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FROM: Mark Buckley, Richard Haynes, Austin Rempel and Wilcox Gleasman

SUBJECT: ECONOMIC ANALYSIS OF H.R. 1526 - RESTORING HEALTHY FORESTS FOR HEALTHY COMMUNITIES ACT

1. Executive Summary

H.R. 1526 is expected to increase Forest Service harvests by 3.73 billion board feet (MMMBF) from the current 2.27 MMMBF annually. While this does represent a large increase from current levels, a harvest of 6.0 MMMBF is roughly equal to harvest levels in the late 1950s, and about 55% of the peak harvest levels reached in the late 1980s.

Expected market impacts would evolve over the first decade of implementation. Timber supply would expand especially in the West leading to increases in production and capacity. The increase in lumber production would lead to lower lumber prices and reduced lumber imports from Canada. All landowners would see an almost 10% decline in stumpage prices in the West and nearly 5% decline in the South. Such price declines will reduce private harvest in the near term by approximately 17% offsetting the increase on national forests. These declines in stumpage values also lead to declines in the capital value of timber perceived by private, state and local public timberland owners. In the South, timberland owners in the near term would see a 1.6% decline in the per acre value of timber stands. In the West this would be 4.8%.

H.R. 1526 sets high expectations for the Forest Service to quickly expand timber sale programs and harvest. Given the nature of the Forest Service's sales process, this would likely be an operational challenge and will require additional staffing. The Forest Service must select sales areas, lay out the sales, and appraise them before being able to offer sales for bid. Once a sale is sold the bidders usually have up to three years to harvest a sale. This transition period would serve to mitigate potential negative economic impacts. The small initial harvest increase reduces impacts on private timberland owners, provides a signal to processors to increase capacity, and alerts producers in other regions of pending market shifts.

Revenue and cost estimates for the harvest changes in Western Forest Service Regions under H.R. 1526 suggest increased federal costs for implementation exceed revenue to the federal treasury (Figure ES-1).

Figure ES-1. Change in Net Revenue and County Payments, Western Region under H.R. 1526

	10 Year Value, Western Region (Millions $)			
	Revenues	Sale Prep Costs	Net Profit/Loss	County Payments
Undiscounted	718	1,597	-879	179
Discounted at 4%	582	1,296	-714	145

This table does not include the federal share of increased road costs nationally, which may

range from $50-100 million per year, or $400-800 million over a decade (discounted 4 percent). The distribution of these costs across national forests is in proportion to increases in harvests but may be higher on those forests that traditionally had small timber programs.

The second purpose of H.R. 1526 is to ensure that counties have a dependable source of revenue from National Forest System land. While H.R. 1526 does not address market volatility, it fails to recognize the tendency of the Forest Service to sell lower valued log mixes. There are opportunities for the Forest Service to improve the log mixes it sells and consequently increase revenues. In addition, the bill assumes surmounting existing restrictions on the 20 national forests that currently face harvest restrictions. It also assumes that every forest can expand harvest in spite of the evidence of weak markets for many national forests.

2. Introduction

On April 12, 2013, Representative Hastings (R-WA-4) introduced H.R.1526 - Restoring Healthy Forests for Healthy Communities Act (H.R. 1526). H.R. 1526 directs the Secretary of Agriculture (Secretary) to establish Forest Reserve Revenue Areas (FRRAs) in all units of the National Forest System to generate forest products for the purpose of generating revenue to support payments to counties containing these forest reserves. The Secretary is also charged to manage these areas to meet specific timber volume targets.

In this memo, we investigate some of the economic implications of implementing H.R. 1526. We focus on the costs associated with the proposed increase in timber harvest as well as the effects that this increase in supply could have on timber markets. What is the market demand for timber, and would the increase from current to proposed levels of annual Forest Service timber harvest lead to changes in private timber harvests, costs of production and market prices? What are the likely costs of implementation for federal agencies? In order to answer these questions, we conduct a series of analyses:

- Identify the changes in national forest harvest levels that would be attributable to H.R. 1526
- Identify the costs that these changes would generate for federal agencies
- Characterize the demand for federal timber harvests, taking into account regional constraints for mills, roads, and other public and private considerations
- Estimate the likely prices and revenues that would be associated with the change in harvest levels

We also investigate a series of related issues in terms of how these changes are regionally distributed, potential market impacts and effects on private timberland owners, cost and revenue implications, the impacts of changes in processing capacity, and past assessments of the profitability of National Forest timber sales.

2.1 H.R. 1526 Proposed Changes in National Forest Management

H.R. 1526 has five titles addressing a wide range of issues related to "restoring healthy forests for healthy communities". Our focus is on Title 1, which has three purposes:

- "To restore employment and educational opportunities in, and improve economic stability of counties containing National Forest System land.
- To ensure that such counties have a dependable source of revenue from National Forest System land.
- To reduce Forest Service management costs while also ensuring the protection of United States forests resources.

Pursuant to the these goals, H.R. 1526 establishes a Forest Reserve Revenue Area (FRRAs) in every national forest, each with an annual timber production requirement and 25% revenue share obligation to counties containing National Forest System land. H.R. 1526 does not specify the target annual harvest volumes for each FRRA, but states that overall annual harvests should be one-half of the sustainable yield of the National Forest System[1]. In a cost estimate for the bill issued by the Congressional Budget Office (CBO), based on information provided by the Forest Service and other affected Federal agencies, it is estimated that required timber sales under H.R. 1526 would need to be six billion board feet (MMMBF) per year, compared to current annual harvest levels of 2.27 MMMBF.[2] H.R. 1526 also has provisions that would expedite timber sales through a streamlined review and permitting process. In their review, CBO recognizes that receipts would also depend on the type of timber offered for sale, the location of that timber, harvest methods, mill capacity, and the ability of the Forest Service to administer increased sales.

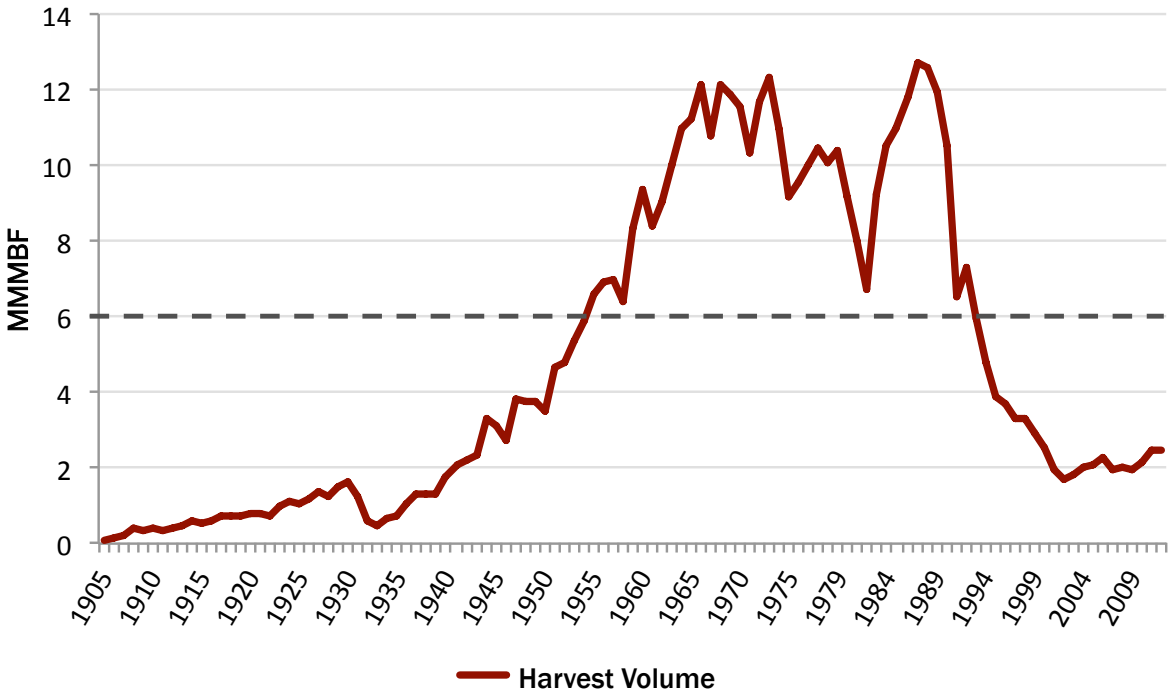
Total harvests between 1905 and 2012 are shown in Figure 1 to provide perspective on the proposed 3.73 MMMBF increase. While it does represent a large increase from current levels, it is important to note that it is roughly equal to harvest levels in the late 1950s, and about 55% of the peak harvest levels reached in the late 1980s (roughly 12.7 MMMBF, as illustrated in Figure 1). In the context of the growth – drain ratio (one way to quickly assess sustained yield management), the Forest Service had a ratio of 1.52 where growth exceeded removals even during the period of high harvest sustained in the late 1980s and by 2002 the growth – drain

[1] The term sustained yield is best understood as the net growth exceeding removals; the Society of American Foresters defines it as "continuous production so planned as to achieve … a balance between increment (growth) and cutting (removals)". Helms, 1998. The Dictionary of Forestry, Society of American Foresters, Washington DC.

[2] Congressional Budget Office. 2013. H.R. 1526, Restoring Healthy Forests for Healthy Communities Act Cost Estimate. http://www.cbo.gov/publication/44586. September 17.

ratio had risen to 11.69 following the 85 % reduction in harvest between those two periods[3] (illustrated in Figure 1).

Figure 1. Timber Harvest From Lands Managed By The U.S. Forest Service, 1905-2012



Source: ECONorthwest, with data from the Forest Service

2.2 Analytical Context

A large body of research exists regarding the efficiency and inefficiency of timber harvests on national forests. Due to difficulty of access, limits to sustainable yield, issues of timber density and timber quality, as well as other factors, increasing harvest volumes are at some point met with increasing costs overall. Similarly, markets cannot indefinitely absorb increasing supply, as limits for harvest and mill capacity as well as final market demand eventually cause declining prices. Studies dating back to the 1980s indicate that national forest timber harvest programs have often operated at a net financial loss to the Forest Service.[4] One of the primary reasons for these losses are that the full costs of a sale, such as the creation and maintenance of logging roads, are not incorporated into the sale price.

[3] Computed from data for both softwoods and hardwoods in provided in tables 20 and 21 from The 2005 RPA Timber Assessment Update. PNW-GTR-699

[4] Wolf, R. 1989. National Forest Timber Sales and the Legacy of Gifford Pinchot: Managing a Forest and Making it Pay. University of Colorado Law Review. Vol. 60. pp. 1037-1089

In this context, we investigate existing data that help us understand how the proposed increase in timber harvests via FRRAs across all national forests would likely affect costs and revenue to federal agencies, primarily the USFS. We utilize harvest data and information on historically profitable and unprofitable harvests, current mill locations, and current road densities in national forests. We identify costs, particularly sale prep costs to federal agencies, and market price responses to increased harvest.

