DOES WILDERNESS MATTER? AN EXAMINATION OF THE POLITICAL CAUSES AND ECONOMIC CONSEQUENCES OF WILDERNESS DESIGNATION

by

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A thesis submitted in partial fulfillment
of the requirements for the degree

Master of Science

in

Applied Economics

MONTANA STATE UNIVERSITY
Bozeman, Montana

February 2013

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of a thesis submitted by

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This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citation, bibliographic style, and consistency and is ready for submission to The Graduate School.

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Shawn Edward Regan

February 2013

ACKNOWLEDGEMENTS

Thank you, Rachel, for your love and support.

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ABSTRACT

This thesis improves upon previous cross-sectional analyses of the economic effects of wilderness designation in two important ways. First, a political economy analysis of wilderness selection is developed using data from a comprehensive inventory of all potential wilderness areas managed by the U.S. Forest Service. Second, the economic consequences of wilderness designation are examined using a novel county-level panel data set of western U.S. counties from 1969 to 2010. The Forest Service and Congress are found to act as arbitrators of competing interest groups by designating areas with high levels of wilderness attributes but low development potential. Wilderness designations are found to not have a significant effect on levels of per capita income, population, employment, or average wage per job. These finding are robust to a broad range of specifications. The results suggest that the Forest Service and Congress have made wilderness selection decisions that do not impose significant costs on local economies.

CHAPTER 1

INTRODUCTION

The Wilderness Act of 1964 gives Congress the authority to designate wilderness areas on federal lands that have not been substantially impacted by human development. Wilderness areas largely prohibit resource extraction, road building, motorized or mechanical vehicles, and other uses that could diminish the land's wilderness character.[1] Such designations are often controversial, especially in western states, because of their perceived impacts on extraction-based industries and the local economies that depend on such industries. Since its creation in 1964, the National Wilderness Preservation System has grown from 54 areas (9.1 million acres) to 757 areas (109.5 million acres) in 2011.[2]

The economic tradeoffs associated with wilderness designations pose an interesting empirical question: On one hand, wilderness designations limit resource development on public lands and could hinder employment and income in extractive industries. On the other hand, protected lands preserve natural amenities that could improve quality of life, provide recreational opportunities, and attract new businesses, migrants, and tourists. Proponents of wilderness designation argue that designations encourage a transition from an economy based on resource extraction to an economy based on service sector employment, tourism, and recreation. Opponents argue that

[1] Mining operations and livestock grazing were permitted to continue in wilderness areas if they existed prior to the Wilderness Act. Mining claims and mineral leases are now prohibited. Hunting is allowed, except in wilderness areas that are within national parks (Coggins et al. 2002).
[2] Data on wilderness areas are available at http://www.wilderness.net.

wilderness designations harm local economies by reducing opportunities for economic development and limiting the use of federal lands.

A recent letter signed by more than 100 economists urged the president and Congress to protect more land in parks and preserves in the West, including wilderness areas, as a way to bolster local economic growth.[3] Such protected areas, they write, "attract innovative companies and workers, and are an essential component of the region's competitive advantage." The authors claim that protected public lands such as wilderness areas are significant contributors to economic growth because they improve the quality of life and attract workers, entrepreneurs, and investors to the region. Signatories to the letter include Nobel laureates Kenneth Arrow, Robert Solow, and Joseph Stiglitz. An examination of the literature on the economic impacts of wilderness designation, however, yields few rigorous studies and little evidence to support such claims.

Previous studies on the economic consequences of wilderness designations are limited to correlation or cross-sectional analyses and generally do not support the claim that wilderness designations promote higher levels of income, population, or employment. In addition, the existing literature provides competing theories for how natural amenities such as wilderness affect levels of income and employment. Moreover, the literature does not address the possibility that wilderness areas are selected based on physical characteristics, such as their potential for resource development, that are likely to influence the extent of the economic effects resulting from designation. By incorporating a political economy analysis of the wilderness selection process by the U.S.

[3] See Appendix A for the text of the letter and the list of signatories.

Forest Service and Congress, this thesis addresses the possibility of such a selection bias among areas chosen for designation and provides testable predictions of the economic effects of wilderness designation.

The goals of this thesis are to examine the political economy of wilderness by identifying the determinants of wilderness selection and to obtain reliable and defensible estimates of the effects of wilderness designation on local economic outcomes by using a county-level panel data set. The benefits of this empirical approach are not necessarily to provide predictions for the economic effects of exogenously determined wilderness designations, independent of any selection bias. Rather, the analysis offers a way to understand the economic impacts of wilderness designations as they exist in reality, given the political and economic factors that influenced their creation. Because the Wilderness Act places restrictions on the type of lands eligible for designation, as well as restrictions on the use of the land once an area is designated, areas that are designated wilderness are likely to exhibit physical characteristics that may influence their economic outcomes. Such characteristics include the land's productivity for resource development, recreation potential, and wilderness attributes. These physical characteristics are likely to influence the decisions of policy makers during the wilderness selection process. As a result, research designs that attempt to remove selection bias and compare the treatment effect of wilderness designation to an otherwise identical control group ignore important political economy realities that are likely to determine wilderness designations. Using data from a comprehensive inventory of all potential wilderness areas managed by the U.S. Forest Service, this paper explains the political economy factors that influence

wilderness selection and how those factors influence the economic consequences of wilderness designations.

Recent proposals to designate wilderness areas in the western United States underscore the political and economic factors that determine if and where wilderness designations occur. A wilderness bill introduced in 2009 by U.S. Senator Jon Tester of Montana contained ample concessions to the timber industry that ensured timber harvests would continue on large portions of national forests outside of the proposed wilderness areas (Straub 2009). The bill, which would designate 600,000 acres of wilderness in addition to releasing non-wilderness areas to resource development, is currently stalled in Congress. The 112th U.S. Congress, which recently ended in 2013, became the first congress since 1966 to designate no additional wilderness areas (Repanshek 2013). Concerns of local communities over the economic effects of proposed wilderness designations force policy makers to carefully consider the potential impacts of wilderness designations. These political concerns shape the wilderness areas that receive designation and must be analyzed to understand the factors that determined where wilderness designations occur. Understanding these factors can provide useful insights into the economic consequences associated with areas that receive wilderness designation.

CHAPTER 2

BACKGROUND

The Wilderness Act

The Wilderness Act established the National Wilderness Preservation System in 1964 to provide an additional layer of protection for exceptional areas of federal lands. The act describes wilderness as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain."[4] Formally, wilderness is defined as:

> an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

Wilderness areas prohibit roads, motorized and mechanical vehicles (including bicycles), commercial enterprises, the landing of aircraft, and structures or installations.[5] Such restrictions largely preclude timber harvesting, mineral exploration, livestock grazing, or other forms of resource extraction (Coggins et al. 2002). Federal lands that were previously mined, harvested, or roaded, and therefore have the appearance of human

[4] The Wilderness Act of 1964 (P.L. 88-577; 16 U.S.C. §§ 1131-1136).
[5] Special provisions are made for such uses that were established prior to designation or are required in emergencies involving the safety of people. In the case of commercial enterprises, the act permits services that are "proper for realizing the recreational or wilderness purposes of the areas."

impact, are also generally precluded from wilderness designation. The prohibitions placed on wilderness make it the most restrictive form of federal land designation in the United States, prohibiting nearly all uses except for low-impact recreation and scientific research (Gorte 2010).

Although Congress designates wilderness areas, the management of wilderness is left to the federal agency that administers the land. In the contiguous United States, the U.S. Forest Service manages 30,403,643 acres (58 percent) of wilderness, the National Park Service manages 10,755,453 acres (21 percent), the Bureau of Land Management manages 8,752,349 acres (17 percent), and the U.S. Fish and Wildlife Service manages 2,009,873 acres (4 percent).[6] The Wilderness Act immediately designated 9.1 million acres of Forest Service lands in 1964 that were previously identified as "wilderness," "wild," or "canoe" areas. It was not until the Federal Land Policy and Management Act of 1976 that lands administered by the Bureau of Land Management became eligible for wilderness designation. Areas managed by the National Park Service and the Fish and Wildlife Service have also been designated wilderness since 1968. The Forest Service, however, remains the agency responsible for managing the majority of wilderness in the contiguous United States (Gorte 2010). The distribution of wilderness across federal land agencies in the contiguous United States is similar to that of western states, which are the focus of this thesis (see Figures 1 and 2).[7] The vast majority of wilderness in the

[6] Alaska contains 57,425,910 acres or 52 percent of all wilderness acres. Within Alaska, the Forest Service manages 10 percent of all wilderness acres, the Fish and Wildlife Service manages 33 percent, and the National Park Service manages 57 percent. The size and distribution of these wilderness lands differs greatly from the rest of the country. In addition, data are limited on the physical characteristics of Alaska's wilderness lands. Thus, the analysis in this thesis is limited to the contiguous United States.

[7] Western states refer to the eleven western-most states in the continental United States: Arizona, California, Colorado, Nevada, Oregon, Idaho, Montana, New Mexico, Utah, Washington, and Wyoming.

contiguous United States (93 percent) is found in western states. A map of wilderness areas in western states as of 2010 is displayed in Figure 3.

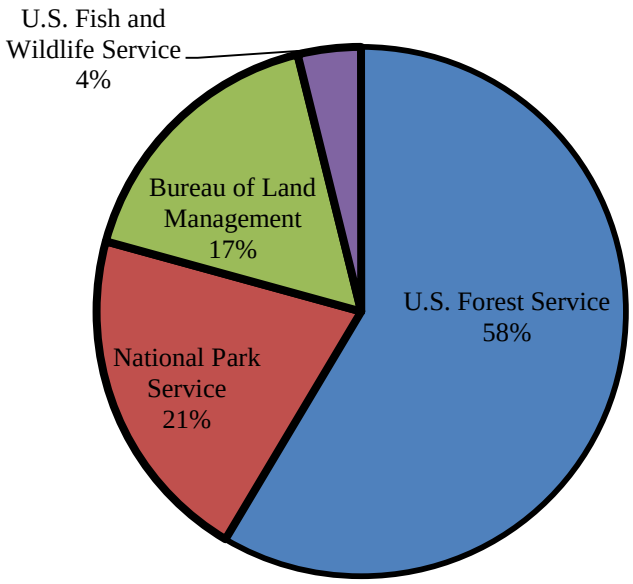

Figure 1: Wilderness in the Contiguous United States.

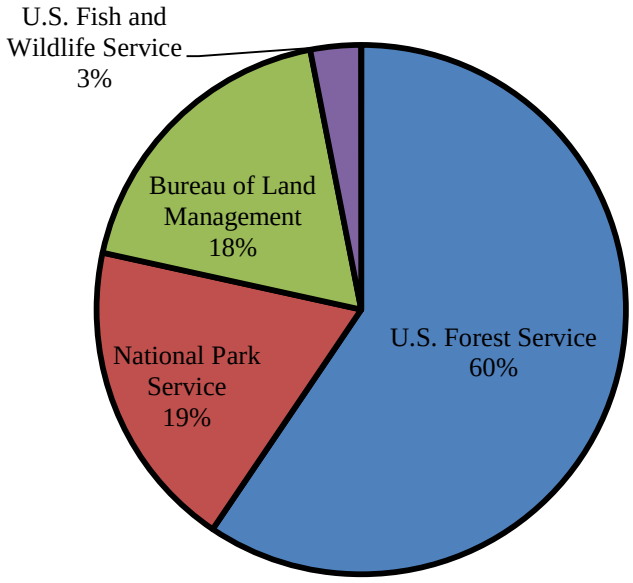

Figure 2: Wilderness in Western States.

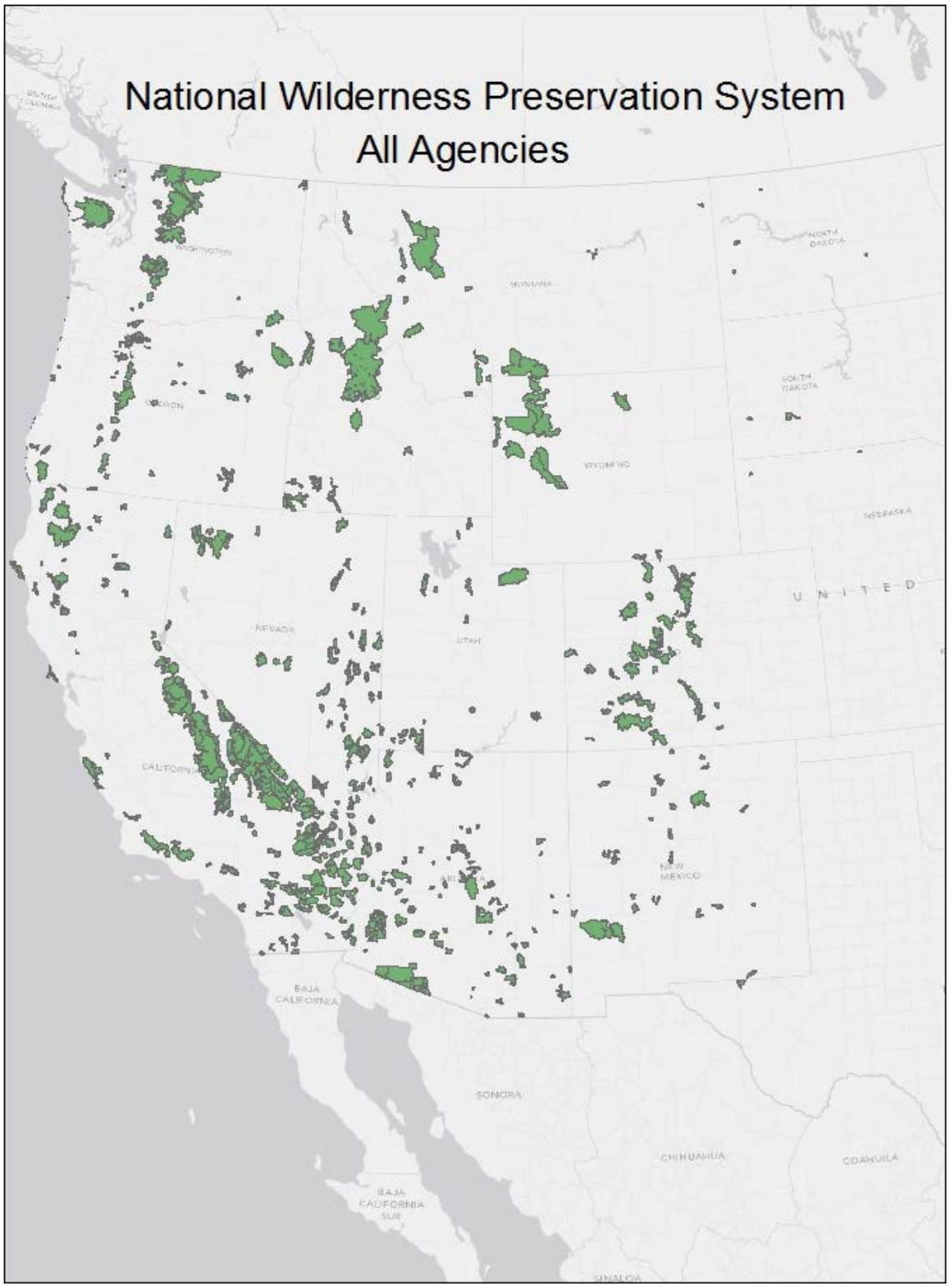

Figure 3: Map of National Wilderness Preservation System.

The amount of land designated wilderness increased from 9.1 million acres in 1964 to 109.5 million acres in 2011. The majority of the designations occurred following the release of a comprehensive inventory in 1979 of all potential wilderness areas managed by the Forest Service. The details of this inventory are described in more detail below. Figures 4 and 5 compare the amount of wilderness designated each year in the contiguous United States with the amount of wilderness designated in western states. Figure 4 displays the number of wilderness acres managed by any federal land agency, and Figure 5 shows only the wilderness acres managed by the Forest Service. Because the vast majority of wilderness is in western states, the distribution of wilderness designations over time in western states is representative of the distribution for the contiguous United States.

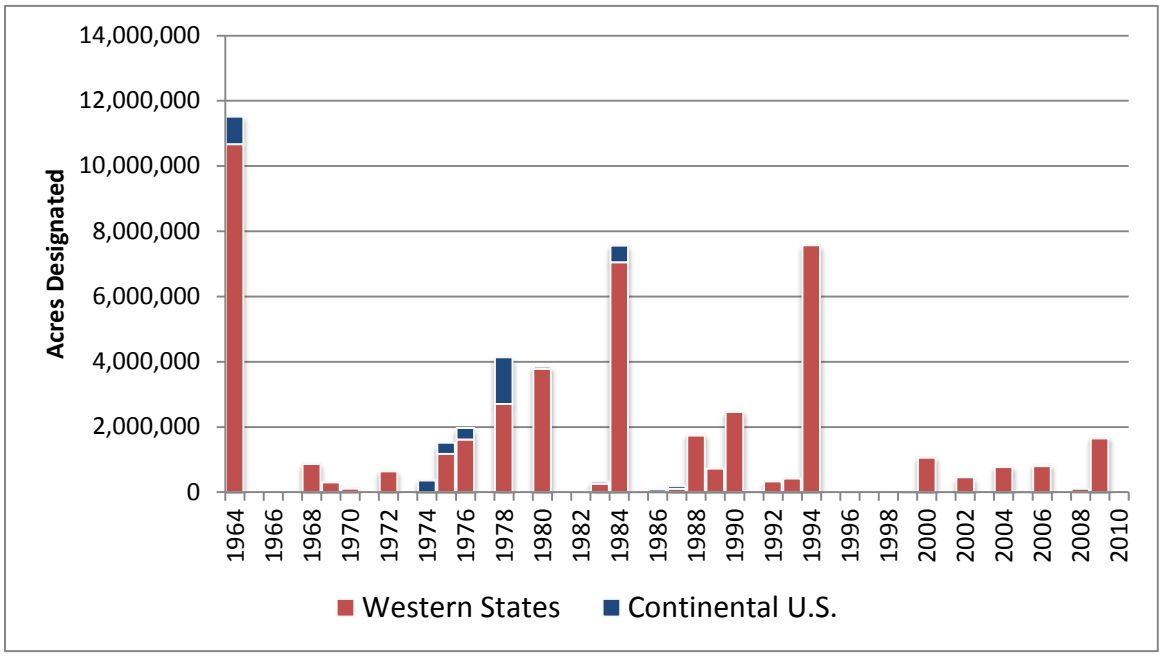

Figure 4: Acres of Wilderness Designated by Year (All Agencies).

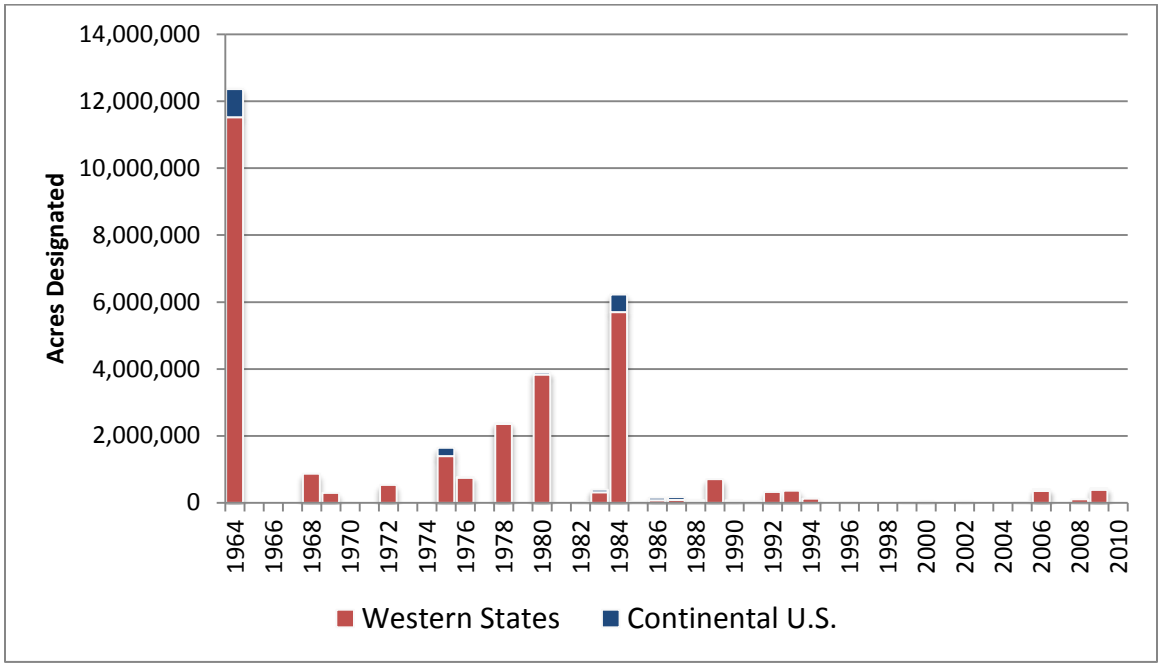

Figure 5: Acres of Wilderness Designated by Year (All Agencies).

