

Research paper

Factors influencing zoning ordinance adoption in rural and exurban townships



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HIGHLIGHTS

- Socioeconomics better predicted zoning adoption than diffusion or natural resources.
- Proactive local planning is an important precursor to zoning adoption.
- Many townships waited to zone until development was well underway.
- Informal controls may be insufficient to address unexpected development.

ARTICLE INFO

Article history:

Received 8 January 2014

Received in revised form

30 September 2014

Accepted 2 October 2014

Keywords:

Zoning

Policy adoption

Local government

Land use

Private land

Planning

ABSTRACT

Though 70% of land in the contiguous U.S. is privately owned, land conservation discourses have focused more on public protected areas than on private land policy. U.S. private land policy is generally implemented by local governments through comprehensive plans and zoning ordinances. While most cities have adopted these policies many non-metropolitan jurisdictions remain unzoned. In this study we investigated factors predicting zoning adoption in rural and exurban Michigan townships. Results from a logit model showed that likelihood of zoning adoption between 1998 and 2003 was higher for townships with more developed land, fewer conservative voters, higher household income, more zoned neighbors, and township-level planning rather than county-level planning. We quantified thresholds at which development levels correlated with zoning adoption. Overall, townships had greater than a 50% probability of adopting zoning when 9% or more of their land base had been developed, but this threshold was higher in townships with no planning (12%) and highest where planning was implemented at the county level (19%). In high-growth townships forestland was negatively correlated with zoning adoption. However, model results showed socioeconomic variables to be better predictors of zoning adoption than natural resource variables. These results highlight the importance that planning and zoning occur at the same level of government, and the importance of multiple policy options in jurisdictions unlikely to adopt zoning. Gaining insight into reasons for land-use policy adoption, or lack thereof, is important for achieving common planning goals, including preserving rural livelihoods, conserving forests and farmlands, and maintaining rural landscape characteristics.

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1. Introduction

Rural landscapes are important providers of resource production, recreation, wildlife habitat, water quality, and aesthetics. Because these qualities can be drastically altered by development, tools for growth management in rural areas deserve attention (Marcouiller, Clendenning, & Kedzior, 2002; Rudel, 1989). Zoning

is the most widely used policy tool for regulating land use in the U.S. (Daniels, 1997), where it is implemented by local governments at the county and municipal levels. However, regulating land use is typically voluntary and local governments vary in their decisions to adopt zoning. Adopting growth control measures gained popularity during the “supercharged” housing booms of the 1970s, 1980s, and 1990s (Neiman & Fernandez, 2000). As of the late 2000s, however, many rural and exurban jurisdictions were still holding out on adopting land-use regulations. Although 97% of developable land area in the U.S. is considered rural (<6 housing units/sq. km) or exurban (6 to 147 housing units/sq. km) (Theobald, 2005), very little policy research has focused on non-metropolitan jurisdictions and why they do or do not regulate land use.

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Table 1
Definitions of study variables, associated hypotheses and data sources.

Variable	Description	Hypothesis	References	Data Sources
Motivation: development and population				
Housing	Number of housing units per land area, 1990	Townships with higher housing density will be more likely to adopt zoning.	Allen, Moorman, Peterson, Hess, and Moore, (2013), Feiock et al. (2008), Hawkins (2014), Heimlich and Anderson (2001), Howell-Moroney (2008), Neiman and Fernandez (2000), Stedman (2003), Theobald (2005), Tilt et al. (2007)	U.S. Census Bureau (1991, 2001), Minnesota Population Center (2011)
Housing and population growth rates	Population and housing growth rates, 1990–2000	Higher population or housing growth will be associated with higher probabilities of zoning adoption.	"	"
% Land developed	% private land area that has been developed; includes low, medium, and high density development	Townships with more developed land area will be more likely to adopt zoning.	"	National Land Cover Dataset (NLCD) 2001 (Homer et al., 2007)
Distance to urban area (km)	Distance (km) to nearest urbanized area (pop. > 50,000)	Less remote townships will be more likely to zone	"	U.S. Census Bureau (2001)
Motivation: socio-political				
Income (\$1000s)	Median household income in 1999	Wealthier townships will be more likely to adopt zoning.	Allen et al. (2013), Feiock et al. (2008), Marcouiller et al. (2002), Morgan and Watson (1991), Howell-Moroney (2008)	U.S. Census Bureau (1991, 2001)
House value (\$1000s)	Median house value in 1990	"	"	"
Conservative voting and voting variability	Mean % votes cast for conservative (Republican or US Taxpayers Party) candidates in gubernatorial and presidential elections 1998–2010 and the standard deviation of this variable	Townships with consistently conservative voting patterns will be less likely to zone.	Kahn (2011)	Mich. Dept. of State (2001–2013)
Motivation: natural resources & amenities				
% Public land	% land in federal, state, or local government ownership	Public lands and lakes attract development, and forests and farmlands represent natural commodities. Townships with more of these resources will be more likely to adopt zoning if they are experiencing high rates of housing growth.	Radeloff et al. (2010); Schnaiberg, Riera, Turner, and Voss (2002)	PAD-U.S. (USGS, 2010)
% Forest	% private land that is forestland	"	Edwards and Haines (2007), Hawkins (2014), York and Munroe (2010)	NLCD 2001 (Homer et al., 2007)
% Farmland	% private land that is farmland	"	"	"
Lake shoreline (km)	Total length of lakefront (Great Lakes and inland lakes)	"	Butsic et al. (2010); Gonzalez-Abraham et al. (2007); Schnaiberg et al., (2002)	Mich. Dept. of Natural Resources (Breck, 2004)
% Houses seasonal	% of total housing units that were classified seasonal or recreational in 1990	This measure will serve as a proxy for amenity value; townships with more seasonal homes will be more likely to zone.	"	U.S. Census Bureau (1991)
Capital resources				
Fiscal	Ratio of revenues minus expenditures to expenditures in 2001	Townships in positive fiscal standing will be more likely to zone.	Berry and Berry (1990), Gray (1973), Satterthwaite (2002), Walker (1969)	Mich. Dept. of Treasury (2001–2013), U.S. Census Bureau (2001)
Tax levy	Per capita property tax levies by township, 2000	Townships with higher tax revenue will be more likely to adopt zoning.	"	"
Other policies				
County and township policies	Land-use policies (other than zoning) present at county and township levels	Townships less likely to adopt zoning where more non-zoning land-use policies are in place.	Berry and Berry (2007)	IPPSR (2004)
Any plan	Presence of any comprehensive plan at the township or county level, or both	Townships where plans are present will be more likely to zone than those without plans.	Burby and Dalton (1994), Norton (2008)	"
County plan	Presence of a comprehensive plan at the county level	"	"	"
External				
Neighbors (Diffusion)	Percent of neighboring townships zoned	Townships having a greater percentage of neighboring townships with zoning ordinances will be more likely to adopt zoning themselves.	Mintrom (1997), Berry and Berry (2007)	IPPSR (2004), Mich. Center for Geographic Info (2011)

Which local communities are more likely to adopt zoning? We developed hypotheses about development, population, sociopolitical, and natural resources motivations, capital resources, and diffusion effects that might influence zoning adoption (Table 1). Based on these hypothesized relationships, we constructed a logit model to distinguish zoning adopters and non-adopter townships in Michigan, USA. We found socio-economic indicators like political leaning and household income to be better predictors of zoning adoption than natural resources like lakes and public protected areas that are known to be important attractors of development in rural and exurban areas (Gonzalez-Abraham et al., 2007; Radeloff et al., 2010). We also reported thresholds of housing development at which rural and exurban jurisdictions were likely to adopt zoning—results that highlight the importance of proactive local land-use planning to protect sensitive habitats, open space, and cultural resources that may be affected by increased population and housing.

