

WINDFALLS FOR WILDERNESS:
LAND PROTECTION AND LAND VALUE
IN THE GREEN MOUNTAINS

by

Spencer R. Phillips

A dissertation submitted to the Faculty of
Virginia Polytechnic Institute & State University
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

in

Agricultural and Applied Economics

Approved by: Anya McGuirk, Chairperson of Supervisory Committee
Leonard Shabman
Jeffrey Alwang
T. Nicholas Tideman
Greg Amacher

February 4, 2004

Blacksburg, Virginia

Keywords: land prices, hedonic model, wilderness, conservation

ABSTRACT

WINDFALLS FOR WILDERNESS: LAND PROTECTION AND LAND VALUES IN THE GREEN MOUNTAINS

by Spencer R. Phillips

Chairperson of the Supervisory Committee: Anya McGuirk, Professor
Department of Agricultural and Applied Economics
Virginia Polytechnic Institute and State University

Land is a composite good, the price of which varies with its characteristics, including proximity to amenities. Analysis of data from sales of land near Green Mountain National Forest wilderness areas in a hedonic price model reveals a positive relationship between proximity to protected wilderness and market values for residential properties. The applications of this result include improved consideration of the positive economic impacts of land conservation in political deliberations over public land management and new mechanisms for financing land conservation, local planning and development efforts, and maintenance of affordable housing in high-amenity/high-cost areas.

For the just and proper use of Your creation

ACKNOWLEDGMENTS

First, I want to The Rice Family Foundation whose generous financial support has made this research possible. I especially thank Ed Rice, for his engagement throughout this and other efforts to better understand the relationship between conservation and economic conditions in the northeast.

Thanks also go to my colleagues at The Wilderness Society, especially Sally Wells for her steadfast encouragement over the years, Mark Wilbert for his help reprojecting GIS layers and otherwise boosting me up the ArcView learning curve, and Tom Bancroft and the rest of the Ecology & Economics Research department for support, inspiration and helpful comments along the way.

I am grateful to those who supplied the data for the empirical portion of this research. Bruce Westcott, then of the Vermont Center for Geographic Information and Charles Ferree of the University of Vermont Spatial Analysis Lab supplied most the geographic information systems layers, and Bob Burnett of the Vermont Department of Taxes made land transfer data available and helped sort out the translation from the Department's file format. (It is a testament to the duration of this project that the first batch of land transfer data came on 9-track tapes but the remainder was downloaded from the Department's web site.)

I am also heartily grateful to my advisory committee, to some for sticking with me, to others for joining later in the game, and to all for their direction and support.

Most of all, I thank my wife, Melissa, and daughters, Molly and Claudia, for their encouragement, understanding and forbearance. My greatest hope for this paper is that it contributes to the conservation for their sake, as Aldo Leopold put it, of "wild country to be young in."

TABLE OF CONTENTS

Abstract	ii
Acknowledgments	iv
Table of Contents	v
List of figures	vi
Chapter 1: Windfalls For Wilderness?.....	1
Overview and Research Objectives.....	1
Political Economy of Public Protection of Northeastern Wildlands.....	3
Public support for and opposition to land conservation	6
Chapter 2: Amenity, Scarcity and Rent.....	12
The Origins of Rent.....	13
Rural Amenities and Rent.....	18
Existing evidence.....	20
Amenity-Based Rent in Hedonic Prices.....	24
Guidance from existing research.....	25
Chapter 3: Estimating Enhancement Value of Green Mountain Wilderness.....	32
Land Price and Attribute Data.....	33
Land Transaction Data.....	33
Town Economic and Demographic Features.....	35
Parcel Location.....	36
Wilderness Indicators: How close and How Much?.....	37
Other Locational Factors.....	40
Definition of Study Area.....	46
Econometric Model and Estimation Procedures	48
Econometric Results.....	50
Chapter 4: Land Price Effect of New Potential Wilderness.....	57
Potential for New Wilderness Areas and Acreage.....	57
Simulation Procedure.....	59
Simulation Results, by Wilderness Indicator.....	61
The effect of the presence of any wilderness in town.	61
The effect of decreased distance to a wilderness area.....	65
The effect of an increase in the proportion of town land in wilderness.	69
Chapter 5: Implications and Applications.....	73
A Double-Edged Windfall.....	73
The Land Value System.....	74
Windfalls, Wipeouts and Wilderness.....	77
Existing Vermont Programs.....	78
A Windfalls for Wilderness Policy	81
Bibliography.....	87

LIST OF FIGURES

<i>Title</i>	<i>Page</i>
Map 1: Green Mountain National Forest, Existing and Potential Wilderness Areas.....	5
Figure 2.1: Bid Rent Function for a Single Production System.....	15
Figure 2.2: Bid Rent Functions for Multiple Production Systems.....	15
Figure 2.3: Spatial Distribution of Production Systems due to Transportation Costs.....	17
Figure 2.4: Spatial distribution of Production Systems with Transportation Costs and Geographic Discontinuities	17
Figure 2.5: Real Estate Advertisements Highlight Amenities Associated with Natural Areas, Public Land and Wildland Recreation Opportunities	22
Table 2.1: Summary of Land Price Influences	28
Map 3.1: Towns with Any Existing Wilderness (WILDTWN0 = 1).....	38
Map 3.2: Study Town’s Distance to Nearest Existing Wilderness Area (DST_WILD).....	39
Map 3.3: Percentage of Towns in Existing Wilderness (PCT_WILD)	41
Map 3.4: Town Distance to Nearest Major Road (DST_RD_1).....	42
Table 3.1: Data Fields and Sources	44
Map 3.5: Study Area	47
Table 3.2: Descriptive Statistics for Data Fields	48
Table 3.3: Regression Results	51
Map 4.1: Existing and Proposed Wilderness.....	58
Map 4.2: Change in WILDTWN0 – the Presence of any Wilderness Acreage, by Town....	63
Table 4.1: Effect on Land Prices of the Creation of New Wilderness Towns.....	64
Map 4.3: Change in DST_WILD – the Distance from the Town Center to the Nearest Existing or Proposed Wilderness	66
Table 4.2: Effect on Land Prices of Greater Proximity to Wilderness.....	67
Map 4.4: Change in PCT_WILD – the Proportion of Town Land in Designated Wilderness, by Town.....	71
Table 4.3: Effect on Land Prices of a Greater Proportion of Town Land Designated as Wilderness	72
Figure 5.1: Land Value Enhancement amid a Larger System.....	75

Chapter 1: Windfalls For Wilderness?

Nature's grace in the East offers the most important kind of hope, not only to a region that has been given a second chance to decide how to inhabit itself, but to a world in terrible need of models.

— *Bill McKibben 1995*

OVERVIEW AND RESEARCH OBJECTIVES

The development of cost-effective wildland management is hampered by the lack of research about the effect of wildland protection on rural land values. Nevertheless, conservation organizations, government agencies and others continue to advance policies regarding these issues at the federal, state and local levels.

Without this crucial land-value information, however, even popular proposals to increase public land ownership or to expand conservation-oriented land management may be opposed by those who fear such measures will erode private land values and the local tax base.

An alternative but no less prevalent concern is that conserving more land will attract possibly unwanted development in an area, thereby driving up land prices and reducing the ability of longtime residents to afford and maintain their land and homesteads.

Reliable information on the effect of conservation on surrounding land prices may serve to overcome the first concern as well as to suggest policy options for addressing the second.

Even when additional public land ownership or enhanced protection of wildland values is welcomed in a particular area, available funds for public land acquisition may be limited. If wildland conservation does in fact elevate nearby land prices — that is, it creates rent for landowners — then information about that effect might also be used to develop novel approaches to public land acquisition financing. For example, a portion of the windfall created by public action to protect wildlands could be used to fund further land purchases, or to service public debt incurred as part of the initial land protection effort.

The discipline of economics has long been concerned with certain determinants of land prices, such as soil productivity, the cost of transporting goods to urban markets, and commuting time to a central business district. Economics has not, however, produced sufficient information or policy tools for connecting rural land prices to the conservation of areas in a wild condition.

To help fill this gap in the context of current conservation opportunities in the northeastern United States, the inquiry described herein seeks to answer two questions.

1. What is the relationship between land protection and land value in a rural setting? More specifically, how does proximity to federally designated wilderness affect the value of private land, as measured by market prices?

Existing theory and empirical evidence from urban, suburban and exurban areas suggest that land values would be expected to increase with proximity to wilderness. A test of this hypothesis will fill a large gap in the information the discipline can offer to conservation organizations, land management agencies and other policy makers.

2. What institutional arrangements are available or might be considered for arranging a transaction among those who benefit from land protection, those who pay for land protection (i.e., the public and current owners of future protected areas) and those who could be adversely affected even by increases in local land values?

To answer the first question, I employ a spatial model of land rent adapted to land transaction and geographic data available for southern and central Vermont. That region contains the Green Mountain National Forest, which in turn contains six wilderness areas at the present time.

A review of available tools for capturing land rents addresses the second question. It also suggests scenarios for capturing wilderness-generated windfalls and using the proceeds to finance public land acquisition, address equity issues raised by such acquisition, and/or support planning and development efforts in the communities that host publicly protected wildlands.

Because the ultimate purpose of this research is to develop such tools for the northeastern U.S., I pay particular attention to land protection, land taxation and development planning institutions already in use in the region. Vermont's land transfer and land gains taxes may be especially appropriate for adaptation to a "windfalls for wilderness" mechanism.

POLITICAL ECONOMY OF PUBLIC PROTECTION OF NORTHEASTERN WILDLANDS

Efforts to identify wildlands in need of protection and to specify means of protecting them are underway across the northeastern United States. Following years of study and discussion under the auspices of the Northern Forest Lands Council, the states of Maine, New Hampshire and Vermont have established land acquisition planning processes.¹ (New York, with its Adirondack Park, has had a similar mechanism in place for some time.)

The Northern Forest Alliance, a coalition of more than forty conservation and community organizations and businesses, has proposed the protection of some 6.7 million acres in a network of ten "wildland areas" spanning the region. These wildland areas would include a mix of managed timberlands and wilderness. Other organizations' proposals include a 3.2 million acre Maine Woods National Park and an 8-million-acre network of ecological reserves that would include much of the northern parts of Vermont, New Hampshire and Maine.

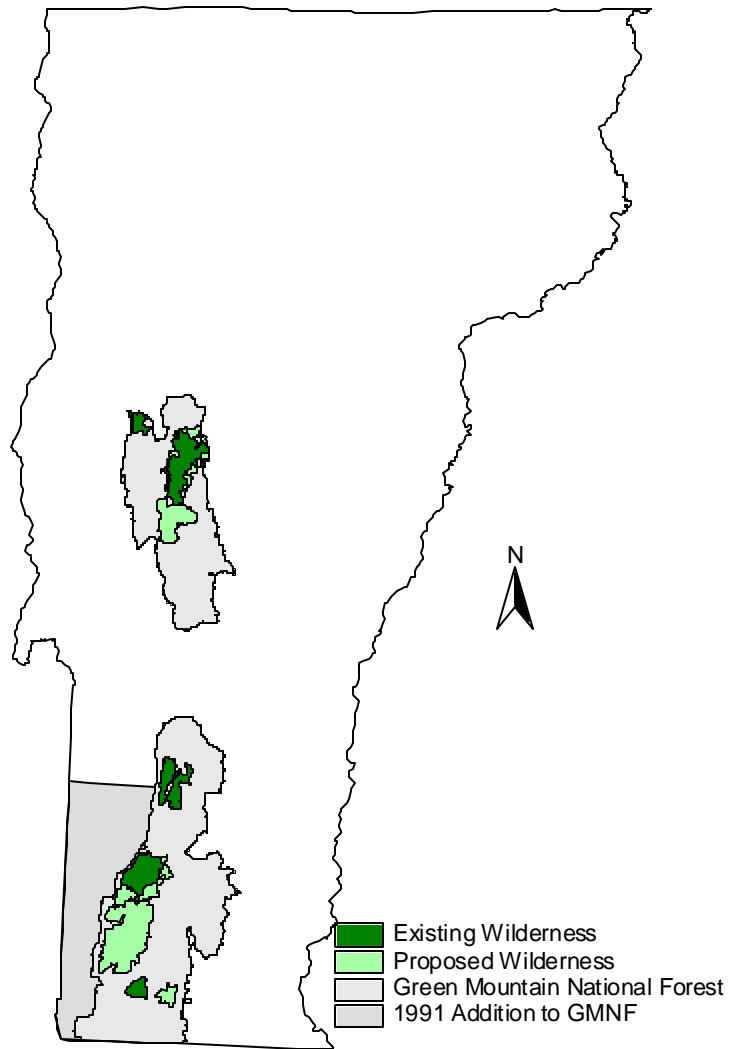
Most germane to this study, the Vermont Wilderness Association and grass roots groups in New Hampshire have coalesced around the designation of lands within the Green Mountain and White Mountain National Forests, respectively, as wilderness. According to the Vermont Wilderness Association, for example, more than 78,000 acres of land in six areas that are already part of the Green Mountain National Forest could become

¹ Land acquisition planning is among the final recommendations of the Northern Forest Lands Council. See the Northern Forest Lands Council, 1994, *Finding common ground: conserving the Northern Forest*, Concord, NH, September and background material cited therein for more information about the Council, its work and land conservation issues in the larger Northern Forest region.

wilderness². If so designated, this acreage would more than double the amount of wilderness in the Green Mountain National Forest (see Map 1).

² “Wilderness,” or “wilderness areas” refers to those portions of land owned and managed by the U.S. government designated as such by Congress under the provision of the Wilderness Act of 1964 or the Eastern Wilderness Act of 1975. According to the Wilderness Act, these areas are places “where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. ... [A wilderness area] is protected and managed so as to preserve its natural conditions.... (Wilderness Act, §2(c))” Existing wilderness areas within the Green Mountain National Forest were established by the Eastern Wilderness Act (1975) and the Vermont Wilderness Act of 1984.

Map 1: Green Mountain National Forest, Existing and Potential Wilderness Areas



Note: In 1991 the Green Mountain National Forest “Proclamation Boundary” was extended westward to the New York border, adding the hatched area on the map to the territory within which the USDA Forest Service may acquire lands for the National Forest. Since 1991 however, few parcels have been acquired within the added area. Nor has the Forest Service assigned the land it has acquired to any particular use. (Such assignments will be made during the Land and Resource Management Plan revision process now underway, but not to be completed before 2006, at the earliest.) Because the focus of my inquiry is wilderness areas wholly contained within the old proclamation boundary, I am ignoring the new boundary for this version of the study. Nevertheless, and as illustrated Map 3.5, below, much of the area covered by the new proclamation boundary is also included in the study area.

Public support for and opposition to land conservation

By many measures, public support for these and other conservation proposals seems to be high. For example, the US Forest Service surveyed residents of the three northeastern counties of Vermont and the northernmost county of New Hampshire in 1991 (Echelberger, Luloff and Schmidt 1991). The survey "...revealed that a majority of residents from both states would support public land purchase to protect wilderness, maintain recreational opportunities, protect wildlife habitat, and assure a continued supply of timber (p. 20)."

This interest in protecting land through public ownership was echoed in 1994 in a series of hearings, called "listening sessions," convened by the Northern Forest Lands Council in places as diverse as New York City and Presque Isle Maine. Over the course of the 20 sessions, nearly 800 citizens offered their opinions on the Council's draft recommendations (1994). A majority (77 percent) of the speakers supported additional public land ownership for the region and urged the Council to include such a strategy for conservation in its recommendations to Congress (Northern Forest Alliance 1994).³

Two further surveys of New England residents' values and attitudes toward management of the Green Mountain and White Mountain National Forests, respectively, found strong support for wilderness designation. In the Green Mountain study (Manning et al. 1996), 58 percent of respondents agreed with the statement "More wilderness areas should be established on the Green Mountain National Forest." A larger majority, 64 percent, of respondents to the White Mountain survey agreed with a similar statement (Manning et al. 1998).

³ Because attendance and participation, through speaking, at the listening sessions is the result of self-selection, this high degree of support may not be representative of the opinions of the region's entire population. That is, attendee/speakers may be more likely than the general population to have had an opinion about the Council's recommendations. A random sample of residents might have found that many respondents had no opinion, which would have diluted measured support for, as well as opposition to, greater public land ownership. Because the listening sessions were equally accessible to all persons there is no reason to suspect bias in the result that support for public land acquisition is greater than opposition to it. Coupled with the results of the more scientific surveys cited, opinions expressed at the Council's listening sessions does suggest support of public land conservation efforts in the Northeast.

These studies also found that economic values are least important among the many values of forest resources, including ecological, aesthetic, educational, scientific and spiritual values. More than nine out of ten survey respondents rated the aesthetic and ecological values of the Green Mountain National Forest as “moderately” “very much” or “extremely” important (Manning, et al. 1996). By contrast, economic forest use values were given that level of importance by only 37 percent of respondents. Similar results were obtained in the study of attitudes toward White Mountain National Forest management (Manning et al. 1998).

Despite this popular support, opposition to increased public land ownership or wilderness designation of current public land remains. To varying degrees, land conservation efforts such as those mentioned above change ownership and/or change management priorities on publicly owned land. These changes are likely to spawn a range of economic impacts, and it is economic impacts, both real and perceived, that are often cited as reasons to oppose public conservation efforts.

From citizen’s testifying at public hearings, to forest products industry spokespersons writing comments on public land acquisition proposals, to elected officials opining on the impact of conservation measures, economic impacts do loom large in public conservation debates.⁴ Those impacts include reduced access to natural resources for commercial extraction, loss of income and jobs associated with resource extraction, land development,

⁴ This observation, though difficult to quantify, is based on my own experience participating in those debates over the past eleven years. Documented expressions of what has been called the “jobs versus environment” viewpoint in the Northeast include: comments of Kerrick L. Johnson of Allied Industries of Vermont on the U.S. Fish Wildlife Service’s proposed “Options for protecting the Nulhegan Basin special focus area,” in U.S. Fish and Wildlife Service, 1999, *Final Environmental Assessment: U.S. Fish and Wildlife Service participation in a partnership to protect “the Champion lands” in Essex County, Vermont*, Hadley, MA: U.S. Department of the Interior; comments of Maine Governor Angus King and others reported in Rimer, Sara, 1996, “In clear-cutting vote, Maine will define itself,” *New York Times*, September 25, p. A1; comments of Bill Sayre of Allied Industries of Vermont regarding the Clinton Administration’s roadless area protection proposal, quoted in Associated Press, 2000, “Forest protection plan draws ire from loggers, environmentalists,” June 28; and another Associated Press article citing Maine “land rights activist” Jon Reisman who is concerned that the national park proposed for northern Maine would result in “a loss of industries and jobs associated with the woodlands that would be taken out of production (Adams, G., 2000, “Survey shows support for Maine national park,” Associated Press, appearing in the *Burlington Free Press*, July 25, p. 5B).”

or certain recreational uses⁵, and impacts on surrounding property values and the local tax base.

These economic effects may be greatest with wilderness designation, as opposed to other land conservation strategies. Wilderness designation affords a high degree of permanent protection from development and degradation, or “impairment” in the words of the Wilderness Act (§2(a)). Wilderness areas are permanently off-limits to commercial resource extraction, motorized equipment, mechanized transportation and man-made structures (§4(c)).

Removing wilderness areas from the land base available for commercial timber harvest, mining, development of alpine skiing facilities and mechanized recreation, and other uses permitted elsewhere on National Forest lands may reduce the regional economic potential of those activities. If so, and to the degree that land prices reflect opportunities for extractive and other more intensive uses of National Forest lands, land prices would be expected to be lower in communities closest to wilderness areas. The tax base in those towns would therefore be smaller, and financing public infrastructure and services would become more difficult. If this scenario is true, political opposition to further wilderness designation would come not only from those who cut and process National Forest timber or sell fuel to snowmobile users. It would also come from local public officials concerned with municipal or county budgets.

At the same time, wilderness designation ensures the availability of other resources and values, such as scenic beauty, peace and quiet, opportunities for solitude and non-mechanized recreation into the indefinite future. As discussed further in the next chapter, those values, and their long-term protection, may attract or retain residents, vacationers and the businesses that serve them.

The amenities associated with wilderness areas also may attract footloose businesses, including especially those taking advantage of new technology as well as information and

⁵ Hunting, for example, is not permitted in National Parks, trapping is generally not permitted in National Wildlife Refuges, and mechanized recreation is not permitted in wilderness areas.

transportation networks (e.g., internet, cellular telephone, overnight package delivery) to serve clients in other places (Levitt 2000; Florida 2000; Lorah 2000; and McGranahan 1999). Such in-migration can have a number of effects, including dilution of local “custom and culture,” increased public service costs as municipalities serve a growing population with roads, emergency services and schools, and increased residential property prices – the focus of this study.

While some of these impacts represent a potential boon to some towns and some local residents, they could be a detriment to others. For every landowner who sells land to an in-migrant at a higher price than he might get in the absence of the attractive local amenity, the child of a long-term resident may find himself priced out of the local housing market. As market land prices rise above assessed values, reappraisals could result in long-time residents’ inability to afford to pay local property taxes.⁶

Whether local property values are higher or lower with wilderness, the views and concerns of public officials and residents in communities in or near the National Forest are extremely important to political debates over how much land the Forest Service should manage and how it should manage it. First, National Forest managers often seek (but do not require) the approval of town officials before adding land to the federal estate. Second, public hearings and other opportunities for providing comments and getting information on National Forest management are more accessible to people who live near the National Forest itself. Local views and concerns regarding the impact of management changes will therefore be disproportionately represented in the decision-making process⁷. Third and finally, local public officials are an important constituency for state congressional delegations who introduce federal legislation both to appropriate funds for the purchase of land to be managed by the Forest Service and to designate additional wilderness in their

⁶ Vermont’s statewide property tax law, Act 60, requires this reappraisal when assessed property values in a town fall below 80 percent of equalized value (market value as estimated by the Vermont Department of Taxes, Division of Property Valuation and Review) (32 V.S.A. 4041a). This effect would be less likely in states where such reappraisal is not required.

