



Research article

Wetlands and open space: The impact of environmental regulations on land use patterns



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ABSTRACT

Section 404 of the Clean Water Act (CWA) has worked toward minimizing the degradation of wetlands since its inception. In 1985 the definition of the US waters regulated under Section 404 was expanded due to a Supreme Court ruling in an effort to specifically reduce environmental damage caused by new residential development. This study analyzes the resulting development permit approval process from the new regulatory environment following Section 404's expansion to examine the regulation's efficacy and illustrate potential tradeoffs between water resource protection and land fragmentation. Land use changes are identified using difference-in-difference estimators in duration analysis and a sample selection model. Results indicated that the new regulatory framework significantly slowed development of environmentally sensitive parcels but also decreased the density of new development.

1. Introduction

Environmental regulations frequently target land development due to the potential negative impacts on water quality, biodiversity and other ecosystem services. However, these regulations have varying levels of efficacy (McConnell and Walls, 2005; Lewis and Plantinga, 2007) and frequently have unintended consequences (Pendall, 1999; Smith et al., 1999; Irwin and Bockstael, 2004; Cunningham, 2007). Unintentional effects from land regulations may include displacing land development to nearby unregulated areas and increasing land fragmentation (Irwin and Bockstael, 2004). Unintended effects can reduce the net benefits of an environmental policy, and given the irreversibility of development projects, can have long-lasting consequences.

Environmental regulations impact land use and development in many ways. Mechanisms of land use regulation include open space requirements (McConnell and Walls, 2005; Kopits et al., 2007), minimum lot zoning (Pasha, 1996), growth boundaries (Katz and Rosen, 1987; Cunningham, 2007), property taxes (Brueckner Jan and Kim, 2003), preservation programs (Nickerson and Lynch, 2001), and other general land use interventions (Brueckner, 2007; Gyourko et al., 2007; Glaeser and Ward, 2009). Theoretically, land use regulations are posited to increase land and housing prices by decreasing available supply, although a strong causal effect is not always found in the empirical literature (Quigley and Rosenthal, 2005). The lack of empirical evidence may stem from the difficulty of incorporating the range of local policies, but also due to impacts on lot and housing sizes

(Ihlanfeldt, 2007), or density and demographic changes (Glaeser and Ward, 2009). Therefore, in order to fully understand the effect of regulations, researchers must consider how these regulations impact land use.

The purpose of this study is to examine a water protection policy in order (1) to evaluate its efficacy, and (2) to understand the potential unintended land use consequences from decreases in development density. Specifically, I analyze an expansion of the coverage of the Clean Water Act (CWA) Section 404. Section 404 of the CWA gave the U.S. Army Corps of Engineers (hereafter Corps) and the Environmental Protection Agency (EPA) authority over land use in wetlands and navigable waterways (Guttery et al., 2000). The expansion of the CWA was the result of a 1985 United States Supreme Court ruling, *United States vs. Riverside Bayview*, 474 U.S. 121 (hereafter RBH). The ruling redefined the waters of the United States, increasing the jurisdiction of the Corps in the enforcement of the CWA. In this study, I use historical parcel-level data of residential subdivision development from a county in the Baltimore metropolitan region to examine how the regulatory expansion of the CWA changed development patterns, and I explore the trade-offs between water regulations and low-density development. I treat the RBH ruling as a natural experiment and use difference-in-difference techniques (Meyer, 1995) to evaluate the land use impacts. The difference-in-difference setup isolates the difference between the development patterns for parcels with and without water features before the ruling, and development patterns for parcels with and without water features in the post-treatment period, allowing for causal

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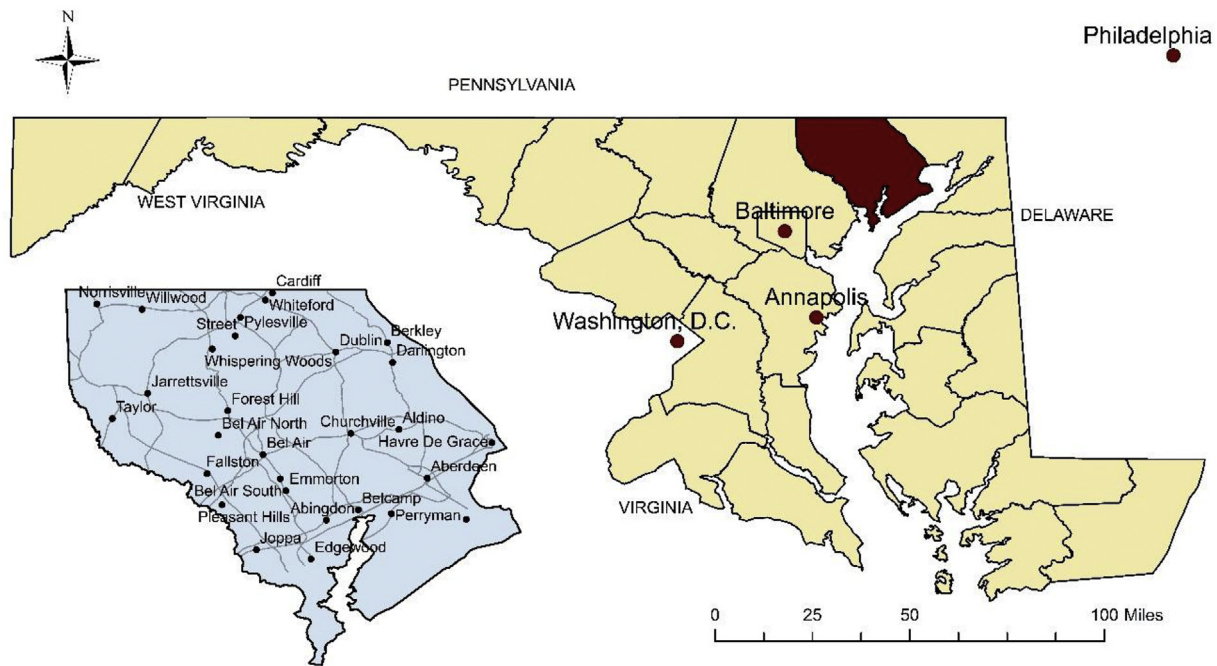


