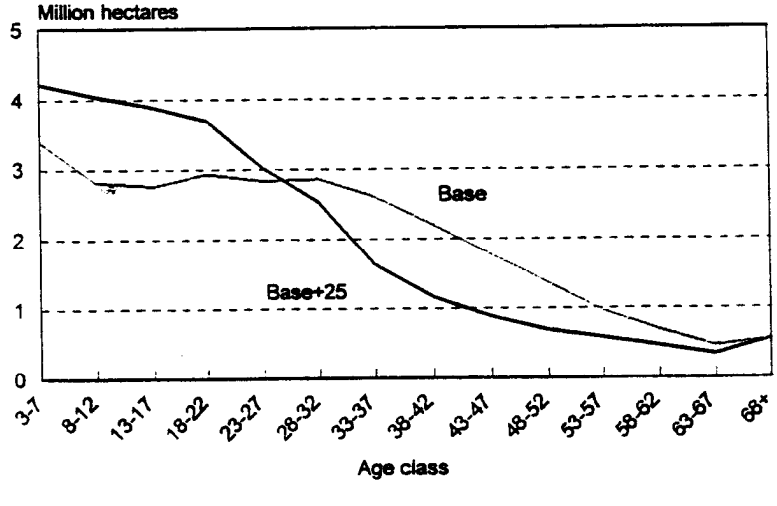

Figure 7.–Age structure distribution at start and end of projection

Under these harvesting and growth regimes, the inventory of growing stock initially declines (figure 8). At the end of the projection, however, growth catches up with removals and inventory stabilizes.

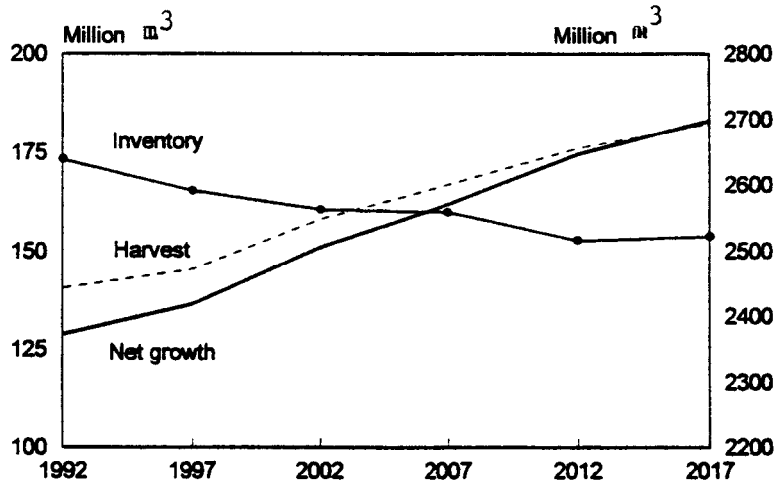

Figure 8.--Projected Southern pine harvest, net growth and inventory

To extract such harvests, owners would have to be enticed to accelerate cutting and harvest sooner than they otherwise might have preferred. More formally, the higher requirements translate into tighter market conditions as a consequence of which prices rise. Some idea of the extent of such increases can be gleaned from the supply functions derived above. As a result of this scenario, the drain-inventory ratios increase through the 25-year projection from 0.052 to 0.072. In constant 1997 dollars, these translate to a rise in pine sawtimber stumpage prices of a third. If we add an assumed underlying annual inflation rate of 2 percent, then in actual dollars prices would be almost 90 percent higher by 2020 than they were in 1995.

These projections are shown in figure 9 along with historical prices. For perspective, the projections made for the 1993 RPA Timber Assessment Update (Haynes et al, (1995)) similarly adjusted for the assumed inflation, are shown through 2030. The two projections are almost identical through 2020. The RPA analysis shows a decline thereafter when growth catches up with removals and inventories begin to recover. The credibility of the RPA projections is bolstered by the fact that they were made in the early 1990's when stumpage prices were considerably lower. Thus the projected increases were a significant departure from prevailing conditions and have been validated by events in the initial part of the forecast period.