⁷ In principal, all U.S. citizens have an equal stake and say in National Forest and other federal land management. As a practical matter, however, federal land managers will hear more from local people and, consequently, local views will have a greater influence on management decisions.

states. Clearly, additions to the Green Mountain National Forest and its wilderness areas are far less likely to happen without addressing local economic concerns.

Just how managers, conservation advocates, legislators and others address those concerns, however, depends crucially on the direction of the impact – does the higher degree of protection from development and impairment afforded by wilderness designation raise or lower property values? Will additional wilderness designations turn vibrant communities with economies based on processing National Forest timber into ghost towns with deflated land prices? Or will additional wilderness attract new residents and entrepreneurs who create a boom town based on diverse forest and community resources where land prices escalate, possibly to the point where long-time residents can no-longer afford to stay?

Environmental economics can suggest a range of policy solutions that would compensate residents, businesses and town governments for land price impacts in either direction. But compensation mechanisms that assume an impact in one direction will be useless if the impact turns out to be in the other direction. Compensating landowners for lost land value due to management changes, for example, would be of little value if the changes actually push land prices up. Conversely, supplying public funds for planning or for infrastructure improvements to address amenity-driven in-migration will not help a ghost town.

In light of this dilemma, and as stated under “Research Objectives” above, the first challenge in crafting the right set of policy options is to determine the direction of land price impacts associated with wilderness. Once that is known, the second challenge – to develop policy instruments that could address the needs of individuals and communities adversely affected by such land price impacts – can be approached.

I present below a conceptual framework within which to consider the question and an econometric test of the hypothesis that wilderness has no relationship to nearby private land prices. Based on estimates of the relationship between wilderness and land prices obtained in the course of that test, I then simulate the effect of additional wilderness designations on land prices throughout the Green Mountain National Forest region.

Finally, the conceptual and econometric model inform a sketch of policy options for assisting individuals and communities affected by wilderness-associated land value changes and possibly, for financing additional land conservation efforts in the first instance. Because land value changes are but one facet of local community and economic conditions, policy options are presented in the context of an overall system of relationships between land conservation, land value and other factors.

Chapter 2: Amenity, Scarcity and Rent

In rural areas where most land is open space and likely to remain so . . . both market and enhancement value will be negligible.

Charles Faushold & Robert Lilieholm (1996)

I'm not aware of studies [of environmental factors and land values] looking at rural locations.

Myrick Freeman (1997)⁸

Paradoxically, Faushold's and Lilieholm's assertion follows their recounting of numerous study results suggesting that natural amenities, such as parks, greenways and open space enhance land value in non-rural areas. Freeman, on the other hand, does not conclude a lack of enhancement effect from a simple lack of studies. Quoted in the *Vermont Environmental Report* (March 1997), he allows that what is true of land near urban parks might also be true of land near a remote wilderness. (He explains the lack of studies by the paucity of good data on rural land prices and characteristics.)

Despite their conclusion that a lack of evidence suggests a lack of effect in rural areas, Faousold and Lilieholm do cover the evidence from urban areas quite well (see also Weichert and Zerbst 1973). Willam Fischel (1990) provides a similar overview of the evidence concerning the other side of the open space amenity coin – the effect of growth controls (often to preserve open space) on land markets.

Together, these authors' meta analyses lay out the case that public land policy influences land value both in the provision of amenities and the restriction of land use. Providing amenities can enhance the value of certain parcels because their location close to the amenity is beneficial or desirable to the parcels' owners. Limiting overall conversion of land to more intensive uses (from timberland to residential development, for example) can

⁸ Freeman's quote appeared in Lindner, W., 1997, Taking the measure of aesthetics, *Vermont Environmental Report*, Montpelier Vermont: Vermont Natural Resources Council, March, pp. 18-21.

increase the value of **all** parcels available for development by making such parcels more scarce.

As these increases in land value accrue to landowners through no effort of their own to improve their own properties, the increases are true additions to the parcels' rent. Hereinafter, the added value due to where a piece of real estate lies, and how much is available for development are termed *location* and *scarcity* rent, respectively.

THE ORIGINS OF RENT

The notion that the characteristics and location of a parcel of land can influence its price is as old as economics itself, with David Ricardo and Johann von Thünen credited with organizing a theory of land rent. In their construction, as now, rent is the unearned portion of the price of an asset. Ricardo focused on the fertility or agricultural productivity of parcels, which in his day was generally not earnable in the sense that farmers or landlords could affect fertility through the application of labor. Instead, site productivity came to landowners as an endowment from nature. Sites with the greatest endowment are the first ones brought into production, for on these sites, returns are highest. As demand for agricultural produce increases, bringing progressively less fertile land into production becomes financially feasible (Alonso 1964; Brooks 1987). Where expansion of cultivation was restricted, say by a limited supply of land capable of supporting crops, added returns to agricultural production would accrue to owners of land already cultivated – scarcity rent.

Ricardo also considered that the distance that agricultural produce would need to be carried to market (usually, in a city center) to be another source of rent, with parcels closer to market garnering higher rent. It was von Thünen, however, who developed that observation into the idea of a bid rent function that determines, in part, the spatial arrangement of land uses.

Von Thünen began with a simple model in which a central city representing the market for agricultural produce lies at the center of a flat, river-less, road-less, and uniformly fertile

plain. In addition to the cost of producing agricultural goods, farmers and landlords must also bear the cost of delivering those goods to market. If only one agricultural commodity is produced near and sold in the city, a single bid rent function describes the location rent of a unit of farmland at each distance from the city (Figure 2.1). The amount of rent that a producer would bid for land at the city center would be equal to the full difference between the price of his produce and its production costs (r_0 in Figure 2.1). From the point of intersection with the vertical axis, the bid rent function slopes down with increasing distance from the market. The slope of the bid rent function is -1 times $c(t)$, the cost of transporting the farm's produce one linear unit closer to the city.

Von Thünen enriches his model by adding more commodities, each with a different price and biological characteristics that affect its cost of transportation. Milk, for example, has higher transportation costs because it is heavy and spoils quickly. (If it spoils before reaching the market the effective cost of transportation becomes the full market price of the milk.) Dairy farmers, therefore would bid more for land close to the market. Livestock might be less expensive to transport because, while heavy, it carries itself. Making sure it carries itself to the right place is labor intensive however, so beef producers might bid less than dairy farmers for land closest to the city but more for land a little farther out. Grain or vegetable producers, for whom transportation costs are lower, would occupy the fertile land farthest from the city center.

Figure 2.2 displays hypothetical bid rent functions for three production systems. Agricultural land closest to the city (from 0 to d_m) is devoted to the production system bidding the highest rent per unit of land – milk, in the example. At d_m , beef producers begin to outbid milk producers for land, and beef production dominates the landscape at a distance of d_m to d_b from the city. In turn corn growers outbid beef producers starting at d_b , and corn is produced from distance d_b from the city out to d_c , beyond which the transportation costs are greater than the market price of corn, less its production costs.

Figure 2.1: Bid Rent Function for a Single Production System

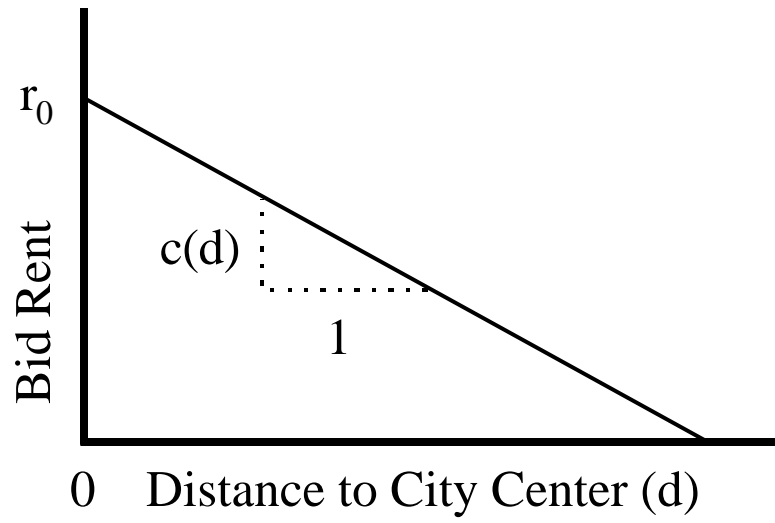
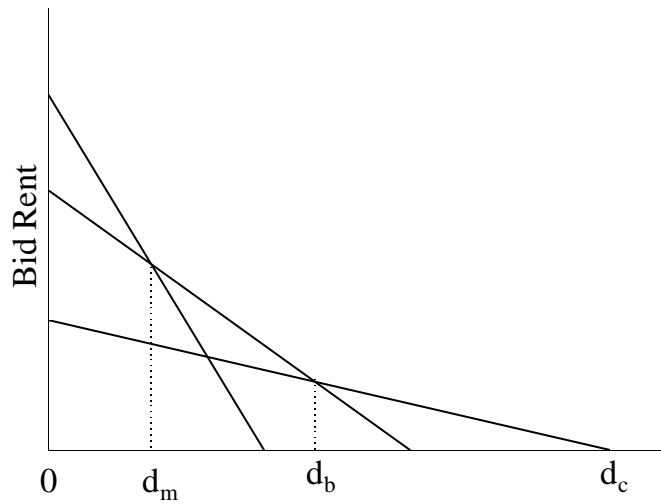


Figure 2.2: Bid Rent Functions for Multiple Production Systems



Remembering that von Thünen assumed that the city (at the origin in Figures 2.1 and 2.2) lies on an unbroken plain and imagining the bid-rent functions Figure 2.2 as pencils on a compass spun around the vertical axis conjures the spatial arrangement of agricultural land uses around the city. Depicted in Figure 2.3, concentric rings of dairy, beef and corn production illustrate the pattern of land use in von Thünen's simple model.

Early complications of his model involved roads, canals and rivers, which reduced per-unit transportation costs for parcels near the roads, and, consequently, increased the rent offered for those parcels. As a result, farmers might bid more for land close to a road even if it is farther from the central city than otherwise identical land. Roads radiating from the central city or a river flowing past the city might produce a star pattern of land use such as that depicted in Figure 2.4. Due to discontinuities the roads and river impose on the landscape, goods with relatively high transportation costs can be produced on land farther from the city than some land still devoted to production systems involving lower transportation costs.

Other natural features, such as mountains or non-navigable rivers, introduce further discontinuities that would raise transportation costs for some parcels. The logic of von Thünen's model suggests that more would be bid for land on the city side of these features.

Heterogeneity in site productivity and agglomeration economies further season von Thünen's plain model and point toward the application at hand. Higher bids for relatively more productive sites will perforate and distort the concentric rings and stars of Figures 2.3 and 2.4. Higher productivity means lower production costs and greater net revenues. That greater revenue, in turn, allows the producer to cover higher transportation costs and locate production farther from the central city, thus bidding up the price of more distant parcels. Similarly, lower productivity on sites close to the city could render those sites unsuitable for the production of higher cost goods. As a result, pockets of dairy production could arise in the Beef and Corn rings, beef production could migrate to the Corn and Dairy rings, and so on.

Figure 2.3: Spatial Distribution of Production Systems due to Transportation Costs

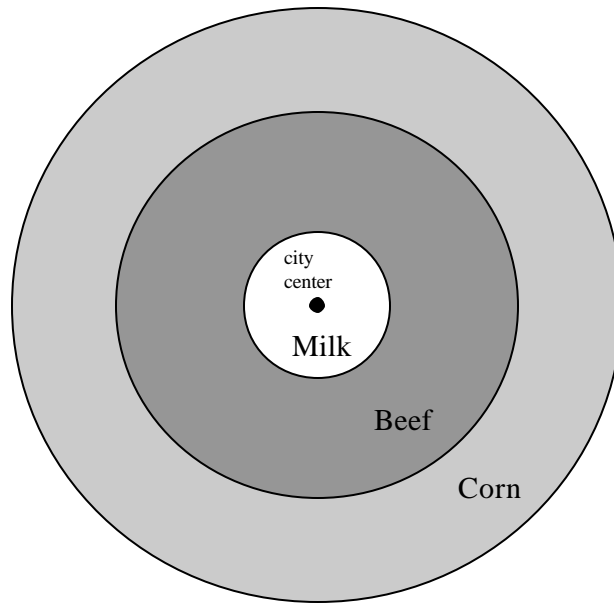
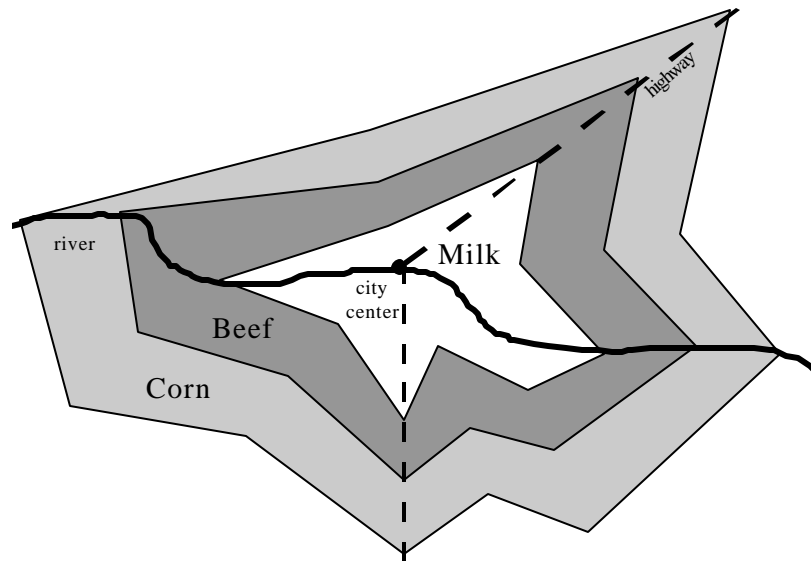


Figure 2.4: Spatial distribution of Production Systems with Transportation Costs and Geographic Discontinuities



Agglomeration economies are available when the costs of production for one system are reduced by the presence of a complementary production system. For example, proximity to a supply of calves or a supply of grain would be valuable to the beef producers of the simple model. Therefore, beef producers might bid more for land near both the inner and outer edges of the Beef ring of Figure 2.3. (At least part of the market for corn, in that scenario, is located not at the center of the city, but in the beef ring. That would push the outer corn production boundary beyond d_c in Figure 2.2 into what we would today call the agricultural/wildland interface.)

Further variations on the Ricardo and von Thünen models introduce technical and other externalities associated with nearby land uses – Coase’s factory/laundry scenario, a scenic vista or recreational access to a lake, for example – and a host of site characteristics that might influence a particular parcel’s productivity in a given use and, therefore, its rent. The mechanical and petrochemical revolutions, which allowed landowners significant control over site productivity, have obscured the von Thünen model’s original focus on the spatial distribution of agricultural production and the price of farmland. Its underlying logic however, that where a parcel of land lays and how much land of similar quality is available can determine its price, is undimmed.

RURAL AMENITIES AND RENT

Ricardo and von Thünen’s farmers and landlords located production systems to maximize the returns from production. Freed from the limits of organic soil productivity and the slow pace of animal-powered transportation, agricultural production is now much more footloose – it need not locate particularly near markets for its produce or on the most fertile soil. Other considerations, such as minimizing land acquisition costs or satisfying preferences unrelated to farms’ production costs, can play a larger role in determining agricultural land use.

The same is increasingly true of non-agricultural production. New technologies, services and infrastructure, from the fax/modem and Federal Express to the internet and interstate highway system have freed more and more industries from former needs to be close to

either input supplies or output markets. For example, overnight package delivery service allowed Numberall, a machine tool manufacturer, to move from Long Island, New York to Guilford, Maine for the latter's small town atmosphere, pace of life and opportunities for backcountry recreation (Morel 1996). Similarly, Essex Junction, Vermont boasts a large IBM facility – the state's largest private employer – that was sited in the state due to a key IBM manager's enthusiasm for Vermont skiing. More recently, two large service industry firms have begun recruiting employees in Vermont who will use the internet, primarily, to execute financial transactions and perform medical transcription, respectively, from home offices (Robinson 2000a,b).

Beyond such anecdotes, economic development researchers have concluded that rural job creation occurs not so much as a result of firms locating where costs are low, but rather, from the entrepreneurial activity of managers and others choosing locations where amenity values are high (Rasker and Glick 1994). (See also Knapp and Graves 1989; McGranahan 1999; Levitt 2000; and Florida 2000). Surveys of business owners and residents reported by Rudzitis and Johansen (1989), Rasker (1994) and Johnson and Rasker (1995) indicate the strong role of amenities in rural economic development. Contrary to the conventional wisdom that firms prefer to locate in areas with a good “business climate” – that is, cheap labor, low taxes, pliable local public officials, and lax environmental regulation – these authors conclude that scenic settings, recreational opportunities, environmental quality, small town atmosphere and pace of life, and other amenities often available in rural, partially protected landscapes are more likely to drive businesses' location decisions.

Such observations bolster an emerging “supply-side” model of rural development.⁹ In this model, amenities attract migrants, who then create jobs both by their own entrepreneurial activity. Because these in-migrants represent greater local labor supply and greater local demand for goods and services they attract still more new firms. In short, people follow amenities and jobs follow people (Johnson and Rasker 1995).

⁹ The alternative “demand-side” model underpins economic base modeling and holds that increases in raw material throughput increases demand for labor, driving up wages and stimulating in-migration.

Evidence from these surveys about the motivation behind firms' and individuals' migration agrees with previous theoretical and econometric research focused more on results of migration decisions. Knapp and Graves (1989), for example, develop the idea that amenities are capitalized into wages, rents and other prices – that is, people would be expected to accept lower wages, and/or pay more for housing and other goods in areas with more amenities.

Roback (1982 and 1988) provides econometric evidence that amenities do explain differences in workers' wages for different cities. Roback's work extends to wages the long-established result from land and urban economics that amenities influence land rents.

Existing evidence

Like Roback's investigation into wages, the existing body of research into the relationship between local amenities (and regulations designed to protect or enhance them) and land values draws almost exclusively from urban and suburban experience. In part, this is the natural consequence of the lower cost of obtaining data concerning urban land prices. Comprehensive planning and zoning are generally less prevalent in rural areas, so the need in rural areas for computer databases covering land transactions and land uses, let alone digitized parcel maps or other resources that would ease the task of public land use regulation as well as spatial econometric modeling is small.

The lack of land value research focused on rural landscapes may also stem from a view of rural development in which natural resource extraction and primary processing of those resources dominates other migration and land management objectives. In this view, land is valuable largely because it is close to a central business district, or because it is suitable for agricultural, silvicultural, energy or mineral production. However, numerous studies have obtained the seemingly counterintuitive result that economic returns from such production generally do not affect the disposition or allocation of rural land. Instead, population pressure and the attendant opportunity cost of withholding land from development tend to drive rural land use decisions. (See, for example, Phillips 1991; Alig 1986; and Alig, White & Murray 1988.)

There is some anecdotal evidence, however, that rural amenities are associated with rural land values. Rasker and Glick (1994) for example, note that while so-called “amenity-based growth” does alleviate rural unemployment and other problems associated with declines in resource extraction-based industries, it often brings its own set of problems, not the least of which are manifest in land markets.


Scarce housing goes to the highest bidder – often the big-city transplant. Gentrification is pushing many local house hunters out of the market. In Jackson Hole, for example, few employees in tourism services can afford housing in town. Land and housing prices have tripled in the last 15 years.... In Bozeman, mid- to low-priced housing is practically nonexistent, and the competition for such properties is fierce. A “feeding frenzy” has ensued in the real estate market, further driving up prices . . . (p. 41).


Jackson and Bozeman are gateway communities to Yellowstone National Park and its surrounding National Forests. It is reasonable to speculate that their rising land prices reflect their proximity to the open space, scenic, recreational and other amenities associated with publicly protected land. National Parks and National Forest wilderness areas are unlikely to be converted to other uses. Therefore, whatever rent accrues to nearby land as a result of that protection may be greater than would be the case if the open spaces of the Greater Yellowstone were privately owned and simply not yet developed, or if a greater portion of the region’s National Forests were open to resource extraction.

Realtors advertise the proximity of house lots to public land or private land with easements (see Figure 2.5). Private land management companies are filling a niche for minimum residential development on large parcels. The opportunity cost of not developing the parcels more intensively is offset by proceeds from the sale of easements on, or fee title to, portions of the parcels to government agencies or private conservation organizations, revenue from low-intensity timber management, and, most significantly, higher sale prices for the developed portions of the parcels.¹⁰

¹⁰ The regional archetype of such land management/development/timber companies is the Lyme Timber Company. Information avowedly applies such a strategy in agricultural areas (G. Phillips, 1995).

Figure 2.5: Real Estate Advertisements Highlight Amenities Associated with Natural Areas, Public Land and Wildland Recreation Opportunities





MLS #: 2000263

Style: Chalet

Price: 74500

Town: Mount Tabor

Location: South End Rd

Acreage: 1.01


Huntington \$287,900 Immaculate designer home on 10 acres surrounded by forest only 45 minutes to Burlington. Mountain views, brook.

Walk to Long Trail. Built in 1995 by local artisan, it merges Victorian farmhouse appearance with open contemporary interior. 3 bedrooms, 2-1/2 baths. – SOLD

Source: <http://www.picketfencepreview.com>, 8/14/2000

Comments: Borders the National Forest.


Source: <http://www.remaxstar.com>, 8/14/2000

SELL
BUY
HOW-TO INFO
AREA INFO
SERVICES
LOANS

Search
Town Info
Tax Rates
Subscribe

Buyer Survey



Private and tucked away, Cape with 3.47 acres with property abutting the Vermont Audubon land. 4 bedrooms, 2-3/4 baths, family, dining, and large living room. 2150 sq. ft. Wonderful floor plan. Full basement and attached 2-car garage. Oil hot water heat. Fenced-in yard.

Want to take a hike, cross-country ski or snowshoe? Do it from your own backyard into the Vermont Audubon 300+ acres! Get to ski areas and major shopping areas in 1/2 hour. House was built in 1989. New roof in 1999. A must see property! \$187,500 Huntington

Source: <http://www.picketfencepreview.com>, 8/14/2000

Note: These advertisements have been modified by removing homeowner identification to protect privacy and, in the case of the lower ad, reformatting to save space.

