FTM–West: Fuel Treatment Market Model for U.S. West

Peter J. Ince[1], Andrew Kramp, Henry Spelter, Ken Skog, Dennis Dykstra, USDA Forest Service

Abstract

This paper presents FTM–West, a partial market equilibrium model designed to project future wood market impacts of significantly expanded fuel treatment programs that could remove trees to reduce fire hazard on forestlands in the U.S. West. FTM–West was designed to account for structural complexities in marketing and utilization that arise from unconventional size distributions of trees and logs removed in fuel treatment operations as compared with conventional timber supply in the West. For example, tree size directly influences market value and harvest cost per unit volume of wood, whereas log size influences product yield, production capacity, and processing costs at sawmills and plywood mills. Market scenarios were projected by FTM–West for two hypothetical fuel treatment regimes that yield wood with divergent size class distributions, evaluated at two hypothetical levels of administrative cost or government subsidy. Results suggest that timber markets could economically utilize substantial volumes of wood from hypothetical treatment programs, even without any subsidy. Given an optimistic overall market outlook, model results indicate potential for expansion of total wood harvest in the West if fuel treatment programs will permit significantly expanded wood supply from forest thinning, in which case fuel treatment programs could partially displace timber harvest from conventional supply sources (mainly state and private forestlands), reduce timber prices, and offset regional timber revenues, while expanding regional forest product output.

Acknowledgments

This study was funded in part by the Joint Fire Science Program (JFSP), a partnership of six federal agencies: USDA Forest Service, Bureau of Indian Affairs, Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service, and U.S. Geological Survey. Additional in-kind contributions were provided by researchers at the USDA Forest Products Laboratory and Forest Service Pacific Northwest Research Station. The study was part of a larger JFSP-funded project, identified as JFSP project 01-1-2-09, "A national study of the economic impacts of biomass removals to mitigate wildfire damages on federal, state, and private lands," coordinated by Jeffrey Prestemon and Karen Lee Abt (Forest Service Southern Research Station). The authors sincerely appreciate the consultation provided by the project coordinators, as well as consultation on the PELPS modeling system from Patti Lebow of the Forest Products Laboratory, data input from Matt Alderman of the Forest Products Laboratory, and consultation or input from other members of the JFSP project, including Roger Fight and Jamie Barbour of the Pacific Northwest Research Station and Bob Rummer and Robert Huggett, Jr., of the Southern Research Station.

[1] Research Forester, USDA Forest Service, Forest Products Laboratory, One Gifford Pinchot Drive, Madison, WI, 53726-2398. pince@fs.fed.us. (608) 231-9364 (v); (608) 231-9592 (fax)

Introduction

The Healthy Forests Restoration Act of 2003 (HFRA) and other administrative rules encourage expansion of hazardous fuel reduction projects on public forestlands in the United States. Most of the area treated in hazardous fuel reduction projects in recent years has involved prescribed burning and mechanical thinning without wood removal. However, some mechanical thinning projects have involved wood removal, and many conventional timber harvest projects on public lands also serve fuel reduction objectives.[2] In general, the hazardous fuel reduction program of the future might involve expanded wood removals. Thus, the purpose of this study was to develop an economic model that could be used to assess market impacts of alternative fuel reduction programs involving forest thinning in the U.S. West. Model development was guided by awareness that forest thinning programs could very likely involve removal of trees with size-class distributions different from the size-class distribution of trees from conventional timber harvests in the West. It was understood that market impacts will be influenced by divergent size-class distributions, because the economics of wood harvesting, utilization, and production processes are all known to depend on tree and log size-class distributions.

Methodology

The "fuel treatment market" model for the U.S. West (FTM–West) employs the Price Endogenous Linear Programming System (PELPS). PELPS is a general economic modeling system developed originally at University of Wisconsin (Gilless and Buongiorno 1985, Calmels et al. 1990, Zhang et al. 1993) and more recently modified for applications at the Forest Products Laboratory (Lebow et al. 2003). PELPS-based models employ Nobel laureate Paul Samuelson's spatial equilibrium modeling approach, with periodic (e.g., annual) market equilibrium solutions obtained via economic optimization. Solutions are derived via maximization of consumer and producer surplus, subject to temporal production capacity constraints, transportation and production costs, and price-responsive raw material supply curves and product demand curves, all of which can be programmed realistically to shift over time and respond to endogenous shifts in market conditions. FTM–West employs the FPL version of PELPS (called FPL–PELPS); Lebow et al. (2003) and earlier PELPS publications provide further mathematical details about the modeling system. PELPS has been used fairly widely for partial market equilibrium models of timber and forest products for many years (for example, Buongiorno et al. 2003, Zhang et al. 1996, ITTO 1993).

Many structural aspects of wood product markets are commonly represented in forest sector market models, including, for example, a regional market structure with regional product demand curves, regional raw material supply curves, interregional transportation costs, regional production capacities, and manufacturing costs. Those general structural features were also included in FTM–West. However, added structural complexities arise with marketing and utilization of wood with divergent size-class distributions from fuel treatment programs, and those complexities required unique structural features to be designed and incorporated into FTM–West (as discussed in the next section).

---

[2] The Stewardship Contracting program on National Forests and BLM lands, for example, has involved removal of trees in thinning projects that seek to reduce hazardous fuels and improve forest health.

Among general structural features, FTM–West included demands for more than a dozen forest product commodities encompassing the full spectrum of products produced from softwood timber in the U.S. West, several demand regions, eight production or supply regions, and both conventional softwood timber supply and wood supply from thinning programs (assumed to be primarily softwoods). Table 1 summarizes the regional and commodity structure. The model includes only demands for forest products produced from softwood timber in the U.S. West, just a partial representation of total U.S. and global demands for forest products. Fairly simple demand curves were specified in the model based on an assumption that demands for all products are inelastic (price elasticity of demand ranged from –0.3 to –0.8 among the various products). Aggregate demand quantities for each product were equated to product output data for the U.S. West in the base year (1997) and proportioned to each of the three product demand regions using estimates of regional shipments from the West. FTM–West was programmed to solve annual market equilibria over a 24-year period, 1997 to 2020, which permits testing of solutions against overlapping historical data. Demand curves were shifted each year based on historical shifts in production in the U.S. West (1997 to 2004), and the model was also programmed with a set of assumed future growth rates in regional demands (2005 to 2020) for each forest product commodity.

