IMPACTS OF THE NORTHERN SPOTTED OWL PRESERVATION POLICY ON WESTERN WASHINGTON

A THESIS

Presented to

The Faculty of the Department of Economics and Business

The Colorado College

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Arts

By

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March 2007

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Mathematical Economics

Abstract

The decline of the Northern Spotted Owl became a significant issue in the Pacific Northwest during the late 1980s and early 1990s. This led to the implementation of a preservation policy and the cessation of old growth timber harvests in Western Washington. This study examines the economic and social effects of the cessation of old growth timber harvests. Seemingly unrelated regression was used to analyze the relationships between crime, local economic conditions, and old growth timber harvests. The empirical evidence suggests that local economic conditions significantly influence crime, while decreasing old growth timber harvests have substantial depressing effect on local economic conditions. This suggests that the cessation of old growth timber harvests in Western Washington may have increased crime.

KEYWORDS: (old growth harvest, Northern Spotted Owl, timber harvest, preservation policy)

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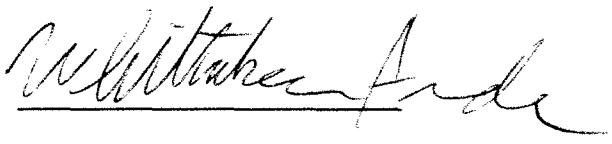

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DEDICATION

TO

DANIEL A. UNDERWOOD PH.D.

FOR HIS IMMEASURABLE CONTRIBUTION

TO MY EDUCATION.

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CHAPTER 1

INTRODUCTION

The main timber producing counties of Washington State underwent significant economic hardship as a result of the reduction of the Federal timber harvest which was due to lawsuits. The Clinton administration then attempted to mitigate this with the Northwest Forest Plan.[1]

The Seattle Audubon Society, et al, filed a lawsuit against the United States Forest Service, et al on 8 February 1989 in the Western Washington United States District Court, to force the United States Forest Service to comply with the National Forest Management Act (NFMA), which required the Forest Service maintain the viability of certain vertebrate species across their historical ranges.[2]

On 18 March 1989, a temporary restraining order[3] was granted blocking 135 timber sales in the Pacific Northwest.[4] This temporary restraining order comprised

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[1] Ross W. Gorte, "The Clinton Administration's Forest Plan for the Pacific Northwest," Congressional Research Service, published July 16, 1993; available from http://www.ncseonline.org/NLE/CRSreports/Forests/for-3.cfm; Internet; accessed 11 November 2006.

[2] Seattle Audubon Soc. v. Evans, No. C89-160 WD (US District Court for Western District of Washington 1991).

[3] A temporary restraining order provides relief from an action which is likely to cause irreparable harm until a hearing can be held and requires a lower standard of proof than a preliminary injunction.

[4] "Temporary Halt Is Ordered in Northwest Timber Sales," New York Times, Published: March 18, 1989; available from http://query.nytimes.com/gst/fullpage.html?res=950DE5DC1131F93BA25750C0A96F948260; Internet; accessed 5 September 2006.

approximately one-fifth of annual Government timber sales in the area, about one billion board-feet.[5] After oral arguments on the 23 March, Judge Dwyer of the Western Washington District Court granted a preliminary injunction, preventing the sale of the timber until the case concluded.[6] Then on the 6 April, the preliminary injunction was altered to include six additional timber sales and require seven days notice on any further sales planned by the Forest Service.[7] This in effect precluded any sales of timber in areas where the Northern Spotted Owl was thought to reside. Several additions to the preliminary injunction followed to add new sales of affected timber.[8]

Through the course of several motions, the final hearing was moved from 13 June 1989 to 13 November 1989. However, on 23 October 1989, section 318 of the Department of Interior and Related Agencies Appropriations Act of 1990 became law.[9] This changed the environmental standards for fiscal year 1990. Thus on 6 November the preliminary injunction was vacated and the hearing cancelled.[10] This allowed the timber sales to resume, admittedly after an eight month pause. The plaintiffs appealed the constitutionality of Section 318 and the Western Washington District Court ruled to

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[5] Ibid.

[6] Seattle Audubon Soc. v. Evans, No. C89-160 WD.

[7] US District Court, Western District of Washington (Seattle), Civil Docket for Case#: 2:89-cv-00160-WLD, 9, available through https://pacer.psc.uscourts.gov/, accessed 4 September 2006.

[8] Ibid.

[9] Portland Audubon Soc'y v. Lujan, 795 F. Supp. 1489 (US District Court, District of Oregon 1992).

