



**Michigan
Technological
University**

Michigan Technological University
Digital Commons @ Michigan Tech

Dissertations, Master's Theses and Master's Reports

2021

Impacts of forest tax programs on property tax rates in Michigan's Upper Peninsula and Northern Wisconsin

Elsa Schwartz

Michigan Technological University, ecschwar@mtu.edu

Copyright 2021 Elsa Schwartz

Recommended Citation

Schwartz, Elsa, "Impacts of forest tax programs on property tax rates in Michigan's Upper Peninsula and Northern Wisconsin", Open Access Master's Thesis, Michigan Technological University, 2021.

<https://doi.org/10.37099/mtu.dc.etdr/1194>

Follow this and additional works at: <https://digitalcommons.mtu.edu/etdr>



Part of the [Economic Policy Commons](#), [Environmental Policy Commons](#), [Forest Management Commons](#), and the [Public Economics Commons](#)

IMPACTS OF FOREST TAX PROGRAMS ON PROPERTY TAX RATES IN
MICHIGAN'S UPPER PENINSULA AND NORTHERN WISCONSIN

By

Elsa C. Schwartz

A THESIS

Submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

In Forestry

MICHIGAN TECHNOLOGICAL UNIVERSITY

2021

© 2021 Elsa C. Schwartz

This thesis has been approved in partial fulfillment of the requirements for the Degree of
MASTER OF SCIENCE in Forestry.

College of Forest Resources and Environmental Sciences

Thesis Advisor: *Dr. Matthew Kelly*

Committee Member: *Dr. Blair Orr*

Committee Member: *Dr. Mark Rouleau*

Committee Member: *Dr. Stephanie Snyder*

Committee Member: *Dr. Mike Kilgore*

College Dean: *Dr. Andrew Storer*

Table of Contents

| | |
|-----------------------------------------------------------------|----|
| Acknowledgements..... | v |
| Abstract..... | vi |
| 1 Introduction..... | 1 |
| 1.1 Overview of Forest Tax Programs | 1 |
| 1.2 Public Policies for Private Forests..... | 3 |
| 1.3 Overview of Property Taxes..... | 6 |
| 1.4 Tax Incidence | 8 |
| 1.5 Literature Review | 10 |
| 1.5.1 Landowner Participation in Tax Programs | 10 |
| 1.5.2 Current use-value assessment programs | 11 |
| 1.5.3 Conservation easements..... | 11 |
| 1.5.4 Forest tax programs..... | 12 |
| 1.6 Study Area..... | 15 |
| 1.6.1 Upper Peninsula of Michigan | 15 |
| 1.6.2 Northern Wisconsin | 17 |
| 1.7 Forest Tax Programs in Study | 19 |
| 1.7.1 Commercial Forest Program..... | 19 |
| 1.7.2 Managed Forest Law..... | 20 |
| 1.8 Research Questions | 21 |
| 2 Methods..... | 23 |
| 2.1 Data Collection..... | 23 |
| 2.2 Spreadsheet Model | 26 |
| 2.3 Sensitivity Analysis..... | 27 |
| 2.4 Correlation Analysis..... | 28 |
| 3 Results..... | 31 |
| 3.1 Michigan’s Upper Peninsula – Commercial Forest Program..... | 31 |
| 3.1.1 Township Data | 31 |
| 3.1.2 Simulation Results | 32 |
| 3.1.3 Correlation Results..... | 35 |
| 3.2 Northern Wisconsin – Managed Forest Law..... | 38 |
| 3.2.1 Township Data | 39 |
| 3.2.2 Simulation Results | 40 |
| 3.2.3 Correlation Analysis | 42 |
| 4 Discussion..... | 46 |
| 4.1 Variability of shifting tax burdens..... | 46 |
| 4.2 Open vs Closed MFL Properties | 49 |
| 4.3 PILT and Revenue Sharing | 51 |
| 4.4 Realistic changes in enrollment..... | 52 |

| | | |
|-------|-------------------------------------------------|----|
| 4.5 | Study limitations..... | 54 |
| 4.5.1 | Other preferential tax programs | 54 |
| 4.5.2 | Benefits of forest tax programs..... | 54 |
| 4.5.3 | Short-term vs long-term trends | 55 |
| 5 | Conclusion | 58 |
| 5.1 | Policy considerations..... | 58 |
| 6 | Reference List | 62 |
| A | Houghton County Timber Cutover Assessment | 68 |
| B | Copyright Documentation..... | 69 |

Acknowledgements

I would like to thank my advisor Dr. Matthew Kelly, as well as my committee members, Dr. Blair Orr, Dr. Mark Rouleau, Dr. Mike Kilgore, and Dr. Stephanie Snyder for all their support and input on my project. I would also like to thank LuAnn Hayrynen, Karen Maidlow and Brett Daul for providing property tax data related to my research. Lastly, I would like to give special thanks to my family and friends for their love and support throughout my graduate career.

Support for this research was provided by the USDA Forest Service, Northern Research Station, RJVA 19JV11242309029.

Abstract

Forest tax programs offer reduced property taxes to private forest owners as incentive to sustainably manage their forests and to encourage the provision of ecosystem services. They also protect forests from conversion to other land uses and ensure the viable supply of timber for forest products industries. Despite the benefits that these programs provide, they can negatively impact local municipalities by reducing the property tax base, which can then cause local governments to increase tax rates for non-preferential properties in order to maintain revenue needed to run their services. This shifts the tax burden from participating properties to nonparticipating properties. The purpose of this study was to simulate and analyze the effects that increases in enrollment in the Commercial Forest and Managed Forest Law programs have on township millage rates in the Upper Peninsula of Michigan and the northern region of Wisconsin. Tax data were collected from the year 2018, and a deterministic model with hypothetical future scenarios was run to estimate the changes in the millage rate with 5%, 10%, and 15% increases in program enrollment. Such increases in enrollment resulted in the average township needing to increase the tax rates on non-enrolled properties by between 0.002% to 64.7%, depending on the magnitude of increased enrollment and pre-enrollment forestland values, to maintain a constant revenue. In general, the magnitude of the increase was rather minimal, but there was a range in sensitivity across townships with some experiencing much higher tax rate increases. Rural townships, with a low population and a smaller tax base were seen to be most sensitive to changes in program enrollment. Possible policy changes to the forest tax programs and the states' reimbursement policies may need to be considered to help mitigate any loss in tax revenue in the township and to lessen its sensitivity. However, this study only focuses on one side of the issue. Future research is needed to study the economic benefits that are received by the townships from enrollment in these forest tax programs, and to study if the benefits outweigh the costs of the programs.

1 Introduction

1.1 Overview of Forest Tax Programs

Forest ecosystem services provide many benefits to individuals and societies, including the provision of timber and wood fiber, protection of water, protection of wildlife habitat, and recreational opportunities (Kilgore et al. 2018b). An estimated 58% of forestland in the United States is privately owned, 36% being owned by family forest owners (Butler et al. 2016a). However, private forests are threatened by poor management, such as high-grading. In some contexts, the decision to not manage forests can prove to be harmful as it can perpetuate existing forest health problems rather than seeking to improve them.

Forests are also threatened by development and parcelization should landowners feel pressured to sell their land due to the burden of property taxes (Butler et al. 2012, Kelly et al. 2016). This is because property taxes are paid on an annual basis regardless of whether or not revenue is generated (Butler et al. 2012). Timberland taxed at high property tax rates could incentivize overcutting, as landowners seek to generate revenues to offset such taxes (Sexton, 2003). Such harvesting practices can be detrimental to the overall health and economic value of the forest, as healthy trees with high economic value are removed, leaving behind the defective and low-vigor trees, which could lead to depletion of natural resources if applied repeatedly (Nyland et al. 2016). To help relieve the tax burden on private forest owners governments have developed forest tax programs, which serve to provide incentives through preferential tax treatment to qualified forested lands.

Forest tax programs are administered by state and local governments and were initially developed to reduce property taxes on private forested property to discourage land-use conversion and maintain timber production (Fortney and Arano, 2010). They are also used to encourage the provision of ecosystem services, as well as continuing to protect forests from conversion to other land uses and to ensure the viable supply of timber for forest products industries (Kilgore et al. 2018b). Forest ecosystem services that are a common focus across different programs include the production of timber and fiber products, protection of soils and wetlands, protection of fish and wildlife habitat, open

space and scenic resources, protection of water quality, and recreational opportunities (Kilgore et al. 2018b). One unexpected benefit of these programs is that they help to promote forest carbon sequestration, through the conservation and management of large, forested areas, which may help to aid the country in its ability to meet the climate change policy obligations. With the current forest tax policies that are in place, it is estimated that by 2050, about \$8 billion per year in climate change mitigation benefits will be provided (Daigneault et al. 2020).

All fifty states offer a preferential tax program to private landowners (Butler et al. 2012), and currently 44% of all eligible private forestland, which include corporate/industrial forestland, in the United States are enrolled in property tax programs (Kilgore et al. 2018b). The programs differ in their goals and qualifications, but the underlying goal is to promote the sustainability of private forests (Kilgore et al. 2018a). Whether or not a property is qualified for preferential tax treatment differs for each program, but in general parcel size and location, type and condition of the forest resources, and the ability to produce certain goods and services determine whether or not a parcel qualifies for a given forest tax program (Kilgore et al. 2018a).

There are uncertainties as to the effectiveness of these programs. Kilgore et al. (2007) found that while program administrators viewed financial incentive programs as having a positive effect on promoting sustainable practices, family forest owners viewed technical assistance and information as more important and were not influenced so much by the incentive programs. Meier et al. (2019) also found that tax programs may not be effective at encouraging landowners to preserve and retain their land as forest, as program participants were just as likely as nonparticipants to express intentions to sell their land at some point. However, there have also been studies which show forest tax programs effectively conserve forests and reduce property taxes. On average, forest tax programs reduce forest property taxes by \$7.68 per acre across the nation (Kilgore et al. 2018b). However, Frey et al. (2019) found that landowners who enroll in forest tax programs do so out of concern to conserve their forests, and that this concern was more influential than to reducing taxes. Forest tax programs have also been shown to be effective in preventing development on forested land (Locke and Rissman, 2012).

Overall, despite the uncertainties as to their effectiveness, forest tax programs are used as a policy incentive tool to encourage the sustainability of forests. Many forest owners are interested and desire to know how to manage their forestland sustainably, and these forest tax programs help enable them to do so (Kilgore et al. 2007).

There are five different types of forest tax programs: ad valorem, current use, flat rate, exemption, and hybrid programs (Hibbard et al. 2003). Ad valorem programs tax forestland according to its fair market value. Current use programs tax the land based on its taxable value according to its current use as forestland. Flat rate programs tax the property at a fixed rate per acre. Exemption programs completely exempt forestland from property taxes. Hybrid programs combine the current use and ad valorem methodology to determine the property tax (Hibbard et al. 2003).

1.2 Public Policies for Private Forests

Forest policies are designed to encourage preservation and sustainable management of forestlands so that society can continue to receive the benefits that private forests provide. Forest policies also help to address externalities, positive and negative, and market failures that arise with the management of private forests (Cubbage et al. 2007). An externality occurs when the actions of an individual or group either bring about harm (a negative externality) or provide benefits (a positive externality) to individuals or a society, but yet do not bear the cost nor are compensated for their actions (Gruber, 2019). For instance, the management of a nearby forest may negatively impact certain groups of individuals by reducing aesthetic value, however those individuals may not be compensated for their loss. Poor forestry practices may also result in erosion and pollution into a nearby stream, which impact fish populations and would thus negatively affect fishers. However, the forest owner may not necessarily bear the cost of the loss experienced by the fishers, thus resulting in a negative externality. Private forest landowners also may not be compensated for the positive externalities that their forests provide to the public, such as providing wildlife habitat, protecting water quality, and providing aesthetic beauty.

Forest policies are meant to address these issues by providing regulations or incentives to ensure the sustainable management of forests, to reduce erosion and pollution, and to help compensate the landowners, such as by reducing taxes, for the benefits that their forests provide to the general public (Cubbage et al. 2007). Figure 1, taken from Aguilar et al. (2019), illustrates how forest policies help to account for the loss in social efficiency caused by externalities.

Externalities can shift the demand or supply curve, thereby causing the two curves to intersect at a different point, away from the market equilibrium. Forest policies help to correct for this by inducing a cost or an incentive to shift the supply curve so as to return to the point of equilibrium and social efficiency. For instance, the demand curve may shift upwards from curve D to D' as forest value increases, but this causes a decrease in social efficiency as the supply curve, or the cost to the forest owners, remains the same. Forest tax programs help to restore social efficiency by offering a tax incentive to the forest owners, thereby reducing the cost of forests which causes the supply curve to shift downwards from curve S to S' (Fig. 1).

There are three main categories of policy instruments that can be used to encourage the participation of private forest landowners: financial, regulative, and informational (Serbruyns and Luyssaert, 2006). *Financial policy tools* include payments for certain management activities, such as planting trees or improving timber stands, and incentives to encourage conservation, such as tax reductions (Cubbage et al. 2009). *Regulatory policy tools* are used to regulate the management strategies of forests to ensure sustainable management, and are used to prevent undesirable or destructive outcomes, such as pollution, excess timber harvests, and resource exhaustion. They are also used to prevent negative externalities and market failures, as well as to ensure forest regeneration and to promote positive externalities, (Cubbage et al. 2009). *Informational policy tools* deals with the education of both the public and the professionals. These tools can be used to educate the public on how to properly manage and preserve their natural resources, and to educate and improve the technical skills of forestry and logging professionals (Cubbage et al. 2007). Informational tools may also be used to inform private forest owners about different incentive programs that they can enroll their properties in for the

purpose of managing and conserving their forests. Compared to the other policy tools, informational tools may be the most important as their implementation and success affects the success of financial and regulative tools. In a study done in Belgium, the more highly educated landowners in matters of forest management were more likely to accept policy instruments than owners who had a poor education and understanding (Serbruyns and Luyssaert, 2006). Figure 2 illustrates how these policy tools help to exchange forest values between the private landowners and society, as well as between the current and the future generations through the means of conserving the forests (Aguilar et al. 2019).

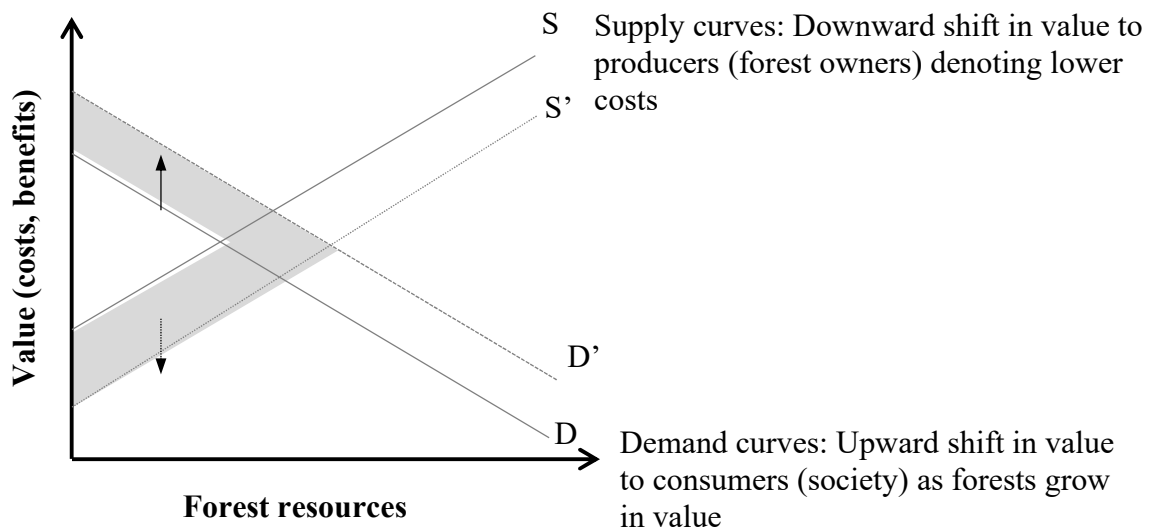


Figure 1. Process of value co-creation within a neo-classical supply-and-demand partial market equilibrium framework. A change in welfare (wellbeing) among groups can be positive (shaded area) as the marginal value (costs or benefits) to each group shift. Solid lines denote value relationships prior to changes (S, D), and dotted lines denote posterior value relationships (S', D'). Public policy can be instrumental to such changes. (Aguilar et al. 2019)

Reprinted/adapted by permission from Springer Nature Customer Service Center GmbH: [Springer Nature, Total economic value, ecosystem services and the role of public policy instruments in the creation and destruction of forest values by F.X. Aguilar, M.C. Kelly, and B. Danley. In: Services in Family Forestry by T. Hujala, A. Toppinen., and B. Butler. \[COPYRIGHT\] \(2019\).](#)

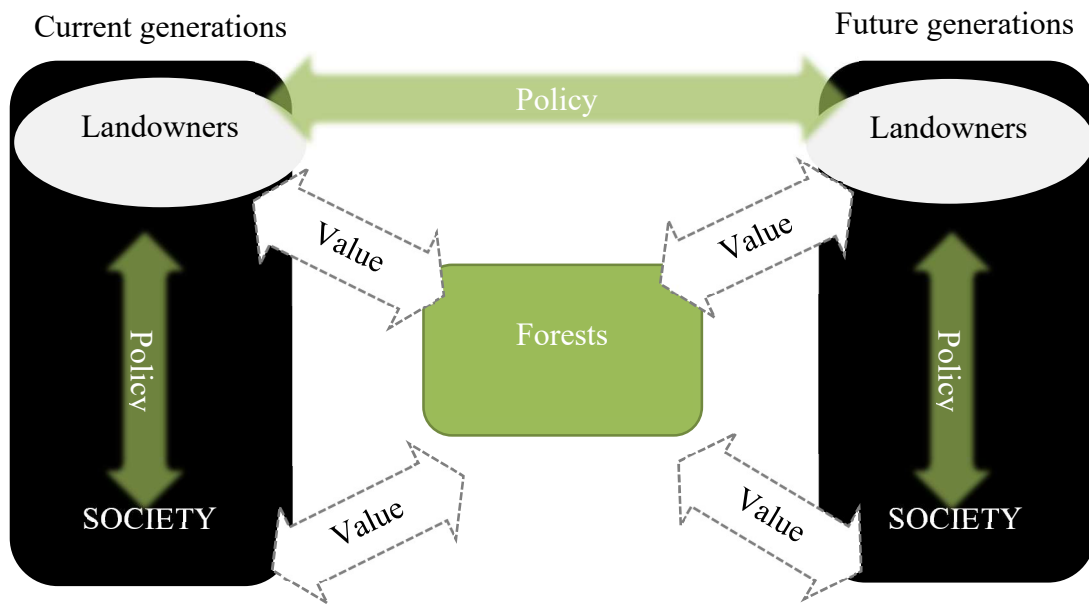


Figure 2. Forest value exchange model to account for temporal changes of value in no-use exchanged between current and future beneficiaries. (Aguilar et al. 2019)

Reprinted/adapted by permission from Springer Nature Customer Service Center GmbH: [Springer Nature, Total economic value, ecosystem services and the role of public policy instruments in the creation and destruction of forest values by F.X. Aguilar, M.C. Kelly, and B. Danley. In: Services in Family Forestry by T. Hujala, A. Toppinen., and B. Butler. \[COPYRIGHT\] \(2019\).](#)

1.3 Overview of Property Taxes

Property taxes are a significant source of revenue for local governments, accounting for three-quarters of the total tax revenue (Ganz, 2014). Local governments depend upon tax revenue to fund public services, including education, transportation, emergency response, parks and recreation, and libraries (Seabury, 2020). The extent to which a local government relies upon property tax revenue depends on three different factors: the total budget of the municipality, the amount of revenue received from federal and state governments, and the amount of revenue that is raised from other tax sources (Brighton, 1993).