Similarly, simple supply curves were used to model conventional softwood timber supply in each of the eight supply regions, while exogenous estimates of wood supply from treatment programs (upper bounds on harvest quantity and harvest costs) were introduced as policy or program variables. Conventional timber supply in the U.S. West is currently obtained primarily from state and private forestlands, subjected mainly to even-aged timber management. Thus, inelastic supply curves were used for conventional timber supply (with an estimated price elasticity of 0.7)[3]. Conventional timber supply curves were programmed to shift over time in proportion to net growth in softwood timber inventory volumes on state and private timberland within each supply region. Annual net growth in timber inventories were computed each year by deducting from standing timber inventories the harvest volumes from the preceding year and adding timber volume growth (based on recent growth rates in each region). Thus, FTM–West incorporated fairly standard techniques to model conventional timber supply (that is, inelastic supply curves shifted over time in proportion to projected net growth in timber inventories).

Table 1. Regional and commodity structure of FTM–West model

Supply/production regions	*Demand regions*	*Demand commodities*
Coast PNW (OR, WA)	U.S. West	Softwood lumber & boards
Eastern Washington	U.S. East	Softwood plywood
Eastern Oregon	Export market	Poles & posts
California		Paper (five grades)
Idaho	*Supply commodities*	Paperboard (three grades)
Montana	“Pines”	Market pulp
Wyoming–South Dakota	“Non-Pines”	Hardboard
Four-Corners (UT, CO, AZ, NM)	(trees, logs, chips)	Fuelwood

[3] Supply and demand elasticities were calibrated based on goodness-of-fit comparisons between model equilibrium projections and actual historical price and quantity data.

Separate supply curves were included in the model for "pines" and "non-pines," with base-level conventional timber supply quantities determined by Forest Service estimates of 1996 timber harvests within each supply region (Johnson 2001). The distinction between "pines" (ponderosa and Jeffrey pines) and "non-pines" (other softwood species) was programmed into the model because some important lumber products in the West (boards and specialty products) are made almost exclusively or predominantly using "pines," and thus "pines" tend to have higher market value than "non-pines." By including separate supply curves for "pines" and "non-pines" and realistic estimates of input requirements by species group among various products, FTM–West modeled more realistically the market differential between these two principal species groups.

The Fuel Treatment Evaluator program (FTE 3.0) was used to derive estimates of potential wood harvest from future treatment programs (2005 to 2020) for both "pines" and "non-pines." FTE 3.0 is a separate computer program[4] that uses Forest Service forest inventory and assessment (FIA) data to derive detailed regional estimates of harvestable wood on public lands in the West under various treatment regimes, given specified assumptions about forest thinning objectives and constraints, such as fire hazard reduction goals and minimum volumes per acre for thinning (McRoberts and Miles 2005, Skog et al. 2005). FTE provided estimates of upper bounds (maximum potential harvest volumes) and size class distributions of harvestable wood under two alternative treatment regimes, which included SDI (stand density index) thinning and TFB (thinning from below).[5] SDI refers to a treatment regime that removes trees across the spectrum of age or size classes, leaving uneven-aged residual stands (with reduced stand-density index), whereas TFB refers to a regime that targets removal of smaller trees or younger age classes of trees only and leaves largely even-aged (older age class) residual stands. Harvesting costs for wood removed by thinning were estimated also by FTE 3.0, using the calculation routine from "My Fuel Treatment Planner" (Biesecker and Fight 2005).

In addition to supply and demand curves, the FTM–West model incorporated estimates of manufacturing capacities for all the various products in each of the eight production regions, manufacturing cost data, and also transportation cost data (for wood raw material and product shipments). A feature of PELPS is that production capacities can shift over time in response to economic conditions, and in FTM–West we used a representation of Tobin's q model to project regional capacity change as a function of the ratio of shadow price (or value) of production capacity to cost of new capacity (Lebow et al. 2003).

Complexities in wood utilization modeled in FTM–West

Beyond the general aspects of model structure, some unique structural elements were also incorporated into FTM–West specifically to account for known complexities associated with marketing and utilization of wood from fuel treatments. The need to model those complexities stems from awareness that the size class distribution of harvest (that is, the distribution of wood volumes by tree diameter class) will likely be different for wood removed in fuel treatments than for conventional timber supply. Also, it is fairly well known that timber market value and harvest

[4] An Internet link to FTE 3.0 is at the following website: www.ncrs2.fs.fed.us/4801/fiadb/. FTE 3.0 was accessed in September of 2005 to obtain data for this report.
[5] The SDI thinning regime was composed of FTE 3.0 uneven-aged treatments 2A and 4A, and the TFB regime was composed of FTE 3.0 treatments 3A and 4A (see Skog et al. (2005) and preceding website).

costs per unit volume are highly dependent on tree size class or diameter, whereas mill production capacity, processing costs, and product yields also vary with log diameter, particularly at lumber and plywood mills.

In recognition of the variable size classes of trees harvested, both the conventional timber harvest and the exogenously specified wood harvest from fuel treatments were modeled by 2-in. (5-cm) diameter classes, ranging from trees <5 in. dbh (diameter at breast height) to trees >15 in. dbh. Thus all wood supplies for both "pines" and "non-pines" were disaggregated into seven different tree size classes, each of which can assume a unique market value in the model. Furthermore, each different tree size class yields different proportions of logs (by 2-in. log size class) along with variable quantities of wood chip raw materials. Estimates of actual log and chip volume yields for each tree size class were derived for each of the eight supply regions based on recovery data from regional utilization studies conducted at the Forest Service Pacific Northwest Experiment Station (compiled from mill studies by Dennis Dykstra, PNW Station).

In addition to modeling wood supply by tree diameter class, with data on wood chip and log recovery by log size class, FTM–West was programmed with data on harvest costs, product recovery, and production costs unique to each size class of material. FTE 3.0 was used to estimate harvest costs for wood from fuel treatments, and timber harvest costs for conventional timber supply were estimated by tree diameter class using a different timber harvest cost model (Keegan et al. 2002). Production costs and product recovery potential were based on known relationships between product yields and production costs across the range of log size classes. In sawmills for example, wood input, production costs, and mill capacity all vary with log size, as product yield and throughput all increase with log size. Realistically, wood input requirements, production costs, and production capacity all vary by log size class in FTM–West for products where efficiencies vary by log size class (lumber, boards, and plywood). In other products such as pulp-based paper products, product yields, costs, and capacity were not programmed to vary by tree or log size class.

Thus, FTM–West incorporated unique structural features to reflect well-known complexities in marketing and utilization of wood, including disaggregating wood supplies into a range of tree size classes, further disaggregating recoverable log sizes and chip recovery by tree size class, and modeling harvest costs, product yields, production costs, and production capacities as variables, by tree or log size class. Those realistic features of the model enable projection of the market impacts of increased wood removal even in cases where wood supplies from treatment programs are expected to have substantially different size-class distributions than conventional timber supply. Figure 1 illustrates general structural aspects of the FTM–West model.