22

Even the internal revenue service recognizes the enhancement value of land protection. The value of a deduction from income claimed for the donation of a conservation easment must be reduced by the increase in the value of other property owned by the donor or related persons (Treasury Regulations § 1.170A-14(h)(3)(i)).

Two recent studies from the northeast examine the relationship between land conservation and property taxes – a dim reflection of property values. In New York’s Adirondack Park, where towns are reimbursed for property taxes forgone on land added to the state-owned Forest Preserve, the first study found no relationship between tax bills and land conservation (Ad Hoc Associates 1996). This suggests that, at a minimum, property values are not diminished by land conservation.

The second study, which focused on public and private conservation of land in three coastal Maine towns, found that land protection is often associated with higher tax **bills** in the short run (Ad Hoc Associates 1997). The study also found that tax **rates** are generally lower in towns with more open land. Therefore it is possible that the increase in tax bills are due to increases in property values, rather than conscious decisions on the part of town taxing authorities to make up for tax revenue lost when conserved land is removed from the tax base. The author does not explore this possibility in the study, however.

For now, such possibilities must remain speculation, for, as Freeman observes above, little is known about the spatial relationship between land protection and land value in rural areas. More than 20 years of research into similar issues in urban and suburban settings, however, does suggest that proximity to open space amenities is a significant source of location rent (e.g., Weicher and Zerbst 1973). Still more research suggests that protecting those amenities also enhances scarcity rent by restricting the supply of land available for development. Both bodies of research identify further characteristics of land parcels and the overall land base that influence land prices.

AMENITY-BASED RENT IN HEDONIC PRICES

Farmers in the Ricardo / von Thünen model sketched above exhibit a willingness to pay for a farm parcel that depends on a small set of factors, namely, the value of crops produced (net of the cost of producing them), and the cost of overcoming the parcel's distance to the market. Similarly, purchasers of land for other uses exhibit a willingness to pay that depends on their incomes (like net revenues from the sale of crops) and various characteristics of the parcel and its surroundings.

For urban office workers, commuting distance to the central business district may take the place of the farm's distance to the market. For the "modern cowboys" of the Greater Yellowstone, distance to scenic amenities may become the distance most relevant to willingness to pay for land. In the northeast, whether a ski lift is nearby could be more important.

More generally, bids for land are likely to vary with the use intended for the land, access to major highways, local property tax rates, the character of the community in which the parcel is located (population and housing growth rates and the level of rental and seasonal housing, for example) and owners' income. Characteristics of the land base, including its overall size and distribution among protected and non-protected uses – that is the degree to which development is restricted – are also likely to influence land prices.

In economic parlance, the many factors that influence the price of land render it a *composite good* and the value at which it is exchanged a *hedonic price* (Rosen 1974). When the demand-relevant characteristics of a composite good are known, it becomes possible, at least conceptually, to decompose the price of the good into the marginal value of each characteristic.

More formally, Rosen describes a composite good \mathbf{z} as the collection of its m characteristics, or $\mathbf{z} \equiv (z_1, z_2, \dots, z_m)$. The price of the composite good, then, is described by $p(\mathbf{z}) = p(z_1, z_2, \dots, z_m)$. Products with different combinations of the m attributes will trade for different prices in the market. Researchers interested in the value of one particular attribute, say z_i , would compare prices of composite goods that differ only in that attribute.

Mathematically, that means computing the first derivative of the price function with respect to the level of the attribute. Econometrically, it means regressing the price of the composite good on the level of each attribute and examining the attributes' estimated coefficients. Either way, the marginal price function, $p_i(\mathbf{z}) = dp(\mathbf{z})/dz_i$, or regression coefficient, β_i , indicates the value of the last unit of attribute z_i in composite good \mathbf{z} when the levels of all other attributes of the composite good are equal.

In the present study, the attributes of interest are those that indicate proximity to or local abundance of national forest wilderness acreage. If z_i is proximity to wilderness, for example, and the associated coefficient estimate β_i , is positive, one may more confidently speculate that wilderness areas do enhance the rent of nearby land.

Guidance from existing research

Leaving the actual estimation of the price of land near Vermont's wilderness areas for the next chapter, it is now instructive to consider the range of land attributes found important in other studies. Table 1, below, summarizes the most applicable results of several studies of land prices and land attributes. For each study included in the table, the attributes of most interest to this application are listed, along with the direction of each attribute's influence (+ or -) when the influence is statistically significant.

By limiting the range of uses allowed on individual parcels of land, zoning has the effect of restricting the supply of land for each possible use. The supply of land for residential housing, for example, would be limited to the sum of the acreage of all parcels in residential zones. While not stating it quite this way, Pollakowski and Wachter (1990) test the hypothesis that such restrictions generate scarcity rent for owners of residential housing in Montgomery County, Maryland. They find that planning areas within the county with more restrictive zoning experience higher housing prices. They also found a spillover effect in that housing prices in a given planning area rise with the relative restrictiveness of zoning in adjacent areas.

Thus restrictive zoning can produce rent within a locality by limiting the local supply of developable land. It can also produce rent elsewhere by shifting demand for such land to localities with fewer restrictions on development. Because individuals cannot build residences on National Forest land (and no one can build anything in wilderness areas), Pollakowski and Wachter's study suggests that the presence of wilderness in a Vermont town could increase land values both in that town and nearby towns.

Traditional zoning can be effective in limiting and directing the amount of land devoted to particular uses. It can also, however, contribute to sprawl and leap-frog development, where low development density and segregation of uses can entail more time driving for residents and workers and more public funds spent on transportation infrastructure. To contain unfavorable patterns of land use, some municipalities have added an urban growth boundary, or greenline, to traditional zoning controls. Beyond the growth boundary, land may not be converted to urban uses, or at a minimum, such conversion is sharply curtailed. Even more so than zoning, an urban growth boundary limits the supply of developable land. It also defines a particular place on the ground where the landscape will change dramatically from largely developed to mostly open or wild land. This suggests that an urban growth boundary could affect land prices both by restricting overall supply in a region and by enhancing amenities in the neighborhood of the boundary itself.

Knaap (1985) addresses the first of those effects for the urban growth boundary in Portland Oregon. He finds that residential parcels inside the boundary sell for more than comparable parcels outside the boundary. While he interprets this as “[land] values [decreasing] with distance to the urban core . . . (p. 30)” he does not include such a distance, *per se*, in his statistical model. It is therefore possible that at least a portion of the rent Knaap's result would ascribe to growth-boundary-induced scarcity is, in fact, due to avoided commuting costs for owners of parcels inside the boundary and, therefore, closer to the city center.

Tang (1995) obtains a similar, but clearer result for Virginia Beach, Virginia. After that city imposed an urban growth boundary in 1979, the price of vacant land beyond the boundary

fell, and the price of land within the boundary rose. The model accounts for each parcel's distance from a development center, which Tang considers a proxy for overall development pressure, rather than merely an indicator of the cost of commuting. With or without the growth boundary, Virginia Beach land prices fall with increasing distance from a development center.

Considering a wilderness area boundary to be an absolute growth management boundary, Knaap's and Tang's results suggest that land prices may be higher in localities with wilderness areas than in those without.

Consistent with the variant of von Thünen's model depicted in Figure 2.4, above, Hushak and Sadr (1979) find that the price of agricultural land per acre decreases with both distance from the city center and distance from a highway. Other negative influences on price in their study include the size of a parcel and whether it is in agricultural, as opposed to residential use. Commercial use is associated with higher per-acre prices.

Turner, Newton and Dennis (1991) examine forestland transactions in Vermont and obtain similar results. In their model, a parcel's price can be expected to decline with greater distance from a major road or from a ski area. Timberland prices are also lower for parcels less suitable for timber management and those in towns with higher property tax rates. Positive influences on the price of timberland include the portion of the parcel that is **not** forested, the population growth rate, and whether the parcel fronts on a road. These latter site characteristics describe land suitable for development rather than strictly working forestland. Their positive influence on price suggests the role of speculation and land conversion in markets for forestland.

Likewise, Chicoine (1981) finds that per-acre farmland prices decrease with distance from the city center and from the nearest freeway exchange. Because price in Chicoine's model declines with parcels' suitability for septic systems and rises with commercial or industrial zoning also suggest that the value of land for development, rather than for agricultural production, is important.

Table 2.1: Summary of Land Price Influences

Study Author(s) / Dependent Variable Selected Independent Variables	Direction of Influence
Pollakowski and Wachter 1990 / housing price index	
zoning restrictiveness index	+
relative restrictiveness of adjacent planning areas	+
Knaap 1985 / land price	
whether land is outside urban growth boundary	-
Tang 1995 / land price	
location inside greenline	+
distance to development center	-
Hushak and Sadr 1979 / land price per acre	
parcel size	-
commercial use	+
agricultural use	-
distance to the urban center	-
distance to a highway	-
Turner, Newton & Dennis 1991 / forest land price per	
parcel size	not significant
portion of parcel that is not forested	+
portion of parcel with > 15% slope (which would make the parcel less suitable for timber management)	-
parcel fronts on a road	+
population growth rate for the town in which the parcel is located	+
distance to major road	-
distance to ski area	-
property tax rate	-
Hamilton and Schwann 1995 / residential property price	
distance to electric transmission tower	-

Table 2.1 Continued: Summary of Land Price Influences

Study Author(s) / Dependent Variable Selected Independent Variables	Direction of Influence
Chicoine 1981 / farmland price per acre	
distance to Chicago	-
distance to nearest town	not significant
distance to freeway exchange	-
soil productivity	not significant
septic tank soil limitations	-
zoned residential	not significant
zoned industrial / commercial	+
parcel size	-
Irwin 2002 / residential property price	
lot size	+
Median household income	+
Population density	-
Distance to Washington, DC	-
Proximity to publicly owned open space	+
Proximity to permanently protected private land (<i>i.e.</i> , land trust holdings)	+
Proximity to open, but not protected cropland	not significant+
Proximity to open, but not protected forestland	+
Coffin 1989 / residential housing price	
size of unit	+
distance to central business district	-
location in historic district	+ in one sample
Correll, Lillydahl and Singell 1978 / residential property price	
distance to greenbelt	-
number of rooms	+
finished square footage	+
larger than average lot size	+
neighborhood distance to city center	+
neighborhood distance to city center squared	-

These last three studies suggest that a reasonably complete model of land values near wilderness areas must also include parcel characteristics that capture the influence of factors other than amenities such as wilderness itself. An alpine ski area or a highway that makes commuting less costly would be expected to elevate land prices. A higher tax rate might be associated with lower property values. In addition, larger overall parcel size seems to be associated with lower per-acre prices.

Irwin (2002), examined suburban/exurban land between Washington, DC and Baltimore, Maryland and found a price premium associated with permanently protected open space relative to open space that could be developed at any time. Her results suggest that wilderness designation – possibly the most permanent protection of open space available in the U.S. – could generate price premiums for nearby residential parcels over and above any benefits generated by other National Forest land or by land that simply remains undeveloped.

In his study of residential property values Coffin (1989) finds typical relationships between the price of a housing unit and its size and its distance from the central business district (positive and negative, respectively). Evidence concerning the relationship between unit prices and their location in a historic district is mixed. In a historic district in Aurora, Illinois, Coffin finds housing prices to be 6-7% higher than in surrounding areas. No significant effect is apparent, however for another district in Elgin, Illinois. Coffin attributes the price effect to higher demand for historic district housing rather than to a higher level of public services in the district.

Finally, two studies come closest to the effect of proximity to amenities and disamenities in determining land prices. The first is the almost canonical study of land prices in suburban Boulder, Colorado by Correll, Lillydahl and Singell (1978). It reveals that residential property prices decline with distance from greenbelts – strips of protected open space – that amounted to some 8,000 acres in the city at the time. “Other things being equal,” they conclude, “there is a \$4.20 decrease in the price of a residential property for every foot one moves away from the greenbelt.” The “other things” controlled for in the model include

the number of rooms and square footage for each residence and whether the house sits on a larger-than-average lot. In a switch from the results of other studies noted above, the Boulder study finds that, at least up to a certain distance from the city center, housing prices increase with commuting distance.

In the second, Hamilton and Schwann (1995) explore the potential that proximity to disamenities can reduce property values. After controlling for various site characteristics, they find that property values do decline with decreasing distance from high-voltage transmission towers, with the greatest effect evident for properties adjacent to the transmission line. The authors attribute the reduction in value to visual externalities, rather than other possible impacts of the transmission lines.

These studies both support traditional notions of what influences land rents – distance from city centers and transportation networks, for example – and expand those notions to include site characteristics unrelated to agricultural, silvicultural, or even sheer residential productivity (that is, proximity of a residence to central business districts). The literature to date suggests that urban and suburban amenities, including historic districts and greenbelts can increase nearby land values. Turner, Newton and Dennis' finding that forest land prices decline with distance from ski areas and Irwin's that residential property values decline with greater distance from permanently protected open space suggests that similar effects could be found in rural areas.

*Chapter 3: Estimating Enhancement Value
of Green Mountain Wilderness*

The theory of land rent and previous statistical results reviewed in the preceding chapter suggest a model of land values that can be summarized as follows: Land is a composite good, the price of which varies with its characteristics. These characteristics include a parcel's own physical attributes (size, improvements), prevailing economic and demographic factors (income level, population density), public policy factors (tax rates, zoning restrictions), and the parcel's proximity to land uses that may represent either a nuisance or an amenity for the parcel's prospective owner. Given sufficient information about parcel prices and characteristics, the total price of a parcel can be decomposed econometrically into the set of prices for its individual characteristics.

Again, following Rosen (1974), the hedonic price of a parcel of land may be represented by a price function:

$$p(\mathbf{z}) = p(z_1, z_2, \dots, z_m) \quad [3.1]$$

where z_1 through z_m represent the presence or quantity of m attributes of the parcel. The price of each attribute would then be:

$$p_i(\mathbf{z}) = dp(\mathbf{z})/dz_i \quad [3.2]$$

The " z_i 's" of greatest interest here are those that reflect the extent to which a parcel's purchaser might expect to enjoy amenities associated with National Forest wilderness areas and/or the degree to which the allocation of land to federal ownership and protected status restricts the supply of land for private uses. In order to distill the effect of such attributes from the overall price, that overall price function must be known. Therefore, additional parcel attributes, such as parcel size, improvements and other factors, such as local population density and income levels, are considered in the empirical model as well.

LAND PRICE AND ATTRIBUTE DATA

Land market and attribute data employed in the empirical model come in three main categories: (1) data describing individual land transfers; (2) data indicating the location of the parcels relative to National Forest wilderness or the relative portion of the immediate vicinity that is wilderness; and (3) data describing key amenity, economic and demographic features of the towns in which the transfers occur. Following a more detailed description of variables or fields in each category, Table 3.1 lists the full set of parcel attributes included in the econometric model. The table also indicates whether the value of each attribute originates from parcel-level land transfer data, from town economic and demographic data, or from geographic information system (GIS) data. Table 3.2 provides descriptive statistics for the attributes.

Land Transaction Data

Transaction-specific information, such as the sale price, and some parcel attributes come from Vermont's land transfer tax returns. In existence since 1968, the Land Transfer Tax amounts to a sales tax on real estate. Real estate purchasers file a return and pay any tax due at the time of the transfer. The return is then completed by the clerk for the town in which the property is located and forwarded to the Vermont Department of taxes for recording. The tax return includes information about the transfer as well as about the property. The transferee supplies most of this information, but some is added by the town clerk.

Because the land transfer tax is an *ad valorem* tax – that is, it is proportional to the value of the property – the land prices recorded on transfer tax returns are true market prices, not assessed property values (the measure used in most previous studies). The returns also supply data describing each property's size and intended use, the type of buildings present on the property, and, in varying degrees of detail, the property's location.

Since 1987, all transfer tax returns have been recorded in a computer database maintained by the Vermont Department of Taxes. For this study, I obtained a copy of this database

comprising 476,982 returns filed between January 1, 1987 and December 31, 2002 from the Vermont the Department of Taxes.

To clean the initial database, I first deleted duplicate returns and those on which key fields, such as acreage, price and location (town), are missing. In addition to records eliminated for such apparent keypunching errors, I also excluded those describing subdivision of a property or the transfer of less than full fee ownership, such as the sale of an easement. The database does not include any information about easements, including type (right-of-way, lake access, conservation, etc.), duration (term versus perpetual) and whether land management restrictions apply, for which one would prefer to control within an econometric model. Therefore, the only way to avoid additional error introduced by inclusion of transfers of less than fee-simple ownership is to exclude them entirely.

Transfers that, to varying degrees, may not reflect actual market transfers were the next to go. The land transfer database includes “exemption” and “special circumstance” codes that suggest cases in which the price recorded for the transfer may differ substantially from a true market price. Such cases include the division of property in cases of divorce, the dissolution of business partnerships, tax sales, sheriffs’ sales, receivership, and transfers to creditors to secure debt. One special circumstance code simply indicates that the price paid is less than the value of the land.

One or more of these issues (bad or missing data, less-than-fee transfer and potentially non-market prices) afflict three quarters of the land transfer records. After excluding the unusable records, 111,235 records remain for analysis.

From the cleaned database of market transfer records, I have retained only those reflecting transfers of parcels to be used primarily for residential purposes after the transfer. Primary uses not considered include industrial, agricultural, silvicultural and other commercial activities. This eliminated just over half of the remaining records, leaving 53,838 records of transfers of residential property.

Because commercial activities may also occur on parcels identified as primarily for residential use, I have removed an additional 87 transfers of residential parcels with buildings classified as a factory and those with buildings classified as a store from the database. The result is a statewide database of 53,751 records of almost exclusively¹¹ residential transfers.

Parcel attributes recorded with the transfer data include price per acre, acreage, and a set of three codes indicating whether the parcel includes several types of buildings (house, barn, mobile home, etc.). I have converted these building indicators into a set of binary variables – one for each building type – to facilitate their inclusion in the econometric model. Price per acre is the dependent variable in the model and would be expected to decline with the size of the parcel. Per-acre price would be expected to be higher with some types of buildings (houses, condos) and lower with others (mobile homes) or for parcels with no buildings at all.

To complete the transfer level data I have added the annual Consumer Price Index for housing (CPI_H) to each transfer record according to the year in which the transfer occurred. The 1987 index has been added to all transfers in 1987, the 1988 index to all 1988 transfers, and so on. The CPI_H is then used to adjust each per-acre price to reflect what that price would have been in the year 2000¹².

Town Economic and Demographic Features

The U.S. Census of Population and Housing (U.S. Bureau of the Census, 1980, 1990 and 2000) and the Vermont Department of Taxes supply information at the town level relevant to local land markets. Median household income, extracted from the Census' Summary Tape File 3A, is an indicator of local ability to pay for housing. Towns with higher median income would be expected to have higher housing prices, other things being equal. Using

¹¹ The data do not allow identification of minor commercial uses, such as home-based businesses or sales of timber from residential parcels. It is likely therefore, that some of the remaining residential transfers do in fact reflect the value of the parcels for more than purely residential use.

¹² I have chosen the year 2000 as the index year so that at least one dollar-valued variable could be used in the model without inflation adjustment – median household income for 2000.

the full Consumer Price Index (CPI-U), I have adjusted median household income in 1990 to 2000 dollars and added the adjusted figure to all records of transfers occurring through 1995. For transactions occurring from 1996 through 2002, median household income for 2000 is applied.

Town population density is a proxy for the overall condition of each town's housing market. Higher population density could indicate a tighter housing market or lower supply of developable land that might be associated with higher housing prices. Population density, in persons per acre, is calculated from the Census population counts and total town acreage derived from geographic information system (GIS) data. As with median household income, I've made these calculations using both 1990 and 2000 population counts and applied a density figure to each transactions according to whether the transaction occurred before or after the end of 1995.

The Vermont Department of Taxes Annual Reports for the years 1987 through 2002 supply total property tax rates, including school tax rates, for each year and for each town. Total town property tax rates have been matched to transactions by town and by year.

Parcel Location

Fields indicating proximity to wilderness areas, to major roads and to alpine ski areas complete the database. Some of these fields come directly from geo-coded information and others I have derived from (GIS) data obtained from the Vermont Center for Geographic Information and the University of Vermont Spatial Analysis Lab.

Given the importance to this inquiry of the distance between individual parcels and other points on the map, an ideal land transfer return database would include very specific geocoding, such as longitude and latitude or a parcel map reference number, for each parcel in the land transfer database. The database does not include latitude/longitude coordinates, but it does include a field for a parcel map reference number.

Unfortunately, this reference number has seldom been recorded with the rest of the transfer data, at least not for transfers of property located in the study area (see below). Many of

these towns do not have parcel maps, so the necessary reference number does not exist. Even for those towns that do have maps, the reference has more often than not been omitted from the transfer tax return at the discretion of the town clerk.