Property tax is an ad valorem tax, meaning that it is based on an assessed value (Sexton, 2014). An assessed value is a percentage of the fair market value, which is the

price that the property would sell for in an open market. For instance, in Michigan the property is assessed at 50% of the market value (Sexton, 2003). There are two different types of property that may be included in the tax base: real and personal property. Real property is defined as land and anything that is permanently attached to it. Personal property is the property that is not part of or permanently attached to real property (Sexton, 2003). Some states include only real property in their tax base, and others offer exemptions and differential treatments for certain types of properties (Sexton, 2003). Some states have classification systems, where different types of property may be taxed at a different rate or assessed differently, and some properties may be all together exempt from property taxes, such as properties owned by schools (Sexton, 2003).

The property tax that a landowner will pay is determined from the taxable value of the property and the millage rate. Some local governments may use the assessed value as the taxable value, but most often the taxable value is lower than the assessed value. This is because the value includes any exemptions that the property may be qualified for, and oftentimes it is capped so as not to exceed a certain amount (Richard, n.d.). The taxable value is then multiplied by the millage rate to determine the tax levy, which is the actual amount the landowner will pay. The millage, or mill, rate is the amount of tax payable per dollar of the assessed (or taxable) value. The mill is a figure that represents 1/10th of a cent. Thus, for \$1,000 of taxable property value the mill rate would equal \$1 (Kagan, 2020). The millage rate is determined by the group (county, township, school, etc.) that is charging the tax, and each legal entity may set a different millage rate (Kagan, 2020).

Property taxes are a main source of revenue for local governments, and yet there are many properties, particularly state and federal lands, that are exempt from paying property taxes. To help offset these losses in property tax revenue, the federal and state governments make a payment in lieu of taxes (PILT) to the local governments. The payment is based on the acreage of land owned by the state and federal governments, and for federal land it is also determined by the population and revenue-sharing payments received from the state within the county (U.S. Department of Interior, n.d.). Revenue-sharing is another additional source of revenue to local governments and is a program where the state shares revenue with the local governments. For example, in Michigan the

state takes 4% of the state's sale tax revenue, and then distributes 15% of that portion of the revenue to all cities, villages, and townships (Michigan Department of Treasury, n.d.).

1.4 Tax Incidence

Tax incidence refers to who bears the true burden of the tax (Gruber, 2019). Regarding the tax of real property, it is considered that the landowner bears the entire burden of the tax because land is inelastically supplied (Sexton, 2014). To be inelastic means that the good has few or no substitutes. Since the consumer cannot substitute for another good there is little change in quantity demanded with changes in price because the consumer cannot leave the market, causing them to bear the full tax burden (Gruber, 2019).

A redistribution of the tax burden can occur when the tax base is reduced by the removal of certain properties, as the tax dollars that would have been due from those properties must now come from other properties that are still part of the tax base (Chamberlin, 1993). Such a tax shift may be caused by tax incentive programs that seek to give tax relief to certain types of properties. Such programs include classification systems, differential assessment programs, forest tax programs, and conservation easements (Chamberlin, 1993; King and Anderson, 2004; Sexton, 2014). With a reduction in the tax base, local governments may experience a loss in tax revenue. This loss may cause the local governments to increase the tax rates (mill rates) for the non-preferential properties in order to maintain the necessary revenue needed to run their services (Brighton, 1993; King and Anderson, 2004; Sexton, 2014). Some states reimburse local governments to help compensate for this loss in tax revenue. In this situation the tax incidence may change so that the burden of the tax shift may now be partially borne by the state, and thereby all taxpayers throughout the state and not fully by the taxpayers within the local municipality. The amount of revenue that is received from federal or state governments helps determine the extent of the tax burden that is borne by the property owners. For example, the State of Vermont fully reimburses the towns for the loss in property taxes due to enrollment in their forest tax programs, thus the state

bears the full burden as the tax is now shifted to the state's general fund rather than to the landowners of the non-participating properties (Brighton, 1993). In Maine the state only reimburses the municipality 90% of its tax losses from forest tax programs, thus causing the remaining 10% of the tax burden to be borne by the municipal taxpayers (Brighton, 1993). Michigan and Wisconsin reimburse the local municipalities at a fixed rate. For enrollment in the Commercial Forest program, Michigan reimburses at the same tax rate that is levied on the enrolled properties, which is currently \$1.30 per acre (Natural Resources and Environmental Protection Act, 2018), and Wisconsin reimburses for enrollment in the Managed Forest Law program at \$0.20 per acre (Managed Forest Law, 2021).

The tax shift may seem unfair, but it is important to note that such an event is not uncommon. Whenever governments offer deductions for different types of taxes a tax shift will occur from the class of taxpayers that are receiving the benefits to the taxpayers who are not receiving the benefits (Chamberlin, 1993). Also, while these tax shifts may be deemed a cost to other property owners, they also help protect private forests and maintain a flow of benefits to local communities, including timber production, public access, and the conservation of forest lands (Chamberlin, 1993).

More research is needed to determine how significantly forest tax programs impact local communities in terms of shifting the tax burden, and to discover if the benefits provided by private forests enrolled in such tax program (e.g. provision of ecosystem services, timber, and recreational opportunities) outweigh the potential costs of these programs in terms of increased taxes on non-enrolled properties. If the programs are indeed causing a reduction in the local government tax revenue through the reduction in the tax base, then it may be that the policy of these programs should be revisited so as to continue to provide the benefits that they offer without causing significant harm to the municipalities. The following literature review provides a background on family forest owner participation in forest tax programs, as well as a review of previous studies which have looked at the impacts of enrollment in these preferential tax programs on the local municipality's property taxes, specifically for current use-value assessment programs on agricultural land, conservation easements, and lastly on forest tax programs.

1.5 Literature Review

1.5.1 Landowner Participation in Tax Programs

Nationwide, about 44% of all eligible private forestland, which includes land owned by individuals, families, corporate organizations, Native American tribes, nongovernmental conservation organizations, and other private entities, is enrolled in a special property tax program (Kilgore et al. 2018b). While nearly half of all private forestland is enrolled, participation of family forest owners accounts for a smaller portion. Only about 17% of family forest ownerships, which accounts for 26% of family forest land, is enrolled nationwide (Butler et al. 2020). One possible reason for low participation of these family forest owners is a lack of awareness about such programs as well as landowner frustrations with the administration and requirements of the programs (Butler et al. 2012). The programs are seen as difficult to access, unpredictable in regard to the funding and requirements, and rigid in their management guidelines, sometimes compelling landowners to manage their land in a way that might not align with their objectives (Kilgore et al. 2007; Butler et al. 2012). However, despite these complaints the landowners who do participate have reported overall satisfaction with the programs, and the programs are generally successful in promoting sustainable management practices (Butler et al. 2012; Kilgore et al. 2007).

Different studies have looked at the differences between landowners who do participate in forest tax programs and those who do not to determine the factors that make a landowner more likely to participate in such programs. In general, landowners that participate in property tax programs tend to have a higher acreage of land and higher levels of education and income compared to those who do not participate (Frey et al. 2019; Meier et al. 2019). Participants are also more likely to own their land for timber and aesthetic reasons, whereas non-participants are more likely to own their land for hunting purposes (Meier et al. 2019). One interesting aspect is that while these programs are designed to offer reduced property taxes to act as an incentive for landowners to enroll, taxes do not seem to be a major factor affecting program enrollment of landowners. Many private forest owners are indeed concerned about property taxes, and

studies have shown that tax uncertainty negatively affects the management decisions of landowners (Butler et al. 2012; Greene et al. 2014), but landowners are more likely to enroll out of concern to protect and conserve forested land, rather than to just simply save money (Frey et al. 2019).

1.5.2 Current use-value assessment programs

The current use-value assessment program taxes qualifying properties according to the property's current use rather than by its highest and best use. Coogan et al. (2014) studied the current use-value assessment program for agricultural lands in Wayne County, Ohio. They found that enrollment in the program reduced the taxable property tax base by 69.7%, which would have consequently resulted in the property tax revenues being reduced by 69.8% if the tax rate was not increased. The authors of that study found that a larger portion of the property tax burden fell on residential and commercial property owners, resulting in a shift in the tax burden. A tax shift was also observed by Dunford and Marousek (1981) who conducted a study on the effects of the use-value assessment program for farmland in Spokane County, Washington. They found that enrollment in the program caused an increase in taxes for the nonparticipating properties, but interestingly the rate of increase was not uniform across the different areas of study, ranging from a tax increase of 1.1% to 21.9%. They found that the size of the remaining tax base greatly impacted how much of a tax increase those nonparticipating properties were likely to receive. Areas which had a large portion of land enrolled in the use-value assessment program had a smaller tax base, which led to those properties experiencing the largest tax increases. The areas with a smaller portion of land enrolled in the program had larger tax base, which led to those areas experiencing much smaller tax increases.

1.5.3 Conservation easements

Another type of tax incentive program for private landowners are conservation easements. Conservation easements are used to preserve both agricultural and forest land. With a conservation easement, landowners receive a tax reduction in exchange for

transferring their development rights to another entity, usually a nonprofit organization (King and Anderson, 2004). While conservation easements have also been found to cause shifts in the tax burden, leading to increases in taxes on nonparticipating properties, Schuster et al. (2018) believes that this mechanism of the tax shift is an efficient means for governments to meet conservation targets without having to reduce tax revenues. Based on their study, conservation targets of increasing protected lands by 17% or 30% in Canada could be feasibly met. The scenario showing a 9% to 17% increase in area protection to meet Convention on Biological Diversity targets with the lowest enrollment uptake of 25% resulted in nonparticipating property tax rates increasing by 0.51%. More proactive targets to conserve a higher percentage of the landscape, such as increasing protected lands by 30%, require larger increases in tax rates, but appears feasible (Schuster et al. 2018).

While these programs tend to cause tax increases on nonparticipating properties in the short-term, a study by King and Anderson (2004) found that in the long-term, these programs may cause tax rates to decrease due to an increase in property value of properties surrounding the protected areas. King and Anderson (2004) analyzed the effects that conservation easements have on the tax rates for towns in Vermont over the span of ten years. While tax rates did increase on non-participating properties within the first few years, the rates were seen to diminish afterwards. This was due to the surrounding properties around the conserved areas experiencing an increase in their appraisal value. While this led to higher tax bills for those surrounding properties, it allowed for the towns to reduce the tax rate overall as the tax levy had increased. This enabled residents whose lands were relatively far away from the easements to receive lower tax bills (King and Anderson, 2004). Even though a shift was still seen to occur on non-enrolled properties, it was shift in the assessed value rather than in the tax rate.

1.5.4 Forest tax programs

Brighton (1993) conducted a study on the current use-value assessment programs for forestland in the four northern forest states of Vermont, Maine, New Hampshire and New York. The shifting of the tax burden also occurred in areas with land enrolled in the

program, but payments coming from the state were found to be a large factor in determining the weight of the shift. In all four of these states the state reimburses the local municipalities for any losses in their tax revenues from the current use-value assessment programs, but the percentage of the loss that is reimbursed affects the weight of the tax burden borne by the non-enrolled properties. In the State of Vermont, the towns are fully reimbursed for their tax revenue losses. This causes the tax burden to be shifted to the state's general fund rather than to the taxpayers of the nonparticipating properties in that local municipality, which consequently results in a shift from the property tax to other taxes, like the income tax. The states of Maine, New Hampshire, and New York only partially reimburse towns for the revenue losses, which means that the tax burden is partially shifted onto the state, and therefore onto taxpayers across the entire state and not just within the particular municipality, and partially onto the taxpayers within the municipality, depending on how much of the full amount the municipalities receive. Brighton (1993) also found that the remaining tax base largely determines how high of a tax rate increase the municipalities experience. Rural towns with a smaller tax base experience a larger increase in their tax bill compared to towns with larger tax bases. It is also important to note that while in the short term these programs can cause a tax shift and a cost onto society, in the long term they provide benefits to society as they encourage the preservation of forestland and discourage development (Brighton, 1993).

A study by Rickenbach and Saunders (2009) focused on the tax implications of a forest tax programs on townships in Wisconsin and found that increases in program enrollment resulted in the average township experiencing an increased tax rate. However, similar to the results found by Dunford and Marousek (1981), they noticed that the relationship varied across townships. While most of the townships experienced only slight changes to their tax rates, some experienced much larger increases or even decreases in their tax rates with increases in program enrollment. This suggests that the townships have different sensitivity levels, with some being more sensitive than others to changes in program enrollment. One possible reason for this difference is the portion of land in a township that is enrolled in other tax incentive programs. Rickenbach and Saunders (2009) noted that the more highly sensitive townships had a greater portion of

land enrolled in the Agricultural Forest classification, which is a program that also reduces property taxes for qualifying properties. In situations like this, a township's property tax base is already lowered because of land enrolled in competing programs, which would make the township more sensitive with even further reductions in the tax base from increasing enrollment in the forest tax program. Rickenbach and Saunders (2009) also found that a township's tax base was related to its sensitivity, as the more highly sensitive townships had a smaller tax base. Additional sources of revenue from the State also affected the township's sensitivity to changes in the forest tax program enrollment, as the more highly sensitive townships received the lower amounts of shared revenue payments, and the townships with typical enrollment and sensitivity received the higher amounts of shared revenue payments. Historically in Wisconsin, shared revenue payments adequately covered any losses experienced in tax revenues, but at the time when the study was conducted those payments had been frozen at 2003 levels, which meant that the payments were no longer being adjusted for any changes in land use classifications in the townships. Seeing as how the more highly sensitive townships received the lowest amount of shared revenue payments, it shows that indeed these payments are not being adjusted for changes in land use. This demonstrates the importance that such revenues have in helping to mitigate any losses in a township's tax revenue, due to reductions in the tax base from property tax incentive programs.

Previous literature shows that enrollment in preferential tax programs can indeed cause a reduction in the local municipality's property tax base, and may consequently cause property taxes to increase for the non-enrolled properties. However, there have been relatively few studies that have looked at how significantly enrollment in these programs impacts the millage rates issued on non-participating properties, and there have been no studies that have looked at the tax implications of forest tax programs in Michigan. My study will contribute to this topic of research by studying how enrollment in the Commercial Forest program in Michigan (https://www.michigan.gov/dnr/0,4570,7-350-79136_79237_80945_83262---,00.html) and the Managed Forest Law program in Wisconsin (<https://dnr.wisconsin.gov/topic/forestlandowners/mfl>) impacts the property tax rates of rural townships, and how significantly they shift the tax burden onto all

classes of non-participating properties. My research will shed more light on the potential costs of forest tax programs to non-enrolled property owners, which is important for economic and social sustainability. It will also further explore possible variables that could be affecting the townships' sensitivity levels to changes in the property tax rates with increasing enrollment in these programs.

1.6 Study Area

The two study areas are Michigan's Upper Peninsula and northern Wisconsin. These areas were chosen as they are rural and heavily forested, and include a mix of ownership types including private, state, and federal lands (Fig. 3).

1.6.1 Upper Peninsula of Michigan

Michigan's forests have been shaped and influenced over time by both natural and human factors. Glaciation during the last ice age created a landscape with a wide variability in topography and soil types, which formed the foundation for the different forest types (Hamel et al. 2013). Prior to European settlement, the Upper Peninsula was dominated by late successional lowland and upland conifer forest types. Other common forest types included hemlock/sugar maple, sugar maple/yellow birch/fir, and beech/sugar maple (Hamel et al. 2013; Matson et al. 2013). In the mid-late 1800s the forests of Michigan were heavily logged, which led to a period of severe wildfires (Hamel et al. 2013). It was after this time, in the early 1900s, when the public began to realize the importance of conserving Michigan's natural resources (Matson et al. 2013). By the 1990s forestry companies had begun practicing sustainable forestry practices (Hamel et al. 2013), which have continued to be the primary focus of forest management today. Currently the dominant forest types are now early successional species, such as aspen, and other deciduous species (Hamel et al. 2013; Matson et al. 2013). The dominant forest type in Michigan is maple/beech/birch, with 44% of it located in the western region of the Upper Peninsula. For softwoods species, spruce/fir is the most dominant forest

type group in Michigan, with 47% of it being found in the eastern region of the Upper Peninsula (Pugh, 2018).

The State of Michigan has over 20 million acres of forest land, of which the Upper Peninsula contains 45% (Pugh, 2018). Statewide, about 65% of Michigan's forests are privately owned, 47.3% owned by family forest owners, 14.6% owned by private corporations, and 3.6% owned by other private entities (Pugh, 2018). The remaining 38% of forested land is publicly owned, 20.8% owned by the State of Michigan, 13.6% owned by the USDA Forest Service, 1.1% owned by the National Park Service, and 2.6% owned by other public groups (Pugh, 2018). Timberland, which is forested land that grows suitable trees or is managed for timber, accounts for 95% of the forested land (Pugh, 2018).