Data

A comprehensive description of all supply, demand, capacity, and cost data in FTM–West is beyond the scope of this brief report, but input data is described here for wood supply from the alternative fuel treatment regimes, SDI and TFB. Raw input data from the FTE 3.0 program included regional estimates of total harvestable wood (and corresponding potential treatment acreages). Those estimates totaled 23.2 billion cubic feet and 10.9 million acres in the West for SDI; 9.9 billion cubic feet and 5.6 million acres for TFB. FTE derived those estimates from

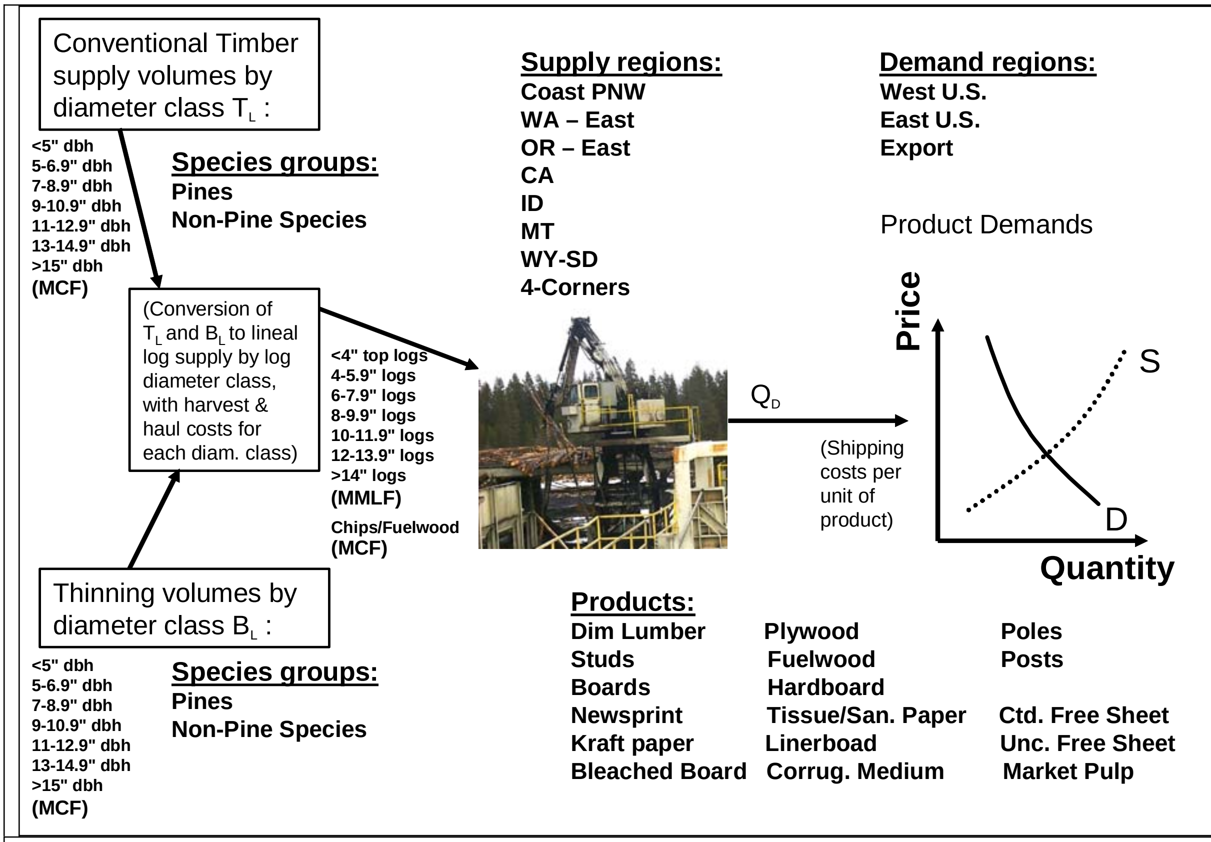

Figure 1. Illustration of FTM–West model structure.

Forest Service (FIA) timber inventory data using a different set of criteria to choose the acres for treatments according to the two treatment regimes. Thus, the SDI and TFB thinning regimes were applied to the same public land base (in the West), but the acres estimated to be treatable and harvestable wood volumes were different under the two regimes because of different treatment criteria (for more details on the fuel treatment criteria, see Skog et al. (2005)).

Some additional basic assumptions were then applied to extrapolate the FTE wood supply and harvest cost data over the projection period from 2005 to 2020. The first assumption was that future treatment programs would require removal of all tree size classes targeted for thinning and not allow “high grading” of the most valuable trees. Under that realistic management assumption, it was reasonable to adopt a simplifying assumption that the size class distribution of trees thinned each year and average harvest cost would remain roughly constant in each region. An additional assumption was that future thinning programs would expand along the path of a reasonable growth function, and therefore a simple log-normal growth function was used to distribute harvestable wood supply over time. Figure 2 shows aggregate projected wood quantities (upper bounds on supply from thinning) available annually in the entire West (total of all eight supply regions) under the SDI and TFB treatment regimes, based on the log-normal growth distribution over time. Figure 3 shows the corresponding acreage of forest that would be thinned annually if all harvestable wood quantities were removed each year.

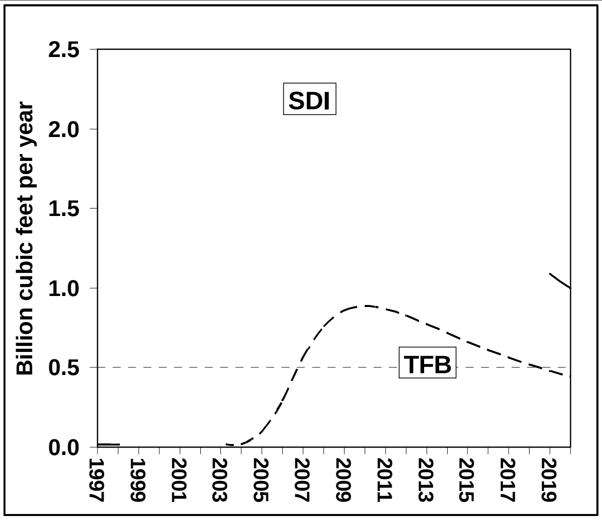

Figure 2. Wood quantities harvestable annually under SDI and TFB treatment regimes.

