No. 27
WINTER 2015

MERCATUS GRADUATE POLICY ESSAY

ANTICOMMONS AND PUBLIC LANDS IN THE WEST

by David Christensen

MERCATUS CENTER
George Mason University

Abstract
In this paper, I examine significant policy issues raised by the checkerboarded nature of land ownership, particularly of public lands, in the western United States. Economic theory predicts that this situation can lead to significant barriers to the economical use of land and natural resources residing on that land. In particular, theory suggests that the tragedy of the anticommons will arise. The tragedy of the anticommons, as the name implies, is closely related to—but the opposite of—the more well-known tragedy of the commons. In an anticommons situation, resources are under- rather than overutilized. I test this theoretical prediction using data from timber auctions managed by the Washington State Department of Natural Resources. I find evidence of checkerboardedness leading to anticommons outcomes, though I do not find as much evidence of anticommons from several other predicted sources. Having established on both theoretical and empirical grounds that the checkerboarded lands of the west present economic barriers, I discuss ways to evaluate land transaction mechanisms. After examining several possible criteria for success, I outline a framework for analyzing and evaluating land transaction mechanisms, provide an example of how that framework might be applied, and conclude with suggestions for future research and application.

Author Bio
David Christensen is an alumnus of the Mercatus Center MA Fellowship at George Mason University and holds an MA economics from George Mason University. David graduated summa cum laude from the University of Utah with a BS economics and a BA international studies. He has worked as an intern both with the Office of the Attorney General of the State of Utah and with Goldman Sachs. He currently works at the USDA Forest Service on budget and planning. His research experience includes authoring an honors thesis, "Harmonization of EU-US Regulatory Standards: Challenges and Opportunities," which he presented at the 2012 National Conference on Undergraduate Research, as well as coauthoring a report on airline deregulation. His current interests include agent-based modeling and new institutional economics.

Committee Members
Thomas Stratmann, scholar, Mercatus Center at George Mason University, and university professor of economics, George Mason University
Paul Dragos Aligica, senior research fellow, Mercatus Center at George Mason University
Emily Washington, policy research manager, Mercatus Center at George Mason University

Acknowledgements
I would like to thank my committee members, Thomas Stratmann, Paul Dragos Aligica, and Emily Washington, for their valuable advice and insight. This paper would be much less than it is without them. I also owe a debt of thanks to Matt Mitchell and Richard Wagner for valuable suggestions and ideas in their classes—classes that this paper grew from. Finally, thanks go to Virgil Storr and Stefanie Haeffele-Balch for their support and to the Mercatus Center at George Mason University for the support and resources that went into bringing this to fruition. Any errors are my own.

Table of Contents

Introduction

Few policy issues arouse as much passion in the rural western United States as government land ownership, use, and disposition. The intensity of feeling involved often leads to stark policy positions: environmental groups demand that land and the natural resources residing in it remain undeveloped while mineral resource companies and local ranchers seek varying degrees of resource extraction; parts of the tourism industry support increased expansion of national monuments while state legislators push for conversion of federal lands to state holdings. County commissioners have even lead ATV enthusiasts in civil disobedience while federal law enforcement officers pressed charges for violation of road and trail closures.

In the midst of this take-no-prisoners drama the implications of mundane but significant policy decisions are often overlooked. In this paper, I turn my attention to one such class of policy questions. As I explain below, due to historical legislation and patterns of settlement, significant portions of land in the west are publicly owned—in some states, well over half of the land is owned by the federal government. This publicly owned land often takes a checkerboard pattern, which, together with rigidities of land acquisition and disposal, raises significant barriers to economical land use. Theory predicts that this checkerboardedness leads to the tragedy of the anticommons. I test this using data from timber auctions managed by the Washington State Department of Natural Resources. I find evidence supporting the notion that checkerboardedness leads to anticommons situations, though I do not find conclusive evidence for several other predicted sources of anticommons problems. Having established on both theoretical and empirical grounds that the checkerboarded lands of the west present economic barriers, I discuss ways to evaluate land transaction mechanisms. Improved policy decisions require a basis for evaluating the various land transaction mechanisms available. After examining several possible criteria for success, I outline a framework for analyzing and evaluating land transaction mechanisms, provide an example, and conclude with suggestions for future research and application.

Background

Land ownership patterns in the western United States are radically different than those of the eastern and central states, leading to tensions over land generally not seen in other parts of the country. Approximately 81 percent of land in Nevada is federally owned. In contrast to this, the highest percentage of federal ownership in a state east of the Rocky Mountain states is New Hampshire, with 13.5 percent (Congressional Research Service [hereafter CRS] 4). Five federal organizations manage the vast majority of federal lands: the Department of Defense (DOD), the Department of Agriculture's Forest Service (USFS), and three agencies of the Department of the Interior—the Bureau of Land Management (BLM), Fish and Wildlife Service (FWS), and National Park Service (NPS). Other federal agencies also administer land, but not on the scale of these five organizations. In addition to the large federal holdings, many state governments in the west own substantial amounts of land, particularly in the form of school trust lands. Native American tribal governments also own large parcels of land.

This distinctive distribution of land ownership in the west arises from the historical circumstances surrounding the westward expansion of the United States. In the early days of the republic, the original states claimed vast, ill-defined tracts of land to their west. These claims were ceded to the federal government, and new states in what is now called the Midwest were created. The United States acquired new tracts of land throughout the 19th century through purchase (most famously from France and Russia via the Louisiana Purchase and the Alaska Purchase, respectively), treaty (as with Britain, notably dividing Oregon along the 49th parallel), annexation (for instance, Texas), and war (much of the western United States was acquired in the Mexican-

American War). The government promoted settlement of these lands throughout the late 18th and 19th centuries and into the early 20th century through land grants to veterans and through various laws such as the Homestead Act of 1862, which granted land to "homesteaders who settled upon and improved vacant agricultural public lands" (US Department of Interior, Bureau of Land Management, 6, Table 1-2 note b).

The need to develop revenue sources for newly created states provided an early impetus for government control of land. In 1785 Congress passed the General Land Ordinance, instituting the rectangular survey of western lands and reserving lot 16 in every township "for the maintenance of public schools within the said township" (Souder and Fairfax, 18). As settlement pushed west into increasingly barren (and thus agriculturally less productive) lands, the number of lots within each township granted to the states for the support of schools (as well as grants for mental asylums, universities, etc.) eventually increased to four sections in each township. Over time, a desire to preserve and federally manage the vast wilderness of the west also arose. The United States Congress created the first national park, Yellowstone, in 1872, and the first national forests in 1891 (CRS, 2). Railroad grants also played an important role in the distribution of government holdings; the federal government granted land to the states to be regranted in turn to railroads (thus providing a substantial subsidy to early railroads) (Souder and Fairfax, 24–27). And under the Taylor Grazing Act of 1934, about 80 million acres of unreserved public lands in the west became subject to the Department of the Interior (U.S Department of Interior, Bureau of Land Management, Casper Field Office). This provided the core of what would become the BLM a decade-and-a-half later.

As a result of these historical processes of land acquisition and disposition, land ownership patterns across much of the western United States now resemble a quilt formed from patches of land owned by various federal agencies, state agencies and trusts, and private land owners. The scattered and noncontiguous nature of land ownership precludes certain land uses that require large contiguous tracts of land, and leads to a higher rate of externalities. While the most valued use of land may not require large tracts of land, it often does, particularly where natural resources and ecological systems are involved. For instance, ranching in the west often requires large swathes of land to support a herd. Harvesting resources such as timber and minerals requires access roads, support facilities, and in the case of oil and gas, pipelines. Sporadic land ownership can also inhibit the successful pursuit of ecological goals, particularly those involving apex predators and migratory herds. Recreational opportunities, especially hunting, also become difficult or impossible in the presence of a jurisdictional crazy-quilt.

Examples of these problems abound. For instance, while wild horses are beloved of groups such as the American Wild Horse Preservation Campaign, they compete with wildlife and livestock for pasture. In an area of south-central Wyoming characterized by checkerboarded land ownership as a relic of railroad grants, wild horses roam freely across private and public lands. In 2013, a group of ranchers sued for the removal of the horses from private checkerboarded lands, arguing that the large herds of wild horses were putting pressure on livestock. The state of Wyoming supported removal of the horses, because they also put pressure on sage grouse, a threatened bird that lives in much of the intermountain west. The ranchers won the suit and the BLM initiated plans to remove the wild horses, but this in turn has been halted as the result of a suit by wild horse advocates (Graff 2014b, Neary).[1]

[1] This clash also serves to highlight another source of acrimony over land use in the west—the American Wild Horse Preservation Campaign is a North Carolina group (Graff 2014a). Often clashes over land use pit westerners who depend on the land for their livelihoods against easterners who value the land for ecological—or in the case of wild horses, sentimental—purposes. This leads to considerable anger, as westerners feel constrained in their use of land by individuals who rarely, if ever, are on the land.

Checkerboarded patterns of land ownership also lead to clashes regarding mineral resources. President Clinton's 1996 creation of the Grand Staircase-Escalante National Monument in southern Utah via executive order brought to light an ongoing controversy, as Utah's School and Institutional Trust Lands Administration possessed inholdings surrounded by federally owned lands. By declaring the federal lands a national monument, any hope the state had for receiving revenues from substantial mineral resources on those lands was virtually eliminated. Furthermore, the state inholdings made federal environmental planning in the area more difficult. Both mineral and environmental uses of the lands were constrained by the checkerboarded nature of ownership, until congressional action eventually lead to a massive land exchange that consolidated land ownership into contiguous parcels.

While concerns regarding checkerboarded land patterns are often associated with ranchers and mineral exploration, environmentalists are also keenly aware of the limitations they present. A 2002 *Idaho Law Review* article by Robert Keiter lists five principles for nature-reserve design identified by an interagency panel of DOI and USFS officials, three of which are directly impacted by land ownership patterns: "large blocks of habitat . . . are superior to small blocks of habitat. . . . Habitat that occurs in less fragmented (that is, contiguous) blocks is better than habitat that is more fragmented . . . [and] blocks of habitat that are well connected in terms of habitat are better than blocks that are not" (Keiter, 304). While his article frequently veers toward the utopic, Keiter's diagnosis of the problems checkerboarded land can pose is insightful. He notes that where land holdings are checkerboarded "ecological management problems are endemic, *reflecting divergent ownership goals and spillover problems*" (Keiter, 307, emphasis added). This holds true not only for ecological considerations, but for many, if not all, of the land uses mentioned above as well.

As shown in the examples above, discontiguous and checkerboarded land holdings can lead to a problem known as the tragedy of the anticommons. While the well-known tragedy of the commons refers to the overuse of a common resource for which there are too few exclusion rights, the tragedy of the anticommons is, as its name suggests, the reverse phenomenon. It arises when an overabundance of exclusion rights leads to underuse of a resource. Consider the suit-countersuit wild horse saga in Wyoming: exclusion rights are possessed by multiple groups with different priorities for use of the land. The variety of land use regulations that exists in both urban and rural settings makes land a nearly ideal subject for examining the tragedy of the anticommons, and there is ample scope for empirical work in this area. Having argued that anticommons situations are characteristic of the problems and challenges facing land use in the west, I look for evidence of this by examining harvesting restrictions due to competing uses on winning bid prices in timber harvest auctions by Washington's Department of Natural Resources. First, however, a deeper examination of the theory of the anticommons is in order.

Anticommons

The first use of the term "anticommons" appears in Frank Michelman's 1982 paper "Ethics, Economics, and the Law of Property," though the term did not become widespread until Michael Heller published "The Tragedy of the Anticommons: Property in Transition from Marx to Markets." The tragedy of the anticommons is generally understood to mean the underutilization of a resource due to the ability of actors to block one another's access to or withdrawal from the resource. Michael Heller writes in his groundbreaking article that "when there are too many owners holding rights of exclusion, the resource is prone to underuse—a *tragedy of the anticommons*" (Heller 1988, italics in original). Sven Vanneste, Alain Van Hiel, Francesco Parisi, and Ben Depoorter define anticommons as "a regime in which two or more joint owners hold effective rights to prohibit one another from utilizing a scarce resource . . . because multiple holders of exclusion rights do not fully internalize the cost created by enforcing their right to exclude others, the common resource will remain idle even in the economic region of positive marginal productivity" (Vanneste, et al., 4). This concept has seen application in a variety of settings, particularly touching intellectual property (see Heller 2013 for a survey). Notable work in this area includes Hazlett (2005), Shapiro (2001), and Libecap and Smith (2002). In each of these cases, multiple individuals possess property-rights bundles that enable them to prevent all or some uses of a given resource.