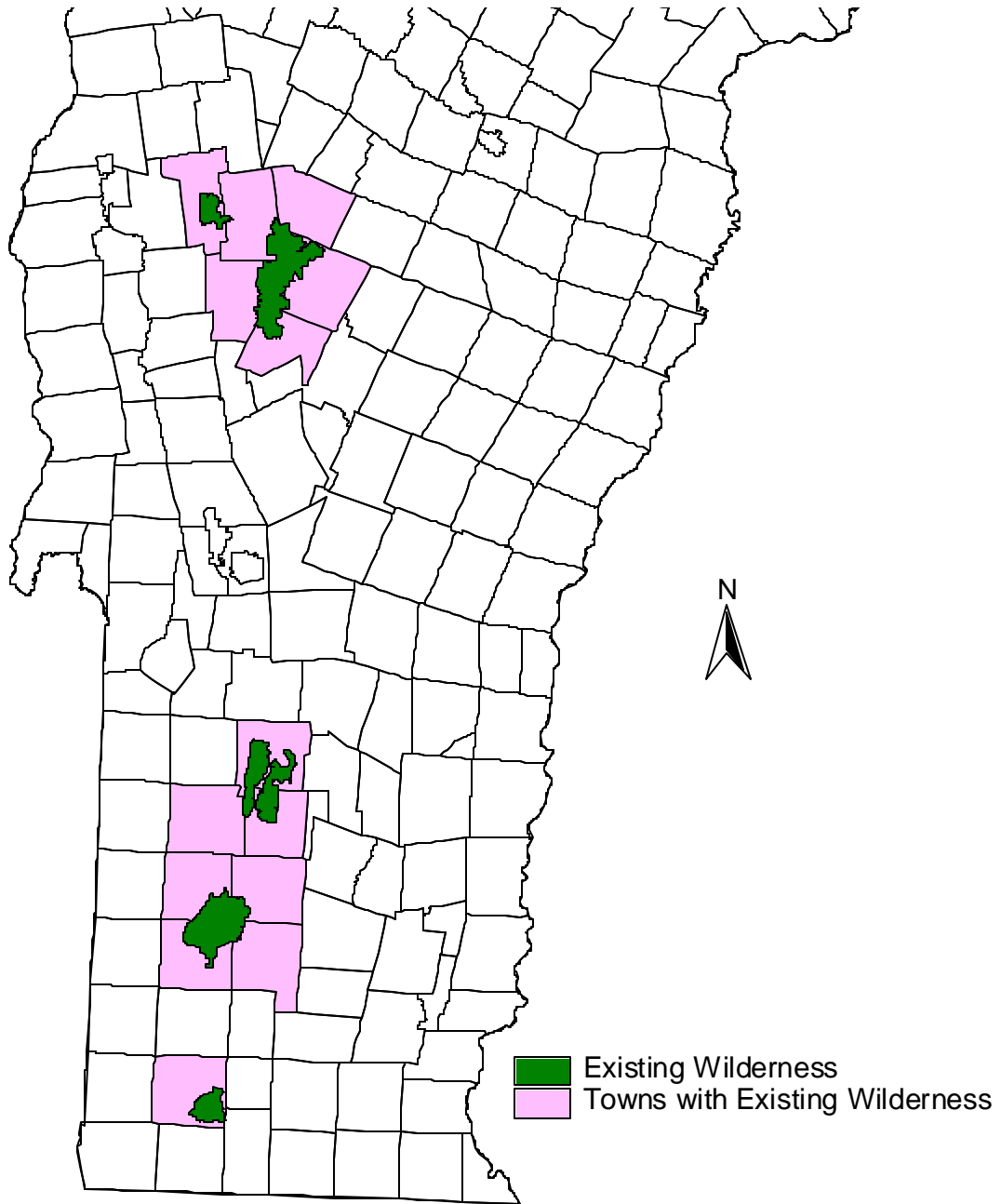
For almost all records, however, the town in which the transferred property is located can be identified. “Town” describes an area of less than 25,000 acres (10,118 hectares) on average, and the geographic scope of the study is large. Together, these facts suggest that the town identifier provides a fine enough second-best indicator of location. As such, the data allow a distinction among transfers involving parcels at varying distances from wilderness areas and among parcels that are closer to or farther from other market-relevant landscape features.

Wilderness Indicators: How close and How Much?

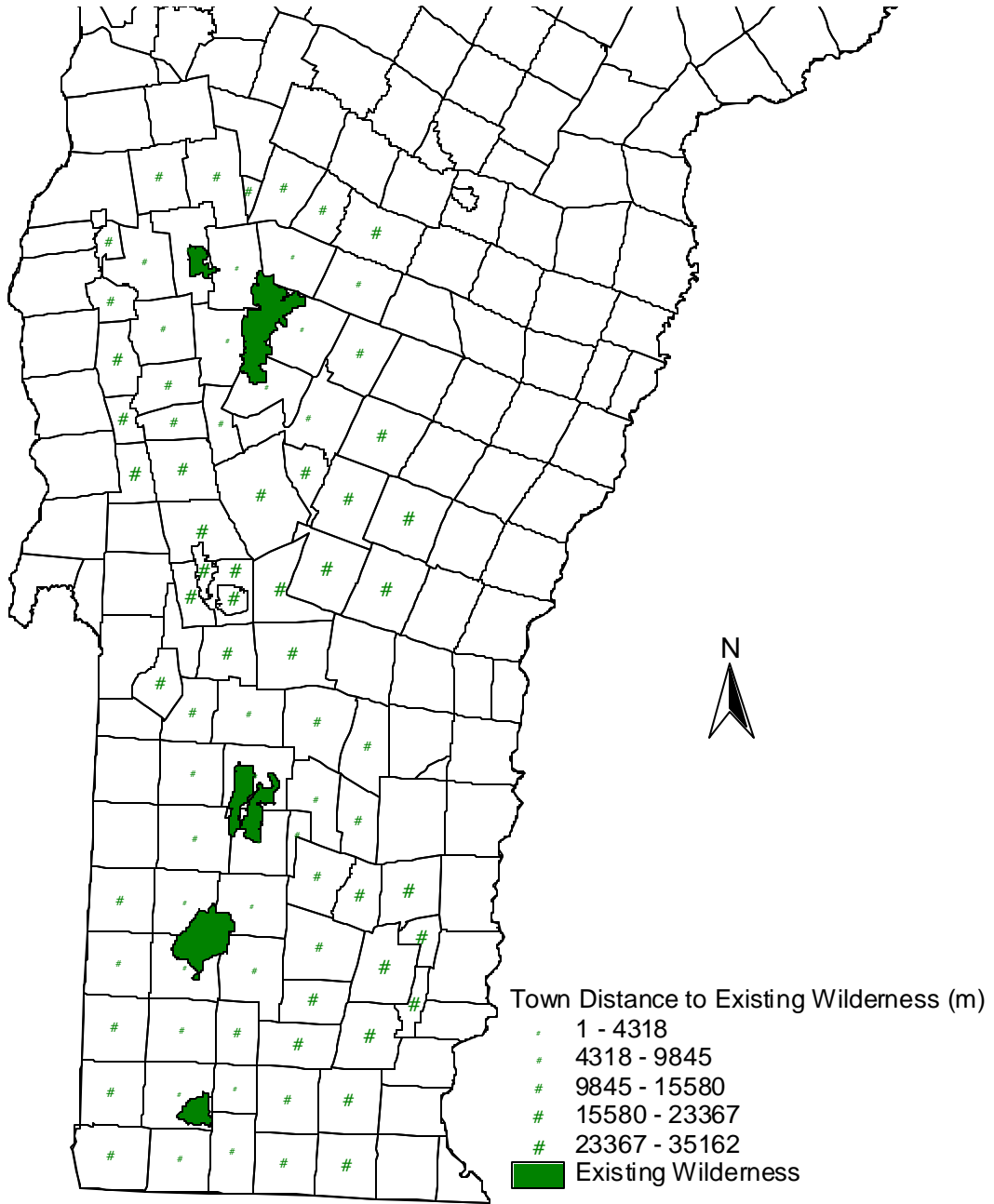
The first measure of proximity to wilderness areas is a binary variable indicating whether the parcel lies in a town that has **any** wilderness acreage. The variable, named “WILDTWN0” takes the value 1 for wilderness towns and 0 for all other towns and is depicted in Map 3.1, below. One exception to this rule is the town of Readsboro in southern Vermont, which contains approximately 140 square meters of the George D. Aiken Wilderness Area. This tiny town/wilderness overlap is an outlier among wilderness towns where the next smallest intersection is 1.5 million square meters. I have therefore assigned Readsboro’s a value of zero for WILDTWN0.

The second measure of proximity to wilderness is the distance from each town center (the “centroid” of the town’s polygon in the GIS layer) to the nearest wilderness area boundary. This serves as a proxy for distance from the parcels themselves to the nearest wilderness boundary. Note that using this continuous measure of proximity (DST_WILD in Table 3.1, below) does adopt the unavoidable fiction that all parcels transferred lie at the exact center of town. Map 3.2 depicts the town-to-wilderness distance for those towns included in the study area (see below for definition of the study area).

Map 3.1: Towns with Any Existing Wilderness (WILDTWN0 = 1)



Map 3.2: Study Town's Distance to Nearest Existing Wilderness Area (DST_WILD)



I have also included a third variable indicating how much of each town is Green Mountain National Forest wilderness. This measure, in-town wilderness acreage as a percentage of total town acreage is shown in Map 3.3. It serves much the same purpose as the binary variable for whether or not a town contains any wilderness at all. It adds, however, some sense of land scarcity associated with wilderness areas, because towns with higher percentages of land in designated wilderness would have a relatively smaller land bases available for private development or for developed uses of National Forest land, such as ski area facilities.

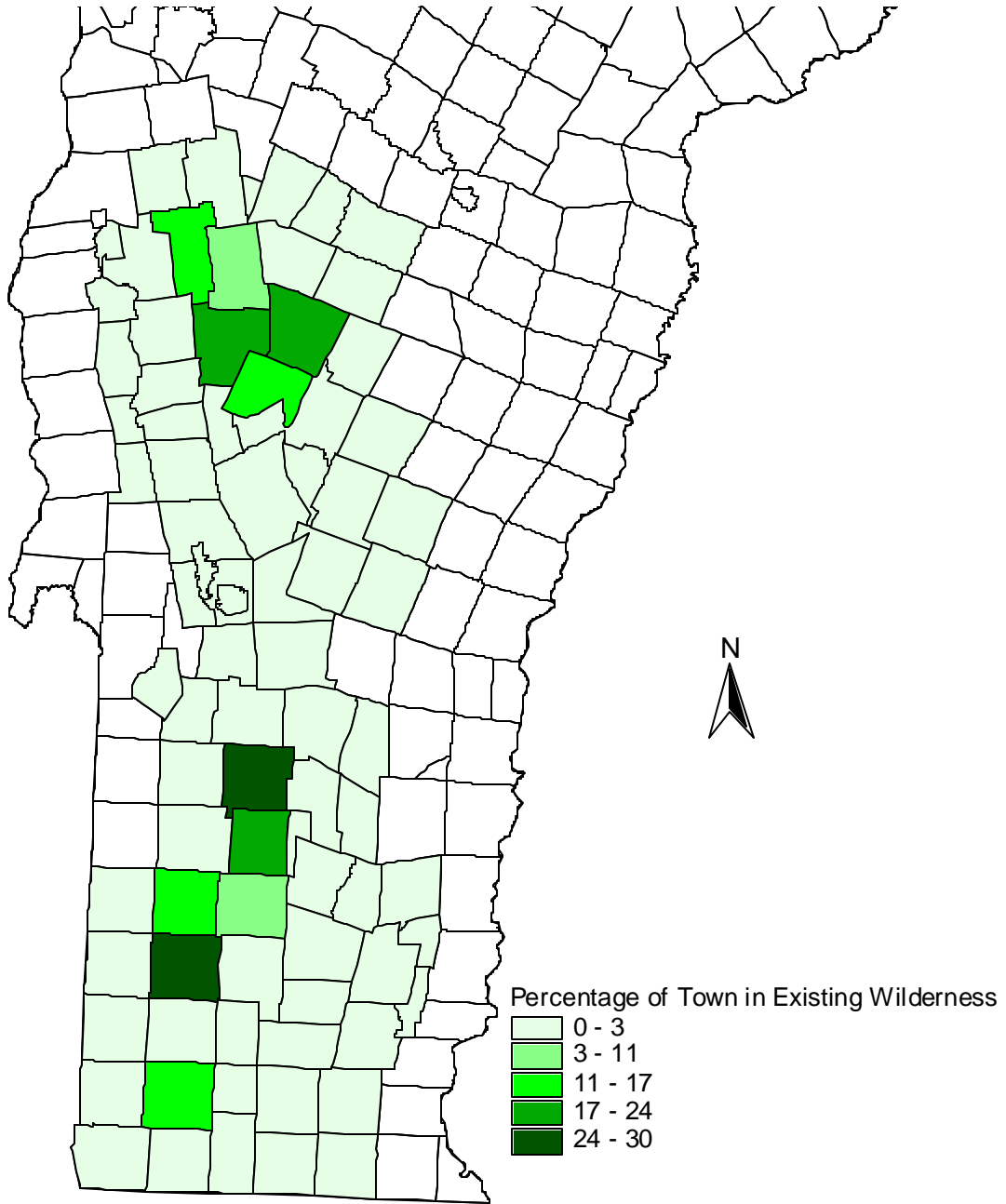
Other Locational Factors

To account for the possible influence of ski areas on land prices (Turner, Newton and Dennis 1991), I have included a binary variable for the presence of an alpine ski area in each town. This variable is based on ski area locations indicated in a state road atlas (Northern Cartographic, 1997). When merged by town with the land transfer database, this variable indicates whether the transfer occurs in a town with an alpine ski area.

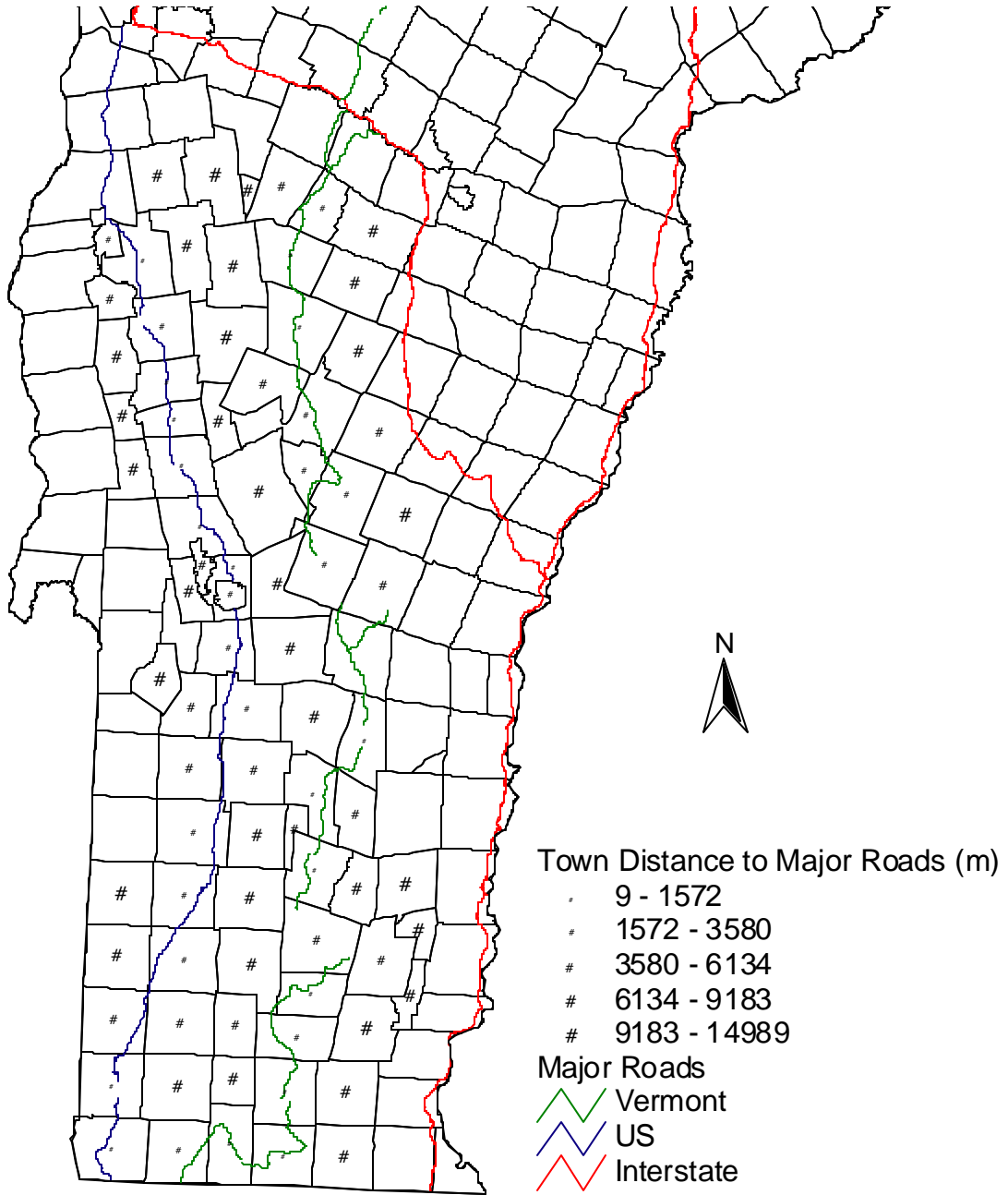
Proximity to major business and retail centers, which translates into shorter commutes and less travel time, is likely to be associated with higher residential land prices (see, for example, Chicoine, 1981). In the models below, that proximity is represented by the distance from the town center to the nearest major north-south highway. These highways are region's major state, U.S. and Interstate highways, namely Vermont 100, U.S. 7, Interstate 89, and Interstate 91.

Travel from the study area to such urban centers as Burlington and Montpelier, Vermont, Springfield and Boston, Massachusetts, Hartford and New Haven Connecticut, and New York City, not to mention much intra-regional travel, would use at least one of these routes. Proximity to them for commuting, for shopping and other purposes would be expected to be associated with higher per-acre residential land prices.

Map 3.3: Percentage of Towns in Existing Wilderness (PCT_WILD)



Map 3.4: Town Distance to Nearest Major Road (DST_RD_1)



These routes, especially U.S. 7 and Vermont 100, are also major travel corridors for leaf peepers, hikers, skiers and visitors of all kinds. Towns closer to these routes might therefore be the most attractive locations for recreation, tourism, and amenity-oriented businesses, and that attractiveness could exert upward pressure on residential land prices.

To facilitate consideration of whether being closer to an arterial road influences land prices, I have calculated the distance from each town center to the nearest segment of the nearest of Vermont 100, U.S. 7, Interstate 89 or Interstate 91. That distance, shown in Map 3.4, is then included among the attributes of each land transaction.

As with the wilderness and alpine ski area proximity measures, distance to major road is then merged with the land transfer database by town. The final data set includes the land transfer data plus related economic, demographic and location information for all transfers occurring in Vermont between 1987 and 2002.

Alternative ways of measuring and incorporating parcel attributes were considered and, based on preliminary data examination, rejected in favor of the final list of variables included in the working versions of the model. These alternatives included, for example, representing proximity to North-South arterial roads (Vermont 100 and the rest) by a set of binary variables indicating whether or not the route in question crossed any portion of the town. Naturally this left many towns with “zero” proximity to arterial routes when in fact the towns were quite close to them.

Another available parcel attribute considered but ultimately eliminated from the modeling procedures was a binary variable for whether the parcel fronts on a road. As noted in Table 2.1, Turner, Newton and Dennis found road frontage to exert a positive influence on the price of parcels used as timberland. It is naturally less costly to move logs from woodlots serviced by existing roads, and that reduced costs is, the authors surmise, capitalized into timberland prices. In this case, nearly all parcels are serviced by a road, making a matrix of independent variables that includes a frontage binary nearly singular. The frontage indicator could therefore not be included in the model.

Table 3.1: Data Fields and Sources

Field Name	Field Description	Data Source
<i>Land Transaction Characteristics (apply uniquely to parcels or transactions):</i>		
ACREPRICE_00 (dependent variable)	parcel sale price (\$ per acre) adjusted to year 2000 dollars using the Consumer Price Index for housing	Land Transfer Tax Returns
ACREAGE	parcel size (acres)	Land Transfer Tax Returns
B_NONE ^a	binary for whether parcel includes no buildings	Land Transfer Tax Returns
B_HOUSE	binary for whether parcel includes a house	Land Transfer Tax Returns
B_VAC	binary for whether parcel includes a vacation home or camp	Land Transfer Tax Returns
B_FARM	binary for whether parcel includes a barn or other farm building	Land Transfer Tax Returns
B_APT	binary for whether parcel includes a apartment	Land Transfer Tax Returns
B_MOBILE	binary for whether parcel includes a mobile home	Land Transfer Tax Returns
B_CONDO	binary for whether parcel includes a condominium	Land Transfer Tax Returns
<i>Wilderness Indicators (calculated for each town and applied to all transactions in each town):</i>		
WILDTWN0	binary for whether town contains wilderness	Town and GMNF GIS layers
PCT_WILD	proportion of town land area within the GMNF wilderness areas	Town and GMNF GIS layers
DST_WILD	Distance (in kilometers) from town center to nearest wilderness area boundary	Town and GMNF GIS layers

Table 3.1 Continued: Data Fields and Sources

Field Name	Field Description	Data Source
<i>Other Town Characteristics (calculated for each town and applied to all parcels/transactions in the town):</i>		
ALP_SKI	binary for whether town contains an alpine ski area	Vermont Road Atlas
MHINC_00	median household income in year 2000 dollars	Census of Population and Housing 1990 or 2000 ^b
POP_DENS	population density (persons per acre)	Census of Population and Housing 1990 or 2000 ^b
TAXRATE	property tax rate (\$ per \$100 assessed value)	Vermont Department of Taxes
DST_RD_1	Distance (in kilometers) to the nearest segment of Vermont 100, US 7, Interstate 91 or Interstate 89	Town and Road GIS layers

Notes:

- a. Because parcels have either no building (B_NONE = 1) or one or more of the types of buildings listed, B_NONE is dropped from estimated models in order to avoid singularity of X.
- b. For transactions that occurred from January 1, 1987 through December 31, 1996, median household income and population estimates from the 1990 census are used. Median household income from 1990 is adjusted to 2000 dollars using CPI-U. Estimates from the 2000 Census are used for transactions that occurred on or after January 1, 1995.

Table 3.1 summarizes the definition and source of those data field that are used in the estimation and simulation procedures described below.

DEFINITION OF STUDY AREA

It is unlikely that 60,000 acres (26,820 hectares) of wilderness in central and southern Vermont affect land prices throughout a state 100 times that sizes. Therefore, the geographic area considered in the model is restricted to one in which transferred parcels are reasonably proximate to wilderness areas. As illustrated by the shaded area in Map 3.5, this area is comprised of all towns whose center is within 14 kilometers of the (old) Green Mountain National Forest proclamation boundary. A plot of that distance by town does show a natural break at 14 kilometers. Moreover, this selection of study area does exclude some of the most urbanized towns and cities in the state, such as Burlington, Montpelier White River Junction and Brattleboro. The study area is therefore primarily, if not homogeneously, rural.