Natural Amenities and Economic Growth

There is broad and growing evidence that the presence of natural amenities is associated with regional economic growth. McGranahan (1999) derives a natural amenities index based on six measures of climate, topography, and water area and demonstrates stark differences in population and employment growth among counties based on their index score. He finds that between 1970 and 1996 average population growth was 120 percent in non-metropolitan counties with high levels of natural amenities while population growth was 1 percent in counties with low levels of natural amenities. Employment changes were also highly related to the presence of natural amenities. Counties with high scores on the natural amenities index had an average of

three times as many jobs in 1996 as in 1969, while low-scoring counties experienced relatively little growth.

Other studies find similar effects of broad natural amenity measures on population, employment, and income growth, particularly in rural western counties (Cromartie and Wardwell 1999; McCool and Kruger 2003; Shumway and Otterstrom 2001). Deller et al. (2001) propose five broad-based indices designed to capture specific environmental amenity and quality of life characteristics: climate, land, water, winter recreation, and developed recreational infrastructure. The land variables include measures such as the amount of land in federal wilderness areas, forestland, farmland, and state park land. In cross-sectional regression analysis, each of the amenity indices was found to be positively related to at least one measure of growth and none were negatively related. Similarly, Booth (1999) examines growth in 86 rural mountain counties in California, Colorado, and Montana between 1985 and 1994 and finds that growth is driven by amenities such as parks, ski areas, and colleges. Rasker and Hansen (2000) also find that natural amenities are correlated with population, employment, and income growth in the Greater Yellowstone Ecosystem, which includes the states of Idaho, Montana, and Wyoming.

The reasons put forth in the literature for growth in areas with natural amenities are varied. In general, there is recognition of the increasing importance of environmental amenities in the location decisions of migrants and the quality of life improvements that result (McCool and Kruger 2003; Johnson and Rasker 1995). Marcouiller (1998) suggests that environmental amenity attributes are inputs into the production processes of local

economies. These inputs produce opportunities for nature-based tourism experiences that generate income and employment opportunities for amenity-rich regions. Rising levels of income and wealth also increase demand for such location-specific amenities (Graves 1979). As environmental amenities increase in importance, their role in the production process of local economies becomes more important. Other factors include the growing influence of retirees as a source of income in high-amenity rural areas. Power (1991) finds that non-labor income flows from retirees into the Greater Yellowstone area exceeded income from extractive industries in the 1970s and 1980s. Because of the "footloose" nature of retirement income, retiree's base location decisions on factors other than wages and employment and are becoming a major income source in the rural Mountain West. Moreover, the general decline in the importance of extractive industries in rural western economies has resulted in a regional economic transition from the "old economy" of the West to a "New West" economy based on service-sector employment, recreation and tourism, and non-labor income (Power and Barrett 2001; Shumway and Otterstrom 2001; Vias 1999).[8]

The notion that households base migration decisions on factors such as amenity levels is formalized by Tiebout (1956). In Tiebout's model, households "vote with their feet" by migrating to areas that provide their optimal bundle of public goods and taxes. Consistent with Tiebout's model, Banzhaf and Walsh (2008) find that households "vote with their feet" for environmental quality in response to changes in air quality. Protected lands such as wilderness areas may have similar effects on household migration decisions. Radeloff et al. (2010) find that 28 million housing units were built within 50

[8] See Hannsen (2008) for a critique of the literature on natural amenities and regional economic growth.

kilometers of protected areas, measured as wilderness areas, national parks, and national forests, between 1940 and 2000. The number of housing units built within 1 kilometer of a wilderness area increased from 9,400 to 54,000 (474 percent) during the same time period.

While many studies find a positive relationship between natural amenities and income growth (e.g. Booth 1999; Rasker 2006; Deller et al. 2001), conventional models of compensating differentials reach a different conclusion. Theoretical work by Roback (1982, 1988) argues that, all else equal, high levels of amenities are capitalized into wage rates. If firms and workers are mobile and can locate wherever is most advantageous to them, a spatial equilibrium will offer wage rates that exactly offset benefits from amenities. Thus, wage rates will be lower in areas with high amenity levels. Blanchflower and Oswald (1996) further this claim by suggesting that workers in amenity-rich areas would be willing to accept more periods of unemployment relative to areas low in amenities. Hedonic models also suggest that if consumers value environmental amenities, then land rental prices will increase in areas once such amenities are provided (Greenstone and Gallagher 2008; Phillips 2000). To the extent that wilderness areas provide natural amenities, the theory of compensating differentials suggests that, all else equal, areas rich in such amenities will be associated with lower wages, higher unemployment, and higher land rental rates. Thus, the finding that natural amenities are, in fact, associated with various measures of economic growth may be explained by growth in non-wage income or income that is not earned locally (Deller et al. 2001).

Economic Consequences of Wilderness Designation

A subset of the literature on regional economic growth and natural amenities examines the economic impact of wilderness areas or other forms of protected lands. Protected lands such as wilderness areas are, in general, off limits to timber harvesting, mineral exploration, and other forms of resource development that historically characterized many rural U.S. economies. The economic effects of wilderness designations may differ from the effects of climate, open space, and other physical variables that are bundled together in existing natural amenity indices. Wilderness designations represent a policy change rather than a change in the underlying physical attributes of the land, which may be largely time invariant. The policy of designation, however, simply protects the amenities provided by a wilderness area by prohibiting resource development from occurring within its boundaries. While the wilderness policy may hinder employment or income in extractive industries, the policy may also provide an important signal to local communities about the continuing existence of those amenities into the future. Such a signal may attract employment, population, and income growth in other sectors of the economy.

Existing empirical studies on the economic consequences of wilderness designations are limited to cross-sectional analyses. Table 1 summarizes the scope, methods, and results from these studies. Two of the studies are correlation analyses that report positive economic effects from wilderness but do not attempt to establish a causal relationship (Lorah and Southwick 2003; Holmes and Hecox 2004). In the first empirical analysis on the topic, Duffy-Deno (1998) finds no evidence that wilderness has an effect

on population or employment growth in 250 nonurban western counties between 1980 and 1990. Booth (1999) also finds no statistically significant impact of wilderness on population, employment, or income growth in 86 rural mountain counties in California, Colorado, and Montana in 1985 or 1994. Phillips finds a positive relationship between market land values and proximity to wilderness areas in the Green Mountains of Vermont. Two studies by Lewis et al. (2002, 2003) find no effect on population, employment, or wage growth. Rasker (2006) champions the stimulating role of western public lands for personal income growth, but is unable to find a statistically significant effect associated with lands classified as "protected," which include wilderness areas. A study of eastern wilderness designations by Rosenberger et al. (2008) finds no effect of wilderness on the timing of transition from an economy based on resource extraction and manufacturing to one dominated by service-sector employment and non-labor income.

Table 1: Existing Literature on the Economic Consequences of Wilderness Designation.

Study	***Scope***	***Model***	***Wilderness Metric***	***Result***
Duffy-Deno (1998)	250 rural western counties	Simultaneous equations	Percent of federal land designated as wilderness or under review for wilderness	No effect on population or employment densities
Booth (1999)	86 rural counties in CA, CO, and MT	OLS	Proportion of county designated wilderness	No effect on population, employment, or income
Phillips (2000)	Land adjacent to Green Mountain National Forest in Vermont	Hedonic	Distance from town to nearest wilderness area	Positive effect on land values

Table 1: Existing Literature on the Economic Consequences of Wilderness Designation (continued).

Study	***Scope***	***Model***	***Wilderness Metric***	***Result***
Lewis et al. (2002)	Rural counties in Northern Forest Region	Simultaneous equations	Percent of county in "preservationist use" (includes wilderness)	No effect on employment or population
Lewis et al. (2003)	Rural U.S. counties	Simultaneous equations	Percent of county in "preservationist use" (includes wilderness)	No effect on income
Lorah and Southwick (2003)	Western counties	Correlation analysis	Amount of protected lands (including wilderness) within a 50 mile radius of county center	Positive correlation with population, income, and employment growth
Holmes and Hecox (2004)	113 rural western counties	Pearson's correlation coefficients	Percent of county designated wilderness	Positive correlation with population, income, and employment growth
Rasker (2006)	Western mainland counties	OLS	Protected lands (including wilderness) in or within 50 kilometers of a county	No effect on income
Rosenberger (2008)	410 counties in the Appalachian Region	Discrete duration	Density of wilderness and wilderness dummy	No effect on timing of economic transition to service sector employment

Current estimates of the economic consequences associated with wilderness are limited for a number of reasons. Cross-sectional analyses are subject to bias due to omitted variables. More reliable estimates could be obtained by using panel data to control for unobserved heterogeneity between counties that could be correlated with

economic outcomes. Existing cross-sectional studies also examine regions during periods long after the wilderness areas were designated. Duffy-Deno (1998), for example, examines data from 1990, but the designation of the region's wilderness areas largely occurred in the 1960s. This timing issue is problematic because the full effects of wilderness designation may not persist indefinitely (Eichman et al. 2010). For example, initial declines in extraction-based industries may be gradually offset by benefits to service-sector industries. In addition, previous studies fail to address the potential for selection bias based on the characteristics of lands that are chosen for wilderness designation. The physical characteristics of a potential wilderness area are likely to influence the local economic outcomes associated with designation. For example, if wilderness areas are not productive for resource development, then the costs of designation are likely to be insignificant on local economies. This selection bias could be addressed by analyzing the political economy of wilderness selection.

Wilderness designations differ from other federal protected land policies in important ways that are likely to influence the extent of their economic impacts. Although opponents of wilderness often claim that wilderness designations shut down resource development on federal lands, the immediate effect of wilderness designations is to protect the existing wilderness attributes of lands on which resource development activities do not currently exist. Restrictions defined in the Wilderness Act on lands suitable for wilderness designation largely preclude areas with ongoing resource development activities. Policies such as the Northwest Forest Plan (NWFP), however, had a more direct effect on existing resource development. Adopted in 1994 by the Forest

Service and Bureau of Land Management, the NWFP reduced timber harvesting on 11 million acres of highly productive federal timberland in the Pacific Northwest to provide habitat for the northern spotted owl (Eichman et al. 2010). Unlike the limited-use restrictions of the wilderness areas, the NWFP applied to federal lands with ongoing resource development and therefore had a direct effect on such industries. Wilderness areas, by contrast, affect resource development industries by limiting the amount of federal lands available for resource extraction. In a study of the NWFP's economic effects, Eichman et al. (2010) find statistically significant negative effects of the NWFP policy on employment growth. The reduction in employment growth was only slightly offset by positive migration-driven effects.

The Political Economy of Wilderness and RARE II

Absent from the literature on the economic impacts of protected lands is an analysis of the determinants of wilderness designation. The political economy of wilderness selection is likely to have an important influence on the characteristics of areas chosen for inclusion into the National Wilderness Preservation System. This selection process is also likely to influence the potential economic consequences of wilderness designations. Historically, the Forest Service has had considerable influence over the wilderness selection decisions by Congress. The Wilderness Act directed the Forest Service to inventory its lands for areas suitable for addition to the wilderness system (Roth 1984). If the Forest Service is more likely to recommend areas with certain qualities for designation, such as areas that are less productive or less accessible for

resource extraction, then analyzing the wilderness selection process is informative to the analysis of the economic consequences of wilderness. Moreover, because only Congress can designate wilderness areas, analyzing the wilderness selection decisions of Congress is necessary for understanding the political economy of wilderness selection.

There is evidence that federally protected areas are, in general, unproductive for resource development. Scott et al. (2001) find that nature reserves in the United States, including wilderness areas, are most frequently found at higher elevations and on less productive soils. Patterns of land ownership reveal that more productive soils are privately owned, found at lower elevations, and already extensively converted to urban and agricultural uses. At a global scale, Joppa and Pfaff (2009) find that protected areas are biased towards areas that are unlikely to face land conversion pressures even in the absence of protection. The authors find that lands with higher protection status are more biased towards areas where they are unlikely to prevent land conversion. Similarly, critics have characterized many U.S. wilderness areas as "rock and ice" areas due to their high elevation and low economic value (Turner 2007). If areas selected for wilderness designation are relatively unproductive for resource extraction, and would not otherwise be developed if they were not designated, it is likely that designation will have little effect on local economic outcomes.

In 1979, the Forest Service completed the second Roadless Area Review and Evaluation (RARE II), a comprehensive inventory of all remaining Forest Service roadless areas that had not been designated as wilderness.[9] The lands inventoried during

[9] An earlier evaluation known as RARE I was completed in 1973 but abandoned by the Forest Service after courts held that the procedure failed to comply with NEPA's environmental assessment procedures

RARE II comprised all potential Forest Service wilderness areas and made up one-third of total Forest Service lands. The goal of the inventory was to determine which areas were suitable for wilderness designation and which could be opened to commodity development or other forms of multiple-use management (Roth 1984). The RARE II process was carried out over two years and resulted in a detailed report that quantified the resource potential and wilderness attributes of Forest Service roadless areas and collected input from the public (see *Final Environmental Statement* 1979). Based on this inventory, the Forest Service made recommendations to Congress for whether each roadless area should be designated as wilderness, released for multiple-use management, or subject to further planning. This process is described in further detail in the data section below.[10]

The RARE II inventory served as an important opportunity for the Forest Service to influence decisions over wilderness selection. The agency, historically characterized by its mandate to manage national forests for multiple uses, opposed the Wilderness Act of 1964 as an assault on its multiple-use policy (Allin 1982). The act granted Congress the authority to create wilderness areas and limited the amount of discretion the agency had over resource use in national forests (Roth 1984). Nevertheless, by the 1970s, the increasing influence of wilderness advocates in federal land-use politics caused the Forest Service to accept some degree of wilderness designations. The RARE II inventory

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(Glicksman 2004). RARE I was challenged based on the completeness of the inventory, the feasibility of public participation, and the methodology used to evaluate roadless areas. The Forest Service admitted the inventory was flawed, and reached an out-of-court settlement in which the agency agreed not to release roadless areas for multiple-use management until an environmental impact statement consistent with NEPA was completed (Allin 1982).

[10] The Federal Land Policy and Management Act of 1976 also mandated the Bureau of Land Management to evaluate the wilderness potential of roadless areas of 5,000 or more acres and make recommendations to the president by 1991 (Brill 2012). The BLM's inventory, however, did not provide detailed and quantified resource characteristic data as in RARE II.

offered the Forest Service the chance to exert considerable influence over which areas would be designated wilderness. The agency presumed that the areas that were not designated wilderness following RARE II would be released for traditional multiple-use management, including resource development (Allin 1982). Commodity groups and wilderness advocates sought to influence the outcome of the RARE II report by intensively lobbying the Forest Service. The increased scrutiny of the Forest Service by commodity groups and wilderness advocates during the RARE II process also pressured the agency to produce a final report that was detailed, accurate, and comprehensive (Allin 1982).

In the years following the RARE II inventory, the growing influence of competing interest groups over the Forest Service's planning processes prompted scholars to advance a model of the agency's behavior similar to that posited by Peltzman (1976). In Peltzman's model, interest groups are assumed to seek wealth redistributions through the regulatory process, in effect bidding for the right to impose costs on the other groups. Regulators maximize their benefit by arbitrating among the competing groups. In the absence of competing interest groups, the Forest Service might adhere to its historic value orientation and become a client of the forest products industry. Peltzman's model is an expansion of Stigler's (1971) theory of economic regulation, which explained how a numerically large group can demand regulations that favor the concentrated interests of the group at the expense of individual consumers.

Culhane (1981) argues that the increased influence of competing groups, such as wilderness preservationists and commodity developers, has transformed the agency's role

into that of a political arbitrator forging compromises between competing groups. The National Environmental Policy Act (NEPA) of 1970, for example, dramatically increased the role of public participation in agency decision making, particularly among environmentalists through NEPA's environmental impact statement process. According to Culhane, the presence of conflicting groups with diverse interests causes the Forest Service to make decisions so as to avoid regulatory capture by any one group.[11]

The Forest Service's multiple-use mandate likely promotes political arbitration between competing users. In his detailed examination of interest group influences on the Forest Service and the Bureau of Land Management during the early 1980s, Culhane finds that "the agencies are responding in variable and locally appropriate ways to balanced, heterogeneous constituencies" (334). According to Culhane, "Balanced constituencies support different aspects of the multiple-use mission: traditional commodity users support the resource development aspects, recreationists and conservationists support the recreation use aspects, and conservationists support the resource protection and sustained yield aspects" (335). The emergence of environmentalists in the mid-twentieth century, along with traditional commodity users, "creates an unusual double-clientele situation" (335). Culhane argues that, as a result, "the agencies, whose commitment to multiple use demands a balanced course of action, can play their more extreme constituents off against each other to reinforce the agencies' preferred middle course" (336). In the context of the RARE II inventory, such a response to balanced constituents enables the Forest Service to make wilderness recommendations

[11] The Multiple Use and Sustained Yield Act of 1960 also encouraged the Forest Service to become an arbitrator between competing interest groups. The act stated that the establishment and maintenance of wilderness areas is consistent with the multiple-use mandate of the Forest Service (Culhane 1981).

that sufficiently appeal to the demands of both wilderness advocates and commodity developers.

While scholars have put forth other theories of Forest Service agency behavior, the Peltzman model of political arbitration of competing interest groups appears to be the most robust. Twight (1983) examines the management of Olympic National Forest in Washington and argues that Forest Service decision making conforms to the agency's professional ideology of maximum sustainable timber yield. According to Twight's perspective, economically efficient use of forestry resources drives the agency's actions while other uses such as wilderness preservation are less influential. Twight's evidence for his theory, however, is limited to a single national forest with highly valuable timber. Moreover, subsequent evidence of the influence by preservationist groups on the Forest Service undermines the theory that the agency conforms only to its traditional value orientation of timber production (Culhane 1984; Booth 1991; Crone and Tschirhart 1998). Another view of Forest Service behavior is the budget maximization hypothesis, as espoused by Niskanen (1971). Johnson (1985) and O'Toole (1988) argue that Forest Service behavior is consistent with this view, which holds that the primary objective of the agency is the maximization of its budget. Loomis (1987), however, finds no strong support for the budget maximization hypothesis in his analysis of Forest Service documents pertaining to fourteen wilderness recommendations in Colorado. In addition, it is unclear which behavior is budget maximizing and whether budget maximization is independent from political arbitration behavior (Booth 1991). For instance, in order to maximize its budget, the Forest Service may have to balance the competing interests of

different constituent groups in a manner consistent with Peltzman and Culhane's balanced interest group theory.

Several empirical studies have examined samples of the RARE II wilderness selection process. Using data from four states inventoried during RARE II, Mohai (1987) finds support for Twight's professional ideology perspective and Culhane's interest group competition perspective, although he does not examine the budget maximization hypothesis. Booth (1991) examines RARE II data from Oregon and Washington and finds that the Forest Service was less responsive than Congress to the states' relative economic dependence on forest products and timber harvesting in its wilderness recommendations in the two states. The Forest Service was also less responsive than Congress to the interests of wilderness advocates. Booth concludes that both Congress and the Forest Service act as political arbitrators between competing interest groups, but finds that the Forest Service was more strongly motivated by its value orientation towards sustained yield principles or by budget maximization than was Congress. Crone and Tschirhart (1998) use RARE II data from nine western states and find that both interest group influences and efficiency considerations factor into the Forest Service's objective function with respect to the agency's wilderness recommendations. While existing studies of RARE II find evidence in favor of the various theories of Forest Service agency behavior, they have difficulty distinguishing between them using RARE II data. All empirical studies of RARE II, however, find some support for the theory that the Forest Service behaves as a political arbitrator between competing interest groups.

