

The effectiveness of state preferential property tax programs in conserving forests: Comparisons, measurements, and challenges



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ABSTRACT

Forest property taxes have been identified as one of the major driving forces behind forest loss and parcelization. Among various policy alternatives for reducing the burden of forest property taxes on landowners, preferential property tax programs have been widely used across states. Existing research has mostly focused on individual property tax programs, particularly those based on current use valuation, while little has been done to document, analyze and compare programs across states. By examining survey data from state preferential property tax program administrators across the United States, this paper describes the commonalities and differences among states regarding their preferential property tax programs, provides a preliminary understanding of the relationship between state preferential property tax policy and trends in private forest conditions, and identifies issues related to the effectiveness of state preferential property tax programs and private forest land management and conservation. Our analysis revealed three fundamental disconnects: (1) Program attributes that were previously considered to be important for preferential property tax programs to be effective in retaining forest land and fostering management did not consistently correlate with program effectiveness as viewed by the administrators of these programs; (2) These program attributes did not consistently correlate with actual program effectiveness as measured at the state level by forest trend indicators used in this study (i.e., change in private forest land cover, change in average size of private forest holdings, extent to which private forest land is being actively managed); and (3) The self-assessed program effectiveness did not consistently correlate with actual program effectiveness, either. The various ways in which the effectiveness of preferential property tax programs is defined and measured contribute to explaining these disconnects. It is particularly important for researchers and policy makers to be explicit about how they define and measure effectiveness and the scale on which they conduct their analysis before assessing and comparing programs or suggesting improvement strategies.

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Introduction

An estimated 11 million private forest owners collectively control 56% of the forest land in the United States (Butler, 2008). Most of these owners are families and individuals with relatively small

tracts of land; however, their collective management behavior has a significant impact on the nation's forest resources. A wide range of policy tools has been adopted to encourage sustainable forest management, including technical assistance, outreach education, financial incentives, and regulations. Among these policies and programs, financial incentives, particularly tax incentives, play a prominent role (Kilgore et al., 2007). Tax incentives include reduced or deferred property, estate and inheritance taxes, favorable tax credits and deductions, favorable capital gains treatment of timber income, as well as incentives linked to specific stewardship practices such as wildlife protection, recreation, and reforestation (Fecso et al., 1982; Greene, 1998; Greene and Blatner, 1986; Kilgore

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et al., 2007; Koontz and Hoover, 2001; Sampson and DeCoster, 1997).

This paper focuses on state-level forest property tax policies, which have been identified as one of the driving forces behind forest fragmentation and parcelization (Mehmood and Zhang, 2001). Imbalanced property tax systems and their associated high property tax burdens can create strong incentives for landowners to sell their land or split it into smaller parcels, which often results in land conversion to more developed uses (Argow, 1996; Haines et al., 2011; Mehmood and Zhang, 2001; Mundell et al., 2010; Sampson and DeCoster, 2000). In an empirical study in two New York state watersheds, for instance, Sanborn–Stone and Tyrrell (2012) found that nearly a third of landowners who parcelized their forest properties reported the burden of property taxes was the number one reason for doing so, while nearly half cited the taxes as one of their top three reasons for subdividing their land.

Among various policy alternatives for reducing the burden of forest property taxes on landowners, preferential property tax programs have been widely used among states and have the potential to “unambiguously delay development,” particularly when tax rates are high or discount rates are low (England and Mohr, 2003). Hibbard et al. (2003) conducted a nationwide review of state preferential property tax programs and classified programs into five major types: (1) Ad valorem—valuation based on fair market value; (2) Current use—valuation according to use in a forested condition; (3) Flat—taxed at a fixed, per acre value; (4) Exemption—forest land is exempt from property tax all together; and (5) Hybrid—commonly a combination of current use and ad valorem values. Besides this study at the national level, research on forest property taxes has generally focused on individual programs within a state or region, focusing on landowner awareness and participation, the effectiveness of the programs, and issues related to program design and implementation.

For instance, Jacobson et al. (2009) surveyed selected forestry officials in 20 northern states about their opinions on financial incentive program. Compared to other public and private financial incentive programs available to forest landowners, preferential property tax programs scored higher for owner awareness but slightly lower for owner appeal. The authors suggested that the higher awareness could be attributed to the longer history of these programs; the lower appeal could be due to owner wariness about involvement in government programs or to the penalties for withdrawing from the program. Although forest owners may be somewhat aware of state preferential property tax programs, their participation has generally been low. For instance, West Virginia has a program based on current use valuation (i.e., Managed Timberland Tax Incentive Program). However, only 2 million acres out of the 9.7 million acres of privately owned forest land have been enrolled in this program (Fortney et al., 2011). A similar trend was observed in southeastern Tennessee (Williams et al., 2004). Less than a quarter of forest owners in the region were enrolled in Tennessee’s Forest Greenbelt Program, which assesses forest land at its use value instead of market value as long as the owner does not convert land to a non-forested use.