Michigan's forests play a significant role in the state's economy. The forest products industries contribute \$20.3 billion in output, \$5.2 billion in labor, and provides 96,623 jobs, taking into account all the direct, indirect, and induced effects of the industries (Leefers, 2016). In the Upper Peninsula where most of the land area is forested, these forest products industries act as an even greater contributor to Michigan's economy. Over a third of the manufacturing jobs in Michigan's Upper Peninsula are in the forest products industries, the most significant industries being the primary paper and paperboard production industry, logging, and the primary solid wood products and wood-based power industry (Leefers, 2016). Overall the forest products industries contribute \$1.8 billion in output, \$3.1 million in labor, and 4,966 jobs in the Upper Peninsula's western region, and \$3.8 million in output, \$61.9 million in labor, and 1,073 jobs in the eastern region (Leefers, 2016). Michigan's forests also serve as a major attraction for tourists, and thus affects other industries related to tourism.

There are 15 counties and 149 townships in Michigan's Upper Peninsula. According to the regions specified by Michigan's Department of Natural Resources, the western region contains 10 of the counties and 102 townships. The eastern region contains the remaining 5 counties and 47 townships (Leefers, 2016). The population in the western region is 172,828, and the eastern region having a population of 132,417. Combined, the population of the Upper Peninsula makes up only 3% of the total

population of the State of Michigan (9,995,915) (U.S. Census Bureau, 2018b). The Upper Peninsula is rural with a lower average household income compared to the State of Michigan overall. The mean income in the Upper Peninsula is \$57,000, while the mean income for Michigan is \$77,000 (U.S. Census Bureau, 2018a). Michigan itself also only contains 3% of the nation's population, the entire United States having a population of 327,167,439 and a mean income of \$87,000 (U.S. Census Bureau, 2018).

1.6.2 Northern Wisconsin

Glacial activity from the last glaciation period shaped and formed the landscape of Wisconsin to its present state, creating thousands of kettle lakes and allowing for a complex array of different habitat types. In the 1800s, during the European settlement, forestland made up 63-86% of the state. The northern region was dominated by pine, spruce, tamarack, sugar maple, hemlock, and yellow birch. The central and northwestern region of Wisconsin consists of sandier soil, making pine forests and barrens more abundant. The southern region was dominated by oak-hickory and maple-basswood forest types. Oak savannahs and prairies were prevalent in parts of the southern and western regions (Wisconsin Department of Natural Resources, 2018).

The great "cutover" began in the late 1800s and lasted into the early 1900s in which the whole state saw a great deal of its timber harvested. This was followed by severe and devastating fires, due to the large amounts of slash left behind from the timber harvests. By the 1930s most of the valuable timber in the northern region had been removed or lost by fires. This allowed for early successional species, such as aspen and birch, to become more prevalent (Wisconsin Department of Natural Resources, 2018).

Currently Wisconsin has over 16.4 million acres of timberland, with most of the forests being located in the northern regions (Wisconsin Department of Natural Resources, 2020a). The dominant forest types in northern Wisconsin are aspen/birch, maple/basswood, spruce/fir, pine, and oak/pine forest groups, and the dominate forest type in southern Wisconsin is the oak/hickory group (Wisconsin Department of Natural Resources, 2020a). Most of the forested land in Wisconsin is privately owned, with 57% owned by individual family landowners and 13% being owned by other private owners.

The remaining 30% is public land, with 14% owned by counties and municipalities, 9% by the federal government, and 7% by the state (Wisconsin Department of Natural Resources, 2018). The number of private forest owners continues to increase, the number of non-industrial private forest owners increasing by 12.4% from 2006-2013. This increase in ownership has also consequently led to an increase in parcelization as more land parcels are needing to be divided, with an average increase of 6,400 new parcels per year (Wisconsin Department of Natural Resources, 2018).

The forest products industry is an important contributor to Wisconsin's economy. About 65,000 people are directly employed by the forest products industry, and more than 110,000 people are indirectly employed. Companies produce about 25 billion dollars of forest products every year (Wisconsin Department of Natural Resources, 2018). Of all the forest products industries, the paper industry is the most significant contributor to the economy, holding nearly half of the jobs in the forest products industry (Wisconsin Department of Natural Resources, 2020b). Besides this direct contribution to the economy, the forests of Wisconsin also offer many recreational opportunities, which help contribute to industries related to tourism.

The northern highland region of Wisconsin consists of 24 counties, but this study will only focus on 10 of those counties: Ashland, Florence, Forest, Iron, Langlade, Lincoln, Marinette, Oneida, Price, and Sawyer counties. Within these 10 counties there are 149 townships. The population of these counties is about 187,563, and the average household income is \$61,000. These northern counties hold 3% of the state's population, with the State of Wisconsin having a population of 5,183,658 with an average income of \$79,000 (U.S. Census Bureau, 2018).

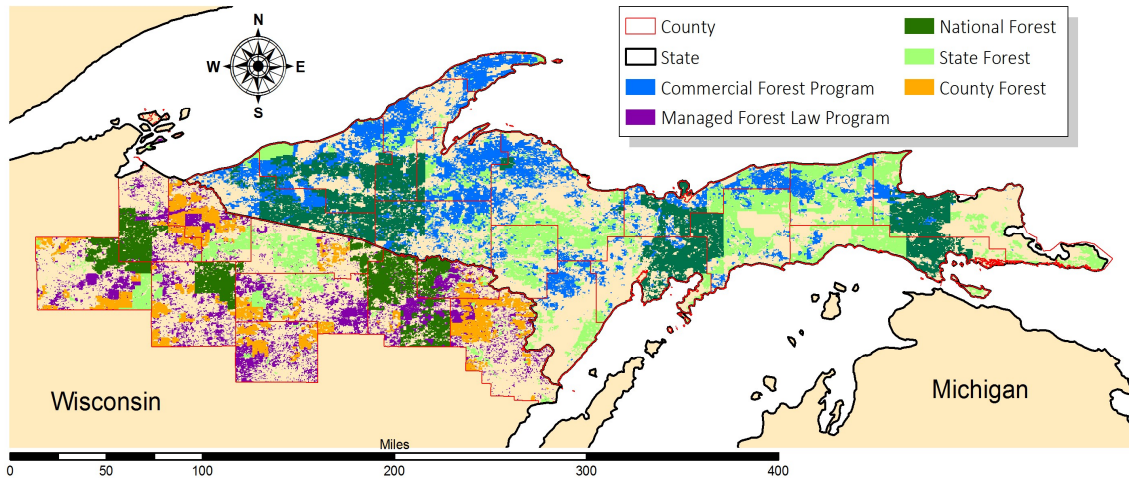


Figure 3: Map of study areas with forest ownership types

1.7 Forest Tax Programs in Study

1.7.1 *Commercial Forest Program*

Michigan's Commercial Forest (CF) program is a property tax incentive program designed to encourage private forest landowners to conserve large tracts of forested land while managing for long-term timber production. It is a voluntary program which is open to all private forest landowners, including family forest owners and commercial forest owners, and is administered by Michigan's Department of Natural Resources.

Participating landowners pay reduced property taxes at a fixed tax rate rather than paying the ad valorem general property tax. From 2017-2021 the tax rate is fixed at a \$1.30 per acre, which is set to increase by 5 cents every 5 years. Eligible properties must be at least 40 acres and be capable of producing a commercial stand of timber and tree species with economic value. Enrolled landowners are required to actively manage their forest according to a qualified management plan. Enrolled land can only be used for producing and harvesting timber. It cannot be used for agriculture, grazing, mineral extraction, or development. It is also required that enrolled land be open to the public for hunting, trapping, and fishing. Once enrolled, properties are classified as Commercial Forest into perpetuity, as long as they continue to meet the requirements. Participating landowners can withdraw their property from the program, but they are subject to a withdrawal

penalty whose amount depends on several factors, including how many years the landowner was in the program and how many acres they are withdrawing (Michigan Department of Natural Resources, 2018). If the enrolled property undergoes a transfer in ownership, its status as Commercial Forest land is not affected. The new owner may either choose to continue or withdraw from the program. If they withdraw, they are responsible for the withdrawal fee. This program is not contractual for the landowners. The legislature may change the rules at any given time, and the landowners are expected to just absorb the changes. Currently over 2.2 million acres of forested land in the Upper Peninsula is enrolled in the Commercial Forest program (Michigan Department of Natural Resources, 2020).

1.7.2 Managed Forest Law

Wisconsin's Managed Forest Law (MFL) is available to all private forest owners, including family forest owners and commercial forest owners, and is administered by the Wisconsin Department of Natural Resources. It is a tax incentive program designed to encourage private landowners to manage their forests sustainably. Eligible parcels must be at least 20 acres, have at least 80% forest coverage, and be capable of growing timber for wood products. It is required that participating landowners have management plans and conduct timber harvests. The landowners must commit to a 25- or 50-year sustainable forest management plan. The landowner can opt to open their land to the public, or to keep it closed. Open land may be used by the public for recreational activities, including hunting, fishing, and hiking. Participating landowners pay an acreage share tax rather than the ad valorem property tax. For open land the acreage share tax rate is based on 5% of the average statewide tax on productive forest land (\$40.80 per acre), which amounts to \$2.04 per acre. For closed land the landowners pay the acreage share tax rate plus an additional closed acreage fee which is based on 20% of the average statewide tax, which amounts to a tax rate of \$10.20 for closed land. These tax rates are applicable for 2018-2022 and are set to adjust every 5 years to reflect the changing property tax rates. These rates apply for properties that are enrolled in the MFL program after 2005. Lands that were enrolled before 2005, from 1987-2004, pay much lower tax

rates: \$0.74 for open land and \$1.75 for closed land. Enrolled properties can be withdrawn from the program, but they are subject to a withdrawal tax plus a withdrawal fee of \$300 (Wisconsin Department of Natural Resources, 2017). Enrolled properties that undergo a transfer in ownership are still enrolled in the MFL program if the new owner agrees to conform to the program rules. If they choose to withdraw from the program, they are responsible for the withdrawal fees. This program is contractual, and once the property is in the program the state cannot change the rules. Currently over 3.4 million acres of forested land in Wisconsin is enrolled in the Managed Forest Law program (Wisconsin Department of Natural Resources, 2020c).

Table 1: Commercial Forest vs Managed Forest Law

| | Commercial Forest | Managed Forest Law |
|---------------------------------|--------------------------|-----------------------------------------------------|
| State | Michigan | Wisconsin |
| Min. Acreage Requirement | 40 | 20 |
| Open to Public | Yes | Optional |
| Management Plan | Required | Required |
| Withdrawal penalty | Yes | Yes |
| Tax rate | \$1.30/acre | Open land: \$2.04/acre Closed land: \$10.20/acre |

1.8 Research Questions

In view of the findings of the previous literature regarding property enrollment in preferential tax programs and their effects on the township's property tax base and millage rates, this research addresses the following questions with regards to the Commercial Forest (CF) program in Michigan and the Managed Forest Law (MFL) program in Wisconsin:

1. How does increased enrollment in CF and MFL affect tax rates on all classes of non-enrolled properties included in the townships tax base?

2. Are some townships more sensitive to changes in their millage rate with changes in property enrollment than others, and if so why?
3. To what degree do the PILT and other government reimbursement payments help to mitigate the shift to non-enrolled properties?
4. For WI, is the sensitivity to changes in the millage rate different depending on whether increasing MFL enrollment occurs in the “open” or “closed” category?

2 Methods

2.1 Data Collection

Data were collected only for the Commercial Forest program in Michigan and the Managed Forest Law program in Wisconsin. The Qualified Forest program in Michigan was not included in the study as the data related to that program are available only at the county level, and this study investigated effects at the township level. Also, unlike the CF program which simply applies a fixed rate to all properties, the tax fee that is due on Qualified Forest properties depends on that property's taxable value, as one of the main tax benefits is a local school operation tax exemption of up to 18 mills. However, individual parcel data is not readily available for the State of Michigan. Due to these complications, township level enrollment and tax revenue data for the Qualified Forest program was not considered in this study.

Census data regarding township demographics and housing characteristics were collected from the United States Census Bureau. Data were collected at the township level for the year 2018, and included population, median household income, median house value, the proportion of housing units that were owner-occupied, renter-occupied, and vacant, and the year that the house owner moved into unit, which was measured according to the number of owner-occupied housing units that were moved into. The variable used shows the proportion of owner-occupied housing units that were moved into before and after 2010. The township's population was divided by the township's total area to get the population density per square mile. The population data does not include seasonal or absentee owners. These data were collected to get an estimate of the number of non-enrolled properties and how valuable they are, which gives an indication of the size of the township's available property tax base.

Property tax data were collected from year 2018 at the township level from various online sources (See Table 2). This particular year was chosen as it was the most recent tax year with available data at the time when this study was initiated. The total acres enrolled in the forest tax programs and the tax rates levied on those enrolled properties were extracted from the respective States' Department of Natural Resources websites (<https://www.michigan.gov/dnr>; <https://dnr.wisconsin.gov/>). The total taxable value of

real property in each of the Michigan townships was extracted from the State's Department of Treasury (<https://www.michigan.gov/treasury>). For Wisconsin, the township's total assessed value for the combined property classes of 5 (undeveloped), 5m (agricultural forest), 6 (forest), and 7 (other) was extracted from the State's Department of Revenue (<https://www.revenue.wi.gov/pages/home.aspx>). The total assessed value was used rather than the taxable value (the DOR Base Value) as the assessed values are used to determine how the tax burden is distributed among the properties (Wisconsin Department of Revenue, 2020). The combined township and school millage rates for the townships in Michigan were extracted from the Ad Valorem Property Tax Report from the State of Michigan's website (State of Michigan, n.d.). The millage rates for Wisconsin were extracted from the Town, Village, and City dashboard on the Department of Revenue website (<https://www.revenue.wi.gov/Pages/RA/TVC-Taxes.aspx>). The net rate was used as it included the school levy credit. The millage rates were then divided by 1,000 to represent the amount of tax payable per \$1,000 taxable value.

Additional sources of revenue for the townships include revenue sharing payments from the state, and Payment-in-lieu-of-taxes (PILT) from lands owned by the federal and state governments. Revenue sharing payments from Michigan were collected from the State of Michigan's Department of Treasury website where the summed total of the constitutional, city, village, and township revenue sharing (CVTRS) statutory, and supplemental CVTRS statutory were included. The revenue sharing payments from Wisconsin were collected from the Wisconsin Department of Revenue website, where the sum of the payments from the county and municipal aid, utility aid, and the expenditure restraint programs were included. PILT payments from federal lands in Michigan were collected from the U.S. Department of Interior website (<https://www.doi.gov/>), and PILT payments from state lands were collected from Michigan's Department of Natural Resources website. Since these payments are reported at the county level a PILT rate was calculated by dividing the total payment made to the county by the total acres in each county. This rate was then applied to the federal/state acreage in each of the townships within that county. PILT payments from federal and state lands in Wisconsin were

collected from the state’s Department of Natural Resources (B. Daul 2020, personal communication, 6 October), and these reports were given at the township level.

Table 2: Sources of Data Collected for Michigan and Wisconsin townships

| State | Type of Data | Source |
|-----------|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Both | Census | United States Census Bureau |
| Michigan | CF Program Enrollment | Michigan Department of Natural Resources – <i>Tax Year 2018 Commercial Forest Reports by County</i> |
| | Total Taxable Value | State of Michigan Department of Treasury – <i>State Tax Commission 2018 Taxable Valuation Report</i> |
| | Millage rates | State of Michigan – <i>2018 Ad Valorem Property Tax Report</i> |
| | Revenue Sharing | State of Michigan Department of Treasury – <i>Constitutional and CVTRS Revenue Sharing Projections FY2018 and FY2019 Actuals</i> |
| | PILT from Federal Lands | U.S. Department of Interior – <i>Payments and Acreage by State/County 2018</i> |
| | PILT from State Lands | Michigan Department of Natural Resources – <i>Payment in Lieu of Taxes Report Taxation Year 2018</i> |
| Wisconsin | MFL Program Enrollment | Wisconsin Department of Natural Resources – <i>2018 Acreage Summary Report by Municipality</i> |
| | Total Assessed Values | Wisconsin Department of Revenue – <i>Preliminary Major Class Comparison Report</i> |
| | Millage Rates | Wisconsin Department of Revenue – <i>The Town, Village, and City Dashboard</i> |
| | Revenue Sharing | Wisconsin Department of Revenue – <i>2019 Estimated Shared Revenue and Expenditure Restraint Payments</i> |
| | PILT from Federal Lands | Wisconsin Department of Natural Resources – <i>FFY2018 USFS PILT</i> |
| | PILT from State Lands | Wisconsin Department of Natural Resources – <i>Payment of State Aid to Municipalities as Provided by Section 70.114 of the Statutes for the Payment Year 2019</i> <i>Payment of 88 cents per acre to Towns for the Year 2019 as Provided by Section 70.113 of the Statutes</i> |

2.2 Spreadsheet Model

A deterministic model was used to simulate the effects of increased acres enrolled in the forest tax programs on townships millage rates, assuming that township property tax revenues need to remain constant. The calculation used for estimating the total property tax revenues received by each township is as follows:

$$R = (TTV * MR) + (A * PR) + X + P + RS$$

The total revenue (R) was calculated by summing together the taxes paid for non-enrolled properties, which is the product of the township's total taxable value for real property (TTV) and that township's millage rate (MR), the taxes paid for enrolled properties, which is the product of the total acres enrolled (A) and the program's tax rate (PR), the state reimbursement payment for properties enrolled in the forest tax programs (X), PILT payments made for federal and state lands (P), and revenue sharing payments (RS). For Michigan the state reimburses townships at the same rate that is levied on the enrolled properties, the \$1.30 per acre of enrolled land. For Wisconsin the state reimburses the townships at \$0.20 per acre of enrolled land.