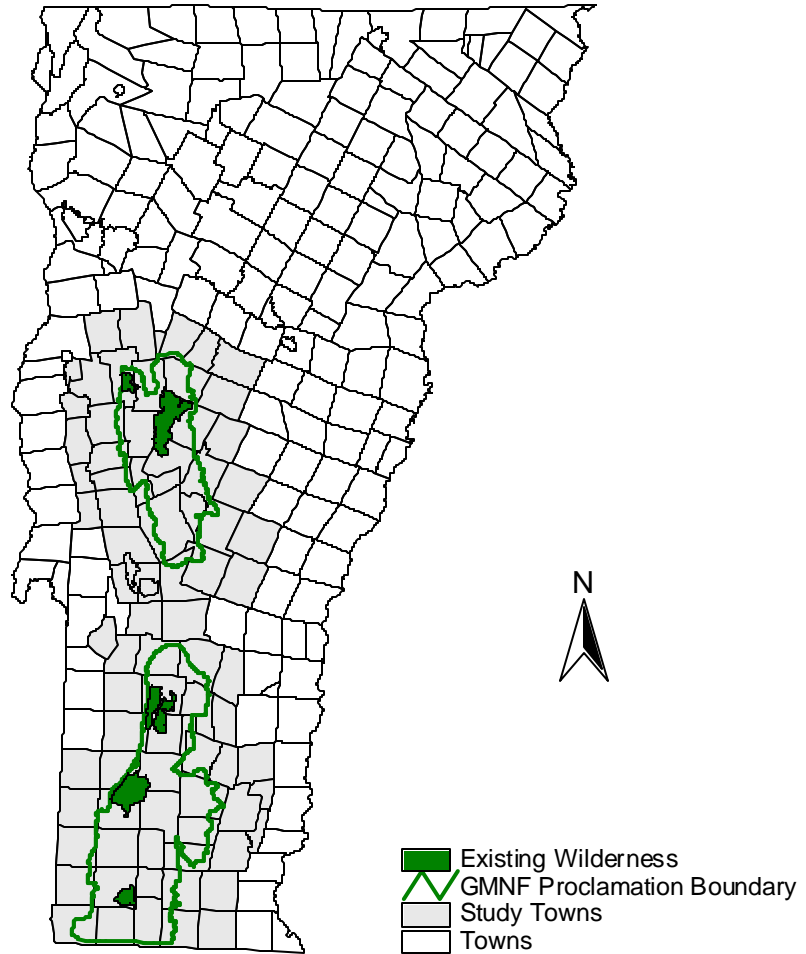
The study region comprises 82 of Vermont's 255 towns. Of these, 79 towns had a total of 12,961 land transfer records that survived the various exclusions mentioned above¹³.

Initial statistical examination revealed skewness in the distribution of per-acre land prices. To partially address this violation of the assumption of normality, I have applied two final rules to eliminate extreme outliers. First, I have excluded transfers of less than one tenth of an acre or of more than 1,000 acres. Second, I have excluded transfers with a per-acre price of less than \$100 or more than \$500,000 (in year 2000 dollars). Taken together these rules filter out 919 transactions, leaving 12,042 transactions for analysis.

Summary statistics for all model variables for these transactions appear in Table 3.2 below.

¹³ The remaining towns of Glastenbury, Somerset and Buel's Gore did have 21 land transfers among them between 1987 and 2002, but all of those transactions were for non-residential properties.

Map 3.5: Study Area



The Study area includes all towns with centers (centroids) within 14 kilometers of the Green Mountain National Forest Proclamation Boundary.

Table 3.2: Descriptive Statistics for Data Fields

n = 12,042	Mean	Median	Maximum	Minimum	Standard Deviation
ACREPRICE_00	119,704	73,702	499,837	101	123,231
LN(ACREPRICE_00)	11.00	11.21	13.12	4.61	1.38
C	1	1	1	1	0
ACREAGE	6.8	1.6	800.0	0.2	23.1
LN(ACREAGE)	0.6707	0.4700	6.6846	-1.6094	1.4115
B_HOUSE	0.8742	1	1	0	0.3316
B_VAC	0.0320	0	1	0	0.1759
B_FARM	0.0474	0	1	0	0.2125
B_APT	0.0268	0	1	0	0.1616
B_MOBILE	0.0531	0	1	0	0.2242
B_CONDO	0.0033	0	1	0	0.0575
WILDTWN0	0.1493	0	1	0	0.3564
PCT_WILD	1.9177	0.0000	29.9193	0.0000	5.4740
DST_WILD	15.2304	13.5088	35.1620	0.0012	8.7304
ALP_SKI	0.0816	0	1	0	0.2738
MEDHINC_00	40,156	39,241	57,750	17,500	5,726
POP_DENS	0.37	0.09	3.71	0.00	0.89
TAXRATE	2.166	2.140	6.750	0.340	0.692
DST_RD_1	4.14	2.56	14.99	0.01	3.38

Econometric Model and Estimation Procedures

Following both theoretical and previous empirical guidance, the relationship between land price and parcel attributes in the study region is assumed to follow transcendental functional form (Alonso 1964; Chicoine 1981; and Hushak and Sadr 1979; and Turner, Newton and Dennis 1991). With this assumption, the implicit price equation (3.1, above) becomes

$$ACREPRICE_00 = \mathbf{b}_0 ACREAGE^{b_1} \exp\left(\sum_{i=2}^n \mathbf{b}_i X_i\right) \quad [3.3]$$

where ACREPRICE_00 is the purchase price per acre (in 2000 dollars), ACREAGE is the total size (in acres) of the parcel and the X_i s are the other parcel and location attributes. The β s are the estimated coefficients. The marginal price of an attribute, as in equation 3.2, above, is the first derivative of this implicit price equation.

$$\partial \text{ACREPRICE}_{-00} / \partial X_i = \mathbf{b}_i \mathbf{b}_0 \text{ACREAGE}^{b_1} \exp\left(\sum_{i=2}^n \mathbf{b}_i X_i\right) \quad [3.4]$$

This form accommodates both the likelihood that per-acre price varies inversely with the size of the parcel and that the marginal value of each attribute, expressed as equation 3.4, depends on the levels of other attributes.

Converting equation 3.2 to logarithmic form allows estimation using ordinary least squares. Thus the estimated model is:

$$\ln(\text{ACREPRICE}_{-00}) = \mathbf{a} + \mathbf{b}_1 \ln(\text{ACREAGE}) + \sum_{i=2}^n \mathbf{b}_i X_i + \mathbf{m} \quad [3.5]$$

where \mathbf{m} is the unexplained error.

The estimated coefficient on $\ln(\text{ACREAGE})$, applied in the following formula, provides the percentage change in price resulting from a one percent increase in the size of the parcel (Turner, Newton and Dennis, 1991).

$$\% \text{ change in price per acre} = e^{b_1 / \text{ACREAGE}} - 1 \quad [3.6]$$

For all other coefficients, the estimated percentage change in price per acre that attends a unitary change in the explanatory variable is

$$\% \text{ change in price per acre} = e^{b_i} - 1 \quad [3.7]$$

I have estimated three versions of equation 3.5 – one with WILDTWN0 as an element of \mathbf{X} , the second with PCT_WILD and the third with DST_WILD. Regression results for each model version are reported in separate tables (3.4a, 3.4b and 3.4c) below.

Due to heteroskedasticity found in the underlying regression model, the model results include standard errors estimated using White's correction procedure (White, 1980; and

Hall, *et al.* 1995). The t-tests based these heteroskedasticity-consistent standard errors are asymptotically justified.

Econometric Results

Tables 3.4.a, 3.4.b and 3.4.c present the estimation results for models using WILDTWN0, DST_WILD and PCT_WILD, respectively, as indicators of a purchased parcel's proximity to wilderness.

Consistent with both theory and previous empirical research, the coefficients on each wilderness indicator suggest that proximity to wilderness and the extent of nearby wilderness conservation has a significant and positive effect on residential property values. Parcels located in towns that contain wilderness have per-acre sales prices that are 18.7 percent higher than towns without wilderness (See Table 3.3.a). The second version of the model reveals that the per-acre price of residential parcels decreases by about one third of a percent per acre with each kilometer farther away from the nearest wilderness boundary (Table 3.3.b). The third version shows that a one percent increase in the amount of town's land that is in designated increase is matched by a 0.81 percent increase in the price of residential properties in the town (Table 3.3.c)

Other things being equal, a parcel that sells for the average price per acre (roughly \$110,500 in for each model) in a town without wilderness would be expected to sell for \$20,698 more per acre if it were in a town with wilderness. Similarly, if an average-priced parcel could be moved to another town, the center of which is 10 kilometers farther away from a wilderness boundary, it would be expected to have price per acre that is lower by \$3,718. Finally, increasing wilderness acreage by one percent in a given town would be expected to increase the value of the average residential property in that town by \$896 per acre.

Table 3.3: Regression Results

Table 3.3.a: With presence of any wilderness in the same town as the parcel as the indicator of proximity to wilderness.

Dependent Variable: LN(ACREPRICE_00)

Independent Variable	Coefficient Estimate	Standard Error	Probability	Percentage Effect ^a	Marginal Implicit Price (\$/acre) ^b
Constant	9.80643	0.074688	0.0000		
Parcel Characteristics					
LOG(ACREAGE)	-0.84292	0.004371	0.0000	-11.69%	-\$12,927.97
B_HOUSE	0.84954	0.058948	0.0000	133.86%	148,071.38
B_VAC	0.43966	0.066377	0.0000	55.22%	61,081.32
B_FARM	0.09180	0.025576	0.0003	9.61%	10,635.68
B_APT	0.73459	0.064171	0.0000	108.46%	119,981.41
B_MOBILE	-0.20354	0.061341	0.0009	-18.42%	-20,372.33
B_CONDO	0.64504	0.100790	0.0000	90.61%	100,228.18
Wilderness Indicator					
WILDTWN0	0.17152	0.016999	0.0000	18.71%	20,698.01
Other Town Characteristics					
ALP_SKI	0.04334	0.016999	0.0302	4.43%	4,899.52
MEDHINC_00	0.00003	0.019991	0.0000	0.0026%	2.88
POP_DENS	0.10064	0.000001	0.0000	10.59%	11,711.93
TAXRATE	-0.01119	0.005394	0.1641	-1.11%	-1,231.06
DST_RD_1	-0.02415	0.008042	0.0000	-2.39%	-2,639.06
R ² :	0.8338			Mean Predicted Price per Acre: \$	110,620
Adjusted R ² :	0.8337			Mean Parcel Size:	6.78
F-statistic:	4643.19				
Probability (F)	0.0000			Number of Observations:	12,042
Durbin-Watson Statistic:	1.80				
Theil Inequality Coefficient:	0.1892				

a. For ln(Acreage), the percentage effect is $(e^{\beta_1/Acreage} - 1)$. For all other independent variables, it is $(e^{\beta_i} - 1)$.

b. Implicit price per acre is evaluated at the mean predicted price per acre.

Table 3.3.b: With distance to nearest wilderness area boundary
as the indicator of proximity to wilderness.

Dependent Variable: LN(ACREPRICE_00)

Independent Variable	Coefficient Estimate	Standard Error	Probability	Percentage Effect ^a	Marginal Implicit Price (\$/acre) ^b
Constant	9.85211	0.074865	0.0000		
Parcel Characteristics					
LOG(ACREAGE)	-0.84540	0.004381	0.0000	-11.72%	-\$12,955.83
B_HOUSE	0.84861	0.058818	0.0000	133.64%	147,742.98
B_VAC	0.43975	0.066290	0.0000	55.23%	61,060.96
B_FARM	0.09326	0.025761	0.0003	9.78%	10,806.52
B_APT	0.73368	0.063944	0.0000	108.27%	119,697.53
B_MOBILE	-0.20612	0.061283	0.0008	-18.63%	-20,592.20
B_CONDO	0.65682	0.100729	0.0000	92.87%	102,665.13
Wilderness Indicator					
DST_WILD	-0.00337	0.000710	0.0000	-0.34%	-371.89
Other Town Characteristics					
ALP_SKI	0.08013	0.000710	0.0001	8.34%	9,223.67
MEDHINC_00	0.00003	0.020359	0.0000	0.0027%	3.04
POP_DENS	0.11035	0.000001	0.0000	11.67%	12,898.53
TAXRATE	-0.03095	0.005997	0.0001	-3.05%	-3,369.12
DST_RD_1	-0.02173	0.007862	0.0000	-2.15%	-2,376.30
R ² :	0.8325			Mean Predicted Price per Acre: \$	110,553
Adjusted R ² :	0.8323			Mean Parcel Size:	6.78
F-statistic:	4598.50				
Probability (F)	0.0000			Number of Observations:	12,042
Durbin-Watson Statistic:	1.79				
Theil Inequality Coefficient:	0.1894				

a. For ln(Acreage), the percentage effect is $(e^{\beta_1/\text{Acreage}} - 1)$. For all other independent variables, it is $(e^{\beta_1} - 1)$.

b. Implicit price per acre is evaluated at the mean predicted price per acre.

Table 3.3.c: With percent of parcel's own town in wilderness
as the indicator of proximity to or prevalence of wilderness.

Dependent Variable: LN(ACREPRICE_00)

Independent Variable	Coefficient Estimate	Standard Error	Probability	Percentage Effect^a	Marginal Implicit Price (\$/acre)^b
Constant	9.79147	0.074691	0.0000		
Parcel Characteristics					
LOG(ACREAGE)	-0.84385	0.004379	0.0000	-11.70%	-\$12,934.82
B_HOUSE	0.84501	0.059047	0.0000	132.80%	146,829.67
B_VAC	0.43625	0.066466	0.0000	54.69%	60,466.33
B_FARM	0.09350	0.025670	0.0003	9.80%	10,836.48
B_APT	0.73316	0.064126	0.0000	108.17%	119,591.94
B_MOBILE	-0.20907	0.061423	0.0007	-18.87%	-20,859.39
B_CONDO	0.63607	0.101318	0.0000	88.90%	98,296.35
Wilderness Indicator					
PCT_WILD	0.00807	0.001049	0.0000	0.81%	896.31
Other Town Characteristics					
ALP_SKI	0.05871	0.001049	0.0030	6.05%	6,686.06
MEDHINC_00	0.00003	0.019753	0.0000	0.0028%	3.04
POP_DENS	0.10270	0.000001	0.0000	10.82%	11,958.98
TAXRATE	-0.02679	0.005418	0.0006	-2.64%	-2,922.93
DST_RD_1	-0.02406	0.007816	0.0000	-2.38%	-2,628.39
R ² :	0.8331			Mean Predicted Price per Acre: \$	110,564
Adjusted R ² :	0.8329			Mean Parcel Size:	6.78
F-statistic:	4618.65			Number of Observations:	12,042
Probability (F)	0.0000				
Durbin-Watson Statistic:	1.79				
Theil Inequality Coefficient:	0.1893				

a. For ln(Acreage), the percentage effect is $(e^{\beta_1/Acreage} - 1)$. For all other independent variables, it is $(e^{\beta_1} - 1)$.

b. Implicit price per acre is evaluated at the mean predicted price per acre.

Coefficients on the other explanatory variables have, for the most part, the expected signs. Per-acre price falls with parcel size, for example, and towns with higher median household income, with an alpine ski area, and those closer to major arterial roads all have higher per-acre prices for residential property. Properties with a house, barn, apartment or condominium understandably command a higher price than those without, and properties with mobile homes command lower prices than otherwise similar properties without mobile homes.

One additional interesting, if ambiguous, result concerns the property tax rate. Conventional wisdom suggests that higher property tax rates drive down property values, and the regression results seem to confirm that view. However, since town governments set property tax rates to meet budgetary needs, it is possible that higher tax rates are the effect, rather than the cause of lower property values. When property values are high, towns can meet their budgets with lower tax rates.

The overall consistency of coefficient estimates from one version of the model to the next suggests a robust result. That is, the choice of a measure of proximity to designated wilderness does not change the result that such proximity exerts a positive effect on land prices. Moreover, changing the wilderness indicator does not change the sign or appreciably change the magnitude of coefficient estimates associated with other parcel attributes.

The results above are also consistent with those from earlier model runs that included some additional variables (S. Phillips, 2000). These variables included the individual “major road intersects the town” measure of proximity to major highways discussed above, an indicator of whether a store is part of the property (transfers of such properties are now excluded from the dataset), and the Consumer Price Index for Housing. The last of these is no longer necessary, as general housing price inflation is incorporated through indexing of land prices to constant (year 2000) dollars.

Most importantly, the earlier model included both WILDTWN0 and DST_WILD in the same model, rather than in separate models, as above. The results were consistent with the

new models in that being in a town with any wilderness and being in a town closer to wilderness were both associated with higher land prices. Coefficient estimates for those and other parcel attributes were of the same order of magnitude as those reported in Tables 3.4.a, .b, and .c.

It is also worth noting that the earlier versions used data through 1997 only. Thus, the fundamental modeling result, and one presumes the underlying data generating (price determining) process, is not altered by passage of time and a near doubling of the number of land transfers included in the database. The relationships can therefore be presumed be fairly stable over time – an important consideration below, as I address how the results might be used to inform public policy responses to the effect of new wilderness designations on residential land prices.

All indications are that the models do a fairly good job both of fitting the data (R values are all higher than 0.83) and of forecasting land prices (Theil inequality coefficients are less than 0.2, indicating that forecasting errors are small relative to actual land prices.)

Two reservations or caveats about this model stem from the incompleteness of the data. First, as discussed above, parcels could only be placed in one of 79 towns and not at a specific location within the town. Thus it is not possible to fully address possible effects of spatial correlation in the underlying land-price-determining process. A parcel might sell for more, for example, because parcels immediately nearby have high prices. But such neighborhood effects, at least to the extent that they exist below the town level, are largely invisible to the models.

To partially address the spatial autocorrelation problem, I have sorted the data first by distance to the nearest wilderness boundary (DST_WILD) rather than by transaction date or some other parcel characteristic. The result is that all transactions from 1987 through 2002 for a given town will appear together in the data set, and spatial correlation, if present in the data, should show up much as serial correlation would in normal time-series data. If the Durban-Watson statistics (1.75+ in each version of the model) are considered to be

indicators of *spatial* correlation in this spatially-ordered data set, then it is likely that spatial correlation does not compromise estimation results.

Moreover, I have included several additional town-specific independent variables (ALP_SKI, DST_ROAD, etc.) in the model, with the result that factors that could lead to spatial correlation are modeled explicitly, rather than being absorbed into the error term.

The second caveat is more serious and stems from the lack of specific information in the dataset regarding the type, age, size or quality of the buildings on the parcels. The model incorporates as much information is available (a parcel with a house can be distinguished from one with a mobile home, for example), but the available data do not allow for modeling the effect of increasing house size, age or other important factors in housing markets. The result, according to Thorsnes (2002), is that estimates of amenity value could be biased or, at best, less precise than could be obtained with better data regarding the characteristics of the residential structure itself.

Nevertheless, the strength of the amenity indicator (*i.e.* proximity to wilderness) in these models is quite high, suggesting that even if more specific structural characteristics could be incorporated, the positive amenity affect would remain as a statistically significant determinant of parcel price. Therefore, one could reasonably conclude that the effect on residential property values of proximity to wilderness is, at a minimum, non-zero. With that fact and the estimates above I now turn to the question of what the effect of a specific proposal to add wilderness acreage in Vermont might be.

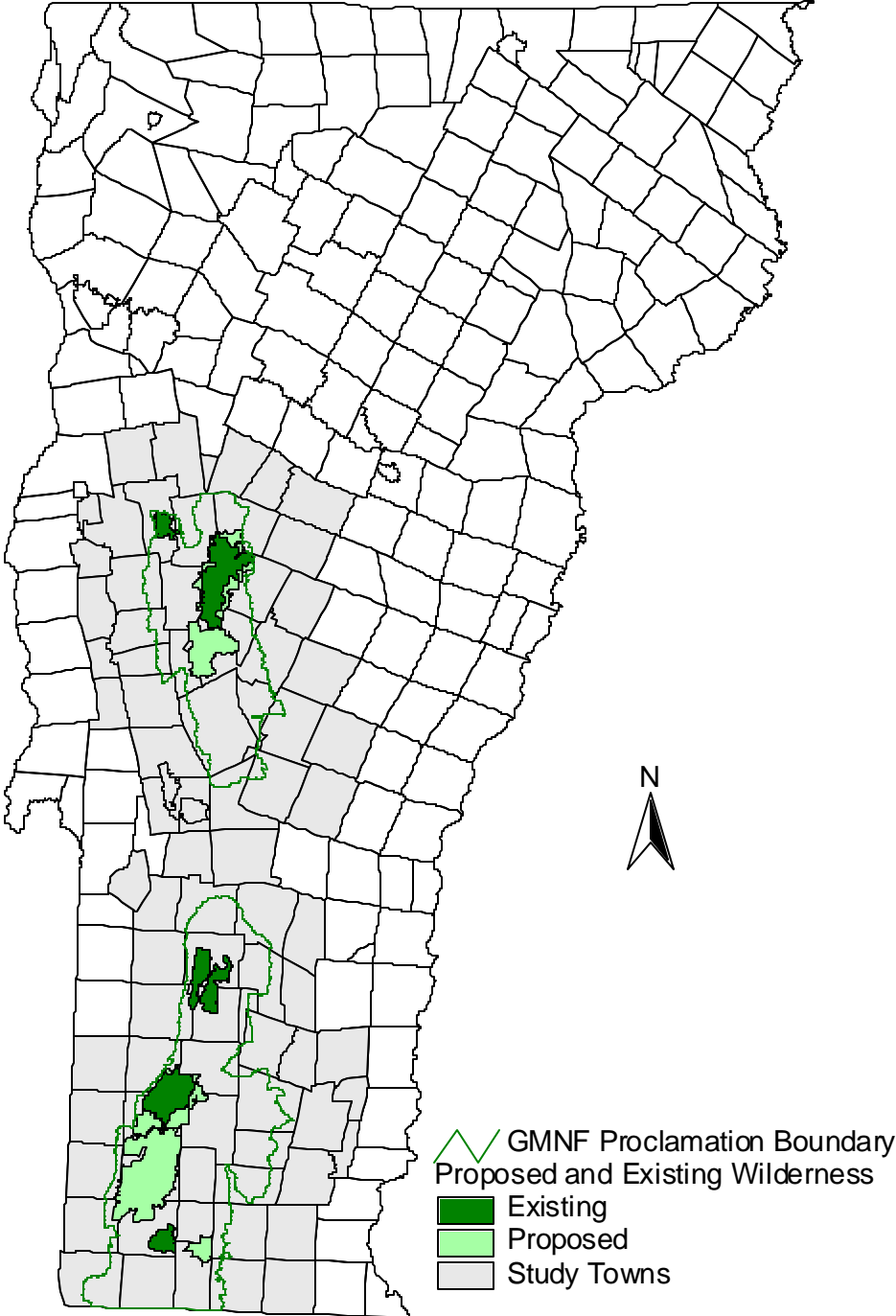
POTENTIAL FOR NEW WILDERNESS AREAS AND ACREAGE

In the fall of 2001, the Vermont Wilderness Association (VWA), a coalition of conservation organizations, publicly released a proposal to designate some 78,870 acres of new wilderness on the Green Mountain National Forest (see Figure 3.1) (Vermont Wilderness Association, 2001 and 2002). Of these, 59,293 acres would be in three new Wilderness Areas and the remaining 19,577 acres would be extensions of two Wilderness Areas established in 1975 and one established in 1984. Under the proposal, designated federal wilderness on the National Forest would total 138,048 acres.¹⁴

Since 2001, the proposal has been presented to Vermont's congressional delegation and discussed extensively with congressional staff, Green Mountain National Forest personnel, interested stakeholder groups, such as the Vermont Association of Snow Travelers (a snowmobile lobby), regional planning commissions, local elected officials (boards of selectmen) and the general public. As a staff economist for The Wilderness Society, (which is a VWA member), I have been involved in both the development of the proposal and many of these discussions. I can attest that the economic impact, including via land value enhancement, is of great interest, particularly to residents of the potentially affected communities and to public officials. As it now appears likely that a wilderness bill reflecting at least some of the VWA proposal will be introduced in the 108th Congress (Keese, 2003), having some measure of that potential impact is both timely and important.