[10] Seattle Audubon Soc. v. Evans, No. C89-160 WD and Seattle Audubon Soc. v. Evans, 771 F.Supp. 1081, 21 Envtl. L. Rep. 21,505 (Court document May 23 1991) case No. C89-160 WD US Dist LEXIS 11401. 952 F.2d 297; 1991 U.S. App. LEXIS 29610 (US Appeals 9th Circuit 1991).

retain jurisdiction and not dismiss the case, pending appeal.[11] The appeal was accepted on February 8th 1990, but a motion for an emergency stay on timber harvesting during the appeal was denied.[12] Section 318 was found partially unconstitutional by the 9th Circuit Court of Appeals on 18 September 1990.[13] The Court ruled part of Section 318 was an attempt to adjudicate rather than to legislate. Therefore, the new environmental standards were in addition to NFMA, rather than in lieu of NFMA.[14] This was appealed, and the United States Supreme Court reversed the decision on 25 March 1992 finding that it was constitutional.[15]

Independent of the appeal, on 10 September of 1990 in the Western Washington District Court, the plaintiffs won a motion for the permanent injunction of the Cowboy timber sale, due to it being in violation of the new environmental standards of Section 318.[16] The plaintiffs also won a motion for the permanent injunction of the Nita and South Nita sales on 1 October 1990, for the same reason.[17] Following this, on 16 October, several similar motions were struck from the record due to the Forest Service withdrawing the sales.[18]

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[11] US District Court, 25.

[12]. US District Court, 29.

[13] Seattle Audubon Soc. v. Evans, No. C89-160 WD and Seattle Audubon Soc. v. Evans, 771 F.Supp. 1081.

[14] Ibid.

[15] Robertson v. Seattle Audubon Soc'y, No. 90-1596 (Supreme Court of the United States 1992).

[16] US District Court, 45.

[17] Ibid., 52.

[18] Ibid., 57.

On 7 March 1991, the District Court ruled that the Forest Service must comply with both NFMA and the Endangered Species Act (ESA) in logging Northern Spotted Owl habitat.[19] This set the stage for additional injunctive relief. On 23 May 1991, the Forest Service was "enjoined from auctioning or awarding any additional timber sales from Forest Service Regions Five and Six that would log suitable habitat for the northern spotted owl."[20] Forest Service Regions Five and Six are the Pacific Southwest and the Pacific Northwest respectively. This injunction would remain in effect, until such a time as it had prepared "revised standards and guidelines to ensure the northern spotted owl's viability, together with an environmental impact statement, as required by NFMA and its implementing regulations."[21]

Meanwhile, on 22 June 1990, the Northern Spotted Owl was listed as a threatened species under the Endangered Species Act, by the Fish and Wildlife Service.[22] After the District Court decision on 7 March 1991, the Forest Service filed an appeal, arguing that regardless of whether it needed to obey NFMA in the past, it was now free of any responsibility as the ESA superseded NFMA.[23] The Appellate Court ruled on 23 December 1991, there was no basis for the appeal and affirmed the District Court decision to require the Forest Service comply with both NFMA and ESA.

On 19 October 1987, a second court class of significance was filed by the Portland Audubon Society, et al against the Secretary of the Department of Interior

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[19] Seattle Audubon Soc. v. Evans, No. C89-160 WD.

[20] Ibid.

[21] Ibid.

[22] Seattle Audubon Soc. v. Evans, 771 F.Supp. 1081.

[23] Ibid., 4.

Manuel Lujan, to similarly restrict Bureau of Land Management (BLM) timber sales, in the Oregon District Court.[24] However, on 21 December 1987 Congress enacted Section 314 of the Department of the Interior and Related Agencies Appropriations Act, which in a manner similar to the later Section 318, protected timber sales from some environmental challenges.[25] Section 314 was renewed the following year without change.[26] Regardless, on 18 May 1989 the Oregon District Court ruled that the decisions of the BLM in its timber sales had failed to obey the National Environmental Policy Act (NEPA), but it refused to order the BLM to comply due to the Section 314 exemption.[27] This decision was affirmed on appeal by the 9th Circuit on 6 September 1989.[28] Subsequent to the passage of Section 318, on 21 December 1989, the Oregon District Court dismissed all the claims and entered judgment for the BLM.

After the 9th Circuit Court of Appeals found Section 318 unconstitutional, the Court reversed the Oregon District Court's entry of judgment for the BLM on 30 October 1990.[29] The Oregon District Court then ruled on 11 September 1991, that the BLM's planned timber sales (the Jamison Strategy) were in violation of the ESA because the BLM did not adequately consult the United States Fish and Wildlife Service as to their impact on the Northern Spotted Owl.[30] The Oregon District Court, enjoined the BLM

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[24] Portland Audubon Soc'y v. Lujan, Civil No. 87-1160-FR (US District Court for the District of Oregon 1992), 2.

[25] Ibid.

[26] Ibid.

[27] Ibid., 3.

[28] Ibid.

[29] Ibid.

[30] Ibid., 4.

from continuing with the Jamison Strategy until it had adequately consulted the U.S. Fish and Wildlife Service. This decision was appealed and on 4 March 1992, the 9th Circuit Court of Appeals further enjoined any future sales and remanded to the District Court the question of enjoining announced but not yet awarded 1991 sales, until the completion of the BLM's consultation with the U.S. Fish and Wildlife Service. On 8 June 1992, the Oregon District Court enjoined the BLM from offering any sales that may contain Northern Spotted Owl Habitat pending the development of a Supplemental Environmental Impact Statement.[31]

The Western Washington District Court's injunction on 23 May 1991 effectively shut down the Federal timber sales west of the Cascades.[32] The situation was exacerbated when the BLM was also enjoined from offering timber sales containing Northern Spotted Owl habitat. The Forest Service attempted to alleviate this issue on its own by drafting new management plans. However, these all failed to be found sufficient by the Western Washington District Court. Due to the lack of further sufficiency language, such as Section 318, timber sales remained enjoined after 1990.[33]

In response to these events the Northwest Forest Plan was created. Under the leadership of President Clinton, on 2 April 1993, the Forest Conference was convened with the goal of bringing together all the interested parties under Presidential leadership to find a compromise.[34] Following this, development of the Northwest Forest Plan

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[31] Ibid., 17-18.