Some studies have been conducted to identify potential factors affecting participation in state preferential property tax programs. Williams et al. (2004) identified a lack of awareness as the principal reason why less than a quarter of eligible participants had taken advantage of Tennessee’s Forest Greenbelt Program. In the case of West Virginia’s Managed Timberland Tax Incentive Program, 62% of non-participants reported the reason they were not enrolled was they had never heard of the program. Other reasons for not enrolling included farm land classification (23%), which is taxed at a lower rate in West Virginia than forest land, concern about property rights (16%), and already homestead exempt (12%). Dennis and Sendak (1992) suggested that continued fragmentation

of the forest and population growth would have a negative effect on landowner participation in Vermont’s use value appraisal property tax program, but these effects may be mitigated by increases in the education level of landowners and by increases in assessed values and property tax rates.

The effectiveness of some state preferential property tax programs, at least in terms of mitigating forest loss, has been called into doubt. For instance, the negative correlations between the probability that a forested parcel would be enrolled in Vermont’s use value appraisal property tax program and a town’s population density and growth rate indicated that the program was ineffective in drawing acreage into the program in areas where it was needed most for maintaining open space (Dennis and Sendak, 1992). Brockett and Gebhard (1999) concluded that Tennessee’s program was little more than a windfall for participating forest owners, while failing to serve those along the development front where taxes were most burdensome. Williams et al. (2004) also found that Tennessee’s program did not necessarily dissuade forest owners from converting their land. Polyakov and Zhang (2008) found that Louisiana’s current use valuation program, while slowing down development of rural lands, had a far greater impact on land-use change by preventing conversion of some of the marginal agricultural land to forestry uses. This contradicts other governmental land-use policies, such as Conservation Reserve Program that attempt to reduce erosion and excess agricultural production by converting cropland to long-term, resource-conserving covers such as forest or permanent grasses. With respect to Georgia’s current use tax program for agricultural land or woodland, Newman et al. (2000) concluded that although the program provided green space and the associated environmental benefits, it was insufficient in and of itself to provide an effective deterrent to land-use change at the urban-rural fringe.

Generally speaking, preferential property tax programs are designed to provide a lower tax bill in exchange for meeting legislatively prescribed forest management and/or land use objectives (Eckhoff et al., 2007). In many states, these programs require a forest management regime dedicated to timber production as a condition for participation. A study of Minnesota’s former Tree Growth Tax Law program showed that participants took a more active approach to management as compared to non-participants (Rathke and Baughman, 1996). Jacobson and McDill (2003) highlighted the fact that Pennsylvania’s Clean and Green Program emphasized timber production even though timber management was seldom cited by private forest owners as a primary ownership objective. Some have argued that the enrollment criteria of existing state programs are so restrictive that a high percentage of forest owners are ineligible to participate (Kernan, 2004). Others believe that having requirements, such as a penalty for defection or early withdrawal or documentation proving prior commitment to the lands in a forested condition, serve as a deterrent for those lacking a genuine interest in the long-term health of their lands (Eckhoff et al., 2007).

With respect to program implementation, administrative difficulties are a challenge for many preferential property tax programs. In a number of states, the county or local property tax assessment office is tasked with program oversight and administration. In Pennsylvania, the Commonwealth sets assessed values based on forest type classification to account for differences in the values of timber grown (Jacobson and McDill, 2003). However, because the state’s preferential property tax program does not require forest owners to have a management plan, assessors are often not able to determine forest type composition of individual parcels and frequently resort to using a single weighted-average value based on coverage for the entire county. This results in forest owners with high-value forest types paying the same per-acre tax as those with low-value forest types (Jacobson and McDill, 2003).

Existing forestry research has mostly focused on individual state preferential property tax programs, particularly those based on current use valuation. In contrast to the number of studies on the participation and effectiveness of these individual programs, little has been done to document, analyze and compare preferential property tax programs across states in a statistically rigorous manner. By examining survey data from state preferential property tax program administrators across the United States, this paper provides an up-to-date, broad understanding of existing state preferential property tax programs and their implications for forest conservation. More specifically, this paper (1) describes the commonalities and differences among states regarding their preferential property tax programs, (2) provides a preliminary understanding of the relationship between state preferential property tax policy and trends in private forest conditions with a focus on land cover, size of land holdings, extent to which forest land is being actively managed, and, (3) identifies issues related to the effectiveness of state preferential property tax programs and private forest land management and conservation.