¹⁴ The VWA has also proposed the creation of one new National Recreation Areas and three new National Conservation Areas. These areas are different enough from Wilderness areas (motorized recreation would be allowed in both areas, for example) that the estimated relationship between land conservation and residential property values estimated above is not assumed to apply, at least not as strongly to these areas. Therefore, they are not counted as part of new protected areas in the simulation presented here.

Map 4.1: Existing and Proposed Wilderness



According to the estimation results described above, the creation of new wilderness areas would be expected to enhance land values in and near Vermont towns that gain wilderness acreage. Of interest here is how much value would be expected to be created with the designation of new wilderness. The implications of enhanced value will be addressed below (see Chapter 5, “Implications and Applications”).

SIMULATION PROCEDURE

Rather than attempt to project wilderness-enhanced land values forward from the end of the available data (*i.e.* for 2003 or after), I have instead simulated that enhancement for the most recent land transfers for which data exist. Using records for land transfers completed in 2001 or 2002 and each measure of proximity to or prevalence of wilderness in turn, I have simulated what the market value of transferred residential properties would have been had the VWA proposal been adopted prior to 2001. Obtaining these estimates is a several step process.

First, geographic information system data from the University of Vermont’s Spatial Analysis Lab and other sources (see Table 3.1) provide the basis for proposed “wilderness indicators,” akin to those defined in the preceding chapter. These indicators are defined for each transaction as follows:

- WILDTWN0_P takes the value of one if the town in which the parcel is located contains any existing or proposed wilderness. It takes the value zero otherwise. (See Map 4.2)
- DST_WILD_P is the distance from the center (centroid) of the town in which the parcel is located to the nearest existing or proposed wilderness boundary. (See Map 4.3)
- PCT_WILD_P is the percentage of total land in the town in which the parcel is located that is in an existing or proposed wilderness area. (See Map 4.4)

Second, the appropriate indicator of proximity or prevalence of existing and proposed wilderness, is substituted, in turn, into equation 3.5 to provide fitted values

($\ln(\text{AcrePrice}_{00})$) and simulated values ($\ln(\text{AcrePrice}_{00_P})$) for each transaction. As the wilderness indicator is the eighth element of \mathbf{X} , the formulas for the fitted and simulated values are as follows:

For fitted values:

$$\begin{aligned} \ln(\text{ACREPRICE}_{00}) = & \hat{\mathbf{a}} + \hat{\mathbf{b}}_1 \ln(\text{ACREAGE}) + \sum_{i=2}^7 \hat{\mathbf{b}}_i X_i \cdots \\ & + \hat{\mathbf{b}}_8([\text{wilderness_indicator}]) + \sum_{i=9}^{13} \hat{\mathbf{b}}_i X_i \end{aligned} \quad [4.1a]$$

where *wilderness_indicator* is either WILDTWN0, DST_WILD, or PCT_WILD as defined in Chapter 3.

For simulated values:

$$\begin{aligned} \ln(\text{ACREPRICE}_{00_P}) = & \hat{\mathbf{a}} + \hat{\mathbf{b}}_1 \ln(\text{ACREAGE}) + \sum_{i=2}^7 \hat{\mathbf{b}}_i X_i \cdots \\ & + \hat{\mathbf{b}}_8([\text{wilderness_indicator}_{-P}]) + \sum_{i=9}^{13} \hat{\mathbf{b}}_i X_i \end{aligned} \quad [4.1b]$$

where *wilderness_indicator_P* is either WILDTWN0_P, DST_WILD_P, or PCT_WILD_P as defined above.

The antilog of $\ln(\text{ACREPRICE}_{00})$ and $\ln(\text{ACREPRICE}_{00_P})$ are, respectively, the fitted and simulated prices per acre (in year 2000 dollars) for the transaction.

Third, *fitted* values are subtracted from *simulated* values to provide the total value enhancement for each transaction. Summed across all transactions within each town and divided by two (since two years' transactions are included in the simulation), a rough estimate of the annual, per-town, enhancement that could result from a new Vermont Wilderness Act is obtained.

Fourth and finally, total value enhancement per year is divided by total acres transferred per year to provide an estimate of the enhancement per acre, as well as summary estimates for all towns' transactions combined.

One final note applies to the simulation. The Simulated value is that which is realized in a given year. That is, I do not simulate the total added residential property value associated with wilderness. Rather, I simulate on the added value of residential properties sold. Enhancement that exists but remains on paper is not part of the simulation.

These procedures are applied to the 1,701 transfers occurring in 2001 or 2002 in one of the 82 study towns. Apart from the three study towns that had no eligible transactions between 1987 and 2002, two more towns, Woodford and Stratton, had no transactions in 2001 or 2002. So, just 77 of the 82 study towns are potentially represented in the simulations.

Because the simulations below are focused on the effect of additional wilderness, the simulations include only those transactions in towns for which the respective wilderness indicator would change with adoption of the VWA proposal. So, for example, only transactions in towns that currently have no wilderness but would gain some under the VWA proposal are considered in the simulation based on the model using WILDTWN0 as its wilderness indicator.

SIMULATION RESULTS, BY WILDERNESS INDICATOR

The effect of the presence of any wilderness in town.

Currently 14 of the study towns include any designated wilderness. Under the VWA proposal 22 towns would include at least some wilderness acreage (See Map 4.2). Of the eight additional towns, two (Somerset and Glastenbury, which is all but covered by the proposed Glastenbury Mountain Wilderness Area in southern portion of the Green Mountain National Forest) had no transactions in the database at all. Thus, only six towns had both a change in the value of "WILDTWN0" and transactions on which to base the simulation.

Applying the procedures outlined above produces the results in Table 4.1. By this simulation, almost \$2.2 million per year in added value of transferred residential property could be expected to attend the adoption of the wilderness proposal. On average, each residential acre would be worth \$4,191 more with newly designated wilderness than without. Naturally, and as indicated in Table 4.1, these benefits accrue to towns in proportion to the number of transactions and the numbers of acres transferred in each town.

Because the simulation does not consider the extent to which designation of wilderness accelerates the rate of land transfer (*i.e.*, by attracting new in-migrants) the simulation could be considered a low-estimate of the potential land-enhancement effect for residential properties.¹⁵ On the other hand, and to the extent that the underlying estimation could not consider detailed structural characteristics (*i.e.*, age, size and quality of homes, condos, mobile homes, etc.) the simulation could be producing an over-estimate of potential enhancement value.

¹⁵ Nor does the estimation outlined in Chapter 3 or the simulation here consider enhancement of the value of nonresidential property. Considering all types of properties could therefore produce simulated enhancement value associated with new wilderness that is higher than that suggested by consideration of residential properties alone.

Map 4.2: Change in WILDTWN0 – the Presence of any Wilderness Acreage, by Town

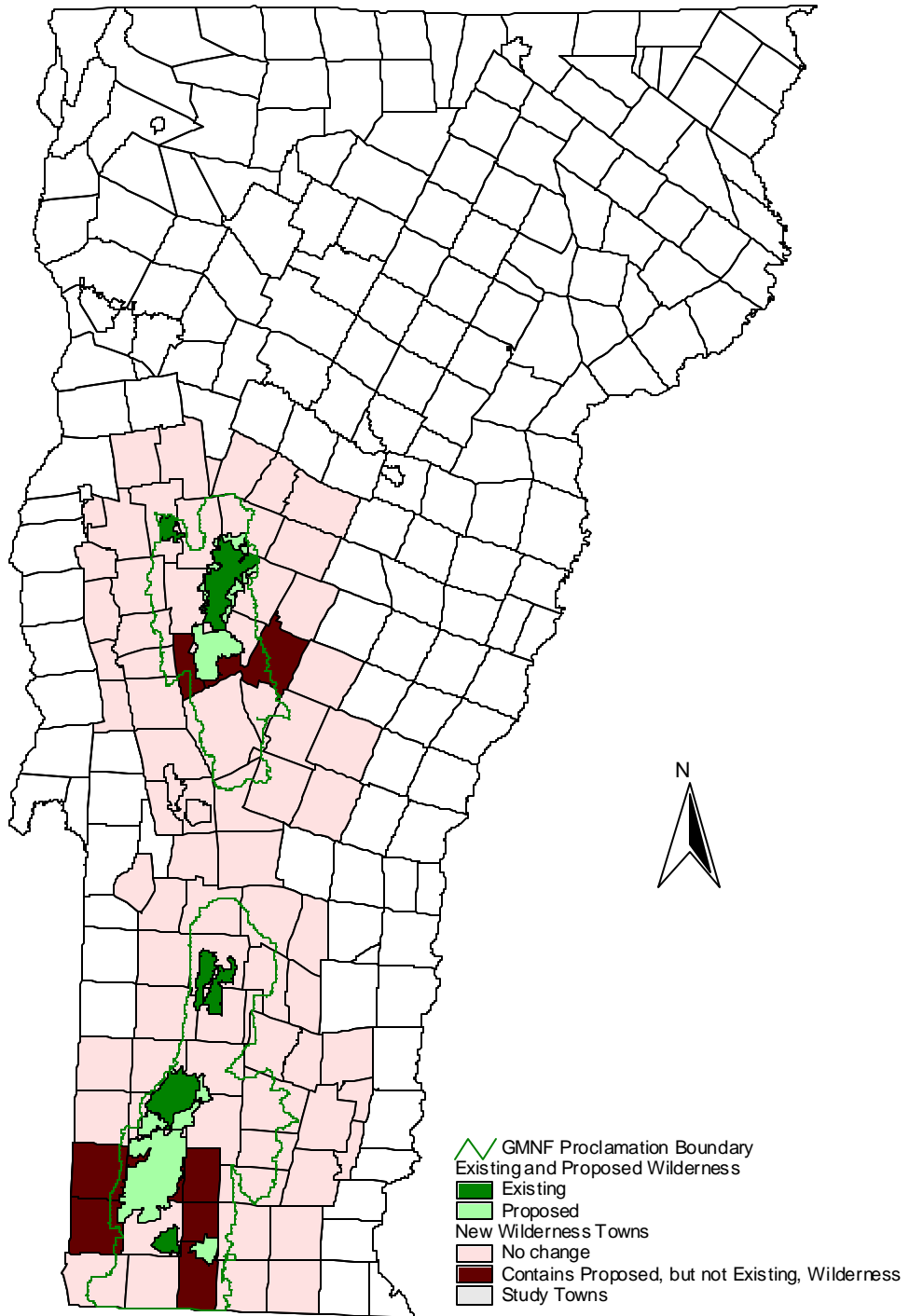


Table 4.1: Effect on Land Prices of the Creation of New Wilderness Towns

Town Name	Change in WILDTWN0	Transfers per Year	Acres Transferred per Year	Average Value Enhancement per Acre (2000\$)	Total Value Enhancement per Year (2000\$)
Bennington	1	60	191.2	\$ 5,945	\$ 1,136,595
Goshen	1	1	4.5	4,376	19,694
Readsboro	1	6	45.9	2,802	128,470
Rochester	1	7	60.8	2,074	126,003
Searsburg	1	1	0.5	10,244	5,122
Shaftsbury	1	29	213.7	3,503	748,382
<i>Total</i>		103	516.5	\$ 4,191	\$ 2,164,266

The effect of decreased distance to a wilderness area.

Creation of new wilderness areas and expanding existing ones will make 57 towns closer to the nearest wilderness area. For some towns, the difference is less than half a kilometer but other towns would find themselves as much as 10 kilometers closer to designated wilderness (see Map 4.3). Somerset and Glastenbury are two of these towns, but they had no transactions in the database at all. Two additional towns, Stratton and Woodford, had no transactions in 2001 or 2002 and are therefore not represented in the simulation.

Results of the simulation based on greater proximity to designated wilderness are presented in Table 4.2. Total value enhancement is \$1.1 million per year for 622 transactions in the 53 towns. Per-acre enhancement is, on average, \$250. We know from Table 3.3.b, above, that each kilometer closer to wilderness is associated with a 0.34% increase in per-acre land prices. Simulated value enhancements vary with that distance and range from an increase of 0.12 percent relative to fitted values for Manchester to 3.4 percent for Shaftsbury.

The same caveats regarding changes in the rate of transfers or possibly over-estimation of the enhancement effect would apply to these simulation results.

Map 4.3: Change in DST_WILD – the Distance from the Town Center to the Nearest Existing or Proposed Wilderness

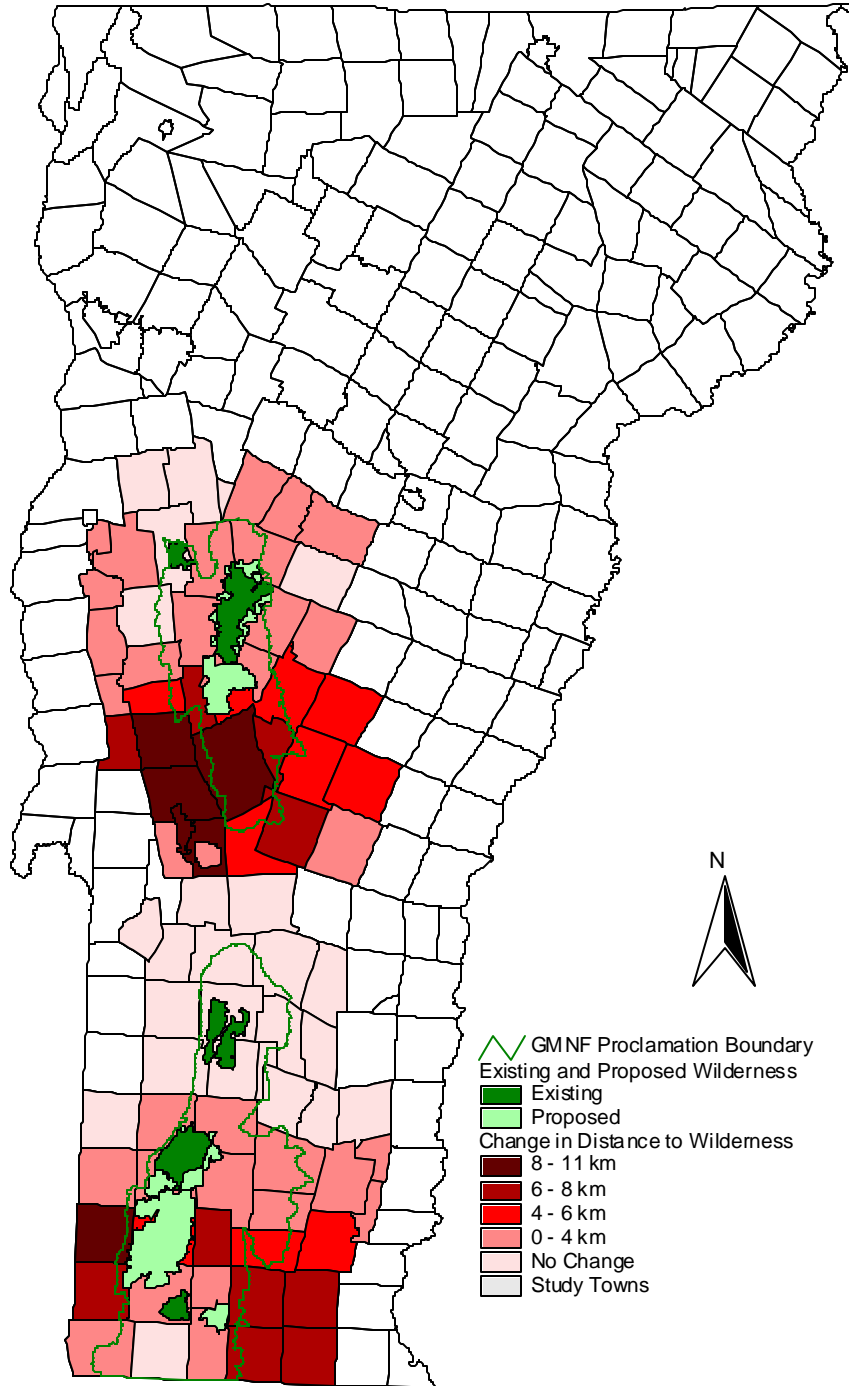


Table 4.2: Effect on Land Prices of Greater Proximity to Wilderness

Town Name	Change in Distance to Wilderness (km)	Transfers per Year	Acres Transferred per Year	Average Value Enhancement per Acre (2000\$)	Total Value Enhancement per Year (2000\$)
Arlington	-1.88	19	64.7	\$208	\$13,476
Athens	-2.42	1	1.8	202	354
Barnard	-5.46	10	236.4	120	28,424
Bennington	-7.21	60	191.2	795	152,012
Bethel	-4.69	18	259.3	106	27,369
Braintree	-0.75	11	141.7	25	3,486
Brandon	-8.81	21	141.0	495	69,735
Bridgewater	-2.68	5	65.1	86	5,601
Brookline	-3.08	5	22.9	205	4,689
Chittenden	-9.32	13	72.8	797	57,963
Cornwall	-0.15	13	239.3	5	1,103
Dover	-4.46	11	63.1	393	24,770
Fayston	-1.18	8	45.3	134	6,076
Goshen	-7.35	1	4.5	617	2,775
Granville	-0.94	2	19.2	37	703
Halifax	-7.14	5	235.1	70	16,380
Hancock	-0.29	2	36.1	5	188
Jamaica	-2.78	9	115.8	77	8,917
Killington	-7.92	3	10.3	1,288	13,264
Leicester	-4.93	7	22.4	490	10,941
Lincoln	-0.13	8	113.7	4	491
Manchester	-0.03	39	117.4	6	710
Marlboro	-7.27	4	30.8	379	11,656
Mendon	-4.64	8	25.4	743	18,871
New Haven	-0.39	11	112.8	23	2,584
Newfane	-5.39	19	108.9	346	37,641
Northfield	-0.67	31	124.6	60	7,453
Pittsfield	-6.30	2	13.3	430	5,725
Pittsford	-9.80	19	406.1	207	83,883
Pownal	-0.62	14	133.2	28	3,694
Proctor	-9.85	6	5.0	3,891	19,263

Table 4.2, Continued

Town Name	Change in Distance to Wilderness (km)	Transfers per Year	Acres Transferred per Year	Average Value Enhancement per Acre (2000\$)	Total Value Enhancement per Year (2000\$)
Readsboro	-2.77	6	45.9	145	6,628
Ripton	-1.31	6	42.6	69	2,947
Rochester	-5.26	7	60.8	200	12,174
Rutland	-9.68	25	40.1	2,918	116,875
Rutland City	-0.71	49	38.0	320	12,159
Salisbury	-2.53	10	59.5	184	10,959
Searsburg	-1.79	1	0.5	342	171
Shaftsbury	-10.05	29	213.7	661	141,160
Stockbridge	-5.52	10	148.5	143	21,296
Sudbury	-7.37	3	14.3	476	6,801
Sunderland	-0.51	7	17.7	84	1,483
Townshend	-2.91	13	93.0	146	13,583
Waitsfield	-2.77	12	99.0	177	17,523
Waltham	-0.27	3	29.1	14	418
Wardsboro	-2.22	7	38.6	133	5,117
Warren	-2.83	13	47.2	463	21,861
West Rutland	-1.84	10	37.6	140	5,258
Weybridge	-0.32	13	105.3	23	2,453
Whiting	-3.65	1	7.8	154	1,195
Whitingham	-6.68	5	21.6	666	14,353
Wilmington	-7.34	12	23.6	1,381	32,601
Winhall	-1.47	8	20.3	328	6,648
<i>Total</i>		622	4,382.5	\$250	\$1,093,859

The effect of an increase in the proportion of town land in wilderness.

The VWA proposal would increase the percentage of 19 towns' respective total land area that is in designated wilderness. The increase in that percentage ranges from about one half percent for Somerset to 86 percent for Glastenbury (see Map 4.4). As in the "distance to wilderness" simulation above, neither of these towns, nor Woodford nor Stratton, had any transactions available on which to base the simulation. The simulation is therefore based on transfers occurring in 15 towns.

Table 4.3 exhibits the result of following the simulation procedures with PCT_WILD and PCT_WILD_P as the wilderness indicators for the fitted and simulated land values, respectively. By this measure, greater wilderness conservation would be expected to generate almost \$1.3 million in added residential land value each year, or an average of \$1,217 per acre sold. These estimates are based on an annual average of 201 transfers involving 1,062 acres of residential property.