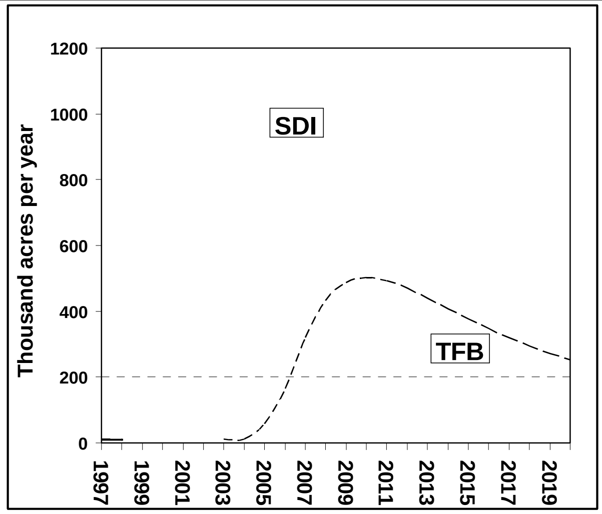

Figure 3. Acreage potentially treatable each year under SDI and TFB treatment regimes.

It can be noted also that total harvestable wood volumes and acreages potentially treatable were much higher under the SDI thinning regime than under TFB (Figures 2 and 3). This is partly because a higher proportion of larger-diameter trees are removed typically under an SDI (uneven-aged) thinning regime and also a larger acreage would be treated under SDI than under the TFB regime. In fact, compared with the estimated distribution of volume by diameter for conventional timber harvest in the West (in 1996), the SDI thinning regime would involve removal of trees with higher average diameter than conventional timber harvests, whereas the TFB regime would involve removal of trees with lower average tree diameter than in conventional timber harvests.

Figure 4 shows for comparison the estimated volume distributions in percentages by tree diameter class for conventional timber harvest in the West (1996) and for wood removals from the TFB and SDI treatment regimes. It can be noted that the estimated distribution of volume by size class for conventional timber harvest (in 1996) was fairly broad and included substantial shares of volume in smaller size classes. Generally speaking, the era of harvesting primarily large old-growth timber in the U.S. West had come to an end well before 1996, resulting in a more normal distribution of harvest volume by tree diameter class (less skewed toward larger size classes than was historically the case). For both treatment regimes (TFB and SDI), a larger proportion of removable volume was estimated to be in the smallest size classes (<5 in. and 5–6.9 in. dbh) than for conventional timber harvest. Thus, both treatment regimes present a challenge of utilizing a higher proportion of small-diameter trees than used conventionally in the West; however the SDI thinning regime (aimed at producing uneven-aged residual stands) would also provide a much higher than conventional share of volume in the largest size class (>15 in. dbh), based on the estimates from FTE 3.0.

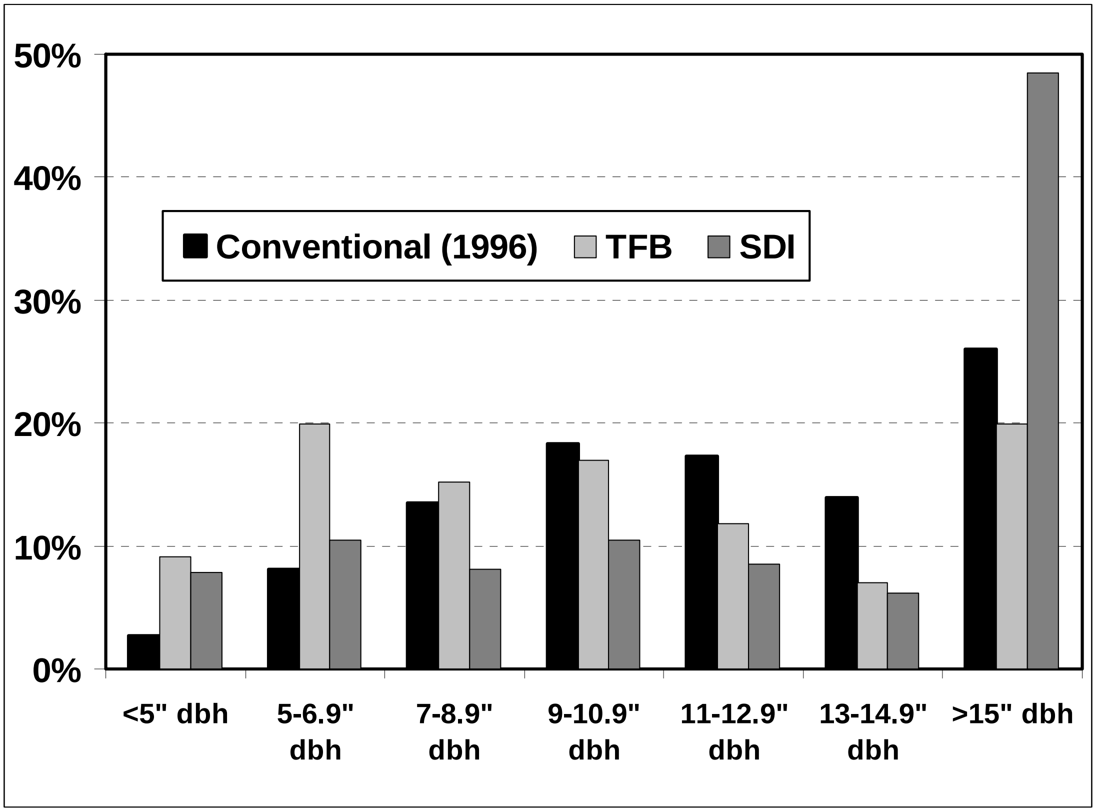

Figure 4. Percentage distribution of wood removal volumes by tree diameter class for conventional timber harvest in the U.S. West (1996) and for wood removed by thinning from TFB and SDI fuel treatment regimes.

Analysis

FTM–West was used to project market impacts from 2005 to 2020 for both the TFB and SDI treatment regimes, with and without hypothetical harvest cost subsidies, as compared to a "base" scenario in which no additional wood was supplied from treatment programs over the projection period. Thus, five different model runs or market scenarios were involved in the analysis, as summarized in Table 2. In the scenarios where no cost subsidy was applied, it was assumed hypothetically that treatment operations would be assessed an administrative fee of $500 per acre (which is in the vicinity of average administrative cost fees charged to conventional timber harvest operations on public lands in the West). In the scenarios with cost subsidy, it was assumed hypothetically that there would be a government subsidy of $200 per thousand cubic feet (MCF) of wood removed, and the administrative costs would be waived. No other fees or subsidies were associated with wood removal under the hypothetical treatment program scenarios.

The administrative cost assumption is reflective of mid-range costs for conventional timber sales on public lands in the West, but it should be emphasized that all assumptions regarding administrative fees and subsidy levels among these scenarios are purely hypothetical and do not necessarily reflect actual costs or potential subsidy levels that may be associated with future fuel

Table 2. Treatment program scenarios analyzed in this study using FTM–West model			
Scenario	Expanded thinning	Cost subsidy	Admin. costs
1. Base	No	N.A.	N.A.
2. TFB—no subsidy	Yes	No	$500/acre
3. TFB—subsidy	Yes	$200/MCF	No
4. SDI—no subsidy	Yes	No	$500/acre
5. SDI—subsidy	Yes	$200/MCF	No

treatment programs.[6] The hypothetical cost and subsidy values were included only to analyze how the market could respond to hypothetical base-level program costs or subsidy levels. At present, subsidies are not generally available for large-scale wood removal programs, although public agencies have subsidized some fuel treatment operations in recent years, mainly prescribed burning and mechanical thinning without wood removal. The hypothetical $500 per acre administrative cost is within the vicinity of typical administrative costs assessed to conventional timber harvest operations on public lands in the West, but the actual extent to which administrative costs might be assessed in future fuel treatment operations remains speculative, and the cost assumption is therefore hypothetical.