[32] E. T. Tuchmann, Martha H. Brookes, Marilyn Daterman, and United States. Dept. of Agriculture, Office of Forestry and Economic Assistance. 1996. *The Northwest Forest Plan : A Report to the President and Congress*, 3.

[33] Ibid., 27.

[34] Ibid., 28.

began; it had three primary segments forest management, economic development, and agency coordination.

The forest management section was primarily interested in crafting a plan that would both allow the current injunctions to be lifted and prevent future legal challenges. In doing this, the plan was crafted such that the viability requirement of the NFMA and the standards of the ESA would be contained in the same management goal. Thus, future changes could be avoided if further species were listed under the ESA.[35] To this end, a set of ten management options were constructed, these and a report was released in July 1993.[36]

Of greater interest was the development of the economic development segment. The economic team was faced with the issue of mitigating the economic consequences of the cessation of Federal timber harvests for several years and only being allowed to start doing so after said several years. Furthermore, given the decisions made in the forest management section, timber harvests would not ever resume at previous levels and would only slowly ramp up to new sustainable sales. The economic assistance had three primary components. First, $1.2 billion would be allocated over 5 years as part of the Northwest Economic Adjustment Initiative (NEAI), providing for worker retraining and similar programs. Due to the lack of timber sales that historically had formed a significant part of the affected counties' budgets, the Federal government would guarantee a portion of these payments to counties for the next 10 years.[37] Further, the economic team sought the repeal of the raw-log export tax credit to encourage the

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[35] Ibid., 32.

[36] Ibid.

[37] Ibid., 34.

processing of logs in the U.S. and aid local mills. The agency coordination is not applicable to this analysis.

Due to lack of Congressional support, the plan was implemented as an administrative action. Thus it was transformed into a Supplemental Environmental impact statement to comply with the courts. This was released for public comment in its final version in February 1994.[38]

Although the economic assistance program began in December 1993, the plan was not completed until 13 April 1994, when the Secretary of Agriculture and the Secretary of interior signed the record of decision.[39] This allowed the plan to be submitted to the courts for approval to lift the injunctions. Finally in June 1994, the Western Washington District Court lifted the injunction on Forest Service lands that had effectively cut off Federal timber harvest in Washington State.[40] Although, it was now possible for the Forest Service to engage in new timber sales, almost a year passed before robust program developed.[41] This was due in part to the long lead time required in preparing Federal timber sales.[42] On average eighteen months are required to plan and award a timber-sale, but this timeframe can range from 10-49 months.[43] Furthermore, the Forest Service could not begin preparing sales until after the Northwest Forest Plan was

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[38] Ibid., 35.

[39] Ibid., 2.

[40] Ibid.

[41] Ibid., 35.

[42] Ibid., 102.

[43] Ibid., 104.

completed.[44] These factors led to a breakdown of the traditional pipeline of timber-sales, which impeded the scaling up of the timber-sale program.

The economic plan was comparatively easy to put into operation. The Administration and Congress allocated the necessary funds to start the NEAI and Congress terminated the raw-log export tax credit, redirecting the funds to pay for the loss of Federal timber receipts by the counties.[45] Yet, in 1994, the first full year of the NEAI's operation, only fifty-one percent of available dollars, about 127 million out of about 248 million, were spent in the Pacific Northwest.[46] In 1995, this increased to eighty-one percent of available dollars, about 218 million out of a total of 268 million.[47] This continued and in 1996 it was 103 percent, or about 216 million out of 209 million dollars.[48]

However, as the government itself admits, the economic assistance program did not begin until after several years of economic hardship.[49] Another aspect of the economic assistance, although not a part of the Northwest Forest Plan, was the award by the Department of Labor of supplemental grants for worker retraining in Washington State. These grants occurred primarily between late 1990 and the announcement of the

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[44] Ibid.

[45] Ibid.

[46] Ibid., 165.

[47] Ibid., 169.

[48] Ibid., 172.

[49] Ibid., 141.

Northwest Forest Plan in 1993. They totaled approximately ten million dollars in Washington State and had anticipated participation of around 3 thousand people.[50]

The Northwest Forest Plan alleviated most of the legal concerns with regards to the preservation of the Northern Spotted Owl habitat. It additionally withstood multiple court challenges after its introduction.[51] The goal was to provide a sustainable supply of timber, while complying with the law and minimizing economic hardship. Yet, as was discussed above, timber sales were slow to resume and will never return to pre-injunction levels. The economic assistance was of dubious utility, due in large part to it beginning only after the communities had been negatively impacted. Overall, the court cases and the subsequent Northwest Forest Plan caused a significant negative impact on the Olympic Peninsula and the other rural timber producing counties of western Washington State.