The introduction of political economy considerations into the analysis offers the insight that wilderness selection is likely to depend, at least in part, on the physical characteristics of an area and the degree of interest group competition over the use of the resources. That is, the Forest Service is unlikely to make wilderness selection decisions that conflict with the interests of its constituent groups. In effect, the agency will attempt to appease both commodity developers and wilderness advocates with its wilderness recommendations to Congress. If Congress follows the recommendations of the Forest Service, it will also act as a political arbitrator of competing interest groups. The economic impacts of wilderness designation will vary depending upon the resource characteristics of a given area. To the extent that the resource characteristics could influence the economic outcomes of wilderness designation, examining the political economy of wilderness selection is an important element in an analysis of the economic consequences of wilderness.

One can imagine two ways to structure hypotheses to examine the wilderness selection process. The two sets of hypotheses are presented below, and briefly discussed in turn:

- Null Hypothesis 1: Wilderness selection decisions by the Forest Service during RARE II were not influenced by interest groups and are based only on criteria established by the Wilderness Act.
- Alternative Hypothesis 1: The Forest Service was influenced by interest groups in its wilderness selection decisions.

The null hypothesis, in this case, can be rejected if there is evidence that interest groups influenced the Forest Service's wilderness selection decisions. In the context of the RARE II inventory, one simple approach to measure interest group influence is to examine whether input from the public influenced the agency's selection decisions. As described in more detail in the next section, the RARE II inventory compiled extensive data on the number of signatures in favor of each recommendation option. This public input process was an important means for interest groups to exert their influence on the wilderness selection process.

If public input was found to influence the Forest Service's wilderness selection decisions, then the null hypothesis is rejected in favor of the alternative hypothesis that the agency was influenced by interest groups. This possibility raises another set of hypotheses:

- Null Hypothesis 2: In making its wilderness selection decisions, the Forest Service was captured by a single large interest group.
- Alternative Hypothesis 2: The Forest Service balanced the competing demands of interest groups by making wilderness selection decisions that appeased both groups.

In the second set of hypotheses, the null hypothesis is similar to the model of regulation posited by Stigler (1971) in which a single interest group dominates an agency's decision making process. The costs of the decision are imposed on consumers, who are less interested in the regulatory outcome than an interest group that is directly affected by the decision. Failure to reject the null hypothesis would require that either

resource development groups or wilderness advocates influence wilderness selection, but not both. The alternative hypothesis follows Peltzman's (1975) theory of regulation in which regulators balance competing interest group demands. This hypothesis is also similar to Culhane's (1984) perspective of Forest Service behavior in the presence of competing interest groups. Support for the alternative hypothesis would require that both resource development and wilderness attributes be predictors of wilderness selection, suggesting that the agency took into consideration the interests of both groups.

The alternative to the second null hypothesis provides the following predictions:

(1) The Forest Service will make wilderness selection decisions such that it balances the interests of competing groups. In effect, the agency will attempt to appeal to wilderness advocates by recommending areas with high levels of wilderness attributes, but will also avoid recommending areas that have high resource development potential.

(2) Congress will also attempt to act as a political arbitrator in its wilderness designation decisions. If the Forest Service is able to effectively arbitrate between competing interest groups, then Congress will make designation decisions similar to those recommended by the Forest Service.

(3) If both the Forest Service and Congress are able to effectively arbitrate between competing groups in their wilderness selection decisions, then the economic consequences of wilderness designation will not be significant.

The extent to which an area's wilderness attributes are uncorrelated (or negatively correlated) with its resource development potential will determine how effectively the

agency can arbitrate between competing interest groups in its wilderness selection decisions. If the variables are highly negatively correlated, then balancing interest groups is simple. If the variables have zero correlation, then the agency is largely able to balance competing groups, but not without some conflict. If wilderness attributes are positively correlated with resource development potential, the ability of the Forest Service to balance competing interest groups will be limited.

CHAPTER 4

DATA AND EMPIRICAL MODELS

This paper consists of three phases of analysis. Phases 1 and 2 examine the political economy of wilderness designation by analyzing the determinants of wilderness selection by the U.S. Forest Service and Congress. Phase 3 examines the economic consequences of wilderness designation using an annual county-level panel data set that spans from 1969 to 2010. The scope of the study is all counties in the 11 western-most states in the contiguous United States: Arizona, California, Colorado, Nevada, Oregon, Idaho, Montana, New Mexico, Utah, Washington, and Wyoming.

Phase 1: Forest Service Wilderness Selection Model

Data on the characteristics of potential wilderness areas have been compiled from the Forest Service's second Roadless Area Review and Evaluation (RARE II). In this report, the Forest Service inventoried all roadless areas within its boundaries and recommended each area as wilderness, non-wilderness, or further planning.[12] During the two-year RARE II process, the agency collected data on the physical characteristics of each roadless area, as well as input from the public on how the roadless areas should be administered. In total, the Forest Service inventoried 62 million roadless acres, or one-third of the agency's land. The final report recommended 21 percent of the inventoried

[12] The report stated that lands recommended as further planning were to be "considered for all uses, including wilderness, during development of land and resource management plans or other specific project plans meeting NEPA requirements" (*Final Environmental Statement* 1979). Prior to the development of the forest plans, activities such as timber harvesting, road construction, and other actions that may reduce the wilderness potential of the land were prohibited.

roadless areas as wilderness, 68 as non-wilderness, and 11 as further planning.[13] In western states (defined as Forest Service regions 1-6, excluding Alaska and Hawaii), the Forest Service recommended 16 percent of roadless areas as wilderness, 72 percent as non-wilderness, and 12 percent as further planning. The purpose of RARE II was to produce final administration recommendations on which areas should be included in the National Wilderness Preservation System. The Forest Service intended for the roadless areas that were not recommended for wilderness in RARE II to be released for resource development and other forms of multiple-use management (Allin 1982).

The RARE II report collected data on the physical characteristics of the 2,919 roadless areas managed by the Forest Service. The variables included renewable resource potential, nonrenewable resource potential, wilderness attributes ratings, and development opportunities ratings. Data on the number of signatures in favor of an area being allotted to wilderness, non-wilderness, or further planning were also collected. The data from RARE II used in this thesis are limited to western states (Forest Service regions 1-6, omitting Alaska and Hawaii), which comprise the majority of the roadless areas managed by the Forest Service. Descriptions of these variables, as well as their mean values for different recommendations in western states, are summarized in Table 2. Roadless areas with no public input data or nonrenewable resource data are omitted, resulting in a data set of 1,621 roadless areas.

[13] Most of the further planning category consisted of lands in California and the Chugach National Forest in Alaska, which were committed to further study by previous legislation, or in the so-called "Overthrust Belt" in Wyoming, where geologists suspected the existence of large oil and gas reserves. As Roth (1984) explains, "the Department of Energy strongly advocated releasing all potential oil and gas land to the nonwilderness category. Allocating most of the Overthrust Belt to further planning was a necessary compromise given the relative lack of data on the nature and extent of its oil and gas reserves" (58).

Table 2: RARE II Variable Descriptions and Average Values – Phase 1.

	Variable Descriptions		**Mean Values**			
	Variable	*Scale*	*Wilderness*	*Further Planning*	*Non-wilderness*	*All Areas*
Renewable resource potential	Potential Sawtimber Yield	Millions of board feet	2.39	1.21	1.75	1.78
	Grazing	Thousands of animal unit months	635	1,127	1,150	1,075
	Motorized Recreation	Thousands of recreation visitor days	1.09	1.63	1.15	1.20
	Nonmotorized Recreation	Thousands of recreation visitor days	6.08	7.01	3.06	3.96
Nonrenewable resource potential	Hard Rock Mineral	0 - 100	48	58	48	49
	Oil and Gas	0 - 100	24	36	34	33
	Coal	0 - 100	10	42	37	15
	Uranium	0 - 100	32	5	16	37
	Geothermal	0 - 100	20	24	19	20
	Low Value Bulk Materials	0 - 100	22	31	19	21
Wilderness attributes	Wilderness Attribute Rating System (WARS)	4 - 28	22	20	18	19
Development potential	Development Opportunities Rating System (DORS)	0 – 15	4	5	6	5
Public input	Wilderness	Number of signatures in favor	1,529	812	767	879
	Further planning	Number of signatures in favor	48	130	294	240
	Non-wilderness	Number of signatures in favor	2,000	945	1,261	1201
Size	Acreage		25,472	34,121	20,823	23,057
Observations	1621 roadless areas in regions 1-6 inventoried during RARE II					

Renewable resource variables quantified during RARE II include potential sawtimber yield, grazing potential, dispersed motorized recreation, and dispersed nonmotorized recreation.[14] Potential yield is defined as the annual timber yield that can be obtained within ten years on a sustained yield basis using intensive forest management practices and is measured in millions of board feet.[15] The grazing potential of a roadless area was estimated and expressed in thousands of animal unit months. The recreation variables are measured in thousands of recreation visitor days, which are equal to a person spending 12 hours recreating in a roadless area.

Ratings based on the potential development of the following nonrenewable resource variables were also created in the RARE II report: hard rock minerals, oil and gas, uranium, coal, geothermal energy, and low-value bulk materials (such as sand, gravel, and rock). Nonrenewable variables were rated on a scale from 0 to 100, with 100 indicating the greatest potential for development. The ratings were created by Forest Service geologists and mining engineers after evaluating mineral data from the Department of Energy, U.S. Geological Survey, Bureau of Mines, and state and industry sources. Data on renewable and nonrenewable resources were collected by the Forest Service at the district and national forest level to insure the most accurate and current data was used for the RARE II inventory.

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[14] A dispersed area refers to an area containing recreation use without developed facilities, and includes off-road vehicle use (*Final Environmental Statement* 1979).

[15] Programmed harvest, a variable similar to potential yield, was omitted from analysis because of its high level of correlation with potential yield. Programmed harvest refers to the amount of the potential yield the Forest Service would put up for sale annually on average if the roadless area were included in the timber production base.

The Forest Service developed the Wilderness Attribute Rating System (WARS) as a measurement of the wilderness quality of each roadless area. The system identifies four wilderness components described in the Wilderness Act and assigns each component a numerical rating from one to seven. The four components are naturalness, apparent naturalness, opportunity for solitude, and opportunity for a primitive recreation experience. The four ratings are summed to create a single WARS rating from 4 to 28, with 28 representing an area with the highest wilderness qualities. According to the report, each area was judged by "an interdisciplinary team of Forest Service professionals to insure the most objective evaluation possible," including additional input from representatives from various interest groups (*Final Environmental Statement* 1979).

The Development Opportunities Ratings System (DORS) expresses the relative potential for development of non-wilderness resources and is similar to a cost-benefit ratio. The rating system develops opportunity costs based on estimates of the total net present values of resources foregone by wilderness classification. The ratings combine economic benefit and cost information on the following outputs: sawtimber and other wood products, grazing, dispersed motorized and nonmotorized recreation, developed recreation, hunting and fishing, and nonhunting wildlife.[16] The costs of producing these outputs include resource management, road building, and fire management. Benefit and cost information were derived from Forest Service planning and financial records required by the 1980 Renewable Resources Program, a planning process required by the Renewable Resources Planning Act of 1974. The flow of costs and benefits for the next

[16] DORS net present values do not recognize non-commodity benefits of wilderness such as the preservation of ecosystems.

100-year period are discounted at 6.625 percent per year to provide estimates in present value terms. When the costs of development equal the benefits, the DORS rating is 5.[17] Ratings greater than 5 indicate that the present value of expected benefits exceeds the discounted expected costs of development.[18]

The DORS ratings provide a useful variable with which to predict wilderness selection by the Forest Service. Unlike variables that measure the amount of resources available in a roadless area, DORS ratings include estimates of the costs of resource extraction such as the development of roads to access the resources. The final RARE II report describes DORS ratings as "essentially indexes of relative profitability of development per unit of land. Areas, regardless of size, with highly valuable resources per acre and with low per acre management and road costs have high DORS ratings. In particular, roadless areas with relatively high per acre road requirements may have low DORS ratings" (W-3). Because many roadless areas are found at high elevations or on steep terrain, the presence of resources alone is not a sufficient estimate of the development potential of a roadless area. By including estimates of the relative costs and benefits of developing existing resources, the DORS variable provides a standardized measurement of the development potential of each roadless area.

To identify the determinants of wilderness selection by the Forest Service, a series of linear and nonlinear models are estimated to determine the variables that influenced the Forest Service's recommendation of roadless areas to the wilderness system. The models incorporate renewable and nonrenewable resource potential, public input, as well

[17] DORS is calculated using the following formula: DORS = 16.60964 $\log_{10}$ [(total benefits/total costs) + 1]. When total benefits equal total costs, the result is a DORS rating of 5.
[18] Additional information on DORS is found in *Final Environmental Statement* (1979), pp. W-1 – W-5.

as an area's wilderness attributes and development potential as measured by the RARE II inventory. The models in Phase 1 are estimated in the following form:

$$
\begin{aligned}
Recommendation_i \\
&= \beta_0 + \beta_1 \log(Acres)_i + \beta_2 Wilderness\ Signatures_i \\
&+ \beta_3 Further\ Planning\ Signatures_i + \beta_4 Nonwilderness\ Signatures_i + \beta_5 WARS_i \\
&+ \beta_6 DORS_i + \beta_7 Grazing_i + \beta_8 Potential\ Yield_i + \beta_9 Motorized\ Recreation_i \\
&+ \beta_{10} Nonmotorized\ Recreation_i + \beta_{11} Highest\ Mineral\ Rating_i + \gamma_i + \varepsilon_i
\end{aligned}
$$

The unit of observation in Phase 1 is a roadless area managed by the Forest Service. The dependent variable, $Recommendation_i$, is assigned a value of 1 if area *i* was recommended by the Forest Service to become wilderness and 0 otherwise. The *Highest Mineral Rating*$_i$ variable is assigned the value of the nonrenewable resource (excluding low value bulk materials) with the highest rating.[19] Forest Service regional fixed effects are expressed as γ_i. A correlation matrix of the RARE II variables used is shown in Table 3.

The variable *Acres*$_i$ is a measure of the size of roadless area *i* expressed in acres. The estimated coefficient is ambiguous because the size of a roadless area is not expected to influence the Forest Service's recommendation. The variable *Wilderness Signatures*$_i$ measures the total number of signatures from the public in favor of roadless area *i* being designated wilderness. RARE II's public input process was an important channel through which interest groups attempted to influence the Forest Service's wilderness recommendations. The estimated coefficient on *Wilderness Signatures*$_i$ is expected to be positive if wilderness advocacy groups influenced the Forest Service's wilderness

[19] Low value bulk materials were excluded because, as the name suggests, the materials are of low value.

selection decisions. Likewise, the estimated coefficient on the *Nonwilderness Signatures*$_i$ variable is expected to be negative if interest groups that opposed wilderness designation influenced the Forest Service's recommendations. The expected coefficient on the *Further Planning Signatures*$_i$ variable, however, is ambiguous because the further planning category did not result in a recommendation for either wilderness or non-wilderness, but simply indicated that the physical characteristics of the roadless area needed further study.

The variable $WARS_i$ is a measure of the wilderness attributes of roadless area i. The estimated coefficient on this variable is predicted to be positive because a roadless area with higher wilderness attribute ratings is expected to increase the probability that the Forest Service will recommend the area for wilderness designation. This result is expected to hold regardless of whether the Forest Service was influenced by pro-wilderness interest groups or simply following its mandate to make wilderness selection decisions based on an area's suitability as wilderness. The *DORS*$_i$ variable measures the relative profitability of developing a unit of roadless area *i*. If commodity developer interest groups influenced the Forest Service's wilderness selection decisions, then the estimated coefficient on *DORS*$_i$ is predicted to be negative. A high DORS rating suggests that the present value of expected benefits exceeds the discounted expected costs of developing the roadless area for its commodity resources. Higher DORS ratings are expected to increase the amount of lobbying by interest groups representing commodity developers in order to influence the Forest Service's recommendation of the roadless area into the non-wilderness category.

Table 3: Correlation Matrix of RARE II Variables.

	Wilderness Signatures	**Further Planning Signatures**	**Non-wilderness Signatures**	**FS Rec.**	**Acres**	**WARS**	**DORS**	**Grazing**	**Potent. Yield**	**Motor Recreat.**	**Non-motor Recreat.**	**Highest Min. Rating**
Wilderness Signatures	1.00											
Further Planning Signatures	-0.22	1.00										
Non-wilderness Signatures	0.33	0.05	1.00									
FS Rec.	-0.18	0.04	-0.02	1.00								
Acres	0.16	-0.02	0.02	0.03	1.00							
WARS	0.26	-0.02	0.06	0.34	0.26	1.00						
DORS	0.14	0.00	0.37	-0.08	-0.03	-0.01	1.00					
Grazing	-0.03	-0.03	-0.11	-0.08	0.48	-0.04	-0.01	1.00				
Potent. Yield	0.29	0.01	0.20	0.05	0.36	0.15	0.07	0.11	1.00			
Motor Recreat.	0.08	0.04	-0.03	-0.01	0.22	0.02	-0.02	0.12	0.16	1.00		
Nonmotor Recreat.	0.13	0.00	0.03	0.06	0.35	0.14	0.02	0.05	0.29	0.40	1.00	
Highest Min. Rating	-0.02	-0.02	-0.14	-0.04	0.21	0.03	-0.10	0.20	0.09	0.07	0.08	1.00

If commodity developers influenced the Forest Service's wilderness decisions, then the estimated coefficients on *Potential Yield*$_i$, *Grazing*$_i$, and *Motorized Recreation*$_i$ are expected to be negative because wilderness designation precludes such uses. The estimated coefficient on *Nonmotorized Recreation*$_i$, however, is ambiguous. Recreational stock users (e.g. horses and mules) and backpackers may prefer wilderness designation because it prohibits off-road motorized vehicles, but other visitors may desire the accessibility provided by roads that reach the interior of wilderness areas. Such access roads are prohibited within the boundaries of wilderness areas. The estimated coefficient on the *Highest Mineral Rating*$_i$ variable is predicted to be negative if commodity developer groups were influential because wilderness designation precludes the development of roadless areas for hard rock minerals, coal, oil and gas, uranium, or geothermal energy.

Phase 2: Congressional Wilderness Designation Model

Phase 2 models the congressional wilderness selection process and examines how influential the Forest Service's recommendations in RARE II were in Congress' decision to designate areas as wilderness. The most apparent way to approach this Phase would be in a manner similar to Phase 1, in which the dependent variable is equal to 1 if Congress designated the roadless area wilderness and 0 otherwise. Congress' wilderness selection decisions, however, did not often align with the boundaries of roadless areas as determined during the RARE II inventory. Instead, Congress often designated portions of RARE II roadless areas or combined parts of multiple roadless areas. Therefore, to

analyze Congress' wilderness selection decisions, the dependent variable is measured as the proportion of a roadless area that received wilderness designation by Congress.

To determine the amount of each roadless area that received wilderness designation, data from Phase 1 are combined with geospatial data of RARE II roadless areas. Comprehensive geospatial data from the RARE II inventory, however, are not available from the Forest Service. Geospatial RARE II data could be acquired from Forest Service regions 1, 2, and 5, as well as from the roadless areas in Coronado National Forest in region 3 and Dixie National Forest in region 4. The resulting data set consists of 629 areas for which geospatial data were available from the RARE II inventory. Table 4 presents descriptive statistics of RARE II variables for the sample of roadless areas used in the Phase 2 analysis. The geospatial data on these RARE II roadless areas are used to calculate the proportion of a roadless area that received wilderness designation by 2010. This proportion is determined by calculating the intersection of RARE II roadless areas with designated wilderness areas using ArcGIS. By calculating the proportion of a roadless area that was designated wilderness by 2010, the wilderness selection decisions of Congress can be examined.

The dependent variable for Phase 2 is the proportion of a roadless area designated as wilderness by 2010, as measured using ArcGIS. The renewable resource potential, nonrenewable resource potential, WARS rating, DORS rating, and public input data from the RARE II inventory are included as regressors, as well as the Forest Service's recommendation. The model is estimated in the following form:

Table 4: RARE II Variable Descriptions and Average Values – Phase 2.