Hypothetical scenarios were run to simulate the effect of increases in enrolled forestland on townships' millage rates, again assuming total revenue (R) remained constant. Three scenarios of a 5%, 10%, and 15% increase in enrolled acres were run for each township, and a new millage rate was calculated based on the changes in enrollment.

$$MR = (R - (A * (1 + r) * PR) - X - P - RS) / (TTV - ((A * (1 + r)) - A) * TV)$$

For each simulated increase in enrollment, total tax revenues from enrolled properties was calculated by multiplying the acres enrolled in the forest tax program in 2018 (A) by the percent increase (1+r) and then by the program's tax rate (PR). The total taxable value for each township was adjusted to account for the acres of forestland enrolled in the

respective forest tax program. Thus, the adjusted total taxable value for the township was calculated by subtracting taxable value of the property that was taken out of the tax base and added to the forest tax program, which is the change in enrolled acres multiplied by its pre-enrollment taxable value (TV), from the original total taxable value (TTV). For Michigan, assumed taxable values for forestland were used across the townships because taxable value data for individual properties is not readily available. These assumed taxable values for MI were informed by actual taxable values for timber cut-over land, 40 acres or more, in Houghton County, which were provided by the Houghton County Equalization Department. Based on that report, the average taxable value of forested properties classified as timber cut-over is \$199 per acre, with a range in taxable value from \$21 to \$1,225 per acre (See Appendix A). For Wisconsin, tax parcel data were used to derive average taxable values of properties 20 acres or more in classification 6 (productive forest). The average taxable value of productive forested land for each township was then used in the model.

The simulated changes in tax levy that would be applied to non-enrolled properties was calculated by subtracting from the total revenue (R) the new tax levy from enrolled properties and the state reimbursement (X), PILT (P), and revenue sharing (RS) payments. The new millage rate (MR) could then be calculated by dividing the new tax levy paid by non-enrolled properties by the new total taxable value. The new millage rate was then subtracted from the 2018 actual millage rate to determine how much it changed, and this was then multiplied by 10,000 to determine the township's change in tax levy per \$10,000 taxable value. The new millage rate (MR) could then be calculated by dividing the new tax levy paid by non-enrolled properties by the new total taxable value.

2.3 Sensitivity Analysis

A sensitivity analysis was conducted showing the average changes in tax levies across different enrollment scenarios for each State. There were five different taxable value scenarios run in Michigan: \$50, \$250, \$500, \$750, and \$1000 taxable value per acre. Each level of taxable value scenario was run with a 5%, 10%, and 15% increase in

CF enrollment. Three different scenarios were run in Wisconsin each with a different ratio between the proportion of enrolled acres in the open and closed classifications to account for the different tax rates associated with each. The increase in MFL enrollment in both open and closed lands were simulated at its current ratio, new enrollment only in the open category, and new enrollment only in the closed category. Each of these three different scenarios were run showing a 5%, 10%, and 15% increase in total MFL enrollment within each township. Descriptive statistics showing the mean change in tax levy per \$10,000 taxable value were calculated for each scenario.

2.4 Correlation Analysis

A correlation analysis was run to see what possible variables are correlated with townships' change in tax levy with an increase in program enrollment. A correlation coefficient value of -1 indicates a perfect negative relationship between two variables, meaning that as one variable increases the other decreases, a value of 1 indicates a perfect positive relationship, meaning that as one variable increases the other increases, and a correlation value of 0 indicates no relationship. Two different types of correlation coefficients were used to measure the correlation between the townships change in tax levy and the other variables: Spearman correlation (ρ), and Kendall's tau correlation (τ). Both correlations are useful for quantitative or ordinal data, and they both indicate how strongly two variables are monotonically related (van den Berg, n.d.). Unlike the Pearson's correlation, they do not carry the assumption that the data needs to follow a normal distribution, which is why these measures were preferred over Pearson's correlation as the change in tax levy variable is not normally distributed.

IBM SPSS Statistics Software was used for the correlation analysis. Four different scenarios were run for Michigan: change in tax levy with 10% increase in CF enrollment at \$200, \$300, \$400, and \$500 taxable values per acre. For Wisconsin, the same three enrollment ratio scenarios from the sensitivity analysis were run, each showing the change in tax levy with a 10% increase in MFL enrollment. The variables examined as correlates with the change in tax levy included population density, median household income, median house value, the proportion of housing units that were owner-occupied,

renter-occupied, and vacant, the proportion of owner-occupied housing units where the owner moved in before 2010 and after 2010, the proportion of land area that was either enrolled in CF or MFL, the proportion of the township's total revenue that came from enrolled properties/state reimbursement, non-enrolled properties, PILT payments from federal and state lands, and revenue sharing payments, and the proportion of total MFL land that was open and enrolled from 1987-2004, closed and enrolled from 1987-2004, open and enrolled after 2005, and closed and enrolled after 2005 (Table 3). Descriptive statistics were also calculated for each of the independent variables.

Population density and housing data were included in the analysis because of their relationship to a township's available property tax base, and to examine how shifts in tax burdens may be impacting rural townships with smaller tax bases, less property value, and smaller incomes. The number of properties already enrolled in the forest tax programs, and the amount of revenue coming from those properties, would also give an indication of the township's available tax base, as one would expect that a township with a greater proportion of land already enrolled would have fewer properties left in the tax base to shift the tax burden onto, thereby resulting in the township's change in tax levy to increase with increasing enrollment. The proportion of revenue coming from PILT and revenue sharing payments variables were included to examine if those additional revenues are in any way helping to reduce the township's sensitivity to increases in program enrollment. The different MFL enrollment categories were included to better understand if properties enrolled in a certain category cause a greater effect on the township's change in tax levy. Since lands enrolled before 2005 pay much more reduced taxes, as well as open land enrolled after 2005, it is expected that these variables would have a positive relationship with the township's change in tax levy. It is expected for the closed lands enrolled after 2005 to have a negative association with the township's change in tax levy. Since a higher tax fee is levied on closed lands, a higher proportion of them in a township may reduce the township's sensitivity to increases in enrollment as a reduced tax revenues would be expected from the non-enrolled properties to make up for the loss in tax revenue.

Table 3: Description of variables used in correlation analysis

| Name | Description |
|--------------------|-----------------------------------------------------------------------------------|
| Pop. Den. | Population density per square mile |
| Med. Inc. | Median household income |
| Med. H. Val. | Median house value |
| % Owner | % of housing units that are owner-occupied |
| % Renter | % of housing units that are renter-occupied |
| % Vacant | % of housing units that are vacant |
| % Moved pre 2010 | % of owner-occupied housing units where owner moved in before 2010 |
| % Moved post 2010 | % of owner-occupied housing units where owner moved in after 2010 |
| % CF Tax | % of total revenue that came from CF enrolled properties and state reimbursement |
| % Non-CF Tax | % of total revenue that came from non-CF enrolled properties |
| % MFL Tax | % of total revenue that came from MFL enrolled properties and state reimbursement |
| % Non-MFL Tax | % of total revenue that came from non-MFL enrolled properties |
| % PILT | % of total revenue that came from federal/state PILT |
| % RS | % of total revenue that came from revenue sharing payments |
| % CF Land | % of total township area that is enrolled in CF |
| % MFL Land | % of total township area that is enrolled in MFL |
| % Pre 2005 Open | % of total MFL that is open and enrolled between 1987-2004 |
| % Pre 2005 Closed | % of total MFL that is closed and enrolled between 1987-2004 |
| % Post 2005 Open | % of total MFL that is open and enrolled after 2005 |
| % Post 2005 Closed | % of total MFL that is closed and enrolled after 2005 |

3 Results

3.1 Michigan's Upper Peninsula – Commercial Forest Program

Currently, approximately 2.2 million acres of private forests are enrolled in the CF program in Michigan's Upper Peninsula. Of the 149 townships in the Upper Peninsula, 129 have at least one parcel of land enrolled in the CF program and 20 of the townships do not have any land enrolled. As this analysis is based on a percent increase in current CF enrollment, the townships that do not have any land currently enrolled were excluded from the analyses as any percent increase would only continue to result in zero land enrolled.

3.1.1 Township Data

The average township has a population density of about 16.6 people per square mile, with a range of 0.2 to 189.1 people per square mile (Table 4). The average township has a median household annual income of around \$49,005, and a median house value of around \$124,143 (Table 4). On average about 44.6% of housing units within a township are owner-occupied while 49% are vacant, and 6.4% are renter-occupied (Table 4). Of the owner-occupied units, an average of 72.2% had the owner moving in before 2010, and 27.8% of the units were moved in after 2010 (Table 4). Longer-tenured owner occupants are an important consideration for Michigan, as the state caps the rate of increase on a property's taxable value so that the annual increases cannot exceed the rate of 1.05 or the inflation rate, whichever is lowest. When a transfer of ownership occurs then the property is uncapped, and its taxable value is assessed at its current market value. In general, longer-tenured occupants pay lower property taxes than those who recently purchased a piece a property, due to the rate of taxable value increase being capped at the year when the purchase was made.

Of all the townships that currently have properties enrolled in the CF program, on average about 20.6% of the total township land area consists of CF land, with some townships having as low as 0.1% of CF land and some having as much as 86.9% of their land area enrolled in the program (Table 4). Of the total property tax revenue that is

received by the township, an average of 75.8% comes from the non-CF enrolled properties, 10.7% from PILT payments from federal and state lands, 8.2% from revenue sharing payments from the state, and 4.9% from CF enrolled properties and the state reimbursement (Table 4).

Table 4: Descriptive statistics for the independent variables in study

| | Mean | Std. Dev. | Min | Max | N |
|----------------------------------------------|-------------|------------------|------------|------------|----------|
| Pop. Den. (per sq. mi.) | 16.6 | 26.42 | 0.2 | 189.1 | 129 |
| Med. Inc. | \$49,005 | \$9,704.27 | \$26,667 | \$79,250 | 127 |
| Med. H. Val. | \$124,143 | \$41,355.80 | \$48,800 | \$272,200 | 127 |
| % Owner | 44.6 | 16.66 | 4.5 | 90.6 | 129 |
| % Renter | 6.4 | 6.49 | 0.0 | 40.8 | 129 |
| % Vacant | 49.0 | 19.75 | 2.3 | 94.8 | 129 |
| % Moved pre-2010 | 72.2 | 8.18 | 41.4 | 88.9 | 129 |
| % Moved post-2010 | 27.8 | 8.18 | 11.1 | 58.6 | 129 |
| % CF Land | 20.6 | 19.06 | 0.1 | 86.9 | 129 |
| % CF Tax | 4.9 | 5.69 | 0.01 | 31.1 | 129 |
| % PILT | 10.7 | 11.73 | 0 | 59.2 | 129 |
| % Non-CF Tax | 75.8 | 12.31 | 33.7 | 95.0 | 129 |
| % RS | 8.2 | 5.16 | 1.3 | 31.1 | 129 |
| % Townships with at least 1 CF parcel | 86.6 | | | | |

Note: Only includes the 129 townships that currently have CF land, excludes 20 townships that do not currently have land enrolled in CF

3.1.2 Simulation Results

The acreage of forested land that is still available in a township to be enrolled in the CF program was estimated using GIS, to determine if the percent increase in enrollment is even possible. This was determined using land cover data from the National Land Cover Database, and shapefiles from the state's website showing acreages of land enrolled in the CF program, as well as federal and state-owned land. Individual parcel data was not readily available for Michigan, so the estimate is based on total available forested acreage disregarding individual parcel size. There was one township for which a 5%, 10%, and 15% increase was not possible due to limited acreage of available forest,

and another township for which a 15% increase was not possible. These townships were excluded from the analyses for the scenarios at which a percent increase was no longer possible.

Overall, tax rates increased for non-CF properties as a result of increased enrollment in CF across all combinations of percent increase and assumed taxable value of non-enrolled forestland (Fig. 4). The increase in the tax levy is higher when the forested property is valued at a higher taxable value and when there is a greater increase in program enrollment (Table 5). Higher valued properties pay higher taxes than lower valued properties, so it would be a greater loss to the township's tax revenue if that higher property was to be removed from the property tax base and enrolled in a forest tax program. Higher increases in program enrollment would also result in higher tax rate increases as more properties are being removed from the tax base, causing a greater shift in the tax burden for the remaining properties. For forested properties that qualify for enrollment (productive forests over 40 acres), with an assumed value \$500 per acre, and assuming a 10% increase in program enrollment, non-enrolled properties would see their tax bills increase by \$5.15 per \$10,000 taxable value (Table 5), which is a 2.32% increase. Assuming a taxable value of \$1,000 per forested acre, and a 10% increase in program enrollment, the non-enrolled properties experience an average tax levy increase of \$13.26 per \$10,000 taxable value across all townships (Table 5), which is a 5.99% increase in the tax rate. In contrast, assuming low taxable values of properties, increasing enrollment in CF resulted in a reduction in the taxes levied on non-enrolled property. For instance, a 10% increase in enrollment of forested properties with an assumed average taxable value of \$50 per acre resulted in a reduction of \$0.86 per \$10,000 taxable value in the tax bills (Table 5). Properties that have such a low taxable value would actually pay higher taxes if they were to enroll in the CF program. For example, in L'Anse township in Baraga County where the current mill rate is 19.55, a 40-acre property valued at \$50 per acre taxable value would be paying \$39.10 in property taxes. If that property enrolled in the CF program their tax bill would increase to \$52, with the program's tax rate of \$1.30 per acre. High enrollment increases of these low valued properties in the CF program would therefore enable townships to reduce the tax rate for non-enrolled

properties, as they would be receiving higher tax revenues. However, such a scenario is unlikely to occur as there would be no tax incentive for the landowners to enroll. While the average township has a rather minimal change in their millage rate with increasing enrollment, some townships experienced much higher changes, resulting in higher tax levies on the non-enrolled properties (Table 5).

Table 5: Descriptive statistics for change in tax levy for various CF enrollment scenarios

| Change in Tax Levy per \$10,000 Taxable Value | | | | | | |
|------------------------------------------------------|----------------------------|-------------|-----------------|-------------|-------------|----------|
| Taxable Value of Non-CF Forest | Increase in CF Land | Mean | Std Dev. | Min. | Max. | N |
| 50 | 5% | -\$0.43 | \$0.55 | -\$2.43 | \$0.00 | 128 |
| | 10% | -\$0.86 | \$1.10 | -\$4.90 | \$0.00 | 128 |
| | 15% | -\$1.24 | \$1.61 | -\$7.41 | \$0.00 | 126 |
| 250 | 5% | \$0.83 | \$1.37 | \$0.00 | \$8.55 | 128 |
| | 10% | \$1.69 | \$2.84 | \$0.00 | \$17.89 | 128 |
| | 15% | \$2.44 | \$4.26 | \$0.00 | \$28.13 | 126 |
| 500 | 5% | \$2.45 | \$3.85 | \$0.00 | \$22.68 | 128 |
| | 10% | \$5.15 | \$8.33 | \$0.00 | \$49.96 | 128 |
| | 15% | \$7.65 | \$13.09 | \$0.00 | \$83.40 | 126 |
| 750 | 5% | \$4.16 | \$6.53 | \$0.00 | \$38.17 | 128 |
| | 10% | \$8.97 | \$14.84 | \$0.00 | \$89.27 | 128 |
| | 15% | \$13.80 | \$24.91 | \$0.01 | \$161.20 | 126 |
| 1000 | 5% | \$5.95 | \$9.43 | \$0.00 | \$55.24 | 128 |
| | 10% | \$13.26 | \$22.71 | \$0.01 | \$138.58 | 128 |
| | 15% | \$21.39 | \$41.73 | \$0.01 | \$278.82 | 126 |

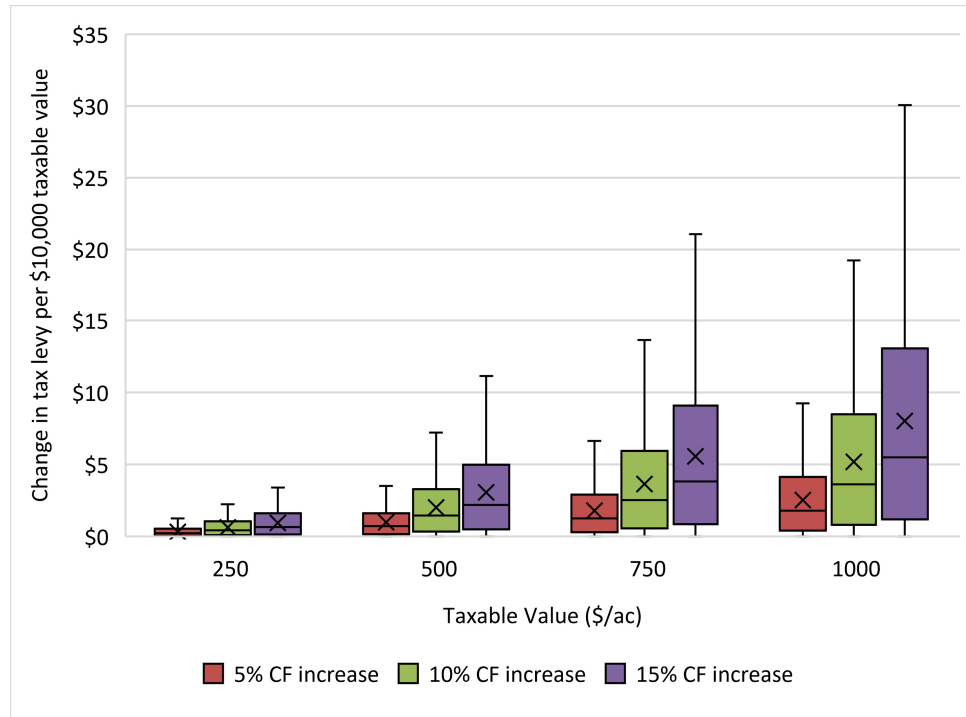


Figure 4: The change in tax levy per \$10,000 taxable value on non-enrolled properties across differing taxable values and increases in CF enrollment. *Note: excludes 23 outliers*

3.1.3 Correlation Results

Correlation coefficients were calculated to identify associations between U.S. Census and revenue source data and changes in tax levy as a result of increased CF enrollment (Table 6). All coefficients were significant, though the strength of the associations varied between the different taxable value scenarios. The Spearman's rho correlation coefficients showed stronger relationships than the Kendall's tau-b correlation coefficients (Table 3). The proportion of the township's total revenue that comes from the payments made by CF taxpayers and the state's reimbursement for enrollment resulted in a strong positive correlation with the township's change in tax levy ($\rho = 0.878$; $\tau = 0.830$ at 500 TV) (Table 6; Fig. 6a). The proportion of a township's total land area that is enrolled in the CF program has a more moderately strong positive correlation with the township's change in tax levy ($\rho = 0.734$; $\tau = 0.622$ at 500 TV) (Table 6; Fig. 5d). Population density ($\rho = -0.635$; $\tau = -0.444$ at 500 TV) (Fig. 5a), the proportion of housing units that are owner-occupied ($\rho = -0.490$; $\tau = -0.335$ at 500 TV) (Fig. 5b), the proportion

of total revenue that comes from non-CF taxpayers ($\rho = -0.466$; $\tau = -0.366$ at 500 TV) (Fig. 6b), and revenue sharing payments ($\rho = -0.551$; $\tau = -0.348$ at 500 TV) (Fig. 6c) all have moderate negative correlations with changes in tax levy for non-enrolled properties. The proportion of vacant housing units has a moderate positive relationship with change in tax levy ($\rho = 0.510$; $\tau = 0.350$ at 500 TV) (Fig. 5c). Median household income, median house value, the proportion of housing units that are renter-occupied, and the proportion of housing units where the owner moved in after 2010 a weakly negatively correlated with change in tax levy (Table 6). The proportion of housing units where the owner moved in before 2010, and the proportion of total revenue that came from PILT payments are weakly positively correlated with change in tax levy (Table 6).

