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The Effects of the New Hampshire Timber Yield Tax on Potential Financial Returns from Forest Management on Private Land

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Abstract

The USDA Forest Service Forest Vegetation Simulator was used to model the application of a three-cut shelterwood and a diameter-limit cut on a 118-acre private forest in New Hampshire to quantify the effects of the New Hampshire timber yield tax on potential financial returns. The yields at each cutting were combined with stumpage values, logging costs, log prices, forestry costs, and capital gains tax to develop net cashflows and to compare the financial returns with and without the tax. The internal rate of return would be 66 and 105 basis points higher without the tax, representing a 31 percent and 138 percent increase for the three-cut shelterwood and diameter-limit prescriptions respectively. Nondiscounted cashflows would be 137 percent higher for the diameter-limit cut and 38 percent higher for the three-cut shelterwood without the timber yield tax. The three-cut shelterwood produced total returns of 135 and 96 basis points higher than the diameter-limit harvest with and without the tax respectively. The findings from the study make a strong business case for eliminating the timber yield tax.

Keywords: timber yield tax, potential financial returns, alternative silvicultural prescriptions

The Board of Directors for the Society of American Foresters released a new position statement on federal and state taxation of private forest land urging governments to treat forests equitably with other capital ventures such as agriculture (SAF 2016). This is not the case in the state of New Hampshire, as timber production is the only business in the state subject to a 10 percent yield tax on harvested products. Forestland owners also pay annual taxes on their forestland like agriculture. Both forestlands and agricultural lands are eligible for current-use tax assessment subject to various provisions. There is no state yield tax in the agricultural sector and no statewide sales tax. State taxation of privately owned timber where harvesting is conducted is not equitable with other sectors including agriculture.

Based on a telephone survey of state forestry agencies for states shown as having either a yield tax or a severance tax on the National Timber Tax Website (2018) and data presented by Cushing and Newman (2018), New Hampshire is one of nine states that tax timber harvested from private land based on its value: West Virginia (1.5 percent), Georgia (0.7–2.5 percent), California (2.9 percent), Idaho (3 percent), Illinois (4 percent), Louisiana (2.5 percent on sawtimber, 5 percent on pulpwood), Washington (5 percent), New York (6 percent), and New Hampshire (10 percent). West Virginia's timber tax will be eliminated completely in 2019, leaving eight states. Michigan eliminated its timber tax in 1994, Massachusetts did the same in 2005, Wisconsin in 2015, and Missouri in 2018. West Virginia is phasing out its timber yield tax because of pressure from forest industry groups and others who successfully argued that the tax was detrimental to forestry as a business. The other four states that did away

Management and Policy Implications

New Hampshire depends on its forests for a wide range of social and economic benefits including a vibrant forest products industry. The vast majority of New Hampshire forests are privately owned and in many areas, particularly the south, are under considerable pressure to convert to alternative uses. Increasing the potential financial returns from forest management of private lands can help slow the rate of forest loss. The research reported here shows clearly that eliminating the timber yield tax would have dramatic effects on the potential financial returns from forestry on private land and should help retain forests. Another key finding from the study is that potential financial returns can be increased through the practice of good silviculture. The literature suggests that most nonindustrial private forest landowners do not rank timber production and the generation of income high on their list of objectives for their forests. Landowners often only consider cutting or management when financial needs dictate. The forestry profession needs to do a better job of educating private forest land owners about the value of their timber and the potential financial returns from good management in order to increase the probability that forests will remain as forests as long as possible.

with the tax have programs that provide property tax relief to landowners that commit to managing their forests with the help of a professional forester. In these states, enrollment was low because of the timber tax or the laws were overly complicated so they were eliminated when the laws were revised.

In the 2018 session of the New Hampshire State Legislature, two bills were introduced pertaining to the timber yield tax. House bill 1470 was cosponsored by eight legislators and one senator, and was aimed at the elimination of the tax. House bill 1473 was sponsored by a single legislator and was limited to minor revisions to rules and regulations relating to the administration of the tax. Bill 1470 passed, whereas bill 1473 was killed. In discussions with forestry professionals about the two bills, it became clear that although there is widespread dislike for the tax and frustration associated with the administrative procedures and execution, no one had explored the forest policy implications of the tax, more specifically the effect it has on potential financial returns to private landowners. This paper reports on such a study conducted on a 118-acre woodlot in south-central New Hampshire.