Methods

Survey of state preferential property tax program administrators

The data for this study were drawn from a 2010 email survey of state forestry agency or department of revenue employees involved in the administration of their state's preferential property tax program(s). For the purpose of the survey, a preferential property tax program was defined as a voluntary program that, by participating, obligates landowners to restricting the use of their land, having a written forest management plan, or paying a penalty for removing land from the program in return for a reduced annual property tax burden. Although all 50 states have policies that reduce or eliminate property taxes for forest properties, [Butler et al. \(2012\)](#) identified 38 states with one or more preferential property tax programs as previously described, among which 37 have one major program applicable to private forest owners statewide. Therefore, our survey questionnaire was emailed to the administrators of these 37 programs. Thirty six questionnaires were completed and returned, representing a response rate of 97%.

The administrators were first asked to verify their program attributes summarized in [Butler et al. \(2012\)](#), including program name, primary goals, minimum acreage to enroll, and requirements on forest management plan, minimum enrollment period, and withdrawal penalty. Additional information was collected with respect to the estimated landowner participation in the program and the estimated tax savings resulting from participation. The administrators were also asked to use a five-point Likert scale to rate their program according to the eight policy effectiveness criteria identified by [Hibbard et al. \(2003\)](#): (1) The program has clearly articulated goals; (2) The magnitude of the tax break is significant; (3) The program complements other state forestry incentive programs; (4) The forest land valuation mechanisms, eligibility requirements, withdrawal penalties, and minimum enrollment periods reflect program goals; (5) The program is consistently administered from county to county; (6) Funding for the forestry tax program has been stable and predictable; (7) The program is periodically reviewed to ensure that objectives are being met; and, (8) Guidance through the application process is available to forest owners. Property tax program administrators were also asked to rate the overall effectiveness of their program for protecting forest resources in areas highly susceptible to development in their state.

Summary statistics of the survey items have been reported in [Butler et al. \(2012\)](#). Overall, 92% of state preferential property tax programs had a minimum acreage for enrollment, 58% required

a forest management plan, 50% specified a minimum enrollment period, and 81% had a withdrawal penalty. Among the 33 states responding to the question about landowner participation, 48% reported at least 50% eligible forest owners participating, while 52% reported less than 50% participation. Among the 29 states responding to the question about estimated savings, 17% reported less than 50% savings, while 83% reported more than 50% savings. With respect to the eight policy effectiveness criteria, the majority of administrators considered their program having clearly articulated goals (86%), providing significant tax break (86%), complementing other state forestry incentive programs (58%), having requirements reflect program goals (72%), being administered consistently (69%), being reviewed periodically (67%), and providing guidance about the application process to forest owners (69%). The only criterion not met by the majority of state programs was related to funding. Only 42% of administrators agreed that funding of their preferential property tax program had been stable and predictable.

Segmentation approach

This study adopted a three-stage analytical approach to describe and compare states based on the characteristics of their preferential property tax program. Three distinct groups of states were defined based on their program attributes, including program requirements and administrators' responses to the eight survey items measuring policy effectiveness using a five-point Likert scale. The first stage of the analytical approach employed a principal component analysis. This procedure was used to reduce the dimensionality of the eight policy effectiveness survey items and transform these correlated variables to a smaller set of composite variables. Second, a cluster analysis was used to identify three distinct groups of states based on variables measuring their preferential property tax program requirements and the composite variables created in the first stage. Last, box plots and analysis of variance were used to compare the groups of states and examine the relationships between state preferential property tax programs and trends in forest conditions. Trends in forest conditions were represented at the state level, by: (1) Percentage change in area of private forest land between 1997 and 2007 ([Smith et al., 2009](#)); (2) Percentage change in average size of private forest holdings between 1993 and 2006 ([Birch, 1996](#); [Butler, 2008](#)); and, (3) Percentage of private forest land owned by families and individuals with a written forest management plan in 2006 ([Butler, 2008](#)). These forest land and ownership data were collected by the USDA Forest Service, Forest Inventory and Analysis Program and through the National Woodland Owner Survey.

Analysis and results

Stage I: Reducing data using principal components analysis

There were eight items in the survey questionnaire measuring various aspects of policy effectiveness ([Table 1](#)). High correlations among several of these items indicated that the data were not uni-dimensional, which warranted a data reduction procedure. Principal component analysis (PCA) is a statistical technique allowing for the transformation of a large number of correlated variables to a smaller set of uncorrelated, composite variables called principal components (PCs) with a minimal loss of information ([Finley et al., 2006](#); [StataCorp, 2011](#)). PCA involves calculating the eigenvalue decomposition of a data covariance matrix or utilizing singular value decomposition of the data matrix ([Samish, 2009](#)). The results of a PCA are usually discussed in terms of PC loadings. A PC loading represents the correlation between the survey item and the PC, and is used to define and name each PC. Absolute PC loadings greater than 0.60 are considered significant and indicate a strong

Table 1
Description and summary of survey items measuring policy effectiveness with principal component analysis summary statistics.