Table 6: Correlation analysis results for all the independent variables against the township's change in tax levy for differing forested property taxable values

| | Change in Tax Levy at 10% increase | | | | | | | |
|--------------------------------------------|------------------------------------|---------|---------|---------|---------|---------|---------|---------|
| | 200 TV | | 300 TV | | 400 TV | | 500 TV | |
| | ρ | τ | ρ | τ | ρ | τ | ρ | τ |
| Pop. Den. <i>N</i> = 128 | -.627** | -.442** | -.625** | -.441** | -.623** | -.442** | -.618** | -.437** |
| Med. Inc. <i>N</i> = 126 | -.379** | -.257** | -.383** | -.266** | -.384** | -.265** | -.381** | -.262** |
| Med. H. Val. <i>N</i> = 126 | -.378** | -.257** | -.370** | -.251** | -.366** | -.248** | -.363** | -.245** |
| % Owner <i>N</i> = 128 | -.498** | -.341** | -.488** | -.336** | -.484** | -.331** | -.480** | -.327** |
| % Renter <i>N</i> = 128 | -.347** | -.239** | -.345** | -.236** | -.341** | -.233** | -.337** | -.230** |
| % Vacant <i>N</i> = 128 | .523** | .363** | .510** | .351** | .505** | .348** | .500** | .344** |
| % Moved pre 2010 <i>N</i> = 128 | .318** | .212** | .338** | .224** | .340** | .226** | .335** | .222** |
| % Moved post 2010 <i>N</i> = 128 | -.318** | -.212** | -.338** | -.224** | -.340** | -.226** | -.335** | -.222** |
| % CF | .728** | .546** | .784** | .598** | .794** | .609** | .799** | .616** |

| | | | | | | | | |
|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| $N = 128$ | | | | | | | | |
| % CF tax | .875** | .711** | .942** | .800** | .954** | .820** | .957** | .828** |
| $N = 128$ | | | | | | | | |
| % PILT | .276** | .189** | .275** | .190** | .276** | .189** | .272** | .187** |
| $N = 128$ | | | | | | | | |
| % Non-CF tax | -.457** | -.302** | -.518** | -.346** | -.531** | -.357** | -.532** | -.359** |
| $N = 128$ | | | | | | | | |
| % RS | -.541** | -.376** | -.505** | -.349** | -.496** | -.342** | -.491** | -.339** |
| $N = 128$ | | | | | | | | |

Note: ** Correlation is significant at 0.01 level

ρ - Spearman's rho correlation coefficient; τ - Kendall's tau-b correlation coefficient

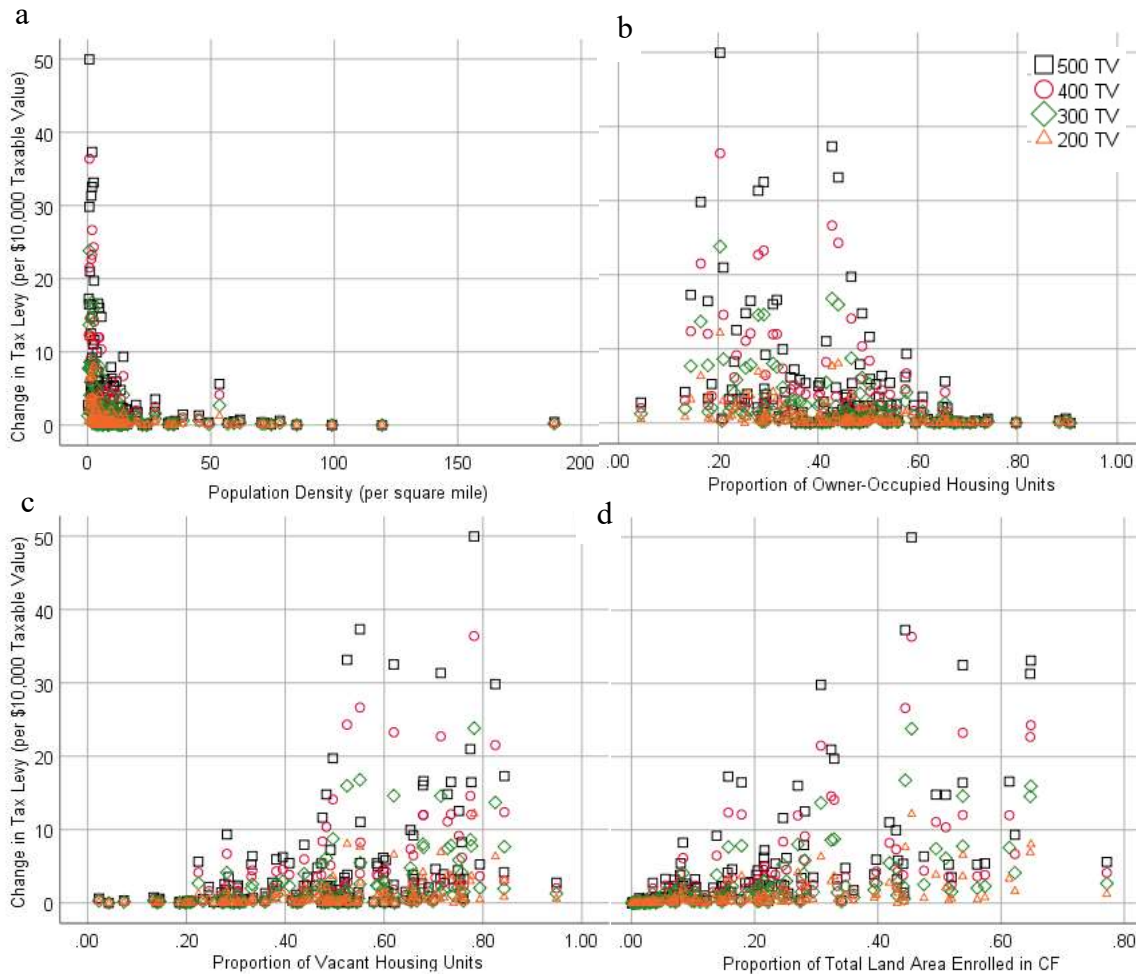


Figure 5: The relationship between (a) population density; (b) the proportion of housing units that are owner-occupied; (c) the proportion of housing units that are vacant; and (d) the proportion of total land area that is enrolled in the CF program with the township's change in tax levy with a 10% increase in CF enrollment with property valued at 200 taxable value, 300 taxable value, 400 taxable value, and 500 taxable value.

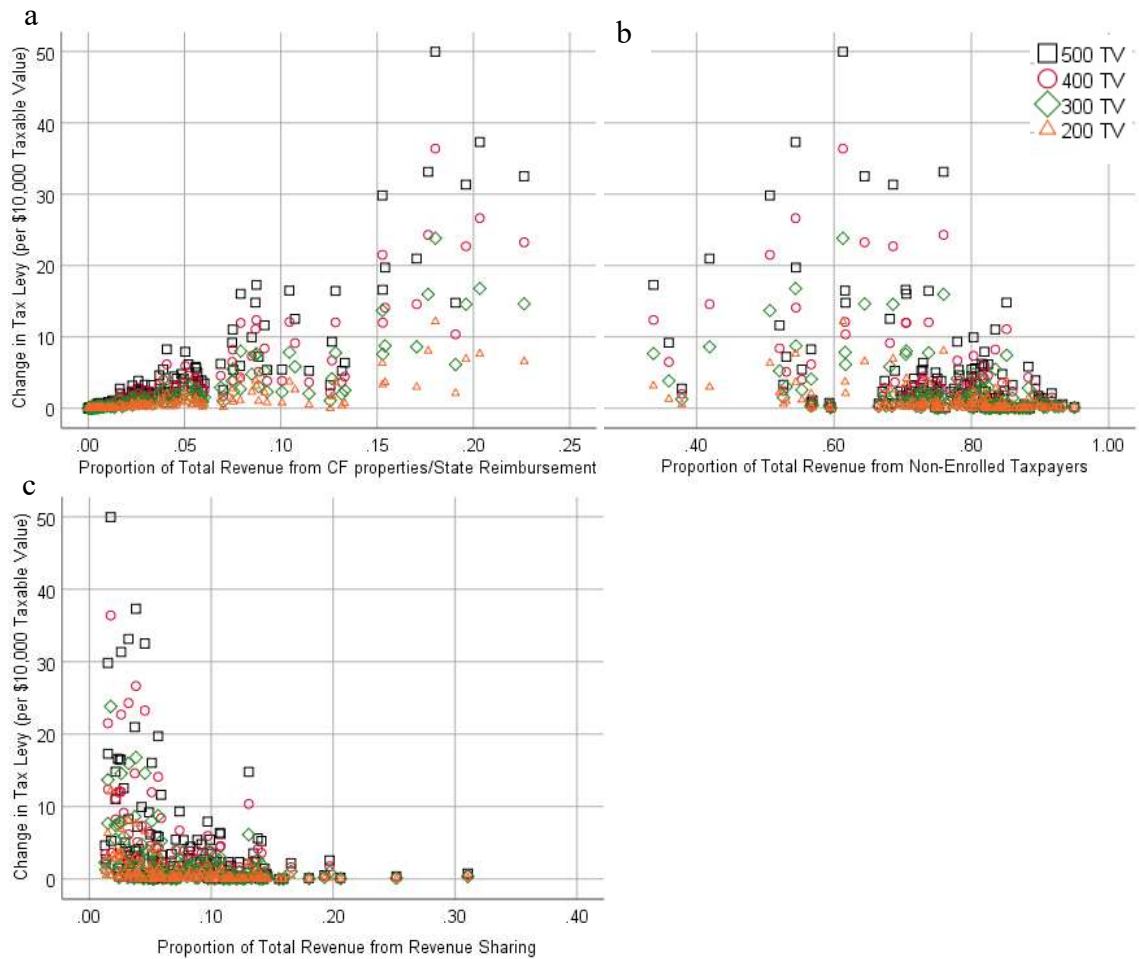


Figure 6: The relationship between the (a) proportion of total tax revenue that comes from properties enrolled in CF and the State reimbursement payments; (b) the proportion of total revenue that comes from non-CF properties; and (c) the proportion of total tax revenue that comes from revenue sharing payments with the township's change in tax levy with a 10% increase in CF enrollment with property valued at 200 taxable value, 300 taxable value, 400 taxable value, and 500 taxable value.

3.2 Northern Wisconsin – Managed Forest Law

There are currently about 1.2 million acres of forest enrolled in Wisconsin's MFL program. All 149 townships included in this study had at least one parcel enrolled in the MFL program. About 19.2% of the total land area in the average township is enrolled in the MFL program, with a range from 1.5% to 83.3% (Table 7). Of the MFL land that was

enrolled prior to 2005, an average of about 29.6% was enrolled in the open category and 26.4% in the closed category (Table 7). Of the MFL land that was enrolled after 2005 to the present, an average of 14.1% is enrolled in the open category and 29.9% is enrolled in the closed category (Table 7). These differences in the enrollment category is an important consideration as they pay differing tax rates. Open MFL land enrolled prior to 2005 makes tax payments at \$0.74 per acre, closed MFL land enrolled prior to 2005 pays \$1.75 per acre, open MFL land enrolled after 2005 pays \$2.04 per acre, and closed MFL land enrolled after 2005 pays \$10.20 per acre in taxes.

3.2.1 Township Data

The average population density in the WI townships included in this study is 13.5 people per square mile, with a range between 0.7 to 66.5 people per square mile (Table 8). The average median household income is \$51,481 and the median house value is \$147,303 (Table 8). The average township has a greater proportion of vacant housing units (50.6%) with 43.4% of the housing units being owner-occupied, and 6% being renter-occupied (Table 8).

Unlike Michigan, average taxable value was based on tax parcel data, where the average taxable value of productive forested property in parcels greater than 20 acres was calculated for each township. The average taxable value of all the non-enrolled forested property is \$1613 per acre, with a range from \$428 to \$2,839 per acre. Of the total property tax revenue generated that came into the various townships in 2018, an average of 70.2% came from non-MFL enrolled properties, 10.6% from federal/state PILT payments, 10% from revenue sharing payments, and 9.2% from MFL enrolled properties and the state reimbursement (Table 8). For some townships the payments from MFL properties and the state reimbursement made up as much as 37.6% of the total tax revenue and as little as 0.6% of the total revenue (Table 8).

Table 7: Descriptive statistics for the different MFL land enrollment categories

| | Mean | Std. Dev. | Min | Max | N |
|---------------------------|-------------|------------------|------------|------------|----------|
| % MFL Land | 19.2 | 14.43 | 1.5 | 83.3 | 149 |
| % Pre 2005 Open | 29.6 | 25.80 | 0.0 | 98.1 | 149 |
| % Pre 2005 Closed | 26.4 | 15.60 | 1.1 | 66.7 | 149 |
| % Post 2005 Open | 14.1 | 10.93 | 0.0 | 51.3 | 149 |
| % Post 2005 Closed | 29.9 | 17.62 | 0.0 | 80.5 | 149 |

Table 8: Descriptive statistics for independent variables in study

| | Mean | Std. Dev. | Min | Max | N |
|--------------------------|-------------|------------------|------------|------------|----------|
| Pop. Den. | 13.5 | 13.86 | 0.7 | 66.5 | 149 |
| Med. Inc. | \$51,481 | \$10,604 | \$25,694 | \$94,375 | 149 |
| Med. H. Val. | \$147,303 | \$37,912 | \$59,000 | \$272,100 | 148 |
| % Owner | 43.4 | 17.61 | 10.6 | 89.1 | 149 |
| % Renter | 6.0 | 4.85 | 0.2 | 36.8 | 149 |
| % Vacant | 50.6 | 19.69 | 3.1 | 88.0 | 149 |
| % Moved pre 2010 | 73.4 | 6.63 | 55.9 | 95.8 | 149 |
| % Moved post 2010 | 26.6 | 6.6 | 4.2 | 44.14 | 149 |
| TV of Forestland* | 1613 | 356.3 | 428 | 2839 | 149 |
| % MFL Tax | 9.2 | 5.86 | 0.6 | 37.6 | 149 |
| % Non-MFL Tax | 70.2 | 15.71 | 12.7 | 93.8 | 149 |
| % PILT | 10.6 | 15.37 | 0.0 | 83.8 | 149 |
| % RS | 10.0 | 8.71 | 0.4 | 49.2 | 149 |

* Property classification code: 6

3.2.2 Simulation Results

Acreage of available forests that could potentially be enrolled was estimated for each township from tax parcel data. Available acreage was based on properties that are classified as productive forest (classification 6) and that are 20 acres or more, which is the MFL minimum acreage requirement. There are 10 townships for which a 5% enrollment increase is not possible, due to limited acreage of available forested properties, 20 townships for whom a 10% increase is not possible, and 34 townships for whom a 15% increase is not possible. These townships were excluded from the analyses.

Within each of the three different enrollment scenarios between open and closed lands, as enrollment increases the mean change in tax levy also increases (Table 9 and Fig. 7). The scenario that assumes all new enrollment is in the open category had the highest average change in tax levy, and the scenario where all the increasing enrollment goes in the closed category had the lowest average change in tax levy (Table 9 and Fig. 7). For the open scenario, with a 10% increase in enrollment, the mean tax levy increases by \$12.21 per \$10,000 taxable value in the average township, which is about an 8.2% increase in the tax rate.

Assuming a 10% increase in new enrollment and assuming the current ratio of closed to open enrollment, the average township experiences an increase in mean tax levy for non-enrolled property of \$10.17 per \$10,000 taxable value, which is a 6.8% increase in the tax rate. With a 10% increase enrollment in the closed scenario, the average tax levy increases by \$6.98 per \$10,000 taxable value, which is an 4.6% increase in the tax rate. There is a wide range across the townships in their tax levy changes with increasing enrollment, with some townships experiencing rather minimal changes in their tax levy and others much higher changes. In the closed scenario there were even some townships that experienced a reduction in the tax levy (Table 9).