New Hampshire Timber Tax

The New Hampshire timber tax is a yield tax calculated at 10 percent of the gross stumpage sale value for all commercially harvested timber from private land levied ostensibly at the time timber is cut but in practice once it is sold. Landowners or their representatives are required to file an "Intent to Cut" application with the municipal government providing information on the location of harvesting operations as well as the volume by species and grade planned for removal. Municipalities are required to sign the intent within 30 days and then send it to the New Hampshire Department of Revenue Administration (DRA), which then issues a Cutting Permit valid until the end of the fiscal year (March 31). Landowners are required to submit a Report of Wood or Timber Cut within 60 days after harvesting is completed or by May 15 whichever comes first. The report specifies the volume by species and grade cut under the permit, which is used by the municipal assessor to determine the gross stumpage value and the applicable tax. Assessors make use of stumpage rate data compiled and analyzed by the DRA, which includes two sets of stumpage values, low and high, by species for three regions in the state (north, central, and south). Low stumpage values are supposed to be used for poor-quality timber or if logging is on difficult terrain or access is remote. High stumpage values are supposed to be used for high-quality timber, less difficult terrain, or easy access.

The tax was instituted in 1949 in response to landowners liquidating their timber assets to avoid paying an annual tax on the assessed value standing in the forest and was intended to promote the conservation of forests. Yield taxes on timber when applied to the stumpage value are neutral (Pearse 1990), meaning they do not affect the decision to harvest at either the intensive or extensive margin—a landowner will only cut a tree or an acre of forest if it is profitable (positive stumpage), at which point the tax captures 10 percent of this value. Application of yield taxes on stumpage value is complicated and costly, because information on timber volumes by species and quality is required as well as current stumpage price data. Moreover, compliance and enforcement require staff, transportation, and legal expertise, all of which adds to the cost of administration. The former State Forester for New Hampshire observed that the New Hampshire timber yield tax was plagued from its beginning with problems associated with administration, equitable application to forest land owners, distribution of tax revenues collected, and enforcement (Natti 1982). Public debate of bill 1470, which ultimately passed, revealed ongoing problems of the nature described by Natti (1982).

The New Hampshire timber yield tax grossed US$3.8 million in 2016 (New Hampshire Department of Revenue 2017a) all of which accrued to local municipalities and almost none of which was spent on forestry programs in the state. The mean and median values for municipalities in 2016 were US$10,919 and US$4970 respectively with a range of US$0 to US$104,591. New Hampshire depends heavily on taxation of private property to fund public programs and in 2016 collected US$3.6 billion in tax from this source (New Hampshire Department of Revenue 2017b). The timber yield tax represented one tenth of 1 percent of the total amount of property tax collected in the state in 2016.

Data and Methods

A privately owned, 118-acre forest located in south-central New Hampshire was used for the case study. The property is on the urban fringe of both Concord the state capital (24 miles to the southeast, 30 min by car) and Manchester the largest city in the state (38 miles southeast, 45 min by car) and is geographically at high risk for development. Evidence to support this is that in 2007 prior to the Great Recession, the tract was listed for almost four times the price it sold for in 2011, presumably anticipating interest by land developers.

In the fall of 2011, an inventory of the timber was conducted in order to establish the cost basis for the purpose of federal tax reporting. The inventory was designed as a fixed area grid of 52 plots with sample trees identified using a 10-factor prism. Sampling procedures consistent with the input requirements for the USDA Forest Service Forest Vegetation Simulator (FVS) (Dixon 2010) were employed. FVS was then used to generate stand and stocking tables for the initial inventory and also to simulate the application of two silvicultural prescriptions: a three-cut shelterwood and a diameter-limit cut. FVS was chosen because it is widely used, is supported by the USDA Forest Service, has a variant applicable to the forests of New Hampshire (region nine, forest 22), and is available free to the public. The harvest yields at each cutting were used in combination with stumpage values, logging costs, and log prices to developed net cashflows for each prescription and to compare the potential financial returns with and without the timber yield tax.

Silvicultural Prescriptions

The case study forest is a well-stocked mixture of primarily eastern hemlock (*Tsuga canadensis*), northern red oak (*Quercus rubra*), eastern white pine (*Pinus strobus*), paper birch (*Betula papyrifera*), and other hardwoods (see Table 1). Total merchantable volume (International ¼ inch rule, ≥12 inch dbh) in 2011 was 7,242 board feet per acre. Total basal area (≥2 inch dbh) was 143.8 square feet per acre. Total merchantable cubic feet per acre (≥7 inch dbh) was 1,995.8. The average for the state of New Hampshire in 2011 taken from the USDA Forest Service Forest Inventory Analysis for the state (USDA Forest Service 2011) was 1,966.8 cubic feet per acre (≥7 inch dbh) indicating that the case study forest had stocking slightly higher (1.5 percent) than the average for the state. The property was formerly a sheep farm, a common land use in the area during the 1800s. According to a neighbor, the last cutting on the property removed primarily white pine and was done in the early 1990s. Rotting white pine stumps that appear to be of this vintage are scattered throughout the property, as is evidence of old skid roads.