2. Background

2.1. Local land-use regulation

Land use in the U.S. is regulated primarily through zoning ordinances adopted by local governments—villages, cities, townships, and counties. Twenty U.S. states contain civil townships with organized governments apart from county or city governments. Typically, a civil township may adopt a county-wide zoning ordinance if one exists, adopt its own zoning ordinance apart from the county-wide ordinance, or remain unzoned. Zoning decisions are sometimes, but often not, guided by a township- or county-level comprehensive or master plan (Rudel, 1989). Neighboring zoned jurisdictions do not necessarily have similar zoning codes despite their close proximity, making land-use policy implementation a truly local activity (Carruthers & Ulfarsson, 2002). This local focus is a point of pride for township governments; the Wisconsin Towns Association describes townships as “among the last vestiges of direct democracy in America” (WTA, 2009). The purposes and requirements of zoning codes vary in scope and complexity by jurisdiction. Generally, zoning ordinances establish minimum lot sizes, building setback requirements, and restricted land uses in defined zones (e.g. agricultural, commercial, residential). Types of zoning that specifically address rural issues include large-lot zoning and exclusive agricultural or forestry zoning to preserve the “rural character” of an area, and cluster zoning or rural planned developments to preserve open space (Bengston, Fletcher, & Nelson, 2004).

2.2. Drivers of policy adoption: Motivations, capital resources, and diffusion

Mohr (1969, p. 114) hypothesized that policy innovation is “directly related to the motivation to innovate, inversely related to the strength of the obstacles to innovation, and directly related to the availability of resources for overcoming such obstacles.” Motivations and obstacles to policy adoption can originate internally or externally. Internal determinants are economic, social, and political characteristics of the jurisdiction that encourage or deter policy adoption or innovation (Gray, 1994). For example, housing growth and political liberalism have been positively associated with the adoption of growth management policies by U.S. states (Howell-Moroney, 2008). In contrast, external determinants include the influences of other jurisdictions that have previously adopted the policy (diffusion), higher-level governments, or other outside groups (Berry & Berry, 2007; Gray, 1994). Hybrid models considering both internal and external determinants have been applied to adoption of lotteries (Buckley & Westerland, 2004),

health care programs (Satterthwaite, 2002), and climate change policy (Pitt, 2010), but such analysis of zoning is lacking.

A local government’s motivation to adopt land-use regulations is affected by development trends and associated demographic shifts. Adoption of growth management policies tends to be more common in wealthier municipalities where organized coalitions form to protect their land-based interests (Molotch, 1976; Rudel, 1989). Rudel (1989) applies growth machine theory (Molotch, 1976) to explain why poorer, less developed rural jurisdictions are unlikely to zone: (1) informal control networks among neighbors render formal rules unnecessary where land-use conflict is rare, (2) low land prices allow current landowners to resolve conflicts by buying land buffers between neighbors, (3) developers are local and known, and (4) residents are predominantly oldtimers (local rural workers) who stand to lose from zoning rather than exurbanites (commuting residents) who stand to gain. Some rural landowners fear that down-zoning (requiring larger lot sizes) will decrease their property values, though the effect of down-zoning on property value is positive in some cases (Liu & Lynch, 2011). Residents might also be concerned that zoning caters to outside development interests (Anderson & Sass, 2004). In rural areas where the most aggressive developer is a local farmer who subdivides his property so family members can build homes, adoption of land-use restrictions tends to be an unpopular proposal (Rudel, 1989). As urbanization brings exurbanites and extralocal developers to a rural area, adoption of rule-based growth controls like zoning becomes likely as the community changes (Rudel, 1989).

Land-use planning and zoning are important in rural areas because the first developments to arise set the stage for future growth patterns (Arendt et al., 1994). As development impinges on open space, planning options for undeveloped land uses become more limited. However, communities and government officials typically express interest in land-use controls only after developers act (Rudel, 1989). Legalistic planning procedures and “forceful leadership” are more characteristic of towns experiencing rapid versus slow growth (King & Harris, 1989), and adoption of planning and zoning to direct growth are more likely to occur in times of economic prosperity after development is already underway (Neiman & Fernandez, 2000). Hawkins (2014) found the extent of low-density development in Massachusetts towns to be correlated with the adoption of specific subdivision bylaws, but thresholds of development associated with zoning adoption have not been well documented.

Natural and scenic resources may also motivate land-use policy adoption. In areas valued for beautiful views and rural charm, changing landscape dynamics associated with suburbanization may diminish the appeal of the area to residents (Stedman, 2003; Tilt, Kearney, & Bradley, 2007). Local land-use plans commonly note the economic, recreational, and aesthetic benefits of open spaces, water bodies, forests and farmland as reasons to manage growth (Arendt et al., 1994). Because natural amenities like lakes and public lands are known to attract housing development and seasonal home growth (Butsic, Lewis, & Radeloff, 2010; Gonzalez-Abraham et al., 2007; Radeloff et al., 2010), we expect jurisdictions with abundant natural resources and large amounts of seasonal homes to be more likely to zone than those without these attributes.

Capacity and fiscal standing are often positively associated with policy adoption (Berry & Berry, 1990; Gray, 1973; Satterthwaite, 2002; Walker, 1969). Juggling potentially conflicting community goals with governmental revenue generation through property taxes is especially challenging in rural townships without the means to coordinate and adapt planning strategies (Zabik & Prytherch, 2013). Some types of zoning have been criticized for enabling social exclusion and maintaining property values for wealthy groups (Rothwell & Massey, 2009). Feiock, Tavares, and Lubell (2008) found that racial homogeneity, affluence and

education, and good fiscal health were correlated with the adoption of exclusionary growth management tools in Florida counties. The comprehensiveness and quality of local land-use plans also rely on capacity, which is often bolstered by state governments (Berke & French, 1994).

Policy adoption also depends on diffusion, the influence of nearby or similar jurisdictions that have already adopted the policy (Berry & Berry, 1990; Mintrom, 1997). Many policy diffusion studies have focused on U.S. states (Berry & Berry, 2007; Buckley & Westerland, 2004) though few have considered local governments (Pitt, 2010). Though governments may be influenced by distant but otherwise similar jurisdictions (Berry & Berry, 2007), we assume here that the sphere of influence on rural townships is primarily local and consider only neighboring townships in our measure of diffusion.

3. Methods

3.1. Study region and township selection

Michigan provides an illuminating venue for studying land-use policy. Michigan is often described as a home-rule state that emphasizes decentralized governance. In a 1980 ranking of all 50 U.S. states, Michigan ranked 16th highest in the degree of “discretionary authority” granted to local jurisdictions (Richardson, 2011). The State granted planning and zoning authority to cities, villages, townships, and counties in the 1920s and 1930s through enabling legislation. County-level zoning is rare, and the decision to regulate unincorporated areas is generally left to townships. The Michigan Townships Association reports that townships “govern over 96% of Michigan’s land area, in which over 58% of Michigan’s property values are located” (MTA, 2013). Townships across the state are diverse in terms of social and environmental dynamics, from populous suburbs outside of metro areas in the southeast to the forested rural areas of the Upper Peninsula. In a survey of local governments collected by Michigan State University’s Institute for Public Policy & Social Research in 2003, 33% of Michigan’s 1241 townships reported having no comprehensive plan and 29% reported having no zoning (IPPSR, 2004).