As was the case with the distance-to-wilderness simulation, the percentage effect for each town will differ from the mean effect, reported in Table 3.3.c, of 0.81 percent higher per-acre value for each one percent increase in the proportion of total town land that is in designated wilderness. Manchester and Sunderland represent the low and high end of the range of percentage effects. The additional 0.8 percent of Manchester that would be designated Wilderness under the VWA proposal would raise property values in that town by just 0.6 percent. In Sunderland, meanwhile, the proposal would add 45 percent to the proportion of the Town allocated to wilderness, and that change would result in a residential land value increase of 44 percent.

Once again, the simulated effects below could be over-stated due to lack of specific structural data and under-stated due a lack of consideration of a designation effect on in-migration. The latter issue is addressed in general way below, as the effect of wilderness designation on housing affordability is considered as part of a larger system in the next chapter.

In summary, depending on how proximity to wilderness is measured, the VWA proposal could add as much as \$2.2 million per year to the value of residential properties sold in the towns closest to new or expanded wilderness areas.

Map 4.4: Change in PCT_WILD – the Proportion of Town Land in Designated Wilderness, by Town

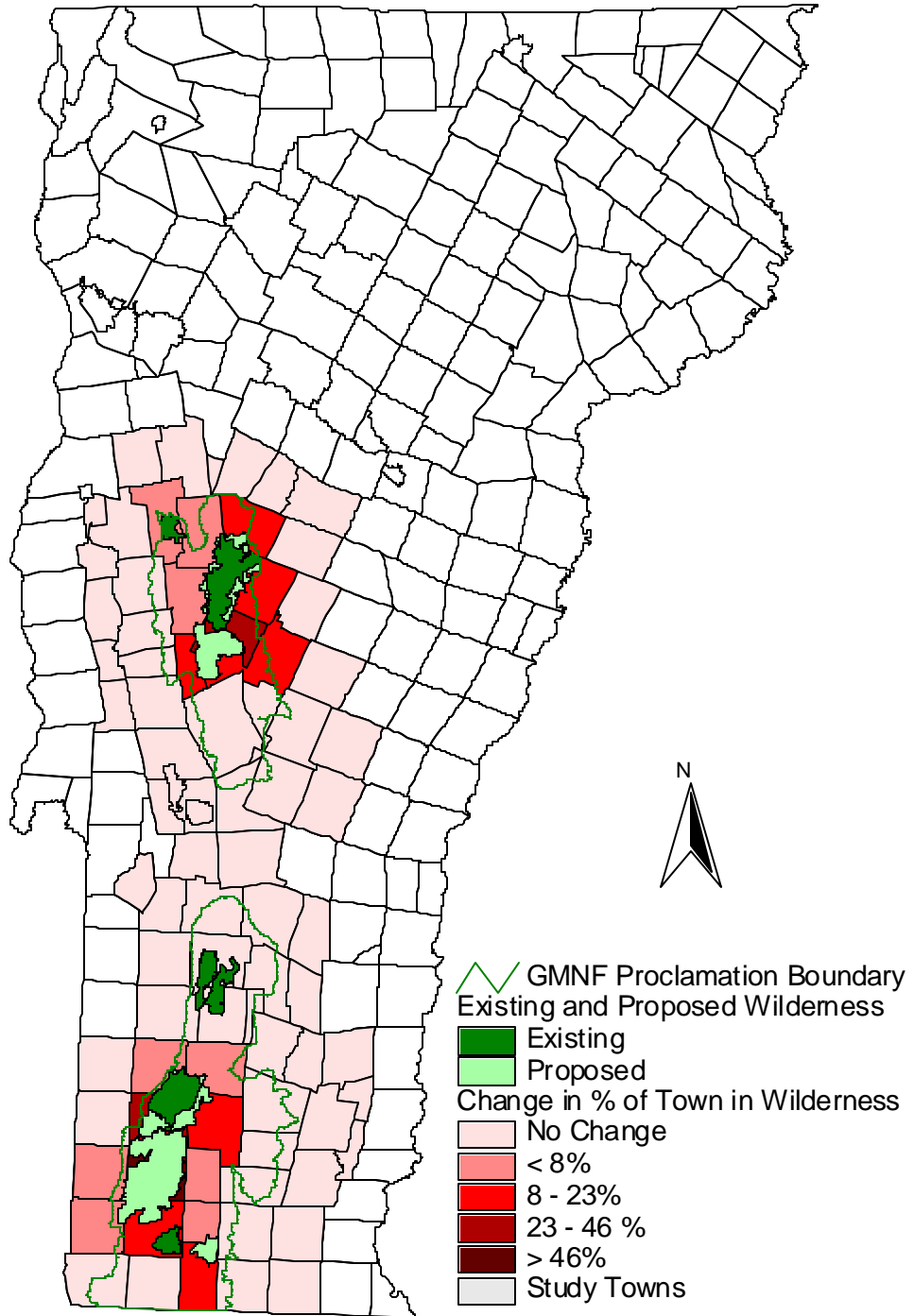


Table 4.3: Effect on Land Prices of a Greater Proportion of Town Land Designated as Wilderness

Town Name	Change in % of Town in Wilderness	Transfers per Year	Acres Transferred per Year	Average Value Enhancement per Acre (2000\$)	Total Value Enhancement per Year (2000\$)
Bennington	3.5%	60	191.2	\$ 907	\$ 173,442
Bristol	0.8%	16	131.3	93	12,168
Goshen	10.1%	1	4.5	2,010	9,043
Granville	10.8%	2	19.2	1,190	22,784
Hancock	39.4%	2	36.1	2,045	73,825
Lincoln	2.9%	8	113.7	248	28,203
Manchester	0.8%	39	117.4	345	40,432
Readsboro	15.7%	6	45.9	2,012	92,231
Ripton	7.1%	6	42.6	1,050	44,672
Rochester	12.1%	7	60.8	1,128	68,500
Searsburg	4.6%	1	0.5	2,031	1,016
Shaftsbury	1.7%	29	213.7	270	57,605
Sunderland	45.4%	7	17.7	25,633	452,425
Warren	9.2%	13	47.2	3,577	168,828
Winhall	4.2%	8	20.3	2,310	46,894
<i>Total</i>		201	1,061.7	\$ 1,217	\$ 1,292,070

Chapter 5: Implications and Applications

You have just given me two more reasons to oppose Wilderness – it will attract a bunch of yahoos from out of state and price me out of the housing market!

— Jonathan Wood, Forester¹⁶

Yes, Wilderness makes living in a place more attractive, but you can't forget about keeping that place affordable for long-time residents.

— Congressman Bernie Sanders¹⁷

A DOUBLE-EDGED WINDFALL

The first policy application of the results presented above is the simple observation that wilderness areas do in fact enhance, rather than diminish, nearby land values. This represents new information that can benefit the process of estimating the economic impacts of land management decisions. It can also bolster the economic argument in favor of further conservation by helping correct common misapprehensions about the costs of conservation.

Even as evidence that designated wilderness enhances, rather than detracts from, local land value however, it is also becoming clear that the fact of land value enhancement (or other features of amenity-based development) alone is unlikely to win support for further wilderness designation. Indeed, thoughtful individuals immediately recognize that the windfall is not uniformly distributed. It benefits those who sell land that the seller owned before the advent of new or expanded wilderness areas, but the cost is borne by new owners, possibly the sons and daughters of long-time local residents. Long-time owners themselves could also be adversely affected if property tax assessments follow enhanced market prices upward and if in-migration stimulated by greater wilderness protection causes an increase in demand for local public services.

¹⁶ Mr. Wood's comment was offered during a panel discussion at the 1998 Vermont Green Space Conference in Montpelier, Vermont, where I presented results from a preliminary version of the econometric model described in chapter 3.

¹⁷ Congressman Sanders' observation (loosely paraphrased) came during meeting with Vermont Wilderness Association representatives in 2001 to discuss the Association's proposal.

A much more challenging application of these results therefore arises from the question of whether and how public policies can address the negative implications of enhancement value while exploiting the positive implications. That is, can policy both encourage additions to the base of conserved land and foster an equitable distribution of the value – the windfall – created by conservation?

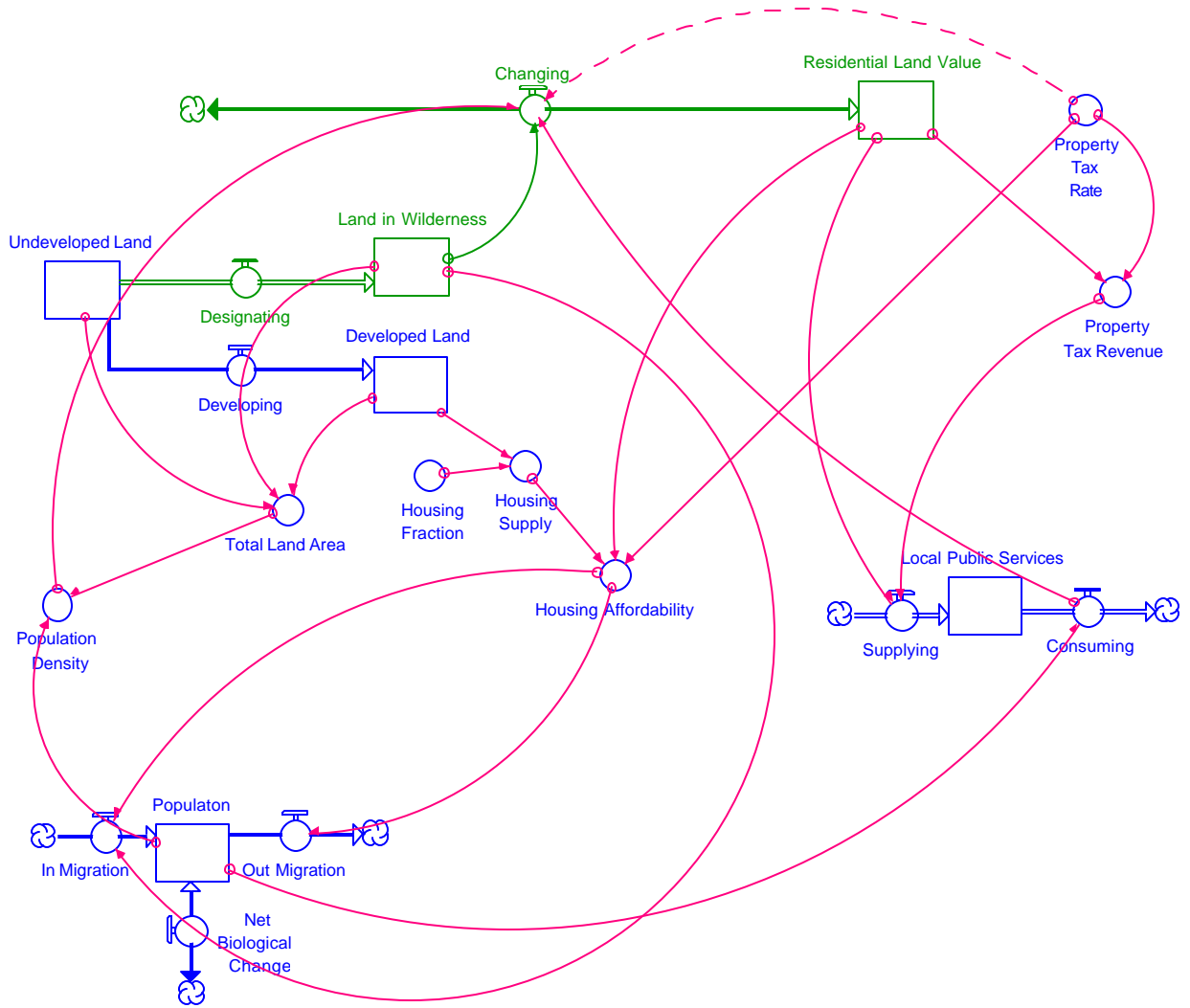
Development of such policies should be informed not only by specific information about individual relationships (such as between wilderness designation and land value), but also by an understanding of the entire system in which those relationships exist and evolve.

THE LAND VALUE SYSTEM

Figure 5.1 depicts a simple systems model in which wilderness designation is one factor among many that make a community an attractive place in which to live. The small portion of the system considered above is shown by the stock “Land in Wilderness,” the flow from the total land base into that stock (labeled “Designating”), and stock and flow at the top of the diagram labeled “Land Value” and “Changing,” respectively. The thin lines connecting stocks, flow regulators and converters (the circles in the diagram) convey either information or action from one part of the system to another. Thus the connector from the Land in Wilderness stock to the “Changing” flow regulator could be thought of as the positive relationship between proximity to wilderness and land value estimated in Chapter 3.

Similarly, the connector from the “Land in Wilderness” stock to the “In-Migration” flow regulator suggests the possible effect that wilderness designation attracts new residents, thereby increasing the “Population” stock. Higher population means higher population density which, per the regression results above, could exert additional upward pressure on land prices (see the connectors from “Population” to “Population Density” and from there to the “Changing” flow regulator at the top of the diagram).

Figure 5.1: Land Value Enhancement amid a Larger System



But there is much more to the system, even to the small sliver of reality that Figure 5.1 represents. For example, “designating” wilderness means both higher land values due to the amenity/enhancement effect and less land available for development for housing. Together these could mean less “Housing Affordability” (a converter at the center of the diagram). As housing becomes less affordable the result intimated by Misters Wood and Sanders – that people will be forced to migrate away from towns with designated wilderness – could occur. Following the logic of the systems model a little farther, however, it could be that this out-migration reduces population density. Because population density is directly related to land prices, reduced density could dampen wilderness-associated increases in housing prices.

What is likely the concern however, is that lower-income out-migrants will be replaced by higher-income in-migrants with vastly different expectations regarding quality of life, level of local public services and other features that make up the custom and culture of rural places. Indeed it is my impression that much of the concern expressed regarding the economic implications of land conservation in rural areas is, at its heart, a proxy for concern about changing rural lifestyles and values.

In the simplified model depicted in Figure 5.1, these concerns are represented by the stock of “Local Public Services” and the “Supplying” and “Consuming” flows attached to it.. Higher quality or more diverse public education services are one component of that stock that illustrates the potential shifts in culture that could attend rapid in-migration by a more urban population.

It is in the context of such a system that the relationship between wilderness designation or protection and land value operates, and any public policy intervention based on those relationships must consider the whole system if it is to be successful. It is that system that informs the proposed intervention described below.

WINDFALLS, WIPEOUTS AND WILDERNESS

Hagman and Misczynski (1978) coined the term “Windfalls for Wipeouts” and explored the concept in their 1978 book of the same name. The concept is based on a recognition that when the public takes some action affecting land, such as siting an interstate exchange, someone gets a windfall (the landowner just down the road from the exchange who can now sell her land to a strip mall developer), and someone gets wiped out (the landowner with a cloverleaf or a strip mall for a front yard). In the parlance of the Ricardo / von Thünen model sketched above, such government actions create rent for some landowners and reduce it for others. Note that the value created is pure rent – the landowners need not have done anything to create the added value. (It is possible that owners would lobby public agencies to take actions likely to enhance the value of their property. This practice is aptly termed “rent-seeking behavior” in the public choice literature.)

The case of wilderness designation differs from the “windfalls for wipeouts” concept in two respects. First, wilderness can be designated only on land already owned by the federal government.¹⁸ Therefore, selecting parcels for wilderness designation does not entail a “wipeout” in the sense that the current owner – the federal government – would lose any value. Second, when the Forest Service or other federal agency acquires land, including wilderness inholdings and even if by an eminent domain taking, it is generally required to pay fair market value. If the calculation of fair market value is correct, then the enhancement value associated with likely future agency decisions or statutory wilderness designation would be capitalized into price, and far from being wiped out, the private seller should receive the windfall.

To the extent that there is any wipeout associated with wilderness designation it is due to the pecuniary externality of higher land prices near the wilderness area. A combination of higher land prices and potentially higher tax bills could make it financially more difficult for lower income residents to simply stay put. The policy challenge then, is to find a way to

¹⁸ Wilderness Areas can be created with private “inholdings,” but the inholding itself is not designated wilderness. An inholding is a privately owned parcel completely surrounded by either public ownership or, at a minimum, a public proclamation boundary – the boundary within which the public agency, such as the USDA Forest Service, may acquire land.

capture the clear windfall and direct it toward alleviating that externality. It is possible that certain public policy tools now available in Vermont and elsewhere¹⁹, coupled with the Vermont Wilderness Association's proposal, could make such a solution part of standard land protection practice for the 21st century.

EXISTING VERMONT PROGRAMS

The State of Vermont has several programs directly related to land transactions, land taxes and conservation. Briefly, these include:

- A Land Transfer Tax paid by the land buyer to the State at the time of the land transfer. The rate is one half of one percent (0.005) of the first \$100,000 in value of the purchaser's principal residence, plus one-and-one-quarter percent (0.0125) of the value in excess of \$100,000. The higher rate is paid on the full value on all property other than one's principal residence. (It is the land transfer tax that generated the data employed in the estimation and simulation procedures described above.)
- Land Gains Tax. This is an additional tax paid on the capital gain from selling land held for fewer than six years. The rate varies according to both the holding period and the magnitude of the gain. The tax is intended to discourage speculative purchase of land and to dampen existing incentives for conversion of open space to more highly developed uses.
- Town and (now) statewide property taxes. The statewide property tax is intended to finance basic local educational expenditures and to equalize educational opportunity across property-rich and property-poor towns throughout the state. The property tax rate is set by the State, and revenues are returned to towns as per-pupil block grants. Several features of this new system, including a town-to-town revenue sharing program, remain very controversial within the state, and further revisions to the system are likely. That state

¹⁹ New York, for example, has a land transfer tax that generates revenue for a Statewide Environmental Protection Fund. The Fund pays public land acquisition and management as well as other environmental improvement projects.

property tax policy remains in flux may provide an opportunity for further adjustments to accommodate conservation-generated land value enhancement.²⁰

- Vermont Housing and Conservation Trust Fund (VHCTF). This fund is financed out of land transfer tax receipts as well as State general revenues. The Fund was created in 1987 as housing advocates, land trusts, and conservation activists came together to better provide for affordable housing and open space conservation. Since 1987, the Fund has provided more than \$88 million for affordable housing and more than \$62 million for conservation projects in the State. According to the Vermont Housing and Conservation Board, which oversees the fund, these funds have leveraged an additional \$515 million in public and private financing for conservation and affordable housing projects (Vermont Housing and Conservation Board, 2002).

Enhancement value associated with new wilderness areas would be expected to produce higher receipts from each of the three taxes as well as higher possible disbursements from the VHCTF. Because different parties (sellers, buyers, speculators or existing landowners) pay the various taxes, and because the enhancement value is unevenly distributed, any policy response should consider who pays the various taxes and who collects the enhancement windfall.

The purchaser pays the Land Transfer Tax. He or she would therefore pay a percentage of the higher, conservation-enhanced parcel value in the form of a higher Land Transfer tax. As in the conceptual and econometric models above, proximity to wilderness or other conservation areas is simply another attribute of the property considered by the purchaser in making an offer. The incremental tax associated with the share of the parcel's value attributable to wilderness would therefore not come as a surprise. There seems to be no argument for relieving purchasers from that increase.

The Land Gains Tax, on the other hand, is paid by the seller. Nearby wilderness designation during the first six years of a landowner's holding period could raise the value

²⁰ Towns do assess property taxes over and above the statewide rate to finance towns' non-educational expenditures as well as educational expenditures over and above the state's per-pupil grant.

of the parcel by more than he or she had expected. The landowner would therefore face Land Gains Tax liability that is higher than would have been expected in the absence of new or expanded wilderness areas. One might argue therefore that it is unfair to collect that additional portion of the land gain from such landowners.

It is, on the other hand, these same landowners who, by selling their property, realize the enhanced value of newly designated wilderness. So even with a higher land gains tax bill, the seller would be able to keep a large portion of the unearned, wilderness-generated windfall. Again, there seems to be no solid case for relieving these landowners of higher tax burdens stemming from wilderness designation.

Property taxes are perhaps another matter. Paid annually by current landowners, property taxes are difficult to avoid, except through enrollment in a current use program, or by donating or selling a conservation easement and having the local taxing authority reduce the assessed value of the eased property. Designation of new wilderness areas would increase landowners' property tax bills in proportion to each parcel's enhanced value. Until these landowners sell their parcels, however, any wilderness-induced rent exists only on paper, and the landowner does not realize any windfall. One could argue therefore that landowners who held their land at the time of nearby wilderness designation should be shielded from the impact on their property tax bills of rents resulting from that designation.

Towns may of course reduce local property tax rates to keep revenues and expenditures in balance. In addition, and because open space conservation is often associated with lower local public service costs, it is also possible that overall town budgets will decrease or at worst rise less rapidly after creation of the conservation unit (American Farmland Trust 1992; Commonwealth Research Group, Inc. 1995; Lerner and Pool 1999; Tibbetts 1998; and U.S. National Park Service, Rivers, Trails and Conservation Assistance 1995). Towns could therefore reduce property tax **rates** thereby lessening the impact of new wilderness designations on landowners' tax **bills**. Even if local property tax rates were to be reduced to zero, there would remain the state-wide portion of property tax rates, over which local

public officials and landowners have no control. So there is a limit to property tax relief that could be provided by fiscal policy changes at the town level.

In any case, and in consideration of the system in which these impacts play out, the wilderness designation itself may set in motion forces that tend to keep local public expenditures from ratcheting downward. In-migration of people with children to be taught or who build homes that need protection from fire, for example, would mean higher local public service costs. It might therefore be overly optimistic to expect that wilderness-related land value enhancement will have no impact on local property tax bills, even if property tax rates are reduced.

Addressing the property tax impacts is particularly important. Increases in land carrying costs due to conservation-related enhancement could prove a burden to owners of working farm and forest land (even if enrolled in use-value-taxation programs) as well as on persons living on fixed incomes and those who are otherwise land rich and cash poor. In addition to questions of distributional equity, an increase in property tax burden could accelerate the conversion of farms, woodlots and other open space to more highly developed uses as long-time residents sell-off or subdivide their land to raise cash to pay tax bills and/or reduce the amount of land on which they have to pay future taxes. This subdivision and conversion could, in turn, generate environmental impacts that might offset environmental quality gains associated with wilderness designation.