Two silvicultural prescriptions were compared to explore the variability in the effects of the timber yield tax on potential financial returns from alternative management scenarios (see Table 2). The first was a three-cut shelterwood comprising a preparatory harvest, the regeneration cut, and the overstory removal. The initial entry was assumed to take place in 2012 with the subsequent cuttings to be completed in 2027 and 2042. All cuttings were simulated using the "ThinDBH" keyword in FVS, which allows for the specification of the dbh range and the intensity of cutting (0–100 percent) by species. The preparatory cut involved removal of approximately 80 percent of the sawtimber-size eastern hemlock, which typically is growing under high-quality 12–24 inch dbh red oak, as well as 50

Table 1. Species composition, case study forest.

Species	BF vol./ac, international ¼ inch rule	Basal area (sq. ft./ac)
Hemlock	2,580.4	46.1
Red oak	1,416.1	28.2
White pine	1,320.6	19.1
Red maple	888.6	23.7
Paper birch	334.7	9.4
Other species	701.6	17.3
Total	7,242.0	143.8

Table 2. Silvicultural prescriptions.

Year	Species	Diameter-limit cut		Three-cut shelterwood	
		Sawlog	Pulpwood	Sawlog	Pulpwood
2012	Hemlock	100 percent, ≥14 inch dbh	Tree tops	80 percent	64 percent
	Red oak	100 percent, ≥14 inch dbh	Tree tops	4 percent	15 percent
	White pine	100 percent, ≥14 inch dbh	Tree tops	7 percent	0 percent
	Red maple	100 percent, ≥14 inch dbh	Tree tops	50 percent	61 percent
	Paper birch	100 percent, ≥14 inch dbh	Tree tops	50 percent	42 percent
	White ash	100 percent, ≥14 inch dbh	Tree tops	80 percent	59 percent
	Other species	100 percent, ≥14 inch dbh	Tree tops	20–35 percent	0–100 percent
2027	Hemlock	0	0	100 percent	100 percent
	Red oak	0	0	50 percent, ≥14 inch dbh	9 percent
	White pine	0	0	0	0
	Red maple	0	0	100 percent	100 percent
	Paper birch	0	0	100 percent	100 percent
	White ash	0	0	100 percent	100 percent
	Other species	0	0	100 percent	100 percent
2042	Hemlock	0	0	0	0
	Red oak	0	0	100 percent, ≥14 inch dbh	Tree tops
	White pine	0	0	100 percent, ≥14 inch dbh	Tree tops
	Red maple	0	0	0	0
	Paper birch	0	0	0	0
	White ash	0	0	0	0
	Other species	0	0	100 percent	100 percent

percent of the sawtimber-size red maple (*Acer rubrum*) and paper birch, 80 percent of the sawtimber-size white ash (*Fraxinus americana*), and small amounts of both red oak and white pine sawtimber. White ash was targeted in this first entry because of the imminent attack of the emerald ash borer (*Agrilus planipennis*). Eastern hemlock was targeted primarily to increase light to the forest floor to prepare the site for regeneration, but also because of the expected attack of the wooly adelgid (*Adelges tsugae*). In addition, between 50 percent and 100 percent of the pulpwood size trees 8–12 inch dbh were removed except for white pine and red oak. Basal area 2 inches dbh and larger is reduced from 143.8 to 94.5 square feet per acre. Predicted annual growth rates for the 15 years after the preparatory cut were 2.8 percent for total cubic feet, 2.7 percent in basal area, and 3.4 percent for board foot volume.

In the regeneration cutting schedule for 2027, 100 percent of the remaining hemlock, red maple, paper birch white ash, and the miscellaneous other species 8 inch dbh and above are removed except for yellow birch (*Betula alleghaniensis*) and white spruce (*Picea glauca*). In addition, 50 percent of the red oak 14 inch dbh and larger is harvested. No white pine is scheduled for cutting in 2027 because this species was apparently targeted by the previous owner, and the remaining trees are deemed critical for seed source and shade to ensure adequate white pine regeneration and development prior to the overstory removal. Basal area 2 inches dbh and larger is reduced from 133.4 to 92.1 square feet per acre. Predicted annual growth rates for the 15 years after the regeneration harvest are 2.8 percent for cubic feet, 2.7 percent in basal area, and 3.1 percent in board foot volume.