We used this survey and U.S. Census data to select zoned and unzoned townships in rural and exurban areas throughout Michigan (Fig. 1). To avoid time-lapse issues common in cross-sectional policy analyses (Gray, 1994), it was important for the 2003 survey and other data sources to reflect conditions near the time of the policy adoption event being analyzed. We included zoned townships if they had adopted zoning within five years of the survey, 1998–2003 ($n = 96$). Unzoned townships were included if they had not adopted zoning by 2003 ($n = 110$). Although the survey

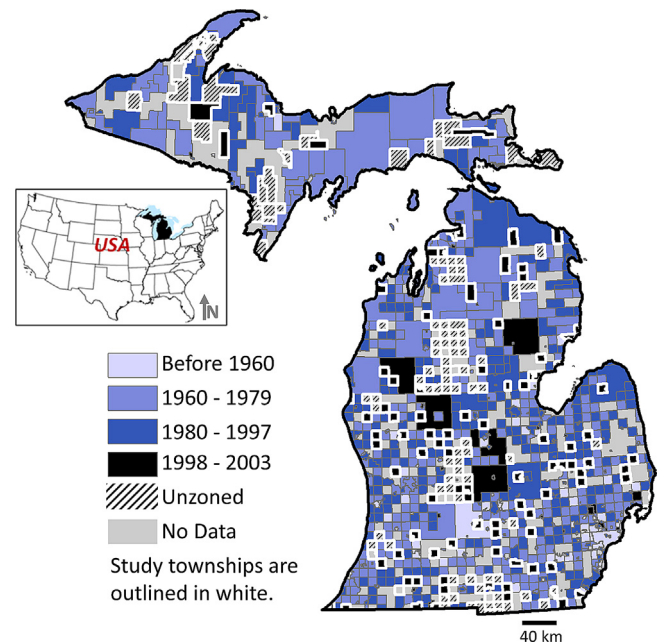


Fig. 1. Year of zoning adoption by cities, townships and counties in Michigan, USA. Data are accurate as of 2003 according to a survey conducted by Michigan State University (IPPSR, 2004).

collectors had a remarkably high response rate (93%), not all questions were answered on returned surveys. Townships without responses for zoning status or year of zoning adoption were not considered for the study. Townships under county zoning that had not adopted their own zoning ordinances were also excluded from the analysis, as were densely populated townships classified as suburban (>147 housing units/sq. km) rather than exurban (6 to 147 housing units/sq. km) or rural (<6 housing units/sq. km) based on published housing density definitions (Theobald, 2005).

Summary statistics showed that zoned study townships generally reflected the characteristics of Michigan townships as a whole, except that they were on average 17 km closer to urban areas (Table 2). Meanwhile, the “average” unzoned study township had 14.6 fewer housing units per sq. km, were 33 km further from urban areas, and had higher percentages of seasonal housing (27% vs. 20%) than the “average” Michigan township, but had comparable landcover characteristics and housing and population change rates.

3.2. Rationale for model form

Policy adoption models can be used to understand how differences among townships predict zoning adoption. Studies of policy

Table 2
Average values for attributes of study townships compared to all Michigan townships.

Variable	All townships Mean (StDev) N = 1240	Zoned study townships Mean (StDev) n = 96	Unzoned study townships Mean (StDev) n = 110
Housing density 1990 (units/km ²)	22.0 (59.7)	18.7 (21.5)	7.40 (4.60)
% Housing change 1990–2000	16.2 (14.8)	15.4 (13.1)	14.7 (13.4)
% Land developed 2001	11.2 (12.9)	10.2 (7.60)	5.80 (2.10)
% Population change 1990–2000	17.2 (20.9)	15.4 (17.5)	15.8 (17.2)
Distance to urban area	68.0 (73.9)	50.9 (65.0)	100.8 (76.7)
Median household income 1999	42.9 (12.0)	43.8 (10.5)	35.7 (6.70)
Median house value	52.2 (21.7)	52.9 (16.3)	37.5 (8.80)
% Conservative voting (Mean)	55.8 (5.50)	54.8 (5.60)	56.9 (5.20)
% Public land	13.5 (20.7)	11.8 (18.4)	15.8 (21.2)
% Forest 2001	30.1 (19.7)	26.7 (16.9)	31.6 (20.1)
% Farmland 2001	36.8 (27.2)	38.6 (25.7)	31.9 (27.9)
% Water	3.30 (8.20)	2.80 (4.40)	3.40 (15.2)
Lake shoreline (km)	35.7 (52.6)	29.6 (30.6)	30.5 (45.7)
% Houses seasonal 1990	19.7 (22.1)	17.3 (20.4)	27.1 (21.9)

Table 3Regression estimates for two general linear mixed models explaining zoning adoption by townships in Michigan, USA ($n=206$).

Variable		Full model		Parsimonious model		Order of removal (Δ Dev)
		Estimate (SE)	$\sqrt{\text{VIF}}$	Estimate (SE)	$\sqrt{\text{VIF}}$	
Development	Housing	−0.074 (0.11)	1.9			6 (0.02)
	Housing growth rate	−5.054 (3.80)	3.6			11 (1.76)
	% Land developed	0.633 (0.43)	3.3	0.440 (0.17)**	1.0	
Population	Population growth rate	0.922 (1.76)	3.2			8 (0.27)
	Distance to urban area	−0.013 (0.01)	1.8			12 (1.11)
Socio-political	Income	0.243 (0.14)	2.3	0.285 (0.09)**	1.5	
	House value	0.051 (0.08)	1.9			9 (0.52)
	Conservative voting	−0.446 (0.20)*	2.3	−0.463 (0.17)**	2.0	
	Voting variability	0.610 (0.27)*	2.1	0.576 (0.23)*	1.9	
Natural resources and amenities	% Public land	0.031 (0.04)	1.5			10 (1.13)
	% Forest	0.017 (0.10)	4.8			4 (0.29)
	% Farmland	−0.055 (0.09)	5.3	−0.053 (0.03)*	1.5	
	Lake shoreline	0.003 (0.01)	1.6			3 (−0.10)
	% Houses seasonal	0.001 (0.04)	2.1			7 (0.08)
Capital resources	Fiscal	0.237 (1.36)	1.1			2 (0.35)
	Tax levy	−0.002 (0.01)	1.6			5 (−0.01)
	County policies	0.324 (0.14)*	1.1	0.333 (0.12)**	1.0	
Other policies and planning	Town policies	0.102 (0.21)	1.1			1 (0.06)
	Any plan	5.685 (1.61)***	1.6	5.268 (1.29)***	1.3	
	County plan	−5.747 (1.37)***	1.4	−5.715 (1.22)***	1.3	
External	Neighbors	0.034 (0.02)	1.3	0.036 (0.02)*	1.0	
Model diagnostics						
Residual deviance	96.1		101.6			
Df	~183		~195			
AIC	142.1		123.6			
% Correctly predicted	96.1		95.6			

Asterisks indicate significant p -values at the * 0.05, ** 0.01, or *** 0.001 levels.

adoption are more robust when they include both internal and external determinants as independent variables (Berry & Berry, 2007). The general model form proposed by Berry and Berry (2007) allowed us to test the relationship between zoning and each of our explanatory variables:

$$ADOPT_{i,t} = f \left(MOTIVATION_{i,t}, RESOURCES_{i,t}, \right. \\ \left. OTHER_POLICIES_{i,t}, EXTERNAL_{i,t} \right)$$