3. Allocation of Increased Federal Harvests

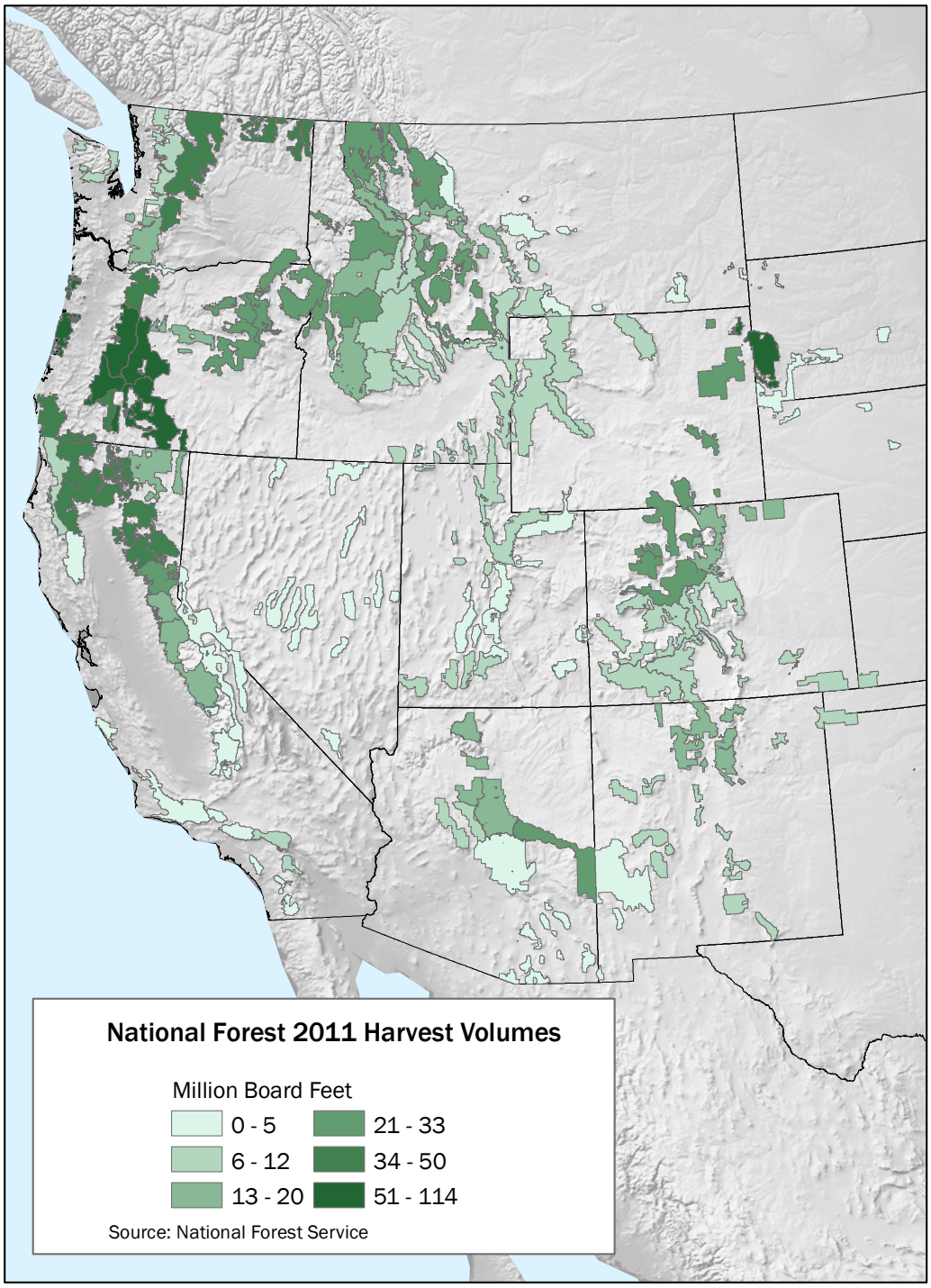
In this section we develop a scenario for how the proposed increase in total annual harvest would affect harvest among individual national forests. We focus on convertible products, primarily sawtimber and pulpwood, and do not distinguish between hardwood and softwood species. Both of these issues are more important in the East than in the West.

Table 1. National Forest Harvest by Forest Service Region

Forest Service Region	Historical Harvest Average Harvest 1988-1990 (MMMBF)	Current Harvest Average Harvest 2009-2011 (MMMBF)	Bill Scenario Proportional increases across all regions
North (8)	1,323	463	1,224
South (9)	780	363	959
Northern Rockies (1)	970	258	683
Rocky Mountains (2)	403	216	570
Southwest (3)	461	100	264
Inter Mountain (4)	423	96	255
Pacific Southwest (5)	1,899	242	640
Pacific Northwest (6)	4,657	499	1,319
Alaska (10)	448	32	85
Total	11,363	2,269	6,000

Source: ECONorthwest with data from the Forest Service 'Production, Prices, Employment, and Trade in Northwest Forest Industries' Annual Reports

Map 1. National Forest Harvest in 2011



Source: ECONorthwest, with data from the U.S Forest Service

Table 1 shows historic (1988-1990)[5] and recent (2009-2011) harvest levels by forest Service region in million board feet (MMMBF). Data for individual national forests and regions can be found in Appendix 1.[6] The historical harvest column represents the average harvest for reach region between 1988 and 1990, a historical high when both US and international (especially Pacific Rim) markets peaked concurrently. The current harvest column presents the same data for 2009 to 2011, a period which includes the 'great recession' and early recovery. The data illustrate the drop in overall harvest that has occurred in recent decades, as well as shifts in the harvest allocation among regions.[7] Map 1 shows the concentration of recent harvests among the western National Forests. While National Forests are spread across the higher elevations of the West, Forest Service timber harvests are concentrated in the Pacific Northwest, northern California, western Montana and northern Idaho. There are large parts of the West where Forest Service timber harvests are relatively small.

While H.R. 1526 calls for an increase in overall harvest, it does not address the regional distributions of this increase, and only briefly considers the process for increasing the sales activity necessary to sustain higher harvest levels. The establishment of FRRAs though does suggest increased harvest in all national forests. Here, Following the logic of the CBO report, we develop a basic scenario to illustrate how harvest levels under H.R. 1526 would occur, assuming equal and proportional harvest increases across forests so as to meet requirements to establish increased revenue for local counties at all national forests. We also consider the Forest Service sales process, how these harvest increases might look from an operational standpoint, and also the potential economic impacts.

The allocation scenario, shown in Appendix 1, is based on a uniform increase in harvest on all national forests by 264.3% (i.e., the total increase from 2.27 to six MMMBF). This scenario maintains the current relative harvest positions of the Forest Service regions, that is, that 64% of the harvest would occur in the western region and the remaining 36% in the two eastern regions (the North with 16%, and the South with 20%). Most of the harvest levels, except for those that would occur in the Rocky Mountain Region, are within historical ranges. Additionally, the cancellation of the two large timber sale contracts and the closure of the two pulp mills on the

[5] Depending on the data set being used, peak harvest occurred in 1987 with roughly 12.7 million board feet. Here because of data availability we are using the average of 1988-1990 as the period just before the Dwyer injunction and the market declines of the early 1990s.

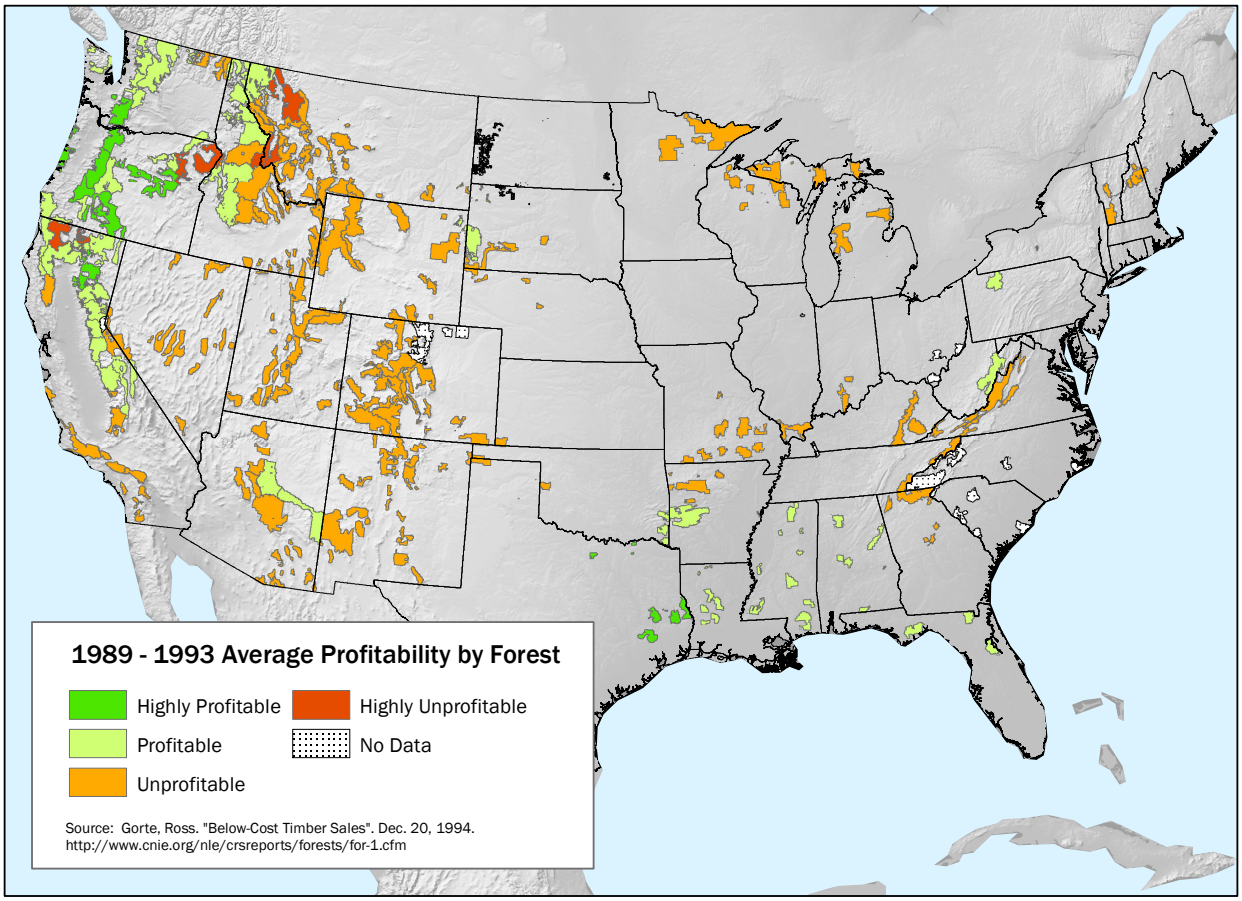
[6] All data presented here and in Appendix 1 are derived from the Forest Service 'Production, Prices, Employment, and Trade in Northwest Forest Industries' Annual Reports and Cut and Sold Reports

[7] Discussion of these shifts and their impacts on the US Forest Sector can be found in the Forest Service's Resource Planning Act documents (see www.fs.fed.us/research/rpa).

Tongass National Forest in the 1990s have reduced the relevance of historic harvest levels in Alaska to the recent levels shown in Table 1.

4. Harvest Profitability and Unprofitability

Map 2. National Forest Harvest Profitability



Source: ECONorthwest, with data from the U.S. Forest Service

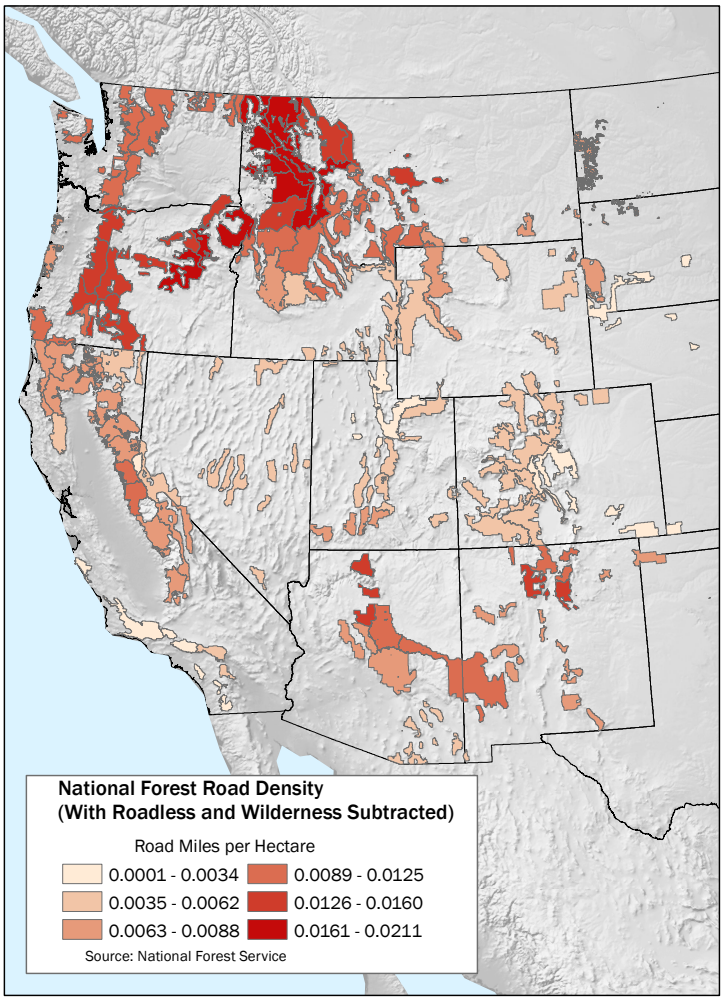
In the 1990s, a body of research developed concerning the variable profitability and unprofitability of harvests from national forests, stemming from debates concerning below cost harvests as described earlier. A 1994 study by the Congressional Research Service investigated the costs and revenues from national forest harvests by national forest. See Appendix 2 for more detail. The study found harvests on a large share of the national forests to be unprofitable. It reported:

> *"In general, three factors -- singly or in combination -- account for the losses. First, rough terrain often leads to high operating costs for the agency, both for access and to prepare and administer the sales. Second, low timber densities and dispersed stands (often the result of rough terrain) lead to small commercial timber sale programs, and thus to relatively high overhead*

costs. Third, some areas have low selling values, either because of poor timber species or quality or because of high operating costs for the purchaser (which could result from rough terrain or from dispersed timber stands)."[8]

This report provides a basis for considering where harvests will be profitable and unprofitable with the proposed increase in harvest volume across all national forests. Map 2 shows the profitability data from this 1994 study by national forest. An important component of profitability is based on road access availability. Map 3 shows the relative road densities of the western national forests. Increased harvests will be more or less profitable based on road availability, and the need to construct new roads and the associated costs. We discuss these costs as a portion of the costs associated with increased Forest Service harvests later.