Variable Descriptions			Mean Values for FS Recommendations			
	Variable	*Scale*	*Wilderness*	*Further Planning*	*Non-wilderness*	*All*
Renewable resource potential	Potential Sawtimber Yield	Millions of board feet	1.40	0.94	1.26	1.23
	Grazing	Thousands of animal unit months	470	984	865	830
	Motorized Recreation	Thousands of recreation visitor days	1.24	2.44	1.20	1.40
	Nonmotorized Recreation	Thousands of recreation visitor days	4.99	9.74	2.98	4.27
Nonrenewable resource potential	Hard Rock Mineral	0 - 100	34	47	46	45
	Oil and Gas	0 - 100	12	18	21	19
	Coal	0 - 100	3	0	5	4
	Uranium	0 - 100	17	9	18	17
	Geothermal	0 - 100	19	15	12	14
	Low Value Bulk Materials	0 - 100	9	9	11	11
Wilderness attributes	Wilderness Attribute Rating System (WARS)	4 - 28	21	19	18	19

Table 4: RARE II Variable Descriptions and Average Values – Phase 2 (continued).

Variable Descriptions			Mean Values for FS Recommendations			
	Variable	*Scale*	*Wilderness*	*Further Planning*	*Non-wilderness*	*All*
Development potential	Development Opportunities Rating System (DORS)	0 – 15	4	5	4	4
Public input	Wilderness	Number of signatures in favor	1111	638	495	599
	Further planning	Number of signatures in favor	35	116	370	287
	Non-wilderness	Number of signatures in favor	431	552	738	669
Size	Acreage		20,701	28,264	19,620	21,070
Congress' decision	Dependent variable	Proportion of roadless area designated	0.54	0.21	0.05	0.14
Observations	629 roadless areas inventoried during RARE II					
Forest Service Recommendations	Wilderness: 84 areas Further Planning: 95 areas Non-wilderness: 450 areas					

$$
\begin{aligned}
Proportion\ Designated_i \\
&= \beta_0 + \beta_1 \log(Acres)_i + \beta_2\ Wilderness\ Signatures_i \\
&+ \beta_3\ Further\ Planning\ Signatures_i + \beta_4\ Nonwilderness\ Signatures_i \\
&+ \beta_5 WARS_i + \beta_6 DORS_i + \beta_7 Grazing_i + \beta_8 Potential\ Yield_i \\
&+ \beta_9 Motorized\ Recreation_i + \beta_{10} Nonmotorized\ Recreation_i \\
&+ \beta_{11} Highest\ Mineral\ Rating_i + \beta_{12} FS\ Recommend\ Wilderness_i \\
&+ \beta_{13} FS\ Recommend\ Nonwilderness_i + \gamma_i + \varepsilon_i
\end{aligned}
$$

The model is similar to Phase 1, with the addition of two dummy variables representing the Forest Service's recommendation. The explanatory variable *FS Recommend Wilderness*$_i$ is assigned a value of 1 if the Forest Service recommended the roadless area to become wilderness in RARE II and 0 otherwise. Likewise, *FS Recommend Nonwilderness*$_i$ is equal to 1 if the Forest Service recommended the roadless area as non-wilderness in RARE II. A similar variable for the further planning recommendation is omitted to avoid singularity. Forest Service regional fixed effects are expressed as γ_i. The model in Phase 2 is first estimated using ordinary least squares. Because a large number of observations (70 percent) were left censored at zero, a tobit model is also estimated.

The estimated coefficient for the *FS Recommend Wilderness*$_i$ dummy variable is expected to be positive because the purpose of the Forest Service's wilderness recommendations in RARE II was to inform the wilderness designation decisions by Congress. Likewise, the estimated coefficient for the *FS Recommend Nonwilderness*$_i$ variable is expected to be negative. The expected signs of the estimated coefficients for the other independent variables in Phase 2 are identical to the predictions made in Phase 1.

The political economy analyses in phases 1 and 2 are distinct from earlier studies of RARE II in a number of ways. First, previous studies examined RARE II data from only a few states (Booth 1991; Mohai 1987). This thesis examines RARE II data from all western states in Forest Service regions 1-6, which allows for a more comprehensive understanding of the Forest Service's wilderness selection process. Second, Phase 2 examines the wilderness selection actions of Congress following RARE II. Earlier studies, with the exception of Booth (1991), neglect the decisions of Congress, which ultimately designates wilderness areas.[20] This study is the first to use geospatial data to determine the variables that influence Congress' decision to designate wilderness. The introduction of geospatial data enables the creation of an accurate data set that measures the number and proportion of RARE II roadless areas that were designated wilderness by 2010. Third, the purpose of analyzing the wilderness selection decisions from RARE II in this thesis is to obtain testable predictions of the economic consequences of wilderness designations. Earlier studies limit their analysis to competing theories of Forest Service agency behavior and neglect the economic implications of RARE II.

The goals of the political economy analysis in this study are twofold. First, the RARE II data are used to test the theory that the Forest Service and Congress act as political arbitrators between competing interest groups in their wilderness selection decisions. Second, the results from these analyses are used to derive testable predictions of the economic consequences of wilderness designations, as modeled in Phase 3. If the

[20] Booth (1991) limits his examination of the congressional wilderness selection process to Washington and Oregon, and only examines wilderness designations that occurred in 1984. In addition, the study does not include data on the nonrenewable resource potential of roadless areas.

Forest Service and Congress are found to effectively balance competing interest groups, then the predicted economic effects from wilderness designation will not be large.

Phase 3: Economic Consequences of Wilderness Designation

In order to assess the economic consequences of wilderness designation, geospatial data on wilderness areas were acquired from the Wilderness Institute at the University of Montana and supplemented with information on the date of creation, as well as the date and amount of any alterations legislated to existing wilderness areas. Using ArcGIS, a balanced county-level panel data set of wilderness acreage in western counties was created.[21] The panel data set consists of annual observations of 408 western counties from 1969 to 2010.[22] Descriptive statistics for the Phase 3 data set are presented in Table 5. The amount of wilderness acreage in a county is expressed as a proportion of the county's total area. This proportion is calculated twice, once using wilderness areas managed by all federal agencies and again using only wilderness areas managed by the Forest Service. In the 11 western states examined, 56 percent of counties have wilderness managed by at least one federal agency in 2010, and 49 percent have wilderness managed by the Forest Service. Fixed effects models are estimated to determine the effect of wilderness designation on per capita income, employment, population, and average wage

[21] A challenge arose when dealing with the minority of wilderness areas (16%) that were altered from their original designations: Data on the boundaries of wilderness areas are only available as they existed in 2010. Therefore, for wilderness areas that span multiple counties, it could not be determined in which county the alterations were made. To deal with this measurement problem, the current distribution of acreage across counties for wilderness areas with alterations was calculated and the ratio was held constant for any alterations made in previous years.

[22] Data from new counties that were formed out of existing counties during the sample period were combined. La Paz County and Yuma County, Arizona were combined; Cibola County and Valencia County, New Mexico were combined; and Adams County, Boulder County, Jefferson County, Weld County, and Broomfield County, Colorado were combined.

per job. Data on county-level economic outcomes are compiled from the U.S. Bureau of Economic Analysis. All income figures are adjusted for inflation and are reported in 2010 dollars. The fixed effect model is described in the following equation:

$$Y_{it} = \alpha + \beta_0 X_{it} + \beta_1 trend_i + \gamma_i + \delta_t + \varepsilon_{it}$$

Table 5: County-Level Wilderness Panel Summary Statistics.

Variable	Mean	Min	Max	Standard Deviation
Proportion Wilderness (all agencies)	0.04	0	0.62	0.075
Proportion Wilderness (Forest Service only)	0.03	0	0.49	0.063
Proportion Wilderness (agency other than Forest Service)	0.01	0	0.57	0.037
Total Acres of Wilderness (all agencies, 1000s of acres)	74.279	0	4,075.077	232.362
Total Acres of Wilderness (Forest Service only, 1000s of acres)	53.871	0	2,196.167	150.371
Total Acres of Wilderness (agency other than Forest Service, 1000s of acres)	20.407	0	3,694.214	166.261
Per capita income	27,010	6,899	131,925	9932.71
Population	125,467	202	9,826,773	511496.9
Employment	55,472	43	4,517,783	240106.3
Average wage per job	32,214	16,783	91,603	10285.06
Number of counties	408			
Number of observations (1969-2010)	17,136			
% of counties with wilderness by 2010	56% (all agencies), 49% (Forest Service only)			
% of counties with wilderness for entire sample period	23% (all agencies), 23% (Forest Service only)			
% of counties without wilderness for part of sample period, and then with wilderness for part	33% (all agencies), 26% (Forest Service only)			
% of counties without wilderness for entire sample period	44% (all agencies), 51% (Forest Service only)			

Note: Panel data set from 1969 to 2010 for the 408 counties in 11 western states: Arizona, California, Colorado, Nevada, Oregon, Washington, Idaho, Montana, New Mexico, Utah, and Wyoming.

The dependent variable, Y_{it}, represents the economic outcome (e.g. per capita income, population, employment, or average wage per job) in county *i* in year *t*. The independent variable, X_{it}, is the wilderness metric of interest. This variable is measured as the proportion of the county designated wilderness in a given year. The $trend_i$ variable is a county-specific linear time trend. County fixed effects are expressed as γ_i and year fixed effects as δ_t.

Recall from the discussion of natural amenities and regional economic growth that the expected sign on the wilderness variable is ambiguous. While wilderness designations may provide natural amenities that promote economic growth, the presence of natural amenities may result in lower wages, higher levels of unemployment, and higher land rental rates, as predicted by the theory of compensating differentials. Moreover, wilderness designations may hinder growth in extractive industries that would have developed the resources within wilderness areas in the absence of their designations. Thus, the estimated coefficient on X_{it} is ambiguous *a priori*.

The results from the political economy analyses of the Forest Service and Congress, however, may provide predictions for Phase 3. If the Forest Service and Congress are influenced by competing interest groups, but are able to select areas for designation that have high wilderness attributes and also have low development potential, then the expected economic consequences of wilderness designation are likely to be insignificant. That is, if the Forest Service and Congress act as political arbitrators between wilderness advocates and commodity developers in their wilderness selection decisions, and the wilderness attributes of a roadless area are not correlated with its

development potential, then wilderness areas will be selected such that they do not impose significant costs or benefits on local economies. If this finding holds, the estimated coefficient for X_{it} is expected to be statistically and economically insignificant.

CHAPTER 5

RESULTS

Phase 1: Forest Service Wilderness Selection

A series of linear and nonlinear regression models are estimated in Phase 1 to determine the variables that influenced the Forest Service's decision to recommend a roadless area for inclusion into the wilderness system. The dependent variable is equal to 1 if the area was recommended by the Forest Service as wilderness and 0 otherwise. Table 6 displays results from Phase 1. To limit the dependent variable to a binary form, roadless areas that were recommended as further planning were excluded in some specifications (model 1 and 5) and coded as either wilderness or non-wilderness in other specifications (models 2 – 4).

Model 1 presents the results from a linear probability model. Because 18 percent of the predicted probabilities from the linear probability model are less than zero, logit models are also estimated. Models 2 – 4 offer various logit specifications, each treating the further planning category differently: Model 2 excludes the further planning category, model 3 codes further planning as wilderness, and model 4 codes further planning as non-wilderness. The results are generally robust to the various treatments of the further planning category, which consist of just 12 percent of the RARE II recommendations made in western states. The estimated coefficients in Table 6 suggest that signatures in favor of wilderness designations and the Wilderness Attribute Rating (WARS) are positive and statistically significant determinants of the Forest Service's recommendation

of an area as wilderness. The Development Opportunity Rating (DORS) and grazing potential of a roadless area are statistically significant negative determinants. In at least one model specification, the potential sawtimber yield, highest mineral rating, non-wilderness signatures, and further planning signatures are also statistically significant negative determinants of wilderness recommendation.

Table 6: Forest Service Wilderness Selection Process.

Dependent variable: Wilderness recommendation (= 1 if wilderness, = 0 otherwise)

Independent Variables	**Model 1 LPM**	**Model 2 Logit**	**Model 3 Logit**	**Model 4 Logit**	**Model 5 Logit**
Constant	-0.546 ***	-9.809 ***	-9.068 ***	-7.979 ***	-8.040 ***
	(0.118)	(1.040)	(0.816)	(0.930)	(1.985)
Log(Acres)	-0.013	-0.071	0.109 *	-0.171 **	-0.261 *
	(0.011)	(0.078)	(0.064)	(0.071)	(0.151)
Wilderness Signatures (1,000s)	0.074 ***	0.631 ***	0.482 ***	0.592 ***	0.886 ***
	(0.011)	(0.095)	(0.078)	(0.088)	(0.219)
Further Planning Signatures (1,000s)	-0.018 **	-0.592 **	-0.168	-0.636 **	-1.047 *
	(0.009)	(0.264)	(0.149)	(0.267)	(0.569)
Non-wilderness Signatures (1,000s)	-0.010	-0.058	-0.168 ***	-0.033	-2.497 ***
	(0.007)	(0.067)	(0.063)	(0.064)	(0.546)
Wilderness Attribute Rating	0.042 ***	0.415 ***	0.339 ***	0.369 ***	0.521 ***
	(0.003)	(0.035)	(0.026)	(0.032)	(0.072)
Development Opportunity Rating (0-15)	-0.006 ***	-0.081 ***	-0.055 ***	-0.077 ***	-0.080 *
	(0.002)	(0.021)	(0.016)	(0.020)	(0.044)
Grazing (1,000 AUMs)	-0.010 ***	-0.154 **	-0.059 **	-0.128 **	-0.534 ***
	(0.004)	(0.062)	(0.037)	(0.061)	(0.202)
Potential Yield (1,000,000 bf)	-0.001	-0.012	-0.035 **	0.001	0.054
	(0.002)	(0.017)	(0.017)	(0.016)	(0.056)
Motorized Recreation (1,000 visitors)	-0.001	-0.007	0.009	-0.017	0.040
	(0.003)	(0.024)	(0.016)	(0.022)	(0.054)
Nonmotorized Recreation (1,000 visitors)	0.001	0.005	0.008	0.004	0.035 **
	(0.003)	(0.005)	(0.006)	(0.005)	(0.015)
Highest Mineral Rating	-0.000	-0.006 *	-0.004	-0.005 *	-0.019 **
	(0.000)	(0.003)	(0.003)	(0.003)	(0.008)
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	1428	1428	1621	1621	534
Adjusted R-squared	0.224	-	-	-	-

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Data set includes all RARE II roadless areas in Forest Service regions 1 – 6.

Model 1 presents the results from a linear probability model. Because 18 percent of the predicted probabilities from the linear probability model are less than zero, logit models are also estimated. Models 2 – 4 offer various logit specifications, each treating the further planning category differently: Model 2 excludes the further planning category, model 3 codes further planning as wilderness, and model 4 codes further planning as non-wilderness. The results are generally robust to the various treatments of the further planning category, which consist of just 12 percent of the RARE II recommendations made in western states. The estimated coefficients in Table 6 suggest that signatures in favor of wilderness designations and the Wilderness Attribute Rating (WARS) are positive and statistically significant determinants of the Forest Service's recommendation of an area as wilderness. The Development Opportunity Rating (DORS) and grazing potential of a roadless area are statistically significant negative determinants. In at least one model specification, the potential sawtimber yield, highest mineral rating, non-wilderness signatures, and further planning signatures are also statistically significant negative determinants of wilderness recommendation.

The statistical significance of the wilderness signatures variable in the models presented in Table 6 suggests that pro-wilderness interest groups influenced wilderness selection decisions by the Forest Service. Commodity groups and wilderness advocates gathered public input from their supporters in an attempt to influence the Forest Service's decisions during RARE II. Both groups are represented in the sample of letters presented in the RARE II document (see Appendix V of *Final Environmental Statement* 1979). The non-wilderness signature variable provides mixed evidence for whether input from

groups opposed to wilderness designation influenced the Forest Service. In model 3 (in which the further planning category is coded as wilderness) and model 5 (described below), the estimated coefficient on the non-wilderness signature variable is negative and statistically significant. In models 1, 2, and 4, however, the variable is not statistically significant at conventional levels. Thus, based on the signature data from RARE II, there is evidence that wilderness advocacy interest groups influenced the Forest Service's recommendations, but less evidence that non-wilderness interest groups had similar influence.

The estimated coefficients on the signature variables in Table 6 can be used to test the first null hypothesis that the Forest Service was not influenced by constituent interest groups. Although in some models $Nonwilderness\ Signatures_i$ is not a statistically significant predictor of the Forest Service's recommendation, the statistical significance of $Wilderness\ Signatures_i$ provides evidence that pro-wilderness groups influenced the agency. This result leads to the rejection of the first null hypothesis in favor of the first alternative hypothesis, which states that interest groups influenced the Forest Service's wilderness selection decisions.

By rejecting the first null hypothesis, the second set of hypotheses can now be examined. These hypotheses largely correspond to Stigler (1971) and Peltzman's (1976) theories of regulation. The models in Table 6 provide support for the theory that the Forest Service behaved as a political arbitrator between competing interest groups in its wilderness selection decisions. The positive and statistically significant coefficient on the wilderness signature variable indicates that wilderness recommendations by the Forest

Service were consistent with public input from wilderness advocates. In addition, the positive and statistically significant coefficient on WARS suggests that the agency recommended lands with high levels of wilderness attributes. Although the non-wilderness signature variable is not statistically significant in models 1, 2, and 4, the negative and statistically significant coefficients on the DORS, grazing, and mineral rating variables suggest that wilderness selection by the Forest Service was also consistent with the interests of commodity development groups. Higher DORS ratings are associated with a lower probability that a roadless area was recommended as wilderness. This suggests that the Forest Service avoided recommending areas that had high resource potential that could be developed with benefits in excess of costs. Areas with high potential for livestock grazing were also less likely to be recommended, as well as areas with high ratings for at least one form of mineral development.[23] Potential sawtimber yield is not found to be a statistically significant predictor of the Forest Service's recommendation in model 2. In model 3, however, the potential yield variable is statistically significant and negative. The results in Table 6 provide evidence that, by appealing to the interests of both wilderness advocates and groups in favor of commodity development during RARE II, the Forest Service balanced competing interest groups in its wilderness selection decisions. These finding lead to the rejection of the second null hypothesis that the Forest Service served the interests of a single large group in favor of

[23] Although existing grazing operations were often permitted to continue in wilderness areas, they were subject to reductions in grazing intensity by the Forest Service. Existing mining operations were allowed to continue only until 1984 and were subject to regulations governing ingress and egress (Coggins et al. 2002).

the alternative hypothesis that the agency attempted to balance competing interests in a manner similar to Peltzman's model of regulation.

The ability of the Forest Service to balance the demands of competing interest groups during RARE II depends on the extent to which the groups' interests are in conflict. If areas with high wilderness qualities are also the same areas with high resource potential, the agency's ability to arbitrate between competing groups is limited. If the areas desired by the two competing groups differ, then the agency can effectively arbitrate and avoid conflict. The correlation matrix of RARE II variables in Table 3 provides some evidence that the Forest Service was able to engage in effective interest group arbitration. The correlation between the WARS and DORS variables, both of which are statistically significant predictors of Forest Service recommendations, is -0.01. This suggests that the Forest Service was able to appease wilderness advocates by recommending areas with high levels of wilderness attributes without compromising the interests of resource development groups, which preferred areas with high DORS ratings to be recommended as non-wilderness. The correlation between WARS and grazing potential is -0.04 and the correlation between WARS and mineral ratings is 0.03. In addition, areas with large amounts of public support for wilderness designation are not highly correlated with areas with high development potential. Wilderness signatures are only slightly correlated with DORS at 0.14, and the correlation is even lower with grazing or mineral ratings.

The correlation matrix in Table 3 provides evidence that, for many of the wilderness selection decisions made by the Forest Service in RARE II, the possibility of

balancing competing interest group demands was feasible. The lack of correlation between these two variables, however, does not suggest that all selection decisions were made easily or without dispute. A strong negative correlation between development potential and wilderness attributes would allow for the most effective balancing of competing groups. In that case, the demands of competing groups would not conflict and wilderness selection decisions would be straightforward. Nevertheless, a lack of correlation between the development potential of a roadless area and its wilderness attributes implies that wilderness selection decisions for many roadless areas could be made such that the demands of both groups were sufficiently met.