In attempting to analyze the impact of this series of events is it important to divide Washington State into rural and urban counties and to then further divide the rural counties into those affected by the injunctions and those that were not affected. The urban counties in Washington State in 1990 were King, Pierce, Snohomish, Spokane, Yakima, Whatcom, Kitsap, Thurston, Clark, Benton, and Franklin.[52] Of the rural counties in Washington State, most eastern counties were outside the North Spotted Owls range and thus not affected. The unaffected rural counties were: Ferry, Stevens, Pend, Oreille, Grant, Lincoln, Adams, Whitman, Walla Walla, Columbia, Garfield, and Asotin.[53]

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[50] Ibid., 152.

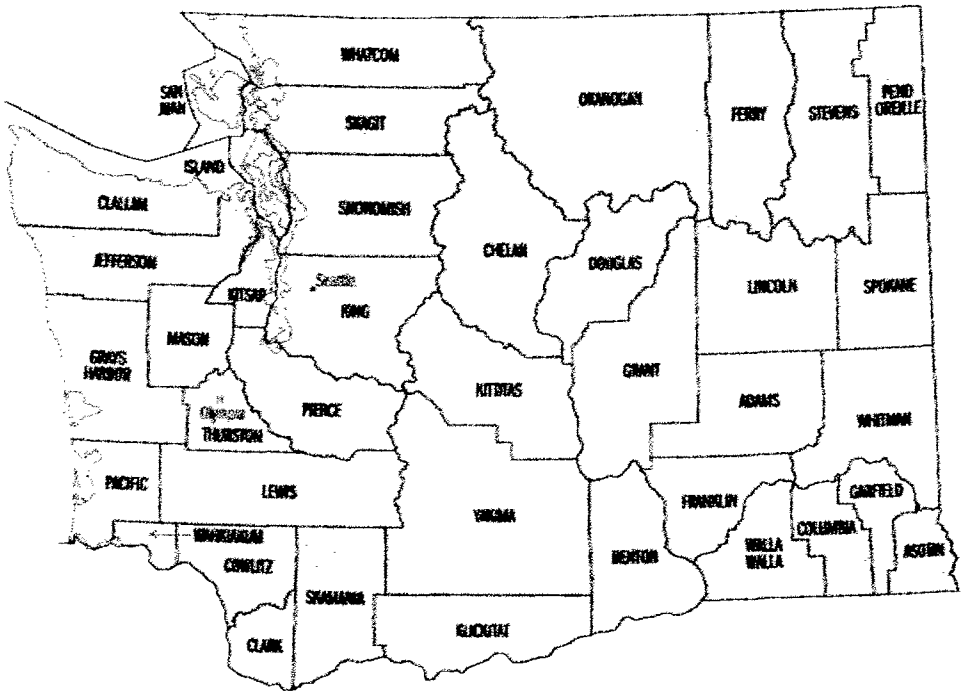
[51] Ibid., 36.

[52] U. S. Census Bureau, "Metropolitan Areas and Components, 1990 with FIPS Codes."

[53] Ibid., 149.

Additionally, of the urban counties, Spokane and Benton were completely outside the range of the Northern Spotted Owl.[54] Of the remainder, there were varying levels of dependence on and prevalence of Federal timber.

Washington State County Map[55]



The timber industry was dramatically altered, by the series of lawsuits and the subsequent Northwest Forest Plan. This came about in Washington State primarily due to the injunction by the Western Washington District Court in 1989 and the subsequent injunction in 1991. Together they caused a substantial shock to the timber

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[54] Ibid.

[55] United States Census Bureau, State and County Quickfacts, Washington County Selection Map; available from http://quickfacts.census.gov/qfd/maps/washington_map.html, accessed 6 September 2006.

industry by practically cutting off the supply of Federal timber. This had a substantial impact on many of the small rural communities whose industry depended on said timber to function. Similarly, the 1992 injunction against the BLM further tightened the supply of timber in the Pacific Northwest. Although the BLM did not manage any lands in Washington State, the impact in Oregon may have had a notable effect.[56] The Northwest Forest Plan only started significantly in 1994, yet it was unable to restore timber sales in a significant way initially, and it will never return timber sales to the previous scale.

[56] Ibid., 24.

CHAPTER 2

LITERATURE REVIEW

A regional relationship between crime and economic status (poverty) is a concern of this study and other analyses. Identifying variables to measure this relationship or the causes of regional poverty has been the focus of many studies. A variety of variables and methodologies have been employed. Related research issues include the analyses of the costs and benefits of regulatory actions and court injunctions relating to the Northern Spotted Owl.