In "Common Interest Tragedies," Lee Anne Fennell provides an alternative definition, which focuses less on questions of ownership and more on strategic behavior. In her account, the tragedy of the commons arises due to externalities, while the tragedy of the anticommons results from hold-out behavior. When a person fails to account for the negative externalities that their use of a resource has on other users (i.e., when actors find themselves in a prisoner's dilemma), it is a tragedy of the commons. When a person blocks an on-net beneficial activity from taking place by making a high (possibly infinite) demand for a side payment (i.e., when actors find themselves in a game of chicken), it is a tragedy of the anticommons. In this view "apparently unified property interests . . . are made possible only by fracturing other interests that could have been bundled together instead" (Fennell, 910). From this perspective, the real issue is not a question of the relative fragmentation of various arrangements "but whether it tends to generate collective action problems that are more costly or harder to solve than those presented by some other arrangement" (Fennell, 911).

This is an appropriately Coasean evaluation of the issue at hand, considering the recognition by Fennell (and others) that ultimately commons and anticommons situations are simply special cases of the Coase theorem. Where multiple individuals possess competing rights to use or possession of the land and its resources, conflict can emerge. Ronald Coase famously illustrated this in his work, particularly in "The Problem of Social Cost." Land use provides one of the central examples he used to illustrate the concept of externalities—in his story, a rancher owns cattle that, absent any preventive action, will trample the crops the farmer is growing (Coase, 2–8). His article focuses on externalities and illustrates the role transactions costs play in an economy. He demonstrates the reciprocal nature of externalities and shows that in the absence of transactions costs the ultimate allocation of resources will be the same regardless of the initial distribution of rights. In the presence of transactions costs, however, maximizing welfare depends crucially on who the law recognizes as the default holder of rights.

Heller recognizes this, stating that “if we lived in a world where people had perfect information and could bargain with each other at no cost, they could avoid anticommons tragedy every time (just as, in a perfect world, there would be no commons tragedy, or for that matter, tragedy of any sort)” (Heller 2013, 24). Similarly, Buchanan and Yoon, when providing a formal model of the anticommons, note that “in either under- or overutilization solutions, there will, of course, exist mutual gain from Coase-like contracts among users and excluders that, if implemented, could generate efficient results. We assume that such contracts between the parties are, for some reason, impracticable. A generalized ‘transactions costs’ explanation may be adduced here.” (Buchanan and Yoon, 4 note 4).

In this paper I use Fennell’s conceptualization of commons and anticommons as instantiations of externalities and hold-out problems, respectively. However, although her argument for doing so is rooted in a vocabulary of game theory, I will retain the nomenclature used by the more widespread and traditional definition of anticommons put forth by Heller and others, which emphasizes fragmentation or duplication of ownership rights. This terminology works well with the specific instances of anticommons I address. Specifically, I recognize the ability to impede resource utilization by others (a hold-out problem) as the defining characteristic of anticommons situations regardless of the possession of de jure property rights. However, such *de facto* rights (which may, for instance, be implicitly granted by a court when blocking the formal owner of property from doing something at the behest of a third party) are most readily expressed using language associated with ownership, particularly if one values reality over rhetoric in social science.

Evidence from Washington State

In the state of Washington various state agencies and public trusts own large swathes of valuable timber land. These forested lands represent significant natural resource wealth in the form of timber. However, these lands are also valued for other uses including fishing, wildlife habitat, and recreational hiking. While these lands are owned by numerous state agencies and trusts, most notably the public school trust lands, they are managed by the Washington Department of Natural Resources (DNR). The department manages the forests, including logging. When the department decides to harvest timber in a certain area, it conducts an auction. Companies can bid for the right to harvest trees of certain species and size within the harvest area being sold as specified in a prospectus provided by the DNR, several examples of which are included below. The winning bidder then owns the right to harvest the timber included in the auction. However, this right to harvest is subject to certain restrictions intended to prevent or reduce disturbance of other uses of the land.

These restrictions come in several forms. The bidder may be required by the Department of Natural Resources to construct, maintain, or deactivate roads within the harvest area. The specific harvest methods allowed also may be subject to restrictions. Timber-harvest methods fall into one of two categories: ground-based and cable-based. In ground-based methods, trees are felled and then removed via heavy equipment, including skidders and forwarders. In cable-based operations, machines called yarders use aerial cables to drag logs from harvest sites to loading sites (Forest Practices Branch, 54–55, 70). Typically, ground-based harvest methods are not allowed on slopes above a certain grade (often 35 percent, sometimes 45 percent) or under certain moisture conditions. Additionally, cable harvesting is sometimes required when stream-crossings are involved. These requirements are based on both technological and environmental considerations. Physics limits the slope that certain types of equipment are capable of traversing, making cable-based systems a necessity in some cases. Additionally, ground-based methods typically cause greater disturbance of the forest floor and sedimentation of streams than cable-based systems.

Where wetlands or streams are present, there may be additional restrictions on harvesting in the vicinity. These restrictions may include disallowing harvesting within a certain distance of the streams or wetlands, restricting harvesting to cable-based methods, or permitting only thinning (as opposed to clear-cutting and other intensive harvest practices). Harvesting may also be restricted to certain times of day or months of the year in order to protect certain species (particularly the northern spotted owl and marbled murrelet) (Washington Administrative Code).

Economic analyses of the timber industry have been undertaken in the past. For instance, Keith Leffler and Randall Rucker analyze the payment structures for private timber sales in North Carolina using a transactions cost framework (Leffler and Rucker 1991). Leffler, Rucker, and Ian Munn have also used private timber sales to examine the effect of measurement efforts in the presence of heterogeneous goods on distributional outcomes (Leffler, Munn, and Rucker 2014). Work has also been done regarding the optimal rules for pricing mechanisms in the timber market, including an examination of efficient pricing hypotheses (McGough, Plantinga, and Provencher 2004). Although not explicitly invoking an anticommons approach, a 1981 paper by William F. Hyde took a related approach in examining allocation of competing forest uses between those uses that are priced and those that are not priced (Hyde 1981).

The case of DNR-managed timberland in Washington provides an opportunity to empirically examine the theory of the anticommons. Because multiple parties have interests in—and explicit or implicit rights to—use of the land that timber companies purchase harvesting rights to, the potential for an anticommons outcome exists. This possibility is expected to reduce the amount timber companies will be willing to pay for harvesting rights. In this paper I test this theory by examining two different indicators of anticommons potential—the presence of fragmented property ownership in the area of the timber harvest, illustrating the role that fragmented or checkerboarded ownership patterns play in anticommons situations, and the presence of certain geographic features associated with competing resources, illustrating the presence of multiple potential veto sources.

Data Collection

I used data freely available on the Washington DNR website (Washington State Department of Natural Resources). Dave Herbert, formerly a research assistant to Thomas Stratmann, created an initial dataset collected from the Timber Sale Auction Results on the DNR site up through 2012. These data are straightforward—number of bidders, winning bid price, and so forth, and thus permit a uniform data-collection method. Beginning with this set of approximately 1,400 observations, I obtained information regarding additional variables of interest for nearly 450 observations drawn from 2010, 2011, and 2012, as well as completely new data for 2013 and 2014. I then used this data set of approximately 450 observations for my analysis. This additional data came from auction packets created by the DNR for every timber auction. These contain information regarding the timber available, harvest restrictions, and maps of the sale. In cases where the DNR had taken down older auction packets from the site, I e-mailed agency officials to obtain them. Examples of the auction packets follow below.

WASHINGTON STATE DEPARTMENT OF
Natural Resources

TIMBER NOTICE OF SALE

SALE NAME: WIZARD *AGREEMENT NO: 30-085084*

AUCTION: March 25, 2010 starting at 10:00 a.m., Pacific Cascade Region Office, Castle Rock, WA **COUNTY:** Grays Harbor

SALE LOCATION: Sale located approximately 12 miles southwest of Porter, WA

PRODUCTS SOLD AND SALE AREA: All timber, except leave trees tagged out with yellow "Leave Tree Area" boundary tags, snags, down timber existing 5 years prior to the day of sale, and pre-existing stumps, bounded by the following: timber sale boundary tags, a rock stockpile site, and the R-2000 road in Unit #1; timber sale boundary tags, a rock stockpile site, and the R-2000 road in Unit #2; timber sale boundary tags in Unit #3; timber sale boundary tags and the R-2000 road in Unit #4; timber sale boundary tags, reprod, and the R-2000 road in Unit #5; timber sale boundary tags in Unit #6; timber sale boundary tags in Unit #7; timber sale boundary tags and Private Property Line; marked with white PVC pipe in Unit #8, and all timber bounded by orange "Right-of-Way" tags in ROW Unit #2, ROW Unit #3, ROW Unit #4, and ROW Unit #5 on part(s) of Sections 12 all in Township 16 North, Range 6 West, Sections 7, 13, 17, 18, 20 and 21 all in Township 16 North, Range 5 West, W.M., containing 260 acres, more or less.

CERTIFICATION: This sale is certified under the Sustainable Forestry Initiative Standard (cert no: BV-SFIS-US09000572)

ESTIMATED SALE VOLUMES AND QUALITY:

Species	Avg DBH	Ring Count	Total MBF	MBF by Grade 1P	2P	3P	SM	1S	2S	3S	4S	UT
Douglas fir	25	7	7,765						5,102	1,989	674	
Red alder	14.6	9	1,219						269	351	599	
Hemlock	15.7		881						388	330	163	
Maple	16		125						19	31	75	
Red cedar	21		112							79	33	
Spruce	22.8	4	27							13	14	
Sale Total			10,129									

MINIMUM BID: $2,189,000.00 **BID METHOD:** Sealed Bids

PERFORMANCE SECURITY: $100,000.00 **SALE TYPE:** Lump Sum

EXPIRATION DATE: October 31, 2011 **ALLOCATION:** Export Restricted

BID DEPOSIT: $218,900.00 or Bid Bond. Said deposit shall constitute an opening bid at the appraised price.

HARVEST METHOD: Cable and Shovel.

ROADS: 166.70 stations of required construction. 60.82 stations of required reconstruction. 126.11 stations of optional construction. 7.63 stations of optional reconstruction. 9.61 stations of road abandonment. 94.68 stations of prehaul maintenance. Rock for construction, reconstruction, and pre-haul maintenance under this contract may be obtained from any commercial source as approved in writing by the Contract Administrator. Possible sources are the Sutton Rock Pit located in Section 22, Township

The first page (above) includes the name of the sale, the species of tree included in the sale and their respective volumes, the harvest method, and stations (1 station = 100 feet) of road construction, maintenance, and abandonment (when a road is decommissioned) including whether gravel for road work is provided free of charge at a quarry in the harvest site or must be commercially obtained, which I tracked as a dummy variable. The term “mbf” in the packet is the timber industry measure of volume, standing for one thousand board feet (a board foot is one foot wide and one inch thick). In some auction packets, the estimated proportions of the sale harvestable by cable and by ground methods are listed in the harvest method section. In other auction packets, as here, the percentages are listed on the second page.

WASHINGTON STATE DEPARTMENT OF
Natural Resources

TIMBER NOTICE OF SALE

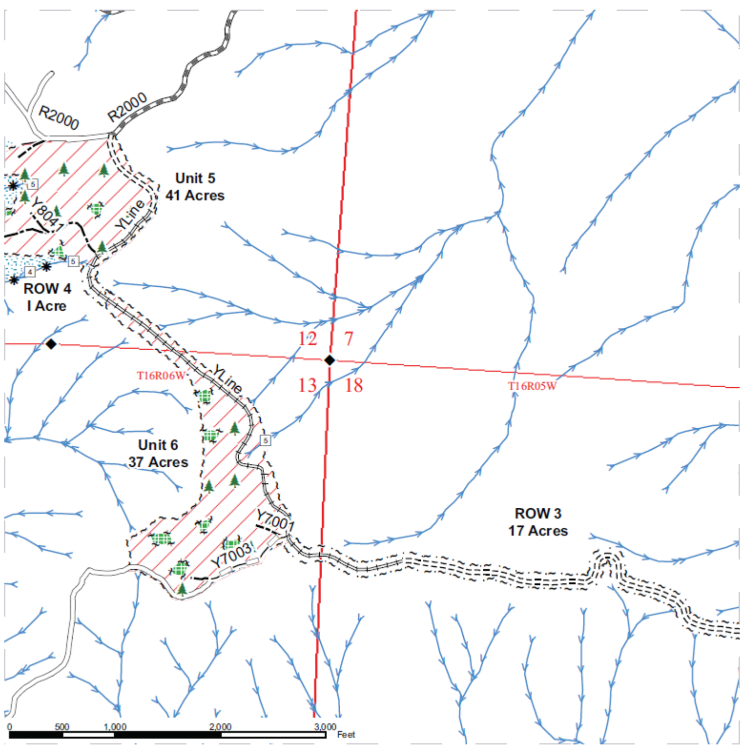
	16 North, Range 05 West, W.M. in Oakville, WA or Northwest Rock, Inc. located in Section 19, Township 16 North, Range 04 West, W.M. in Oakville, WA. Road construction will not be permitted from September 30 to May 1 unless authorized in writing by the Contract Administrator.
ACREAGE DETERMINATION CRUISE METHOD:	The sale acres were determined by GPS. The sale area was cruised using a variable plot cruise method. Harvesting activities are estimated to be approximately 80% ground-based and 20% cable harvesting.
FEES:	Purchaser will provide the State a check payable to Paul Isaacson in the amount of $22,500.00 on day of sale for Right-of-Way timber to be removed on the Isaacson property. $134,910.00 is due on day of sale. $9.00 per MBF is due upon removal. These are in addition to the bid price.
SPECIAL REMARKS:	See map for gate locations. Gate keys can be obtained from the Pacific Cascade Region office. Purchaser shall submit a written Extreme Hazard Abatement Plan for slash along Williams Creek Road. The plan must be approved by the Contract Administrator. ROW #1 will not be part of the Products Sold area due to the purchase of the Right-of-Way timber on the day of sale.