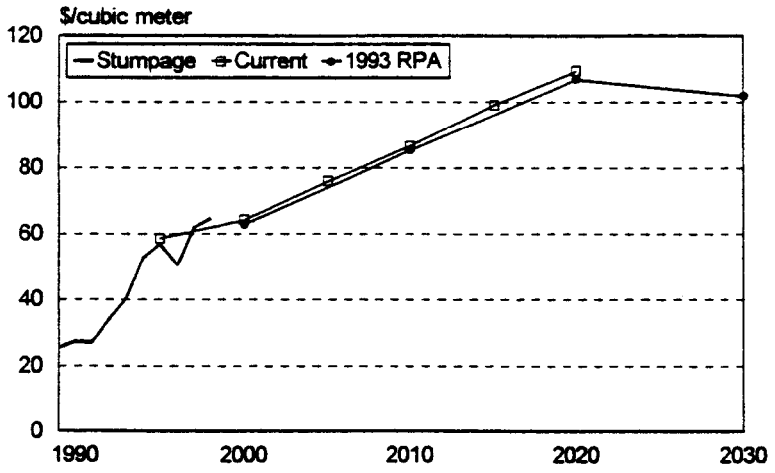

Figure 9.—Southern pine stumpage prices

Discussion

In this exercise I simulated the effects of a 25 percent increase in timber demand on southern timber markets at a time when harvests are recognized to be equal to or even greater than growth in many parts of the South. Notwithstanding the magnitude of this increase, the demand can be met from accelerated harvests of existing stocks and from moderate increases in forest productivity. The downside is that prices rise significantly over the next two decades before growth catches up with cuts and inventories stabilize. Faster growth assumptions would dampen these price increases, but more in the long- than near-term future.

Taking the increased demands as given, there remain several assumptions that invite examination. First is the assumption that the forest land area stays fixed. One of the concerns raised in critiques is that the productive land base is decreasing due to urbanization. An irony of the forestry business is that a key driver of its prosperity, home construction, also undermines its viability because it permanently removes land from the production base. This is especially so in the present era where development is increasingly expansive in terms of land.

A review of the forest area statistics supports this concern. Private forestlands have decreased by over 4 percent since 1952 (figure 10). However, from 1987 to 1992, in response to incentives under the CRP program, the trend reversed with the conversion of a million hectares of farmland. Looking. ahead, an argument could be made that this will repeat because of changes in farming. Under the 1996 Freedom to Farm Act, set asides and area limitations on farms were eliminated, allowing farmers to produce to their maximum capacity. This has increased supplies which have contributed to depressed agricultural prices. In

ability to grow grains, the Midwest, with its loamy, productive soils, has a competitive advantage over the more marginal, clayey southern soils. If the economics of grain fanning deteriorate, more southern farmland, previously used for grain and feed production, may end up being converted to forestry through a catalyst such as the CRP program. This could act as a countervailing force against the conversion of forestlands for urban uses.

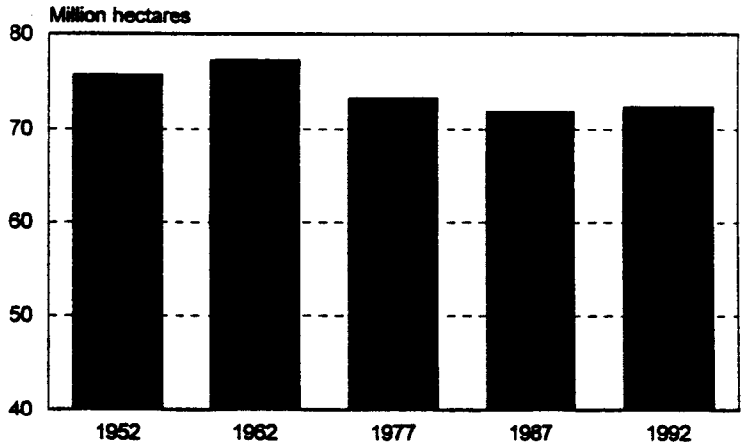

Figure 10.—Area of all private timberland in the south

Second there is the question of how much forest productivity will increase The increases assumed here reflect higher levels of management than has been typical of the past. Some of this is based on advances in genetics which can be applied with little effort on the part of individuals beyond buying the improved stock. Other aspects such as cultivation, weed control and fertilization require more organizational effort. There is little concern that such management can be applied to plantations owned by the forest industry itself, but on the more fragmented and small non-industrial holdings such gains may be harder to come by. In this area, however, there is increased managerial and capital resources being brought to bear in the form of Timber Management Organizations (TIMO's) which are in essence mutual funds invested in timberland. These organizations have built their assets from transfers of both industrial and non-industrial lands. To the extent that small non-industrial ownerships are consolidated, an increase in productivity can be expected.

A corollary concern is how well harvested stands will be replaced. In cases where cutover areas are allowed to restock naturally, a large portion of the replacement often comes in the form of mixed hardwoods, reducing the site's potential pine yield. This is accounted for here by the 25 percent reduction in the yield functions necessary to duplicate the enumerated inventory. With the recent and prospective price escalation, the incentives are to tighten those practices. If so, the maintenance of these reduction factors might be conservative.

Field tests confirm most observers' belief that productivity of timber in the South can be greatly increased. There are inevitable lags between management actions and supply responses owing to the time horizons of timber growing. But, with the rise in the value of timber, the motivation for forest owners of all kinds to step up management intensity has increased. As more areas fall under intensive management regimes, the result will be a rise in productivity that wiil increase supplies over the long-term in much the same way that agriculture output has been raised, even from a possible declining land base.

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Session Three: Issues in the Western Hemisphere

United States: Where to Cut? Where to Run?

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