The significantly rural nature of the area being studied may be an important economic characteristic. It may be that rural (i.e., "nonmetropolitan") areas have residents that are significantly poorer than urban (i.e., "metropolitan") residents. If so, rural residents may be relatively more severely impacted by a negative economic disturbance. "Does Economic Vulnerability Depend on Place of Residence? Asset Poverty across Metropolitan and Nonmetropolitan Areas" tests the importance of a household's place of residence in determining asset poverty. It also suggests that a better view of welfare may be provided by the combination of household income and household wealth.[1] The idea is that by combining these measures an understanding can be gained of

[1] Monica Fisher and Bruce A. Weber, "Does Economic Vulnerability Depend on Place of Residence? Asset Poverty across Metropolitan and Nonmetropolitan Areas," *Review of Regional Studies* 34, no. 2 (2004): 139.

both current and future ability to sustain the household. Wealth is especially important to include in the measure to better deal with the issue of unemployment. An asset rich household will not experience the same level of distress as one that suddenly must struggle for basic needs. Asset poverty is broken into three categories based on net worth, net financial assets (net worth excluding main home and vehicle value), and liquid assets (additionally excludes debt, real estate and farm and business net value).[2] A random-effects logistic model is used to analyze the distinction between urban and rural areas in determining asset poverty.[3]

The results suggest that rural residents are more likely to be net financial asset poor and more likely to be liquid asset poor, *ceteris paribus*.[4] This implies that rural residents may be less able to weather a reduction in income, due to their low asset levels.[5]

The region being studied, western Washington state, may have characteristics that answer the question of why did everyone not choose to leave the area as the effects of the Northern Spotted Owl grew. "The Geographic Mobility of Displaced Workers: Do Local Employment Conditions Matter?" attempts to determine the degree to which migration is determined by local labor markets. The author attempts to quantify this using a "competing-risks application of the Cox partial-likelihood proportional hazards model."[6] The results suggest that homeowners will have a lower level of migration, while those in

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[2] Ibid., 141.

[3] Ibid., 142.

[4] Ibid., 152.

[5] Ibid., 153.

[6] Jeffrey J. Yankow, "The Geographic Mobility of Displaced Workers: Do Local Employment Conditions Matter?" *Review of Regional Studies* 34, no. 2 (2004): 124.

professional occupations will have a higher level of migration due to increased human capital.[7] Levels of education and marriage appear to have an insignificant impact on migration hazard due to their having both positive and negative impacts on costs.[8] Furthermore, both wages and the employment level have a significant positive impact on reducing migration.[9]

Local unemployment could induce commuting rather than migration. This choice by a resident might be reflected in retail sales. One study attempts to ascertain the importance of commuting in reducing local retail sales, independent of agglomeration.[10] The results suggest that commuting results in an increase in out of area shopping for items such as groceries and restaurant expenditures. However, commuting does not appear to be a factor in "larger or more infrequent expenditures."[11]

A reduction in supply, ceteris paribus, might result in a price increase sufficient to maintain (or even increase) total regional revenue and thereby alleviate the effects of the court mandate to curtail timber production. However, the existence of close substitutes or imports would prevent a price increase. "Federal Timber Restrictions and Interregional Arbitrage in U.S. Lumber" analyzes the impact of the reduction in timber harvests due to the Northern Spotted Owl in the Pacific Northwest on the integration of

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[7] Ibid., 132.

[8] Ibid.

[9] Ibid., 134.

[10] Jake Burkey and Thomas R. Harris, "Modeling a Share or Proportion with Logit or Tobit: The Effect of Outcommuting on Retail Sales Leakages," *Review of Regional Studies* 33, no. 3 (2003): 333.

[11] Ibid., 341.

he Pacific Northwest and Southern timber markets.[12] The issue was to what extent the Pacific Northwest lumber producers were able to raise prices due to the reduction in the supply, and to what extent Southern lumber was able to substitute for Pacific Northwest production.[13] The empirical results suggest that a structural shift occurred in 1989 due to the reduction in timber harvests in the Pacific Northwest. Based on Granger causality tests, the Pacific Northwest was the dominant player before 1989.[14] However, from 1989 onward, the results suggest that the Pacific Northwest price depended on the Southern price, and that the markets were more closely linked. Additionally, the markets appear to have become more integrated, reducing the insulation of Pacific Northwest lumber producers from Southern competitors.[15] This means that higher prices will be less able to compensate for the reduced output, due to the competition from outside the region, which may cause additional economic stress.

If a regulatory action (i.e., the court's restriction of timber harvests) is anticipated, its effect may occur well before implementation. Similarly, a surprising decision may have a delayed impact. Additionally, multiple regulatory actions make the timing of the social effects of an economic action difficult to measure. "Using information diffusion models to estimate the impacts of regulatory events on publicly traded firms" examines the effects of the regulatory action involving the Northern Spotted Owl using information diffusion models. The nature and speed of the spread of information about new

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[12] Murray, Brian C. and David N. Wear, "Federal Timber Restrictions and Interregional Arbitrage in U.S. Lumber," *Land Economics* 74, no. 1 (02//) (1998) : 76.

[13] Ibid., 77.

[14] Ibid., 89.