Results

A leading result of the analysis was that the market could economically utilize two-thirds or more (but not all) of the harvestable wood volumes from either the SDI or TFB regimes, and (as expected) wood removals increase with higher subsidy levels. Projected wood removals from thinning regimes in the West are illustrated in Figure 5, which shows equilibrium projections of annual wood removals reaching 0.5 to 1.5 billion cubic feet per year, depending on treatment regime and subsidy levels. For the SDI (uneven aged) thinning regime, 67% of total harvestable (upper bound) wood supply was projected to be actually harvested and utilized by the market when charged an administrative fee of $500 per acre. Similarly, under the TFB regime 68% of harvestable wood volume was projected to be harvested and utilized by the market with an administrative fee of $500 per acre. Substantially higher shares of harvestable wood volumes were projected to be harvested and utilized by the market if the $500 per acre administrative cost is replaced by a harvest subsidy of $200 per MCF (84% for SDI and 91% for TFB).

Equilibrium levels of wood removals correspond to sizable projected acreages of public forestland treated in the West. Figure 6 illustrates projected acreage treated annually via thinning and wood removal under the SDI and TFB thinning scenarios, with and without hypothetical subsidies. The acreage treated increases with subsidy, but substantial acreages are also projected to be treated without subsidy (at administrative fees of $500 per acre). Over the 16-year projection period 5.8 million acres are projected to be treated under the SDI regime and 3.4 million acres under the TFB regime without any subsidies, while 8.4 million acres are projected

[6]Future thinning programs may for example include additional stumpage fees for wood removed.

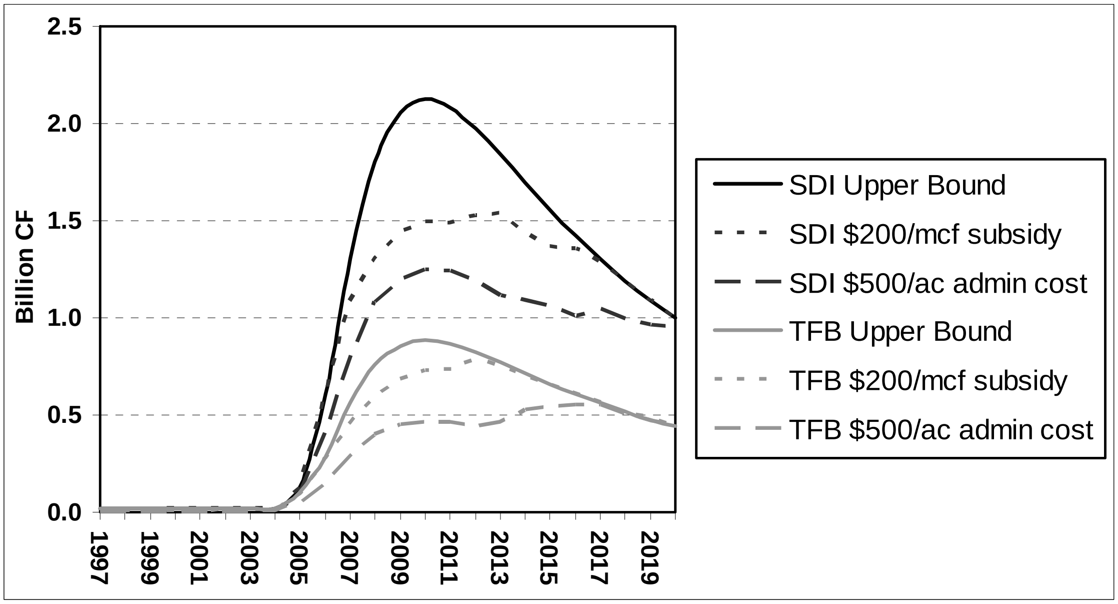

Figure 5. Upper bounds on harvestable wood volumes from SDI and TFB regimes and equilibrium wood harvests under alternative subsidy or administrative cost scenarios.

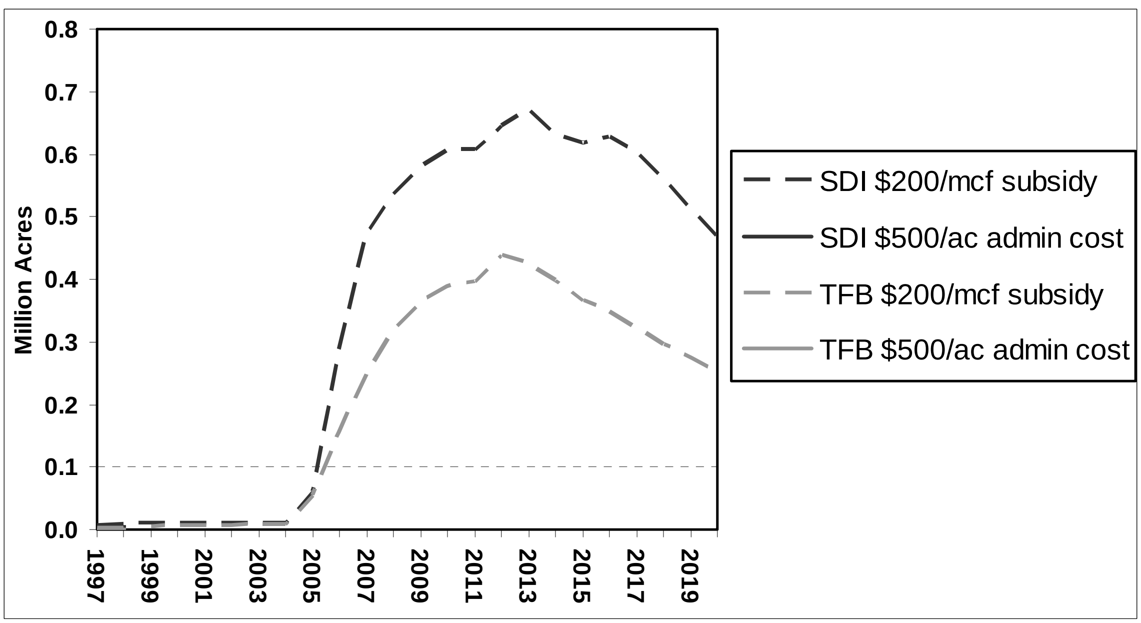

Figure 6. Projected acreage treated annually by SDI and TFB treatment regimes under alternative subsidy or administrative cost scenarios.

to be treated under the SDI regime and 5.0 million acres under the TFB regime with a subsidy of $200 per MCF of wood removals.