The results from Phase 1 provide support for Culhane's view that the Forest Service attempts to forge compromises between competing constituencies in a manner consistent with Peltzman's model. The agency's ability to appeal to the desires of both wilderness advocates and commodity developers only improved its ability to strike a valid political balance between competing groups and reaffirm its multiple-use mission. The result is reminiscent of Culhane's explanation for the Forest Service's desire to balance competing interest groups. To conclude his detailed analysis of interest group influences on the Forest Service, Culhane explains that the Forest Service "thus find themselves in a fortuitous position in which all criteria of administrative responsibility converge. They have so arranged matters that the political necessity of responding to their multiple clienteles reinforces the dictates of their professional expertise and statutory mandates" (341). As Culhane concludes, "Most agencies in the federal bureaucracy are not so fortunate" (341). The public participation programs required by NEPA, as

incorporated into the RARE II process, further aided the agency's ability to anticipate conflict and balance opposing groups.

While the resource development potential of most roadless areas is not correlated with the area's suitability for wilderness designation, some areas possess both high wilderness attributes and development potential. Table 7 presents results from a linear probability model of roadless areas that are in the top quartiles of both WARS and DORS ratings. Roadless areas recommended to the further planning category are omitted to preserve the binary form of the dependent variable. The WARS variable is a statistically significant positive predictor of wilderness recommendation and the DORS rating is a statistically significant negative predictor of recommendation. The magnitude of these coefficients is identical. Thus, a one-unit increase in the WARS rating is associated with a 9 percent increase in the probability that the Forest Service recommended the area as wilderness and a one-unit increase in an area's DORS rating decreases the probability the area will be recommended as wilderness by an equal percentage. The remaining independent variables are not statistically significant at conventional levels. By giving approximately equal weight to marginal increases in WARS and DORS ratings among these roadless areas, the Forest Service's behavior appears consistent with the theory of interest group arbitration. That is, in the roadless areas that have high wilderness attributes and development potential, and thus the highest potential for interest group conflict, the agency's recommendations appear to forge compromises between groups by making recommendations based their relative WARS and DORS ratings.

Table 7: Forest Service Wilderness Selection Process – Top Quartiles of WARS and DORS.

Dependent variable: Wilderness recommendation (= 1 if wilderness, = 0 otherwise)	
Independent Variables	**Model 1 LPM**
Constant	-0.593 (1.010)
Log(Acres)	-0.023 (0.053)
Wilderness Signatures (1,000s)	0.024 (0.042)
Further Planning Signatures (1,000s)	-0.006 (0.105)
Non-wilderness Signatures (1,000s)	0.007 (0.058)
Wilderness Attribute Rating	0.093 *** (0.033)
Development Opportunity Rating (0-15)	-0.093 ** (0.037)
Grazing (1,000 AUMs)	0.003 (0.015)
Potential Yield (1,000,000 bf)	-0.003 (0.025)
Motorized Recreation (1,000 visitors)	-0.011 (0.019)
Nonmotorized Recreation (1,000 visitors)	0.000 (0.034)
Highest Mineral Rating	-0.003 (0.002)
Region Fixed Effects	Yes
Observations	110
Adjusted R-squared	0.254
Fitted values <0 or >1	8

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'
Note: Data set includes all RARE II roadless areas that are in the top quartiles for both WARS and DORS ratings.

Successful interest group arbitration by the Forest Service implies that the economic consequences associated with the areas recommended for wilderness designation will likely be insignificant if adopted by Congress. That is, if wilderness areas are unproductive for resource development then designations are unlikely to impose economic costs on local communities. The wilderness selection decisions by the Forest Service, however, do not result in formal designations. Only Congress can designate wilderness and, therefore, any political economy study of wilderness selection must take into account the actions of Congress with respect to wilderness selection.

Phase 2: Congressional Wilderness Selection

Phase 2 extends the analysis in Phase 1 to congressional decisions over wilderness designations. Using the sample of roadless areas from RARE II for which geospatial data were available (as described in the data section), the proportion of each roadless area that received wilderness designation by 2010 is calculated using geospatial software. Descriptive statistics for this sample of roadless areas are presented in Table 4. Model 5 in Table 6 repeats the Phase 1 regression for Forest Service wilderness selection (dropping the further planning category) to ensure that the sample for which geospatial data were available is representative of all western states. The levels of statistical significance of each coefficient are similar to those found in models 1 – 4, indicating that the sample of roadless areas examined in Phase 2 are representative of all western states.

The results from Phase 2 are presented in Table 8. The dependent variable is the proportion of a roadless area inventoried during RARE II that was designated wilderness

by 2010.[24] Model 1 presents output from an OLS regression on the same set of explanatory RARE II variables as used in Phase 1. Model 2 includes two additional dummy variables indicating the Forest Service's recommendation in RARE II. Because 442 of the 629 roadless areas in this RARE II sample were never designated wilderness, the regressions from models 1 and 2 are estimated using a tobit and are shown in models 3 and 4. Models 5 and 6 include only the dummy variables indicating the Forest Service's recommendation in RARE II and are estimated using OLS and a tobit model, respectively.

Roadless areas recommended as wilderness by the Forest Service during RARE II are found to be influential in eventual congressional designations (see models 2, 4, 5, and 6). The positive and statistically significant coefficient on the Forest Service's wilderness recommendation dummy variable in model 2 suggests that a roadless area recommended as wilderness by the Forest Service is associated with an increase of 0.345 in the proportion of the roadless area that is designated wilderness by 2010. Non-wilderness recommendations are likewise significant negative determinants of eventual designations. The influence of the Forest Service on Congress' wilderness decisions is not surprising if the Forest Service had a considerable information advantage over Congress with respect to the individual characteristics of roadless areas. The results presented in models 1 and 3 are similar to those found in Table 6 in Phase 1. Wilderness signatures and WARS are found to be statistically significant positive predictors of the proportion of a roadless area

[24] After the RARE II report, Congress did not introduce the Forest Service's recommendations as omnibus wilderness legislation, but gradually passed state-specific wilderness acts in the years that followed (Allin 1982). During this process, boundary adjustments to proposed wilderness areas were often made. Therefore, the dependent variable in Phase 2 is no longer binary as in Phase 1, but is measured as the proportion of a roadless area that was designated wilderness.

designated wilderness. Non-wilderness signatures are found to be statistically significant negative predictors of the amount of a roadless area designated wilderness. In at least one specification, the DORS rating, grazing potential, and highest mineral rating are found to be statistically significant negative predictors of wilderness designation.

Table 8: Congressional Wilderness Selection Process.

Dependent variable: Proportion of roadless area designated wilderness in 2010

Independent Variables	**Model 1 OLS**	**Model 2 OLS**	**Model 3 Tobit**	**Model 4 Tobit**	**Model 5 OLS**	**Model 6 Tobit**
Constant	0.168	0.240 *	-0.322	0.218	0.063	-0.130 *
	(0.154)	(0.136)	(0.366)	(0.329)	(0.039)	(0.075)
Log(Acres)	-0.032 **	-0.013	-0.071 **	-0.044		
	(0.013)	(0.011)	(0.032)	(0.028)		
Wilderness Signatures	0.088 ***	0.055 ***	0.281 ***	0.213 ***		
	(0.018)	(0.016)	(0.046)	(0.040)		
Further Planning Signatures	0.010	0.026 **	0.067	0.137 ***		
	(0.011)	(0.011)	(0.046)	(0.041)		
Non-wilderness Signatures	-0.048 **	-0.004	-0.375 ***	-0.205 ***		
	(0.024)	(0.021)	(0.071)	(0.062)		
Wilderness Attribute Rating	0.011 **	-0.004	0.050 ***	0.009		
	(0.004)	(0.004)	(0.013)	(0.011)		
Development Opportunity Rating	-0.008 ***	-0.005 *	-0.011	-0.007		
	(0.003)	(0.003)	(0.009)	(0.008)		
Grazing	-0.016 **	-0.010 *	-0.044 *	-0.022		
	(0.007)	(0.005)	(0.024)	(0.020)		
Potential Yield	0.001	-0.001	-0.008	-0.011		
	(0.004)	(0.003)	(0.014)	(0.012)		
Motorized Recreation	0.006 *	0.006 **	0.003	0.004		
	(0.003)	(0.002)	(0.008)	(0.007)		
Nonmotorized Recreation	0.002	0.001	0.009 ***	0.006 **		
	(0.001)	(0.001)	(0.003)	(0.002)		
Highest Mineral Rating	-0.000	0.000	-0.004 ***	-0.002 *		
	(0.000)	(0.000)	(0.001)	(0.001)		
FS Recommend Wilderness		0.345 ***		0.412 ***	0.365 ***	0.585 ***
		(0.062)		(0.103)	(0.059)	(0.099)
FS Recommend Nonwilderness		-0.067 *		-0.373 ***	-0.084 **	-0.397 ***
		(0.040)		(0.084)	(0.040)	(0.082)
Region Fixed Effects	Yes	Yes	No	No	Yes	No
Observations	629	629	629	629	629	629
Adjusted R-squared	0.213	0.356	-	-	0.332	-
Log likelihood	-	-	-358.7	-320	-	-354.6

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

The wilderness selection processes by the Forest Service and Congress are likely to differ. Booth (1991) argues that, relative to Congress, the Forest Service is more politically insulated from interest group influence and therefore less interested in considering public input. While wilderness signatures clearly influenced the Forest Service's recommendations in Phase 1, the statistical significance of both wilderness and non-wilderness signatures in Phase 2 provides support for Booth's argument. Because Congress is likely to be more influenced by interest groups than the Forest Service, the role of political arbitration between competing groups is arguably more prominent in Congress' wilderness selection decisions. Given that wilderness areas could be designated so as to appease both wilderness advocates and commodity development interests, the results in Phase 2 provide further evidence that wilderness designations were unlikely to be made in areas that were productive for resource development. Moreover, because Congress' wilderness selection decisions lead to formal wilderness designations, this finding suggests that the political economy of wilderness results in wilderness areas being designated such that the costs they impose on local economies are limited. The result from Phase 1 and 2 that the Forest Service and Congress were able to effectively arbitrate between competing constituent groups in their wilderness selection decisions yields a testable prediction of the economic consequences of wilderness designation: If wilderness designations generally occur in areas with high wilderness attributes but low development potential, as indicated by phases 1 and 2, then the economic costs associated with wilderness designations will be insignificant. This hypothesis is tested in Phase 3 below.

While the wilderness selection process may bias designations toward areas that do not impose significant economic costs, the wilderness policy may have certain benefits to local economies. As discussed before, wilderness designation does not create new natural amenities, but protects existing amenities found in wilderness areas. The policy of wilderness designation, therefore, could provide an important signal about the continued preservation of the natural amenities within a wilderness area's boundaries.

Phase 3: Economic Consequences of Wilderness Designations

As a preliminary investigation into the effect of wilderness on economic outcomes, Figure 6 compares average county growth rates between 1969 and 2010 for counties with and without wilderness areas. The average growth rates in per capita income, population, and employment are higher for counties with wilderness areas than for counties without wilderness areas. The growth rate in average wage per job is 4 percent higher for counties without wilderness than for counties with wilderness. If counties with wilderness areas, in general, grow faster than counties without wilderness areas, the comparisons in Figure 6 provide initial support for the claim that wilderness designations contribute to economic growth. Further support is provided by simple cross-sectional regressions of county growth rates from 1969 to 2010 on the proportion of a county designated wilderness in 2010. The results from these regressions are presented in Table 9 and include specifications for wilderness areas managed by any federal agency and wilderness areas managed by the Forest Service only. The proportion of a county designated wilderness in 2010 is found to be a positive and statistically significant

predictor of per capita income, population, and employment growth rates from 1969 to 2010 in at least one specification for each outcome variable. The statistically significant negative coefficient in the average wage specifications suggests that wilderness is a negative predictor of growth in average wage per job.

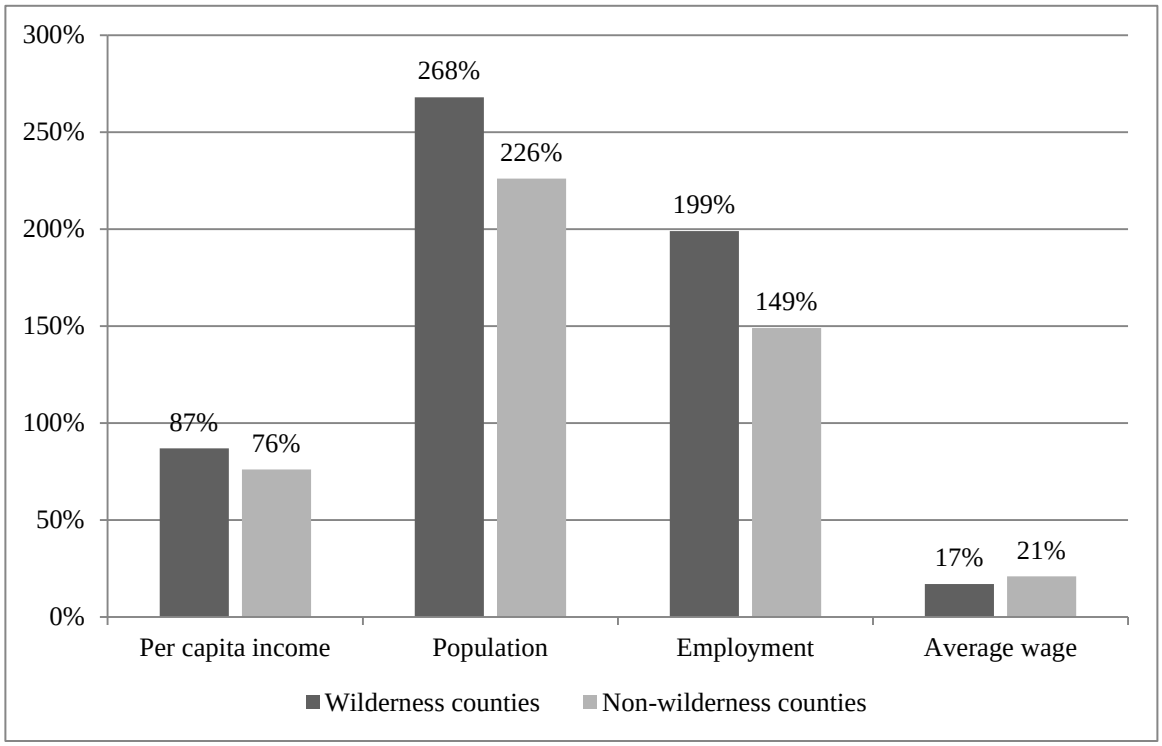

Figure 6: Wilderness vs. Non-wilderness County Growth Rates (1969-2010).

The relationship between county growth rates and wilderness areas suggests that, for most economic outcomes, the presence of wilderness areas is associated with economic growth. This preliminary analysis supports the correlation established in earlier work between wilderness and income, population, and employment growth (Lorah and Southwick 2003; Holmes and Hecox 2004). The negative relationship between wilderness and average wages, however, suggests that the results from such analyses are

sensitive to different measures of income. Per capita income is measured as the sum of income received by a person from all sources, including personal dividend and interest income, as well as transfers. Average wage per job is measured as the total of wage and salary disbursements divided by total wage and salary employment and does not include non-wage income. The increasing influence of non-labor income in rural western economies suggests that distinguishing between these two income measures is important (Power 1991; Power and Barrett 2001). The results from the preliminary correlation and cross-sectional regression analyses in Figure 6 and Table 9 suggest that the presence of wilderness may be associated with per capita income growth, which includes non-labor income, but reduced average wage per job. The opposing relationships between wilderness and the two income measures may partially explain the source of public disagreement over the economic effects of wilderness. In addition, the theory of compensating differentials suggests that average wages will be lower in high-amenity areas, but the effect of amenities on non-labor income is less clear.

If counties that contain wilderness areas experience higher levels of per capita income, population, and employment growth relative to counties without wilderness areas, then observers may conclude that wilderness designations drive economic growth. Counties with wilderness areas, however, are also likely to have other attributes that may be the source of economic growth rather than the wilderness policy. These attributes may be associated with counties that contain wilderness areas, but may not be the cause of growth. Using county-level data from McGranahan's (1999) Natural Amenity Index, the average natural amenity rating for counties without wilderness is 2.40, while the average

natural amenity rating for counties with wilderness is 4.52. The natural amenity scale is standardized with a mean of zero and a standard deviation of one. A higher rating on the natural amenity scale indicates a higher level of natural amenities in a county. Thus, counties with wilderness areas are generally counties with higher levels of natural amenities. Growth in counties with wilderness areas, therefore, could be attributed to the presence of natural amenities rather than to wilderness designations per se. By using county-level panel data, a fixed effects model can control for time invariant natural amenity attributes and separate out the effect of the wilderness policy on economic outcomes.

Table 9: Effect of Wilderness on Economic Outcomes – County Growth Rates.

Outcome variable	**Variable**	**Any Agency Wilderness**	**Forest Service Wilderness**
Per capita income	Intercept	0.794 ***	0.786 ***
		(0.023)	(0.022)
	Proportion County in Wilderness in 2010	0.454 **	0.837 ***
		(0.213)	(0.266)
	Adjusted R-squared	0.009	0.021
Population	Intercept	2.244 ***	2.223 ***
		(0.357)	(0.350)
	Proportion County in Wilderness in 2010	4.688	6.940 *
		(3.333)	(4.186)
	Adjusted R-squared	0.002	0.004
Employment	Intercept	1.532 ***	1.539 ***
		(0.222)	(0.218)
	Proportion County in Wilderness in 2010	4.339 **	5.736 **
		(2.074)	(2.606)
	Adjusted R-squared	0.008	0.009
Average Wage	Intercept	0.201 ***	0.200 ***
		(0.012)	(0.012)
	Proportion County in Wilderness in 2010	-0.254 **	-0.330 **
		(0.112)	(0.141)
	Adjusted R-squared	0.010	0.011

Significant. codes: 0.01 '***', 0.05 '**', 0.1 '*'
Note: Growth rates calculated for 408 western counties between 1969 and 2010.

Results from the various fixed effect models in Phase 3 are presented in Tables 10 – 25. County fixed effects, year fixed effects, and county-specific linear time trends are included where specified. For all specifications in Phase 3, F-tests for joint significance of the county and year fixed effects reject the null hypothesis of no effects. To account for different error structures in county economic outcomes, standard errors are clustered at the county level (Bertrand, Duflo, and Mullainathan 2004).[25] Results are first presented in Tables 10, 14, 18, 22 with the proportion of a county designated wilderness (the dependent variable) calculated two ways: first with wilderness managed by any federal land agency and then with wilderness managed by the Forest Service only. The correlation between these two wilderness measurements in the panel is 0.873. The remaining tables present the results with the proportion of a county designated wilderness managed by the Forest Service and the proportion of a county designated wilderness managed by agencies other than the Forest Service as separate explanatory variables to test whether there are varying effects from wilderness managed by the different federal land agencies. As a robustness check, appendix B presents results from similar regressions with wilderness measured as the number of wilderness acres in a county rather than as a proportion of the total county area.

Wilderness areas managed by the Forest Service provide the most interesting form of wilderness to examine for two reasons. First, the majority of wilderness in the contiguous United States is managed by the Forest Service (see Figure 1). Second, wilderness areas designated on Forest Service lands have a higher opportunity cost than

[25] Standard errors were also double clustered on county and year, following Thompson (2011). The results from double clustering were found to be very similar to the single-clustered standard errors presented.

wilderness areas designated by other federal land agencies. That is, if an area administered by the Forest Service was not designated wilderness, it could be available for timber harvesting, mineral exploration, livestock grazing, or other forms of multiple-use management. By contrast, wilderness administered by the National Park Service or the Fish and Wildlife Service have a lower opportunity cost. Lands administered by those agencies are not available for resource development in the absence of wilderness designation (Roth 1984).[26] Useful insights may be gained from separately estimating the effects of wilderness managed by different agencies.

The effect of wilderness on per capita income is examined in Tables 10 – 13 The dependent variable in these regressions is the natural log of per capita income, except in model 5, where the dependent variable is expressed in levels. In Tables 10 and 11, results are presented with and without linear time trends and fixed effects. Estimated coefficients for the proportion of the county designated wilderness are statistically significant in the models without either time trends or fixed effects included (columns 1 – 3) and larger than the model with both fixed effects and time trends included (column 4). The coefficients in the models with fixed effects and time trends (columns 4 and 5) are not statistically significant for either of the specifications in Table 10.