The overstory removal in the three-cut shelterwood is scheduled for 2042 and involves harvesting 100 percent of the white pine and red oak 14 inch dbh and larger, and 100 percent of the small amount of yellow birch 8 inch dbh and larger. Basal area 2 inches dbh and larger is reduced from 129.4 to 96.1 square feet per acre.

The second prescription was simply a 14-inch dbh diameter-limit harvest conducted in 2012. No pulpwood was removed except from the tops of sawtimber trees. Essentially this is a commercial clearcut or liquidation harvest and represents what a landowner who needs to maximize immediate returns might choose. Basal area 2 inches dbh and larger is reduced from 143.8 to 46.1 square feet per acre.

Product Pricing

Two sources of information were used for pricing pulpwood and sawtimber by species. Stumpage price data collected by the New Hampshire Timberland Owners Association (NHTOA 1984–2017) were used for species that do not command premiums based on size or grade and for species with very small volumes in the inventory. These include eastern hemlock, white pine, yellow birch, sugar maple (*Acer saccharum*), balsam fir (*Abies balsamea*), white spruce, and American beech (*Fagus grandifolia*). Stumpage prices were also used for all pulpwood.

Log prices obtained from a local sawmill were used for red oak, red maple, and white ash. These species are three of the most abundant on the property, especially red oak, and they all show considerable variation in price based on log small-end diameter and quality. The three-cut shelterwood prescription was designed to manage for red oak and white pine and to take advantage of the size and grade price premium for red oak.

Stumpage prices for the Southern Region reported by NHTOA and log prices from a local sawmill for the 2012 were used (see Tables 3 and 4). Prices were held constant for all cuttings, as an analysis of price changes over the last 30 years showed that, generally speaking, prices rise at slightly less than the rate of inflation—slight real decrease in price with time (see Appendix A).

Cashflows

Conventional analyses of potential financial returns from forest management employ the Faustmann (1849) formula referred to as the soil rent or soil expectation value, which explicitly links the land with the timber growing on it (for example, see Dennis and Remington 1985 or Howard and Temesgen 1997). However, as researchers have pointed out (Gamponia and Mendelsohn 1987, Pearse 1990) the application of the Faustmann formula is appropriate only when the land is suitable for just growing timber, and there is no, so-called, higher and better use (development). Davis and Johnson (1987) add the assumption that the prescription for future management of the land is known and will be repeated in perpetuity. In much of New Hampshire, particularly near the urban fringe, these conditions do not apply, and land and timber behave and are managed as two separate assets with different expectations regarding pricing and rates of return. Moreover, because of the complexity of the forests of New Hampshire, particularly in mixed conifer-hardwood stands, and the fact that they are largely in an unmanaged state, standard soil rent financial analyses are extremely difficult, if not impossible, to apply because of the difficulty in specifying a single,

Table 3. NH Southern region stumpage prices, (NHTOA, Spring 2012).

Species	Sawlog (US$/mbf)
White pine	122.50
Hemlock	37.50
Spruce and fir	80.00
Sugar maple	200.00
White birch	55.00
Yellow birch	140.00
Beech	55.00
	Pulp (US$/ton)
Spruce and fir	2.13
Hardwood	3.13
Pine	1.38
Hemlock	2.25

Table 4. Log prices, spring of 2012 in US$/mbf, international ¼ inch rule.

	Veneer		Sawlog								
Species	16-4*	14-4	16-4	14-4	14-3	12-4	12-3	12-2	10-4	10-2	Pallet
Red oak	1,000	900	600	500	450	450	375	300	300	300	250
Red maple			350	300	250	250	250	150	150	150	100
White ash			450	400	350	350	350	300	300	300	200

* Grade specifications shows minimum small-end diameter in inches first, then number of clear faces.

repeatable silvicultural prescription. Add to this the imminent complete or nearly complete loss of at least two very important commercial species because of invasive insects, white ash and eastern hemlock, and developing a management prescription beyond 20 or 30 years and expecting it can be repeated indefinitely is unrealistic. Discounted cash-flow analysis based on relatively short planning horizons with forest-specific management prescriptions and growth and yield modeling using regional or preferably local product pricing and costing is the best alternative for estimating potential financial returns.