Table 9: Descriptive statistics for the change in tax levy for different MFL enrollment scenarios

| Change in Tax Levy per \$10,000 Taxable Value | | | | | | |
|------------------------------------------------------|-----------------------------|-------------|------------------|------------|------------|----------|
| Open vs Closed Ratio | Increase in MFL Land | Mean | Std. Dev. | Min | Max | N |
| Current | 5% | \$5.09 | \$6.06 | \$0.14 | \$34.80 | 139 |
| | 10% | \$10.17 | \$14.62 | \$0.28 | \$97.29 | 129 |
| | 15% | \$11.71 | \$13.53 | \$0.43 | \$120.38 | 115 |
| Open | 5% | \$6.09 | \$6.44 | \$0.22 | \$36.30 | 139 |
| | 10% | \$12.21 | \$15.42 | \$0.43 | \$101.48 | 129 |
| | 15% | \$14.70 | \$14.67 | \$0.65 | \$126.77 | 115 |
| Closed | 5% | \$3.55 | \$3.68 | -\$1.24 | \$21.84 | 139 |
| | 10% | \$6.98 | \$8.06 | -\$2.53 | \$55.15 | 129 |
| | 15% | \$8.93 | \$9.33 | -\$3.89 | \$71.49 | 115 |

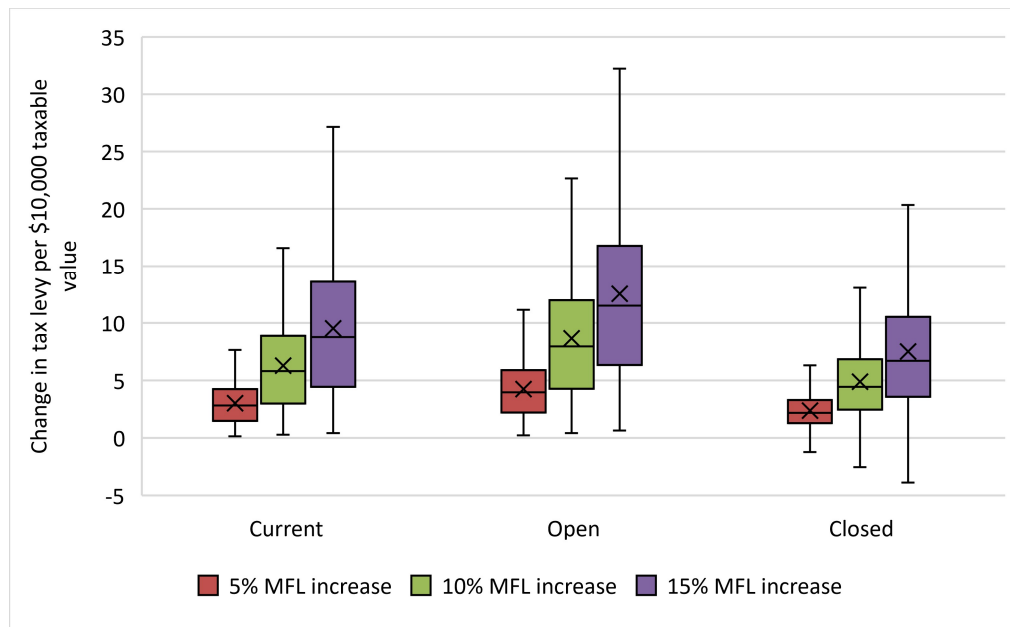


Figure 7: The change in tax levy per \$10,000 taxable value on non-enrolled properties for the different MFL enrollment scenarios. *Note: excludes 32 outliers*

3.2.3 Correlation Analysis

All the correlation analyses were conducted with a 10% enrollment increase within each of the three enrollment ratio scenarios. The proportion of land area enrolled in the MFL program has a moderately strong positive correlation when considering ρ correlation coefficient (Current - $\rho = 0.751$; Open - $\rho = 0.759$; Closed - $\rho = 0.713$), and a more moderate positive correlation when considering τ correlation coefficient (Current - $\tau = 0.571$; Open - $\tau = 0.577$; Closed - $\tau = 0.535$) that is significant with a township's change in tax levy across each of the three scenarios (Table 10; Fig. 8a). The proportion of total revenue that comes from MFL taxes and the state reimbursement also has a significant positive correlation with change in tax levy that is moderately strong when looking at ρ correlation coefficient (Current - $\rho = 0.695$; Open - $\rho = 0.732$; Closed - $\rho =$

0.691) and more moderate when looking at τ correlation coefficient (Current - $\tau = 0.521$; Open - $\tau = 0.556$; Closed - $\tau = 0.516$) (Table 10; Fig. 8d).

The proportion of MFL lands that were enrolled in the open category prior to 2005 has a moderate positive correlation with change in tax levy in the current ratio ($\rho = 0.590$; $\tau = 0.426$) and fully open ($\rho = 0.551$; $\tau = 0.395$) scenarios, but a moderately-weak positive correlation in the fully closed ($\rho = 0.426$; $\tau = 0.306$) scenario (Table 10; Fig. 8b). The proportion of MFL lands enrolled in the closed category after 2005 has a moderate negative correlation with change in tax levy in the current ratio ($\rho = -0.549$; $\tau = -0.400$) and fully open ($\rho = -0.518$; $\tau = -0.376$) scenarios, and a moderately-weak negative correlation in the fully closed ($\rho = -0.384$; $\tau = -0.281$) scenario (Table 10; Fig. 8c). The proportion of MFL lands enrolled in the closed category prior to 2005, the proportion of total revenue that comes from non-MFL enrolled properties, population density, and the proportion of owner-occupied housing units all have significant weak negative correlations with a township's change in tax levy (Table 10). The proportion of vacant housing units has a significant weak positive correlation with a township's change in tax levy (Table 10). Median household income, median house value, the proportion of housing units that are renter-occupied, the proportion of housing units where the owner had moved in either before or after 2010, the average taxable value of forested property, the proportion of total revenue that came from either PILT or revenue sharing payments, and the proportion of MFL lands that were enrolled in the open category after 2005 all are insignificantly correlated with a township's change in tax levy from increasing enrollment (Table 10).

Table 10: Correlation analysis results for all the independent variables against the township's change in tax levy for the differing MFL enrollment scenarios

| | Change in Tax Levy with 10% enrollment increase | | | | | |
|--------------------------------------------|-------------------------------------------------|---------|---------|---------|---------|---------|
| | Current Ratio | | Open | | Closed | |
| | ρ | τ | ρ | τ | ρ | τ |
| Pop. Den. <i>N</i> = 129 | -.303** | -.217** | -.308** | -.216** | -.193* | -.135* |
| Med. Inc. <i>N</i> = 129 | -0.145 | -0.100 | -0.154 | -0.106 | -0.079 | -0.051 |
| Med. H. Val. <i>N</i> = 128 | -0.148 | -0.095 | -0.160 | -0.105 | -0.125 | -0.088 |
| % Owner <i>N</i> = 129 | -.238** | -.163** | -.252** | -.171** | -.184* | -.124* |
| % Renter <i>N</i> = 129 | -0.124 | -0.085 | -0.125 | -0.081 | -0.099 | -0.064 |
| % Vacant <i>N</i> = 129 | .229** | .156** | .240** | .163** | .194* | .129* |
| % Moved pre 2010 <i>N</i> = 129 | 0.106 | 0.068 | 0.096 | 0.066 | 0.036 | 0.022 |
| % Moved post 2010 <i>N</i> = 129 | -0.106 | -0.068 | -0.096 | -0.066 | -0.036 | -0.022 |
| TV <i>N</i> = 129 | -0.116 | -0.083 | -0.111 | -0.078 | 0.074 | 0.052 |
| % MFL Tax <i>N</i> = 129 | .678** | .501** | .725** | .542** | .678** | .499** |
| % Non-MFL Tax <i>N</i> = 129 | -.301** | -.216** | -.294** | -.210** | -.242** | -.172** |
| % PILT <i>N</i> = 129 | 0.139 | 0.095 | 0.128 | 0.088 | 0.138 | 0.094 |
| % RS <i>N</i> = 129 | -0.111 | -0.072 | -0.134 | -0.086 | -0.129 | -0.086 |
| % MFL Land <i>N</i> = 129 | .708** | .530** | .719** | .538** | .661** | .489** |
| % Pre 2005 Open <i>N</i> = 129 | .542** | .389** | .495** | .352** | .339** | .244** |
| % Pre 2005 Closed <i>N</i> = 129 | -.314** | -.221** | -.256** | -.176** | -0.142 | -0.100 |
| % Post 2005 Open | 0.137 | 0.096 | 0.103 | 0.074 | 0.110 | 0.077 |

| | | | | | | |
|--------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| $N = 129$ | | | | | | |
| % Post 2005 | | | | | | |
| Closed | $-.481^{**}$ | $-.346^{**}$ | $-.444^{**}$ | $-.319^{**}$ | $-.283^{**}$ | $-.208^{**}$ |
| $N = 129$ | | | | | | |

Note: * Correlation is significant at 0.05 level; ** Correlation is significant at 0.01 level
 ρ - Spearman's rho correlation coefficient; τ - Kendall's tau-b correlation coefficients

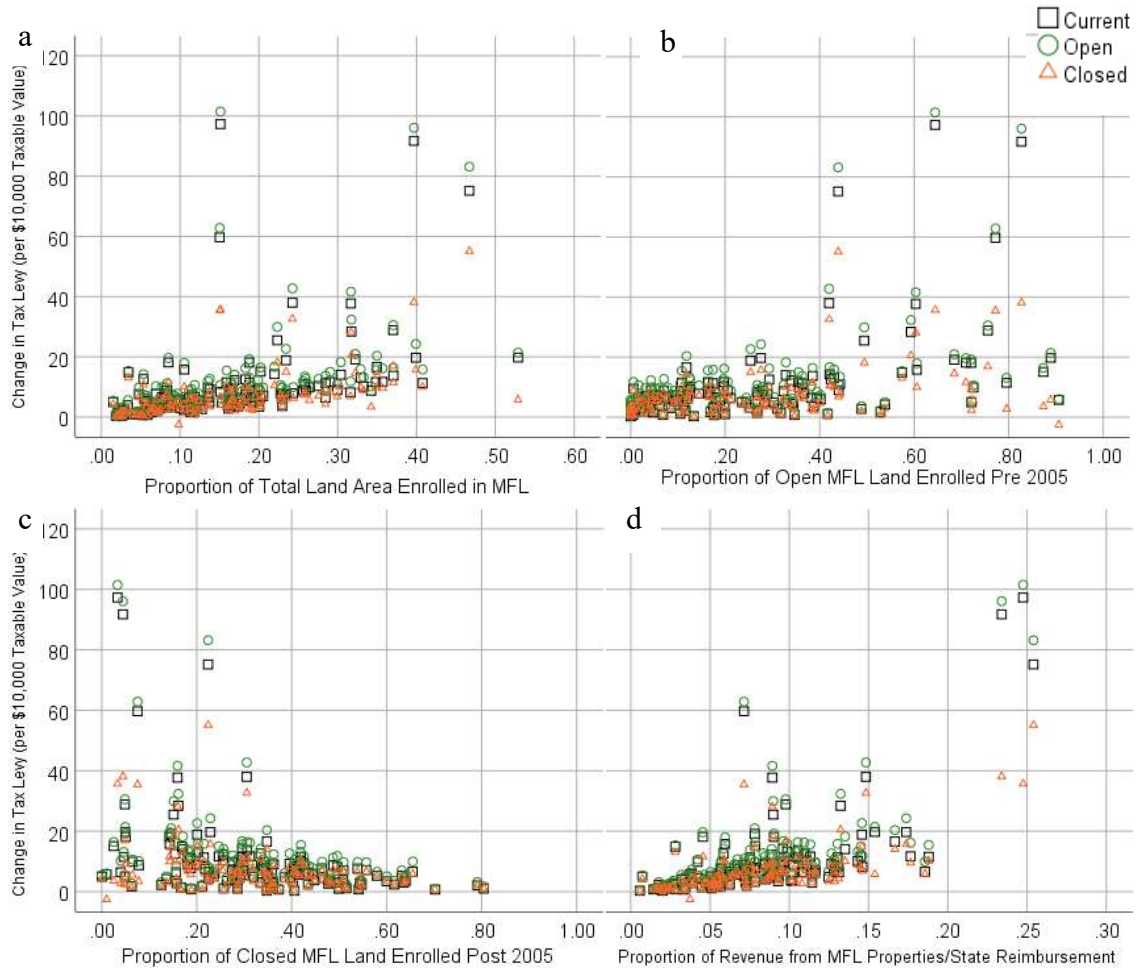


Figure 8: The relationship between the (a) proportion of total land area that is enrolled in MFL; (b) the proportion of open MFL land that was enrolled prior to 2005; (c) the proportion of closed MFL land that was enrolled after 2005; and (d) the proportion of total revenue that comes from MFL properties and State reimbursement with the township's change in tax levy with a 10% increase in MFL enrollment across three different enrollment scenarios: at the current open/closed ratio, increase in just open, and increase in just closed category.

4 Discussion

4.1 Variability of shifting tax burdens

Increasing enrollment in forest tax programs can result in subsequent increases in a township's property tax rate, assuming that the township needs to maintain a constant tax revenue, which shifts the tax burden onto non-enrolled properties. This increase occurs because the township's tax base is reduced due to forestland being enrolled in a forest tax program and therefore no longer subject to local tax rates. Based on these simulated results, the effect of the tax shift is relatively small for most townships in Michigan's Upper Peninsula and northern Wisconsin. However, there is a range in sensitivity amongst the townships to changes in program enrollment, with some townships experiencing much higher property tax rate increases and others rather minimal changes to the tax rate with increasing enrollment. For example, while the average township in the Upper Peninsula experienced a 2.3% tax rate increase with a 10% increase in CF enrollment assuming forest properties are valued at \$500 taxable value (See Appendix A), individual townships ranged in tax increases from as low as 0.002% to as high as 16.8%. The variability was even greater in northern Wisconsin, where the average township experienced a 6.8% increase in the tax rate with a 10% increase in MFL enrollment at the current ratio of opened to closed enrollment types, but the range in tax rate increase fell between 0.002% to 64.7%.

A wide range in sensitivity to changes in program enrollment has also been seen in past studies. Dunford and Marousek (1981) found that tax rate increases ranged from 1.1% to 21.9% in Spokane County, Washington, due to increases in enrollment in the use-value assessment program for farmland. Rickenbach and Saunders (2009) reported similar findings in Wisconsin, where some townships experienced only slight changes in the tax rate while others experienced much larger changes with changes in MFL enrollment.

The results of this study indicate that the difference in sensitivity seems to be connected with the ruralness of a township and the size of its tax base, which includes all the non-enrolled properties. This result is similar to findings from past studies (Dunford and Marousek, 1981; Brighton, 1993; Rickenbach and Saunders, 2009). According to the

correlation analysis, the proportion of enrolled land in a township had the strongest positive correlation with the change in tax levy per \$10,000 of taxable value, along with the proportion of revenue that comes from the enrolled properties, which includes State reimbursements (Tables 6 and 10). This result suggest that a higher proportion of enrolled forestland reduces the available tax base, thereby shifting the tax burden to make up for the lost revenue to fewer properties that have a relatively small combined taxable value. For example, a township with 60% of its land area enrolled in a forest tax program would mean only 40% of the land includes property that is subject to adjustment in millage rates that would be required to make up for reduced tax revenues as a result of increases in forest tax program enrollment. Arguably, non-enrolled properties would feel the tax shift more heavily in a township with a smaller tax base than would non-enrolled properties in a township with a larger tax base, as there are fewer properties available to shift the burden onto.

A smaller population density suggests a more rural township, and also may indicate a relatively smaller tax base. Population density was negatively correlated with changes in tax rates, although this relationship was much weaker in Wisconsin than in Michigan (Tables 6 and 10). This result may suggest that increased enrollment into a forest tax programs in low population density townships shift the tax burden onto fewer properties, which would mean that they would have to bear a greater share to make up for the loss in tax revenue due to the increasing enrollment in the forest tax program.

A negative association was observed between the proportion of housing units that are owner-occupied and the change in tax rate for non-enrolled properties. The more sensitive townships in Michigan were those that only had about 20-40% of its housing units being owner-occupied, with about 60-80% being vacant (Fig 5b and 5c). A higher proportion of owner-occupied units in a township could suggest a larger tax base and hence more properties available to shift the burden of the property tax onto, leading to a smaller change in tax levy for that township. In Michigan it is also important to note that owner-occupied units are subject to a cap on their property taxes. When a property is purchased in Michigan, the rate of increase in the property's taxable value becomes capped so that it cannot exceed 1.05 or the inflation rate, whichever is less. The taxes

being levied on these units may be even lower than what it would normally be based on the current market value of that property, depending on the tenure of ownership. Considering this aspect, it is difficult to explain why there is a negative correlation between change in tax levy and proportion of owner-occupied units, as the taxable value of the property depends on the tenure of the current owner as well as the market value. They could be paying much lower taxes if the unit has been occupied by its current owner for several years, or the taxes could be relatively higher if the unit has been more recently purchased and its property uncapped.

The proportion of housing units that are classified as vacant has a positive correlation in Michigan and Wisconsin, meaning that the greater the percent of vacant units, the higher the change in tax levy, according to the simulation. However, this result is difficult to interpret because the vacant classification includes both vacation homes that are not listed as the primary residence of the owner and units that are abandoned. It would be expected that a higher proportion of vacation homes would result in a lower change in tax levy as a result of increased forest tax program enrollment assuming such homes are higher valued properties. Moreover, the cap applied to the rate of increase of a property's taxable value is not applicable to second homes, only to properties of primary residence in Michigan. In contrast, if a township has a high proportion of truly vacant units (i.e. abandoned) that would be assumed to have low values, then the townships would likely receive little tax revenues from such units. However, since this difference cannot be distinguished in the variable it is hard to conclude what is causing this variable to have positive relationship with the change in tax levy.

This capping of the rate of taxable value increase on owner-occupied units in Michigan would also explain why the year that the owner moved into the unit would be significant, although the correlation for that variable is rather weak (Table 6). The lower the proportion of owner-occupied units where the owner moved in before 2010, the lower the change in tax levy experienced in the township, and the higher the proportion of owner-occupied units where the owner moved in after 2010, the higher the change in tax levy. Under Michigan's capping law, when ownership is transferred the property's taxable value is uncapped and is set at 50% of its true cash value. Thus, more recently

purchased properties tend to pay higher property taxes than properties that have not changed ownership for many years as the property's value would have increased to its current market value. Wisconsin does not cap the rate of increase of taxable values of properties at time of purchase, which no doubt explains why these variables are not significantly correlated with the township's change in tax levy for that state.

