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The ability of zoning and land acquisition to increase property values and maintain largemouth bass growth rates in an amenity rich region

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HIGHLIGHTS

- Zoning and land acquisition affect property prices and the environment.
- These effects are typically positive but small in our setting.
- Both policies have larger effects when geographically targeted.
- The cost of land acquisition is more than the increased tax revenue it generates.

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ABSTRACT

Land use change is a leading cause of environmental degradation in amenity rich rural areas. Numerous policies have been used to combat these negative effects, including zoning and land acquisition. The empirical effects of these policies on the environment and land markets are still debated. Using a coupled economic–ecological model in conjunction with landscape simulations we investigate the effect of zoning and land acquisition on property prices and largemouth bass (*Micropterus salmoides*) growth in Vilas County, WI, an amenity rich region with growing rural development. Using econometric models of land use change and property prices, we simulate four alternative land use scenarios: a baseline simulation, a zoning change simulation, a land acquisition program simulation, and a land acquisition program + zoning simulation. Each scenario is simulated over 82 separate lakes. For each scenario we calculate the length of a 20-year old largemouth bass, property prices, and number of new residences at simulation years 20, 40 and 60. The policies have small effects on largemouth bass size and property prices on most lakes, although the effects are more pronounced on some. We also test if the increased property values due to land acquisitions are greater than the cost of the land acquisition program and find that in our case, land acquisition does not "pay for itself". Our methodology provides a means to untangle the complex interactions between policy, land markets, and the environment. Empirically, our results indicate zoning and land acquisition are likely most effective when targeted to particular lakes.

1. Introduction

Housing growth, particularly in rural areas, is a leading cause of land-use change throughout much of the United States (Radeloff, Hammer, & Stewart, 2005; Radeloff, Hammer, Stewart, Fried, et al., 2005). This trend is likely to continue (Radeloff et al., 2010) and will exacerbate a host of ecosystem changes already influenced by housing growth including increased exotic invasions (Gavier Pizarro, Radeloff, Stewart, Huebner, & Keuler, 2010; Gavier Pizarro, Stewart, Huebner, Keuler, & Radeloff, 2010), biodiversity losses (Green & Baker, 2003; Hansen et al., 2005; Lepczyk et al., 2008), and increasing wildfire risk to home (Bar Massada, Radeloff, Stewart, & Hawbaker, 2009; Syphard et al., 2007). In response to these environmental changes, communities throughout the United States commonly use zoning and land acquisition to manage rural growth and preserve the environment (Ingram, Carbonell, Hong, & Flint, 2009).

Rural planning to preserve the environment, however, impacts more than just natural systems. Zoning and land acquisition impact land markets and thus directly impact the wealth and land use decisions of landowners. Zoning influences land markets by determining permissible use, which in turn influences property prices and land conversion rates (Lewis, Provencher, & Butsic, 2009;

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Mills, 1990; Spalatro & Provencher, 2001). Likewise, land acquisition can affect land markets by both limiting the supply of land (Armsworth, Daily, Kareiva, & Sanchirico, 2006; Armsworth & Sanchirico, 2008) and by adding amenity value to properties near newly-protected open space (Albers, Ando, & Chen, 2008; Geoghegan, 2002; McConnell & Walls, 2005). The challenge to policy makers charged with organizing rural growth is to understand the dynamic interplay of land use policy, land markets, and the environment in order to make decision that do not result in unintended consequences.

Understanding this interplay is further complicated by the complex, heterogeneous, and often feedback driven relationships between policy, markets, and the environment. Zoning sometimes works to direct growth and manage the landowner decisions (Bowers & Daniels, 1997). In other instances though, zoning simply codifies market outcomes (Butsic, Lewis, & Ludwig, 2011; Wallace, 1988). Likewise, the effect of zoning on property prices is both theoretically (Spalatro & Provencher, 2001) and empirically (Netusil, 2005) heterogeneous and depends on the relative effects of zoning on amenity creation and development regulation. And last but not least, the environmental impact of zoning is largely unknown (Butsic, Lewis, & Radeloff, 2010; Conway & Lathrop, 2005; Lewis, 2010).

Land acquisition, theoretically (Lewis et al., 2009; Wu & Plantinga, 2003) and empirically (Lewis et al., 2009) also has heterogeneous effects on the decision to subdivide. In the worst case, acquisition can lead to the perverse effect reducing open space across the broader landscape (Armsworth et al., 2006). Land acquisition generally increases property prices (McConnell & Walls, 2005). In some situations, this increase in property prices due to land protection may be able to pay for the cost of land purchases, a pattern known as the proximate principle (Crompton, 2001). However, while there is ample evidence for this in urban areas (Nelson, 1986; see Crompton, 2001 for a review), the existence of the proximate principle in rural settings is less certain.