Policy effectiveness survey items ^a	Mean (Std. dev.)	Rotated principal component loading			Cronbach's alpha
		PC 1	PC 2	PC 3	
The program has clearly articulated goals	4.25 (0.77)	0.6634	−0.0095	0.0828	0.8506
The program complements other state forestry incentive programs	3.72 (1.06)	0.7662	−0.0139	0.0589	
The program is consistently administered from county to county	3.78 (1.05)	0.6366	0.0115	−0.2188	
The program is periodically reviewed to ensure that objectives are being met	3.78 (0.87)	0.6467	0.3889	−0.3655	
Guidance through application process is available to landowners	4.06 (0.83)	0.7191	0.0914	−0.3479	
The magnitude of the tax break is significant	4.39 (0.90)	0.5106	−0.6604	0.1815	0.8166
Funding for the forestry tax program has been stable and predictable	3.36 (1.02)	0.1058	0.8341	0.4415	
The forestland valuation mechanisms, eligibility requirements, withdrawal penalties, and minimum enrollment periods reflect program goals	3.86 (0.87)	0.5672	−0.1033	0.6812	0.8055

^a Item scale: 1 = strongly disagree, 5 = strongly agree.

association among survey items used to generate that particular PC (Finley et al., 2006; Hair et al., 1998). Those items that do not load significantly on derived PCs are often left to stand alone in later analyses.

In this study, PCA was performed on eight policy effectiveness criteria for 36 complete state records. Table 1 displays the PC loadings for the first three PCs. All three PCs had an eigenvalue greater than one and allowed for practical interpretation of the meaning of the PCs. Based on the common theme of the survey items that loaded on each PC, we defined PC 1 as having an administrative advantage, represented by variable *admin_adv*; PC 2 as having a financial advantage, represented by variable *finan_adv*; and PC 3 as having consistent program requirements and goals, represented by variable *consist_adv*. Combined, these three PCs accounted for 66% of the total variance in measurements of policy effectiveness. Cronbach's Alpha was calculated for each PC (Cronbach, 1951). All PCs met suggested Cronbach's Alpha minimum of 0.70 (Nunnally, 1978), suggesting reasonable scale reliability. Cronbach's alpha determines the internal consistency or average correlation of items in a survey instrument to gauge its reliability (Santos, 1999). Using the PCA, the original eight survey items measuring policy effectiveness were reduced to three composite variables. PC scores served as data observations for the new composite variables. In the second stage of the analysis, cluster analysis defined distinct groups of states based on this reduced set of composite variables.

Stage II: Grouping states using cluster analysis

Following the PCA, a cluster analysis was conducted to identify groupings of states with similar preferential property tax program attributes. The results of this analysis were used to examine the relationship between state preferential property tax programs and trends in private forest conditions. Cluster analysis is a multivariate technique that attempts to determine the natural groupings (or clusters) of observations, such that within-group similarity is maximized and among-group similarity is minimized (Hair et al., 1998; StataCorp, 2011). Cluster analysis is exploratory in nature (absent of *p*-values) and is intended largely for generating rather than testing hypotheses (StataCorp, 2011). The *k*-means clustering algorithm was used to assign states into exclusive groups based on the composite variables derived from the PCA, as well as three state-level preferential property tax program requirement variables (requiring management plan, specifying enrollment period, and having withdrawal penalty). To arrive at an appropriate number of state groupings, two-, three-, four-, and five-cluster solutions were explored and the final solution was selected by examining the consistency within and across groups. The three-group solution yielded the most stable and interpretable results, and therefore, was selected as the basis for further analysis.

Groupings of states are shown in Table 2. Thirteen states are in Group 1. They generally had preferential property tax programs that required a management plan, specified a minimum enrollment period, had withdrawal penalties, and had (on average) the highest administrative and financial advantages. By contrast, the 13 states in Group 2 tended to have preferential property tax programs that were least likely to require a management plan or specify a minimum enrollment period, and had the least administrative and financial advantages. However, the administrators of these states tended to think that their program requirements, including forest land valuation mechanisms, eligibility requirements, withdrawal penalties, and minimum enrollment periods, reflected program goals, as suggested by the positive mean score for PC 3 (*consist_adv*). Ten states are in Group 3. Their preferential property tax programs also seemed to lack administrative and financial advantages, and the administrators did not think that their program requirements were aligned with program goals.

All the administrators were asked if they considered their program to be effective in protecting forest resources in areas highly susceptible to development. Overall, 53% of administrators considered their program to be effective, while 47% did not agree with the statement. When comparing the three groups of states, the difference in perception of effectiveness is statistically significant across groups (Table 3). More specifically, Group 1 (69%) and Group 2 (62%) programs were similarly perceived effective, while only 20% of Group 3 programs were perceived effective.