An important set of additional results from the economic analysis were the projections of broader economic impacts of expanded fuel treatment thinning programs on timber markets in the U.S. West. In particular, the analysis projected impacts on regional timber prices and overall timber harvest (including timber harvest from conventional supply sources). Combining projected impacts on regional timber prices and regional harvest of timber, the results provided an indication of projected impacts on timber revenues in the region. Because most timber supply in the West is currently obtained from state and private forestlands, the projected impact on timber revenues would be primarily an impact on state and private timber revenues.

Increased wood supplies from the hypothetical fuel treatment programs were projected to substantially offset projected increases in timber stumpage prices in the U.S West. The base scenario, with no expansion of wood supply from fuel treatment programs (and limited expansion of timber supply from conventional sources in the region) resulted in a steadily increasing real price trend for softwood timber stumpage over the projection period, more or less in line with the historical price trend of recent years. Figure 7 illustrates the projected average real price trend for softwood timber stumpage in the West (weighted by volume across all timber size classes) for the base scenario (with no expansion of supply from fuel treatments) and also projected timber price trends under the hypothetical TFB and SDI treatment regimes, both with and without subsidies. In contrast to the steadily increasing real price trend of the base scenario, the projected regional timber price trends under the hypothetical treatment programs were substantially lower. In all scenarios timber prices were projected to eventually increase in the West (beyond 2010), but the near-term impacts of the expanded treatment programs were to stabilize or reduce projected timber prices for a number of years (Figure 7).

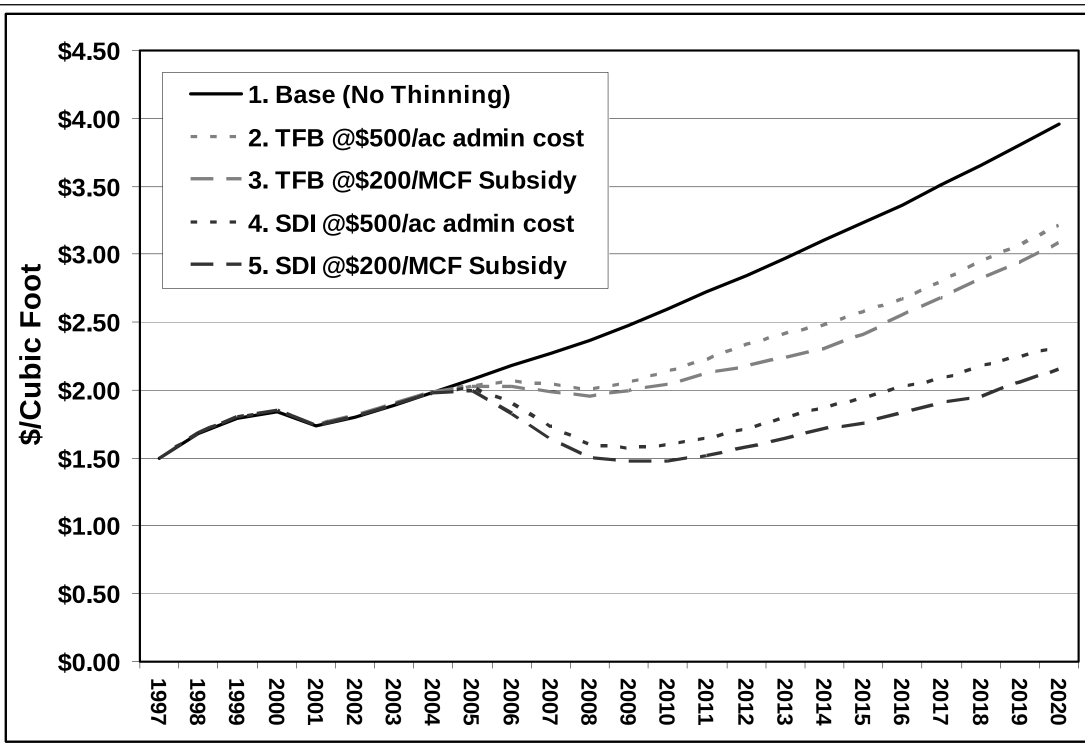

Figure 7. Projected average real timber stumpage price trends in U.S. West for base scenario (no expansion of fuel treatment thinning) and with hypothetical TFB and SDI treatment scenarios (at two different levels of administrative cost or subsidy).

Results indicated that total wood harvest in the U.S. West could expand with thinning from fuel treatment programs, partly displacing harvest of timber from conventional supply sources (mainly state and private forestlands) and resulting in lower average timber stumpage prices. The SDI treatment regime has a larger impact than the TFB regime because larger wood volumes are removed under the SDI regime. Figure 8 illustrates projected impacts of the SDI treatment programs on annual wood harvests relative to the base scenario. Total wood harvest increases with fuel treatments, but there is a displacement of timber harvest from conventional supply sources. Smaller but similar impacts were observed in the results for the TFB regimes. Wood removals from the hypothetical fuel treatment programs were projected to reach peak levels of 15% to 39% of total annual wood harvest in the West during the next decade, depending on scenario.

Reduced timber prices (Figure 7) and displacement of harvests from conventional timber supply sources in the West (Figure 8) combine to offset regional timber revenues for conventional timber suppliers (mostly state and private forests in the West). Relative to the base scenario, the TFB treatment with no subsidy was projected to offset timber revenues for conventional suppliers of timber by 37 billion dollars cumulatively over the period from 2005 to 2020, while the subsidized TFB treatment offset conventional timber revenues cumulatively by 49 billion dollars. Similarly, the SDI treatment without subsidy was projected to offset conventional timber revenues cumulatively by around 78 billion dollars, whereas the subsidized SDI treatment was projected to offset conventional timber revenues cumulatively by upwards of 90 billion dollars from 2005 to 2020.