[15] Ibid.

regulations is difficult to rigorously ascertain.[16] The article engages in a case study of the Bush Sr. administration's reduction of the total allowable cut on federal lands in the Pacific Northwest from 3.85 billion board feet to 3 billion board feet for the 1991 fiscal year.[17] It is worth noting that this decision became moot after the 23 May 1991 injunction by the Western Washington District Court. The authors find that it took approximately two months after the announcement by the administration for the adjustment effects to fully play out.[18] The logistic diffusion model finds that total negative impact was about nineteen percent.[19] The results further suggest that the stock market changes were not primarily driven by external influences such as the press or the regulator's announcement, but rather by some sort of internal influence.[20]

The event being analyzed here might be, in a regional context, a major economic shock. Using a threshold model may an appropriate methodology for examining the economic shocks impact on retail sales. "Evaluating Threshold Effects in Consumer Sentiment" argues that during major economic or political shocks, consumer sentiment is important in forecasting aggregate consumer spending.[21] The consumer sentiment's

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[16] Anthony Boardman, Ilan Vertinsky, and Diana Whistler, "Using information diffusion models to estimate the impacts of regulatory events on publicly traded firms," *Journal of Public Economics* 63, no. 2 (1997/1): 284.

[17] Ibid., 292.

[18] Ibid., 293.

[19] Ibid., 295.

[20] Ibid., 296.

[21] Brigitte Desroches and Marc-Andre Gosselin, "Evaluating Threshold Effects in Consumer Sentiment," *Southern Economic Journal,* v.70, iss.4 (April 2004): 942.

value is theorized to be a function of its ability to indicate changing levels of consumer uncertainty.[22] The research suggests that consumer sentiment is only useful in periods of extremity and that during these periods the consumer sentiment index demonstrates high volatility.[23] Thus by using a threshold model, wherein values of consumer sentiment that did not significantly exceed the "average level over the two previous quarters" are excluded, only those times of high volatility will impact the model.[24] Using this criterion, the authors found that the predictive value of consumer sentiment was improved as compared to models that make no such restriction.[25]

Apart from a possible benefit to the owl, it is worthwhile to study if the forest product firms benefited or suffered from the court mandated reduction in the supply of timber from western Washington. "Environmental Regulation and the Spatial Distribution of Capital and Resources" examines whether the increase in the cost of raw materials associated with the protection of the Northern Spotted Owl increased or decreased the paper and pulp industries profits.[26] In order to measure this, firms were divided based on the importance of their operations in the Pacific Northwest. A second issue was that because some paper and pulp firms have significant timber holdings, the increase in the value of said holdings may sufficiently offset the increase in raw material costs to lead to higher profits. The authors found that there was not a statistically

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[22] Ibid., 944.

[23] Ibid., 945.

[24] Ibid., 946.

[25] Ibid., 951.

[26] Ted W. Chiles Jr. and Joy Clark, "Environmental Regulation and the Spatial Distribution of Capital and Resources," *Review of Regional Studies* 29, no. 1 (1999): 51.

significant disadvantage to having a high concentration of paper and pulp plants in the Pacific Northwest.[27] However, firms with significant Pacific Northwest timber holdings were shown to have an advantage, but timber holdings overall are not important.[28]

In a search for alternative explanations of the economic shock to western Washington State, the housing market seems a likely candidate. One article provides an important insight into the relative importance of Northern Spotted Owl regulatory action as compared to the housing market on log prices in the Pacific Northwest.[29] The issue was one of external shocks due to public policy. Thus a time dummy variable was chosen as opposed to a measure of the Federal timber program.[30] Then, using intervention analysis and causality tests, they found that the primary driver for the log price changes was the regulatory action. The empirical evidence suggests that at a minimum 71 percent of the log price movement was due to public policy, while the rest may be explained by the demand for lumber due to the economic conditions.[31]

"Benefits of Preserving Old-Growth Forests and The Spotted Owl" examines methods for quantifying the benefit of Old-Growth Forest and Northern Spotted Owl preservation.[32] The article notes that the Northern Spotted Owl is used as an indicator

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[27] Ibid., 59.

[28] Ibid., 59.

[29] Yin, Runsheng Yin, "Spotted Owl Protection, Booming Housing Market, and Log Price Changes in the Pacific Northwest," *Natural Resource Modeling* 14, no. 4 (2001): 575.

[30] Ibid., 577.

[31] Ibid., 591.

[32] Daniel A. Hagen, James W. Vincent, and Patrick G. Welle, "Benefits of Preserving Old-Growth Forests and the Spotted Owl," *Contemporary Policy Issues* 10, no. 2 (04//) (1992): 13.

species for the health of the Pacific Northwest's old-growth forests and that said forests have significant impact on the ecology of the area. The authors suggest that the dispute, although nominally over the conservation policy, should be framed in terms of determining what maximizes the value of the land.[33] This inherently ignores distributional implications and instead focuses on society as a whole. In order to adequately value the old-growth and the Northern Spotted Owl, the authors choose to examine four aspects of its value: use value, option value, quasi-option value, and existence value.[34] In order to estimate these non-market values, the authors used contingent valuation.[35] To gather the necessary data they mailed 1000 surveys to a sample of households.[36] However, only 291 of these surveys were returned sufficiently completed to be used in the regression.[37] Although, the authors discuss a rigorous estimate of the timber costs, said discussion may no longer be correct due to the significant alterations that have occurred to the conservation plan since publication. The authors acknowledge there may be significant issues in the use of contingent valuation, but argue that these have been minimized through the study's design.[38] They concluded that even under the most generous assumptions, the estimated benefits of preservation exceed the costs of the conservation policy.[39] Due to the wide margin of error present it

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[33] Ibid., 14.