In this study, $ADOPT_{i,t}$ was the probability that township i adopted a zoning ordinance during time t . In this case t represents the time period 1998–2003. $ADOPT$ was a binary response variable; all townships that adopted zoning ordinances during the years 1998–2003 were coded “1,” and all townships unzoned as of 2003 were coded “0.” To the extent that existing data would allow, the independent variables represented conditions during the approximately 13-year time period immediately before and during the policy adoption period (1990–2003):

1. *MOTIVATION* represents pressures, incentives, or disincentives to adopting a given policy. In their planning documents, jurisdictions often cite rapid growth and loss of rural character as justifications for codifying land-use policies. In this study, we separated variables serving as proxies for *MOTIVATION* into three groups: development and population, socio-political, and natural resources. Election data were unavailable at the township level before 1998, so in order to get a meaningful average characterizing each township we included recent data up to 2010 in this metric. Landcover variables included in the *MOTIVATION* category included the percentages of private land in developed (urban) uses, farmland and forestland, measured at 30-m resolution available via the 2001 National Land Cover Dataset (Homer et al., 2007). Thirty-meter resolution is not fine enough to allow for reliable detection of dispersed exurban housing developments (Irwin & Bockstael, 2007), but these data did allow for a

coarse measure of the extensiveness of urban development (and farmland and forestland) at the township level.

2. We referred to *RESOURCES* as *CAPITAL RESOURCES* in order to differentiate from natural resources. The primary revenue source for townships is property taxes, so one proxy we used for capital resources was township property tax levies per capita. The second financial variable was a ratio of township revenues to expenditures to give a measure of overall fiscal health.
3. *OTHER POLICIES* are policies other than township zoning that might affect the probability of a township adopting zoning. These might be subdivision ordinances or planned unit developments that allow townships to address their land-use issues without zoning. Conversely, policies like mandatory planning laws (which were not present in Michigan) would serve as an impetus for townships to adopt zoning. The IPPSR survey contained a list of 28 policies and regulations having to do with land use (see Appendix A for full list). We scored townships by the percentage of these regulations present at both the township and county levels. Half the survey respondents (103 of 206) left this section unanswered, so we called townships and counties to fill in these blanks. Out of 68 follow-up responses, only five indicated that the policy in question was adopted before 2003. We therefore felt confident in assuming that blank survey responses for *OTHER POLICIES* indicated an absence of the policy in question.
4. *EXTERNAL* refers to outside influences on a jurisdiction, i.e. policy diffusion through neighbor effects. We measured diffusion by calculating the percentage of a township's neighbors that had adopted zoning before the study period. Townships were considered neighbors if any part of their boundaries touched on a side or a diagonal.

3.3. Statistical model

We fit generalized linear mixed models (GLMMs) using the “glmer” function in R, specifying the binomial family and the logit

link function. Using a mixed model allowed us to include a random variable to account for county effects (the 206 townships in the study were located in 61 counties). We used a backwards elimination model selection process based on Akaike's Information Criterion (AIC) (Burnham & Anderson, 2002). The AIC penalizes for model deviance and number of parameters. When comparing nested models, the better model has the lower AIC. At each step of model simplification, we removed the variable whose elimination resulted in the largest drop in AIC. Table 3 shows a comparison of the full model and the parsimonious model that resulted from the model selection process, as well as the order of variable removal and associated change in residual deviance resulting from each variable elimination step.

Because multi-collinearity can greatly impact standard errors in non-orthogonal data, we calculated a variance inflation factor (VIF) for each variable included in the model (Belsley, Kuh, & Welsch, 1980, p. 93). We report the square root of the VIF, which indicates how much larger the standard error of the coefficient is compared to what it would be if that variable were independent of all other explanatory variables (Belsley et al., 1980). If the square root of VIF is 2, the standard error is double what it would be if that variable were truly independent. Values greater than 2 or 3 have been proposed as rules of thumb to raise alarm, though such "rules" should be used with caution (O'Brien, 2007). Though the variables of the parsimonious model had greatly reduced VIF values, results of a likelihood ratio test showed the parsimonious model to fit the data as well as the full model ($\chi^2 = 6.35$, $p = 0.898$).

3.4. Model predictions

We used the parsimonious model to predict likelihood of zoning adoption by manipulating variables of interest while keeping all other variables constant at their median values: conservative voting = 56%, voting variability = 9.79, income = \$37.55 thousand, county policies = 0, neighbors = 50%, % land developed = 6.83%, % farmland = 31.34%. We used Bolker's method for predicting from GLMMs using model matrices in R, and reported confidence intervals based on uncertainty of the fixed effects (Bolker et al., 2009).

4. Results

4.1. Statistical model

The results of a logit model described conditions under which local governments have adopted zoning ordinances:

1. MOTIVATION

- Development and population*—Percentage of land developed was positively related to zoning adoption, and accounted for more variation in the dependent variable than did the housing and population variables.
- Socio-political*—Consistent with prior studies, poorer, conservative townships were less likely to zone than more affluent townships with less conservative voters.
- Natural resources*—In exploring relationships in the natural resource variables without considering socio-political variables, we found that farmland was positively correlated with zoning adoption and forestland was negatively correlated with zoning adoption in high-growth townships (Fig. 2). However, natural resources did not explain much variation in zoning adoption in the GLMM models, likely because household income was positively correlated with lakes and farmland and negatively correlated with forestland. Note that the logit model coefficient for % farmland is negative, whereas when zoning adoption is regressed against this

Table 4

Counts of zoned and unzoned study townships where comprehensive plans are present or not present.

Planning status	Township zoning	No township zoning	Total
Any plan ^a	89	70	159
No any plan	7	40	47
Total	96	110	206
County plan	52	65	117
No county plan	44	45	89
Total	96	110	206
Township plan	83	10	93
No township plan	13	100	113
Total	96	110	206

^a Any Plan denotes the presence of a county plan, township plan, or both.

variable alone it is slightly positive (coefficient = 0.009, $p = 0.076$). This indicates % farmland is acting as an error term rather than a predictor of the dependent variable and its model coefficient should not be interpreted directly (Cohen & Cohen, 1983).

- CAPITAL RESOURCES*—Contrary to the hypotheses, township property tax levies and income to expenditure ratio had no significant correlation with zoning adoption.
- OTHER POLICIES*—Townships in counties that had adopted county-level comprehensive plans were less likely to zone than those where no plan had been adopted. Despite county-level planning being negatively correlated with township zoning, presence of county-level land-use policies was positively related to township zoning adoption. Rather than replacing the need for township zoning, as hypothesized, county policies were common in the same policy hotspots where township zoning was common.
- EXTERNAL*—Townships were more likely to adopt zoning if neighboring townships were zoned; this relationship was significant but its magnitude was small.

4.2. Model predictions

Manipulating individual variables allowed us to make predictions based on the parsimonious model (Fig. 3). Keeping all other variables constant at their median levels, we predicted thresholds for zoning adoption based on three variables of interest: extent of developed land, household income, and presence of zoning in neighboring townships. We were interested in identifying predicted threshold levels where zoning adoption became more likely than unlikely, i.e. the probability of zoning was greater than 50%.