In models 4 and 5 in Table 11, the coefficient on the wilderness variable that measures wilderness managed by the Forest Service is not statistically significant, while

[26] It could be argued that wilderness areas administered by the Bureau of Land Management (BLM) also have a high opportunity cost because they are eligible for multiple-use management in the absence of wilderness designation. Significant wilderness designations did not occur on BLM lands until the late 1970s and today make up less than 20 percent of wilderness in the contiguous United States. The effect of BLM wilderness is measured jointly with the wilderness managed by the National Park Service and the Fish and Wildlife Service in Phase 3.

the coefficient on the variable that measures wilderness managed by an agency other than the Forest Service is statistically significant. This suggests that failing to control for county and year fixed effects or preexisting county time trends overstates the economic effect associated with wilderness on per capita income. Focusing on the specifications that control for county fixed effects, year fixed effects, and county-specific time trends (columns 4 and 5 in Tables 10 and 11), the statistically insignificant coefficients on the proportion of a county designated wilderness by the Forest Service suggest that Forest Service wilderness designations do not have a measurable effect on per capita income. This result provides some evidence in support of the prediction derived in the political economy analyses during Phases 1 and 2 that wilderness designations do not significantly impact local economic outcomes.

Table 10: Effect of Wilderness on Per Capita Income.

	(1) Without linear time trends		(2) Without linear time trends		(3) With linear time trends		(4) Dependent variable logged		(5) Dependent variable not logged	
	Any Agency	**Forest Service**	**Any Agency**	**Forest Service**	**Any Agency**	**Forest Service**	**Any Agency**	**Forest Service**	**Any Agency**	**Forest Service**
Proportion of County Designated Wilderness	0.713 *** (0.141)	0.729 *** (0.195)	0.278 *** (0.093)	0.552 *** (0.153)	-0.201 ** (0.097)	-0.385 *** (0.137)	0.033 (0.071)	0.133 (0.120)	-1876.281 (1888.193)	-491.199 (3173.514)
County Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Linear Time Trends	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.035	0.030	0.009	0.017	0.724	0.692	0.453	0.453	0.626	0.626
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observations	17,136	17,136	17,136	17,136	17,136	17,136	17,136	17,136	17,136	17,136

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented. The dependent variable is the log of per capita income unless stated otherwise. The R-squared presented is the adjusted R-squared for the respective panel model.

Table 11: Effect of Forest Service and Non-Forest Service Wilderness on Per Capita Income.

	(1) Without linear time trends	(2) Without linear time trends	(3) With linear time trends	(4) Dependent variable logged	(5) Dependent variable not logged
(Intercept)	10.140 ***		9.929 ***		
	(0.011)		(0.011)		
Proportion of County Designated Wilderness by the Forest Service	0.699 ***	0.552 ***	-0.136	0.136	-368.581
	(0.197)	(0.153)	(0.139)	(0.120)	(3175.504)
Proportion of County Designated Wilderness by Agency Other Than Forest Service	0.752 ***	0.005	-0.352 ***	-0.097 *	-3790.204 **
	(0.182)	(0.100)	(0.098)	(0.057)	(1690.772)
County Fixed Effects	No	Yes	No	Yes	Yes
Year Fixed Effects	No	Yes	No	Yes	Yes
Linear Time Trends	No	No	Yes	Yes	Yes
Adjusted R-squared	0.040	0.017	0.724	0.453	0.626
p-value	0.000	0.000	0.000	0.000	0.000
Observations	17,136	17,136	17,136	17,136	17,136

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented. The dependent variable is the log of per capita income unless stated otherwise. The R-squared presented is the adjusted R-squared for the respective panel model.

Table 12: Effect of Wilderness on Per Capita Income – Protected Land Quartiles.

	Proportion of County Designated Wilderness	**(1) Dependent variable logged**	**(2) Dependent variable not logged**
1st Quartile	Forest Service	77.181	1489830.363
		(53.317)	(921222.626)
	Other Agency	-0.661	-28740.315 ***
		(0.413)	(9779.255)
	Adjusted R-squared	0.414	0.547
2nd Quartile	Forest Service	-0.057	-3616.776
		(0.502)	(10975.693)
	Other Agency	-0.502 ***	-14813.957 ***
		(0.163)	(4972.104)
	Adjusted R-squared	0.504	0.686
3rd Quartile	Forest Service	-0.206	-9555.903
		(0.277)	(7667.305)
	Other Agency	0.462	14638.890
		(0.454)	(9564.696)
	Adjusted R-squared	0.419	0.517
4th Quartile	Forest Service	0.262 *	4466.446
		(0.138)	(3413.715)
	Other Agency	0.013	328.571
		(0.059)	(1898.472)
	Adjusted R-squared	0.498	0.687

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented. County fixed effects, year fixed effects, and linear time trends included. The first quartile has the least amount of protected land.

Table 13: Effect of Wilderness on Per Capita Income – Natural Amenities Index Quartiles.

Outdoor Amenities	Proportion of County Designated Wilderness	(1) Dependent variable logged	(2) Dependent variable not logged
1st Quartile	Forest Service	0.137	2885.997
		(0.204)	(7150.233)
	Other Agency	0.204	-2720.876
		(1.065)	(23546.182)
	Adjusted R-squared	0.278	0.285
2nd Quartile	Forest Service	-0.316 *	-5797.228
		(0.182)	(5149.679)
	Other Agency	-0.060	-5649.816
		(0.323)	(6411.322)
	Adjusted R-squared	0.490	0.700
3rd Quartile	Forest Service	-0.098	-5157.265
		(0.148)	(3311.268)
	Other Agency	-0.441 **	-16393.155 ***
		(0.201)	(5287.715)
	Adjusted R-squared	0.520	0.599
4th Quartile	Forest Service	0.221	1615.797
		(0.186)	(5395.494)
	Other Agency	-0.043	-1130.896
		(0.042)	(1454.184)
	Adjusted R-squared	0.563	0.704

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented. County fixed effects, year fixed effects, and linear time trends included. The first quartile has the lowest natural amenity rating.

Tables 12 and 13 examine whether the economic effects of wilderness on per capita income vary across different subsamples of counties. If wilderness designations adversely affect economic outcomes in certain counties, but positively affect economic outcomes in other counties, the coefficients on wilderness in column 4 in Tables 10 and 11 will not capture these varying effects. By splitting western counties into subsamples based on certain characteristics, this possibility can be tested. In Table 12, counties are grouped based on a broader county-level protected lands variable used to measure the proportion of wilderness-like lands within a county. This measurement extends beyond formally designated wilderness lands to include other areas that have wilderness attributes (i.e, do not allow resource development). Because wilderness amenities are assumed to be time invariant across all periods, and therefore were not created but merely protected by federal land laws, this broad protected lands measurement is assumed to be constant. The variable is calculated at the county level as the sum of the acres designated as wilderness managed by the Forest Service in 2001, the acres inventoried as a Forest Service roadless area in 2001, and the acres managed as a national park.[27] The variable is expressed as a proportion of total county acres. Counties are divided into quartiles based on the proportion of protected lands within their boundaries and separate regressions are run on each quartile.[28] Table 12 summarizes the results from these regressions on per capita income with county fixed effects, year fixed effects, and linear time trends

[27] The Forest Service conducted another inventory of roadless areas in 2001 as part of the Roadless Area Conservation Rule, which limited road construction on the remaining Forest Service roadless areas that were not designated as wilderness. The protected status of these roadless areas has been challenged but has generally been upheld (Glicksman 2004). This measurement of roadless areas was used because, unlike the geospatial data from RARE II, geospatial data for all western states were available.

[28] Rasker (2006) relies on a similar protected land county classification system. He finds that public lands protected from resource development are not statistically significant predictors of total personal income growth in a county.

included. The results are largely statistically insignificant and do not suggest a discernible pattern in the different county groupings.

In Table 13, quartiles were created based on the level of natural amenities found in each county, as measured by McGranahan's (1999) natural amenities index. These regressions examine how designating wilderness affects counties with different levels of natural amenities and provide evidence for whether or not the lack of a statistically significant effect in Tables 10 and 11 is an average effect of counties with positive and negative effects. The natural amenities index combines data on average January and July temperature levels, average hours of January sunlight, average relative humidity in July, topography, and the percent of water area found in each county. As in Table 12, the results in Table 13 are largely statistically insignificant and do not indicate a pattern of statistically significant positive and negative effects in different county groupings.

While the results presented in Tables 10 – 13 suggest that Forest Service wilderness areas are not associated with statistically significant effects on per capita income, the economic consequences of wilderness areas managed by agencies other than the Forest Service are less certain. Table 10 provides specifications in which wilderness areas managed by any federal land agency are included. The coefficients on these wilderness variables in the columns 4 and 5 are not statistically significant. In Table 11, wilderness is measured by two explanatory variables, one that measures wilderness managed by the Forest Service and another that measures wilderness managed by any agency other than the Forest Service. In columns 4 and 5, the coefficients on the variable measuring the proportion of a county designated wilderness that is managed by agencies

other than the Forest Service are statistically significant and negative. The coefficient in column 4 (-0.097) suggests that a one standard deviation increase in the proportion of a county designated wilderness managed by any agency other than the Forest Service (equal to 0.037, see Table 5) is associated with a 0.4 percent decrease in per capita income. Stated differently, a 10 percent increase in the proportion of a county designated wilderness managed by agencies other than the Forest Service is associated with a 0.4 percent decrease in per capita income. For the average western county, this corresponds to a decline in per capita income of approximately $108.

The Forest Service manages the majority of the wilderness designated in the contiguous United States (58 percent), but significant amounts of wilderness are also managed by the National Park Service (21 percent) and the Bureau of Land Management (BLM) (17 percent).[29] As discussed earlier, wilderness areas managed by the National Park Service are unlikely to be associated with significant economic effects because the opportunity cost of designation is low relative to the Forest Service (Roth 1984). Wilderness managed by the BLM, however, may have a high opportunity cost because, like the Forest Service, BLM lands that are not designated as wilderness are eligible for multiple-use management. While data similar to RARE II are not available for BLM roadless areas, BLM lands are widely known to possess significant energy development potential, particularly in the southwestern United States. Wilderness designations on energy-rich BLM lands, therefore, could be the source of the negative and statistically significant coefficients found in columns 4 and 5 in Table 11, although the economic

[29] The Fish and Wildlife Service only manages 4 percent of the wilderness designated in the contiguous United States.

significance of the effect is not certain. Moreover, as discussed below, statistically significant effects from non-Forest Service wilderness are not observed for other economic outcomes.

Tables 14 – 25 present similar results for the effect of wilderness on population, employment, and average wage per job. As with per capita income, the coefficients on the proportion of county designated wilderness are generally found to be statistically insignificant in specifications with two-way fixed effects and county-specific time trends included. This finding appears robust to various specifications and county groupings. In addition, the statistically insignificant effect is consistent across different measurements of wilderness, including wilderness managed by agencies other than the Forest Service. Tables 14 – 17 estimate the effect of wilderness on population. Focusing on the coefficients in column 4 on Tables 14 and 15, the statistically insignificant coefficients suggest that population growth is not responsive to changes in the amount of wilderness designated. Likewise, wilderness does not appear to be a reliable, statistically significant predictor of employment (Tables 18 – 21) or average wage per job (Tables 22 – 25). The results are robust to the county quartile groupings discussed in the context of Tables 12 and 13.

Table 14: Effect of Wilderness on Population.

	(1) Without linear time trends		(2) Without linear time trends		(3) With linear time trends		(4) Dependent variable logged		(5) Dependent variable not logged	
	Any Agency	**Forest Service**	**Any Agency**	**Forest Service**	**Any Agency**	**Forest Service**	**Any Agency**	**Forest Service**	**Any Agency**	**Forest Service**
Proportion of County Designated Wilderness	1.001 (1.098)	-0.859 (1.253)	0.792 *** (0.226)	0.768 *** (0.281)	0.250 *** (0.087)	0.401 *** (0.107)	0.099 (0.077)	0.079 (0.112)	7492.823 (21354.804)	944.248 (14219.513)
County Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Linear Time Trends	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.002	0.001	0.022	0.010	0.884	0.884	0.851	0.851	0.922	0.922
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observations	17,136	17,136	17,136	17,136	17,136	17,136	17,136	17,136	17,136	17,136

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented. The dependent variable is the log of population unless stated otherwise. The R-squared presented is the adjusted R-squared for the respective panel model.

Table 15: Effect of Forest Service and Non-Forest Service Wilderness on Population.

	(1) Without linear time trends	(2) Without linear time trends	(3) With linear time trends	(4) Dependent variable logged	(5) Dependent variable not logged
(Intercept)	9.975 ***		9.700 ***		
	(0.090)		(0.082)		
Proportion of County Designated	-1.131	0.732 ***	-0.538	0.074	411.012
Wilderness by the Forest Service	(1.224)	(0.278)	(1.095)	(0.112)	(13516.508)
Proportion of County Designated	6.853 ***	0.852 **	-1.763	0.131	16482.697
Wilderness by Agency Other Than Forest Service	(2.441)	(0.396)	(1.104)	(0.107)	(37462.115)
County Fixed Effects	No	Yes	No	Yes	Yes
Year Fixed Effects	No	Yes	No	Yes	Yes
Linear Time Trends	No	No	Yes	Yes	Yes
Adjusted R-squared	0.022	0.022	0.769	0.851	0.922
p-value	0.000	0.000	0.000	0.000	0.000
Observations	17,136	17,136	17,136	17,136	17,136

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented. The dependent variable is the log of population unless stated otherwise. The R-squared presented is the adjusted R-squared for the respective panel model.

Table 16: Effect of Wilderness on Population – Protected Land Quartiles.

Outdoor Amenities	Proportion of County Designated Wilderness	(1) Dependent variable logged	(2) Dependent variable not logged
1st Quartile	Forest Service	43.834 ***	996795.397 ***
		(16.788)	(225093.874)
	Other Agency	0.379 ***	31806.614 ***
		(1.220)	(10586.692)
	Adjusted R-squared	0.851	0.920
2nd Quartile	Forest Service	-0.489	236120.765
		(0.447)	(187478.201)
	Other Agency	-0.441	106117.358
		(0.314)	(393513.443)
	Adjusted R-squared	0.825	0.915
3rd Quartile	Forest Service	-0.311	-58069.663
		(0.281)	(46979.105)
	Other Agency	1.177 ***	32352.371
		(0.399)	(26822.930)
	Adjusted R-squared	0.870	0.921
4th Quartile	Forest Service	0.235 **	-5744.620
		(0.115)	(11449.378)
	Other Agency	0.223	7643.973
		(0.152)	(6160.559)
	Adjusted R-squared	0.831	0.922

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented. County fixed effects, year fixed effects, and linear time trends included. The first quartile has the least amount of protected land.

Table 17: Effect of Wilderness on Population – Natural Amenities Index Quartiles.

Outdoor Amenities	**Proportion of County Designated Wilderness**	**(1) Dependent variable logged**	**(2) Dependent variable not logged**
1st Quartile	Forest Service	0.407	3328.284
		(0.475)	(7187.783)
	Other Agency	0.781	15849.846
		(0.744)	(25931.067)
	Adjusted R-squared	0.839	0.903
2nd Quartile	Forest Service	-0.283	3517.503
		(0.242)	(11962.120)
	Other Agency	0.227	37560.121
		(0.610)	(37787.743)
	Adjusted R-squared	0.796	0.913
3rd Quartile	Forest Service	0.018	33970.153
		(0.111)	(38069.046)
	Other Agency	0.010	186057.535
		(0.261)	(215624.857)
	Adjusted R-squared	0.819	0.920
4th Quartile	Forest Service	-0.023	-31668.946
		(0.175)	(22659.095)
	Other Agency	0.099	-37298.273
		(0.090)	(26672.389)
	Adjusted R-squared	0.850	0.910

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented. County fixed effects, year fixed effects, and linear time trends included. The first quartile has the lowest natural amenity rating.

Table 18: Effect of Wilderness on Employment.

	(1) Without linear time trends		(2) Without linear time trends		(3) With linear time trends		(4) Dependent variable logged		(5) Dependent variable not logged	
	Any Agency	Forest Service	Any Agency	Forest Service	Any Agency	Forest Service	Any Agency	Forest Service	Any Agency	Forest Service
Proportion of County Designated Wilderness	1.618 (1.099)	-0.041 (1.284)	0.957 *** (0.266)	1.280 *** (0.384)	0.400 ** (0.159)	0.655 *** (0.242)	0.255 * (0.147)	0.375 (0.235)	1162.610 (10062.142)	-12742.996 (10909.979)
County Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Linear Time Trends	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.004	0.000	0.022	0.019	0.840	0.840	0.758	0.758	0.849	0.849
p-value	0.000	0.853	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observations	17,136	17,136	17,136	17,136	17,136	17,136	17,136	17,136	17,136	17,136

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented. The dependent variable is the log of employment unless stated otherwise. The R-squared presented is the adjusted R-squared for the respective panel model.

Table 19: Effect of Forest Service and Non-Forest Service Wilderness on Employment.

	(1) Without linear time trends	(2) Without linear time trends	(3) With linear time trends	(4) Dependent variable logged	(5) Dependent variable not logged
(Intercept)	8.921 ***		8.553 ***		
	(0.095)		(0.088)		
Proportion of County Designated Wilderness by the Forest Service	-0.316	1.253 ***	0.026	0.371	-13377.747
	(1.258)	(0.383)	(1.153)	(0.235)	(10761.933)
Proportion of County Designated Wilderness by Agency Other Than Forest Service	6.928 ***	0.662 **	-1.822	0.108	19620.600
	(2.465)	(0.328)	(1.137)	(0.129)	(16240.057)
County Fixed Effects	No	Yes	No	Yes	Yes
Year Fixed Effects	No	Yes	No	Yes	Yes
Linear Time Trends	No	No	Yes	Yes	Yes
Adjusted R-squared	0.020	0.024	0.765	0.758	0.849
p-value	0.000	0.000	0.000	0.000	0.000
Observations	17,136	17,136	17,136	17,136	17,136

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented. The dependent variable is the log of employment unless stated otherwise. The R-squared presented is the adjusted R-squared for the respective panel model.

Table 20: Effect of Wilderness on Employment – Protected Land Quartiles.

Outdoor Amenities	**Proportion of County Designated Wilderness**	**(1) Dependent variable logged**	**(2) Dependent variable not logged**
1st Quartile	Forest Service	68.528 *	1143907.390
		(35.680)	(1379952.732)
	Other Agency	-0.177	34988.434 ***
		(0.681)	(13400.966)
	Adjusted R-squared	0.752	0.824
2nd Quartile	Forest Service	-0.643	39862.605
		(0.813)	(78965.300)
	Other Agency	-0.746	174983.766
		(0.497)	(141661.037)
	Adjusted R-squared	0.755	0.837
3rd Quartile	Forest Service	-0.533	8110.331
		(0.529)	(17551.604)
	Other Agency	1.749 **	14641.836
		(0.811)	(26729.712)
	Adjusted R-squared	0.738	0.900
4th Quartile	Forest Service	0.675 ***	-247.209
		(0.251)	(4141.756)
	Other Agency	0.281	3273.015
		(0.181)	(3363.526)
	Adjusted R-squared	0.739	0.903

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented. County fixed effects, year fixed effects, and linear time trends included. The first quartile has the least amount of protected land.

Table 21: Effect of Wilderness on Employment – Natural Amenities Index Quartiles.

Outdoor Amenities	Proportion of County Designated Wilderness	(1) Dependent variable logged	(2) Dependent variable not logged
1st Quartile	Forest Service	0.767	6323.308
		(0.844)	(5249.167)
	Other Agency	2.331 ***	23738.291
		(0.549)	(10157.739)
	Adjusted R-squared	0.733	0.899
2nd Quartile	Forest Service	-0.901 **	-8442.803
		(0.429)	(5506.215)
	Other Agency	0.315	22596.816 **
		(1.087)	(10330.690)
	Adjusted R-squared	0.718	0.909
3rd Quartile	Forest Service	0.210	18846.329
		(0.253)	(17067.830)
	Other Agency	-0.462	115128.224
		(0.404)	(80309.710)
	Adjusted R-squared	0.733	0.909
4th Quartile	Forest Service	0.419	-58771.459 *
		(0.354)	(33413.113)
	Other Agency	0.134	-8513.565
		(0.106)	(10268.132)
	Adjusted R-squared	0.751	0.775

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented. County fixed effects, year fixed effects, and linear time trends included. The first quartile has the lowest natural amenity rating.