The second page (above) in this instance includes the estimated percentage of harvesting activities to be conducted using ground-based and cable-based methods. In other instances, this information is contained in the "Harvest Method" section on the first page. Additional fees, including right-of-way fees to be paid to owners of non-DNR-administered lands, are listed on the second page. A fee listed as lump sum (but which is calculated based on estimated mbf in the sale) and an additional charge per mbf (thousand board feet) of timber harvested, both payable to the DNR, are listed there as well.

TIMBER SALE MAP

SALE NAME: WIZARD
AGREEMENT#: 30-085084
TOWNSHIP(S): T16R05W, T16R06W
TRUST(S): Common School and Indemnity(3), Capitol Grant(7), Normal School(8)

REGION: Pacific Cascade Region
COUNTY(S): GRAYS HARBOR
ELEVATION RGE: 112-935



Sale Area
Riparian Mgt Zone
Leave Trees
Leave Tree Tags
Property Line/Boundary
Reprod
Sale Boundary Tags
Right-of-Way Tags
Existing Road
Required Pre-Haul Maintenance
Required Construction
Required Reconstruction
Optional Construction
Optional Reconstruction
Streams
Distance Indicator
Gate
Monumented Corner
Stream Type
Stream Type Break
Leave Tree Area
DNR Managed Lands

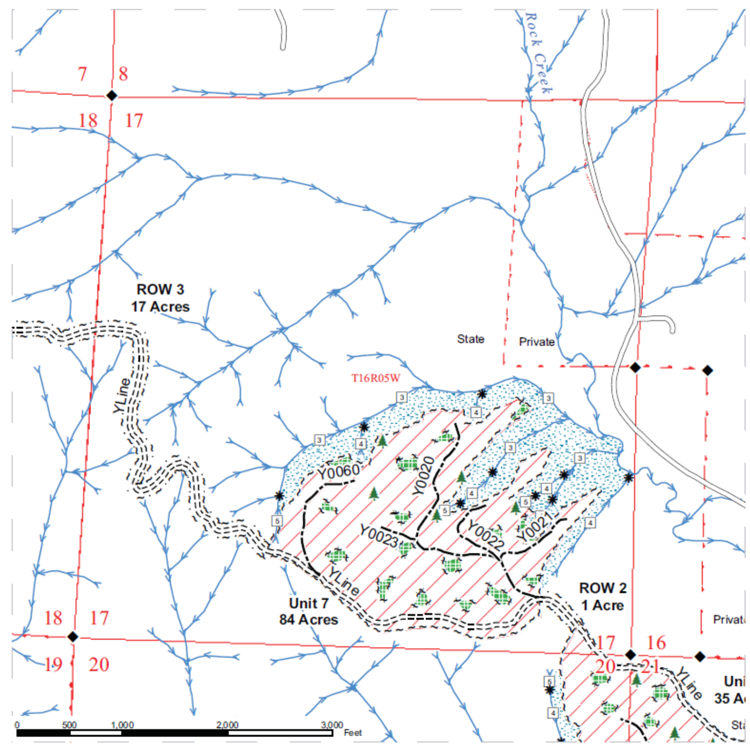
N

Prepared By: dmel490 Creation Date: 8/25/2009 Modification Date: 11/24/2009

TIMBER SALE MAP

SALE NAME: WIZARD
AGREEMENT#: 30-085084
TOWNSHIP(S): T16R05W, T16R06W
TRUST(S): Common School and Indemnity(3), Capitol Grant(7), Normal School(8)

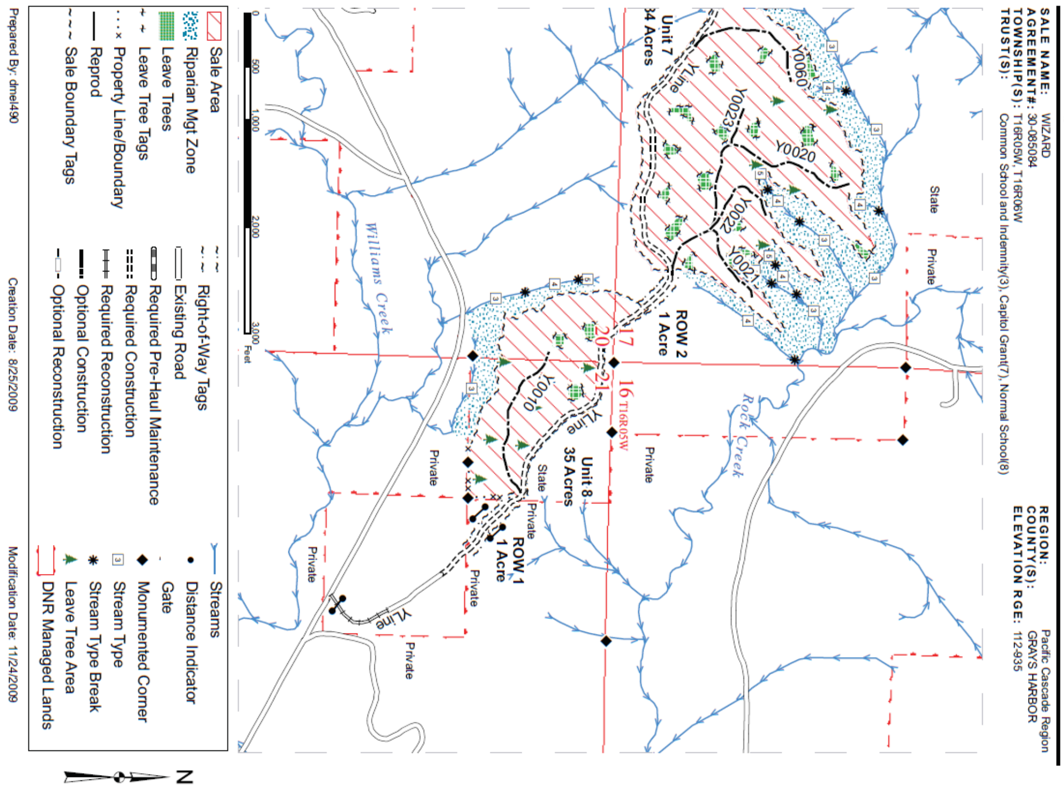
REGION: Pacific Cascade Region
COUNTY(S): GRAYS HARBOR
ELEVATION RGE: 112-935



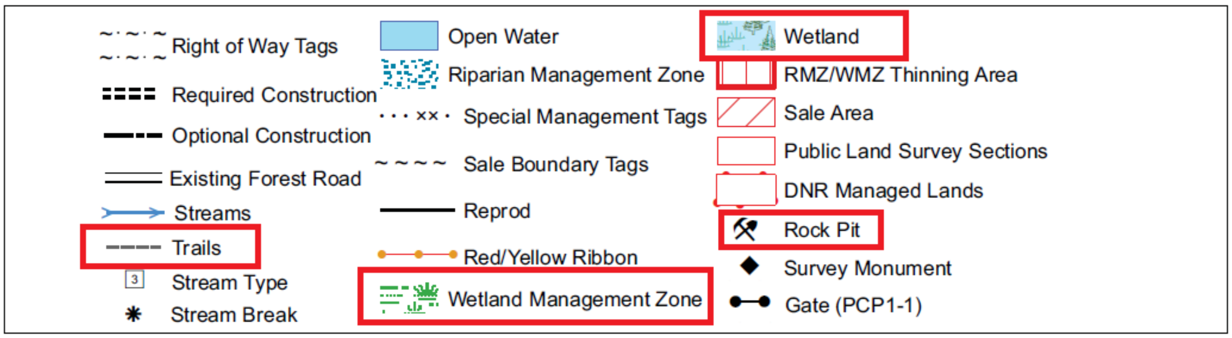
Sale Area
Riparian Mgt Zone
Leave Trees
Leave Tree Tags
Property Line/Boundary
Reprod
Sale Boundary Tags
Right-of-Way Tags
Existing Road
Required Pre-Haul Maintenance
Required Construction
Required Reconstruction
Optional Construction
Optional Reconstruction
Streams
Distance Indicator
Gate
Monumented Corner
Stream Type
Stream Type Break
Leave Tree Area
DNR Managed Lands

N

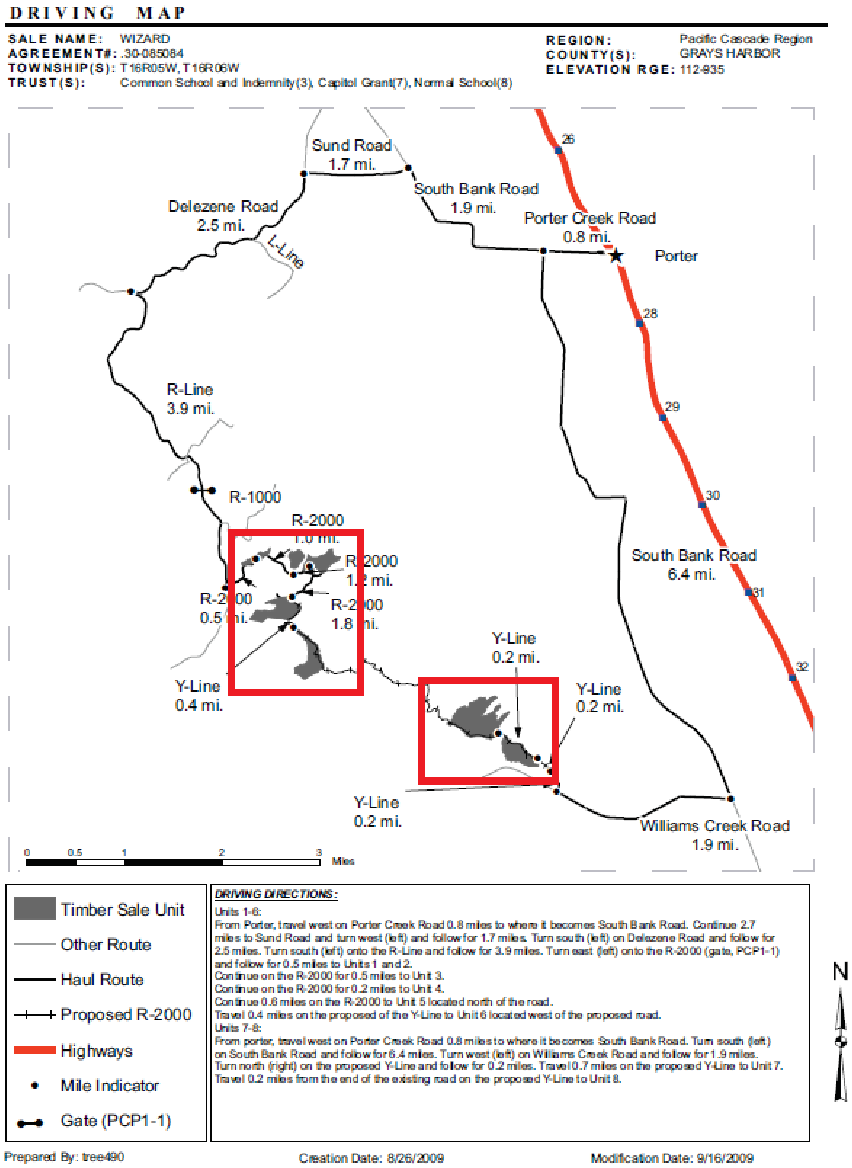
Prepared By: dmel490 Creation Date: 8/25/2009 Modification Date: 11/24/2009



The next set of pages (above) consists of maps displaying the sale area and surrounding features, including any wetlands, streams, and trails, the presence of which I coded as binary variables. The presence of checkerboarded land ownership patterns (or its absence) is observed in the maps and recorded as a dummy variable equal to 1 if checkerboarded ownership patterns are present abutting or in close proximity to sale boundaries. In this particular sale, fragmented ownership of the land is present, as is especially clear on the fourth page of the map where the harvest boundaries follow straight lines along the edges of the DNR-managed land; the interplay of DNR and other (in this case private) land ownership is very evident from the dashed red lines indicating ownership boundaries forming some of the edges of the sale area.