4.2 Open vs Closed MFL Properties

There are two categories of enrollment for the MFL program in Wisconsin - landowners can opt to have their land either open or closed to the public. This is unlike the CF program where all enrolled properties are required to be open to the public for recreational purposes, such as hunting, trapping, and fishing. In Wisconsin, MFL properties kept open to the public are subject to a lower fixed tax rate of \$2.04 per acre, whereas closed properties are subject to a \$10.20 per acre fixed rate. There is also a difference in tax rates depending on when the property was enrolled. If enrolled between 1987 and 2004, properties are taxed at \$0.74 per acre for open land and \$1.75 for closed land. According to the simulations, the proportion of land enrolled in these MFL categories correlated with a township's sensitivity. Townships with a higher proportion of open land that was enrolled before 2005 tend to be the ones most sensitive to changes in further enrollment, having higher changes in tax levy. With such a reduced tax rate, pre-2005 open enrollments resulted in a greater shift in the tax burden, as more tax revenue would need to come from the remaining properties in the tax base to offset the reduced revenue coming from the enrolled properties. Closed lands enrolled after 2005 had the opposite correlation, where a higher proportion of closed properties correlated with a lower change in tax levy for the townships. These properties pay a much higher tax rate than MFL properties in the other categories, and for some townships this rate is even greater than what the non-enrolled properties are being levied. For example, in Sanborn township in Ashland County the average tax levy per acre on non-enrolled properties is \$2.03 per acre. In these instances, closed MFL properties are paying even more in taxes than the non-enrolled properties, which would make sense why higher enrollment would

end up aiding the townships making them less sensitive to further changes in enrollment. Sanborn township was even seen to experience a reduction in its tax rate with increasing enrollment in the closed category (Table 9). Interestingly the proportion of open MFL land enrolled after 2005 does not have any correlation with a township's change in tax levy (Table 10). With the reduced rates on open land in general, the scenario where 100% of the increasing enrollment occurred in the open category was seen to have the highest changes in tax levy for the average township (Fig. 7). Though based on the correlations, the proportion of open land enrolled before 2005 has a greater influence on a township's sensitivity to further increases in enrollment than the open land enrolled after 2005. This is most likely due to the much lower rates that are levied on pre-2005 open properties. It makes sense that the shifting of the tax burden in a township would be more influenced by its proportion of open lands that were enrolled before 2005 than of any other category, as more revenue is lost from those enrolled properties. For some townships as well the tax rate levied on open lands enrolled after 2005 is not much different from the current average tax levy per acre on non-enrolled properties, such as is the case for Sanborn township. This could also explain why the proportion of those enrolled properties does not have a significant relationship with a township's sensitivity.

For Michigan different scenarios were simulated with different assumed taxable values of forested property before being enrolled into the program. The correlations were the same across differing taxable values, showing that the relationship between increasing enrollment and change in tax levy is the same no matter what the taxable value is. The sensitivity analysis, however, shows higher average changes in tax levy with higher valued properties than with lower valued properties. This is logical, as the townships would experience a greater loss in tax revenue if the properties that were removed from the tax base were more valuable. Lower valued properties would not impose as great a loss, and the property tax rate would not need to increase as much. In the Wisconsin analyses the actual average taxable value of forested properties was known for each township, so the values could be added to the correlation as another variable. However, for Wisconsin, the taxable value of a forested property was not seen to have a significant correlation with the townships change in tax levy.

4.3 PILT and Revenue Sharing

Federal and state lands as well are exempt from property taxes, but to make up for this loss in property taxes, they make a payment-in-lieu of taxes to the municipalities. Both the States of Michigan and Wisconsin also contribute revenue sharing payments to the municipalities to help the local governments offset any losses they may be experiencing. Both of these types of payments were accounted for in this study. In the Upper Peninsula, both the PILT and revenue sharing payments are significantly correlated with a townships change in tax levy, though the revenue sharing payments have a stronger relationship than the PILT payments (Table 6). The more help that a township receives through the revenue sharing payments, the less sensitive they are to changes in CF enrollment (Fig. 6c). The most sensitive townships had less than 10% of their revenue coming from revenue sharing payments. In Michigan, the constitutional revenue sharing program distributes revenue to the municipalities according to population, so it makes sense that the most sensitive townships, which have a lower population, would receive smaller payments. With less additional revenue, these rural, low population townships with high amounts of CF land may be even more likely to increase taxes on non-enrolled properties to make up for the loss in tax revenue from increasing enrollment. PILT payments from the federal and state lands had a positive relationship with the township's change in tax levy, though a relatively weak one. The higher the proportion of total revenue that came from PILT, the higher the township's change in tax levy. This is probably because a higher PILT payment would mean a higher acreage of land that is federal or state owned, and therefore would mean a lower available tax base in that township, making it more sensitive to changes in CF enrollment. As the PILT payments are positively correlated, it would seem that they do not provide significant aid to the townships. This may mean that the payments being currently paid are not high enough to offset the township's loss in property tax revenues. The PILT and revenue sharing payments are not significantly correlated with a townships change in tax levy in northern Wisconsin. It seems then that such payments neither aid nor cause harm to the townships, as there is no real correlation between how much additional revenue a township receives with the its sensitivity to changes in enrollment. Rickenbach and

Saunders (2009) in their study found that the more sensitive townships in Wisconsin to changes in MFL enrollment were indeed receiving a lower amount in revenue sharing payments, and they noted that the revenue sharing payments in Wisconsin were frozen at the 2003 levels and were no longer being adjusted for any future changes in the land use classifications. As our findings do not demonstrate a significant correlation between revenue sharing payments and the townships sensitivity to changes in enrollment, it may suggest that the payments are indeed not sufficient enough to offset any losses in tax revenue experienced by the townships. If the payments were providing sufficient aid to the townships it would be expected then to see the less sensitive townships receiving higher revenue sharing payments.

4.4 Realistic changes in enrollment

This study implemented hypothetical increases in forest tax program enrollment, running scenarios with a 5%, 10%, and 15% increase in enrollment. While the results presented here reflect the changes in tax levy with such levels of increase, in reality the effect may be much smaller as such increases are rarely seen on a year-to-year basis. In Michigan, enrollment in the CF program has changed slightly over the last few years. The large boom in enrollment was around 1980, and since then new enrollment acreage has steadily decreased (Fig. 9). While the number of applications has slightly increased over recent years (Fig. 10), the actual acreage enrolled has been rather minimal, though it can be seen that new acres are enrolled into the program every year (Fig. 9). According to the National Woodland Owner Survey (NWOS), enrollment of family forests in property tax programs in Michigan has increased slightly over the last few years. In 2013 fewer than 1% of family forests were enrolled in such programs, accounting for 4.8% of the acreage (Butler et al. 2016a). In 2018 family owner participation has increased to 3%, accounting for 11% of the acreage (Butler et al. 2020). According to Michigan's Department of Natural Resources, though, the change in enrollment on a yearly basis is minimal as the new acreage enrolled nearly equals the acreage that is withdrawn from the program (K. Maidlow 2020, personal communication, 9 December). For Wisconsin, family forest owner participation in property tax programs has slightly decreased by ownership, but the

actual acreage of forests enrolled has increased. According to NWOS, in 2013 about 21.8% of family forest owners were enrolled in a property tax program, accounting for 36.6% of the acreage (Butler et al. 2016b). In 2018 the acreage enrolled increased to 39%, but family ownerships decreased slightly to 21% (Butler et al. 2020). Looking at total MFL acreage, including both family forest owners and private corporations, the actual change in acreage has only slightly increased by around 1% every year (Table 11) (Wisconsin Department of Revenue, 2019). When properties are withdrawn from the program they are required to pay a withdrawal fee which goes to the municipalities, to make up for the property taxes that have not been being paid on the property. This study did not consider decreasing enrollment and did not include withdrawal penalties as a source of revenue for the townships, as the amount paid depends on several factors including how long the property was enrolled in the program and the property's acreage. However, this additional source of revenue would help to mitigate any losses in tax revenue from the properties that are enrolled in the townships, and may help to reduce the shift in the tax burden.

While the average township may be only minimally affected by increasing enrollment, it is clear that this affect is not uniform across all the townships and some are much more sensitive. In the Upper Peninsula, Baraga and Keweenaw Counties in particular are both noted for their large percentages of land being held in the CF and other conservation programs, and in Baraga County local citizens have expressed their concerns over the county's declining tax base, due to the large enrollment of land in the CF program, and the townships' ability to generate revenue (Drue, 2021). The results of this study show that these concerns are legitimate, as enrollment in forest tax programs can cause property tax rates to increase on non-enrolled properties, particularly more so in rural townships with a smaller available tax base, such as those in Baraga and Keweenaw Counties in Michigan.

4.5 Study limitations

4.5.1 *Other preferential tax programs*

This study focused only on two forest tax programs, CF in Michigan and MFL in Wisconsin, but there are other preferential tax programs that offer reduced property taxes, such as the Qualified Forest Program in Michigan, as well as conservation trusts where the enrolled properties are completely exempt from paying taxes. These other programs were not taken into consideration in this study, but may have an effect on a township's property tax rate as enrollment would further reduce the tax base and cause shifts in the tax burden. Rickenbach and Saunders (2009) found that the more sensitive townships in Wisconsin to changes in MFL enrollment also were townships that had more land enrolled in the Agricultural Forest classification, a program that also reduces property taxes for qualifying properties. Michigan also has a Qualified Agricultural classification where qualifying agricultural properties can be exempt from certain local school operating taxes up to 18 mills. However, future research is needed to determine how these other tax reduction programs may be affecting the local municipalities and to study if there is more or less of a tax reduction compared to the CF and MFL forest tax programs.

4.5.2 *Benefits of forest tax programs*

This study did not take into account the benefits of forest tax programs. Forests provide multiple ecosystem services, including timber, protection of wildlife habitat, and recreational opportunities, especially for the CF and open MFL properties which are open to the public for hunting and other recreational activities. These programs also require the enrolled properties to conduct timber harvests, which makes forestry related industries an important contributor to the local economy, Wisconsin in particular being ranked second out of the top ten states nationwide where a large percentage of its GDP is attributed to forestry related industries, contributing about 5% (Pelkki and Sherman, 2019). Forestry is an important contributor to the economy in the Upper Peninsula. For example, in the

Western region of the Upper Peninsula, the forestry industry accounts for 14% of labor income, 13% of employment, and 16% of output, while the Eastern region contributes 3% of labor income, employment, and output (Leefers, 2016). The forest products industry is the leading manufacturer employer in the Eastern Region, and in the Western region accounts for over one third of manufacturing jobs (Leefers, 2016).

Forests can also indirectly affect the local economy in ways other than through the forest products industries. For instance, private forests open for public recreation promote tourism, which contributes to local businesses. Conservation of large tracts of forested land increases the aesthetic appeal of an area, furthering the appeal for both the tourists and the local citizens. In Michigan's Upper Peninsula and Northern Wisconsin regions, forests enrolled in the USDA Forest Legacy Program, which is a federal conservation program, were found to contribute about \$6.9 million in total output in the recreation industry, as well as about \$138 million in output in the timber industry, including both direct and secondary effects (Murray et al., 2018). While forest tax programs can reduce a township's tax base and cause property tax rates to increase on non-enrolled properties, these programs also help to conserve forests and to prevent them from converting to non-forest use and development. The benefits received from forests could help to mitigate any negative effects felt by the townships, particularly in the more sensitive and rural townships. Future research is needed to consider the economic contributions of forest tax programs, particularly in rural municipalities, to determine if the benefits outweigh the costs of enrollment in these forest tax programs.

4.5.3 Short-term vs long-term trends

It is also important to note that this study is based upon only one year of tax data, and does not show the effects that enrollment has on the property tax rates over a long period of time. In a study by King and Anderson (2004) on the effects of conservation easements, they found that in the short-term program enrollment did cause an increase in property tax rates for non-enrolled properties, but in the long-term, municipalities were able to reduce property tax rates due to an increase in the values of properties surrounding the protected areas. Tax bills were still higher on these surrounding

properties, due to their higher value, but the tax rate being levied on the properties was lower. This study shows that enrollment in the MFL and CF programs can cause property tax rates to increase, but the long-term effects have not been well studied. For Wisconsin at least, it may be that on the long-term the effects have lessened, due to an increase in value of properties surrounding the MFL forests. In Michigan this may not matter as much, due to the capping of the rate of taxable value increase on properties.

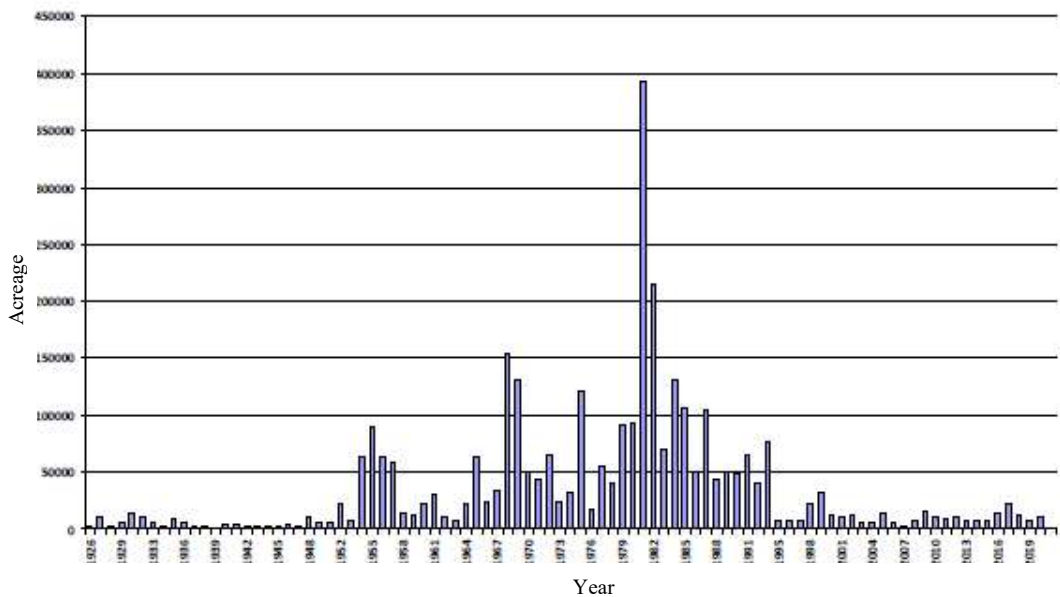


Figure 9: Acreage enrolled in Commercial Forest program from 1926-2020 (K. Maidlow 2021, personal communication, 25 February)

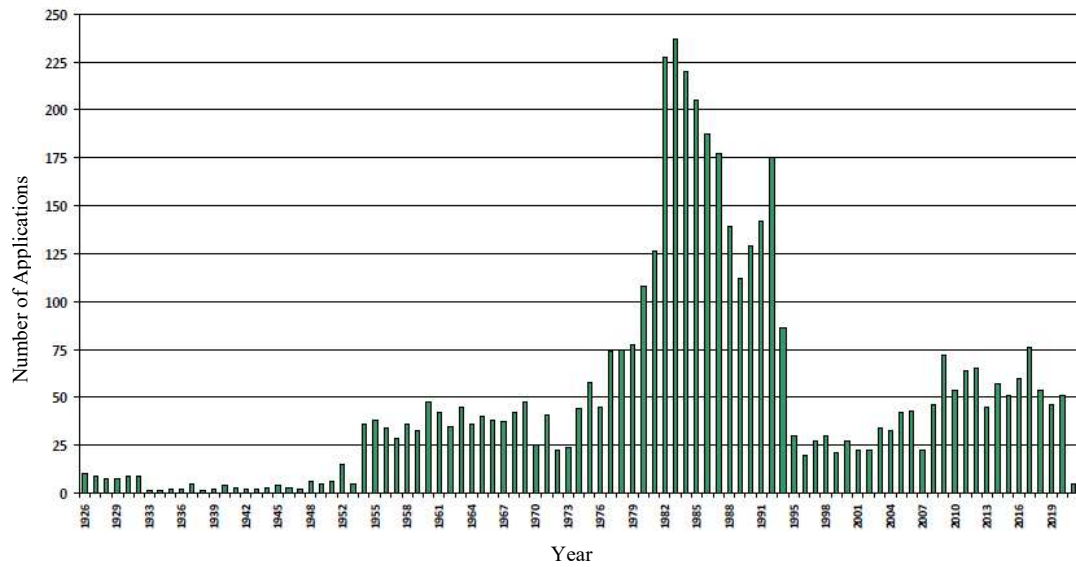


Figure 10: Number of applications per year for the Commercial Forest program 1926-2020 (K. Maidlow 2021, personal communication, 25 February)

Table 11: Change in MFL acres from 1990-2018

| Year | Total MFL Acres | % Growth |
|------|-----------------|----------|
| 1990 | 372,102 | NA |
| 1995 | 804,269 | 116.14% |
| 2000 | 1,971,474 | 145.13% |
| 2005 | 2,784,889 | 41.26% |
| 2010 | 3,079,985 | 10.60% |
| 2011 | 3,133,534 | 1.74% |
| 2012 | 3,195,894 | 1.99% |
| 2013 | 3,236,030 | 1.26% |
| 2014 | 3,271,936 | 1.11% |
| 2015 | 3,305,206 | 1.02% |
| 2016 | 3,316,955 | 0.36% |
| 2017 | 3,344,858 | 0.84% |
| 2018 | 3,378,413 | 1.00% |

(Wisconsin Department of Revenue, 2019)

5 Conclusion

The purpose of this study was to assess the implications of increasing enrollment in the Commercial Forest and Managed Forest Law forest tax programs on non-enrolled property tax rates in Michigan's Upper Peninsula and northern Wisconsin. Based on the hypothetical scenarios in which program enrollment increased 5%, 10%, and 15%, the enrollment increases required townships to increase property tax rates to maintain revenues, thereby shifting the tax burden onto the non-enrolled properties. In general, the magnitude of this increase appears to be rather minimal for the average township, especially considering that actual increases in enrollment are likely much lower than the simulated increases that were used for this analysis. Overall, rural, less populated townships with a small available property tax base appear to be most sensitive to changes in program enrollment, experiencing higher tax rate increases. Additional revenue from the state and federal governments through revenue sharing and PILT payments do not seem to be adequately aiding the townships in helping to mitigate shifts in the tax burden. In Michigan, the more sensitive townships were seen to receive the lowest amount of revenue from the revenue sharing program, demonstrating that these payments from the state are not distributed according to the specific needs of the township. In view of these results, the forest tax programs and the states may need to consider making policy changes to better address variability in the effects on townships and to help lessen the burden of the tax shift on the non-enrolled properties.

5.1 Policy considerations

- States reimburse the townships at differing levels, with regards to the sensitivity of each township

It is evident that state aid to the townships through its reimbursement payments for enrolled properties and its revenue sharing programs may not be sufficiently aiding the townships that are most sensitive to changes in program enrollment. To acknowledge this disparity, the reimbursement payments for the forest tax programs from the state could be altered such that townships are reimbursed according to their specific needs. Currently

both states reimburse at a flat rate across all townships, but a possible change could be considered such that the reimbursement rate is more dependent on the population and size of the township's tax base. More sensitive townships with low population and a smaller tax base could be reimbursed at higher rates than less sensitive townships with a larger tax base. With this policy change the tax rate levied on enrolled properties may be able to stay the same, as adjusting the reimbursement payments may be sufficient to lessen township sensitivity. State reimbursement rates may also need to change on an annual basis to reflect any changes in enrollment that occur. Similar policy changes should possibly be considered for the states revenue sharing programs as well, so that more revenue is being distributed to the townships with lower populations. However, it is unlikely that this policy will change for Michigan as its part of the state constitution, which places more importance on the reimbursement payments from the state.