Cashflows for the two prescriptions were generated by combining predicted timber yields at each harvest by species (one for the diameter-limit prescription and three for the three-cut shelterwood) with product prices. Inflation was ignored for both costs and product prices (constant 2011 dollars). As was stated above, stumpage and log prices in southern New Hampshire have generally lagged inflation slightly so product prices were also held constant over the planning horizon. The total value of the timber in 2011 prior to cutting was assumed to be equal to the initial investment and, consequently, shows as a negative cashflow at the beginning of the planning horizon—year zero. This value also corresponds to the total depletion allowed in figuring the capital gains tax due at each harvest. Butler et al. (2010) reported that the average length of time a private forest owner retains their land is 26 years, so a planning horizon of 30 years was chosen to approximate this value while providing the opportunity to complete the three-cut shelterwood prescription using a reasonable cutting cycle—15 years. For all species except red oak, red maple, and white ash, the average stumpage price reported by the NHTOA in the spring of 2012 for the southern region (US$/mbf for sawtimber and US$/green ton for pulpwood) was applied directly to the predicted harvest yields in board feet (sawtimber) and tons (pulpwood) per acre and then multiplied by 118 acres and summed. FVS predicts pulpwood yields in cubic feet. These were converted to green tons using the values shown in Table 5 taken from Miles and Smith (2009).

Taper equations (Larson 2016) were used to derive log populations for red oak, red maple, and white ash based on the dbh and number of trees for each dbh class for the harvest levels predicted with FVS. The equations for yellow poplar were used to model taper in white ash, as there are no equations for this species. The taper equations were used to estimate the diameter outside bark as a function of log length and dbh class. Bark thickness equations for red maple and white ash published by Fowler et al. (1999) were used to calculate the small-end diameter inside bark. A bark thickness equation published by Thomas and Bennett (2014) was used to calculate the small-end diameter inside bark for red oak. Log lengths were varied for each species, dbh class, and log position such that the total volume per acre predicted using the small-end diameter of the logs was equal or close to equal to the total volume per acre predicted by FVS. Log volumes were estimated using Grosenbaugh's integrated formula for the international ¼ inch rule (from USDA Forest Service 1974).

Table 5. Conversion factors, cubic feet to green weight (Miles and Smith 2009).

Species	Green lbs per ft^3
Balsam fir	45
White pine	35
Hemlock	50
Red maple	50
Sugar maple	55
Yellow birch	59
Paper birch	53
Beech	79
White ash	50
Red oak	64
White spruce	35

Log grades were assigned as follows. For red oak, all logs with small-end diameter 16 inches inside bark and greater were assumed to qualify for the 16-4 grade (minimum 16 inches inside bark small-end diameter and four clear faces). In addition, 3 percent, 5 percent and 7 percent of logs with small-end diameter inside bark 14 inches and greater were assumed to qualify as veneer logs for cuttings made in 2012, 2027, and 2042 respectively. Logs with a small-end diameter inside bark between 14.0 and 15.9 inches were assumed to be split evenly between logs with four clear faces and logs with three clear faces. Logs with a small-end diameter inside bark between 12.0 and 13.9 inches were assumed to have three clear faces. There was no price differences for logs smaller than 12.0 inches small-end diameter inside bark as a function of the number of clear faces. For red maple and white ash, the same assignment rules were applied except that for logs with a small-end diameter inside bark between 12.0 and 13.9 inches, the log profile was split evenly among logs with four, three, and two clear faces.

Per acre values for red oak, red maple, and ash logs were computed by multiplying the prices shown in Table 2 by the log volumes by log grade and subtracting logging and trucking costs. Trucking costs were set at US$75/mbf, and logging costs were set at US$150/mbf, which were the going rates in 2012. Inflation was ignored in the discounted cash flow analysis, so logging and trucking rates were held constant over the planning horizon, as were product prices. Total value was computed by multiplying the per acre values by 118 acres and then summing for the three species. The sum of the values calculated with stumpage prices and log prices gives the total gross revenue for the harvest.

Net cashflows were calculated as follows. First, the timber yield tax of 10 percent of gross harvest revenues was subtracted. Then, a 15 percent commission on the gross harvest revenues for forester supervision of the timber sale was subtracted. Finally, federal long-term capital gains tax assuming a 15 percent rate was subtracted after figuring the depletion allowance applicable at each harvest. This is the 2018 rate applicable to single filers with taxable income between US$38,601 and US$425,800. All but filers in the lowest income bracket in the range US$38,601–38,700 would pay higher taxes if the income from timber sales was not treated as a long-term capital, as it would be reported as ordinary income. The timing and magnitude of net cashflows for the two prescriptions with and without the timber yield tax are shown in Table 6. Note that the cashflows for year 2042 include the ending value of inventory.