The first of the above legends is the enlarged legend from the preceding maps and shows relevant features observed on the map. These include streams and riparian management zones, which can be seen in or abutting the harvest area on the map. The boundary of the DNR-managed lands is also shown on the key. Also of interest are elements shown in the second key, taken from a different sale in the same auction booklet. In addition to many of the same items, this key includes recreational trails, Wetland Management Zones, wetlands, and a rock pit—all items of interest found on many maps that can indicate the presence of additional veto points.



The last page of each sale in the auction booklet (above) is a summary map that shows the outline of the timber sale unit as well as highway and road access.

Data on the actual auction is found on the DNR website by fiscal year. Each series of auctions undertaken is summarized in a table in the auction results document. The information recorded is shown below.

DEPARTMENT OF NATURAL RESOURCES
Board Sales Results
March 23-25, 2010

AGREEMENT	FSC ∞	NAME OF SALE	COUNTY	REGION	VOLUME OFFERED MBF	MINIMUM BID	BID PRICE	PRICE /MBF	% OVER	# OF BIDS	APPARENT HIGH BIDDER
84815		River View Too Sorts *	Clallam	OLY	6,212	$1,303,672	$1,675,621.44	$269.74	29%	2.1	See Chart on Page 4
84549		Plumb Bob Pole	Clark	PC	1,478	$512,000	$512,500.00	$346.75	0%	1	McFarland Cascade Pole & Lumber Company
85026		[illegible]	Clark	PC	1,631	$397,000	$517,062.00	$317.02	30%	4	Merrill & Ring Forest Products, LP
85084		Wizard	Grays Harbor	PC	10,129	$2,189,000	$2,290,000.00	$226.08	5%	2	Sierra Pacific Industries
85391		Relief Resale	Grays Harbor	PC	5,118	$1,939,000	$1,949,532.00	$380.92	1%	1	Murphy Company
84700		Booyah	King	SPS	3,708	$932,000	$1,083,646.46	$292.25	16%	5	Seattle-Snohomish Mill Co., Inc.
84760		Pearamount	Klickitat	SE	2,738	$649,000	$1,035,329.00	$378.13	60%	3	Boise Building Solutions Mfg., LLC
84762		Jive Sorts *	Lewis	PC	1,363	$374,183	$439,620.80	$322.54	17%	2.2	See Chart on Page 4
85056		Rob Roy	Lewis	PC	6,513	$1,801,000	$2,146,274.00	$329.54	19%	4	Sierra Pacific Industries
85057		Clark Bar	Lewis	PC	1,766	$495,000	$700,902.73	$396.89	42%	8	Hampton Tree Farms, Inc.
83716		Nordeast Sorts *	Mason	SPS	2,326	$739,987	$819,295.58	$352.23	11%	1.6	See Chart on Page 4
83906		Burr	Mason	SPS	1,434	$407,000	$475,175.00	$331.36	17%	2	Merrill & Ring Forest Products, LP
84857		Bear Lake	Okanogan	NE	2,661	$270,000					NO BIDS
83838		Bear Tooth Sorts *	Pend Oreille	NE	5,710	$645,583	$1,695,627.78	$296.96	163%	2.3	See Chart on Page 4
84191		Duet	Skagit	NW	3,157	$460,000	$826,355.00	$261.75	80%	3	Sierra Pacific Industries
84855		Gold Mine	Skagit	NW							Withdrawn
84291		Transmutation	Snohomish	NW	5,042	$1,387,000	$1,935,530.00	$383.88	40%	5	Sierra Pacific Industries
84330		Byers Bad Bear	Stevens	NE	1,966	$381,000	$408,526.00	$207.80	7%	1	Vaagen Brothers Lumber, Inc.
84599		Endurance	Thurston	PC	4,821	$1,383,000	$1,809,709.00	$375.38	31%	5	Merrill & Ring Forest Products, LP
84686		Ascend	Thurston	PC	4,479	$1,150,000	$1,385,750.30	$309.39	21%	3	Simpson Lumber Company, LLC
81711		Mayflower	Whatcom	NW	2,483	$350,000					NO BIDS
84573		Hello John	Whatcom	NW	4,690	$732,000	$1,048,851.88	$223.64	43%	2	Hampton Tree Farms, Inc.
84574		Cauliflower	Whatcom	NW	2,140	$340,000	$451,120.00	$210.80	33%	2	Sierra Pacific Industries
82470		Bullfrog	Yakima	SE	4,560	$520,000	$1,076,679.60	$236.11	107%	3	High Cascade, Inc.

* Contract Harvesting Sort; bid values converted from delivered value to estimated stumpage rate. Information summarizes sold sorts only.
∞ If marked, all or part of this sale is certified under Forest Stewardship Council Certificate No. BV-FM/COC-080501

The table above includes information including a unique identifier—the agreement number—as well as the name of the sale, the county and DNR-defined region it is in, the total volume on offer, the minimum bid (the reserve price), the winning bid price, the winning bid price per mbf, the percentage by which the winning bid exceeds the reserve price, and the number of bids. The entry outlined in blue is the information associated with the winning bid for the sale used in the auction book example above. A map showing the number of timber auctions used in this study for each county may be found in the appendix.

From the dataset detailed above, I use the following variables (all monetary values are adjusted to 2010 dollars):

a. *defpricembf*, the bid price divided by the estimated volume of timber available for harvest, where bid price is the dollar value of the winning bid in 2010 dollars and mbf is the timber industry measure of volume, standing for one thousand board feet (a board foot is one foot wide and one inch thick);
b. *ofbids*, the number of bids on the sale;
c. *year*, categorical variable for the years 2010, 2011, 2012, 2013, and 2014, 2009 being omitted;
d. The amounts of the five most common types of timber included in the auctions (most common both by the number of auctions they appeared in and by their volume relative to other timber types in sales):

i. *douglasmbf*, the total volume of Douglas fir included in the sale;
ii. *hemlockmbf*, the total volume of hemlock included in the sale;
iii. *redaldermbf*, the total volume of red alder included in the sale;
iv. *redcedarmbf*, the total volume of red cedar included in the sale;
v. *maplembf*, the total volume of maple included in the sale;

e. *reqwork*, the total stations of required roadwork (the sum of stations of required construction, reconstruction, maintenance, and abandonment/deactivation), where 1 station equals 100 feet
f. *stream*, a dummy variable equal to 1 if a stream is within or abutting the harvest boundaries, 0 otherwise
g. *wetland*, a dummy variable equal to 1 if a wetland is within or abutting the harvest boundaries, 0 otherwise
h. *mua*, a dummy variable equal to 1 if checkerboarding influences the shape of the sale area, 0 otherwise

Basic Results

Using this dataset, I examine the hypothesis that as opportunities for other players to exercise veto power of one sort or another increase, the tragedy of the anticommons will be reflected in lower sale prices. To test this hypothesis I regressed *mua* on *defpricembf*, controlling for year effects and volume of the timber species mentioned above, estimating equation 1 using robust standard errors (used in all specifications in this paper).

(eq. 1) $defpricembf = \alpha + \beta_1 mua + \beta_2 2010 + \beta_3 2011 + \beta_4 2012 + \beta_5 2013 + \beta_6 2014 + \beta_7 douglasmbf + \beta_8 hemlockmbf + \beta_9 redaldermbf + \beta_{10} redcedarmbf + \beta_{11} maplembf + \varepsilon$

The results are shown in table 1. The variable mua, indicating the presence of checkerboardedness, is statistically significant at the 5 percent level and has a practically meaningful effect, decreasing the price per mbf of the winning bid by approximately $21; year effects are also all statistically significant at the .1 percent level; the effect of the timber types varies, with hemlock and red cedar the only two statistically significant (both at .1 percent levels) though with opposite signs, suggesting that red cedar is more valuable than most timber types available to harvest, and hemlock less.

I then proceeded to test for the robustness of the result by including several other factors.[2] First, as shown in equation 2, I included the variable *reqwork*, as an increase in the amount of road work needed could be a significant cost factor bidders consider.

(eq. 2) $defpricembf = \alpha + \beta_1 mua + \beta_2 2010 + \beta_3 2011 + \beta_4 2012 + \beta_5 2013 + \beta_6 2014 + \beta_7 douglasmbf + \beta_8 hemlockmbf + \beta_9 redaldermbf + \beta_{10} redcedarmbf + \beta_{11} maplembf + \beta_{12} reqwork + \varepsilon$

The results are shown in table 2. As shown in the table, *mua*, the presence of checkerboardedness, now falls barely outside the 5 percent significance level, although it continues to have a practically meaningful effect, decreasing the price per mbf of the winning bid by approximately $17; the year effects remain significant at the .1 percent level; all timber effects continue to have the same signs, though hemlock is now only significant at the 1 percent level while red cedar remains significant at the .1 percent level; the newly added *reqwork* variable is statistically significant at the .1 percent level, though its practical significance—a price decrease of approximately $0.10 per mbf—is small.

Next, as shown in equation 3, rather than *reqwork* I included the variables *stream* and *wetland*, because they represent potential points of veto power over timber harvesting activities by competing interests, due to their ecological, recreational, and aesthetic importance.

[2] I also retested each of these specifications using the natural log of *defpricembf* and *ofbids*. The overall results were fairly similar. In every case, the R^2 increased slightly (typically by about .01 and never by more than .02). In equations 1, 3, 5, 6, 7, and 8 *helmockmbf*'s significance level decreased to 1 percent, and in equations 2 and 4 to 5 percent. In equations 1, 2 and 4 *redaldermbf* changed signs but continued to lack any significance. In equations 5 and 6 *redcedarmbf* was no longer significant within the 5 percent range. Most notably, in equation 4 *mua* lost significance, falling outside of the 5 percent range, while in equations 5, 6, and 8 it gained significance so that it fell within the .1 percent range. Overall, then, the differences are for the most part not substantial.

(eq. 3) $defpricembf = \alpha + \beta_1 mua + \beta_2 2010 + \beta_3 2011 + \beta_4 2012 + \beta_5 2013 + \beta_6 2014 + \beta_7 douglasmbf + \beta_8 hemlockmbf + \beta_9 redaldermbf + \beta_{10} redcedarmbf + \beta_{11} maplembf + \beta_{12} stream + \beta_{13} wetland + \varepsilon$

The results are shown in table 3. As shown in the table, *mua* is statistically significant at the 5 percent level and continues to have a practically meaningful effect, decreasing the price per mbf of the winning bid by approximately $22; the year effects remain significant at the .1 percent level; all timber effects continue to have the same signs, with hemlock and red cedar remaining significant at the .1 percent level; the newly added *stream* and *wetland* variables are not statistically significant.

Putting all of these variations on the regression together, as shown in equation 4, I include *reqwork*, *stream,* and *wetland*.

(eq. 4) $defpricembf = \alpha + \beta_1 mua + \beta_2 2010 + \beta_3 2011 + \beta_4 2012 + \beta_5 2013 + \beta_6 2014 + \beta_7 douglasmbf + \beta_8 hemlockmbf + \beta_9 redaldermbf + \beta_{10} redcedarmbf + \beta_{11} maplembf + \beta_{12} reqwork + \beta_{13} stream + \beta_{14} wetland + \varepsilon$

The results are shown in table 4. As shown in the table, *mua* is statistically significant at the 5 percent level and continues to have a practically meaningful effect, decreasing the price per mbf of the winning bid by approximately $18; the year effects remain significant at the .1 percent level; the *reqwork* variable is statistically significant at the .1 percent level, and continues to represent a price decrease of approximately $0.10 per mbf; all timber effects continue to have the same signs, again with hemlock and red cedar significant at the .1 percent level; the *stream* variable remains statistically insignificant, with *wetland* significant at the 5 percent level and associated with an approximately $17 increase in the price per mbf when present.

Price is not the only measure by which to examine the effect of checkerboardedness and other potential sources of anticommons. The risk of encountering the anticommons could also manifest in the number of bidders in an auction. In order to test this, I regressed on *ofbids* rather than *defpricembf*, using the same explanatory variables. The first equation of this group, equation 5, is shown below.

(eq. 5) $ofbids = \alpha + \beta_1 mua + \beta_2 2010 + \beta_3 2011 + \beta_4 2012 + \beta_5 2013 + \beta_6 2014 + \beta_7 douglasmbf + \beta_8 hemlockmbf + \beta_9 redaldermbf + \beta_{10} redcedarmbf + \beta_{11} maplembf + \varepsilon$

The results are shown in table 5. As shown in the table, *mua*, the presence of checkerboardedness, is statistically significant at the 1 percent level and has a practically meaningful effect, decreasing the number of bids by .45; year effects now show varied statistical significance, with 2010, 2013, and 2014 significant at the .1 percent level, 2012 at the 5 percent level, and 2011 not statistically significant; the effect of the timber types varies, with hemlock significant at the .1 percent level and red cedar at the 5 percent level, both with negative signs.

I then proceeded to test for the robustness of the result by including several other factors. First, as shown in equation 6 I included the variable *reqwork*, as before.