It was apparent that previous comprehensive plan adoption had a major effect on zoning predictions, so we calculated values for each of these conditions separately: townships with township-level comprehensive plans, townships in counties with county-level comprehensive plans, and townships with no plans (Table 4). Predictions of zoning likelihood were consistently highest for townships that had adopted their own plans and lowest for townships in counties with county-level plans. Townships that had adopted comprehensive plans were likely also to zone (i.e. were above the 50% probability threshold) regardless of land development, but only townships with at least 19% of land developed were likely to zone where county-level comprehensive plans were in place. The threshold for townships with no township- or county-level planning was slightly lower at 12% land developed. Townships that had adopted comprehensive plans were likely also to zone when median household income was greater than \$26 thousand, compared to townships with no planning which were likely to zone when median household income was above \$47 thousand. The planning variables overwhelmed policy diffusion effects of

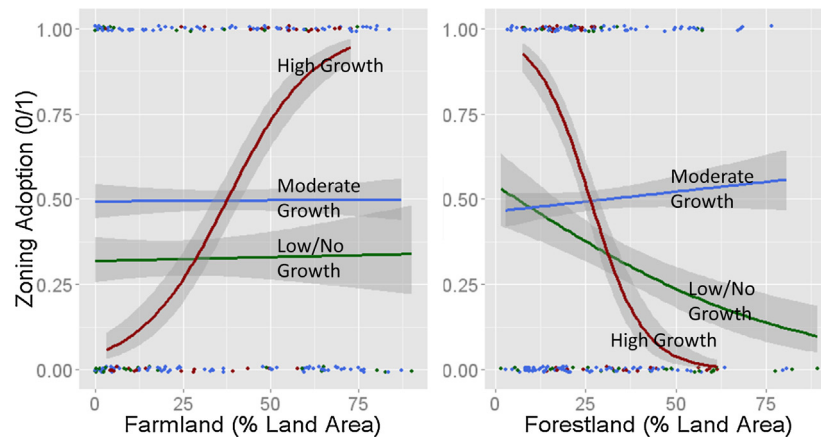


Fig. 2. Zoning adoption in Michigan townships experiencing high, moderate, or low housing growth, plotted against percentage of township as (a) farmland, and (b) forestland. “High Growth” indicates housing growth of greater or equal to 25% from 1990 to 2000, “Moderate” indicates an increase between 5 and 25%, and “Low/No” indicates a change of less than 5% growth, including 15 townships with negative growth. Fitted values and 50% confidence intervals are plotted using a generalized linear model fit.

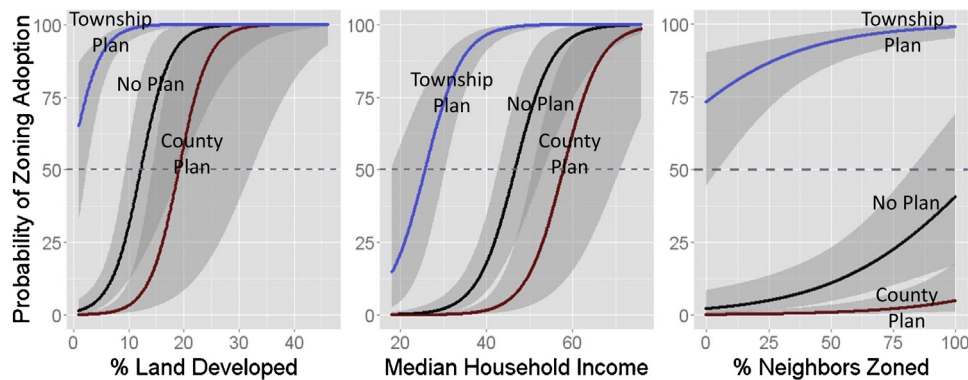


Fig. 3. Predicted associations between township zoning adoption and (1) percent of township's land that is developed, (2) median household income, and (3) percent of neighboring townships that are zoned. Lines correspond to the presence of a township comprehensive plan, county comprehensive plan, or no plan. All other variables in the model were held constant at their median values. Shaded areas indicate 50% confidence intervals.

neighboring townships. According to model predictions, townships with township-level comprehensive plans were likely to zone even when they had no zoned neighbors, while townships without plans were unlikely to adopt zoning even when 100% of the neighboring townships were zoned.

5. Discussion

5.1. Characterizing zoning adopters and non-adopters

In this study of township zoning adoption, we developed a statistical model to predict zoning adoption based on internal determinants and external diffusion effects. Township zoning adoption generally occurred in areas with more land in urban uses, a finding consistent with prior studies showing the adoption of growth management policy to be reactionary (Howell-Moroney, 2008; Neiman & Fernandez, 2000). Zoning was particularly reactionary in townships that had adopted county comprehensive plans, which tended to zone at higher levels of development than those with township-level plans or no plans. These results suggest that if planning and zoning processes occur at different levels of local government, time-sensitive land-use issues may be unlikely to be addressed before development is widespread. Our results are also consistent with diffusion studies finding that policy activity in neighboring jurisdictions is an important predictor of policy adoption (Berry & Berry, 2007; Mintrom, 1997), but the diffusion effect

in our study was much weaker than the effects of socio-political and land-use variables.

Codifying community goals is important in proactive implementation of land-use policy, and the importance of early planning to address rural community goals has been well documented in case-study research (Healy & Short, 1979; King & Harris, 1989). We highlight the importance of another factor influencing local government policy adoption: intergovernmental relations. Our logit model predicted that townships in counties with county-level comprehensive plans were likely to zone only if greater than 19% of the township was developed, higher than the 12% threshold for townships with no comprehensive plan at all. At these levels of development, housing patterns are well established and may already be affecting the natural resources and rural character of the township. On the other hand, townships that had adopted their own comprehensive plans were likely to zone at low levels of development. Before development is widespread, planning for large open spaces is still possible.

Although townships may have an incentive to adopt their own zoning regulations rather than follow county-level rules, we found township-level zoning to be less likely when a county-level planning was underway. One reason for this might be the perceived role of counties versus townships in land-use regulation. If the county has a comprehensive plan, townships may operate as if planning is not within their realm of duties. In follow-up phone calls, township and county staff indicated that land-use policy happened at either the township or the county level, and they could give very little

information on the other. Greater communication among county and sub-county governments may be necessary to clarify roles in planning and zoning and communicate those roles to citizens.

Development and other signs of change to the physical environment are integral in defining perceptions of “rural character” (Stedman, 2003; Tilt et al., 2007) and may initiate community interest in planning and zoning. Although the presence of natural resources may shape the content of growth management policies in communities where such policies exist (O'Neill, Rudel, & McDermott, 2011), natural resource variables were not good predictors of zoning adoption in our study. There was no relationship between lakes or public lands and zoning adoption, despite evidence that these resources attract development (Butsic et al., 2010; Gonzalez-Abraham et al., 2007; Radeloff, Hammer, & Stewart, 2005; Theobald, Miller, & Hobbs, 1997). Farmland protection in particular is a common theme in many rural communities' land-use plans, and is often implemented in zoning ordinances as a minimum parcel size in farm zones (Coughlin, 1991). Though housing rate was not significant in the model, trends indicated that townships with more agricultural land were more likely to adopt zoning if they experienced high housing growth. Conversely, zoning adoption was less likely in high-growth townships with more forestland. One explanation for these trends is that visually apparent developments in agricultural landscapes likely stir public attention more so than hidden ones nestled into wooded areas (Stedman, 2003; Tilt et al., 2007). Furthermore, political participation tends to be positively associated with income, education and status (Verba & Nie, 1987), and in this study household income was positively correlated with amount of farmland and negatively correlated with forestland.