However, in addition to offsetting effects on regional timber revenues, FTM–West also projected

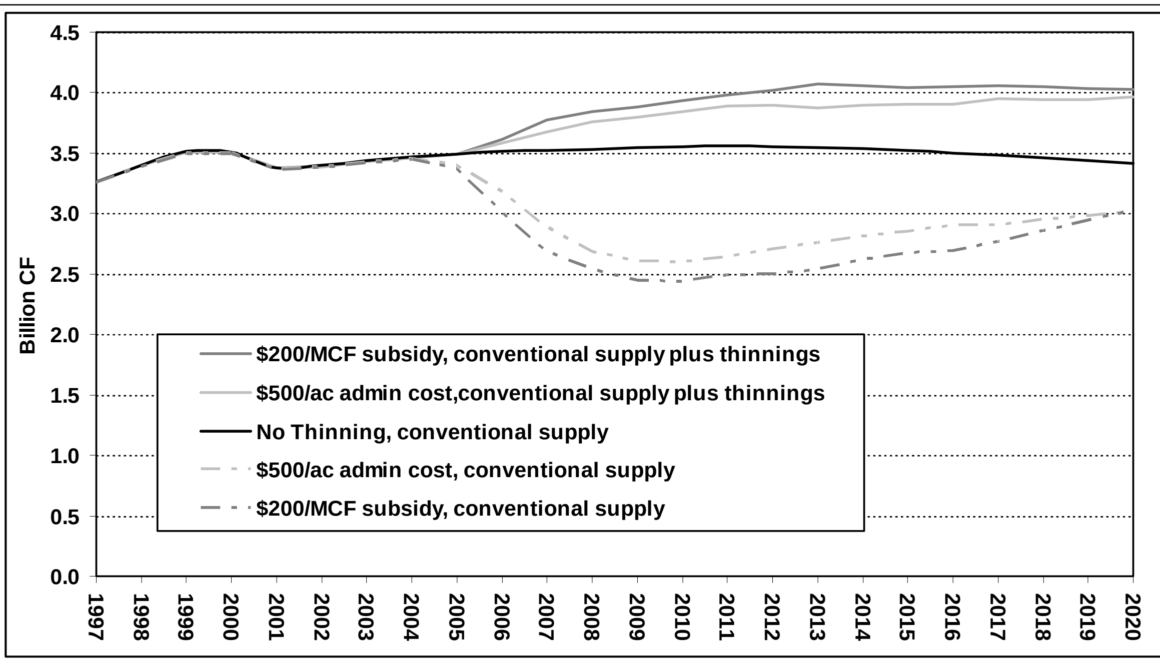

Figure 8.— Projected timber harvest in U.S. West from conventional supply sources with no expansion of thinning, and also total harvest and harvest from conventional supply sources with SDI treatment thinning program (at two levels of admin. cost or subsidy)

a positive effect of the treatment programs—expanded output of forest products in the West and lowered cost of forest product production in the region (with lower timber costs). The full extent of consumer welfare implications of that effect are beyond the scope of this report and can be approached only in a partial sense because FTM–West is a partial market equilibrium model (and does not include economic sectors that could benefit from lower costs or increased output of forest products, such as the housing sector). Nevertheless, the model does suggest that losses of timber revenues to conventional suppliers of timber will be at least partly mitigated by benefits that would accrue as a surplus to consumers of timber and wood products as a result of increased product output with lower timber costs. A separate study by our colleagues in the JFSP project (Abt and Prestemon 2006) led to development of another economic model of interrelated timber markets in the U.S. West, and their findings concluded that revenue losses to U.S. private timber producers would exceed gains for timber consumers (mills).

Summary and Discussion

This paper provides a brief overview of FTM–West and shows some of the model's projections for hypothetical fuel treatment programs involving forest thinning on public lands in the U.S. West. The scenarios allow wood from treatment programs to enter the market for timber and wood products in the U.S. West. FTM–West was designed to project the market equilibrium in wood utilization, balancing supply and demand for wood from thinning programs against conventional timber supply and demand in the region. Results show that a substantial share (two-thirds or more) of wood available from treatment programs could be utilized by the market, partly displacing conventional timber harvest and offsetting projected timber stumpage prices in the region. In the treatment scenarios, two alternative levels of administrative cost or subsidy were imposed, either an administrative fee of $500 for every acre thinned or a subsidy of $200 per thousand cubic feet (MCF) of wood removed (with no administrative fee). No other fees or subsidies for wood removal were assumed for the hypothetical thinning programs.[7]

FTM–West was designed to model economic complexities that can arise in utilization of wood from treatments that produce unconventional size-class distributions, such as higher proportions of smaller diameter timber (which increases harvest costs, reduces product yield and throughput capacity at sawmills, and increases production costs). Those structural complexities were embedded in the scenarios analyzed in this study, yet the model still projected that the market could economically utilize substantial volumes of wood from the treatment programs in the U.S. West. Furthermore, large volumes of wood projected to enter the market from expanded treatments resulted in significant projected timber revenue impacts within the region. The cumulative timber revenue impacts were an order of magnitude larger than the cumulative amounts of subsidies or administrative fees associated with the hypothetical fuel treatment programs. Table 3 summarizes the cumulative thinning accomplishments and regional timber revenue impacts (from 2005 to 2020) of the treatment program scenarios examined in this study.

[7] The fact that substantial volumes of wood from thinning were projected to be removed even under the higher administrative fee assumption suggests that yet higher administrative fees or added stumpage fees could be charged, but that would of course reduce the quantity of material absorbed by the market.

Table 3. Cumulative thinning results, costs, and regional timber revenues (2005–2020) for base scenario and hypothetical treatment programs analyzed using FTM–West model					
	Treatment program (public lands)				
Scenario	Acres thinned (million acres)	Wood removed (million cubic feet)	Subsidies ($billion, cumulative)	Admin. fees ($billion, cumulative)	Regional timber revenue[8] ($billion, cumulative)
1. Base	(0)	(0)	(0)	(0)	164.55
2. TFB—no subsidy	3.390	6,752	(0)	1.69	127.50
3. TFB—subsidy	4.982	9,085	(1.82)	(0)	115.62
4. SDI—no subsidy	5.758	15,458	(0)	2.88	87.03
5. SDI—subsidy	8.426	19,350	(3.87)	(0)	74.87

Conclusions and Caveats

FTM–West provides a tool for forest economists to model market impacts of expanded fuel treatment thinning programs in the U.S. West, taking into account the structural complexities of tree and log size in relation to marketability and utilization of wood from thinning regimes. Initial analysis concludes that markets could economically utilize large volumes of wood from expanded fuel treatments despite divergent size-class distributions, expanding overall wood harvest in the West. Large-scale expansion could, however, have broader welfare implications via market impacts on price and harvest from conventional timber supply sources. Hypothetical thinning programs were projected to offset the increasing timber price trend in the West, displace timber harvest from conventional timber supply sources (mainly state and private timberlands), and thus offset timber revenues for conventional suppliers of timber in the region. Cumulative timber revenue impacts were projected to be an order of magnitude larger than the administrative costs or subsidies associated with the expanded fuel treatments.