(eq. 6) $ofbids = \alpha + \beta_1 mua + \beta_2 2010 + \beta_3 2011 + \beta_4 2012 + \beta_5 2013 + \beta_6 2014 + \beta_7 douglasmbf + \beta_8 hemlockmbf + \beta_9 redaldermbf + \beta_{10} redcedarmbf + \beta_{11} maplembf + \beta_{12} reqwork + \varepsilon$

The results are shown in table 6. As shown in the table, *mua*, the presence of checkerboardedness, is statistically significant at the 1 percent level and it continues to have a very similar practical effect, decreasing the number of bids by .43; the year effects are significant at the .1 percent level for 2010, 2013, and 2014, and at the 5 percent level for 2012; all timber effects continue to have the same signs as in the previous specification, with hemlock significant at the .1 percent level and red cedar at the 5 percent level; the newly added *reqwork* variable falls barely outside of significance at the 5 percent level, and its practical significance is negligible.

As before, equation 7 includes the variables *stream* and *wetland* rather than *reqwork*, as shown below.

(eq. 7) *ofbids* = $\alpha + \beta_1 mua + \beta_2 2010 + \beta_3 2011 + \beta_4 2012 + \beta_5 2013 + \beta_6 2014 + \beta_7 douglasmbf + \beta_8 hemlockmbf + \beta_9 redaldermbf + \beta_{10} redcedarmbf + \beta_{11} maplembf + \beta_{12} stream + \beta_{13} wetland + \varepsilon$

The results are shown in table 7. As shown in the table, *mua* is statistically significant at the .1 percent level and it continues to have a very similar practical effect, decreasing the number of bids by .47; the year effects are significant at the .1 percent level for 2010, 2013, and 2014, and at the 5 percent level for 2012; all timber effects continue to have the same signs, with hemlock remaining significant at the .1 percent level and red cedar at the 5 percent level; the newly added *stream* and *wetland* variables are not statistically significant.

Putting all of these variations on the regression together, as shown in equation 8, I include *reqwork*, *stream,* and *wetland*.

(eq. 8) *ofbids* = $\alpha + \beta_1 mua + \beta_2 2010 + \beta_3 2011 + \beta_4 2012 + \beta_5 2013 + \beta_6 2014 + \beta_7 douglasmbf + \beta_8 hemlockmbf + \beta_9 redaldermbf + \beta_{10} redcedarmbf + \beta_{11} maplembf + \beta_{12} reqwork + \beta_{13} stream + \beta_{14} wetland + \varepsilon$

The results are shown in table 8. As shown in the table, *mua* is statistically significant at the 1 percent level, and it continues to have a very similar practical effect, decreasing the number of bids by .45; the year effects are significant at the .1 percent level for 2010, 2013, and 2014, and at the 5 percent level for 2012; all timber effects continue to have the same signs except for red alder, although once again only hemlock and red cedar are statistically significant at the .1 percent and 5 percent levels, respectively; *reqwork* again falls barely outside of significance at the 5 percent level, and its practical significance is negligible; *stream* also falls barely outside of significance at the 5 percent level, though with a notable practical significance, decreasing the number of bids by .75; and *wetland* remains statistically insignificant.

While many of the variables in each of the specifications carry the expected signs, it is worth noting that I initially expected negative signs on *stream* and *wetland* as they proxy for other activities aside from logging on the parcel of land. However, *wetland* carries a positive rather than negative sign in every specification that it is included in (though it never quite attains statistical significance at the 5 percent level); *stream* carries the expected negative sign in equations 7 and 8, but a positive sign in equations 3 and 4. It is difficult to ascertain what should be read into this. *Stream* only comes close to meaningful statistical significance in the instances where it carries the expected (negative) sign (it falls barely outside of the 5 percent significance range in those cases). One possible explanation for the seemingly counterintuitive sign on wetlands could lie in the fact that western red cedars (*Thuja plicata)* grow well in humid regions with abundant moisture, including wetlands (USDA Forest Service). The volume of red cedar in sales with wetlands is slightly greater than in those without, and is statistically significant at the 5 percent level. Because western red cedar is a particularly valuable wood, the positive sign on wetlands may be due to the contribution of wetlands to the healthy growth of this species.

The coefficients on the timber types are not terribly interesting; they are all so small as to have limited practical significance. Hemlock and red cedar do both attain statistical significance in every case, with hemlock consistently maintaining a negative sign and red cedar a positive sign in equations 1–4 and a negative sign in equations 5–8. The lower value of hemlock is surprising given hemlock's versatility of use.

Reqwork takes a negative sign in every equation, as expected. Furthermore, it is statistically significant at the .1 percent level for equations 2 and 4, while barely falling outside of the 5 percent significance range in equations 6 and 8. The practical effect is also much more substantial in equations 2 and 4 than it is in 6 and 8. Taken together, the relatively stronger practical and statistical significance of *reqwork* in equations 2 and 4 than in 6 and 8 indicates that required road construction, maintenance, and deactivation plays a larger role in how much companies are willing to bid than it does on whether they are willing to bid.

In summary, I find evidence in support of the theory of anticommons as it applies to timber harvests on DNR-managed lands in Washington State. The presence of fragmented land ownership, which lends itself to anticommons problems and carries substantial policy implications, as discussed in the remainder of this paper, does indeed appear to be associated with a reduction of both the number of bidders in a given auction and the price they are willing to pay. This holds true at a significance level of 5 percent or better in 7 of the 8 specifications examined. The results for other hypothesized sources of anticommons behavior are more mixed. The evidence regarding streams and wetlands, which I ex ante theorized would work in the same direction as fragmented land (i.e., lowering the number of bidders and the prices they pay) in some specifications appears to support that notion, while in others it does not. Further, the very reason that wetlands could be a potential source of anticommons behavior—the unique ecological niche they fill—also means wetlands are associated with highly valuable timber products. This points to a potential complication that research in anticommons may encounter in a wide variety of natural resource settings, namely, that the very places where conflict over resource use is highest will be the instances where resource use is the most valuable, thus making negative effects on market-mediated action more difficult to detect. These competing values for land provide the impetus for the discussion of a framework that could be used by analysts in the future when evaluating exchange mechanisms for reducing land fragmentation in any particular instance.

Institutional Analysis Framework

In this section I propose an analytical method for comparing different mechanisms for exchanging land. I consider possible measures by which to evaluate them, and provide some recommendations on this basis. To illustrate the proposed method and measures, I provide an abbreviated example of the evaluative process as related to one possible mechanism of exchange.

Land is valued by people for a variety of reasons. People may value land for mineral resources, as a production input, for sentimental reasons, for recreational opportunities, for scenic beauty, or for its ecological functions. Land can, of course, satisfy more than one of these values, but tradeoffs are inherent in all uses of the land. Even the most seemingly compatible of the uses—scenic beauty and ecological function—involve tradeoffs on the margin. Arches National Park, famous for breathtaking geological formations such as Delicate Arch, is also home to "biological soil crust," formed by cyanobacteria and other microorganisms (US Department of the Interior, Arches National Park). These organisms bind soil particles together, making the ground stable enough for plant life to grow; however, simply walking on this crust destroys it—a stark example of the tradeoffs between scenic beauty (which requires a beholder's eye) and ecological function.

Because different people value land to differing degrees for a variety of uses, the value of one piece of land relative to another will vary among people. This fact is not unique to land and is the foundation of exchange. Though a person may value two pieces of land they will be willing to trade the lesser-valued of the two for the more-valued. Even better (from that person's point of view) if they do not have to choose between the two (though this does not eliminate cost but merely directs it along new paths).[3] In ordinary market praxis, people willingly exchange one thing they value for another they value more. It is on this basis that economists since Adam Smith have viewed market exchange as welfare enhancing.[4]

As the rubber of economic theory hits the road of policy reality, the picture becomes more complex. While the basic principles governing exchange hold true, exchanges in the real world occur in institutional settings that very rarely match the smooth and sterile settings of theory.

---

[3] James Buchanan's points regarding the subtleties of cost and choice in his 1969 book *Cost and Choice*, while tremendously important, simply go beyond the scope of this paper but ought to be borne in mind by the reader.

[4] Economists do, of course, spend a great deal of time analyzing exceptions to this, notably externalities; however, the tremendous increase in material wealth in those areas of the globe most strongly characterized by markets demonstrates the power of exchange in a setting of property, contract, and liability to generate wealth even in the presence of externalities.

Rather, they occur in a world of humans who, in addition to being rational individuals with "the propensity to truck, barter, and exchange one thing for another" are also "by nature . . . political animal[s]" (Smith, 19; Aristotle, 4). Thus, the same people engaging in the voluntary exchange of market theory modify one another's behavior via other praxes. Most prominently among these is the political, characterized by the modification of exchange by a third party—a modification which one or both of the first two may support,[5] acquiesce to, or be coerced to accept, but in any case originates from outside the exchange.

The current nature of land possession, acquisition, and disposition in the western United States reflects this characterization of human nature. Land changes hands not in the pure market of theory but in an institutional setting characterized by "entangled political economy" (Smith et al., esp. 2–4). In this view, transactions in land (indeed, all transactions) take forms that often feature political and market praxis, the interaction of which depends upon the institutional setting. In the spirit of Elinor Ostrom's approach to institutions, and drawing on the insights of entangled political economy, I propose a method to compare a variety of mechanisms for exchanging land. In my discussion of these methods I view private-to-private disposition of land as a baseline against which to conduct an analysis of various mechanisms by which government and quasi-government entities engage in exchange. Likewise, I treat the opposite extreme—eminent domain—primarily as a point of reference, and not as a primary subject of analysis. I take this approach not because market transactions and eminent domain are unimportant—far from it. However, in developing an

[5] Traditional definitions of government (usually conflated with politics) see all government as coercive. However, it should come as no surprise that one party in an exchange may welcome outside intervention as a means of improving their position in the exchange. At times, both parties may in fact support outside intervention ex ante as an institutional means of preventing cheating, or ex post to resolve conflict (as seen in the use of mediators). Elinor Ostrom provides an example of welcome third-party intervention in the Gal Oya left bank project in Sri Lanka (Ostrom, 172). However, in this case, the outside intervention is not a centralized command-and-control form of intervention but one that facilitates bargaining and creates space for endogenously developed institutions rather than exogenously imposed ones.

analytic method for comparative purposes, stable reference points become necessary. The large government holding of lands in the western United States makes the topic an area of especial interest to survey using tools from public choice and Ostromian political economy.

The analytic framework I propose, however, does not suggest proceeding to examine our subject matter primarily by institution—or at least not in the way that most people would expect when hearing the word "institution." Rather than examining first all varieties of BLM land transactions, then state school trust land transactions, and so forth, I suggest a method of engaging in a comparative analysis of first one transactional mechanism, then another. In doing so, a researcher can discover the essential elements of each mechanism by examining its manifestation in transactions conducted by a variety of different agencies, looking for similarities across each.

The question naturally arises, what is the appropriate measure of success by which the various exchange mechanisms should be evaluated? There are three main options. Conceptually, success could be considered from the viewpoint of those using bureaucratic and political action[6] to achieve goals, in which case the measure of success is how much third-party intervenors were able to achieve beyond what they could have realized without the use of political force. Or should success be measured by the achievement of policy goals as set forth in statute and agency rules? Alternatively, economists often praise the (idealized) market for its efficiency, and efficiency certainly could be a logical goal for government to pursue, so the extent to which the various mechanisms approximate market outcomes could conceivably serve as the measuring rod. (This is to some degree implicit in my preceding analysis of timber prices, where I seek to identify the presence of the tragedy of the anticommons via market transactions.) Each of these three—the

[6] It should go without saying that action undertaken by bureaucracy is political action; unfortunately, even after decades of work by social scientists demonstrating this, the Wilsonian notion that bureaucracy somehow operates outside the realm of the political persists even among those who ought to know better.

success of political actors, the achievement of stated policy goals, and the closeness to market outcomes—would seem a plausible goal, however, the difficulty does not end there.

Success of Political Actors

If the ability to achieve desired outcomes using political mechanisms is the measure of success, how is it determined which outcomes are desirable? For it is surely evident that competing goals are as much a part of politics as they are of the market—if not more so. In the market, while the goals pursued may be as numerous as the participants in the market, the price mechanism allows profit to proxy for the achievement of these goals and helps to reconcile them. In the political realm there is no such single proxy. Votes are often cited as the political equivalent to prices in the market. While the two certainly do share some commonalities, they differ in important ways.[7]

Because the nature of political transactions varies and because (except in the most venal of cases) they do not take the form of direct cash payments, it becomes difficult, if not impossible, to identify the actual outcomes being pursued and to thus evaluate the efficacy of the various possible mechanisms in achieving those goals. The individual's goal may be in keeping with the stated goal of the agency under whose auspices the transaction occurs (for instance, a person working for FWS may indeed have as their goal the preservation of a certain species), or it may be a less ethically acceptable goal, such as gaining a promotion within the agency.[8] In any event, evaluating success on the basis of the ability of the given mechanism to achieve goals through the actions of third-party intervenors that are not otherwise realizable will often (nearly always, in fact) be impossible

---

[7] Though considerable work has been done since, Buchanan and Tullock's *The Calculus of Consent* remains one of the most important expositions on the nature of collective decision-making.