Fig. 1. Harford county and the Baltimore/Washington, D.C. MSA.

identification of the effect of the RBH ruling.

Prior research has found local land use policy has potential spatial spillovers into other geographic regions (Towe et al., 2017). In a similar fashion, this research examines whether local land use policy that targets the conservation of a particular natural resource (e.g. wetlands) could have adverse spillover effects on other natural resources (e.g. open space) in the same geographical region. Analyzing the implementation of the RBH ruling at a highly localized level allows detailed spatial effects, both intended and unintended, to be better understood, informing future environmental regulations.

2. Background

The United States during the 20th century experienced extensive land use change as large expanses of forests and wetlands were converted into subdivisions around cities, and into agricultural land to feed the growing population (Dahl and Allord, 1997). From the 1950s through the 1980s wetland loss amounted to nearly 500,000 acres per year (Dahl and Allord, 1997). In 1982, during the lead up to the RBH ruling, only 90 million wetland acres remained out of the historical estimate of 220 million acres (Dahl and Allord, 1997). Myriad factors contributed to wetland loss despite attempts to regulate wetlands starting as early as the 1899 Rivers and Harbor Act, which required permits for dredging, filling, and construction on United States waters (Spring, 1991). However, significant restrictions did not occur until the CWA in 1972, when the federal government directly regulated and protected wetlands from certain activities (Spring, 1991). Section 404 of the CWA designated land in areas with wetlands and navigable waterways as under the Corps jurisdiction (Guttery et al., 2000). The development process for these land parcels became substantially more difficult, increasing the length of time and the effort necessary to acquire development permits (Scodari, 1990).

Initially, Section 404 was restricted to protect tidal wetlands and navigable waters of the United States; however, differing interpretations of the precise language led to contention over the jurisdictions of waterways not traditionally associated with tidal wetlands. The RBH case was an example of the tension involved with this interpretation. The land developer, Riverside Bayview Homes Inc., was in the process of dredging and filling non-tidal wetlands for a development in

Michigan without the necessary exception needed if those waters fell under Section 404. The Corps filed a lawsuit against the developer claiming the definition of the waters of the United States covered the disputed area. The lawsuit reached the United States Supreme Court, which ruled in favor of the Corps. As a result, the Supreme Court ruling expanded the functional definition of the United States' waters to include intrastate wetlands as well as non-navigable tributaries (Manning, 1987). New water features under the Corps jurisdiction included tributaries and streams that experience periodic flooding or at least seasonal continuous flow (DeVoe, 1986). Furthermore, land adjacent to navigable waters were included as wetlands "even if not inundated or frequently flooded by the navigable water" (United States v. Riverside Bayview Homes, Inc, 1985) as long as the land was able to sustain aquatic vegetation through either surface or groundwater (Trichka, 1986). In Harford County, this new definition affected land developers, who were confronted with a vast stream and wetland tributary network. Land affected by these streams now required Corps approval for new development.

Previous relevant research on wetlands has largely focused on two broad questions. First, multiple studies have empirically estimated the value of wetlands (Barbier et al., 1997; Brander et al., 2006). These studies use a wide variety of valuation techniques (Freeman, 1993; Woodward and Wui, 2001), including contingent valuation (Brouwer et al., 1999), hedonic pricing (Kaza and BenDor, 2013), and travel cost methods (Creel and Loomis, 1992). Researchers have found that wetlands are valued for a variety of reasons, including increased property values due to the positive amenity of living near wetlands, value from recreation, and value derived from regulating ecosystem services (Boyer and Polasky, 2004; Brander et al., 2006). Second, a series of articles have focused on wetland loss mitigation, including policies of avoidance, minimization of impacts, and restoration (Clare et al., 2011). Researchers have found that restoration of damaged wetlands and streams influence land use patterns and economic development (Morris et al., 2008; BenDor and Stewart, 2011). Additionally, it is important to consider the spatial dimension within the ecological and economic modeling of wetland management (Van Den Bergh et al., 2012). Previous research has linked wetland valuation to the RBH ruling, finding that the ruling resulted in a small, negative price effect for houses inside wetland designated areas in Louisiana using a quasi-

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