The conflicting theoretical and empirical effects of zoning and land acquisition on the environment, land owner decisions, and property prices, have made many skeptical of their overall effectiveness, and ultimately hindered their implementation. Planners in rural areas are left with a situation where uncertainty over changes in property values coupled with unproven environmental results make the application of any policy difficult. To provide guidance to these complex interactions we propose a method to jointly estimate the effects of zoning and land acquisition on the environment, land development decisions, and property prices. Directly estimating these effects helps to clarify the complex and interacting effects of policy, property prices, and the environment; provides a mechanism to directly compare the effectiveness of alternative policies; provides a way to target specific areas where each policy will be most effective; and provides a way to compare direct fiscal cost of the policies implementation with potential changes in tax revenue due to changing land values. Ultimately, we propose that our modeling approach provides the information planners need to engage their constituents in the planning process.

We conducted our analysis in Vilas County, WI, a lake-rich landscape with high amenity value (Peterson et al., 2003), using land-use simulations based on econometric models of land development and land prices, which incorporate land market feedbacks on land development, zoning, and land acquisition. We tested for the ecological effects of zoning and land acquisition by simulating land development under four policy scenarios: a baseline simulation, a zoning simulation, a land acquisition simulation, and a land acquisition + zoning simulation over a 60-year time frame. We coupled the output of these simulations with models of largemouth bass (*Micropterus salmoides*; hereafter referred to as LMB) growth and property prices, which allowed us to compare the ecological and land market outcomes under alternative land use planning scenarios.

We used this methodology to address four questions. First, using LMB growth as a metric of ecologically relevant disturbance, we ask if LMB growth rates change under alternative policies. Second, we ask how the land market effects of zoning and land acquisition programs affect individual property prices. Third, we test if these property price effects are large enough to offset the cost of land acquisition, i.e., does the proximate principle hold? And fourth, we ask on which specific lakes are each policy more successful.

2. Methods

2.1. Study area

Vilas County, located in Northern Wisconsin harbors over 1300 lakes and water covers over 15% of the County (Vilas County, 2008) (Fig. 1). The county has long been a bastion for second home development. Since the 1960s, over half of all homes have been built on parcels with lake frontage (Schnaiberg, Riera, Turner, & Voss, 2002). The dense development along some lakes has lead to a host of ecosystem changes including: decreased growth rates for bluegills (*Lepomis macrochirus*; Schindler, Geib, & Williams, 2000), decreased amounts of coarse woody habitat (Christensen, Herwig, Schindler, & Carpenter, 1996), species extirpation (Woodford & Meyer, 2003), and invasions by exotic species (Carpenter et al., 2007).

Recreational fishing, in particular, has been a pillar of the region economy in Vilas County (Postel & Carpenter, 1997; Peterson et al., 2003). Largemouth bass are a commonly sought game fish in the region and are known to act as keystone species (Mittelbach, Turner, Hall, Rettig, & Osenberg, 1995) that can affect entire lake ecosystems (e.g., Carpenter, Kitchell, & Hodgson, 1985; Mittelbach et al., 1995). Altered LMB ecology is associated with lakeshore residential density (e.g., Francis & Schindler, 2009; Lawson, Gaeta, & Carpenter, 2011; Scheuerell & Schindler, 2004). Indeed, recent research has shown that growth rates of adult LMB are negatively correlated with lakefront residential density (Gaeta, Guarascio, Sass, & Carpenter, 2011). This effect is especially pronounced in larger fish that are most sought after by anglers, indicating that residential growth may be negatively related to fishery quality. The sensitivity of LMB to lakeshore residential density in conjunction to this species potential to alter entire lake ecosystems makes LMB an ideal candidate to detect ecologically relevant levels of anthropogenic disturbance on lake ecosystems. In this study we use LMB growth as a metric of ecologically relevant anthropogenic disturbance.

Zoning is the main land use control in Vilas County, and Vilas County was one of the first counties in Wisconsin to require more stringent shoreline zoning than the state minimum frontage of 100 ft. In 1999 all of the lakes in the County were rezoned based on a matrix of residential density and ecological sensitively. Lakes deemed sensitive to development and that had low residential density were zoned 300 ft. Lakes deemed insensitive to development and that had higher levels of residential density were zoned 200 ft or 150 ft.

Recently, local and national land trusts, along with the state government have begun to purchase private land for public use. Between 2004 and 2007, the Nature Conservancy with joint funding from the State's Knowles–Nelson Stewardship fund purchased over 3000 acres in Vilas County at a cost of over $4,000,000 (State of Wisconsin, 2007). In addition, a local land trust – the Northwoods Land Trust – has acquired properties in the county (Northwoods Land Trust, 2010). Thus, land conservation in Vilas County appears to follow the upward nationwide trend (Land Trust Alliance, 2010).