Stage III: Relationship between state preferential property tax programs and trends in forest conditions

As mentioned earlier, box plots and ANOVA analyses were used to examine the relationships between preferential property tax programs and forest trends at the state level. Table 4 shows forest trends, measured as the percentage change in area of private forest land between 1997 and 2007 (Smith et al., 2009), the percentage change in average size of private forest holdings between 1993 and 2006 (Birch, 1996; Butler, 2008), and the percentage of private forest land owned by families and individuals with a written management plan in 2006 (Butler, 2008), for each of the 36 states with a preferential property tax program applicable to private forest owners statewide. When comparing groups of states (Table 4 and Fig. 1), Group 1 states, on average, seemed to have experienced the largest loss in private forest acreage from 1997 to 2007 and the largest decrease in private forest parcel size during the same time period. On the contrary, private forest acreage seemed to have increased slightly in Group 2 and Group 3 states, and private forest parcel size did not decrease nearly as much as in Group 1 states. However, when using a different measurement, Group 1 states were ahead of Group 2 and Group 3 states—over 20% of private forest land owned by families and individuals in Group

Table 2
Summary of state preferential property tax program attributes by groups of states.

Groupings of states	Requiring a management plan ^a	Specifying a enrollment period ^b	Having withdrawal penalty ^c	PC 1 (admin.adv) ^d	PC 2 (finan.adv) ^d	PC 3 (consist.adv) ^d
Group 1 (13 states): California, Delaware, Indiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, North Carolina, Rhode Island, Washington, Wisconsin	1.000	0.769	1.000	0.956	0.349	0.222
Group 2 (13 states): Alabama, Connecticut, Florida, Iowa, New Hampshire, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, Vermont, Virginia, West Virginia	0.231	0.077	0.769	-0.648	-0.263	0.701
Group 3 (10 states): Colorado, Georgia, Idaho, Illinois, Missouri, Montana, New York, North Dakota, Ohio, Utah	0.500	0.700	0.600	-0.400	-0.113	-1.199

^a Statistics reported here are means. Item scale: 1 = requiring a management plan, 0 = otherwise.
^b Statistics reported here are means. Item scale: 1 = specifying a enrollment period, 0 = otherwise.
^c Statistics reported here are means. Item scale: 1 = having withdrawal penalty, 0 = otherwise.
^d Statistics reported here are mean principal component scores. Positive scores suggest having an advantage and negative scores suggest having a disadvantage. The absolute values of the mean scores indicate the strength of the advantage or disadvantage.

Table 3
Cross-tabulation by groups of states for self-assessed program effectiveness.

Groups of states	Percent of administrators considering their state preferential property tax program to be effective in protecting forest resources in areas highly susceptible to development	Pearson χ^2
Group 1 (13 states): California, Delaware, Indiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, North Carolina, Rhode Island, Washington, Wisconsin	69.2%	6.1232 ($p = 0.047$)
Group 2 (13 states): Alabama, Connecticut, Florida, Iowa, New Hampshire, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, Vermont, Virginia, West Virginia	61.5%	
Group 3 (10 states): Colorado, Georgia, Idaho, Illinois, Missouri, Montana, New York, North Dakota, Ohio, Utah	20.0%	