The generalizability of our results relies on assumptions about the consistency of local government motivations across time and space. Applicability outside of Michigan is supported by studies showing negative correlations between land-use policy adoption and rurality and positive correlations between adoption and affluence in Florida counties (Feiock et al., 2008), Massachusetts towns (Hawkins, 2014), and 658 counties across the U.S. (Steel & Lovrich, 2000). We expect parallels in the underlying motivations and processes of land regulation wherever capitalistic land-based markets exist and municipalities have a large degree of discretionary authority (Logan & Molotch, 2007). A second issue is temporal generalizability. The first township in Michigan to adopt zoning did so in 1944, and the majority of currently zoned townships adopted ordinances in the 1970s, 1980s and 1990s. All zoned townships in our study adopted zoning between 1998 and 2003 and can therefore be considered late adopters, though were representative of Michigan townships as a whole based on the characteristics we measured. Unzoned study townships were not representative of Michigan townships as a whole, and the stark differences we found between adopters and non-adopters may have been less pronounced in past decades. More local-level research would be needed to test multi-decadal trends like those studied at the state level with event history analysis (Berry & Berry, 2007). Unfortunately consistent, long-term data collection from rural, local governments is not common practice. The U.S. Census of Governments collects information on staff size, finances and taxes, but data are limited to certain years and to municipalities with populations over 25,000. Land use and landcover data have become more readily available since the 2000s (e.g., Homer et al., 2007), but matching the time and spatial scales of these data with local demographic and political data remains difficult.

5.2. Challenges and opportunities for local governments

Though new growth may provide beneficial tax revenue and services, spurious development can compromise cultural and

natural resources and in turn compromise future development and quality of life. Housing development is permanent in a way that other land-use change is not, and a trajectory of development patterns is created when the percentage of land developed is still low. Voters and municipalities are challenged to define and foster the “right kind of growth” while discouraging undesirable development patterns (York & Munroe, 2013). Growth restrictions may be desirable when new development impedes residents' privacy, sense of place, property values, recreational opportunities, or environmental health (Fischel, 2001; Gieryn, 2000). Thus, developers and affluent newcomers to exurban areas tend to disapprove of new industrial developments that diminish aesthetics and property values, while established landowners may disapprove of new subdivisions that impinge on trails or hunting land (Salamon, 2007). In other cases, especially in impoverished areas, residents may welcome new development that brings the promise of job creation or better services (Gerber & Phillips, 2003; Humphrey & Wilkinson, 1993). Municipal governments must also weigh the priorities of tax revenue generation through growth against the cost of providing services to newly developed areas (Munroe, Croissant, & York, 2005).

Both local and regional solutions have been proposed to balance favorable land-use outcomes with the financial costs of addressing land-use issues (Berke & French, 1994; Loh & Sami, 2013; Rudel, 1989). At the local level, complaint-based zoning can be used in rural areas where placing checks on all development projects is impractical (Rudel, 1989). Using this approach, a jurisdiction would only apply zoning rules to development proposals that receive a complaint from a resident; in this way local knowledge about “good” and “bad” developers is taken into account while lowering costs of enforcement compared to performance zoning (Rudel, 1989). This method requires that development proposals are clearly communicated to the public. It also has a potential downside of allowing discrimination against outside or minority groups. Regional approaches include state-level planning mandates that promote high-quality local plans and land-use ordinance adoption (Berke & French, 1994; Burby & Dalton, 1994). Loh and Sami (2013) argue that state support is imperative for cohesive regional planning in cases where local control is strong. However, state mandates have been criticized for incentivizing standardized plans without community-driven visions and participatory processes (Bunnell & Jepson, 2011). Even when community goals are successfully encapsulated in comprehensive plans, plans often state purposes and goals in broad terms and are difficult to defend legally (Loh, 2012). Because legally binding ordinances will only be enforceable with local government support and resources, land-use policies adopted at any governmental level must take into account the diversity of local growth dynamics and residents' perspectives.

Rural land-use conflicts can often be resolved through informal networks when land-use changes are gradual, predictable or rare (Rudel, 1989). However, conflicts can arise suddenly and stochastically even in slow-growth areas that have not experienced the notable housing growth or demographic shifts that accompany urbanization. Rural economies suffer when abandoned, unfinished subdivisions follow boom-and-bust land speculation and housing demand does not keep up with increasing supply (Holway, Elliott, & Trentadue, 2014). In recent years unzoned rural townships have scrambled to manage emerging industries like wind farming and non-metallic mining through ad-hoc license agreements or development contracts in the absence of established land-use regulations (Pearson, 2013). The persistence of contiguous, sustainably managed forestland is feared to be in jeopardy following large scale divestment of industrial forestland across the U.S. in the 1990s and 2000s (Bliss et al., 2010). In all of these cases rural jurisdictions may be faced with a difficult decision to either allow unknown, extralocal developers to continue with their projects unimpeded

or to adopt regulations that often must apply more widely than the community considers necessary or desirable.

Predicting the likelihood of land-use policy adoption can show us which communities are vulnerable to these unplanned social and environmental perturbations. Where important social, cultural or ecological resources are found in areas unlikely to adopt land-use regulations (e.g. in poorer forested areas), nonprofits or higher level governments may take interest in alternative ways to manage or conserve these resources. Examples are state and federal technical assistance, cost-sharing and tax incentive programs (Hibbard, Kilgore, & Ellefson, 2003; Kilgore et al., 2007) that promote sustainable forestry practices and ease financial burdens on private forest owners, though their effectiveness in preventing forestland conversion to agricultural or developed uses is unknown. Evaluating the effectiveness of land-use policies is an overarching goal to which policy adoption models provide a necessary first step. Our study identifies the variety of factors involved in the zoning adoption decision. Only after we understand these factors can we assess how zoning regulations affect siting decisions by developers and mining companies, and other drivers of land-use change.

6. Conclusions

Zoning is the most widely used regulatory tool for land use, but in rural areas is often disconnected from planning or is not undertaken at all. Local governments often wait to plan for growth and adopt zoning regulations until development is well underway. We found planning status and the percentage of land in developed uses to be key predictors of zoning adoption from 1998 to 2003. When planning and zoning occurred at different levels of government, an average of 19% of land was developed before townships adopted zoning, compared to an average of 9% for all study townships. Reactive zoning is problematic because unexpected threats from extralocal development interests can arise in areas that are well below these development thresholds. Higher levels of government may need to incentivize proactive land-use planning or regulation to achieve consistent zoning adoption, but local variability should be taken into consideration in regional or state efforts to shape broad-scale development patterns.

Acknowledgments

This project was supported by Agriculture and Food Research Initiative Competitive Grant no. 2012-67011-19876 from the USDA National Institute of Food and Agriculture, and USDA McIntire-Stennis Formula Grant no. WIS01661. The authors would like to thank Aslı Göçmen, Harvey Jacobs and Kurt Paulsen of UW-Madison and two anonymous reviewers for helpful feedback, Catherine Harris of UW-Madison for technical support, and Michigan township officials for up-to-date policy information.