Taxes on the land were not included in the analysis, as these accrue to the land, which is a separate asset from standing timber with unique pricing and potential rates of return that are independent of the condition and value of the timber. There is no income tax in the state of New Hampshire, and because the income is assumed to be for an individual, neither the state's business profits tax or the business enterprise tax applies. The standing inventory at the end of the planning horizon was treated as if it was harvested in the final year of the planning horizon with the corresponding timber yield tax applied except for the no-tax scenarios. Net cashflows were used to compute the net present value (NPV) assuming a discount rate of 1.5 percent real, and the internal rate of return (IRR) for the two silvicultural prescriptions. It was assumed that all cuttings were made at the end of the year beginning in year 1, so net cashflow for the first cuttings in all scenarios was discounted 1 year. The second cutting in the shelterwood prescription was discounted 16 years (15 years of growth), and the final cutting for both scenarios was discounted 31 years (15 additional years of growth). The IRR is the discount rate when applied to the net cashflows that yields an NPV of 0. The effects of the timber yield tax were determined by simply not subtracting the tax in separate scenarios for each prescription and comparing the resulting NPVs, IRRs, and net nondiscounted cashflows to the same from the scenarios for the two silvicultural prescriptions with the tax included.

A sensitivity analysis was applied to the three-cut shelterwood prescription to explore the effects of two variables: slower tree growth and lower harvest yields. Slower tree growth was modeled by simply adding 5 years to the timing of the second and third cuttings, so in this scenario the regeneration cutting occurs at the end of year 2032 (discounted 21 years), and the overstory removal occurs at the end of 2052 (discounted 41 years). This scenario can be viewed as representing a well-stocked stand on a poorer site and results in a 25 percent reduction in growth across the three measures (cubic feet, basal area, and board foot volume). Lower harvest yields were modeled by simply reducing the gross harvest revenues by 25 percent in all three cuttings. This scenario represents a poorer stocked stand on a good site.

Table 6. Net cashflows by year.

	Net cash flows (US$)			
	Diameter-limit cut		Three-cut shelterwood	
Year	Tax	No tax	Tax	No tax
2011	–92,984	–92,984	–92,984	–92,984
2012	53,816	60,991	14,432	16,356
2027	0	0	41,129	47,123
2042	50,004	57,719	94,549	108,599
Totals	10,835	25,726	57,126	79,094

Results

The New Hampshire timber yield tax has a large, negative effect on the potential financial returns for the case study forest whether measured by IRR or NPV (see Table 7). The effects of the tax are substantially worse with the diameter-limit cut than the three-cut shelterwood, largely because of the hefty tax bill in the first year associated with the liquidation cut. The IRR for the three-cut shelterwood is 96 and 135 basis points higher (53 and 178 percent) than the IRR for the diameter-limit cut for the no timber yield tax and taxed scenarios respectively.

Logically, the effects of the timber yield tax on net cashflow are also negative and substantial. The proportional increase in net revenue without the tax for the diameter-limit cut is about the same as the proportional increase in the IRR. Conversely, the proportional increase in net revenue without the timber yield tax for the three-cut shelterwood is slightly higher than the proportional increase in the IRR without the tax. The three-cut shelterwood generates almost 5.3 times the net cashflow produced by the diameter-limit cut when the timber yield tax is collected. The timber yield tax takes more than US$7000 additional revenue from the landowner if the three-cut shelterwood is applied instead of the diameter-limit cut.

Predictably, the 25 percent slower growth scenario produced lower NPVs and IRRs than with the base case three-cut shelterwood, about 25 percent lower for both the taxed and no timber yield tax scenarios (see Table 8). The absolute differences between the two are substantial, 51 and 68 basis points for the taxed and no-tax scenarios respectively. What is not so obvious is that a 25 percent reduction in timber yields had essentially no effect on the IRR for the three-cut shelterwood. The reason is that the volume, and therefore value, of the initial inventory was also reduced by 25 percent, so the initial investment was 25 percent lower. All other costs are calculated as fixed percentages of the gross timber value at each harvest, so they are proportionately lower. The differences in the IRR between the taxed and no-tax scenarios for all three of the three-cut shelterwood simulations are very similar and, when expressed as a percentage of the taxed scenario, are essentially identical at roughly 31 percent—the total possible return to the landowner with shelterwood management would be almost a third higher without the tax.

The findings from the sensitivity analysis show no change in net cashflow between the base case three-cut shelterwood and the 25 percent slower growth. This is because the cashflows were simply shifted in time, 5 years later for the regeneration cut, overstory removal, and valuation of the ending inventory, so the total did not change just the timing. By definition, net cashflows for the 25 percent lower yield scenario are 25 percent lower than with the three-cut shelterwood base case. These findings, combined with those showing the effects on the IRR, suggest that the negative impact of the tax on potential financial returns from privately owned forests is relatively constant across stocking levels and site qualities.