The final consideration is the impact on housing affordability for existing and new residents noted by Rasker and Glick (1994). New conservation units could enhance the value of local land right out of the price range of long-time residents, their children and grandchildren.

A WINDFALLS FOR WILDERNESS POLICY

Each of the programs and considerations just described play a critical role a role in the design of a hypothetical “Windfalls for Wilderness” policy. One additional element that

does not currently exist in the State of Vermont, but which is quite common elsewhere, is the sale of public bonds to finance land acquisition for conservation purposes.

While the VHCTF addresses some current conservation funding needs, taking advantage of future conservation opportunities, including purchasing inholdings within new and existing wilderness areas, may require additional sources of funds. Issuing tax-exempt bonds is one way for states to increase available funds in the short term while deferring expenditures until future revenue can service the bond debt. Because of lags between expenditures to establish conservation units and the realization of increased land-based tax revenue, such bonds would be particularly well-suited to the purpose at hand.

In order to finance additional land protection, the State of Vermont could issue bonds in an amount sufficient to cover land or easement acquisition costs. The coupon rate of these bonds would be set according to expectations about future increased revenue from the Land Transfer and Land Gains taxes. A simulation based on the land price model presented above and enhanced to cover different types of land conservation (*e.g.* state parks, wildlife management areas, conservation easements) could assist the State bonding authority in setting an appropriate rate.

Most of these bonds would be sold to investors in the usual fashion, but some bonds would be withheld for a special offering to current residents of towns either containing or lying near new conservation land units. The bonds could be sold to those residents at discounted prices, or the bonding authority could grant the residents an option to purchase bonds in the future at the initial bond price. In this way, residents who do not sell land at conservation-enhanced prices can nevertheless reap a portion of the enhanced value.

Meanwhile, towns containing new conservation units would be allowed and encouraged to cap the inflation-adjusted assessed value of existing landowners' parcels at the level current at the time of the unit's establishment. (Under the new statewide school funding law, reappraisal is mandatory when assessed value falls below 80% of equalized, or estimated fair market value.) This would shield landowners from property-tax-increase-induced incentives to subdivide or convert land from less developed to more developed uses.

Needless to say, federal and/or state payment in lieu of tax programs should be fully funded and implemented to offset the reduced tax base associated with new public ownership.

In addition, the VHCB could direct additional funds to support the construction and repair of affordable housing in towns containing new conservation lands. Both by providing lower cost units and by increasing the overall housing stock in those communities, this measure would help ensure that lower-income homebuyers are not priced out of the market.

The expenditures implied by these measures – debt service, property tax abatement, and increases in affordable housing would be paid for by increased revenue generated by the Land Transfer and Land Gains tax programs. To the extent that all Vermont residents benefit to some degree from land protection anywhere in the state, it would be reasonable to simply leave the Land Gains and Land Transfer tax rates at their current levels. In that way, all Vermont taxpayers would share in the cost of additional conservation.

Because landowners nearest newly protected units realize the greatest direct financial gain however, it would also be reasonable to adjust the Land Gains Tax to reflect and capture a portion of the incremental land rent created by the land conservation. Such adjustments could include town-specific increases in the Land Gains Tax rate, an extension of the holding period during which the Land Gains Tax would be owed, or both.

Finally, and as a further means of alleviating wilderness-conservation-induced increases in local property tax bills, increases in the Land Transfer Tax receipts associated with wilderness designation and other conservation initiatives could be directed toward property tax relief for individual landowners in the communities closest to the new conservation areas. The statewide school funding program already includes means-tested assistance to landowners in the form of property tax rebates. The portion of additional Land Transfer revenues attributable to wildland conservation could be earmarked for the purpose of giving larger property tax rebates to lower-income landowners in those communities where new conservation units are established.

In addition to property tax relief and interest payments on bonds, enhancement value associated with new wilderness designations or other conservation might also fund local community visioning, planning and economic development initiatives. Deliberate, inclusive, and fact-based community planning efforts are widely regarded as necessary components of successful economic development, particularly for communities in transition from traditional natural resource extraction-based economies to economies more oriented toward natural resource amenities. Howe, McMahon and Propst, for example, note that successful “gateway” communities (those closest to National Parks and other public lands) “actively involve a broad cross-section of residents in determining and planning for the future (1997, p.47).” The Rocky Mountain Institute’s *Economic Renewal Guide* (Kinsley, 1997) also stresses the importance of both community visioning and participatory assessment of local conditions and trends to achieving sustainable community development.

Such efforts can also reduce polarization of the debate over public land management and help make progress in addressing both the challenges and opportunities that conserved wildlands can present (Phillips and Ingerson, 2002). Tools for supporting community planning can range from pencil-and-paper trends assessment to group modeling processes, in which community members use systems thinking and modeling, such as depicted in Figure 5.1, to explore the past and future implications of changes in land ownership and management.

Financial resources to support local visioning and planning programs are often scarce, however. Vermont’s statewide planning program, established by “Act 200” in 1988 has foundered due to lack of financial support (Wilhelm, Glitman, and Perkins, n.d.; Vermont Public Interest Research Group, 2003). This planning could be supported by conservation-enhanced transfer tax receipts, with the additional funds earmarked for planning in towns with new wilderness or other land conservation efforts.

To rural communities, even modest amounts of financial support can make the difference between planning to address demographic, economic and land use change or continuing to

be at the mercy of larger outside forces. The Town of Charleston in far northern Vermont, for example, recently appropriated the sum of \$2,000 from local property tax revenues to support the creation of a first-ever town plan (Town of Charleston, 2003). Additional funds from transfer tax receipts could enhance that process by providing training to the citizen volunteers who comprise the planning commission, hiring consultants, or to sponsor additional community outreach and involvement efforts.²¹

Based on the simulation of land value enhancement resulting from a decrease in the distance to the nearest wilderness area, added land transfer tax revenues would be in excess of \$12,000 per year. The distance-to-wilderness (DST_WILD / DST_WILD_P) simulation produced the lowest enhancement estimates of the three options, so this figure is possibly a conservative estimate of the added Land Transfer Tax that could be devoted to a targeted tax rebate program, to local planning assistance, or both. One must also recall that the \$12,000 estimate does not reflect any of the value associated with **existing** wilderness areas – it is merely the incremental Land Transfer Tax revenue value that could result from enactment of the VWA’s wilderness proposal.

Other policy responses to increases in land rent associated with proximity to protected land are possible. One more in line with the ideal of a comprehensive land value tax might entail setting the land transfer tax equal to the entire wilderness-induced enhancement value. This option would produce higher revenues that could be turned to further conservation, affordable housing, property tax relief and local planning purposes. Moreover, and assuming that at least some of the benefits associated with complete land value taxation system would apply to such a partial measure, taxing the entire wilderness-associated windfall would promote distributional equity, discourage exurban sprawl and otherwise promote more efficient use of land and other natural resources (Tideman, 1998).

Such policy options are perhaps topics for further study. The analysis and policy options presented here, however, should serve as a guide to the development of new instruments to

²¹ I make these observations as a member of the Charleston Town Planning Commission and from experience working with rural communities for whom planning assistance is generally too costly to finance with exclusively local resources.

take advantage of land conservation opportunities now present in the northeastern U.S. while addressing potential resistance to those opportunities. In so doing, the region could provide a model for conservation across the nation, particularly in those regions where close mingling of publicly protected wildlands and private parcels could mean greater potential for conservation-enhanced land value.

BIBLIOGRAPHY

- Ad Hoc Associates. 1996. *Property Taxes, Growth, and Land Conservation in the Adirondacks*. Elizabethtown, NY: The Adirondack Council.
- Ad Hoc Associates. 1997. *Open Land, Development, Land Conservation and Property Taxes in Maine's Organized Municipalities*. Brunswick, ME: Maine Coast Heritage Trust.
- Alig, R. J. 1986. Econometric analysis of the factors influencing forest acreage trends in the Southeast. *Forest Science*, 32:119-34.
- Alig, R. J.; White, F. C.; and Murray, B. C. 1988. *Economic factors influencing land use changes in the south central United States*. Southeastern Forest Experiment Station Research Paper SE-272. Asheville, NC: U.S. Department of Agriculture Forest Service.
- Alonso, W. 1964. *Location and Land Use: Toward a General Theory of Land Rent*. Cambridge, MA: Harvard University Press.
- American Farmland Trust. 1992. *Does farmland protection pay?* Northampton, MA: American Farmland Trust. 36 p.
- Boussard, L., ed. 1995. *Keeping the Promise: Priorities for the Land and Water Conservation Fund — FY '96*. Washington, DC: LWCF Coalition.
- Brooks, D. H. 1987. *Land use in economic theory: principles and prospects*. Economic Research Service Staff Report No. AGE870806. Washington, DC: US Department of Agriculture, Economic Research Service.
- Chicoine, D. L. 1981. Farmland values at the urban fringe: an analysis of sale prices. *Land Economics*, 57:353-62.
- Coffin, D. A. 1989. The impact of historic districts on residential property values. *Eastern Economic Journal*, 25:221-8.
- Commonwealth Research Group, Inc. 1995. *Cost of community services in southern New England*. Chepachet, RI: Southern New England Forest Consortium. 102 p.
- Correll, M. R.; Lillydahl, J. H.; and Singell, L. D. 1978. The effects of greenbelts on residential property values: some findings on the political economy of open space. *Land Economics*, 54:207-217.
- Eastern Wilderness Act. 1975. P.L. 93-622, 88 Stat. 2096.

- Echelberger, H.E.; Luloff, A.E.; and Schmidt, F.E. 1991. *Northern Forest Lands: Resident Attitudes and Resource Use*. Research Paper NE-653. Radnor, Pennsylvania: US Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 26 p.
- Epple, D. 1987. Hedonic prices and implicit markets estimating demand and supply functions for differentiated products. *Journal of Political Economy*, 95:59-80.
- Faushold, C.J.; and Lilieholm, R.J. 1996. *The Economic Value of Open Space: A Review and Synthesis*. Lincoln Institute of Land Policy Research Paper No. WP96CF1. Cambridge, MA: Lincoln Institute of Land Policy.
- Fischel, W.A. 1990. *Do Growth Controls Matter? A Review of Empirical evidence on the Effectiveness and Efficiency of Local Government Land Use Regulation*. Cambridge, MA: Lincoln Institute of Land Policy.
- Florida, R. 2000. Competing in the age of talent: environment, amenities, and the new economy. Report prepared for the R. K. Mellon Foundation, Heinz Endowments, and Sustainable Pittsburgh. Pittsburgh, PA: Carnegie Mellon University. January. 60 p.
- Goodstein, E.B. 1994. *Jobs and the Environment: The Myth of a National Trade Off*. Washington, DC: Economic Policy Institute.
- Grether, David M., and Miezkowski, Peter. 1980. The Effects of nonresidential land uses on the the prices of adjacent housing: some estimates of proximity effects. *Journal of Urban Economics*, 8:1-15.
- Hagman, D.; and Misczynski, D., eds. 1978. *Windfalls for wipeouts: land value capture and compensation*. Washington, DC: American Planning Association.
- Hall, R.E., et al. 1995. *Eviews: user's guide*. Irvine, California: Quantitative Micro Software.
- Harper, S.C.; Falk, L.L.; and Rankin, E.W. 1990. *Northern forest lands study of New England and New York*. Washington, DC: USDA Forest Service and Governors' Task Force on Northern Forest Lands.
- Hamilton, S. W.; and Schwann, G. M. 1995. Do high voltage electric transmission lines affect property valuee? *Land Economics*, 71:436-44.
- Howe, J., McMahon, E., and Propst, L. 1997. Balancing nature and commerce in gateway communities. Washington, DC: Island Press.
- Hushak, L. J.; and Sadr, K. 1979. A spatial model of land market behavior. *American Journal of Agricultural Economics*, 61:697-701.

- Irwin, E.G. 2002. The effects of open space on residential property values. *Land Economics* 78:465-80.
- Johnson, J. D.; and Rasker, R. 1995. The role of economic and quality of life values in rural business location. *Journal of Rural Studies*, 11:405-16.
- Keese, S. 2003. Planning begins for expanded wilderness area. Radio report. Vermont Public Radio. October 2.
- Kinsley, M.J. 1997. Economic renewal guide: a collaborative process for sustainable community development. Snowmass, CO: Rocky Mountain Institute.
- Knaap, G. J. 1985. The price effects of urban growth boundaries in metropolitan Portland, Oregon. *Land Economics*, 61:26-35.
- Knapp, T. A.; and Graves, P. E. 1989. On the role of amenities in models of migration and regional development. *Journal of Regional Science*, 29:71-87.
- Lerner, S.; and Poole, W. 1999. *The economic benefits of parks and open space: how land conservation helps communities grow smart and protect the bottom line*. Washington, DC: The Trust for Public Land. 48 p.
- Levitt, J. 2000. Networks, land use and conservation. Presentation to Conservation in the internet age: strategic threats and opportunities, June 15.
- Lorah, P. 2000. Population growth, economic security, and cultural change in wilderness counties. In: Cole, D.; McCool, S. 2000. *Proceedings: wilderness science in a time of change*. Proc. RMRS-P-000. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.
- Manning, R., Minter, B., and Valliere, W. 1996 *Social values, environmental ethics, and National Forest management: study completion report to the North Central Forest Experiment Station*, Burlington, VT: University of Vermont School of Natural Resources, June. 91 p.
- Manning, R., Treadwell, J., Minter, B., Valliere, W. 1998. *Forest values, environmental ethics, and attitudes toward National Forest management: study completion report to the North Central Forest Experiment Station and the Pacific Southwest Forest Experiment Station*. Burlington, VT: University of Vermont School of Natural Resources, October. 56 p.
- McGranahan, D.A. 1999. Natural amenities drive rural population change. Food and Rural Economics Division, Economic Research Service, Agricultural Economic Report No. 781. Washington, DC: U.S. Department of Agriculture, September. 24 p.
- McKibben, B. 1995. An explosion of green. *The Atlantic Monthly*, April, pp 61-83.

- Meyer, S.M. 1992. *Environmentalism and Economic Prosperity: Testing the Environmental Impact Hypothesis*. Cambridge, MA. Department of Political Science, Massachusetts Institute of Technology.
- Meyer, S.M. 1993. *Environmentalism and Economic Prosperity: An Update*. Cambridge, MA.: Department of Political Science, Massachusetts Institute of Technology.
- Morrel, J. 1996. Personal communication. March.
- Nelson, A.C. 1985. A unifying view of greenbelt influences on regional land values and implications for regional planning policy. *Growth and Change*, 16:43-8.
- Northern Cartographic. 1997. *Vermont road atlas and guide, third edition*. South Burlington, VT: Northern Cartographic.
- Northern Forest Alliance. 1994. *A Forest at Risk: The Citizens' Agenda for Saving the Northern Forest*. Montpelier, VT.
- Northern Forest Lands Council. 1994. *Finding Common Ground: Final Recommendations*. Concord, NH.
- Patterson, R.W., and Boyle, K.J. 2002. Out of sight, out of mind? Using GIS to incorporate visibility in hedonic property value models. *Land Economics* 78:417-25.
- Phillips, G. 1995. *Real estate tools for the farmer: habitat preservation, tax benefits and capitalization through limited development*. Carrboro, NC: Weaver Street Realty. 8 p.
- Phillips, S.R. 1991. *Evaluating agricultural pesticide use and risk for the Chesapeake Bay*. Masters Thesis. Blacksburg, VA: Department of Agricultural Economics, Virginia Polytechnic Institute and State University.
- Phillips, S.R. 1993. *Forest Products Manufacturing: Factors and Trends Affecting the Working Forest*. Washington, DC: The Wilderness Society.
- Phillips, S.R. 1994. *Toward a Sustaining Forest: Development Opportunities for the Maine Woods*. Washington, DC: The Wilderness Society.
- Phillips, S.R. 2000. Windfalls for Wilderness: Land protection and land value in the Green Mountains. In Cole, David N., and McCool, S.F. *Proceedings: Wilderness science in a time of change*. Proc. RMRS-P-15-VOL-2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.
- Phillips, S. and Ingerson, A. 2002. Community economic assessment workbook. Washington, DC: The Wilderness Society. 83pp.

- Pollakowski, H.O.; and Wachter, S. M. 1990. The effects of land-use constraints on housing prices. *Land Economics*, 66:315-24.
- Power, T.M., ed. 1995. *Economic Well-Being and Environmental Protection in the Pacific Northwest: A Consensus Report by Pacific Northwest Economists*. Missoula, , MT: Economics Department, University of Montana.
- Rasker R.; and Glick, D. 1994. The footloose entrepreneurs: Pioneers of the new west? *Illahae*, Number 10 (Spring): 34-43.
- Rasker, R. 1994. A new look at old vistas: the economic role of environmental quality in western public lands. *University of Colorado Law Review*, 65:369-99.
- Repetto, R.. 1995. *Jobs, Competitiveness, and Environmental Regulation: What Are the Real Issues?* Washington, DC. World Resources Institute, February.
- Roback, J. 1982. Wages, rents and the quality of life. *Journal of Political Economy*, 90:1257-78.
- Roback, J. 1988. Wages, rents and amenities: Differences among workers and regions. *Economic Inquiry*, 26:23-41.
- Robinson, S. 2000a. Hundreds apply for Putnam's work-at-home jobs. *Burlington Free Press*. July 20, p.10A.
- Robinson, S. 2000b. IDX training at-home workers. *Burlington Free Press*. July 25, p.6A.
- Rosen, S. 1974. Hedonic prices and implicit markets: product differentiation in pure competition. *Journal of Political Economy*, 82:34-55.
- Rudzitis, G., and H.E. Johansen. 1989. Migration into western wilderness counties: Causes and consequences. *Western Wildlands*, 15:19-23.
- Tang, M. 1995. *The effect of an urban growth boundary on property prices: the case of virginia beach, Virginia*. Masters Thesis. Blacksburg, VA: Department of Agricultural Economics, Virginia Polytechnic Institute and State University.
- Thorsnes, P. 2002. The value of a suburban forest preserve: estimates from sales of vacant residential building lots. *Land Economics* 78:426-41
- The Wilderness Society. 1984. *The Wilderness Act Handbook*. Washington, DC: The Wilderness Society.
- Tibbetts, J. 1998. *Open space conservation: investing in your community's economic health*. Cambridge, MA: Lincoln Institute of Land Policy. 34 p.

- Tideman, T. N. 1970. *Land Use Control through Administered Compensation*. Program on Regional and Urban Economics Discussion Paper No. 59. Cambridge, MA: Harvard University.
- Tideman, T.N. 1998. Applications of land value taxation to problems of environmental protection, congestion, efficient resource use, population and economic growth. In Netzer, ed. *Land value taxation: can it an will it work today?* Cambridge, Massachusetts: Lincoln Institute of Land Policy.
- Turner, R.; Newton, C. M.; and Dennis, D. F. 1991. Economic relationships between parcel characteristics and price in the market for Vermont forestland. *Forest Science*, 37:1150-62.
- U.S. Bureau of the Census. 1980. *Census of population and housing, STF3A*. 9-track computer tape. Washington, DC: U.S. Department of Commerce.
- U.S. Bureau of the Census. 1990. *Census of population and housing, STF3A*. CD-ROM. Washington, DC: U.S. Department of Commerce.
- U.S. Bureau of Economic Analysis. 1999. *Regional Economic Information System CD-ROM*. Washington, DC: U.S. Department of Commerce.
- U.S. National Park Service, Rivers, Trails and Conservation Assistance. 1995. *Economic Impacts of Protecting Rivers, Trails, and Greenway Corridors, Fourth Edition*. Washington, DC: U.S. Department of the Interior.
- Vail, D. 1987. *Contract Logging, Chainsaws and Clearcuts: The Human and Environmental Effects of Forest Management Systems in Maine (USA)*. Helsinki, Finland: World Institute for Development Economics Research, United Nations University.
- Vermont Department of Taxes. 1987 through 2002. *Annual Report*. Waterbury, Vermont: Division of Property Valuation and Review.
- Vermont Housing and Conservation Board. 2002. The economic benefits of investments by the Vermont Housing & Conservation Board. Montpelier Vermont, August, 4pp.
- Vermont Natural Resources Council. 1997. Taking the measure of aesthetics. *Vermont Environmental Report*, March.
- Vermont Public Interest Research Group. 2003. Sprawl: Vermont's #1 Threat (fact sheet) http://www.vpirg.org/pubs/fs_sprawl.html.
- Vermont Wilderness Act of 1984. P.L. 98-322, 98n STAT.253.
- Vermont Wilderness Association. 2001. *Wilderness: A Vermont Tradition* (Brochure). Montpelier, VT: Vermont Wilderness Association.

- Vermont Wilderness Association and University of Vermont Spatial Analysis Lab. 2001. Geographic Information System data via personal communication with Jim Northup (WVA) and Charles Ferree (UVM).
- Weicher, J. C.; and Zerbst, R. H. 1973. The externalities of neighborhood parks: an empirical investigation. *Land Economics*, 49:99-105.
- White, H. 1980. A heteroskedasticity-consistent covariance matrix and a direct test for heteroskedasticity. *Econometrica*, 48.
- Wilderness Act. 1964 1975. P.L. 88-577, 16 U.S. C. 1131-1136.
- Wilhelm, D., Glitman, M., and Perkins, K.L. n.d.. Exploring sprawl. Vermont Forum on Sprawl (<http://www.vtsprawl.org/>).

VITA

Spencer R. Phillips received a B.A. in economics from the University of Virginia in 1985 and an M.S. in Agricultural and Applied economics from Virginia Polytechnic Institute and State University in 1991.

He is currently a Senior Resource Economist at the The Wilderness Society, a Washington, DC-based conservation organization. His previous professional experience includes positions in economic and policy analysis at the White House Council on Environmental Quality, Pracon, Inc., the Federal Trade Commission, and as a consultant to Resources for the Future and the Commonwealth of Virginia's Air Pollution Control Department.

Mr. Phillips lives with his family in West Charleston, Vermont.