- CF and MFL programs increase the tax rate on enrolled properties

It may be necessary for the CF and MFL program administration to consider increasing the tax rates in general that are levied on enrolled properties. Reduced taxes are a main incentive for these types of programs, but it may be that the current tax rates are set too low. Higher tax rates that are still lower than what the normal taxpayer is levied may help to lessen the burden of the tax shift. In fact, a recent news report indicated that Michigan's 38th District State Senator, Ed McBroom, is working to try and raise the CF program's tax rate on the enrolled properties and to have conservancies pay higher taxes on the properties that are locked in preservation (Drue, 2021). For the MFL program in particular, it may be beneficial to consider increasing the tax rates levied on enrolled properties, especially the open MFL properties that were enrolled prior to 2005, as it was this enrollment category that most influenced Wisconsin township sensitivity. However, since properties that enroll in the MFL program sign up with either a 25- or 50-year contract, it may not be possible for the program to change its policy and increase the tax rates levied on those properties.

- Incorporate a variable tax rate on enrolled properties

Another consideration is for the tax rate levied on enrolled properties to be based on the average property's taxable value for that particular township, or on the actual property's taxable value rather than having a flat rate tax applied across the state. This would be more tailored to the individual township, better accounting for the differences in sensitivity across the townships. However, this would add complexity to the programs, and may be a deterrent to landowners enrolling in the program. These programs provide many benefits, such as its preservation of forested land, and as much as they can cause a negative implication to the property tax revenues in a township, it is also desired for enrollment to increase.

- Incorporate different tax rates for corporate/industrial landowners and family forest owners

Another consideration for the forest tax programs is to incorporate different tax rates for different types of landowners, possibly having higher tax rates on corporate/industrial lands than for family forest landowners. Only about 902 acres of family forests in Michigan and 3,543 acres of family forests in Wisconsin are currently enrolled in a property tax program (Butler et al. 2020). Considering how about 2.2 million acres are currently enrolled in the Commercial Forest program (Michigan Department of Natural Resources, 2020), and 3.4 million acres are enrolled in the Managed Forest Law program (Wisconsin Department of Natural Resources, 2020c), it can be assumed that most private forestland enrolled in these programs are owned by industrial or corporate landowners. It may help to lessen the township sensitivity if these lands were taxed at a higher rate. By only increasing the tax rate on industrial/corporate properties it would allow it to stay at its current reduced rate for enrolled properties owned by family forest owners, and would continue to act as an incentive to encourage family forest owners to enroll in the programs.

- Including a closed option for properties enrolled in CF program

It is also worth considering whether the CF program should offer an option for the landowners to keep their land closed to the public, at the expense of a higher tax rate than if they were to keep it open to the public. For the MFL program, a higher proportion of

closed properties helped to lessen the townships' sensitivity, due to the higher amount of taxes that were being paid from those properties. The most sensitive townships were the ones with a higher proportion of properties that were kept open to the public, particularly if they were enrolled before 2005 and paying the more reduced tax rate. Offering a closed option for the CF program may similarly help to lessen township sensitivity in the Upper Peninsula and help to mitigate the shift in the tax burden felt by the non-enrolled properties. However, offering such an option may also lead to an increase in program enrollment, particularly by family forest owners who may want to keep their properties closed to public recreational access. While it may be desired to promote further enrollment, a sudden increase in enrollment may also have more negative implications than positive, resulting in a greater shift in the tax burden despite the positive effects from the higher tax fees on closed lands. While theoretically there is a closed option for landowners to be found in the Qualified Forest Program, future research is needed to determine the difference in tax rates between this program and the Commercial Forest program, and to determine whether offering a closed option for the Commercial Forest program is worth considering.

In conclusion, forest tax programs at simulated levels of increased enrollment can have negative effects on rural township property tax rates, and these effects differ among townships. Rural townships that have a high percentage of land enrolled in forest tax programs are most sensitive to increased enrollment, resulting in greater increases in tax rates for non-enrolled property. However, the shifting tax burden associated with forest tax programs is only one side to the issue. This study only focused on the costs of these programs to local municipalities. It is important to also consider the benefits of these programs, through active forest management, preservation of large tracts of forested land, and public access. Future research is needed to study the economic benefits that these programs provide, to whom the benefits accrue, and to study if the benefits outweigh the costs of these programs.

6 Reference List

- Aguilar, F.X., Kelly, M.C., and Danley, B., 2019. Total economic value, ecosystem services and the role of public policy instruments in the creation and destruction of forest values. In: Hujala, T, Toppinen, A, and Butler, B. *Services in Family Forestry*. World Forests 24. Springer, Cham. https://doi.org/10.1007/978-3-030-28999-7_6
- Brighton, D., 1993. Forestland, current use, and local property taxes. *Prop. Tax J.* 12 (4), 373-380.
- Butler, B.J., Catanzaro, P.F., Greene J.L., Hewes, J.H., Kilgore, M.A., Kittredge, D.B., Zhao, M., and Tyrell, M.L., 2012. Taxing family forest owners: implications of federal and State policies in the United States. *J. For.* 110 (7), 371-380.
- Butler, B.J., Hewes, J.H., Dickinson, B.J., Andrejczyk, K., Butler S.M., and Markowski-Lindsay, M., 2016a. Family forest ownerships of the United States, 2013: findings from the USDA forest service's national woodland owner survey. *J. For.* 114 (6), 638-647.
- Butler, B.J., Hewes, J.H., Dickinson, B.J., Andrejczyk, K., Butler, S.M., and Markowski-Lindsay, M. 2016b. USDA Forest Service National Woodland Owner Survey: national, regional, and State statistics for family forest and woodland ownerships with 10+ acres, 2011-2013. *Res. Bull. NRS-99*. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station.
- Butler, B.J., Butler, S.M., Caputo, J., Dias, J., Robillard, A., and Sass, E.M. 2020. Family forest ownerships of the United States, 2018: Results from the USDA Forest Service, National Woodland Owner Survey. *Gen. Tech. Rep. NRS-199*. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station. 56 p. <https://doi.org/10.2737/NRS-GTR-199>
- Chamberlin, R., 1993. The costs and benefits of differential assessment programs in the northern forest region. *Prop. Tax J.* 12 (4), 341-371.
- Coogan, D., Bell, M., and Brunori, D., 2014. A note on the distributional consequences of use value assessments. *Public Financ. Manage.* 14 (2), 118-132.
- Cubbage, F., Harou, P., and Sills, E., 2007. Policy instruments to enhance multi-functional forest management. *For. Policy Econ.* 9, 833-851.
- Daigneault, A.J., Sohngen, B.L., and Sedjo, R. 2020. Carbon and market effects of U.S. forest taxation policy. *Ecol. Econ.* 178, 106803. <https://doi.org/10.1016/j.ecolecon.2020.106803>

- Drue, B. 2021. Legislative reps visit L'Anse: hear from constituents, local officials. The L'Anse Sentinel, 17 February, pg. 1A, 3A.
- Dunford, R.W., and Marousek, D.C., 1981. Sub-County property tax shifts attributable to use-value assessments on farmland. *Land Econ.* 57 (2), 221-229.
- Fortney J., and Arano, K.G., 2010. Property taxes and forests in West Virginia: a historical review. *Small-scale For.* 9, 67-80.
- Frey, G.E., Meier, J.T., Kilgore, M.A., Snyder, S.A., and Blinn, C.R., 2019. Factors associated with family forest landowner enrollment in State preferential forest property tax programs in the United States. *Land Use Policy* 89, 104240.
- Ganz, A., 2014. The property tax lag. <https://opengov.com/article/the-property-tax-lag> (accessed 31 July 2020).
- Gruber, J., 2019. *Public finance and public policy*, sixth ed. Worth Publishers, New York.
- Hamel, J., MacKay, M., Price, D. L., and Jones, S. L., 2013. Western Upper Peninsula regional State forest management plan. Michigan Department of Natural Resources. https://www.michigan.gov/dnr/0,4570,7-350-79136_79237_80916_85456---,00.html (accessed 8 July 2020).
- Hibbard, C., Kilgore, M.A., and Ellefson, P.V., 2003. Property taxation of private forests in the United States: a national review. *J. For.* 10 (3), 44-49.
- Kagan, J., 2020. Property taxes guide: mill rate. <https://www.investopedia.com/terms/m/millrate.asp> (accessed 11 August 2020).
- Kelly, M.C., Germain, R.H., and Mack, S.A., 2016. Forest conservation programs and the landowners who prefer them: profiling family forest owners in the New York city watershed. *Land Use Policy* 50, 17-28.
- Kilgore, M.A., Greene, J.L., Jacobson, M.G., Straka, T.J., and Daniels, S.E., 2007. The influence of financial incentive programs in promoting sustainable forestry on the Nation's family forests. *J. For.* 105 (4), 184-191.
- Kilgore, M.A., Ellefson, P.V., Funk, T.J., and Frey G.E., 2018a. State property tax programs promoting sustainable forests in the United States: a review of program structure and administration. *J. For.* 116 (3), 257-265.
- Kilgore, M.A., Ellefson, P.V., Funk, T.J., and Frey, G.E., 2018b. Private forest owners and property tax incentive programs in the United States: a national review and

- analysis of ecosystem services promoted, landowner participation, forestland area enrolled, and magnitude of tax benefits provided. *For. Policy Econ.* 97, 33-40.
- King, J.R., and Anderson, C.M., 2004. Marginal property tax effects of conservation easements: a Vermont case study. *Am. J. Agric. Econ.* 86 (4), 919-932.
- Leefers, L. A., 2016. Forest products industries' economic contributions to Michigan's regional economies 2016 update. Michigan Department of Natural Resources. https://www.michigan.gov/dnr/0,4570,7-350-79136_79237_80943_85943---,00.html (accessed 10 July 2020).
- Locke, C.M., and Rissman, A.R., 2012. Unexpected co-benefits: forest connectivity and property tax incentives. *Landsc. Urban Plan.* 104, 418-425.
- Ma, Z., Butler, B.J., Kittredge, D.B., and Catanzaro, P., 2012. Factors associated with landowner involvement in forest conservation programs in the U.S.: implications for policy design and outreach. *Land Use Policy* 29, 53-61.
- Managed Forest Land, Wis. Stat. § 77.80 *et seq.* (2021).
<https://docs.legis.wisconsin.gov/statutes/statutes/77/vi/80>
- Matson, K., MacKinnon, S., Price, D.L., and Jones, S.L., 2013. Eastern Upper Peninsula regional State forest management plan. Michigan Department of Natural Resources. https://www.michigan.gov/dnr/0,4570,7-350-79136_79237_80916_85456---,00.html (accessed 8 July 2020).
- Meier, J.T., Kilgore, M.A., Frey, G.E., Snyder, S.A., and Blinn, C.R., 2019. A comparison of participants and non-participants of State forest property tax programs in the United States. *F. Policy Econ.* 102, 10-16.
- Michigan Department of Natural Resources. 2018. Commercial forest summary. https://www.michigan.gov/dnr/0,4570,7-350-79136_79237_80945_83262---,00.html (accessed 17 July 2020).
- Michigan Department of Natural Resources. 2020. Commercial forest lands. https://www.michigan.gov/dnr/0,4570,7-350-79119_79147_81529_82010_82074---,00.html (accessed 20 July 2020).
- Michigan Department of Treasury, (n.d.). Constitutional revenue sharing. https://www.michigan.gov/treasury/0,4679,7-121-1751_2197_58826_62375---,00.html (accessed 30 July 2020).
- Murray, H., Catanzaro, P., Markowski-Lindsay, M., Butler, B., and Eichman, H. 2018. Economic contributions of land conserved by the USDA forest service's forest legacy program. USDA Forest Service.

https://www.fs.usda.gov/sites/default/files/media_wysiwyg/flp-economiccontributionsreportfullresolution.pdf (accessed 20 March 2021).

Natural Resources and Environmental Protection Act of 1994, 451 Mich. Comp. Laws § 324.511 *et seq.* (2018). <http://legislature.mi.gov/doc.aspx?mcl-451-1994-III-2-4-TAX-INCENTIVES-511>

Nyland, R.D., Kenefic, L.S., Bohn, K.K., and Stout, S.L. 2016. *Silviculture: concepts and applications*, third ed. Waveland Press Inc., Illinois.

Pelkki, M., and Sherman, G. 2019. Forestry's economic contribution in the United States, 2016. *For. Prod. J.* 70 (1), 28-38.

Pugh, Scott A. 2018. *Forests of Michigan, 2017. Resource Update FS-153*. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 4 p. <https://doi.org/10.2737/FS-RU-153>.

Richard, L. (n.d.) What is the difference between assessed value and taxable value of real eState? <https://budgeting.thenest.com/difference-between-assessed-value-taxable-value-real-eState-23124.html> (accessed 11 August 2020).

Rickenbach, M., and Saunders, L., 2009. The managed forest law and property tax revenues for townships: a study of enrollment shifts and local impacts. UWEX Cooperative Extension Service GWQ52 & Wisconsin Department of Natural Resources PUB-FR-432 2009.

Schuster, R., Law, E.A., Rodewald, A.D., Martin, T.G., Wilson, K.A., Watts, M., Possingham, H.P., and Arcese, P., 2018. Tax shifting and incentives for biodiversity conservation on private lands. *Conserv. Lett.* 11 (2), 1-7.

Serbruyns, I., and Luyssaert, S., 2006. Acceptance of sticks, carrots, and sermons as policy instruments for directing private forest management. *F. Policy Econ.* 9, 285-296.

Seabury, C. (2020, April 6). How Property Taxes Are Calculated. <https://www.investopedia.com/articles/tax/09/calculate-property-tax.asp> (accessed 11 August 2020).

Sexton, T.A., 2003. The property tax base in the United States: exemptions, incentives, and relief. *Assess. J.* 10 (4), 5-33.

Sexton, T.A., 2014. Property tax expenditures: classified property tax systems. *Public Financ. Manage.* 14 (2), 221-244.

- State of Michigan. (n.d.) 2018 625 Ad valorem property tax report.
https://www.michigan.gov/documents/taxes/2018_625_Ad_Val_Tax_Levy_Report_648625_7.pdf (accessed 15 September 2019).
- U.S. Census Bureau. 2018a. Mean income in the past 12 months (in 2018 inflation-adjusted dollars), 2010-2018 American Community Survey.
https://data.census.gov/cedsci/table?q=median%20income%20for%20ashland%20County%20wisconsin&g=0500000US55003_0100000US&tid=ACSST5Y2018.S1902&t=Income%20%28Households,%20Families,%20Individuals%29&layer=VT_2018_050_00_PY_D1&cid=S1901_C01_001E&vintage=2018&hidePreview=true (accessed 16 July 2020).
- U.S. Census Bureau. 2018b. Total population, 2010-2018 American Community Survey.
https://data.census.gov/cedsci/table?g=0500000US55003_0100000US&hidePreview=true&tid=ACSDT5Y2018.B01003&layer=VT_2018_050_00_PY_D1&cid=DP05_0001E&vintage=2018 (accessed 16 July 2020).
- U.S. Department of the Interior, (n.d.). Payments in lieu of taxes.
<https://www.doi.gov/pilt> (accessed 30 July 2020).
- van den Berg, R.G. (n.d.) Kendall's tau: simple introduction. <https://www.spss-tutorials.com/kendalls-tau/> (accessed 19 March 19, 2021).
- Wisconsin Department of Natural Resources, 2017. Wisconsin's managed forest law: a program summary. (PUB-FR-295).
<https://dnr.wi.gov/topic/ForestLandowners/mfl/#:~:text=The%20Managed%20Forest%20Law%20%28MFL%29%20program%20is%20a,forest%20management%2C%20the%20landowner%20pays%20reduced%20property%20taxes.> (accessed 17 July 2020).
- Wisconsin Department of Natural Resources, 2018. Wisconsin forest management guidelines (DNR PUB-FR-226).
<https://dnr.wi.gov/topic/ForestManagement/guidelines.html> (accessed 15 July 2020).
- Wisconsin Department of Natural Resources. 2020a. Wisconsin's forest resources.
<https://dnr.wisconsin.gov/topic/forestbusinesses/publications> (accessed 15 July 2020).
- Wisconsin Department of Natural Resources. 2020b. Wisconsin's forest products industry. <https://dnr.wisconsin.gov/topic/forestbusinesses/publications> (accessed 15 July 2020).
- Wisconsin Department of Natural Resources. 2020c. Managed forest law: 2020 acreage summary report by municipality. (M3A2-ML).
<https://dnr.wi.gov/topic/ForestLandowners/reports.html> (accessed 20 July 2020).

Wisconsin Department of Revenue, 2019. Forest tax laws.
<https://www.revenue.wi.gov/DORReports/forest-2019.pdf> (accessed 4 March 2021).

Wisconsin Department of Revenue, 2020. Guide for property owners.
<https://www.revenue.wi.gov/DOR%20Publications/pb060.pdf> (accessed 27 January 2021).

A Houghton County Timber Cutover Assessment

The assumed taxable values of forested property that were used for the hypothetical scenarios for Michigan were derived from actual taxable values of forested properties 40 acres or greater and classified as timber cutover land in Houghton County. The average taxable value was \$199 per acre, with a range between \$21 and \$1,225 taxable value per acre (Table A1).

Table A1: Descriptive Statistics for Timber Cutover Land 40+ acres in Houghton County

| | Mean | Std. Dev. | Min | Max | N |
|----------------------------------------|-------------|------------------|------------|------------|----------|
| Taxable Value (\$ per acre) | 199 | 176.71 | 21 | 1,225 | 536 |
| Acres | 75 | 50.11 | 40 | 480 | 536 |

B Copyright Documentation

Figures 1 and 2 are licensed for reuse under Springer Nature Customer Service Centre GmbH. See below for full citation information.

Figures 1 and 2 taken from:

Aguilar, F.X., Kelly, M.C., and Danley, B., 2019. Total economic value, ecosystem services and the role of public policy instruments in the creation and destruction of forest values. In: Hujala, T, Toppinen, A, and Butler, B. Services in Family Forestry. World Forests 24. Springer, Cham. https://doi.org/10.1007/978-3-030-28999-7_6

Licensed under Springer Nature Customer Service Center GmbH:
<https://s100.copyright.com/CustomerAdmin/PLF.jsp?ref=32397637-f98d-4183-8e0b-e0918f7107ce>