Table 22: Effect of Wilderness on Average Wage.

	(1) Without linear time trends		(2) Without linear time trends		(3) With linear time trends		(4) Dependent variable logged		(5) Dependent variable not logged	
	Any Agency	Forest Service	Any Agency	Forest Service	Any Agency	Forest Service	Any Agency	Forest Service	Any Agency	Forest Service
Proportion of County Designated Wilderness	-0.009 (0.089)	-0.150 (0.110)	-0.069 (0.071)	-0.084 (0.122)	-0.593 *** (0.114)	-0.823 *** (0.148)	-0.038 (0.059)	0.006 (0.092)	-1113.732 (1994.203)	1185.755 (2996.536)
County Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Linear Time Trends	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.000	0.002	0.001	0.001	0.339	0.339	0.500	0.500	0.571	0.571
p-value	0.279	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000
Observations	17,136	17,136	17,136	17,136	17,136	17,136	17,136	17,136	17,136	17,136

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented. The dependent variable is the log of average wage unless stated otherwise. The R-squared presented is the adjusted R-squared for the respective panel model.

Table 23: Effect of Forest Service and Non-Forest Service Wilderness on Average Wage.

	(1) Without linear time trends	(2) Without linear time trends	(3) With linear time trends	(4) Dependent variable logged	(5) Dependent variable not logged
(Intercept)	10.359 ***		10.345 ***		
	(0.010)		(0.010)		
Proportion of County Designated Wilderness by the Forest Service	-0.166	-0.082	-0.228	0.009	1321.807
	(0.111)	(0.123)	(0.141)	(0.092)	(2985.416)
Proportion of County Designated Wilderness by Agency Other Than Forest Service	0.423 **	-0.056	-0.454 ***	-0.099	-4205.483 *
	(0.194)	(0.098)	(0.157)	(0.064)	(2444.008)
County Fixed Effects	No	Yes	No	Yes	Yes
Year Fixed Effects	No	Yes	No	Yes	Yes
Linear Time Trends	No	No	Yes	Yes	Yes
Adjusted R-squared	0.007	0.001	0.622	0.498	0.567
p-value	0.000	0.000	0.000	0.000	0.000
Observations	17,136	17,136	17,136	17,136	17,136

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented. The dependent variable is the log of average wage unless stated otherwise. The R-squared presented is the adjusted R-squared for the respective panel model.

Table 24: Effect of Wilderness on Average Wages – Protected Land Quartiles.

Outdoor Amenities	Proportion of County Designated Wilderness	(1) Dependent variable logged	(2) Dependent variable not logged
1st Quartile	Forest Service	60.481	2090535.100
		(45.807)	(1706287.917)
	Other Agency	-0.721	-36338.126 ***
		(0.448)	(13807.322)
	Adjusted R-squared	0.505	0.590
2nd Quartile	Forest Service	-0.271	-9548.988
		(0.332)	(12443.693)
	Other Agency	-0.363	-10169.216
		(0.258)	(8977.508)
	Adjusted R-squared	0.471	0.556
3rd Quartile	Forest Service	-0.790 **	-23294.464 **
		(0.308)	(9670.800)
	Other Agency	0.459 *	8451.301
		(0.258)	(15087.386)
	Adjusted R-squared	0.516	0.601
4th Quartile	Forest Service	0.225 **	7450.150 **
		(0.094)	(3005.923)
	Other Agency	0.016	130.846
		(0.052)	(1698.076)
	Adjusted R-squared	0.507	0.515

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented. County fixed effects, year fixed effects, and linear time trends included. The first quartile has the least amount of protected land.

Table 25: Effect of Wilderness on Average Wages – Natural Amenities Index Quartiles.

Outdoor Amenities	Proportion of County Designated Wilderness	(1) Dependent variable logged	(2) Dependent variable not logged
1st Quartile	Forest Service	0.342	7970.036
		(0.511)	(16106.902)
	Other Agency	0.698 *	11222.871
		(0.362)	(9935.862)
	Adjusted R-squared	0.411	0.433
2nd Quartile	Forest Service	-0.707 **	-17874.484 *
		(0.315)	(9778.320)
	Other Agency	-0.048	-7890.796
		(0.238)	(7927.867)
	Adjusted R-squared	0.536	0.589
3rd Quartile	Forest Service	-0.221 *	-6558.927
		(0.128)	(4363.951)
	Other Agency	-0.422 *	-18243.259 **
		(0.231)	(8049.562)
	Adjusted R-squared	0.452	0.513
4th Quartile	Forest Service	0.281 **	12840.924 ***
		(0.141)	(4572.280)
	Other Agency	-0.081	-2108.972
		(0.051)	(1552.140)
	Adjusted R-squared	0.595	0.655

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented. County fixed effects, year fixed effects, and linear time trends included. The first quartile has the lowest natural amenity rating.

Earlier studies have found that natural amenities are insufficient for economic growth and must be coupled with access to metropolitan centers (Booth 1999; Rasker 2006). To test whether the effect of wilderness varies when counties are grouped based on their proximity to urban centers, the data set is divided into metropolitan and nonmetropolitan county samples. The results from fixed effect regressions on these two samples are presented in Table 26. The estimated coefficients for Forest Service wilderness in metropolitan counties are negative and statistically insignificant in column 1, while the estimated coefficients for Forest Service wilderness in nonmetropolitan counties are positive (except for average wage per job) and also statistically insignificant (except for employment) in column 3. The statistically insignificant coefficients in these specifications suggest that economic outcomes in both metropolitan and nonmetropolitan counties are not responsive to changes in the proportion of the county designated as wilderness.

Given that the economic effects of wilderness designation may vary across sectors of the economy, the economic effects of wilderness are perhaps better measured within a single sector. Data on income and employment from the Bureau of Economic Analysis, however, are often censored at the county level. For sectors such as forestry and mining, two sectors that could be affected by wilderness designations, too few observations are available at the county level to create a panel data set. Sufficient data on service sector employment are available and can be used to estimate the effect of wilderness on employment in service industries only. This sector provides an interesting sector to examine because of its growing importance in western economies (see Power and Barrett

2001; Shumway and Otterstrom 2001; Vias 1999). The growth in service sector employment is an important feature of the transition of western economies based on extractive industries to "New West" economies based on service industries. The Bureau of Economic Analysis defines the service sector as including "establishments primarily engaged in providing a wide variety of services for individuals, business, and government establishments, and other organizations." This includes hotels and other lodging facilities; personal, business, repair, and amusement services; health, legal, engineering, and other professional services; education institutions; and other miscellaneous services.

Data on service sector employment are used to create an unbalanced panel of western counties from 1969 to 2000, totaling 12,603 observations.[30] The results of fixed effect models that estimate the effect of wilderness on service sector employment are presented in Tables 27 – 28. Table 27 presents results for specifications that measure wilderness as the proportion of the county designated wilderness by the any agency, and then again with wilderness managed by only the Forest Service. Table 28 displays results with wilderness split into two variables: one that measures the proportion of a county designated Forest Service wilderness and the proportion of the county designated wilderness managed by other agencies. As before, the coefficients in Tables 27 – 28 are not statistically significant at conventional levels. This suggests that, although service sector employment has increased in western counties, wilderness designations do not appear to be the source of such growth.

[30] The method the Bureau of Economic Analysis uses to calculate service sector employment changed after 2000. Thus, data available after 2000 are not comparable with data from 1969-2000.

Table 26: Effect of Wilderness on Economic Outcomes – Metro vs. Nonmetro Counties.

		Metro Counties		Non-metro Counties	
Outcome Variable	**Proportion of County Designated Wilderness**	**(1) Dependent variable logged**	**(2) Dependent variable not logged**	**(3) Dependent variable logged**	**(4) Dependent variable not logged**
Per Capita Income	Forest Service	-0.132	-3711.505	0.214	1032.688
		(0.103)	(2668.417)	(0.140)	(3918.176)
	Other Agency	-0.217 *	-7501.732 **	-0.093	-3352.425 *
		(0.113)	(3762.474)	(0.073)	(2008.415)
	Adjusted R-squared	0.639	0.741	0.422	0.527
Population	Forest Service	-0.211	-56151.963	0.100	-2992.537 *
		(0.145)	(99150.537)	(0.118)	(1784.745)
	Other Agency	0.009	34639.223	0.151	6826.575
		(0.115)	(160329.088)	(0.139)	(5180.331)
	Adjusted R-squared	0.875	0.905	0.834	0.901
Employment	Forest Service	-0.099	-49733.966	0.461 *	-803.696
		(0.209)	(58647.173)	(0.249)	(958.304)
	Other Agency	0.051	53292.998	0.096	1740.371
		(0.136)	(67366.815)	(0.174)	(1601.826)
	Adjusted R-squared	0.831	0.817	0.735	0.875
Average Wage	Forest Service	-0.145	-3143.952	-0.001	75.158
		(0.102)	(4355.239)	(0.104)	(3334.240)
	Other Agency	-0.239 ***	-8696.388 ***	-0.080	-2818.418
		(0.037)	(3229.853)	(0.083)	(2878.258)
	Adjusted R-squared	0.647	0.695	0.453	0.484

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of western counties from 1969 to 2010. Standard errors clustered on county are presented. County fixed effects, year fixed effects, and linear time trends included.

Table 27: Effect of Wilderness on Service Sector Employment.

	(1) Dependent variable logged		(2) Dependent variable not logged	
	Any Agency	**Forest Service**	**Any Agency**	**Forest Service**
Proportion of County Designated Wilderness	0.101 (0.152)	0.222 (0.289)	1928.761 (3402.780)	1520.762 (5383.463)
County Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Linear Time Trends	Yes	Yes	Yes	Yes
Adjusted R-squared	0.710	0.710	0.914	0.914
p-value	0.000	0.000	0.000	0.000
Observations	12,603	12,603	12,603	12,603

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2000. Standard errors clustered on county are presented.

Table 28: Effect of Forest Service and Non-Forest Service Wilderness on Service Sector Employment.

	(1) Dependent variable logged	(2) Dependent variable not logged
Proportion of County Designated Forest Service Wilderness	0.223 (0.289)	1478.800 (5379.326)
Proportion of County Designated Other Agency Wilderness	-0.034 (0.064)	2426.080 (3566.274)
County Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Linear Time Trends	Yes	Yes
Adjusted R-squared	0.710	0.914
p-value	0.000	0.000
Observations	12,603	12,603

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2000. Standard errors clustered on county are presented.

Thus far, the results presented provide evidence that the average effect of wilderness designation on economic outcomes is not statistically significantly different than zero. The panel models in Tables 10 – 25, however, do not address whether wilderness designations have effects on economic outcomes in certain years, such as the period immediately following designation, that are not discernible in estimates of the average effect of wilderness. Wilderness designations could have immediate negative impacts on extractive industries that are gradually offset by positive impacts in other sectors. Eichman et al. (2010), for example, argue that the full effects of wilderness designations may not persist indefinitely. In their study of the economic impacts of the Northwest Forest Plan, the authors find that employment losses in extractive industries were slightly offset by gains in other economic outcomes such as population increases. These economic transitional processes are unlikely to occur instantaneously (Rosenberger et al. 2008). Alternative specifications are needed to address whether temporal effects exist and, if they do, to test for the timing of such effects.

In order to test for the timing of economic effects associated with wilderness designation, dummy variables are created that represent the years following a county's initial designation. These dummy variables are also interacted with the proportion of a county that is designated wilderness to account for the amount of wilderness that was initially designated. As before, county and year fixed effects and county-specific linear time trends are included. The result is the following panel model:

$$Y_{it} = \alpha_1 X_{it} + \alpha_2 Dum0_{it} + \alpha_3 Dum1_{it} + \alpha_4 Dum2_{it} + \alpha_5 Dum3_{it} + \alpha_6 Dum4_{it} + \alpha_7 Dum5_{it} + \alpha_8 Dum6_{it} + \alpha_9 Dum7_{it} + \alpha_{10} Dum8_{it} + \alpha_{11} Dum9_{it} + \alpha_{12} Dum10_{it} + \delta_1 Dum0_{it} * X_{it} + \delta_2 Dum1_{it} * X_{it} + \delta_{3121 tered\ on} Dum2_{it} * X_{it} + \delta_4 Dum3_{it} * X_{it} + \delta_5 Dum4_{it} * X_{it} + \delta_6 Dum5_{it} * X_{it} + \delta_7 Dum6_{it} * X_{it} + \delta_8 Dum7_{it} * X_{it} + \delta_9 Dum8_{it} * X_{it} + \delta_{10} Dum9_{it} * X_{it} + \delta_{11} Dum10_{it} * X_{it} + \beta_1 trend_i + \gamma_i + \theta_t + \varepsilon_{it}$$

The model tests for whether effects exist in the ten years following initial wilderness designations that occur in county *i* from 1970 to 2010. As before, the proportion of county *i* designated wilderness by any agency in year *t* is expressed as X_{it}. The $Dum0_{it}$ variable is equal to 1 for county *i* in the year that wilderness was initially designated, and 0 otherwise. The $Dum1_{it}$ variable is equal to 1 for county *i* one year after wilderness was designated, and 0 otherwise, and so on for the other dummy variables. The interaction terms allow the amount of wilderness designated in county *i* to vary with the dummy variables indicating the year in which the effect is measured. County-specific linear time trends are expressed as $\beta_1 trend_i$. County fixed effects are expressed as γ_i and year fixed effects as θ_t.

The results from this model are provided in Tables 29 and 30. Results with the dependent variable expressed in logged form are presented in Table 29 and results with the dependent variable in level form are presented in Table 30. A statistically significant coefficient on one of the dummy variables would indicate the number of years after an initial designation in a county that statistically significant economic effects exist. The

estimated coefficients for the dummy variables and the interaction terms are generally statistically insignificant at conventional levels for both the logged and level specifications. In addition, with the exception of the employment specification in Table 29, the X_{it} wilderness variable remains statistically insignificant as in the previous models. In the employment specification in Table 29, the wilderness variable, X_{it}, is positive and statistically significant, however, none of the dummy variables or interaction terms are statistically different than zero. The coefficient on the wilderness variable in the employment specification in Table 30 is not statistically significant at conventional levels.

The statistically insignificant results in Tables 29 and 30 suggest that wilderness designations are not associated with significant temporary economic effects.[31] This finding is similar to the results of a study by Rosenberger et al. (2008) of eastern wilderness designations. The authors find that wilderness designations have no effect on the timing of transition from an economy based on resource extraction and manufacturing to an economy based on service-sector employment and non-labor income. While a similar transitional economic process has occurred in western states, wilderness designations do not appear to be associated with the timing of the transition.

[31] As a robustness check, the models in Tables 29 and 30 were estimated without the interaction terms and found to be very similar.

Table 29: Effect of Wilderness from Any Agency – Dummy Variables.
Dependent variable = logs

	PCI	**Population**	**Employment**	**Avg. Wage**
Proportion of County	0.037	0.062	0.283 **	-0.037
Designated Wilderness	(0.073)	(0.079)	(0.136)	(0.063)
Dum0	0.007	-0.002	-0.002	-0.000
	(0.010)	(0.009)	(0.014)	(0.009)
Dum1	0.011	0.001	0.000	-0.002
	(0.010)	(0.009)	(0.014)	(0.009)
Dum2	-0.003	-0.000	-0.009	0.003
	(0.011)	(0.010)	(0.016)	(0.010)
Dum3	-0.010	0.001	-0.001	0.002
	(0.011)	(0.010)	(0.016)	(0.009)
Dum4	0.010	-0.003	0.000	0.008
	(0.012)	(0.009)	(0.016)	(0.011)
Dum5	0.016	-0.010	0.005	0.006
	(0.011)	(0.009)	(0.017)	(0.011)
Dum6	0.012	-0.008	0.005	0.004
	(0.012)	(0.010)	(0.018)	(0.011)
Dum7	0.014	-0.008	0.011	0.005
	(0.011)	(0.009)	(0.017)	(0.010)
Dum8	0.013	-0.004	0.012	0.005
	(0.010)	(0.009)	(0.016)	(0.010)
Dum9	0.005	-0.001	0.007	-0.000
	(0.010)	(0.009)	(0.015)	(0.009)
Dum10	0.013	-0.001	0.007	0.004
	(0.008)	(0.008)	(0.013)	(0.008)
Dum0 * propwild	-0.122	0.078	-0.232	-0.039
	(0.198)	(0.120)	(0.235)	(0.194)
Dum1 * propwild	-0.135	0.085	-0.167	-0.046
	(0.174)	(0.128)	(0.215)	(0.168)
Dum2 * propwild	0.008	0.148	-0.006	-0.073
	(0.186)	(0.130)	(0.258)	(0.165)
Dum3 * propwild	0.047	0.097	-0.220	-0.108
	(0.189)	(0.131)	(0.283)	(0.164)
Dum4 * propwild	-0.148	0.091	-0.303	-0.155
	(0.164)	(0.113)	(0.244)	(0.164)
Dum5 * propwild	-0.114	0.079	-0.364	-0.055
	(0.171)	(0.113)	(0.243)	(0.129)
Dum6 * propwild	-0.010	0.121	-0.046	-0.010
	(0.214)	(0.122)	(0.283)	(0.132)
Dum7 * propwild	-0.081	0.168	-0.062	0.052
	(0.167)	(0.129)	(0.245)	(0.132)
Dum8 * propwild	-0.038	0.113	-0.116	0.040
	(0.158)	(0.129)	(0.267)	(0.149)
Dum9 * propwild	0.003	0.065	0.046	0.097
	(0.132)	(0.135)	(0.245)	(0.136)
Dum10 * propwild	-0.254 *	0.064	-0.195	-0.116
	(0.133)	(0.123)	(0.227)	(0.092)
Adjusted R-squared	0.446	0.849	0.754	0.505
p-value	0.000	0.000	0.000	0.000
Observations	16,728	16,728	16,728	16,728

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Table 30: Effect of Wilderness from Any Agency – Dummy Variables.
Dependent variable = levels

	PCI	Population	Employment	Avg. Wage
Proportion of County	-1968.631	3904.282	4592.055	-1163.230
Designated Wilderness	(2098.935)	(22706.344)	(9964.784)	(2201.073)
Dum_0	220.708	-1453.821	-986.363	114.733
	(254.305)	(1744.749)	(1550.519)	(305.656)
Dum_1	343.038	-1213.628	-655.346	41.900
	(272.687)	(1749.802)	(1678.666)	(312.770)
Dum_2	38.947	-434.860	-354.549	123.041
	(294.047)	(1494.945)	(1845.817)	(316.848)
Dum_3	-182.987	179.809	366.434	125.209
	(293.605)	(1423.625)	(2027.625)	(299.303)
Dum_4	277.134	792.216	1557.424	435.247
	(300.206)	(1488.213)	(2401.733)	(392.640)
Dum_5	420.988	1153.368	2084.847	307.182
	(271.349)	(1663.757)	(2534.498)	(364.326)
Dum_6	286.235	1161.211	2446.600	230.689
	(303.261)	(1658.747)	(2677.613)	(369.091)
Dum_7	339.183	685.085	1102.104	238.233
	(275.801)	(1431.511)	(1822.292)	(344.055)
Dum_8	281.197	67.394	61.753	263.243
	(262.579)	(1420.595)	(1335.649)	(318.220)
Dum_9	127.743	202.542	47.326	123.679
	(248.411)	(1383.488)	(974.643)	(289.502)
Dum_10	315.775	196.105	499.422	238.358
	(205.798)	(1341.675)	(1045.427)	(257.580)
Dum_0 * propwild	-1594.245	6792.470	-11714.503	-1431.683
	(5603.042)	(15204.579)	(16796.500)	(6775.579)
Dum_1 * propwild	-2711.411	5185.643	-12278.193	-1744.573
	(4903.605)	16806.918	(16420.275)	(5813.590)
Dum_2 * propwild	371.071	272.312	-8485.898	-1571.402
	(4874.724)	15468.996	(15259.785)	(5666.909)
Dum_3 * propwild	1818.410	-2287.365	-9956.897	-3455.374
	(5130.252)	15088.837	(16306.415)	(5684.502)
Dum_4 * propwild	-3451.991	-6730.542	-21688.405	-5914.332
	(4354.252)	14938.244	(18967.100)	(5878.101)
Dum_5 * propwild	-1715.397	-9430.923	-27096.429	-2677.400
	(4717.574)	16296.306	(19691.295)	(4364.563)
Dum_6 * propwild	257.911	-7002.581	-34919.579	-964.311
	(5639.942)	16175.303	(21854.760)	(4282.058)
Dum_7 * propwild	-2331.038	2549.790	-23317.719	1429.465
	(4076.419)	12086.076	(16102.776)	(4292.778)
Dum_8 * propwild	-839.907	13033.920	-7729.922	939.301
	(4056.411)	14915.138	(11435.806)	(5059.317)
Dum_9 * propwild	-245.110	14132.762	-3979.915	2432.706
	(3342.662)	13889.730	(8696.782)	(4623.974)
Dum_10 * propwild	-6711.515 **	14849.109	-1683.418	-5054.677 *
	(3244.183)	(14003.391)	(10823.027)	(3032.152)
Adjusted R-squared	0.582	0.919	0.843	0.573
p-value	0.000	0.000	0.000	0.000
Observations	16,728	16,728	16,728	16,728

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

CHAPTER 5

CONCLUSIONS AND FUTURE RESEARCH

This thesis investigates the political economy of wilderness area selection and derives testable predictions of the economic consequences of designating wilderness areas. Using data from a comprehensive inventory of all potential Forest Service wilderness areas known as RARE II, the factors that influence the wilderness selection decisions of the Forest Service and Congress are analyzed. The Forest Service and Congress are found to act as political arbitrators that balance competing interest groups. The wilderness attributes of roadless areas examined during RARE II are not correlated with their development potential, allowing the Forest Service to successfully arbitrate between competing groups by recommending areas for designation that have high levels of wilderness attributes but low levels of resource development potential. Congress was highly influenced by such recommendations in its wilderness selection decisions. Thus, there is evidence that the Forest Service and Congress are largely able to make wilderness selection decisions that sufficiently appeal to wilderness advocates but are unlikely to impose significant costs on local economies.