Map 3. Road Density on National Forests



Source: ECONorthwest, with data from the U.S. Forest Service

[8] Source: Gorte, Ross. "Below-Cost Timber Sales". Dec. 20, 1994. http://www.cnie.org/nle/crsreports/forests/for-1.cfm. Congressional Research Service.

5. Market Impacts of Increased Forest Service Harvest Flows

Price impacts resulting from increased Forest Service harvest flows have been a long-standing concern, and estimates of such impacts have been a part of forest policy discussions since the RARE II controversy in the late 1970s. It is likely that that harvest increases in the western FS regions will lower stumpage prices both in the affected regions and competing regions, reduce private harvests in the regions where national forest harvest increases occur, reduce lumber imports from Canada, and reduce production in the South relative to the West. Because of the commensurate shifts in regional production, there is often little price effect in the final product markets.

H.R. 1526 sets high expectations for the Forest Service to quickly expand timber sale programs and harvest. Given the nature of the Forest Service's sales process, this would likely be a real operational challenge for the agency. Beyond establishing the new FRRAs, the Forest Service must select sales areas, lay out the sales, and appraise them before being able to offer sales for bid; at best, a cycle that can take several years. Once a sale is sold the bidders usually have up to three years to harvest a sale. This process delays the expected economic consequences. For example, a reasonable expectation for the first year of increased harvest is an 8.3% increase, assuming that it would take four years to fully expand agency capacity to administer sales and that only one third would be logged in the first year of increased sales. Under these assumptions, the full increase would evolve over four years (33.5% in year two, 75% in year three and 100% by year four).

This transition period would serve to mitigate some potential negative economic impacts. An incremental harvest increase reduces impacts on private timberland owners, provides a signal to processors to increase capacity, and alerts producers in other regions of pending market shifts. Given the length of the transition period, capacity could be added in a steady manner, especially if building at existing sites. This is also a long enough period of time that some of the price effects might be masked by the usual market volatility, characteristic of both stumpage and product markets.

We use two approaches to view the market impacts of increased Forest Service harvest flows. First, we summarize the results from existing assessments of similar harvest increases from past Forest Service Planning efforts. Second, we construct supply and demand functions to examine changes in the western Oregon stumpage market.

5.1 Past Planning Efforts

Potential market impacts can be illustrated using projections reported in the 2005 RPA Timber Assessment[9]. In that report, the authors considered a scenario that involved the implementation of larger harvest volumes in the interior West. The specific log harvest increase was 2.0 billion board feet (log scale) per year across all western national forests, except for those on the western side of the Pacific Northwest. According to their scenario, as timber supply expands, processing capacity expands and lumber production in the interior West rises by 2.0 billion board feet (lumber scale[10]). The increase in lumber production leads to a four percent decline in softwood lumber prices and a 560 MMBF decline in production in other regions, primarily the South. Annual softwood lumber imports are also sensitive to these price shifts, and decline by 890 MMBF. As a result the net increase in annual US softwood lumber consumption is only some 560 MMBF, slightly more than one-quarter of the original production increment in the interior West.

Declines in the stumpage market and their duration vary by region. In the West stumpage prices decline by 4.1% in the fourth year of implementation, reach 4.8 % a decade later and return to their expected levels thereafter. In the South, stumpage prices decline by 2.4 % and 2.1 % for the same time period but don't return to their expected levels as quickly because of regional shifts in lumber production. These declines in stumpage values also lead to declines in the capital value of timber perceived by private timberland owners. In the South, timberland owners in the near term would see a 1.6% decline in the per acre value of timber stands. In the West this would be 4.8%.[11] These declines in capital assets would persist for several decades reflecting the shift between public and private timber harvests.

Expanded public timber harvest reduces stumpage prices in the interior West and the incentive to expand harvest timber on private timberlands. Private harvests fall 17% in the near term. This public-for-private harvest substitution yields a gradually accumulating "inventory savings" on private lands that is available in the future. In this particular scenario, the program of increases of Forest Service timber ends in 2035 and private harvests rise by 21% afterwards.[12]

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[9] See the discussion of "Restoration thinning on Public Lands in the West" (pp113-117) in Haynes and others, 2007. The RPA Timber Assessment Update. . Gen Tech Rep. PNW-GTR-699. Portland, OR: US Department of Agriculture, Pacific Northwest Research Station. 212 p.

[10] The difference between log and lumber scale is called overrun and is the difference between the greater volume actually sawn and the lesser estimated log scale volume. Average overruns vary among regions and currently average about 1.6. That is lumber volumes are about 60 % higher than log volumes.

[11] This was computed by comparing the expected present value of private stands in the two regions between the base scenario and the restoration thinning scenario for 2020 (see table 41, PNW-GTR-699) and assuming a 4 % real rate of return and a 14 year period between the start of the restoration thinning and 2020.

[12] These results were based on a bioeconomic modeling framework used by the Forest Service for nearly 25 years[12]. It is from a class of models that have become known as forest sector models, since they attempt to explain production,

5.2 Specific Market Example

Some aspects of these changes can be illustrated using relatively straight-forward supply and demand representations. For example, we can illustrate the impact of increased national forest harvest flows (on stumpage prices and private harvest reductions, for example) by looking at the simultaneous solution of stumpage supply and demand as shown in Figure 2. See Appendix 3 for how these equations can be parameterized. The prices ($/MBF) and harvest volumes (MMBF) are actual data for 2011 (the most recent year for which data is available).

The solution of the supply (#1) and demand equations is the equilibrium price and quantity observed in 2011 ($194.09, 3225.3 MBF). Supply #2 is the revised stumpage supply equation for the expected annual increase in supply. From Table 1, given the expected total increases in Forest Service harvest, a reasonable first year increase for Western Oregon would be 96.7 MBF. This assumes that it would take 4 years to expand agency capacity to increase and sell sales. We also assume that, of the 293 MBF sold in the first year, only one third would actually be logged in the first year of increased sales.

The solution of the demand and revised supply equations leads to changes in both the equilibrium price and quantity ($186.72, 3295.55 MBF) consistent with a shift outward in supply. The drop in stumpage prices leads to a small drop in private timber harvest (26.45 MBF) that reduces the net change in harvest to 70.25 MBF. This drop in prices may also lead to lower expectations about timber as a capital asset among private timberland owners and reduced market incentives for practices that contribute to sustained yield management. Federal revenues also rise, as the revenue from the increase in harvest exceeds the losses due to lower prices. However, these results also illustrate that expected revenue or job estimates should be made after allowing for market adjustments. For example, job estimates are often made assuming the full change in harvest rather than the net change. Here in this case that would overestimate job increases by 38%.

In an economic sense these results are only illustrative, as they are developed while holding all other variables constant. Markets are relentless and once a change is introduced in one region, timberland owners, producers and consumers all react, producing outcomes like those described in the 2005 RPA.

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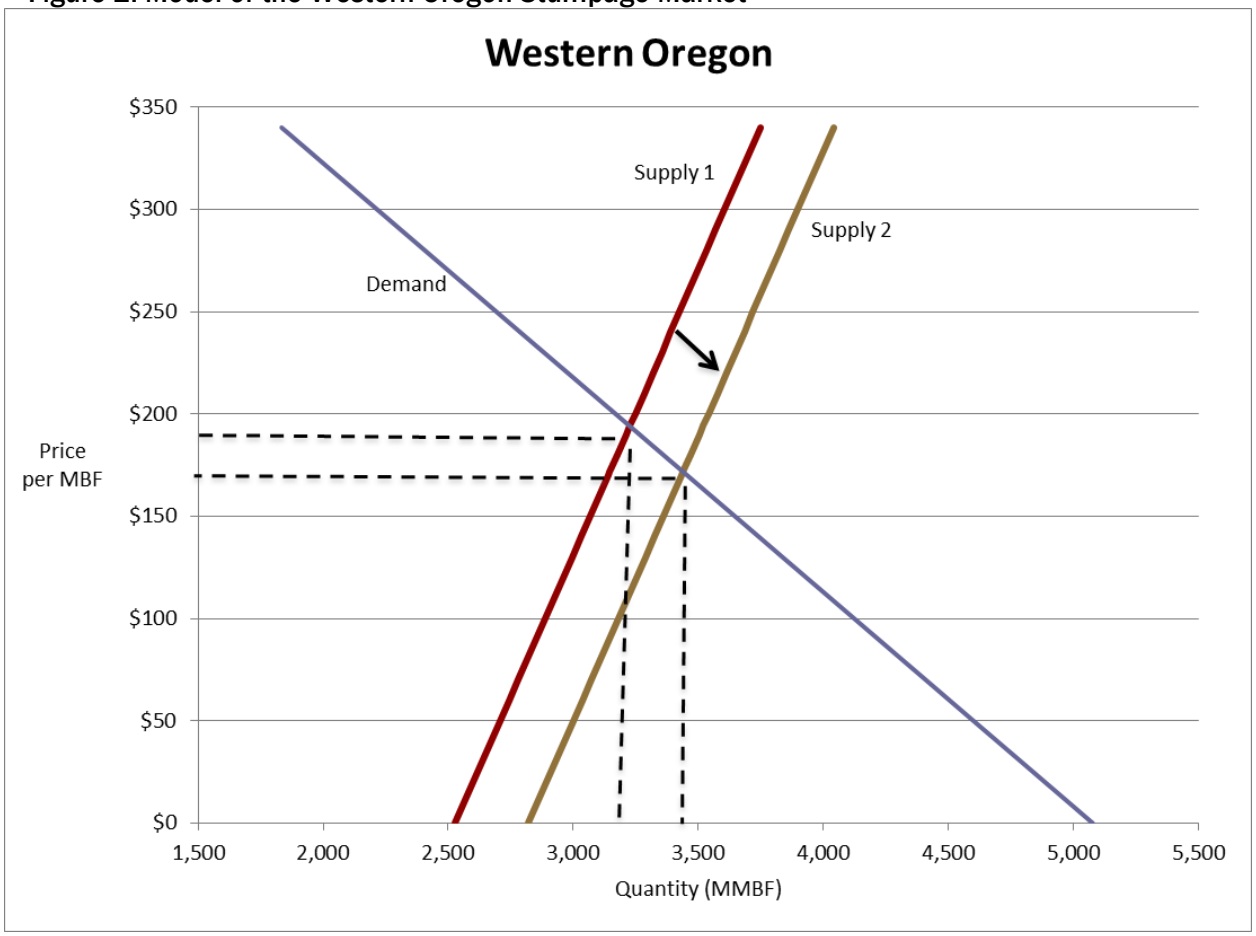
consumption and forest growth at broad regional or national scales. In the US these models were developed to support the planning requirements impose by Resources Planning Act (RPA).

Figure 2. Model of the Western Oregon Stumpage Market



Source: ECONorthwest

5.3 Costs and Revenues

5.3.1 Sale Preparation Costs

Currently, the Forest Service is funded for a 2.3 MMMBF timber program, and H.R. 1526 calls for a 3.7 MMMBF increase. This increase in harvest would entail a 160% increase in workload for the program. There are two main issues that would face the Forest Service as it attempted to respond to the increased harvest requirements. First, there is the need for additional staff at the district and national forest offices. Some of the sales design, layout and appraisal skills are currently in short supply, and take years to develop. There would also be additional need for sale related skills, such as engineering and contracting (timber sales are sold following federal contracting regulations). In the past these skills were developed in a hierarchical fashion among districts, forests, and regional offices. Much of the work was carried out at the district level, supported by the Forest office. As the Forest Service has downsized many of these skills have

been "zoned",[13] resulting in a loss of personnel and skills at the district level. This will complicate efforts to increase timber sales, as there are no longer sufficient skilled personnel in timber management, engineering and contracting at the district level.