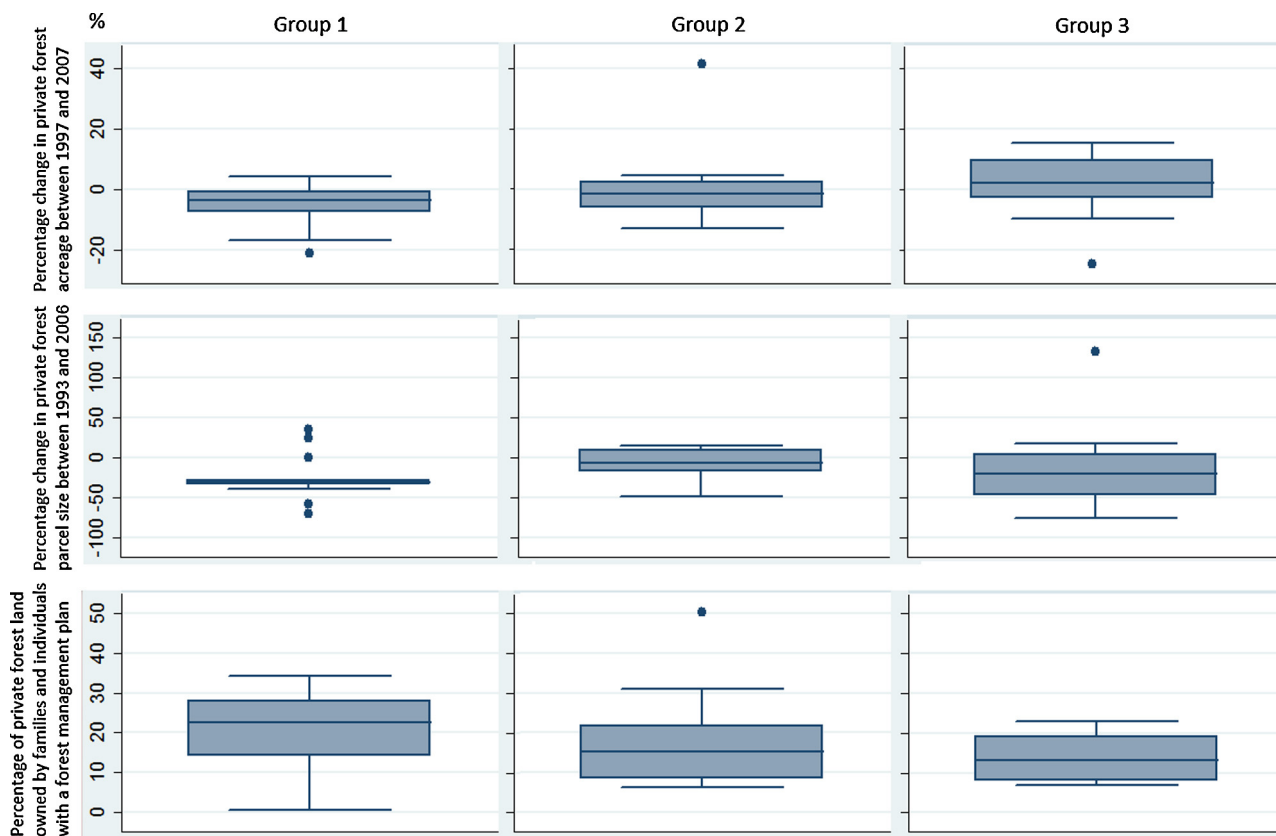


Fig. 1. Box plots of differences in trends in forest conditions at the state level by groups of states based on their preferential property tax program attributes.

Table 4

Trends in forest conditions at the state level by groups of states based on their preferential property tax program attributes.

Groups of states	Trends in forest conditions, measured by		
	Percentage change in area of private forest land between 1997 and 2007	Percentage change in size of private forest holdings between 1993 and 2006	Percentage of private forest land owned by families and individuals with a written forest management plan in 2006
Group 1 means (13 states)	–5.7%	–24.9%	20.6%
California	–21.2%	35.0%	14.2%
Delaware	–5.9%	–70.9%	0.4%
Indiana	4.2%	–30.1%	8.3%
Maine	–0.9%	0.6%	34.2%
Maryland	–13.7%	–28.0%	33.4%
Massachusetts	–16.9%	–39.6%	25.9%
Michigan	–0.2%	–33.2%	13.3%
Minnesota	–2.4%	–29.0%	16.7%
New Jersey	–4.6%	–30.4%	28.6%
North Carolina	–7.6%	24.1%	22.4%
Rhode Island	–3.5%	–31.4%	18.6%
Washington	–0.1%	–57.7%	23.5%
Wisconsin	–0.7%	–32.5%	27.9%
Group 2 means (13 states)	0.5%	–10.0%	17.7%
Alabama	2.3%	12.3%	22.1%
Connecticut	–13.1%	–17.9%	6.2%
Florida	–6.0%	–40.7%	18.4%
Iowa	41.2%	–48.2%	7.1%
New Hampshire	–5.6%	–38.0%	30.9%
Oregon	2.6%	14.3%	19.7%
Pennsylvania	–6.1%	–2.9%	7.2%
South Carolina	–1.3%	10.1%	21.7%
Tennessee	4.7%	–6.7%	8.3%
Texas	–7.1%	–16.0%	12.2%
Vermont	–0.4%	–8.3%	50.3%
Virginia	–3.5%	10.4%	15.3%
West Virginia	–1.6%	1.9%	10.1%
Group 3 means (10 states)	1.1%	–12.3%	13.7%
Colorado	–9.7%	–72.8%	16.5%
Georgia	1.8%	18.7%	19.0%
Idaho	–24.7%	4.1%	20.0%
Illinois	2.2%	–36.1%	10.9%
Missouri	6.6%	–8.8%	6.9%
Montana	12.1%	132.6%	23.0%
New York	–0.1%	–30.9%	9.3%
North Dakota	15.4%	–47.1%	7.8%
Ohio	–2.7%	–7.2%	7.8%
Utah	9.8%	–75.0%	15.6%
F statistic (p-value)	1.42 (0.2566)	1.34 (0.2748)	0.56 (0.5743)

1 states had a written forest management plan in 2006, while 18% and 14%, respectively, in Group 2 and 3 states had a plan. Nevertheless, none of these observed differences among the three groups of states was statistically significant (Table 4).