Does wilderness designation matter for economic outcomes? Counties with wilderness areas have higher average per capita income, population, and employment growth rates than counties without wilderness areas. This relationship, however, may not be causal. Counties with wilderness also have, on average, higher levels of natural amenities that may be the source of economic growth rather than the wilderness policy.

The prediction derived from the political economy analysis that wilderness designations will have insignificant effects on local economies is tested using a novel panel data set of western U.S. counties from 1969 to 2010. The economic effects of wilderness on levels of per capita income, population, employment, and average wage per job are examined. Despite claims by wilderness proponents of the economic benefits of wilderness, or claims by wilderness opponents of detrimental economic impacts associated with wilderness, wilderness designations are found to not have a statistically significant effect on levels of per capita income, population, employment, or average wage per job. In addition, this thesis does not find evidence that wilderness designations are associated with short-term economic effects that diminish over time. These findings appear robust to various specifications and county groupings.

While this thesis provides evidence that the economic consequences associated with designating wilderness areas are insignificant, the issue of wilderness designation is undoubtedly controversial. Casual observers of western U.S. politics are likely aware of conflicts over proposed wilderness designations, such as the recent bill proposed by Montana Senator Jon Tester (Straub 2009). The findings in this thesis suggest that, in general, designations of roadless areas managed by the Forest Service could be made such that opposing groups' interests could be satisfied and thus the economic impacts could be limited. The attributes of the roadless areas that have yet to receive designation, however, may not present policy makers with such good fortune. The remaining roadless areas may be characterized by considerably more conflict, as indicated by their lack of designation following RARE II. In addition, this thesis does not address the physical

characteristics of roadless areas managed by federal agencies other than the Forest Service, such as the Bureau of Land Management, which often contain considerable energy development potential. With the increasing use of technologies such as hydraulic fracturing, solar panels, and wind farms on federal lands, conflicts over the competing uses of existing roadless areas are likely to persist as new technologies change the resource values of the land. The political economy analysis in this thesis seeks to shift the focus away from broad policy goals such as establishing new protected areas as a means of promoting economic development, to recognizing that physical attributes and interest group competition are important factors in determining whether designating a roadless area will have measureable economic consequences.

Future research could improve upon the contents of this thesis by considering the impact of wilderness areas that are nearby but not within a given county. A wilderness metric that includes wilderness areas in adjacent counties or within a defined buffer zone of a county could improve the wilderness variable used to test for economic consequences. In addition, future work might investigate how the attributes of Forest Service roadless areas affect the timing of wilderness designation.[32] Other political variables could also be included in the political economy analysis, such as whether a roadless area is in a congressional district with a representative on the Natural Resource committee or the League of Conservation Voters' score of the representative. In addition, the economic consequences of wilderness may be better measured with independent

[32] Figure 5 indicates that the majority of Forest Service wilderness designations following RARE II occurred between 1980 and 1984. Significant amounts of Forest Service land have not received wilderness designation since then. Given the short time period during which most Forest Service wilderness designations occurred, the additional insights that might be gained from analyzing the timing of these designations may be limited.

variables for wilderness managed by each federal land agency individually. This would allow for the effect of wilderness managed by the Bureau of Land Management, for instance, be isolated from the effect of wilderness managed by other agencies. Additional research should also examine in more detail the roadless areas that did not receive wilderness designation. Administrative rulings such as the 2001 Roadless Rule placed limits on road construction in the remaining non-wilderness roadless areas, but the legality of the ruling, and the extent that it has been enforced, has varied over the last decade (Glicksman 2004). Future work should consider the extent to which resource development has occurred on these roadless areas.

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APPENDICES

APPENDIX A

LETTER FROM ECONOMISTS

November 30, 2011
President Barack Obama

Dear Mr. President,

As economists and academics in related fields, we believe that federal protected public lands are essential to the West's economic future. These public lands, including national parks, wilderness areas and national monuments, attract innovative companies and workers, and are an essential component of the region's competitive advantage.

The West's public lands contribute to our economic well being in a variety of ways, including resource extraction and recreation. These activities can and must coexist with expanding protections for America's world-class natural amenities.

The U.S. is now predominantly a service-based economy, and the fastest-growing regions are those that have been able to attract talented workers, entrepreneurs, and investors across all sectors of the economy. In the West especially, public lands play a pivotal role in attracting and retaining people and businesses. This is the case for all sectors, including manufacturing.

The rivers, lakes, canyons, and mountains found on public lands serve as a unique and compelling backdrop that has helped to transform the western economy from a dependence on resource extractive industries to growth from in-migration, tourism, and modern economy sectors such as finance, engineering, software development, insurance, and health care.

Today, one of the competitive strengths of the West is the unique combination of wide-open spaces, scenic vistas and recreational opportunities alongside vibrant, growing communities that are connected to larger markets via the Internet, highways and commercial air service.

Increasingly, entrepreneurs are basing their business location decisions on the quality of life in an area. Businesses are recruiting talented employees by promoting access to beautiful, nearby public lands. This is happening in western cities and rural areas alike.

Together with investment in education and access to markets, studies have repeatedly shown that protected public lands are significant contributors to economic growth.

America's public lands can be used responsibly while expanding protections for the nation's world- class natural amenities. We urge you to create jobs and support businesses by investing in our public lands infrastructure and establishing new protected areas such as parks, wilderness, and monuments.

Sincerely,

The following individuals have endorsed the contents of this letter. Institutional references are provided for identification only.

Kenneth J. Arrow, Stanford University (Emeritus), Nobel Laureate, California
Robert M. Solow, Massachusetts Institute of Technology (Emeritus), Nobel Laureate, Massachusetts
Joseph Stiglitz, Columbia University, Nobel Laureate, New York
HJ Albers, Oregon State University, Oregon
Donna M. Anderson, University of Wisconsin – La Crosse, Wisconsin
Paul Baer, Georgia Institute of Technology, Georgia
Richard Barrett, University of Montana, Montana House of Representatives, Montana
Mimi Larsen Becker, University of New Hampshire, New Hampshire
Frank Benford, Economist, Oregon
Robert P. Berrens, University of New Mexico, New Mexico
William B. Beyers, University of Washington (Emeritus), Washington
Douglas Booth, Marquette University (retired), Wisconsin
Gardner Brown, University of Washington (Emeritus), Washington
Greg Brown, Central Washington University, Washington
Arthur J. Caplan, Utah State University, Utah
David Carrier, Appalachian Regional Commission, District of Columbia
Ken Casavant, Washington State University, Washington
Karen Conway, University of New Hampshire, New Hampshire
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Frank L. Farmer, University of Arkansas, Arkansas
Yeganeh H. Farzin, University of California — Davis, California
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Nancy Folbre, University of Massachusetts — Amherst, Massachusetts
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Heidi Garrett-Peltier, University of Massachusetts — Amherst, Massachusetts
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Philip Graves, University of Colorado — Boulder, Colorado
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Jonathan Isham, Jr., Middlebury College, Vermont
Christopher Juniper, CORE, Colorado
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Deirdre N. McCloskey, University of Illinois at Chicago, Illinois
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James Pittman, Prescott College, Arizona
Thomas Michael Power, University of Montana, Montana
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Kristen Sheeran, Economics for Equity and the Environment Network, Oregon
Nathan Sivers-Boyce, Willamette University, Oregon
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George Tolley, University of Chicago (Emeritus), Illinois
Austin Troy, University of Vermont, Vermont
John Tschirhart, University of Wyoming, Wyoming
William Ward, Clemson University, South Carolina
John C. Whitehead, Appalachian State University, North Carolina
John Willoughby, American University, District of Columbia
Randall K. Wilson, Gettysburg College, Pennsylvania
Maggie Winslow, Presidio Graduate School, California
Michael W. “Mick” Womersley, Unity College, Maine
Richard O. Zerbe, University of Washington, Washington

APPENDIX B

ALTERNATE SPECIFICATIONS

As an additional robustness check for the statistically insignificant results found in Phase 3, a series of alternative specifications are considered. Phase 3 measures the amount of wilderness in a county as a proportion of the total area of a county. In the specifications that follow, the wilderness variable is expressed as the total number of wilderness acres in a county (in thousands of acres). These alternative specifications provide a way to test the robustness of the results found in Phase 1, as well as provide a clean interpretation of the marginal effect of increases in wilderness acres in a county. Descriptive statistics for the total acres of wilderness in a county are provided in Table 5.

The regressions in this appendix repeat the first two sets of models in Tables 10 – 22 (the A and B tables) with the wilderness explanatory variables expressed in terms of total wilderness acres. Similar to Table 10, Table 31 examines the effect of wilderness on per capita income with two specifications for each model: one measuring wilderness managed by any federal land agency, and a second measuring wilderness managed by the Forest Service. The models examined in Table 31 include county fixed effects, year fixed effects, and county-specific linear time trends, similar to models 4 and 5 in Table 10. As in Tables 10 – 25, the standard errors in this appendix are clustered on county. Table 32 repeats the same regression as Table 31 but splits the wilderness variable into two explanatory variables in a manner similar to Table 11. One explanatory variable measures wilderness acres managed by the Forest Service, and the other measures wilderness acres managed by other federal land agencies: the Bureau of Land Management (BLM), the National Park Service, and the Fish and Wildlife Service.

The estimated coefficients for the wilderness variables in Table 31 are statistically significant and negative for wilderness acres managed by any agency, but are not statistically significant at conventional levels for wilderness acres managed by the Forest Service only. Likewise, in Table 32, the coefficient for Forest Service wilderness acres is not statistically significant, but the coefficient for wilderness acres managed by other agencies is statistically significant and negative. The coefficient for Forest Service wilderness indicates that the amount of wilderness managed by the Forest Service is not associated with growth in per capita income. This result is similar to the finding in models 4 and 5 in Tables 10 and 11 that the proportion of a county designated Forest Service wilderness is not associated with per capita income growth. The negative and statistically significant coefficient on other agency wilderness is also similar to the result found in models 4 and 5 in Table 11 that the proportion of a county designated wilderness managed by agencies other than the Forest Service is associated with a decrease in per capita income. As discussed earlier, this negative and statistically significant result could be caused by wilderness managed by the BLM. The statistically significant and negative coefficient in Table 31 for wilderness managed by any agency could also be due to the effect from BLM wilderness.

Interpreting the statistically significant coefficients from Tables 31 and 32 suggest that the economic significance of the effect may be small. The estimated coefficient for the log specification in model 1 of Table 31 suggests that a 100,000-acre increase in the number of wilderness acres in a county is associated with a 0.29 percent decrease in per capita income. In addition, a one standard deviation increase in total wilderness acres

(232,262 acres) is associated with a 0.67 percent decrease in per capita income. This suggests that, for the average western county in 2010 (with an average per capita income of $35,071), a one standard deviation increase in total wilderness acres is associated with a decline in per capita income of $234.98. Focusing on the statistically significant coefficient for wilderness managed by agencies other than the Forest Service in model 1 in Table 32, the effect is also not large in economic terms. The coefficient suggests that, given a one standard deviation increase in the number of acres in a county managed by an agency other than the Forest Service (166,261 acres), per capita income declines by 0.54 percent. For the average western county in 2010, this effect is equal to a $189.38 decrease in per capita income. While Tables 31 and 32 suggest the effect of the total amount of non-Forest Service wilderness on per capita income is statistically significant, the coefficients suggest that the effect is likely to be economically insignificant.

Tables 33 – 38 repeat the process described above by examining the impact of total wilderness acres in a county on population, employment, and average wage per job. The coefficients on the wilderness variables in these models, however, are not statistically significant at conventional levels for any specifications. Unlike the specifications in Tables 31 and 32, the coefficients on the explanatory variables that measure the total wilderness acres managed by agencies other than the Forest Service are statistically insignificant. These results are similar to those found in the regressions in Phase 3 that measure wilderness as a proportion of the county and provide evidence for the robustness of this result.

Table 31: Effect of Wilderness on Per Capita Income – Acres of Wilderness per County.

	(1) Dependent variable logged		(2) Dependent variable not logged	
	Any Agency	**Forest Service**	**Any Agency**	**Forest Service**
Acres of Wilderness in County (1000s)	-0.000029 ** (0.000012)	-0.000013 (0.000036)	-1.117463 ** (0.458611)	-1.613365 (1.387940)
County Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Linear Time Trends	Yes	Yes	Yes	Yes
Adjusted R-squared	0.452	0.452	0.586	0.585
p-value	0.000	0.000	0.000	0.000
Observations	17,136	17,136	17,136	17,136

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented.

Table 32: Effect of Forest Service and Non-Forest Service Wilderness on Per Capita Income – Acres of Wilderness per County.

	(1) Dependent variable logged	(2) Dependent variable not logged
Forest Service Wilderness Acres in County (1000s)	-0.000010 (0.000037)	-1.5838 (1.4277)
Other Agency Wilderness Acres in County (1000s)	-0.0000324 ** (0.0000143)	-1.0331 ** (0.4450)
County Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Linear Time Trends	Yes	Yes
Adjusted R-squared	0.452	0.583
p-value	0.000	0.000
Observations	17,136	17,136

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented.

Table 33: Effect of Wilderness on Population – Acres of Wilderness per County.

	(1) Dependent variable logged		(2) Dependent variable not logged	
	Any Agency	**Forest Service**	**Any Agency**	**Forest Service**
Acres of Wilderness in County (1000s)	0.0000066 (0.0000172)	0.000062 (0.000050)	2.785293 (7.70622)	5.5191 (10.6844)
County Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Linear Time Trends	Yes	Yes	Yes	Yes
Adjusted R-squared	0.851	0.851	0.922	0.022
p-value	0.000	0.000	0.000	0.000
Observations	17,136	17,136	17,136	17,136

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented.

Table 34: Effect of Forest Service and Non-Forest Service Wilderness on Population – Acres of Wilderness per County..

	(4) Dependent variable logged	(5) Dependent variable not logged
Forest Service Wilderness Acres in County (1000s)	0.0000595 (0.0000484)	4.745097 (9.691056)
Other Agency Wilderness Acres in County (1000s)	-0.00000605 (0.00001529)	0.072252 (7.629998)
County Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Linear Time Trends	Yes	Yes
Adjusted R-squared	0.851	0.921
p-value	0.000	0.000
Observations	17,136	17,136

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented.

Table 35: Effect of Wilderness on Employment – Acres of Wilderness per County.

	(1) Dependent variable logged		(2) Dependent variable not logged	
	Any Agency	**Forest Service**	**Any Agency**	**Forest Service**
Acres of Wilderness in County (1000s)	0.0000021 (0.000021)	0.0001049 (0.00010171)	4.0404 (3.695091)	-3.6769 (6.025467)
County Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Linear Time Trends	Yes	Yes	Yes	Yes
Adjusted R-squared	0.758	0.758	0.849	0.849
p-value	0.000	0.000	0.000	0.000
Observations	17,136	17,136	17,136	17,136

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented.

Table 36: Effect of Forest Service and Non-Forest Service Wilderness on Employment – Acres of Wilderness per County.

	(4) Dependent variable logged	(5) Dependent variable not logged
Forest Service Wilderness Acres in County (1000s)	0.0000998 (0.0001004)	-4.1883 (5.6981)
Other Agency Wilderness Acres in County (1000s)	-0.0000191 (0.0000182)	4.8441 (3.7864)
County Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Linear Time Trends	Yes	Yes
Adjusted R-squared	0.755	0.844
p-value	0.000	0.000
Observations	17,136	17,136

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented.

Table 37: Effect of Wilderness on Average Wage – Acres of Wilderness per County.

	(1) Dependent variable logged		**(2) Dependent variable not logged**	
	Any Agency	**Forest Service**	**Any Agency**	**Forest Service**
Acres of Wilderness in County (1000s)	-0.000018 (0.000015)	-0.000015 (0.000043)	-0.63849 (0.5549754)	-0.15960 (1.42973)
County Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Linear Time Trends	Yes	Yes	Yes	Yes
Adjusted R-squared	0.498	0.498	0.565	0.565
p-value	0.000	0.000	0.000	0.000
Observations	17,136	17,136	17,136	17,136

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented.

Table 38: Effect of Forest Service and Non-Forest Service Wilderness on Average Wages – Acres of Wilderness per County.

	(4) Dependent variable logged	**(5) Dependent variable not logged**
Forest Service Wilderness Acres in County (1000s)	-0.0000167 (0.0000436)	-0.22022 (1.42055)
Other Agency Wilderness Acres in County (1000s)	-0.0000207 (0.0000168)	-0.79287 (0.64193)
County Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Linear Time Trends	Yes	Yes
Adjusted R-squared	0.505	0.573
p-value	0.000	0.000
Observations	17,136	17,136

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2010. Standard errors clustered on county are presented.

The effect of the total wilderness acres in a county on service sector employment are examined in Tables 39 and 40. As in Tables 27 and 28, which measure wilderness as the proportion of the county, the number of wilderness acres in a county is found not to be a statistically significant predictor of service sector employment. Only in column 1 of Table 40 is the coefficient on the number of acres of wilderness managed by an agency other than the Forest Service found to be statistically significant and negative. The result, however, does not appear to be robust.

Table 39: Effect of Wilderness on Service Sector Employment.

	(1) Dependent variable logged		**(2) Dependent variable not logged**	
	Any Agency	**Forest Service**	**Any Agency**	**Forest Service**
Acres of Wilderness in County (1000s)	-0.00000727 (0.0000121)	0.00000004 (0.00000009)	0.939 (0.972)	0.000932 (0.00214)
County Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Linear Time Trends	Yes	Yes	Yes	Yes
Adjusted R-squared	0.710	0.710	0.914	0.914
p-value	0.000	0.000	0.000	0.000
Observations	12,603	12,603	12,603	12,603

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2000. Standard errors clustered on county are presented.

Table 40: Effect of Forest Service and Non-Forest Service Wilderness on Service Sector Employment.

	(1) Dependent variable logged	**(2) Dependent variable not logged**
Acres of Forest Service Wilderness in County (1000s)	0.00000004 (0.00000009)	0.000857 (0.00213)
Acres of Other Agency Wilderness in County (1000s)	-0.0000144 ** (0.00000710)	0.952 (1.050)
County Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Linear Time Trends	Yes	Yes
Adjusted R-squared	0.710	0.914
p-value	0.000	0.000
Observations	12,603	12,603

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

Note: Panel regression of 408 western counties from 1969 to 2000. Standard errors clustered on county are presented.