[8] It is not unreasonable to assume that bureaucrats desire promotion, so the choice of mechanism used may be that which is most likely to produce an outcome pleasing to their superiors and lead to a promotion. The revolving-door phenomenon is well-known, and can also motivate political action.

for the outside observer, except as an almost-tautological observation that each individual tries to drive the transaction into the institutional setting most compatible with their goals.

Achievement of Stated Policy Goals

I suspect that many people, if asked how the various possible mechanisms for government land acquisition and disposal should be evaluated, would respond in favor of evaluating them according to their success in achieving policy goals as stated in statute and agency rules and guidelines.[9] While this sounds simple on paper, in practice it is anything but. Stated policy goals can conflict with each other, and often do in the case of land policy. For instance, the official policy governing the four primary federal lands agencies regarding land disposition requires that "the public interest be well served" (GAO, 9). This means "giv[ing] full consideration to better Federal land management and the needs of the State and local people, including needs for lands for the economy, community expansion, recreation areas, food, fiber, minerals, and fish and wildlife." (43 U.S.C. 1716(a)). Clearly these various goals can and do come into conflict. In fact, this reads not so much as a directive as it does a list of the majority of uses to which land can be put, encompassing everything from drilling for oil to building Las Vegas subdivisions to protecting the spotted owl.

In calling everything a priority, the law essentially calls nothing a priority, giving discretionary power to bureaucrats within the relevant agency to choose which of these goals to prioritize. Additionally, a person or group with an interest in one of the listed considerations for use of federal lands can (and often does) sue to prevent a competing use from occurring—and in

[9] It can (I believe correctly) be argued that on closer analysis this criteria collapses back into the previous criteria. Ultimately it is people who write statutes, rules, and guidelines, and they do so to achieve specific goals. In theory, it could be possible for those writing the rules to do so in a way that will lead to their desired outcomes, which may not be the outcomes explicitly advocated in the rules but instead other outcomes which they anticipate as allegedly "unintended" consequences of the application of the rules. This may in fact occur, but I suspect with far less precision than the practitioners of this art desire or its critics fear.

claiming standing asserts property rights after a fashion, thus bringing us back to the problem of the anticommons. For instance, it is not at all unusual in the hydrocarbon-rich Colorado plateau for environmental groups to sue when drilling on federal lands is permitted, and for oil and gas companies to sue when it is not. The uncertainty and paralysis resulting from the overlapping rights created by the actions of legal intervenors under the auspices of such multiple-use laws readily leads to tragedies of the anticommons. Following the inevitable lawsuit, the judges then also possess a good deal of discretion.[10] Even the most public-spirited individuals could reasonably disagree regarding which use ought to take priority and what mix of uses best suits the public interest. This is perhaps the inevitable result when, as Vilfredo Pareto noted, "the happiness of the wolf consists in eating the lamb, that of the lamb in not being eaten" (Pareto et al., 33).

Evaluating the various mechanisms for transacting land requires selecting one among numerous stated goals. However, all but the most ardent of environmentalists or industrialists will likely agree that evaluating exchange mechanisms solely on their ability to facilitate wildlife preservation or oil drilling or mountain biking (my favored use) is to evaluate them on a basis that seems in one way or another undesirable. This is an instinctual recognition of what is to the economist the fundamental nature of choice—cost. Every choice comes with economic costs (objective and subjective), including the next best alternative forgone as a result of the choice. A recognition that many desiderata exist—something the price mechanism accounts for in market-mediated action—seems to underlie the litany of uses to be given "full consideration" in the aforementioned code.

[10] The point regarding lawsuits is an important one. The discretionary power the law provides to officials may seem at first glance to be a boon to them, but this view is far too simplistic. As Peter Schuck points out, bureaucrats may in fact prefer far less discretion, because the use of formal rules can "[protect] officials against criticism . . . [and] mak[e] their work easier" (Schuck, 314). This seems borne out by BLM officials citing litigation as a source of delay in completing land exchanges when questioned by the GAO (GAO, 15).

Evaluating land policy on the basis of only one of these desiderata clearly becomes undesirable to most people at some point. Alternatively, land policy could be evaluated not on the basis of a single goal but on the basis of some factor the various goals have in common. Such a factor as a basis of evaluation would need to be one that is measurable, and which ex ante does not favor any one specific policy goal. As I mentioned previously, anticommons, including checkerboardedness of land in the west, can be inimical to virtually all of the above-mentioned uses. As such, the goal of reducing checkerboardedness suggests itself as a reasonable policy goal to be pursued. Production of food, fiber, and minerals, and fish and wildlife management all benefit from occurring in the presence of less rather than more checkerboarding. Community expansion and recreation areas are somewhat more ambiguous cases—the tradeoff between proximity to open space and recreational opportunities (which checkerboardedness can *sometimes* incidentally promote) and adequate space, while present for all of the previously mentioned activities, is arguably most strongly manifested by these two. The ideal distribution of residential real estate may include some interspersed recreation areas and other potential land uses (many people do value living near open space), but clearly also can be detrimental to that ideal due to the rigidities it introduces. Overall, decreasing checkerboardedness seems to fit the criteria of measurability and use neutrality, and is a criterion I suggest if the achievement of policy goals is to be the measure of success for land transactions.

Closeness to Market Outcomes

There is of course another measure by which land transaction mechanisms may be evaluated. As an economist, my mind almost instantly defaults to evaluating various institutional arrangements against the criterion of market efficiency. When considered on a blackboard, such a comparison has much to recommend it. A competitive market tends to direct land toward its highest valued use. Questions regarding the appropriate degree of checkerboardedness for community expansion and recreation resolve themselves in the idealized market of blackboard economics. The price system provides an amazing and effective means of communicating information dispersed among countless individuals (Hayek, esp. 525–527). In fact, the efficiency of market outcomes played such a central role in twentieth-century economics that the notion that (under certain rarely met assumptions) competitive equilibrium always produces Pareto efficiency was named the *first fundamental* welfare theorem.[11]

While evaluating the various possible mechanisms against the mechanism of market efficiency does indeed sound appealing (hence its frequent use), such an approach suffers from some drawbacks. First, the nirvana fallacy is at play here—comparing various nonmarket institutions against a Platonic ideal market has about as much validity as the frequently made mistake of comparing imperfect markets to some ideal, perfectly conceived and implemented governmental market correction (Demsetz, 1). Further and even more pernicious is the notion that an economist can sit down and calculate what the market would do.[12] While the economist can certainly calculate equilibrium conditions when making certain heroic assumptions and taking as given information that in reality is not available to anyone, the result they arrive at will for these very reasons not be the same as what the market would have arrived at. Additionally, if one takes seriously the notion that the market process involves discovery and exploration of realms of sheer

[11] The assumptions underlying the first welfare theorem, and the notion of equilibrium generally, have been variously attacked by economists ranging from Austrians to Marxists to Behavioral Economists to Complexity Economists to reflective neoclassicists. I do not address these criticisms here not because they are not valid but because they are somewhat irrelevant to this discussion in light of the nirvana fallacy.

[12] My empirical work above, while it does implicitly compare against market efficiency in exchange of land, is looking for evidence that a difference exists, not for proof of what method will in fact come closest to market efficiency. That said, it does seem to suggest that the focus should be on mechanisms that reduce the transactions costs associated with access due to fragmented ownership.

ignorance, the givens plugged into the equation are fundamentally not the interesting, relevant, and important parts of the market (Kirzner, 62–64).

So if calculating and mimicking market outcomes is an unobtainable ideal, should market efficiency as a measure of success be dismissed out of hand? Not necessarily. While it is true that the market outcome cannot be paralleled by deliberate design, we do know enough about the mechanisms of the market to state that certain institutional features will tend to lead to outcomes nearer or further from what the idealized market would achieve. For instance, mechanisms with low transactions costs come closer than those with high transactions costs. Mechanisms which allow transaction proposals to originate from numerous nodes will tend to come closer to the ideal than those that only or primarily allow proposals from the managing agency and will tend to reduce the presence of anticommons by increasing the range of possible Coasean-style resolutions. Mechanisms that incentivize officials in agencies to maintain the status quo by declining or preventing transactions will be further from the ideal than those which avoid such incentivizes. Mechanisms that put the power to act in the hands of field agents and other officials "on the ground" can lead to better-informed transactions than those made by headquarters officials (though the tradeoff between the costs of multiple veto points must be balanced against the costs of concentrating decision-making). Furthermore, econometric studies such as the example utilized in this paper can help to identify the specific avenues through which anticommons manifests (in this instance, in de jure land ownership more strongly than through de facto veto power related to interests in streams and wetlands), and thus help to suggest where a prescriptive analysis may most fruitfully be focused.

Analyzing Transactional Mechanisms

The above discussion indicates several possible criteria on which to evaluate the success of various mechanisms of government land acquisition and disposition. I suggest evaluating each transactional method on the basis of its probable impact on checkerboardedness, the costs of utilizing it, and the principle of subsidiarity and the related principle of multiple veto points. These provide bases for evaluation that ex ante do not appear to systematically favor any one use of land. I contend that the proper means of analyzing transactional mechanisms generally is on the basis of such common factors. An operationally useful and coherent analysis will involve examining the incentive structure facing the primary actors within each exchange mechanism. It will allow prediction of relative changes in outcomes across mechanisms on the basis of predicted changes in the interactions of the relevant actors arising from the incentives faced. The actors in a given exchange will be one of three types: private parties, agency officials, and third-party intervenors. (Note that these are three possible types—however, the method of analysis does not rely on the presence of all three types in a given transaction—it often happens that an exchange takes place between a federal agency and state agency, in which case two of the actors involved will be agency officials).

The variables that feed into the incentive structures of an agency official and impact their predicted actions may include whether and how much engaging in a transaction will change the amount of land they (and their agency) manage; change the size of their budget; consume their time; require approval of superiors, colleagues, etc. (another manifestation of veto points); and make the imposition of their will in the future more or less difficult.[13] The likelihood of a third-party intervenor choosing to insert themselves into the transaction (for instance, an

[13] Although this final consideration may sound rather Nietzschean, it is simply a more general formulation of the motivation that may lead a person to want less checkerboarded land in order to make desired utilization of the land more feasible. This same motivation underlies the actions of an intervenor that favors maintaining checkerboardedness as a way of preventing movement in an unwanted direction away from the status quo.

environmentalist organization that sues to stop a transaction) may be determined by factors such as the transparency of the transaction (the less transparent the more difficult it will be for an outsider to object—a fact the contracting parties will take into account), the number of veto points within the transactional process, and so on.

One potential mechanism for the disposition, acquisition, and exchange of publicly owned lands in the western United States would involve an exchange market for owners of undeveloped lands, be they private, commercial, federal, state, local government, or nonprofit organizations. Owners of land willing to trade a parcel they own for another parcel could list their land parcel as available for trade on the exchange. Potential counterparties willing to part with a parcel of land of their own could then bid for the parcel with their land parcels. If both parties found their counterpart's land parcel to be of greater value for their purposes then their current holdings, the exchange could then be executed. The operator of the exchange (whether operated by the state or a private organization) would assess a small flat fee for each transaction to cover the cost of operating the market.

One important element necessary to make such an exchange realize its potential would be counteracting bureaucratic inertia. Ceteris paribus, it will take less effort on the part of a government agency to simply maintain its current structure of holdings than to engage in a transaction, which would involve the effort of searching for and evaluating potential exchange opportunities. In order to balance against this tendency, the agency, or more specifically certain employees within the agency, must be incentivized to make exchanges. To achieve this, the performance evaluations of agency officials responsible for identifying and executing exchanges should be contingent upon actually executing exchanges.

If we evaluate this proposal on the basis of the criteria laid out above (probable impact on checkerboardedness, the costs of utilizing it, and the principle of subsidiarity and the related principle of multiple veto points), there is much to recommend it. First and foremost, land owners, be they public or private, will execute a trade in such a forum only when doing so furthers their goal. As such, this will tend to reduce checkerboardedness where its effects are undesirable. Additionally, the costs of utilizing such a mechanism are likely to be relatively low; a common market reduces discovery costs without imposing significant overhead. Of course, questions remain regarding the bureaucratic incentives affecting the particulars of trades that public agencies enter into. To the extent that increased transparency impinges upon bureaucratic discretion, such a mechanism may in fact encourage bureaucratic inertia. The primary risk to such a mechanism arises from the possibility of multiple veto points. As long as laws such as NEPA remain unchanged, agency actions, including swaps in a market, will be subject to review and thus potential suits. Furthermore, losing bidders will be able to claim standing to sue over bid outcomes they dislike (though it seems likely this difficulty would significantly subside in a sufficiently dense market, as a denser market would make establishment of relative prices of land parcels more readily discernible).