Secondly, there are the direct costs associated with a 2.6 fold increase in harvest. While there has always been some ambiguity concerning the Forest Service's internal costs, we can develop a rough estimate from data collected from the US Forest Service Timber Sale Program Information Reporting System (TSPIRS). The TSPIRS was in operation for five years (FY 1989 to FY 1993), and remains the only published data available regarding timber sale costs and revenues on national forests. Associated documents report a sales preparation cost which includes inventory, planning, sale preparation, harvest administration, and resource support. As shown in Table 2, timber sale preparation costs (estimated in 1993, and adjusted for inflation) vary widely by region.

Table 2. Regional Sale Preparation Costs

FS Region	Timber sale preparation costs ($/MBF - inflation adjusted)
Northern Rockies (1)	70.21
Rocky Mountains (2)	56.47
Southwest (3)	139.34
Inter Mountain (4)	54.19
Pacific Southwest (5)	45.39
Pacific Northwest (6)	68.09
North (8)	54.79
South (9)	53.94
Alaska (10)	85.12

Source: ECONorthwest with data from Forest Service TSPIRS

Based on these figures, the sale preparation costs associated with the 3.7 MMMBF increase in timber sales under H.R. 1526 would be roughly $160 million a year.

5.3.2 Net Revenue

As noted previously (and in Appendix 2), there are many forests that have not been able to cover their costs historically, and still would not be able do so under H.R. 1526. The average sales price per thousand board feet was $127.00 in 1989-1993 (the timeframe for which the profitability data were reported), while the average price in recent years (2008-2012) was $54.62.[14] The preparation costs reported in Table 2 generally match or exceed prevailing market prices, which indicates that an even greater number of national forest timber sale programs would be unprofitable in today's market if greater cost efficiencies have not arisen.

[13] "Zoned" refers to the way that districts and forests have combined specialized skills into staffs that serve wider geographic areas.

[14] See the 'FY 1905-2012 National Summary Cut and Sold Data and Graph' (available online at http://www.fs.fed.us/forestmanagement/products/sold-harvest/index.shtml/index.shtml) for a historical summary and graph of Forest Service cut and sold data.

Based on the regional harvest allocation, the average timber prices in 2009-2011, and the regional timber sales preparation costs, we provide a rough estimate of net revenue potential that would come from the western regions in Table 3, below. Revenues from timber sale programs do not exceed costs.

Corresponding data are not available for non-western regions, but western forests are the primary sources of harvest, and are the most profitable, so proportional costs for other regions would likely be greater. These estimates are presented as the present value of revenue and costs over a ten year period (undiscounted and discounted at 4%), which incorporates the expected market dynamics and revenue implications described in the 2005 RPA Timber Assessment (i.e. increased supply lowers stumpage prices and revenue by as much as 10% in the West in the near term, and prices gradually return to initial levels by year ten).[15]

Table 3. Revenue and Cost Estimates for the Western Forest Service Regions under H.R. 1526

	10 Year Value, Western Region (Millions $)			
	Revenues	Sale Prep Costs	Net Profit/Loss	County Payments
Undiscounted	718	1,597	-879	179
Discounted at 4%	582	1,296	-714	145

Source: ECONorthwest with data from the Forest Service PPET Annual Reports and Cut and Sold Reports

We also examined the case with all of the harvest increase allocated in the West, and sale prep costs still exceed revenue. County payments, which amount to 25% of total revenues, would further increase the financial cost for the Forest Service and the Federal Treasury.

5.3.3 Road Costs

Road related costs, including administration and maintenance, constitute 60% of the expenditures for the timber sales program.[16] The Forest Service is currently responsible for an extensive road system comprised of over 380,000 miles, the vast majority of which were built in previous decades to support timber harvest.

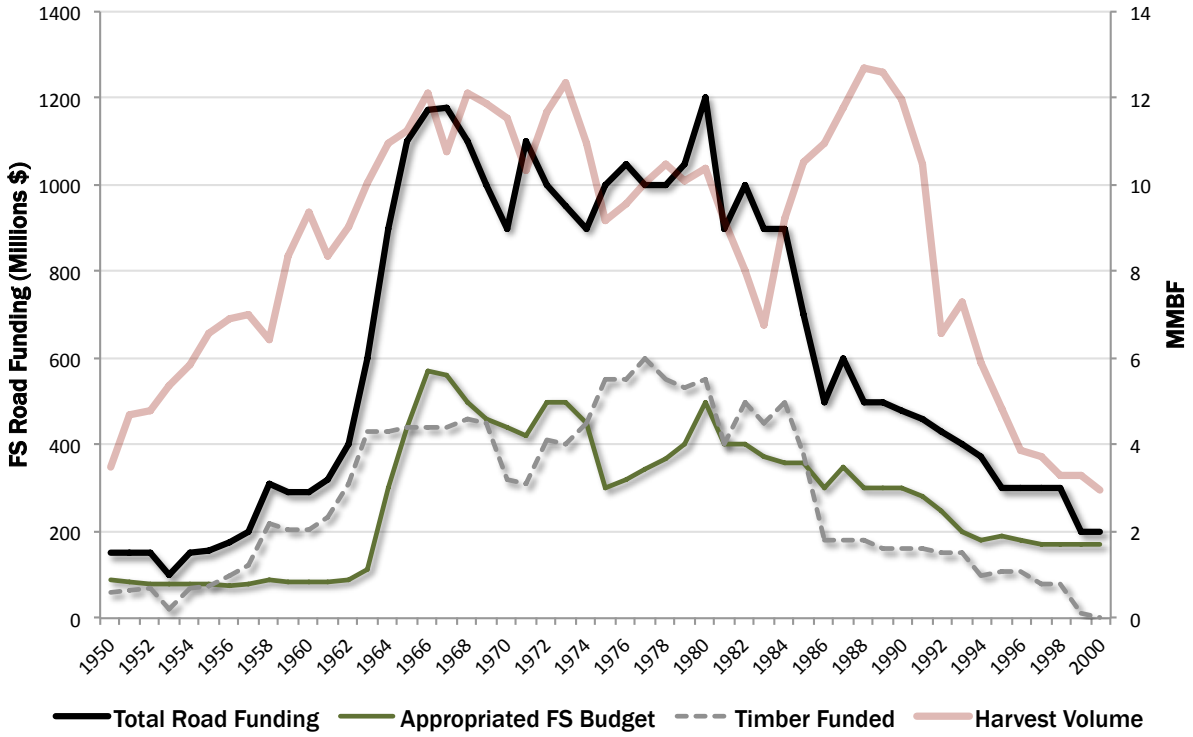
To provide context and a means for assessing what harvest increases under H.R. 1526 might mean for the FS road budget, Figure 3 shows historical funding (including road planning,

[15] See the price changes in Table 41 (pp200-204) between base and thinning, scaled linearly for greater harvest under H.R. 1526 than restoration thinning scenario. In Haynes and others, 2007. The RPA Timber Assessment Update. Gen Tech Rep. PNW-GTR-699. Portland, OR: US Dept. of Agriculture, Pacific Northwest Research Station. 212 p.

[16] Secretary of the Interior, 1994. The Impact of Federal Programs on Wetlands: A Report to Congress by the Secretary of the Interior; Part I, Chapter VI. Federal Programs To Promote Resource Use, Extraction, And Development. Available online at: http://www.doi.gov/pmb/oepc/wetlands2/v2ch6.cfm. Accessed 11/12/13.

construction, reconstruction and maintenance) for NFS roads.[17] The appropriated budget was largest between 1965 and 1985, with an appropriated road budget that reached levels over three times larger than today's, in addition to timber funding. Road building activity and funding is generally correlated with harvest activity, though this relationship is not always consistent.

Figure 3. Historical Forest Service Road Funding



Source: ECONorthwest, adapted from Bower (2008)

The increase in road construction and reconstruction under H.R. 1526, and therefore the direct costs, are difficult to analyze due to variation in the condition and location of existing road systems, relative to the potential locations of the FRRAs. The cost of new road construction varies with design standards and local conditions, depending on many of the same factors that drive up other sales costs. While costs can range from just a few thousand dollars per mile up to $150,000 or more per mile, the average range is typically $50,000 to $100,000 per mile. Reconstruction of existing roads to meet current design standards, which would certainly increase with implementation of H.R. 1526, costs approximately $45,000 per mile. Additionally,

[17] Bower, Fred. 2008. Forest Service Roadless Area Conservation, National Forest System Lands in Idaho Final Environmental Impact Statement, Roads Specialist Report, Washington, DC. Available online at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm8_036221.pdf. Accessed 11/14/13

annual maintenance on new roads costs, on average, approximately $1,500 per mile.[18]

Increased use (mainly recreational) and reduced funding over the last decade have resulted in the deterioration of existing forest roads, and the current maintenance and reconstruction backlog has been estimated at $4-8 billion. According to Forest Service estimates, recent funding levels equate to only 20% of the annual maintenance funding that would be required to maintain the road system to current environmental and safety standards.[19] Each new mile of NFS road competes for limited road maintenance funding, while each year's unmet maintenance needs also increase the existing backlog, as roads deteriorate and the cost of repairs continues to rise.

Based on the proportional road costs relative to harvest over time shown in Figure 3, it seems reasonable to expect $50-100 million annually in increased road costs. This equates to $400-800 million over a decade, discounted at 4%. The distribution across forests of these required road construction and maintenance costs would largely be concentrated in areas with the most dramatic increases in harvest.

5.4 Dependable Source of Revenue

The second purpose of H.R. 1526 is to "ensure that such counties *[those containing National Forest System land]* have a dependable source of revenue from National Forest System land." Such revenue is intended to replace the expired Secure Rural Schools and Community Self-Determination Act (SRS) payments to local governments. While there are concerns about whether H.R. 1526 will lower county payments from current SRS levels, we want to focus on two other issues that might impact a steady stream of revenues derived from timber sales: the volatility in stumpage prices (Figure 4) and the tendency of the Forest Service to sell lower valued log mixes (Figure 5).

Stumpage markets and stumpage prices are notoriously volatile. They are factor markets in a highly competitive domestic industry that is also closely linked to export markets for both logs and forest products. The US is unique among softwood producing nations in the competitive nature of its stumpage market. Both Figure 4 and 5 illustrate the volatility in these markets, and how changes in one are closely linked to the other. Figure 4, in addition to illustrating the large decades-long cycles in real[20] stumpage prices, also illustrates a slight upward trend in real

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[18] Krause, Joel 2000. Forest Service Roadless Area Conservation, Final Environmental Impact Statement, National Forest System Roads Specialist Report, Washington, DC. Available online at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm8_035775.pdf. Accessed 11/13/13.

[19] U.S Forest Service. 2002. Road Management Website, Questions and Answers. Available online at: http://www.fs.fed.us/eng/road_mgt/qanda.shtml. Accessed 11/14/13.

[20] These prices have been adjusted for inflation. See Haynes 2008, PNW-GTR-747 for an explanation and discussion of stumpage price trends.

prices. The point is that county revenue payments tied to Forest Service stumpage payments (called cut prices) will likely exhibit much of this same volatility.

The second implication for future federal revenues is the impact of lower quality log mixes being offered by public agencies. These mixes are a result of shifting from traditional silvicultural regimes to contemporary ecosystem and restoration management regimes where the emphasis is often on thinning, removal of dead or dying trees and removal of smaller trees in the understory. The impacts of these changes can be illustrated with log price data collected by the Oregon Department of Forestry (Figure 5). These data show the persistent differences between the four log grades common in Western Oregon (the highest grades average 4.3 times greater than the lowest grades).[21] For example, in 2012 the difference in average log prices between a good mix of log grades (25% #1 logs, 25% #2, 40% # 3 logs, and 10% # 4 logs) and a mix more typical of federal sales (0% #1 logs, 25% #2, 25% # 3 logs, and 50% # 4 logs) is $167 per MBF.