Appendix A: Supplementary data

List of 28 OTHER POLICIES (township and county levels) from IPPSR survey (2004)

Access Regulations
Brownfield Authorities
Building Code
Cluster Development (at least 50% open space)
Condominium Regulations
Environmental Area Regulations
Farm Land Protection Regulations
Floodplain Protection Regulations
Groundwater Protection Regulations
Growth Management Ordinances

High Risk Erosion Regulations
Historic Preservation Regulations
Lot Splits Regulations
Natural Rivers Regulations
Planned Unit Development
Private Road Regulations
Purchase of Development Rights
Sand Dune Regulations
Shoreline Protection
Sign Regulations
Site Plan Review
Special Land Uses
Subdivision Regulations
Traditional Neighborhood Development/ Form-Based Zoning
Transfer of Development Rights
Wetlands Regulations
Woodlands Regulations
Other innovative or unusual regulations

References

- Allen, S., Moorman, C., Peterson, M., Hess, G., & Moore, S. (2013). Predicting success incorporating conservation subdivisions into land use planning. *Land Use Policy*, 33, 31–35.
- Anderson, J. L., & Sass, E. (2004). Is the wheel unbalanced?—A study of bias on zoning boards. *The Urban Lawyer*, 36(3), 447–474.
- Arendt, R., Brabec, E. A., Dodson, H. L., Reid, C., & Yaro, R. D. (1994). *Rural by design: Maintaining small town character*. Chicago, IL: Planners Press, American Planning Association.
- Belsley, D., Kuh, E., & Welsch, R. (1980). *Regression diagnostics—Identifying influential data and sources of collinearity*. New York, NY: Wiley & Sons.
- Bengston, D., Fletcher, J., & Nelson, K. (2004). Public policies for managing urban growth and protecting open space—Policy instruments and lessons learned in the United States. *Landscape and Urban Planning*, 69(2), 271–286.
- Berke, P., & French, S. P. (1994). The influence of state planning mandates on local plan quality. *Journal of Planning Education and Research*, 13(4), 237–250.
- Berry, F. S., & Berry, W. D. (1990). State lottery adoptions as policy innovations—An event history analysis. *The American Political Science Review*, 84(2), 395–415.
- Berry, F. S., & Berry, W. D. (2007). Innovation and diffusion models in policy research. In P. A. Sabatier (Ed.), *Theories of the policy process*. Boulder, CO: Westview Press.
- Bliss, J. C., Kelly, E. C., Abrams, J., Bailey, C., & Dyer, J. (2010). Disintegration of the US industrial forest estate—Dynamics, trajectories, and questions. *Small-Scale Forestry*, 9(1), 53–66.
- Bolker, B. M., Brooks, M., Clark, C., Geange, S., Poulsen, J., Stevens, M., et al. (2009). Generalized linear mixed models—A practical guide for ecology and evolution. *Trends in Ecology & Evolution*, 24(3), 127–135.
- Breck, J. (2004). *Lake polygons shapefile*. Ann Arbor, Michigan: Michigan Department of Natural Resources, Institute for Fisheries Research.
- Buckley, J., & Westerland, C. (2004). Duration dependence, functional form, and corrected standard errors—Improving EHA models of state policy diffusion. *State Politics and Policy Quarterly*, 4(1), 94–113.
- Bunnell, G., & Jepson, E., Jr. (2011). The effect of mandated planning on plan quality. *Journal of the American Planning Association*, 77(4), 338–353.
- Burby, R. J., & Dalton, L. (1994). Plans can matter!—The role of land use plans and state planning mandates in limiting the development of hazardous areas. *Public Administration Review*, 54(3), 229–238.
- Burnham, K. P., & Anderson, D. (2002). *Model selection and multi-model inference—A practical information-theoretic approach*. New York, NY: Springer.
- Butsic, V., Lewis, D., & Radeloff, V. (2010). Lakeshore zoning has heterogeneous ecological effects—An application of a coupled economic-ecological model. *Ecological Applications*, 20(3), 867–879.
- Carruthers, J. I., & Ulfarsson, G. F. (2002). Fragmentation and sprawl: Evidence from interregional analysis. *Growth and Change*, 33(3), 312–340.
- Cohen, J., & Cohen, P. (1983). *Applied multiple regression for the behavioral sciences*. Hillsdale, NJ: Erlbaum.
- Coughlin, R. E. (1991). Formulating and evaluating agricultural zoning programs. *Journal of the American Planning Association*, 57(2), 183–192.
- Daniels, T. L. (1997). Where does cluster zoning fit in farmland protection? *Journal of the American Planning Association*, 63(1), 129–137.
- Edwards, M. M., & Haines, A. (2007). Evaluating smart growth implications for small communities. *Journal of Planning Education and Research*, 27(1), 49–64.
- Feiock, R. C., Tavares, A., & Lubell, M. (2008). Policy instrument choices for growth management and land use regulation. *Policy Studies Journal*, 36(3), 461–480.
- Fischel, W. A. (2001). *The homeowner hypothesis—How home values influence local government taxation, school finance and land-use policies*. Cambridge, MA: Harvard University Press.
- Gerber, E. R., & Phillips, J. (2003). Development ballot measures, interest group endorsements, and the political geography of growth preferences. *American Journal of Political Science*, 47(4), 625–639.