Discussion and conclusions

The literature has raised concerns regarding the effectiveness of some state preferential property tax programs in terms of mitigating forest loss (Brockett and Gebhard, 1999; Dennis and Sendak, 1992; Newman et al., 2000; Polyakov and Zhang, 2008; Williams et al., 2004). However, this literature so far has focused on individual state programs. Lacking is a broader look at programs across the United States. Our study applied multiple statistical techniques to examine and categorize state preferential property tax programs based on their program attributes, allowing the assessment and comparison of programs across three groups of states. Three disconnects have been observed: (1) Program attributes that were previously considered important for a program to be effective in retaining land in forest cover and fostering management (Hibbard et al., 2003) did not consistently correlate with self-assessed program effectiveness; (2) These program attributes did not necessarily link to the actual program effectiveness as

measured by three forest trend indicators in this paper (i.e., percentage change in area of private forest land, percentage change in average size of private forest holdings, percentage of private forest land owned by families and individuals with a written forest management plan); and, (3) The self-assessed program effectiveness did not reflect the actual effectiveness, either.

With respect to the first disconnect, most administrators from Group 1 states considered their preferential property tax program to be effective in protecting forest resources in areas highly susceptible to development (Table 3). Their self-assessments were supported by the program attributes characterizing Group 1 states. More specifically, programs in these states generally had clear requirements with respect to eligibility, enrollment, and withdrawal procedures (Table 2), which contribute to attracting landowners with a genuine interest in long-term forest health and conservation (Eckhoff et al., 2007). In addition, these programs had the biggest administrative and financial advantages (Table 2), suggesting that they generally met the aforementioned eight policy effectiveness criteria (Hibbard et al., 2003). On the contrary, the relationship between program attributes and self assessments of program effectiveness by administrators from Group 2 and Group 3 states was not straightforward. The preferential property tax programs in Group 2 and Group 3 states were similar in that they

tended to have limited requirements and lack administrative and financial advantages (Table 2). However, the administrators from Group 2 states were significantly more confident in the effectiveness of their program than their counterparts in Group 3 states (Table 3). The major difference between the two groups of states was related to the self-assessed consistency between program requirements and program goals (Table 2). The administrators from Group 2 states considered their program to be more consistent, which may have led to their confidence in the overall effectiveness of their program. Further research is needed to better understand the ways that program administrators assess their program effectiveness and the potential for adjusting program requirements to better reflect program goals.

The disconnect between the self-assessed effectiveness of state preferential property tax programs and the actual effectiveness as measured by three forest trend indicators (i.e., percentage change in area of private forest land, percentage change in size of private forest holdings, percentage of private forest land owned by families and individuals with a written forest management plan) also deserves further attention. As mentioned earlier, more than 60% of administrators from Group 1 and Group 2 states considered their program to be effective, while only 20% of administrators from Group 3 states felt the same way. However, the actual effectiveness as measured in our study was not statistically significantly different between the three groups of states. In other words, the self-assessed effectiveness level did not reflect the actual forest conditions on the ground at the scale examined given the data utilized. This also means that the program attributes (including ratings of the eight policy effectiveness criteria) used to characterize and distinguish state preferential property tax programs did not reflect the actual effectiveness of the programs measured at the state level.

These three disconnects raise two important, interconnected questions: (1) How is effectiveness defined? and, (2) How is effectiveness measured on the ground? Answers to these two questions will help understand the disconnects we observed. The eight policy effectiveness criteria suggested by Hibbard et al. (2003) emphasize the structural and procedural aspects of state preferential property tax programs, and are not directly connected to forest outcomes on the ground. Another way of defining state preferential property tax program effectiveness is based on the protection of forest resources in areas highly susceptible to development, as used by program administrators in our survey. One way to measure effectiveness under this definition is to ask the administrators to rate their own program (what we did) and the other way is to actually measure the change of forest conditions on the landscape, which may be further complicated by various ways of identifying “areas highly susceptible to development.” An effective state preferential property tax program may also be defined as one that keeps forests as forests, minimizes forest parcelization, and promotes sustainable forest management (Argow, 1996; Mehmood and Zhang, 2001; Sampson and DeCoster, 2000), and this definition was translated into three forest trend indicators used in our study. Although having a written forest management plan is not necessarily a perfect indicator of managing forests sustainably, it is used as a surrogate for sustainable forest management due to data available for our analysis.

An underlying assumption of identifying an effective program based on its structural and procedural attributes is that structurally and procedurally sound programs will yield desirable forest outcomes. However, our results suggest that positive program attributes were not necessarily linked to either self-assessed or actual program effectiveness. For example, within Group 1 there was a wide range of variations across states with respect to the three forest trend indicators, particularly when looking at the percentage change in size of private forest holdings in Delaware (-70.9%) and Maine (0.6%) between 1993 and 2006 as two ends