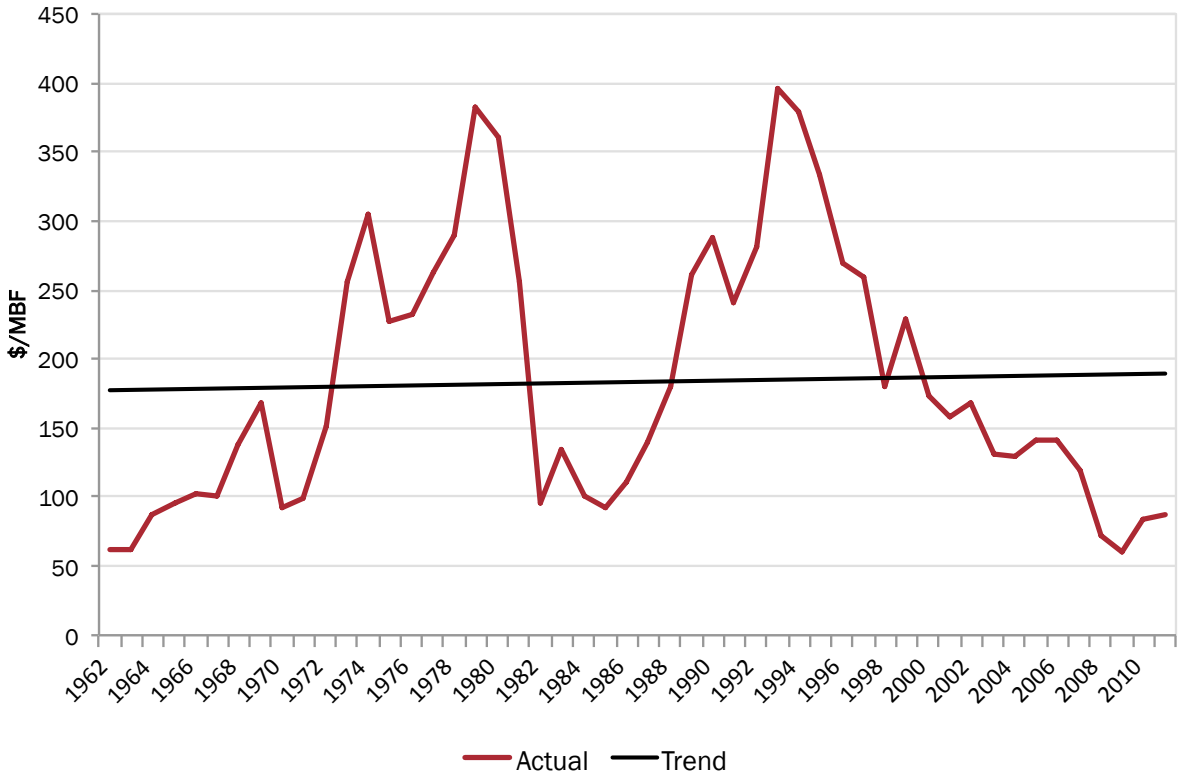
Further evidence of lower quality federal sales can be seen in western Washington, where this difference was illustrated by comparing stumpage prices between Washington State Department of Natural Resources (DNR) and national forest sales. Washington DNR prices since the mid-1990s have averaged 152% more than prices for Forest Service sales.[22] The Washington DNR still sells an average to good log mix while Forest Service sales, since the mid-1990s, have been mostly thinning sales containing smaller and lower quality timber.

In an economic context, the lower stumpage prices associated with Forest Service sales is an opportunity cost associated with more environmentally constrained logging on federal lands. While the per MBF amount may seem small, it would represent a nearly half million dollar loss on a 3 million board foot sale with attendant reductions in various revenue sharing programs associated with timber sales.

[21] High grade are #1 sawlogs and #1,2 Peeler grades; Grade 2 is generally #2 sawlogs and lower grade peerler logs, Grade 3 is generally #3 sawlogs, and low grade is generally utility grade sawlogs.

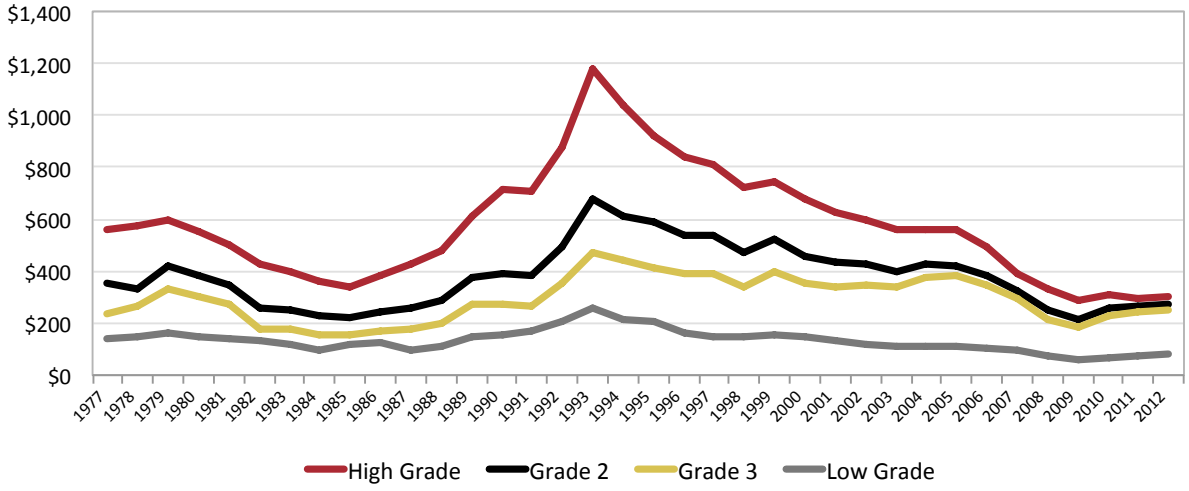
[22] See page 26, Haynes 2008.PNW-GTR-747

Figure 4. Average Public Real Stumpage Prices for Western Oregon, 1962-2011



Source: ECONorthwest

Figure 5. Douglas-Fir Log Prices by Grade, 1977-2012



Source: ECONorthwest, with data from the Oregon Department of Forestry

5.5 Price Expectations

Throughout this memo we have used stumpage prices as both a market indicator and a determinant of expected Forest Service revenues. H.R. 1526 will, as described previously in the Market section, lower stumpage prices in the West by as much as 10% in the near term, reducing expected Forest Service revenues and the value of harvests from non-federal public and private timberland, as well as the value of private timberland held as a capital asset. Timber market modeling suggests that a price reduction attributable to the increase in supply dissipates over a decade as production capacity and private harvest adjusts to changes in financial incentives.

Long-term price expectations can be assessed in the context of Figure 4, which reflects the volatility of the stumpage market and the fact that market cycles can last for roughly 25 years. There is an upward long term trend in the real western Oregon prices (shown in Figure 4) that is consistent with recent projections of stumpage prices for most US regions. [23] In the near term, it would be reasonable to expect that stumpage price declines from increased harvest would gradually dissipate over a decade and return to the market trend.

6. Additional Issues

These cost, revenue, and market price results and the underlying assumptions raise several questions about the economic consequences associated with both the intent of H.R. 1526 as well as the broad issue of how the Forest Service participates in US timber markets[24]. These issues include implications for net forest sector jobs (timber and non-timber based), the problem of national forests with existing harvest restrictions, reconsidering the implied east/west shift in H.R. 1526, the impact of low quality sales on Forest Service revenues, and the inferences for a more efficient allocation of harvest increases among national forests.

6.1 The Jobs Issue

The jobs issue in forest policy debates has many facets. The prevalent belief is that, due to the bulky nature of logs, they are typically processed close (within 50 miles) of where they are harvested, creating local manufacturing jobs that are relatively well paid (the family wage jobs

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[23] See table 11 in PNW-GTR-699 and figure 68 in WO-GTR-87.

Haynes, R.W. and others 2007. The 2005 RPA timber assessment update. . Gen Tech Rep PNW-GTR-699. Portland, OR, US Dept. of Agriculture, Forest Service, Pacific Northwest Research Station. 212 p.

U.S. Department of Agriculture.2012. Future of America's Forest and Rangelands. Forest Service 2010 Resources Planning Act Assessment. Gen Tech Rep WO-87, Washington, D.C. 198 p.

[24] In the context of the U.S. forest sector, the U.S. Forest Service manages roughly 20 % of U.S. timberlands. It has a relatively transparent timber sale process, a well-developed public involvement process for management actions, and supports research and assistance efforts of great value to the public.

issue). These jobs both directly and indirectly provide economic stability to forest based communities. History challenges these beliefs.

Here we look at only one facet of the jobs debate, which is the direct creation of jobs tied to timber harvest associated with an increase in Forest Harvest like called for in H.R. 1526. Recall from the earlier examples of the commensurate changes between owners and regions, including imports from Canada. Using an employment factor of 8.3 direct jobs per MMBF[25] and assuming a net 1.31 billion board feet increase in US timber harvest[26], 10,880 jobs would be created. At the regional level, harvest reductions in the north and south would lead to job losses of 160 and 3,920 direct jobs, respectively. The west, meanwhile, would gain 14,960 direct jobs. Many of these jobs would be concentrated in the current clusters of manufacturing activity. It would take time for private investors to see potential opportunities elsewhere. These do not include potential job losses from reduced state and private harvests.

6.2 National Forests with Harvest Restrictions

While the intent of HR1526 is to establish a Forest Reserve Revenue Area on each forest, where "the Secretary shall manage the Forest Reserve Revenue Area in the manner necessary to achieve the annual volume requirement for the Forest Reserve Revenue Area" (Sec 104 (a)) there are twenty western national forests where this may encounter legal issues. These forests have had their harvests restricted because of existing laws or records of decision. The most restricted are the Tongass National Forest in southeast Alaska, the nine national forests west of the Cascade crest in Washington and Oregon, and four national forests in northern California.[27] Additionally, minor portions of six national forests along the east side of the crest of the Cascades face some restrictions. Most of these restrictions have been in place for two decades. In addition private industry has adjusted to these reductions in federal harvest, ranging from complete shutdown (and plant removal) of an integrated processing industry in southeast Alaska to the closure of individual mills in Washington, Oregon and California. Furthermore, the location of processing capacity has shifted to fewer large mills located near urban centers on major transportation routes and near private timberlands.

6.2.1 The Tongass Case

The Tongass timber reform Act (TTRA 1990) states that the Secretary of Agriculture will "… seek to provide a supply of timber from the Tongass National Forest which (1) meets the annual

[25] Average of Washington and Oregon published in PPET, 2012.

[26] Computed using the net change in US harvest shown in Table 41 comparing the base and restoration thinning scenario. PNW-GTR-699

[27] These are the "owl forests". They are the Gifford-Pinchot, Mount Baker- Snoqualmie, Mount Hood, Olympia, Rogue River, Siskiyou, Siuslaw, Umpqua, Willamette, Klamath, Mendocino, Six Rivers, and Shasta-Trinity. There are also six BLM districts in western Oregon and northern California that are included in the NWFP.

market demand for timber from such forest and (2) meets the market demand from such forest for each planning cycle." Since 1990 a series of four publications have provided the required projections of Alaska timber products output, the derived demand for logs and chips, and timber harvest by owner.[28] The series of studies reflect the consequences of downward changes in the Alaska forest sector and trends in the markets for Alaska products. Since the last demand study harvests in SE Alaska have been most closely aligned with the lowest projected demand scenario that assumes the continuation of a small-nonintegrated industry focused on producing relatively high-grade lumber for export and domestic markets. Under these conditions, national forests have averaged 29.8 MMBF harvested for 2007-2011. The poor competitive position of Alaskan producers relative to others in these markets raises questions about how they will increase capacity to the level anticipated for the bill, 84.7 MMBF.

6.2.2 The Northwest Forest Plan

The Northwest Forest Plan (NWFP) poses another complication to increasing Forest Service harvest flows. H.R. 1526 does not directly address how the Standards and Guides imposed[29] on Federal forest management in the range of the Northern Spotted Owl will be modified. Key in the Northwest Forest Plan (NWFP) was the selection of an alternative that limited timber harvests on the "owl forests" and BLM districts to 1.1 MMMBF (a decrease from historic harvests of 3.4 MMMBF). In the past two decades there have been several small decreases to the expected potential sales quantity and this has recently been estimated at 958 million board feet annually. Annual harvest, however, during this period has not approached this level and in the 2009-2011 period used here as a base period was 280 million board feet for the thirteen "owl forests". Under the bill, harvest would rise on these forests to 788 million board feet but still short of what is currently allowed under the NWFP. There are few concerns about processing capacity in the owl region but most is now located at large plants closer to private timber rather

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[28] Brooks, David J.; Haynes, Richard W. 1990. Timber products output and timber harvests in Alaska: projections for 1989-2010. Gen. Tech. Rep. PNW-GTR-261. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 48 p.

Brooks, David J.; Haynes, Richard W. 1994. Timber products output and timber harvests in Alaska: projections for 1992-2010. Gen. Tech. Rep. PNW-GTR-334. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 48 p.

Brooks, David J.; Haynes, Richard W. 1997. Timber products output and timber harvest in Alaska: projections for 1997-2010. Gen. Tech. Rep. PNW-GTR-409. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 17 p.

Brackley, Allen M., Rojas, Thomas D.; Haynes, Richard W. 2006. Timber products output and timber harvest in Alaska: projections for 2005-25. Gen. Tech. Rep. PNW-GTR-677. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 33 p.