As shown in condensed form above, our analysis of transaction mechanisms, centered on the incentive structure generated by them, provides the means for an evaluation grounded in methodological individualism. Utilizing this framework will allow policy analysts to make pattern predictions regarding transactions. Further, the positive analysis of the features of transaction mechanisms will allow policymakers to more fully perceive the normative choices made when one transactional mechanism is chosen over another.

Conclusion

Land ownership in the west is a source of acrimony and contention. Much of this arises from the checkerboarded ownership patterns that characterize western land, especially public lands. Using timber auction data from Washington's DNR-managed lands, and identifying the negative impact of fragmentedness on the number of bids on timber auctions as well as the level of the winning bid prices, I have shown that fragmentedness does indeed lead to the tragedy of the anticommons. Having shown this, I then address how to evaluate means of reducing such checkerboardedness. The evolution of federal land policy has been such that today the acquisition and disposition of land is a difficult proposition and is often carried out by mechanisms other than sales on the open market. In this paper I have proposed a framework for analyzing such transactional mechanisms. An evaluation of the various mechanisms used in the acquisition and disposition of land outside of the open market requires determining a metric of success. Following such a determination, positive predictions may be made about the actions of relevant representative actors given the incentive structures they face under the various mechanisms.

Future research ought to be done to operationalize this framework of analysis by considering specific mechanisms beyond the short example I provided. In this paper I have demonstrated the empirical exploration of some specific predictions regarding the effects of aspects of these mechanisms by evaluating the effect of multiple veto points on timber auction prices and number of bidders. Similar empirical research could be deployed to evaluate other land or resource sales or leases in the presence of potential anticommons problems with respect to the land. Western land policy provides fertile ground for the development of this framework; in time, as an understanding of this framework's advantages and limitations grows, it may be usefully applied in other settings.

Tables

Table 1						R^2: .26
defpricembf	Coef.	Robust S.E.	t	P>t	[95% Conf.	Interval]
mua	-20.94734	9.140595	-2.29	0.022	-38.9142	-2.98045
year						
2010	144.5453	15.77114	9.17	0	113.5453	175.5453
2011	165.5766	16.98493	9.75	0	132.1907	198.9624
2012	121.6451	16.89795	7.2	0	88.43024	154.86
2013	188.9078	19.03591	9.92	0	151.4905	226.3251
2014	236.8203	20.21383	11.72	0	197.0877	276.5529
douglasmbf	0.0056083	0.0034897	1.61	0.109	-0.00125	0.012468
hemlockmbf	-0.0111468	0.0030659	-3.64	0	-0.01717	-0.00512
redaldermbf	-0.0110583	0.0132481	-0.83	0.404	-0.0371	0.014982
redcedarmbf	0.0900397	0.0231157	3.9	0	0.044603	0.135476
maplembf	0.018486	0.0423169	0.44	0.662	-0.06469	0.101665
_cons	152.8365	18.19017	8.4	0	117.0817	188.5914

Table 2						R^2: .31
defpricembf	Coef.	Robust S.E.	t	P>t	[95% Conf.	Interval]
mua	-17.26072	8.881258	-1.94	0.053	-34.7182	0.196778
year						
2010	145.6818	15.72763	9.26	0	114.7667	176.5969
2011	168.3952	16.65489	10.11	0	135.6574	201.1329
2012	127.7977	16.58914	7.7	0	95.18916	160.4062
2013	196.2544	18.94947	10.36	0	159.0063	233.5025
2014	244.9318	20.01044	12.24	0	205.5981	284.2654
douglasmbf	0.0063642	0.0040525	1.57	0.117	-0.0016	0.01433
hemlockmbf	-0.0097088	0.0033437	-2.9	0.004	-0.01628	-0.00314
redaldermbf	-0.008194	0.0119374	-0.69	0.493	-0.03166	0.015271
redcedarmbf	0.0872816	0.0223222	3.91	0	0.043404	0.131159
maplembf	0.0210769	0.0437119	0.48	0.63	-0.06485	0.106999
reqwork	-0.0955917	0.0268757	-3.56	0	-0.14842	-0.04276
_cons	162.098	18.64745	8.69	0	125.4435	198.7524

Table 3						R^2: .26
defpricembf	Coef.	Robust S.E.	t	P>t	[95% Conf.	Interval]

mua	-21.80922	9.108579	-2.39	0.017	-39.7136	-3.9049
year						
2010	144.1142	15.25206	9.45	0	114.1339	174.0945
2011	164.0881	16.48048	9.96	0	131.6932	196.483
2012	120.7109	16.55995	7.29	0	88.15972	153.262
2013	187.0317	18.75584	9.97	0	150.1642	223.8992
2014	235.6057	19.75072	11.93	0	196.7826	274.4288
douglasmbf	0.0051078	0.0034551	1.48	0.14	-0.00168	0.011899
hemlockmbf	-0.0120201	0.0030285	-3.97	0	-0.01797	-0.00607
redaldermbf	-0.0129369	0.0136277	-0.95	0.343	-0.03972	0.013851
redcedarmbf	0.086224	0.023419	3.68	0	0.04019	0.132258
maplembf	0.0182675	0.042287	0.43	0.666	-0.06485	0.101389
stream	14.5132	22.77642	0.64	0.524	-30.2574	59.2838
wetland	11.20103	9.055186	1.24	0.217	-6.59835	29.00041
_cons	139.5119	25.94913	5.38	0	88.50481	190.5189

Table 4						R^2: .32
defpricembf	Coef.	Robust S.E.	t	P>t	[95% Conf.	Interval]
mua	-18.06531	8.817375	-2.05	0.041	-35.3976	-0.73302
year						
2010	145.2169	15.06615	9.64	0	115.6015	174.8324
2011	166.3309	15.97237	10.41	0	134.934	197.7277
2012	125.7323	16.09228	7.81	0	94.09979	157.3649
2013	193.6662	18.57707	10.43	0	157.1493	230.1831
2014	243.3393	19.38217	12.55	0	205.2398	281.4387
douglasmbf	0.0057162	0.0040009	1.43	0.154	-0.00215	0.013581
hemlockmbf	-0.0108307	0.0032939	-3.29	0.001	-0.01731	-0.00436
redaldermbf	-0.0102879	0.0122628	-0.84	0.402	-0.03439	0.013817
redcedarmbf	0.0816417	0.0225441	3.62	0	0.037327	0.125957
maplembf	0.0207953	0.0433059	0.48	0.631	-0.06433	0.105922
reqwork	-0.0997186	0.0268792	-3.71	0	-0.15256	-0.04688
stream	18.99341	20.76903	0.91	0.361	-21.8322	59.81902
wetland	17.14326	8.665259	1.98	0.049	0.109984	34.17653
_cons	144.4901	24.4311	5.91	0	96.46602	192.5143

Table 5						R^2: .16

ofbids	Coef.	Robust S.E.	t	P>t	[95% Conf.	Interval]
mua	-0.45102	0.14532	-3.1	0.002	-0.73667	-0.16538
year						
2010	1.538231	0.281553	5.46	0	0.984807	2.091655
2011	0.44646	0.264394	1.69	0.092	-0.07324	0.966158
2012	0.650856	0.270866	2.4	0.017	0.118438	1.183274
2013	1.240737	0.277117	4.48	0	0.696032	1.785443
2014	0.99568	0.298949	3.33	0.001	0.408061	1.583299
douglasmbf	8.94E-05	5.73E-05	1.56	0.12	-2.3E-05	0.000202
hemlockmbf	-0.00016	4.86E-05	-3.37	0.001	-0.00026	-6.8E-05
redaldermbf	-5.3E-05	0.000209	-0.25	0.8	-0.00046	0.000359
redcedarmbf	-0.00064	0.000316	-2.03	0.043	-0.00126	-2E-05
maplembf	-0.00037	0.000673	-0.55	0.584	-0.00169	0.000954
_cons	2.273292	0.28505	7.98	0	1.712994	2.833589

Table 6						R^2: .16
ofbids	Coef.	Robust S.E.	t	P>t	[95% Conf.	Interval]
mua	-0.43041	0.145788	-2.95	0.003	-0.71698	-0.14384
year						
2010	1.525366	0.278667	5.47	0	0.977604	2.073129
2011	0.458978	0.261886	1.75	0.08	-0.0558	0.973756
2012	0.675094	0.268237	2.52	0.012	0.147833	1.202356
2013	1.267846	0.275663	4.6	0	0.725988	1.809704
2014	1.026712	0.296298	3.47	0.001	0.444293	1.609131
douglasmbf	0.000091	5.93E-05	1.54	0.125	-2.6E-05	0.000208
hemlockmbf	-0.00016	4.75E-05	-3.29	0.001	-0.00025	-6.3E-05
redaldermbf	-3.3E-05	0.000217	-0.15	0.878	-0.00046	0.000392
redcedarmbf	-0.00065	0.000318	-2.04	0.042	-0.00127	-2.3E-05
maplembf	-0.00035	0.00069	-0.51	0.612	-0.00171	0.001006
reqwork	-0.00038	0.000193	-1.95	0.051	-0.00075	2.35E-06
_cons	2.306082	0.282565	8.16	0	1.750657	2.861507

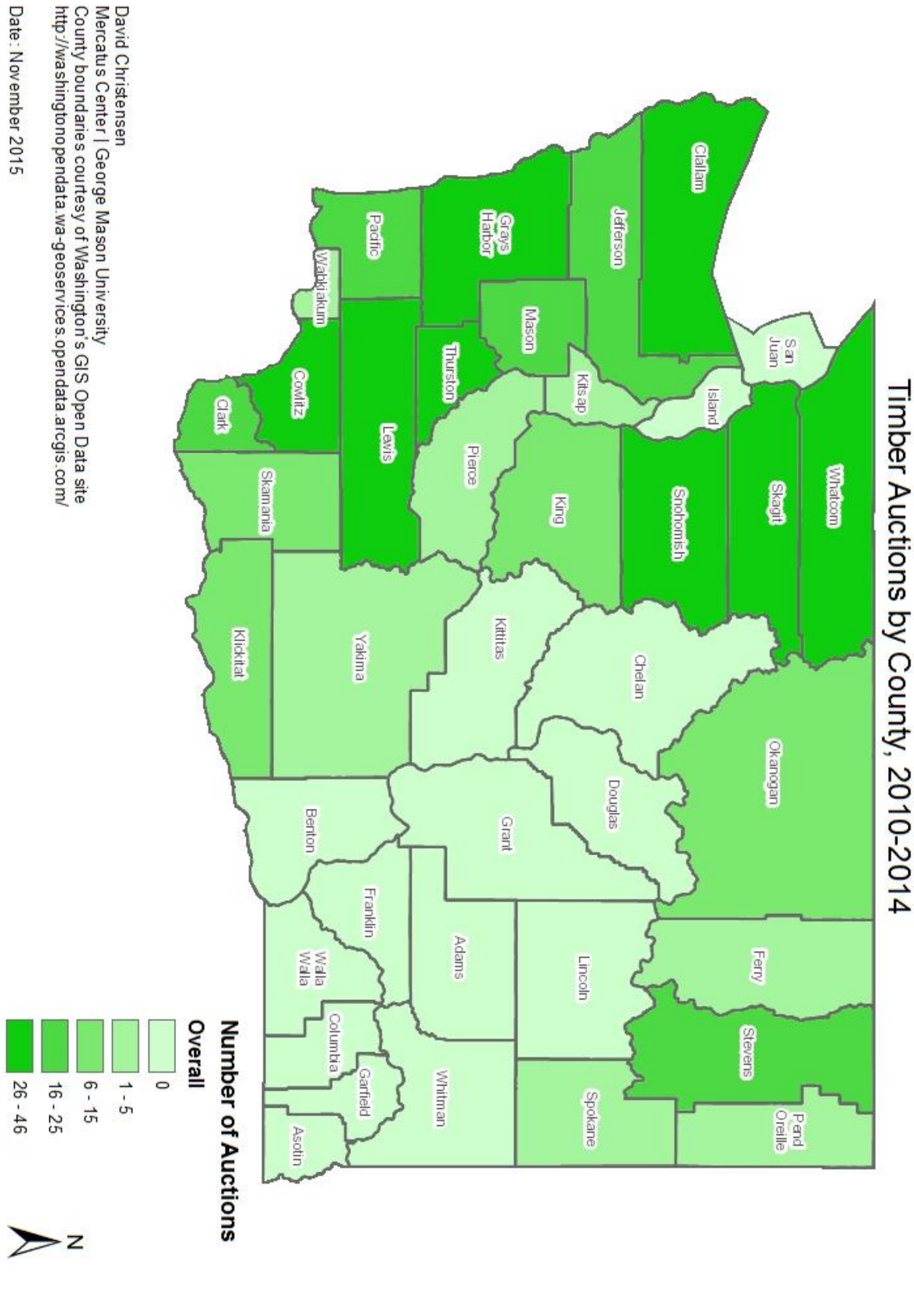
Table 7						R^2: .17
ofbids	Coef.	Robust S.E.	t	P>t	[95% Conf.	Interval]