- Gieryn, T. F. (2000). A space for place in sociology. *Annual Review of Sociology*, 26, 463–496.
- Gonzalez-Abraham, C. E., Radeloff, V., Hawbaker, T., Hammer, R., Stewart, S., & Clayton, M. (2007). Patterns of houses and habitat loss from 1937 to 1999 in northern Wisconsin, USA. *Ecological Applications*, 17(7), 2011–2023.
- Gray, V. (1973). Innovation in the states—A diffusion study. *The American Political Science Review*, 67(4), 1174–1185.
- Gray, V. (1994). Competition, emulation, and policy innovation. In L. C. Dodd, & C. C. Jilison (Eds.), *New perspectives on American politics* (2nd ed., pp. 230–248). Washington, DC: CQ Press.
- Hawkins, C. V. (2014). Landscape conservation through residential subdivision bylaws—Explanations for local adoption. *Landscape and Urban Planning*, 121, 141–148.
- Healy, R. G., & Short, J. (1979). Rural land—Market trends and planning implications. *Journal of the American Planning Association*, 45(3), 305–317.
- Heimlich, R. E., & Anderson, W. (2001). Development at the urban fringe and beyond—Impacts on agriculture and rural land. In *Economic research service report no. 803*. Washington, DC: U.S. Department of Agriculture. Retrieved from (<http://www.ers.usda.gov/publications/aer-agricultural-economic-report/aer803.aspx#.Usw-qvu0aaM>).
- Hibbard, C. M., Kilgore, M., & Ellefson, P. (2003). Property taxation of private forests in the United States—A national review. *Journal of Forestry*, 101(3), 44–49.
- Holway, J., Elliott, D., & Trentadue, A. (2014). Arrested developments—Combating zombie subdivision and other excess entitlements. In *Policy focus report*. Cambridge, MA: Lincoln Institute of Land Policy. Retrieved from (www.lincolnst.edu).
- Homer, C., Dewitz, J., Fry, J., Coan, M., Hossain, N., Larson, C., et al. (2007). Completion of the 2001 National Land Cover Database for the conterminous United States. *Photogrammetric Engineering and Remote Sensing*, 73(4), 337.
- Howell-Moroney, M. (2008). A description and exploration of recent state-led smart-growth efforts. *Environment and Planning C: Government and Policy*, 26(4), 678–695.
- Humphrey, C. R., & Wilkinson, K. (1993). Growth promotion activities in rural areas—Do they make a difference? *Rural Sociology*, 58(2), 175–189.
- Institute for Public Policy and Social Research. (2004). *To plan or not to plan—Current activity within Michigan's local governments (policy brief volume 8)*. East Lansing, MI: Michigan State University.
- Irwin, E. G., & Bockstael, N. E. (2007). The evolution of urban sprawl: Evidence of spatial heterogeneity and increasing land fragmentation. *Proceedings of the National Academy of Sciences*, 104(2), 20672–20677.
- Kahn, M. E. (2011). Do liberal cities limit new housing development?—Evidence from California. *Journal of Urban Economics*, 69(2), 223–228.
- Kilgore, M. A., Greene, J. L., Jacobson, M. G., Straka, T. J., & Daniels, S. E. (2007). The influence of financial incentive programs in promoting sustainable forestry on the nation's family forests. *Journal of Forestry*, 105(4), 184–191.
- King, L., & Harris, G. (1989). Local responses to rapid rural growth—New York and Vermont cases. *Journal of the American Planning Association*, 55(2), 181–191.
- Liu, X., & Lynch, L. (2011). Do zoning regulations rob rural landowners' equity? *American Journal of Agricultural Economics*, 93(1), 1–25.
- Logan, J. R., & Molotch, H. L. (2007). *Urban fortunes: The political economy of place*. California: Univ of California Press.
- Loh, C. G. (2012). Four potential disconnects in the community planning process. *Journal of Planning Education and Research*, 32(1), 33–47.
- Loh, C. G., & Sami, N. (2013). Death of a planning department—Challenges for regionalism in a weak mandate state. *Land Use Policy*, 32, 39–49.
- Marcouiller, D. W., Clendenning, J., & Kedzior, R. (2002). Natural amenity-led development and rural planning. *Journal of Planning Literature*, 16(4), 515–542.
- Mich. Center for Geographic Info. (2011). *Michigan geographic framework—State of Michigan*. Lansing, MI: Center for Shared Solutions and Technology Partnerships.
- Mich. Dept. of State. (2001–2013). *Elections in Michigan*. State of Michigan. Retrieved from (<http://www.michigan.gov/sos>) (May 20, 2013).
- Mich. Dept. of Treasury. (2001–2013). *Michigan taxes*. State of Michigan. Retrieved from (<http://www.michigan.gov/treasury>) (May 20, 2013).
- Minnesota Population Center. (2011). *National historical geographic information system—version 2.0*. Minneapolis, MN: University of Minnesota. Retrieved from (<http://www.nhgis.org>) (May 20, 2013).
- Mintrom, M. (1997). Policy entrepreneurs and the diffusion of innovation. *American Journal of Political Science*, 738–770.
- Mohr, L. B. (1969). Determinants of innovation in organizations. *The American Political Science Review*, 63(1), 111–126.
- Molotch, H. (1976). The city as a growth machine—Toward a political economy of place. *American Journal of Sociology*, 82(2), 309–332.
- Morgan, D. R., & Watson, S. (1991). Political culture, political system characteristics, and public policies among the American states. *Publius: The Journal of Federalism*, 21(2), 31–48.
- MTA. (2013). *Michigan Townships Association*. Retrieved from (<http://www.michigantownships.org/>) (November 6, 2013).
- Munroe, D. K., Croissant, C., & York, A. (2005). Land use policy and landscape fragmentation in an urbanizing region—Assessing the impact of zoning. *Applied Geography*, 25(2), 121–141.
- Neiman, M., & Fernandez, K. (2000). Local planners and limits on local residential development. *Journal of the American Planning Association*, 66(3), 295–305.
- Norton, R. K. (2008). Using content analysis to evaluate local master plans and zoning codes. *Land Use Policy*, 25(3), 432–454.
- O'Brien, N. M. (2007). A caution regarding rules of thumb for variance inflation factors. *Quality & Quantity*, 41(5), 673–690.
- O'Neill, K. M., Rudel, T., & McDermott, M. (2011). Why environmentally constrained towns choose growth controls. *City & Community*, 10(2), 111–130.
- Pearson, T. W. (2013). Frac sand mining in Wisconsin—Understanding emerging conflicts and community organizing. *Culture, Agriculture, Food and Environment*, 35(1), 30–40.
- Pitt, D. (2010). The impact of internal and external characteristics on the adoption of climate mitigation policies by US municipalities. *Environment and Planning C: Government and Policy*, 28(5), 851–871.
- Radeloff, V. C., Hammer, R., & Stewart, S. (2005). Rural and suburban sprawl in the US Midwest from 1940 to 2000 and its relation to forest fragmentation. *Conservation Biology*, 19(3), 793–805.
- Radeloff, V. C., Stewart, S. I., Hawbaker, T., Gimmi, U., Pidgeon, A., Flather, C., et al. (2010). Housing growth in and near United States protected areas limits their conservation value. *Proceedings of the National Academy of Sciences*, 107(2), 940.
- Richardson, J. J. (2011). Dillon's rule is from Mars, home rule is from Venus—Local government autonomy and the rules of statutory construction. *Publius: The Journal of Federalism*, 41(4), 662–685.
- Rothwell, J., & Massey, D. (2009). The effect of density zoning on racial segregation in US urban areas. *Urban Affairs Review*, 44(6), 779–806.
- Rudel, T. K. (1989). *Situations and strategies in American land-use planning*. Cambridge, UK: Cambridge University Press.
- Salamon, S. (2007). *Newcomers to old towns—Suburbanization of the heartland*. Chicago: University of Chicago Press.
- Satterthwaite, S. B. (2002). Innovation and diffusion of managed care in Medicaid programs. *State & Local Government Review*, 34(2), 116–126.
- Schnaiberg, J., Riera, J., Turner, M. G., & Voss, P. (2002). Explaining human settlement patterns in a recreational lake district—Vilas County, Wisconsin, USA. *Environmental Management*, 30(1), 24–34.
- Stedman, R. C. (2003). Is it really just a social construction? The contribution of the physical environment to sense of place. *Society & Natural Resources*, 16(8), 671–685.
- Steel, B. S., & Lovrich, N. P. (2000). Growth management policy and county government: Correlates of policy adoption across the United States. *State & Local Government Review*, 32(1), 7–19.
- Theobald, D. M. (2005). Landscape patterns of exurban growth in the USA from 1980 to 2020. *Ecology and Society*, 10(1), 32.
- Theobald, D. M., Miller, J., & Hobbs, N. (1997). Estimating the cumulative effects of development on wildlife habitat. *Landscape and Urban Planning*, 39(1), 25–36.
- Tilt, J. H., Kearney, A., & Bradley, G. (2007). Understanding rural character—Cognitive and visual perceptions. *Landscape and Urban Planning*, 81(1), 14–26.
- U.S. Census Bureau. (1991). *Census 1990 summary file 1*. Washington, DC: U.S. Census Bureau.
- U.S. Census Bureau. (2001). *Census 2000 summary file 1*. Washington, DC: U.S. Census Bureau.
- USGS. (2010). Protected areas database of the United States (PADUS), version 1.1. In *Gap analysis program (GAP)*. US Geological Survey.
- Verba, S., & Nie, N. H. (1987). *Participation in America—Political democracy and social equality*. Chicago, IL: University of Chicago Press.
- Walker, J. L. (1969). The diffusion of innovations among the American states. *The American Political Science Review*, 63(3), 880–899.
- WTA. (2009). *Town quick facts*. Wisconsin Towns Association. Retrieved from (<http://www.wiscstowns.com/about-towns>) (on November 6, 2013).
- York, A. M., & Munroe, D. (2010). Urban encroachment, forest regrowth and land-use institutions—Does zoning matter? *Land Use Policy*, 27(2), 471–479.
- York, A., & Munroe, D. (2013). Land-use institutions and natural resources in fast-growing communities at the urban-rural fringe. In E. S. Brondizio, & E. F. Moran (Eds.), *Human-environment interactions—Current and future directions* (vol. 1) (pp. 295–318). The Netherlands: Springer.
- Zabik, M. J., & Prytherch, D. (2013). Challenges to planning for rural character—A case study from exurban southern New England. *Cities*, 31, 186–196.

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