[29] These land allocations and standards and guides were imposed by the Record of Decision for the Northwest Forest Plan (See PNW-GTR-651 for a general description of the plan and the results for its first decade of implementation).

than federal timberlands. This results in longer haul distances for federal timber further reducing stumpage prices paid for federal timber.

6.3 The Implied Shift to the East

The Bill scenario maintains the current relative harvest positions of the Forest Service regions, that is, that 64% of the harvest would occur in the western region and the remaining 36% in the two eastern regions (the North with 16%, and the South with 20%). This shift has resulted from various changes in forest management objectives that have impacted western national forests to a greater extent. This shift also has reduced the political effectiveness of some traditional western focused advocacy groups.

This raises questions about the possible design of a scenario to restore the historic balance between eastern and western Forest Service regions. Such a scenario would reduce the eastern regions share of Forest Service harvest to 18.5% while the West would regain its historical proportion of 81.5%. In this scenario, harvests in the East would rise 34.4% under H.R. 1526, to a total of 1.11 MMMBF, while harvests across the West would rise by 338.9% for a total of 4.89 MMMBF. Most of these increases, except for those in the Rocky Mountain Region (which historically had lower harvests), would be within historic harvest levels. The increases for Alaska, while higher than recent harvest levels, would still be a fraction of historic levels because of the cancellation of the two large long term timber sale contracts and the closure of the two dependent pulp mills.

6.4 The Impact of Lower Quality Sales

The Forest Service has historically tended to sell lower quality sales than private sales resulting in lower revenues. Results comparing revenues and costs reflect these low quality sales. It seems challenging to expect a simultaneous increase in harvest volume and the proportion of high quality log mixes and species. The price data from western Oregon (shown in figure 5) can provide insight into this issue. In that example, we assumed the Forest Service sold a mix that was 0% #1 logs, 25% #2, 25% #3 logs, and 50% #4 logs. An alternative mix, still typical of thinning and restoration prescriptions, could contain 0% #1 logs, 33% #2, 34% #3 logs, and 33% #4 logs and provide an average of18% more revenue than the previous sale. Given H.R. 1526's emphasis on revenue, it is important to also recognize the need for agency administrators to examine the hidden revenue implications of various management prescriptions that tend to reduce the value of sales.

6.5 More Efficient Opportunities

Finally, we would like to discuss the options for a more efficient approach to increasing Forest Service harvest, and how H.R. 1526 would prevent such allocations. Maps 1-3 and the historic harvest data suggest that economic forces have led to the evolution of clusters of forest manufacturing centers, especially across the West. These facilities are not evenly distributed across space, but rather are located in close proximity to raw materials, mill sites, and access to both domestic and export markets. At the same time relentless economic changes have changed the forest products industry, reducing the number and diversity of mills but also increasing the

size of the remaining mills. An ubiquitous allocation of Forest Service harvest across all forests risks the potential of a high number of sales going unsold or being sold at the minimum bid, reducing local revenue opportunities.

The harvest levels stipulated in H.R. 1526 could be better allocated and designed so that they have the better chance to be sold, and at a price that achieves the overall goal of increasing local revenue sharing. Tradeoffs would also be inherent to this approach, however, as a successful sale program would lead to increase revenues in the counties near manufacturing clusters, and continued revenue problems elsewhere.

Appendix 1. National Forest Harvest and Price Data 2009-2011 and Scenario Modeling

The data in the following table were obtained from the 'Production, Prices, Employment, and Trade (PPET) in Northwest Forest Industries' Reports (1988-2012). Where data for individual national forests was not reported in the PPET reports, data were obtained from the annual cut and sold reports. Note that cut and sold reports report data for the fiscal year, while PPET reports cover the calendar year. The discrepancies between the two data sources were minor, however, and did not alter the overall scenario estimates.

Table 4. National Forest Harvest 2009-2011, and Bill Scenario

Forest Service Region	National Forest	Average Value (per MBF)				Total Harvest (MMBF)				Bill Scenario
		2011	2010	2009	09-11 Average	2011	2010	2009	09-11 Average	Proportional increases across all regions
Northern Rockies (1)	Beaverhead/Deerlodge	14.9	18.7	20.6	18.1	22.2	20.9	31.8	25.0	66.0
	Bitterroot	8.9	9.1	8.8	8.9	10.2	7.4	15.0	10.9	28.7
	Clearwater	89.3	55.8	57.6	67.5	33.3	14.1	33.4	26.9	71.2
	Custer	10.7	10.6	11.9	11.1	1.9	2.2	7.0	3.7	9.8
	Flathead	31.3	42.6	29.7	34.5	25.3	43.1	86.4	51.6	136.5
	Gallatin	12.1	10.3	10.7	11.0	8.3	4.9	10.4	7.9	20.8
	Helena	9.6	13.9	11.3	11.6	16.6	12.9	8.4	12.6	33.4
	Kootenai	78.7	53.4	73.0	68.4	29.3	28.5	57.4	38.4	101.6
	Lewis and Clark	11.8	11.1	8.0	10.3	3.1	2.6	7.4	4.4	11.5
	Lolo	28.1	9.9	26.1	21.4	14.6	22.1	50.8	29.2	77.1
	Nez Perce	27.0	21.0	15.7	21.2	20.3	11.2	29.6	20.4	53.9
	Panhandle	41.3	31.1	48.6	40.3	25.0	22.8	34.8	27.5	72.8
	Northern Idaho	58.0	36.0	41.7	45.2	78.6	48.0	97.8	74.8	197.8
	Montana	32.3	29.9	33.6	31.9	131.4	144.5	274.8	183.6	485.5
	All Forests	41.9	31.4	35.7	36.3	210.0	192.5	372.7	258.4	683.4
Rocky Mountains (2)	Arapaho/Roosevelt	3.8	6.9	17.0	9.2	12.2	11.4	3.5	9.0	23.9
	Bighorn	23.1	12.5	42.4	26.0	5.4	3.0	4.8	4.4	11.6
	Black Hills	24.5	27.5	25.9	26.0	113.9	117.6	112.3	114.6	303.0
	Grand Mesa	21.4	8.0	38.0	22.5	9.7	8.6	6.8	8.4	22.1
	Medicine Bow/Routt	14.2	14.4	22.1	16.9	28.3	28.4	27.9	28.2	74.6
	Nebraska N.F.	11.0	12.5	3.5	9.0	0.1	0.1	0.3	0.1	0.4
	Pike/San Isabel	8.6	11.3	15.2	11.7	7.4	13.0	7.3	9.2	24.4

	Rio Grande	17.6	28.1	22.3	22.7	8.8	8.7	9.4	9.0	23.7
	San Juan	15.3	14.7	29.7	19.9	11.0	6.7	7.1	8.2	21.8
	Shoshone	39.3	20.4	18.3	26.0	8.1	7.4	10.4	8.6	22.8
	White River	23.0	31.5	19.1	24.5	21.4	9.1	6.4	12.3	32.6
	Colorado	23.0	15.6	21.7	20.1	87.4	79.8	63.1	76.8	203.1
	Nebraska	11.0	12.5	3.5	9.0	0.1	0.1	0.3	0.1	0.4
	South Dakota	24.6	27.6	25.8	26.0	106.2	96.7	93.4	98.8	261.2
	Wyoming	26.3	22.5	28.0	25.6	32.6	37.4	39.2	36.4	96.3
	All Forests	21.1	24.6	22.7	22.8	226.3	218.7	202.0	215.7	570.4
Southwestern (3)	Apache/Sitgreaves	6.8	7.7	8.2	7.5	27.5	16.6	16.4	20.2	53.3
	Carson	8.8	9.8	9.6	9.4	13.5	14.7	13.1	13.8	36.4
	Cibola	11.7	13.0	12.1	12.3	7.4	6.0	6.0	6.5	17.1
	Coconino	8.8	14.2	14.5	12.5	17.8	15.2	13.8	15.6	41.2
	Coronado	24.3	42.1	24.3	30.2	0.6	0.4	0.7	0.6	1.5
	Gila	16.7	22.4	13.3	17.5	3.5	4.5	5.5	4.5	11.9
	Kaibab	7.3	6.6	9.6	7.8	13.4	8.0	10.7	10.7	28.3
	Lincoln	10.5	13.3	9.8	11.2	5.7	2.4	4.0	4.1	10.7
	Prescott	13.5	13.1	12.7	13.1	5.6	5.6	4.2	5.1	13.6
	Santa Fe	9.9	10.3	10.1	10.1	13.4	14.0	13.8	13.7	36.3
	Tonto	14.3	15.7	13.1	14.4	4.0	4.4	2.4	3.6	9.5
	Arizona	8.5	11.1	11.2	10.3	68.9	50.1	48.2	55.7	147.4
	New Mexico	10.5	12.0	10.6	11.0	43.5	41.6	42.4	42.5	112.4
	All Forests	9.3	10.7	11.2	10.4	112.4	100.2	86.9	99.8	264.0
Intermountain (4)	Ashley	17.7	21.1	20.2	19.6	4.8	4.7	4.8	4.8	12.6
	Boise	15.9	17.7	5.5	13.0	18.7	20.0	8.2	15.6	41.3
	Bridger/Teton	16.7	18.2	17.7	17.5	10.3	10.3	7.3	9.3	24.6
	Caribou/Targhee	20.7	19.6	32.9	24.4	11.4	11.2	13.4	12.0	31.7
	Dixie	38.3	26.9	3.8	23.0	6.5	3.5	5.1	5.0	13.3
	Fishlake	26.8	42.0	90.3	53.0	2.3	2.5	4.2	3.0	7.9
	Humboldt/Toiyabe	19.9	11.9	22.9	18.2	1.6	7.6	3.3	4.2	11.0
	Manti-Lasal	13.6	14.1	10.4	12.7	3.7	4.0	3.1	3.6	9.5
	Payette	12.0	-11.4	43.5	14.7	23.6	13.4	11.2	16.1	42.5
	Salmon-Challis	11.3	15.7	11.7	12.9	10.3	9.4	5.3	8.3	22.0
	Sawtooth	18.7	28.0	31.4	26.0	5.5	5.2	5.2	5.3	14.0
	Wasatch/Uinta	26.0	23.9	19.9	23.3	9.5	8.7	6.9	8.4	22.1
	Southern Idaho	14.9	12.1	27.6	18.2	69.5	59.2	43.3	57.3	151.6
	Nevada	19.9	8.7	19.9	16.1	1.6	5.7	1.4	2.9	7.7

	Utah	25.3	23.7	26.2	25.1	26.5	23.2	23.6	24.4	64.6
	Wyoming	18.6	19.0	22.0	19.9	10.6	10.5	7.9	9.7	25.6
	All Forests	17.9	15.5	26.4	19.9	110.6	100.5	78.0	96.4	254.9
Pacific Southwest (5)	Angeles	56.3	65.1	63.7	61.7	0.3	0.2	0.3	0.3	0.7
	Cleveland	50.0	50.0	50.0	50.0	0.1	0.1	<0.1	0.1	0.3
	Eldorado	22.7	24.8	-29.3	6.0	16.3	10.4	3.8	10.2	26.9
	Inyo	32.7	36.4	32.0	33.7	4.0	2.6	3.7	3.4	9.1
	Klamath	22.4	9.8	9.4	13.9	43.6	36.1	12.8	30.8	81.5
	Lassen	46.4	28.3	11.3	28.6	47.6	34.7	27.9	36.7	97.2
	Los Padres	19.8	22.1	20.2	20.7	0.4	0.3	0.3	0.3	0.9
	Mendocino	6.4	15.4	10.1	10.6	3.3	3.8	0.9	2.7	7.1
	Modoc	10.9	36.0	8.6	18.5	12.7	7.6	6.9	9.1	24.0
	Plumas	24.6	12.3	15.9	17.6	43.1	58.5	23.8	41.8	110.6
	San Bernadino	16.8	4.7	10.9	10.8	7.0	17.0	6.1	10.0	26.5
	Sequoia	10.3	11.4	13.4	11.7	4.5	6.1	4.2	4.9	13.0
	Shasta-Trinity	84.9	36.0	11.9	44.3	50.3	20.7	22.5	31.2	82.4
	Sierra	19.2	30.0	29.3	26.1	19.4	13.9	5.0	12.8	33.8
	Six Rivers	23.5	17.3	18.4	19.7	5.6	1.9	3.5	3.7	9.7
	Stanislaus	18.5	13.8	-0.9	10.5	14.0	27.4	19.9	20.4	54.0
	Tahoe	33.2	15.6	7.5	18.8	25.6	21.8	14.8	20.7	54.8
	LTBMU	25.2	26.4	7.3	19.6	0.7	0.8	6.0	2.5	6.6
	All Forests	36.9	18.4	10.2	21.8	299.2	263.6	162.7	241.8	639.6
Pacific Northwest (6)	Colville	44.9	54.6	43.1	47.5	43.3	47.7	57.6	49.5	131.0
	Deschutes	30.3	32.3	18.7	27.1	60.5	51.1	46.9	52.8	139.7
	Fremont/Winema	26.0	36.5	15.0	25.8	59.2	55.0	47.4	53.9	142.5
	Gifford Pinchot	70.0	64.0	35.7	56.5	14.8	17.0	25.4	19.1	50.4
	Malheur	105.6	106.8	7.9	73.4	22.8	20.2	35.3	26.1	69.0
	Mount Baker-Snoqualmie	11.5	28.2	19.8	19.8	7.9	17.1	4.8	9.9	26.3
	Mount Hood	62.4	30.7	37.2	43.4	37.7	28.2	28.7	31.5	83.4
	Ochoco	15.3	11.6	11.6	12.8	16.7	7.5	8.9	11.0	29.2
	Okanogan-Wenatchee	41.7	44.5	16.8	34.3	44.4	38.8	28.8	37.3	98.7
	Olympic	36.1	28.9	21.9	28.9	11.7	21.6	13.2	15.5	41.0
	Rogue River-Siskiyou	54.3	53.5	38.1	48.6	39.3	21.7	11.3	24.1	63.7
	Siuslaw	65.7	49.8	44.6	53.4	59.8	48.8	21.6	43.4	114.8
	Umatilla	112.4	95.9	65.2	91.1	23.2	38.9	38.8	33.6	89.0
	Umpqua	56.3	33.5	12.2	34.0	58.7	26.4	9.7	31.6	83.6