	Coef.	Robust S.E.	t	P>t	[95% Conf.	Interval]
mua	-0.46712	0.144888	-3.22	0.001	-0.75191	-0.18232
year						
2010	1.526356	0.287597	5.31	0	0.961039	2.091673
2011	0.40285	0.277116	1.45	0.147	-0.14186	0.947565
2012	0.624777	0.283124	2.21	0.028	0.068253	1.181302
2013	1.214815	0.289065	4.2	0	0.646614	1.783017
2014	0.985161	0.305785	3.22	0.001	0.384093	1.586229
douglasmbf	9.15E-05	5.98E-05	1.53	0.127	-2.6E-05	0.000209
hemlockmbf	-0.00016	4.74E-05	-3.32	0.001	-0.00025	-6.4E-05
redaldermbf	-8.27E-06	0.000206	-0.04	0.968	-0.00041	0.000397
redcedarmbf	-0.00065	0.000311	-2.08	0.038	-0.00126	-3.6E-05
maplembf	-0.00025	0.000663	-0.38	0.706	-0.00155	0.001053
stream	-0.76203	0.390309	-1.95	0.052	-1.52924	0.005184
wetland	0.179983	0.145593	1.24	0.217	-0.1062	0.466168
_cons	2.933399	0.475264	6.17	0	1.999194	3.867605

Table 8						R^2: .17
ofbids	Coef.	Robust S.E.	t	P>t	[95% Conf.	Interval]
mua	-0.44679	0.145336	-3.07	0.002	-0.73248	-0.16111
year						
2010	1.513992	0.284783	5.32	0	0.954195	2.073789
2011	0.415086	0.27449	1.51	0.131	-0.12448	0.954651
2012	0.646687	0.280655	2.3	0.022	0.095005	1.19837
2013	1.240548	0.287326	4.32	0	0.675754	1.805343
2014	1.015301	0.303203	3.35	0.001	0.419296	1.611306
douglasmbf	9.29E-05	6.16E-05	1.51	0.132	-2.8E-05	0.000214
hemlockmbf	-0.00015	4.64E-05	-3.24	0.001	-0.00024	-5.9E-05
redaldermbf	1.19E-05	0.000214	0.06	0.956	-0.00041	0.000432
redcedarmbf	-0.00066	0.000313	-2.1	0.036	-0.00127	-4.2E-05
maplembf	-0.00024	0.000679	-0.35	0.729	-0.00157	0.0011
reqwork	-0.00038	0.000196	-1.95	0.052	-0.00077	3.72E-06
stream	-0.74845	0.388685	-1.93	0.055	-1.51249	0.015586
wetland	0.190236	0.147601	1.29	0.198	-0.0999	0.480374
_cons	2.953438	0.473441	6.24	0	2.022796	3.88408

Variable	# of Obs.	Mean	Std. Dev.	Min	Max
defpricembf	433	308.1132	104.4353	47.23221	620.8172
ofbids	433	2.939954	1.556378	1	10

Map


Timber Auctions by County, 2010-2014
Whatcom
San Juan
Skagit
Island
Snohomish
Clallam
Jefferson
Kitsap
Mason
King
Grays Harbor
Thurston
Pierce
Pacific
Wahkiakum
Lewis
Cowlitz
Clark
Skamania
Kittitas
Chelan
Okanogan
Douglas
Yakima
Klickitat
Grant
Benton
Franklin
Adams
Lincoln
Ferry
Stevens
Pend Oreille
Spokane
Whitman
Walla Walla
Columbia
Garfield
Asotin
Number of Auctions
Overall
0
1 - 5
6 - 15
16 - 25
26 - 46
N
David Christensen
Mercatus Center | George Mason University
County boundaries courtesy of Washington's GIS Open Data site
http://washingtonopendata.wa-geoservices.opendata.arcgis.com/
Date: November 2015

Code

Using Stata Release 14

```
*Equation 1
reg defpricembf mua i.year douglasmbf hemlockmbf redaldermbf redcedarmbf maplembf, r
*Equation 2
reg defpricembf mua i.year douglasmbf hemlockmbf redaldermbf redcedarmbf maplembf reqwork, r
*Equation 3
reg defpricembf mua i.year douglasmbf hemlockmbf redaldermbf redcedarmbf maplembf stream wetland, r
*Equation 4
reg defpricembf mua i.year douglasmbf hemlockmbf redaldermbf redcedarmbf maplembf reqwork stream wetland, r
*Equation 5
reg ofbids mua i.year douglasmbf hemlockmbf redaldermbf redcedarmbf maplembf, r
*Equation 6
reg ofbids mua i.year douglasmbf hemlockmbf redaldermbf redcedarmbf maplembf reqwork, r
*Equation 7
reg ofbids mua i.year douglasmbf hemlockmbf redaldermbf redcedarmbf maplembf stream wetland, r
*Equation 8
reg ofbids mua i.year douglasmbf hemlockmbf redaldermbf redcedarmbf maplembf reqwork stream wetland, r
*Summary statistics
summarize defpricembf
summarize ofbids
```

References

Aristotle. 1885. *The Politics of Aristotle*. Translated by Benjamin Jowett. Oxford, United Kingdom: Clarendon Press. Internet Archive (ark:/13960/t6g162153). https://archive.org/details/politicsaristot05arisgoog.

Buchanan, James M. 1969. *Cost and Choice*. Chicago, IL: Markham Publishing Company.

Buchanan, James M., and Gordon Tullock. 1962. *The Calculus of Consent*. Ann Arbor, MI: University of Michigan.

Buchanan, James M., and Yong J. Yoon. 2000. "Symmetric Tragedies: Commons and Anticommons." *Journal of Law and Economics* 43 (1): 1–14.

Coase, Ronald. 1960. "The Problem of Social Cost." *Journal of Law and Economics* 3 (October): 1–44.

Congressional Research Service. 2015. "Federal Land Ownership: Current Acquisition and Disposal Authorities." Carol H. Vincent, Laura B. Comay, M.L. Corn, and Katie Hoover. Accessed October 13, 2014. http://fas.org/sgp/crs/misc/RL34273.pdf.

Demsetz, Harold. 1969. "Information and Efficiency: Another Viewpoint." *The Journal of Law and Economics* 12 (1): 1–22.

Exchanges of Public Lands or Interests Therein Within the National Forest System, US Code 43 §§ 1716.

Fennell, Lee Anne. 2004. "Common Interest Tragedies." *Northwestern University Law Review* 98 (3): 907–90. SSRN (474380). http://ssrn.com/abstract=474380.

Forest Practices Branch, British Columbia Ministry of Forests. 1999. "Harvesting Systems and Practices in British Columbia." Accessed December 4, 2014. http://www.for.gov.bc.ca/hfd/pubs/docs/sil/Sil468-2-1.pdf.

GAO. 2009. "Federal Land Management: BLM and Forest Service Have Improved Oversight of the Land Exchange Process, but Additional Actions Are Needed." Accessed November 13, 2014. http://www.gao.gov/assets/300/290765.pdf.

Graff, Trevor. 2014a. "Wyoming to Intervene in Wild Horse Lawsuit." *Casper Star-Tribune*, August 16. http://trib.com/news/state-and-regional/wyoming-to-intervene-in-wild-horse-lawsuit/article_2f4354ae-8307-5c2f-a009-8117d5c20a3d.html.

Graff, Trevor. 2014b. "BLM Delays Wild Horse Removal in Checkerboard Lands." *Casper Star-Tribune*, August 24. http://trib.com/news/state-and-regional/blm-delays-wild-horse-removal-in-checkerboard-lands/article_c723a6fd-955c-566b-8b1c-7d8389fd0e36.html.

Ground-Based Logging Systems, Washington Administrative Code 222-30-070. Accessed December 4, 2014. http://app.leg.wa.gov/wac/default.aspx?cite=222-30-070.

Hayek, F. A. 1945. "The Use of Knowledge in Society." *The American Economic Review* 35 (4): 519–30.

Hazlett, Thomas W. 2005. "Spectrum Tragedies." *Yale Journal on Regulation* 22 (2): 242–74.

Heller, Michael A. 2013. "The Tragedy of the Anticommons: A Concise Introduction and Lexicon." *The Modern Law Review* 76, (1): 6–25. doi: 10.1111/1468-2230.1200.

Heller, Michael A. 1998. "The Tragedy of the Anticommons: Property in Transition from Marx to Markets." *Harvard Law Review* 111 (3): 62188.

Hyde, William F. 1981. "Timber Economics in the Rockies: Efficiency and Management Options." *Land Economics* 57 (4): 630–38.

Keiter, Robert B. 2001. "Biodiversity Conservation and the Intermixed Ownership Problem: From Nature Reserves to Collaborative Processes." *Idaho L. Rev.* 38: 301–24.

Kirzner, Israel M. 1997. "Entrepreneurial Discovery and the Competitive Market Process: An Austrian Approach." *Journal of Economic Literature* 35 (March): 60–85.

Leffler, Keith B., and Randal R. Rucker. 1991. "Transactions Costs and the Efficient Organization of Production: A Study of Timber-Harvesting Contracts." *Journal of Political Economy* 99 (5): 1060–87.

Leffler, Keith B., Randal R. Rucker, and Ian A. Munn. 2000. "Transaction Costs and the Collection of Information: Presale Measurement on Private Timber Sales." *Journal of Law, Economics, & Organization.* 16 (1): 166–88.

Libecap, Gary D., and James L. Smith. 2002. "The Economic Evolution of Petroleum Property Rights in the United States." *Journal of Legal Studies* 31 (June): S589–608.

McGough, Bruce, Andrew J. Plantinga, and Bill Provencher. 2004. "The Dynamic Behavior of Efficient Timber Prices." *Land Economics* 80 (1): 95–108.

Michelman, Frank I. 1982. "Ethics, Economics, and the Law of Property." In *Ethics, Economics, and the Law*, edited by James R. Pennock and John W. Chapman: 663–690. New York City, NY: New York University Press.

Neary, Ben. 2014. "Wild Horse Groups Challenge Wyoming Roundup." *Associate Press* in *Casper Star-Tribune*, August 4. http://trib.com/news/state-and-regional/wild-horse-groups-challenge-wyoming-roundup/article_15ec9b85-e446-5e71-b0a6-b308796399bd.html.

Ostrom, Elinor. 1990. *Governing the Commons*. New York City: Cambridge University Press.

Pareto, Vilfredo, Aldo Monetsano, Alberto Zanni, Luigino Bruni, John S. Chipman, and Michael McLure, eds. 2014. *Manual of Political Economy*. Oxford, United Kingdom: Oxford University Press.

Schuck, Peter H. 2014. *Why Government Fails So Often*. Princeton, NJ: Princeton University Press.

Shapiro, Carl. 2000. "Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting." *Innovation Policy and Economy* 1: 119–50.

Smith, Adam. 1991. *An Inquiry into the Nature and Causes of the Wealth of Nations*. Amherst, NY: Prometheus Books.

Smith, Adam, Richard E. Wagner, and Bruce Yandle. 2011. "A Theory of Entangled Political Economy, with Application to TARP and NRA." *Public Choice* 148, (1–2): 45–66.

Souder, Jon A., and Sally K. Fairfax. 1996. *State Trust Lands: History, Management, and Sustainable Use*. Lawrence, KS: University Press of Kansas.

StataCorp. 2015. *Stata* (Release 14). Statistical Software. College Station, TX: StataCorp LP.

US Department of Agriculture, Forest Service. "Western Red Cedar." Accessed December 13, 2014. http://www.na.fs.fed.us/pubs/silvics_manual/Volume_1/thuja/plicata.htm.

US Department of the Interior, Arches National Park — National Parks Service. "Soils." Accessed November 15, 2014. http://www.nps.gov/arch/naturescience/soils.htm

US Department of the Interior, Bureau of Land Management. "Public Land Statistics 2013." Accessed October 13, 2014. http://www.blm.gov/public_land_statistics/pls13/pls2013.pdf.

US Department of the Interior, Bureau of Land Management, Casper Field Office. "The Taylor Grazing Act." Accessed December 16, 2015. http://www.blm.gov/wy/st/en/field_offices/Casper/range/taylor.1.html.

Vanneste, Sven, Alain Van Hiel, Francesco Parisi, and Ben Depoorter. 2006. "From 'Tragedy' to 'Disaster': Welfare Effects of Commons and Anticommons Dilemmas." *International Review of Law and Economics* 26: 104–22. SSRN (548622). Accessed December 14, 2014. http://ssrn.com/abstract=548622.

Washington State Department of Natural Resources. "Timber Sales." Accessed December 10, 2015. http://www.dnr.wa.gov/programs-and-services/product-sales-and-leasing/timber-sales.