Discussion

New England experienced an annual average forest loss of 0.19 percent between 1990 and 2000 and 0.15 percent from 2000 to 2005 (Jeon et al. 2013). The trend in forest loss is referred to as "forest transition reversal," a reversal of the trend since the mid 1800s when the abandonment of agricultural land began, and forest area began to increase. Massachusetts and southern New Hampshire experienced the highest rate of forest conversion in New England, and residential and commercial development drove the loss of forest between 1990 and 2005. A followup study (Olofsson et al. 2016) using remotely sensed data up to 2011 reported similar findings and concluded that New England has experienced continuous forest deforestation since the 1980s with a total loss of almost 500,000 hectares.

Table 7. Effects of timber sales tax on potential financial returns.

	Diameter-limit cut			Three-cut shelterwood, base case		
	Net cash flow (US$)	IRR (percent)	Net present value (US$)	Net cash flow (US$)	IRR (percent)	Net present value (US$)
With timber tax	10,835	0.76	–8,446	57,126	2.11	13,241
Without timber tax	25,726	1.81	3,486	79,094	2.77	28,716
Absolute difference	14,890	1.05	11,932	21,968	0.66	15,475
Percentage difference	137.4	138.2	141.3	38.5	31.3	116.9

Table 8. Sensitivity analysis, three-cut shelterwood.

	25 percent slower growth			25 percent lower yields		
	Net cash flow (US$)	IRR (percent)	Net present value (US$)	Net cash flow (US$)	IRR (percent)	Net present value (US$)
With timber tax	57,126	1.60	2,671	42,492	2.10	9,708
Without timber tax	79,094	2.09	16,583	58,969	2.76	21,315
Absolute difference	21,968	0.49	13,911	16,476	0.66	11,606
Percentage difference	38.5	30.6	520.7	38.8	31.4	119.6

According to these researchers, New Hampshire is experiencing the greatest forest loss among the six New England states.

A recent study on patterns of forest harvesting in New England and New York (Belair and Ducey 2018) showed that “exploitive” logging such as commercial clearcutting and high grading accounted for almost a third of all harvesting that was not simply incidental (removal of less than 10 percent of basal area). What they term “classic” silvicultural methods were found to be relatively rare. These researchers also found a tendency for logging to target valuable species (oak and pine) of sawtimber size resulting in a decline in the quality of the residual growing stock because of the increase in less valuable shade-tolerant species such as American beech and eastern hemlock as well as suppressed, poor form stems of more valuable species. The findings for New Hampshire reported by these researchers fit this general pattern, which the authors concluded was because of decisionmaking based on short-term financial gain and pragmatic concerns.

These studies show that in New England, private forests are disappearing slowly but steadily because of conversion for development, and those that remain, if harvested, are frequently degraded through poor silvicultural practices. How can these two trends be reconciled with what is known about private forestland owners’ objectives? In a summary of the literature at the time, Young and Reichenbach (1987) reported that the vast majority of forest owners do not believe that timber production, which presumably means financial returns, is a major reason for owning forestland. According to Butler et al. (2010) timber production ranked 11th out of the set of 12 objectives listed in their study of family forest owners in the United States. Only 11 percent of family forest owners stated that timber production was one of their objectives, but this represents 32 percent of the total forest area owned by families. However, these researchers also found that 27 percent of family forest owners have harvested trees in the past, representing 58 percent of the total forest area owned by families. Land as an investment ranks sixth out of 12, which suggests that family forest owners think of their land as a separate asset from the timber growing on it.

While apparently most private forest land owners do not consider the potential financial returns from their forests as important, indeed it is the inability of forest management to compete financially with land conversion that leads to the loss of forests. As Brockett and Gebhard (1999) observed, the lure of substantial financial returns from land conversion becomes irresistible, and in many cases unavoidable, because of financial needs of forest owners, especially when ownership passes from one generation to the next, and particularly on the urban fringe. As Sampson and Decoster (2000) pointed out, taxes on forests yield little to nothing in the way of publicly provided services to private forest land owners, and this imbalance puts the financial viability for forest management at risk. Even preferential land taxes on forests are not enough to make potential returns from forest management attractive or retard the conversion of forests for development (Brockett and Gebhard 1999, Jacobson and McDill 2003). The findings presented here show that the New Hampshire timber yield tax exacerbates the problem by reducing the potential financial returns from forest management.