[34] Ibid.

[35] Ibid., 15.

[36] Ibid., 14.

[37] Ibid., 24.

[38] Ibid., 17-18.

[39] Ibid., 20.

is possible these results hold with the new cost structure that has come about due to the court injunctions. The study notes that the costs of the policy would be geographically concentrated, while the benefits would be distributed nationally.

Although the study discussed above employed significant measures to reduce the likelihood of survey bias, it is unclear if they were sufficient. This was due in part to the lack of any market data to use as an empirical check. In "Contingent Valuation: Is Some Number Better than No Number?" Diamond and Hausman examine several issues with the use of contingent valuation to inform public policy.[40] Diamond and Hausman suggest that contingent valuation is useless because it does not provide accurate measurements of willingness to pay.[41] One issue is determining whether survey responses are measuring true preferences. It is possible that the respondent is expressing support for a policy because it makes them feel better, or they may be reacting to recent events regarding the policy (such as the pictures of clear cutting used to encourage forest conservation).[42] This is explicitly not what the survey is designed to measure, and thus it in these or other forms may induce bias. The authors note that there is a significant body of evidence suggesting that the number of questions and the question order may significantly alter the results.[43] It is rather difficult to resolve this while maintaining that people are expressing their actual willingness to pay.[44]

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[40] Peter A. Diamond and Jerry A. Hausman "Contingent Valuation: Is Some Number Better than No Number?" *Journal of Economic Perspectives* 8, no. 4 (1994): 45.

[41] Ibid., 47.

[42] Ibid.

[43] Ibid., 49.

[44] Ibid., 50.

Another aspect of problems with contingent valuation is the embedding effect. The embedding effect comes about when willingness to pay doesn't vary in a logical way. Such as when willingness to pay is the same for a part of some good such as a segment of old growth in a forest, as for saving the entire forest, which includes the old growth.[45] The authors suggest that this is due to the "warm glow" effect, that is people want to protect the environment to a certain extent, but the actual policy being considered is not important.[46] In attempting to more fully test the hypothesis of the "warm glow" effect, the authors suggest an "Adding-up Test."[47]

> For example, assume that one group is asked to evaluate public good X; a second group is told that X will be provided and is asked to evaluate also having Y; and a third is asked to evaluate X and Y (together). Now the willingness-to-pay for X and Y (together) should be the same as the sum of the willingness-to-pay for X and the willingness-to-pay for Y, having been given X (the same up to an income effect that can be measured in the survey and that empirically is small).[48]

The authors state that there has not been a contingent valuation survey that has passed internal consistency tests, such as the "Adding-up Test."[49] Furthermore, these tests are necessary because there is a completely lack of direct market parallels to use for

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[45] Ibid., 46.

[46] Ibid., 51.

[47] Ibid., 52.

[48] Ibid.

[49] Ibid., 62.

empirical verification.[50] The authors conclude that contingent valuation is " a deeply flawed methodology for measuring nonuse values, one that does not estimate what its proponents claim to be estimating."[51]

It is worth noting that "Benefits of Preserving Old-Growth Forests and The Spotted Owl" did not perform this or any other tests for embedding or the "warm glow" effect. However, they did ask general questions such that "the good of old-growth forest preservation is identified with the larger issues of 'protection of the environment and "protection of endangered species.' "[52] The stated goal was to help "mitigate biases resulting from the embedding, or part-whole, problem."[53] There does not appear to be any evidence that would suggest that this will reduce the embedding problem.

The contingent valuation survey results may be questionable due to methodological issues. Alternative methodologies are used in the following studies. "The Marginal Cost of Species Preservation: The Northern Spotted Owl" constructs a marginal cost curve for the survival of Northern Spotted Owl, on the basis the level of certainty of species survival.[54] The study suggests that it is inappropriate to treat the preservation of the Northern Spotted Owl as all or nothing.[55] The authors construct a marginal cost curve using a model of owl survival based on the amount of habitat conserved. This is then

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[50] Ibid., 62.

[51] Ibid.

[52] Hagen, Vincent, and Welle, 18.

[53] Ibid., 18.

[54] Claire A. Montgomery, Gardner M. Brown Jr. and Darius M. Adams, "The Marginal Cost of Species Preservation: The Northern Spotted Owl," *Journal of Environmental Economics and Management* 26, no. 2 (1994/3): 111.

[55] Ibid., 114.

linked with the Timber Assessment Market Model to provide projections for the total welfare loss of a given Northern Spotted Owl preservation certainty.[56] The results suggest that 95 percent confidence of owl survival costs about 46 billion in 1990 dollars, while an 82 percent confidence only costs 21 billion in 1990 dollars.[57] The marginal cost per unit of probability is 3.8 billion at 95 percent confidence, while it is only .6 billion at 82 percent confidence.[58]

Another interesting paper, the "Interregional Effects of Reduced Timber Harvests: The impact of the Northern Spotted Owl Listing in Rural and Urban Oregon," uses a core-periphery, multiregional, input-output model to disaggregate the regional effect of listing the Northern Spotted Owl as an endangered species.[59] The authors estimate the reduction in timber harvest on the basis of the Interagency Scientific Committee's report recommendations, which the courts later found inadequate, for the number of acres required for the preservation of the Northern Spotted Owl.[60] The study makes note of the decreasing employment in the Pacific Northwest wood products industries per MMBF (million mean board feet), due to advancing technology.[61] The authors found that an increase of state-wide unemployment was expected to be about 2.9 percent with unemployment benefits explicitly included, while unemployment would reach five

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[56] Ibid., 125-126.