This paper provides what some might view as a relatively optimistic assessment of the economic viability of fuel treatments on public lands, an outlook that appears at odds with current experience. For example, according to fuel treatment data reported by federal agencies, the number of acres that have been treated by mechanical thinning with biomass removal has increased in recent years, but that acreage is still dwarfed by the acreage projected to be treated via thinning in this study. In the past year, fuel treatments on public lands encompassed over 4 million acres nationwide, but well over 90% of the fuel treatment acreage on public lands involved only prescribed burning or mechanical treatments without biomass removal, and thus it remains speculative whether future fuel treatment programs will permit significantly expanded wood supply from forest thinning. However, acreages projected to be treated via TFB and SDI thinning regimes (Figure 6, Table 3) are at most only about 25% to 50% of the acres identified

[8] Timber revenues in Table 3 refer to projected timber stumpage sale revenues (2005–2020) for conventional timber supply in the West (which is primarily from state and private timberlands in the region).

by FTE as being at high risk of catastrophic fire in the U.S. West. In other words, as optimistic as the results may seem, they suggest that treatment by TFB or SDI thinning regimes would not be economically viable on 50% to 75% of high-risk acreage on public lands in the U.S. West.

Another reason for the relatively optimistic assessment of fuel treatment viability was that the results presented here were based on a set of assumptions that did not place wood from fuel treatments at a big disadvantage in the market relative to conventional timber supply, and that helped to boost demand for wood from fuel treatments. Those assumptions included optimistic forest product demand growth, modest differences in harvest cost estimates for conventional timber supply and wood removals from fuel treatments, and volume distributions by size class that did not cause wood supplied from fuel treatments to be at a big disadvantage in utilization compared with conventional timber supply. Reasonable variation in any of these key assumptions could of course result in a different assessment of fuel treatment program viability.

All scenarios presented in this study assumed, for example, the same level of fairly robust forest product demand growth. The robust demand growth outlook contributed to projected timber price increases in the base scenario. A less robust demand outlook will of course result in lower projected timber prices for all scenarios and will tend to diminish the viability and expansion of fuel treatments. Harvest cost estimates for the model were obtained from two different sources, including FTE 3.0, which provided harvest costs for wood removed in fuel treatments, and a different model that provided harvest costs for conventional timber supply (Keegan et al. 2002). Discrepancies in harvest costs between those sources were not very large, but certainly larger variation in assumptions about harvest costs, administrative costs, or subsidies could affect relative competitiveness of wood supply from fuel treatments versus conventional timber supply sources. In addition, the projected distribution of harvest volumes by tree diameter from the fuel treatment regimes were similar enough to the distribution of conventional timber harvest in the West (as shown in Figure 4) that the model allowed substantial volumes of material from the fuel treatment regimes to be assimilated by the market (and to partly displace conventional timber supply). If future fuel treatment regimes were to offer a really different volume distribution (for example, a much higher proportion of smaller timber in comparison to conventional timber supply), then the economic viability and projected expansion of fuel treatments would likely diminish; however, generally speaking, the wood industry in the U.S. West has been adapting to increased use of smaller diameter timber for years.

In summary, the conclusions and results should be viewed in the context of a number of appropriate caveats about basic assumptions used in the FTM–West model. However, those caveats and assumptions also serve as a reminder that FTM–West is a tool that can be used to explore a number of other alternative outcomes and issues related to fuel treatment programs for the future. With tools such as FTM–West, it is possible to explore the likely economic viability and market impacts of alternative treatment regimes, with various assumptions about rates of forest product demand growth, harvest costs, and administrative costs or subsidies for fuel treatments, variation in size class distributions of wood removed in fuel treatments, and variation in other relevant parameters.

References

Abt, K.L., and J.P. Prestemon. 2006. Timber markets and fuel treatments in the western U.S. Natural Resource Modeling 19(1).

Biesecker, R.L., and R.D. Fight. 2005. My fuel treatment planner: a users guide. Gen. Tech. Rep. PNW-GTR-XX. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. (Draft manuscript)

Buongiorno, J., S. Zhu, D. Zhang, J. Turner, and D. Tomberlin. 2003. The global forest products model: structure, estimation and applications. Academic Press. 300 p.

Calmels, P., J. Buongiorno, and D. Zhang. 1990. PELPS II: A microcomputer price-endogenous linear programming system for economic modeling. Research Report R3477. College of Agricultural and Life Sciences, Univ. of Wisconsin–Madison. 40 p.

Gilless, J.K., and J. Buongiorno. 1985. PELPS: Price-endogenous linear programming system for economic modeling. Research Report R3329. College of Agricultural and Life Sciences, Univ. of Wisconsin–Madison. 34 p.

ITTO. 1993. Analysis of macroeconomic trends in the supply and demand of sustainably produced tropical timber from the Asia-Pacific region, phase I. International Tropical Timber Organization: Yokohama, Japan.

Johnson, T.G. (ed.). 2001. United States timber industry—An assessment of timber product output and use, 1996. Gen. Tech. Rep. SRS-GTR-45. Asheville, NC: USDA Forest Service, Southern Research Station. 145 p.

Keegan, C.E., M.J. Niccolucci, C.E. Fiedler, J.G. Jones, and R.W. Regel. 2002. Harvest cost collection approaches and associated equations for restoration treatments on National Forests. Forest Products Journal 52(7/8).

Lebow, P.K., H. Spelter, and P.J. Ince. 2003. FPL-PELPS, A price endogenous linear programming system for economic modeling, supplement to PELPS III, Version 1.1. Res. Pap. FPL-RP-614. Madison, WI: USDA Forest Service, Forest Products Laboratory. 32 p. *www.fpl.fs.fed.us/documnts/fplrp/fplrp614.pdf*

McRoberts, R.E., and P.D. Miles. 2005. Computer-based application tools using forest inventory data from the United States of America. Forest Biometry, Modeling and Information Sci. 1:11-18.

Skog, K., J. Barbour, K. Abt, T. Bilek, F. Burch, R. Fight, B. Huggett, P. Miles, E. Reinhardt, and W. Sheppard. 2005. An evaluation of silvicultural treatments and biomass use to reduce fire hazard in western States. USDA Forest Service. (Draft manuscript)

Zhang, D., J. Buongiorno, and P.J. Ince. 1993. PELPS III: A microcomputer price endogenous linear programming system for economic modeling, version 1.0. Res. Pap. FPL-RP-526. Madison, WI: USDA Forest Service, U.S. Forest Products Laboratory. 43 p.

Zhang, D., J. Buongiorno, and P.J. Ince. 1996. A recursive linear-programming analysis of the future of the pulp and paper industry in the United States: Changes in supplies and demands and the effects of recycling. Annals of Operations Res. 68:109-139.

In: Proceedings of southern forest economics workgroup (SOFEW), forestry; Economics and environment; 2005 April 18-20; Baton Rouge, LA. Baton Rouge, LA: Louisiana State University; pp. 275-291.