	Wallowa-Whitman	38.5	28.8	18.6	28.6	31.3	17.3	18.3	22.3	59.0
	Willamette	74.9	50.6	44.5	56.7	69.3	58.9	35.1	54.4	144.0
	Western Oregon	63.9	45.2	38.9	49.3	264.8	183.9	106.4	185.0	489.4
	Eastern Oregon	38.7	47.2	20.8	35.6	205.9	179.6	185.9	190.5	503.8
	Western Washington	45.0	39.1	29.7	37.9	34.4	56.5	43.4	44.8	118.4
	Eastern Washington	59.3	62.3	41.0	54.2	95.6	90.4	96.2	94.1	248.8
	All Forests	53.5	48.3	30.7	44.1	600.7	510.5	385.0	498.7	1,319.1
	Chugach	130.4	65.7	68.2	88.1	0.1	0.2	0.1	0.1	0.4
Alaska (10)	Tongass	102.0	53.6	21.3	59.0	31.6	35.7	28.3	31.9	84.3
	All Forests	36.9	68.0	26.4	43.8	31.8	35.8	28.5	32.0	84.7
Total - All Forests		**N/A**	**N/A**	**N/A**	**N/A**	**1,591**	**1,422**	**1,316**	**1,443**	**3,816**

Appendix 2. Historical Profit and Loss on National Forest Harvests

Data on below cost sales were previously collected and analyzed in a 1994 report by the Congressional Research Service (an arm of the Library of Congress which conducts research and prepares reports for the U.S. Congress) titled "Below-Cost Sales: An Overview". The key findings of the report are presented here. Data collected from the US Forest Service Timber Sale Program Information Reporting System (TSPIRS), developed at the request of Congress in response to the below cost sales issue, form the basis of this report. TSPIRS was in operation for five years (FY 1989 to FY 1993), and remains the only published data available regarding timber sale costs and revenues on national forests. During this five-year study period, certain regions and forests consistently reported net financial losses on their national forest timber programs, while others reported net profits.

The regions and states that consistently reported net financial losses were:

- Alaska
- The Rocky Mountains- Arizona, Colorado, part of Idaho, Southern California, Montana, Nevada, New Mexico, Utah, and Wyoming
- The Southeast (the Appalachians to the Ozarks) - Arkansas, Georgia, Kentucky, Missouri, North Carolina, Tennessee, and Virginia
- The Lake States - Illinois, Indiana/Ohio, Michigan, Minnesota, and Wisconsin
- New England - New Hampshire and Vermont

It is important to note that there are exceptions to these regional trends. For example, the Allegheny (PA), Monongahela (WV), Black Hills (SD), Apache-Sitgreaves (AZ), Coconino (AZ), and Kootenai (MT) National Forests all reported net profits during this period.

Overall, 77 out of the 120 national forests lost money over the five-year period. Six national forests reported losses of more than 2 million dollars a year, on average: the Klamath (CA), the Wallowa-Whitman (OR), the Flathead (MT), the National Forests of North Carolina (four forests administered as one unit), the Tongass (AK) and the Bitterroot (MT).

Regions that generally reported net profits, meanwhile, were:

- The Pacific Coast - northern California, part of Idaho, Oregon, and Washington
- The Atlantic and Gulf Coast - Alabama, Florida, Louisiana, Mississippi, South Carolina, and Texas

There are also exceptions to the general profitability of these areas. For example, the Klamath (CA), Wallowa-Whitman (OR), Colville (WA), and the Okanogan (WA) National Forests all reported large losses over the 5-year period.

In total, 43 out of 120 national forests reported net profits over the 5-year period. The top five forests - the Willamette (OR), the Umpqua (OR), the Gifford Pinchot (WA), the Malheur (OR),

and the Siuslaw (OR) - reported average net profits of more than $20 million a year during this period.

Table 5. Historical Profit/Loss on National Forest Harvests

National Forest/State	Net Profit/Loss (Millions $) 1989	1990	1991	1992	1993	Average 1989-1993
Alabama	0.79	0.25	0.7	0.11	0.08	0.386
Alabama NFs	0.79	0.25	0.7	0.11	0.08	0.386
Alaska	0.56	9.45	3.67	-13.94	-14.46	-2.944
Chugach	-0.67	-0.31	-0.27	-0.62	-0.75	-0.524
Tongass	1.23	9.76	3.94	-13.32	-13.71	-2.42
Arizona	4.74	0.59	-3.71	-2.38	-7.61	-1.674
Apache -Sitgreaves	1.77	0.67	-0.05	1.08	1.35	0.964
Coconino	2.98	1.89	0.41	0.9	-3.72	0.492
Coronado	-0.29	-0.19	-0.17	-0.16	-0.61	-0.284
Kaibab	0.64	-1.03	-2.73	-3.37	-2.88	-1.874
Prescott	-0.2	-0.22	-0.34	-0.34	-1.39	-0.498
Tonto	-0.16	-0.53	-0.83	-0.49	-0.36	-0.474
Arkansas	1.12	0	-2.11	-2.16	-0.31	-0.692
Ouachita	0.83	-0.06	-1.09	-0.66	1.02	0.008
Ozark-St. Francis	0.29	0.06	-1.02	-1.5	-1.33	-0.7
California	80.7	65.85	36.96	34.9	25.23	48.728
Angeles	-0.32	-0.24	-0.14	-0.66	-0.13	-0.298
Cleveland	-0.22	-0.17	-0.23	-0.26	-0.06	-0.188
Eldorado	5.94	4.74	10.08	3.53	10.58	6.974
Inyo	0.37	-0.3	-0.33	0.16	0.12	0.004
Klamath	0.67	-4.93	-7.19	-2.19	-7.71	-4.27
Lake Tahoe Basin	-0.26	0.52	-0.35	-0.68	-0.75	-0.304
Lassen	20.1	14.99	11.23	17.01	7.74	14.214
Los Padres	-0.29	-0.24	-0.22	-0.27	-0.14	-0.232
Mendocino	2.77	1.22	-0.26	-3.43	-3.34	-0.608
Modoc	6.29	8.59	2.81	2.49	3.52	4.74
Plumas	11.37	10.92	15.7	7.68	-0.06	9.122
San Bernardino	-0.83	-0.86	-0.68	-0.7	-0.33	-0.68
Sequoia	-1.03	-2.07	-1.24	0.53	2.38	-0.286
Shasta-Trinity	9.06	15.35	0.35	6.52	5.12	7.28
Sierra	6.66	8.54	-0.85	1.14	5.27	4.152
Six Rivers	13.74	6.22	7.49	4.32	0.2	6.394
Stanislaus	3.03	0.65	0.16	0.91	3.96	1.742
Tahoe	3.65	2.92	0.63	-1.2	-1.14	0.972
Colorado	-6.66	-4.75	-7.08	-5.03	-2.58	-5.22
Arapaho-Roosevelt	-0.81	-0.51	-0.76	-0.79	-0.56	-0.686
G.Mesa-Unc.-Gunn.	-1.74	-1.4	-1.88	-1.71	-0.89	-1.524
Pike-San Isabel	-0.74	0.12	-0.94	-0.45	-0.49	-0.5
Rio Grande	-0.91	-0.31	-0.28	-0.1	0.21	-0.278
Routt	-0.76	-1.52	-1.46	-1.09	-0.25	-1.016
San Juan	-0.95	-0.61	-0.87	-0.49	-0.47	-0.678
White River	-0.75	-0.52	-0.89	-0.4	-0.13	-0.538
Florida	1.63	0.8	0.19	2.2	0.11	0.986
Florida NFs	1.63	0.8	0.19	2.2	0.11	0.986
Georgia	-0.63	-0.57	-0.57	-0.16	-0.13	-0.412
Chatta.-Oconee	-0.63	-0.57	-0.57	-0.16	-0.13	-0.412

Idaho	2.92	1.96	-0.78	9	27.44	8.108
Boise	-1.48	0.17	-0.06	2.49	21.14	4.452
Caribou	-0.15	-0.16	-0.32	-0.05	-0.29	-0.194
Challis	-0.34	-0.3	-0.24	-0.27	-0.03	-0.236
Clearwater	-0.16	0.25	0.59	0.6	0.46	0.348
Idaho Panhandle	5.44	3.6	2.38	5.15	10.4	5.394
Nez Perce	0.22	-0.56	-3.29	-2.1	-1.17	-1.38
Payette	1.76	0.96	1.89	5.15	-0.12	1.928
Salmon	-0.16	-0.52	-0.46	0.28	-0.46	-0.264
Sawtooth	-0.44	-0.43	-0.48	-0.58	-0.35	-0.456
Targhee	-1.77	-1.05	-0.79	-1.67	-2.14	-1.484
Illinois	-0.73	-1.07	-0.93	-0.81	-0.55	-0.818
Shawnee	-0.73	-1.07	-0.93	-0.81	-0.55	-0.818
Indiana-Ohio	-0.24	-0.16	-0.29	-0.54	-0.57	-0.36
Wayne-Hoosier	-0.24	-0.16	-0.29	-0.54	-0.57	-0.36
Kentucky	-1.45	-1.39	-1.33	-1.33	-1.58	-1.416
Daniel Boone	-1.45	-1.39	-1.33	-1.33	-1.58	-1.416
Louisiana	2.67	4.1	2.61	4.86	2.32	3.312
Kisatchie	2.67	4.1	2.61	4.86	2.32	3.312
Michigan	-2.35	-2.04	-3.36	-3.8	-3.1	-2.93
Hiawatha	-0.82	-0.69	-1.42	-1.34	-0.87	-1.028
Huron-Manistee	-0.55	-0.53	-0.73	-0.95	-0.94	-0.74
Ottawa	-0.98	-0.82	-1.21	-1.51	-1.29	-1.162
Minnesota	-3.26	-2.72	-1.56	-1.7	-1.18	-2.084
Chippewa	-0.92	-0.86	0.02	-0.11	-0.1	-0.394
Superior	-2.34	-1.86	-1.58	-1.59	-1.08	-1.69
Mississippi	5.44	7.61	7.64	9.34	8.75	7.756
Mississippi NFs	5.44	7.61	7.64	9.34	8.75	7.756
Missouri	-0.86	-0.8	-0.4	-0.51	-0.44	-0.602
Mark Twain	-0.86	-0.8	-0.4	-0.51	-0.44	-0.602
Montana	-15.28	-13.47	-14.78	-6.06	0.01	-9.916
Beaverhead	-1.18	-2.84	-1.93	-1.37	-1.22	-1.708
Bitterroot	-1.35	-2.64	-1.75	-2.31	-2.19	-2.048
Custer	-0.91	-0.7	-0.68	-0.8	-0.53	-0.724
Deerlodge	-1.19	-1.26	-1.31	-1.62	-1.37	-1.35
Flathead	-3.55	-3.48	-3.19	-2	-2.7	-2.984
Gallatin	-1.5	-1.92	-2.37	-1.18	-1.06	-1.606
Helena	-1.24	-1.96	-1.58	-1.59	-1.07	-1.488
Kootenai	-0.01	2.92	2.54	6.28	8.03	3.952
Lewis & Clark	-0.93	-0.91	-1.08	-0.87	-0.62	-0.882
Lolo	-3.42	-0.68	-3.43	-0.6	2.74	-1.078
Nebraska	-0.09	-0.1	-0.17	-0.18	-0.67	-0.242
Nebraska	-0.09	-0.1	-0.17	-0.18	-0.67	-0.242
Nevada	-0.19	-0.26	-0.23	-0.5	-1.59	-0.554
Humboldt	-0.03	-0.03	-0.04	-0.04	-0.85	-0.198
Toiyabe	-0.16	-0.23	-0.19	-0.46	-0.74	-0.356
New Hampshire	-0.65	-0.72	-0.77	-1	-0.97	-0.822
White Mountain	-0.65	-0.72	-0.77	-1	-0.97	-0.822
New Mexico	-4.84	-7.57	-7.39	-7.82	-10.22	-7.568
Carson	-1.32	-2.28	-1.35	-1.81	-1.98	-1.748
Cibola	-0.7	-0.56	-1.05	-0.82	-1.1	-0.846
Gila	-0.82	-1.6	-2.12	-1.96	-3.41	-1.982
Lincoln	-0.68	-1.42	-0.97	-1.4	-1.06	-1.106
Santa Fe	-1.32	-1.71	-1.9	-1.83	-2.67	-1.886