of the wide spectrum. The state preferential property tax programs in these two states shared similar attributes as measured, but the forest outcomes on the ground in these two states were greatly different. This disconnect suggests that internal factors (e.g., program attributes) may be less crucial than external factors (e.g., urbanization rate, population density and growth rate, real estate value) in determining the effectiveness of a program. In fact, Delaware has been one of the most urbanized state in the country with over 80% of its population living in urban areas from 1990 to 2000 and Maine was the least urbanized state with less than 40% urban population from 2000 to 2010 (U.S. Census 2013). This further suggests that in states facing significant urbanization and development pressure, the external force may override the internal structural or procedural advantage of a land use program, affecting the actual effectiveness of the program. However, one shall not dismiss the value of state preferential property tax programs too quickly. Although the literature has been inconclusive with respect to the effectiveness of preferential property tax programs (Brockett and Gebhard, 1999; Dennis and Sendak, 1992; Newman et al., 2000; Polyakov and Zhang, 2008; Williams et al., 2004), many scholars, as well as forest landowners do believe the potential role of these programs in delaying development (Butler et al., 2012; England and Mohr, 2003; Sanborn-Stone and Tyrrell, 2012). Particularly when tax rates are high or discount rates are low, the financial pressure on forest landowners from urbanization and development of nearby land may be lessened, although may not be eliminated, by a preferential property tax program, to a certain extent (Mehmood and Zhang, 2001). Under this scenario, it may be more important to have any preferential property tax program in a state facing tremendous challenge of losing forests to development than building a good program in a state with relatively stable forest conditions. Likewise, it is highly likely that each state has regions with different development pressures, and that one overarching preferential property tax program will not work for all regions. Instead, it may be more effective for states to develop different programs that can be effective in a variety of landscape conditions. It is particularly important for researchers and policy makers to be explicit about how they define and measure effectiveness before assessing and comparing programs or suggesting improvement strategies.

Although all the state preferential property tax programs examined in our study were applicable statewide, their effects may be localized. Therefore, it may not be appropriate to examine forest loss and parcelization at the state level. A program may be very effective in some areas, but less so in others. Making an average assessment across a state may mask some of the localized effects and the internal and external factors contributing to the design and implementation of the program. This nature of geographically differential effects of state preferential property tax programs also leads to another challenge in assessing these programs, namely data limitations. There is a general lack of forest property tax data at finer than the state scale. As discussed earlier, in a number of states, the county or other local assessing agency is tasked with day-to-day program administration. Some counties have been better at collecting and sharing relevant property tax data than others. In addition, forest land and ownership data at the county level are very limited or not readily accessible for analysis or evaluation. Although individual real estate transactions are recorded at the county level, they often do not include land-use data, and merely include a number of acres and price. This makes it very difficult to assess the effectiveness of state preferential property tax programs at the local level. Moreover, even at the state level, there is a lack of consistent data for both forest land and ownership. For example, forest measurements have been taken for decades by Forest Service's Forest Inventory and Analysis Program. However, relevant measurements and the associated ownership data only became available for private forests

in 1997. In recent years, private forests owned by families and individuals have gained more and more attention among researchers and policy makers. But only starting in 2006, did systematic data on family forest land and ownership become available. Continuing efforts have been made to collect consistent data on both forest land and ownership over time, which will make it easier to assess forest outcomes of not only state preferential property tax programs, but also other forest conservation policies and programs.

Lastly, when examining the effectiveness of state preferential property tax programs, one needs to consider the issue of time. Many programs we examined were established in the 1970s and 1980s, although one program was established in 2004. The three forest trend indicators we measured were based on data between 1993 and 2006. The question is how long we need to wait to see the effects of state preferential property tax programs on the forest landscape. Not being able to observe any statistically significant relationship between state preferential property tax programs and trends in forest conditions may be due to the time lag between program implementation and actual effects. Therefore, it is important to keep monitoring these state programs and the changes of forest conditions on the ground over time in order to better assess program effectiveness. It is also critical to ask whether or not state preferential property tax programs that were developed three or four decades ago, typically for goals such as sustainable timber production, are still good tools for keeping forests or forests, minimizing forest parcelization, and promoting sustainable forest management, or if they need to be re-evaluated and re-designed to better address the challenges of today and tomorrow.

While our study focused on state preferential property tax programs, we believe that the three-stage analytical approach to describe and compare states based on the characteristics of their programs has wider application for other types of forestry or land use policies and programs. The issues we identified, related to defining and measuring effectiveness, need to be considered when assessing other types of forestry or land use policies and programs as well. It is important to establish structurally and procedurally sound policies and programs, but they do not guarantee effectiveness measured by on-the-ground forest or land use outcomes. Efforts are needed to future examine and quantify the relationship between internal (e.g., program attributes) and external factors (e.g., urbanization rate, population density and growth rate, real estate value) with respect to policy and program effectiveness. Our hope is that as the need for forest conservation and sustainable land use continues to grow, others will expand upon what our study has learned to further develop strategies to accurately assess state preferential property tax programs and other types of land management initiatives and to improve forest and other sustainable land use outcomes on the ground.

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