While the evidence from studies cited above indicates that private forest land owners do not emphasize timber production, it is not clear from these studies whether forest owners are aware of the potential financial returns from forest management. Butler et al. (2007) reported that a mere 3 percent of family forest owners have a forest management plan, and only 16 percent have sought professional advice on how to manage their land. They also found that only 22 percent of family forest owners enlisted the help of forestry professionals when they harvested timber. Given the technical know-how required to perform a reliable valuation of standing timber, the projection of growth and yield for alternative silvicultural prescriptions, and model formulation and computations involved in performing a discounted cashflow analysis and to estimate potential financial returns, it is probable that most private forest land owners do not know the monetary value of the timber they own or the potential financial returns from forest management. In the absence of such knowledge, it is not surprising to learn that private forest land owners do not consider timber production a major objective. It is critical that forestry professionals and the public through their governments remedy this state of affairs as a first step in setting the stage for incorporating sound information on potential financial returns into decisionmaking regarding management of private forests and ultimately creating conditions that favor retention of forests. As Butler et al. (2007) commented, how privately owned forests are managed and whether or not they are converted to alternative uses is of significant public interest.

But knowledge and well-informed decisionmaking is not enough if potential financial returns from forest management are too low to compete with alternative land uses. Forest researchers, policymakers, forestry professionals, and the forest industry must find ways to increase potential financial returns from forest management. In New Hampshire, eliminating the timber yield tax is a logical first step, given the findings presented above, and would put the state on equal footing with its New England neighbors, none of which assess a tax on the sale of timber.

Summary, Conclusions, and Recommendations

The New Hampshire timber yield tax represents a tiny fraction of the total tax revenue collected by the state but has an outsized, detrimental effect on the potential financial returns from forest management of a mixed conifer-hardwood forest in the south-central region of the state. The IRR would be more than 31 percent and 138 percent higher for the three-cut shelterwood and diameter-limit cut respectively over a 30-year planning horizon without the tax. The three-cut shelterwood has the potential to produce a 135-basis point better rate of return than the diameter-limit cut, but this option leads to a tax bill that is more than US$7000 higher over the 30-year planning horizon. Nominal yields for the three-cut shelterwood base-case scenario are between 4 and 5 percent annually, which is comparable to the dividend from a good blue-chip stock, about double the current interest rate on a 5-year certificate of deposit, and 100–200 basis points higher than the current rate for a 30-year US Government bond. The nondiscounted net cashflows for the three, three-cut shelterwood scenarios would be more than 38 percent higher without the timber yield tax.

The New Hampshire timber yield tax is antithetical to the recent SAF position statement on federal and state taxation of private forest land, as forestry is not treated equitably with other capital ventures such as agriculture. The findings from this study present a strong business case for eliminating the timber yield tax because of its dramatic negative effect on the potential financial returns compromising the ability of forestry to compete with alternative uses. Corroboration from additional studies on different properties would strengthen the case further. In the long run, the tax will hasten the depletion of New Hampshire's timber resources with commensurate impacts on the forest industry, forestry sector, and ecosystem services provided by private forests.

The following recommendations are offered:

1. Eliminate the New Hampshire timber yield tax to increase the competitiveness of forest management as a land use.
2. Begin a dialogue among foresters, forest industry representatives, and private land owners about the potential financial returns from forest management on private land and develop a means for educating all parties on the methods for conducting financial analyses of forest management.
3. Investigate ways to increase the potential financial returns from forest management of private forest lands with the goal of improving the competitiveness of the sector compared to alternative land uses.

Appendix A—Calculation of Real Change in Stumpage Prices

The change in product prices, stumpage and/or delivered to mills in real terms must be considered explicitly when conducting financial analyses spanning longer time periods (Dennis and Remmington, 1985). Real rates of price change for stumpage were calculated using historic price data published by the New Hampshire Timberland Owners Association (NHTOA, 1984–2017). Nominal changes in stumpage prices were adjusted for inflation using data from the United States Bureau of Labor and Statistics Forestry and Logging Product Price Index. Compound rates of inflation for the past 10, 20, and 30 years are 1.56 percent, 0.22 percent and 1.98 percent. The resulting real rates of change for stumpage prices from 1987 to 2017

Table A1. Historic real rates of change in stumpage prices, 1987–2017.

	Compound real rates of change (percent)		
	2007–2017	1997–2017	1987–2017
Sawtimber (US$/mbf)			
White pine	–2.3	0.6	–0.7
Hemlock	–0.2	–0.2	–1.5
Spruce/fir	2.1	4.0	
Yellow Birch	–1.6	2.8	0.5
White birch	1.0	–1.0	–3.7
Sugar maple	–5.0	0.1	1.7
Red maple	0.3	4.8	2.2
White ash	4.2	1.4	–0.4
Red oak	–1.1	–0.9	–1.1
Pallet	0.7	0.1	–1.4
Pulpwood (US$/cord)			
Hardwood	–0.8	0.0	
Hemlock	–8.0	–0.2	
White pine	9.5	1.5	
Spruce/fir	13.3		

are shown in Table A1. Generally speaking, stumpage prices have not appreciated in real terms over the past 30 years.

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