North Carolina	-2.64	-2.67	-2.9	-2.46	-2.05	-2.544
No. Carolina NFs	-2.64	-2.67	-2.9	-2.46	-2.05	-2.544
Oregon	388.26	303.15	251.4	113.38	119.63	235.164
Deschutes	5.01	3.78	1.97	2.92	-0.89	2.558
Fremont	12.16	11.86	9.17	12.13	16.56	12.376
Malheur	27.33	25.29	24.29	24.45	16.99	23.67
Mt. Hood	21.66	27.22	23.64	11.09	-1.3	16.462
Ochoco	16.07	14.73	25.31	15.45	14.51	17.214
Rogue River	18.96	11.71	3.46	5.47	6.75	9.27
Siskiyou	22.49	12.27	7.31	-1.03	-8.74	6.46
Siuslaw	39.09	30.91	23.78	13.49	0.93	21.64
Umatilla	7	3.32	2.79	1.62	-3.21	2.304
Umpqua	79.24	65.19	42.76	12.46	12.21	42.372
Wallowa-Whitman	1.93	-1.2	-4.64	-7.9	-4.67	-3.296
Willamette	105.33	80.26	82.8	22.6	33.52	64.902
Winema	31.99	17.81	8.76	0.63	36.97	19.232
Pennsylvania	6.88	8.27	8.13	10.91	8.97	8.632
Allegheny	6.88	8.27	8.13	10.91	8.97	8.632
Puerto Rico	-0.34	-0.31	-0.42	-0.47	-0.11	-0.33
Caribbean	-0.34	-0.31	-0.42	-0.47	-0.11	-0.33
South Carolina	3.54	2.99	-0.62	1.25	0.69	1.57
Marion-Sumter	3.54	2.99	-0.62	1.25	0.69	1.57
South Dakota	1.69	1.72	1.26	4.26	5.25	2.836
Black Hills	1.69	1.72	1.26	4.26	5.25	2.836
Tennessee	-0.99	-1.06	-1.14	-0.91	-0.97	-1.014
Cherokee	-0.99	-1.06	-1.14	-0.91	-0.97	-1.014
Texas	0.36	1.04	1.89	6.01	4.04	2.668
Texas NFs	0.36	1.04	1.89	6.01	4.04	2.668
Utah	-2.69	-2.47	-2.49	-3.66	-2.61	-2.784
Ashley	-0.75	-0.75	-1	-0.94	-0.6	-0.808
Dixie	-0.73	-0.44	-0.66	-1.64	-1.12	-0.918
Fishlake	-0.19	-0.32	-0.11	-0.11	-0.26	-0.198
Manti-LaSal	-0.43	-0.39	-0.36	-0.41	-0.5	-0.418
Uinta	-0.22	-0.1	0.06	-0.14	0.15	-0.05
Wasatch	-0.37	-0.47	-0.42	-0.42	-0.28	-0.392
Vermont	-0.66	-0.67	-0.86	-0.86	-0.65	-0.74
Green Mountain	-0.66	-0.67	-0.86	-0.86	-0.65	-0.74
Virginia	-2.36	-2.61	-2.62	-2.74	-2.16	-2.498
George Washington	-1.33	-1.46	-1.35	-1.34	-1.06	-1.308
Jefferson	-1.03	-1.15	-1.27	-1.4	-1.1	-1.19
Washington	63.28	57.13	45.71	8.01	-13.26	32.174
Colville	1.61	0.32	-0.27	-2.4	-4.25	-0.998
Gifford Pinchot	36.11	30.42	32.72	11.19	13.8	24.848
Mt. Baker-Snoq.	12.3	16.62	12.18	4.68	-8.64	7.428
Okanogan	3.3	0.6	-1.28	-2.05	-2.05	-0.296
Olympic	5.63	5.93	1.66	-1.63	-8.36	0.646
Wenatchee	4.33	3.24	0.7	-1.78	-3.76	0.546
West Virginia	-0.14	0.5	0.28	0.34	1.1	0.416
Monongahela	-0.14	0.5	0.28	0.34	1.1	0.416
Wisconsin	-2.38	-2.41	-3.06	-2.85	-2.85	-2.71
Chequamegon	-1.44	-1.47	-1.58	-1.49	-1.51	-1.498
Nicolet	-0.94	-0.94	-1.48	-1.36	-1.34	-1.212
Wyoming	-2.71	-3.28	-3.18	-2.84	-2.7	-2.942
Bighorn	-0.36	-0.63	-0.55	-0.31	-0.35	-0.44

Bridger-Teton	-1.21	-0.94	-0.94	-0.75	-0.85	-0.938
Medicine Bow	-0.59	-1.19	-1.02	-1.18	-0.76	-0.948
Shoshone	-0.55	-0.52	-0.67	-0.6	-0.74	-0.616

Appendix 3. Developing a Price Impact Model

Price setting in an economic context is established by the intersection of supply and demand functions. This can be reduced to the simultaneous solution of relatively simple linear two variable equations for supply and demand. These functions can be developed for regional stumpage markets and from existing information, utilizing linear functional forms, and the economic constructs of supply, derived demand and market arbitrage.[30] The framework starts by describing the stumpage market using linear equations for demand (Q_d) and supply (Q_s):

$$Q_d = a1 - a_2 * P \quad (1)$$

$$Q_s = b_1 + b_2 * P \quad (2)$$

In this form the parameters a_1, a_2 , $b_1, and\ b_2$ can be estimated from the observed market price, quantity, and estimates of the stumpage supply and demand elasticities. Key is the relation for estimating elasticity ($\in$) as:

$$\in = \frac{\Delta Q}{\Delta P} \times \frac{p}{q} \quad (3)$$

Equation 3 can be rewritten to solve for the slope of equations 1 and 2 (a_2, b_2) as:

$$slope = \in \times \frac{q}{p} \quad (4)$$

The intercept terms of equations 1 and 2 (a_1, b_1) can be solved as:

$$intercept = \frac{q}{slope \times p} \quad (5)$$

The development of the supply and demand relations each involve additional steps described in the following paragraphs. Once the equations are parameterized they can be solved as simultaneous equations for market equilibrium (where $q_s = q_d$ and $p_s = p_d$). In the case of analyzing increases in NF harvest, we can assume that market arbitrage following changes in NF timber harvest will lead to new market equilibrium prices and private harvest levels.

[30] Timber markets are regional in nature defined by available species and mix of manufacturing facilities. See expanded details see Haynes (2008). Emergent lessons from a century of experience with Pacific Northwest timber markets. Gen Tech Rep. PNW-GTR-747. Portland, OR: US Dept. of Agriculture, Pacific Northwest Research Station. 45 p.

Determining Stumpage Supply. The supply curve is constructed as a composite of the behavior of different groups of timberland owners. In this case, it represents the timber harvest behavior of five different timberland owners/agencies (private, State, National Forests, BLM, and other public). Of these five owner groups, only the private timberland owners are known to be responsive to different price levels. The four public owner groups are assumed to set harvest levels through various planning processes that generally are not price responsive. In the context of equation 2, this means that the slope coefficient is based on the elasticity of private timberland owners. Public owners contribute only to the intercept term, the q in equation 5 includes both public and private timber harvest.

Determining Stumpage Demand. The stumpage market is considered to be a factor market where in the case of sawtimber the product markets are most commonly for solidwood products like lumber and panel products.[31] In this case the stumpage demand function is derived from product demand. In agricultural literature factor and product markets are linked through a concept called the elasticity of price transmission (∂) defined as:[32]

$$\partial = \frac{\Delta P^p}{\Delta P^s} \times \frac{P^s}{P^p} \qquad (6)$$

Where P^p is product price and P^s is the stumpage price. The elasticity of price transmission is calculated in two steps. First we need to estimate what is called a marketing margin expressed as:

$$P^s = c_1 + c_{2\times} P^p \qquad (7)$$

Second, using the results from equation 7 we can calculate ∂ as:

$$\partial = \frac{1}{c_2} \times \frac{P^s}{P^p} \qquad (8)$$

The importance of the elasticity of price transmission is the ability to estimate the elasticity of the derived demand for stumpage consistent with product markets as shown in equation 9.

$$\epsilon_s = \epsilon_p \times \partial \qquad (9)$$

Once we have ε_s, we can use equation 4 to estimate the slope of the stumpage demand function and equation 5 to estimate the slope coefficient.

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[31] See the discussion in Adams and Haynes (1980). The 1980 softwood timber assessment market model: structure, projections, and policy simulation. Forest Sci Mono 22. Also see Adams and Haynes (2007) Resource and Market Projections for Forest Policy Development. Springer, Dorndrecht 589 pp.

[32] See George and King for a good summary of derived demand as it is used here. George and King (1971) Consumer demand for food commodities in the United States with projections for 1980. Giannini Foundation Monograph # 26.

The Western Oregon Example.

To illustrate this approach, we have collected the following data for western Oregon:

Table 6. Timber Harvest and Price Data for Western Oregon

	Harvest	Prices	Elasticities
Private	2515		.277[33]
State	264.8	343.2	
National Forest	245.1	86.57	
BLM	161.1	112.57	
Other Public	39.3		
Softwood Lumber Elasticity			685[34]
Elasticity of Price Transmission			.838[35]

From this information, and following the steps outlined earlier, we can develop the following supply and demand functions:

$q_s = 2528.269 + 3.5913\ P$

$q_d = 5076.687 - 9.5389\ P$

The solution of these two equations is the equilibrium price and quantity observed in 2011 ($194.09, 3225.3 million board feet). To illustrate how we can use these equations in the analysis of H.R. 1526 we need to revise the stumpage supply equation (q_s) for the expected annual increase in supply. From the table above giving the expected increases in HF harvest, a reasonable first year increase for Western Oregon would be 96.7 million board feet. This assumes that it would take 4 years to expand agency capacity to increase and sell sales. We also assume that of the 293 million feet sold in the first year, only one third would be logged in the first year of increased sales. The revised stumpage supply curve is now:

[33] See Table 3.4, Adams and Haynes (2007) Resource and Market Projections for Forest Policy Development. Springer, Dorndrecht 589 pp.

[34] For softwood lumber and panels, see Adams and Haynes (2007) Resource and Market Projections for Forest Policy Development. Springer, Dorndrecht 589 pp.

[35] This was estimated by first estimating the market margin (equation 7, Appendix 1) using lumber price data (table 7) and BLM stumpage price (table 96) from PPET, 1986-2011. The elasticity of price transmission was computed using equation 8 (Appendix 1).

$q_s^r = 2624.97 + 3.5913\ P$

The solution of the demand and revised supply equations leads to changes in both the equilibrium price and quantity ($186.72, 3295.55 million board feet) consistent with a shift outward in the supply function. The drop in stumpage prices leads to small drop in private timber harvest (26.45 million board feet) that reduces the net change in harvest 70.25 million board feet and an increase in jobs of 702. This drop in prices also may lead to lower expectations about timber as a capital asset among private timberland owners and reduced market incentives for practices that contribute to sustained yield management. Federal revenues also go up as the increase in quantity harvest exceeds the decline due to lower prices but these results also show that expected revenue estimates should be made after allowing for market adjustments.