[57] Ibid., 125.

[58] Ibid.

[59] Edward C. Waters, David W. Holland and Bruce A. Weber, "Interregional Effects of Reduced Timber Harvests: The Impact of the Northern Spotted Owl Listing in Rural and Urban Oregon," *Journal of Agricultural and Resource Economics* 19, no. 1 (07//) (1994.): 141.

[60] Ibid., 142.

[61] Ibid., 152.

percent in the periphery areas.[62] Furthermore, Metro area job loss would only account for between eleven and fifteen percent of total job loss.[63] The authors suggest that "most of the development benefits resulting from a better environment in the region will accrue along the already dynamic Interstate-5 corridor, whereas most of the economic sacrifice will be felt in smaller rural communities." [64]

Comparatively, I am attempting to quantify the social costs of protecting the Northern Spotted Owl. The literature focuses on valuing the economic costs of saving the Northern Spotted Owl and the national benefits that may be accrued. Although, it appears to be widely accepted that there are significant distributional consequences, there has been little attempt to quantify the social implications. It is important to both recognize the distribution of economic costs and the social implications that will result from some communities being disproportionately impacted.

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[62] Ibid., 157

[63] Ibid., 156.

[64] Ibid., 157.

CHAPTER 3

THEORY

This study is primarily concerned with the social effects of an exogenous shock. In this case the exogenous shock is the total impact of the decision to protect the Northern Spotted Owl. This decision had a multitude of effects on the economy of the Washington state counties both on the Olympic Peninsula and in the I-5 corridor. These included the closure of all the mills on the Olympic Peninsula and the cessation of the harvest of old growth timber.

In attempting to model this I have constructed a two equation system. The first equation has crime as the dependent variable. The second equation has taxable retail sales as the dependent variable. For the crime model, the independent variables are a measure of the level of youth in a given county, the total population in said county, and the level of taxable retail sales in the county. While the taxable retail sales model has as independent variables crime in the given county, per capita income in the county and the old growth harvest in the county.

Measurement problems are, in part, due to the difficulty or impossibility of directly observing social effects. Old growth harvest is used as a proxy for the impact of the Northern Spotted Owl, as it is the only available variable with yearly by county data. Therefore it is expected to have a positive and significant coefficient as the impact of the

Northern Spotted Owl was to depress the local economic conditions via the decrease in the old growth harvest. While, per capita income is used to take into account changes that may have occurred due to exogenous factors such as the business cycle. Crime is included as an independent variable in the taxable retail sales model so as to allow crime to influence taxable retail sales. Comparatively, in the crime model taxable retail sales are included as local economic conditions are believed to significantly influence the propensity of the population to engage in crime. Additionally, population and the proportion of youth in said population are included in the crime model to account for the effect of population density and composition on crime rates.

CHAPTER 4

RESULTS

Introduction

These results provide compelling evidence that localized economic downturns, due to preservation policy related to the Northern Spotted Owl, are significantly associated with an increase in crime. These results are not concerned with a general economic downturn. The null hypothesis of no relationship between crime and local economic conditions, H_0: R=0, is rejected by statistically significant results for each of eleven definitions of crime with one alternative specification of the relationship for each definition of crime. The resulting twenty-two regression results are presented Table 4.1 a-d Summary of Results. The R^2 statistics range from 0.58 to 0.95. Almost all independent variables are statistically significantly different from zero at the ten percent level or better. Overall crime is disaggregated in order to analyze the effects of local economic conditions on specific types of crime as data allow. There are two reasons to examine disaggregated data: Aggregation of data may mask or distort relationships in the underlying data and, as a policy issue, some crime categories may be of greater concern than others. As shown in Table 4.1, when the crime index is disaggregated by crime type, the relationships of arson, aggravated assault, and motor vehicle theft shift. As subsequently discussed in the analysis of each relationship between local economic conditions and crime type, these crimes are atypical.

The most surprising aspect of these results is that there appears to be a significant relationship between certain types of crime and the level of the old growth harvest in the periods reviewed. When crime is specified as total reported index crimes (which includes reported murder, rape, robbery, aggravated assault, arson, burglary, theft, and motor vehicle theft), there is a strong negative relationship between the level of the old growth harvest and crime. This provides a striking view of the impacts of public policy with regard to the cutting of old growth forests. Typically public policy regarding the management of natural resources is presented as a tradeoff between economic benefits of harvesting today, and the unknown benefits of preservation to maintain biodiversity or protect a given species. Social costs have been ignored in large part, with the thinking being that there is not a substantive difference between the social costs of a given economic downturn of a general recession, as opposed to a localized downturn due to preservation.

Some regressions exhibit Durbin-Watson statistics that may suggest that serial correlation of error terms for ordinary least squares regression may exist. However, given the use of seemingly unrelated regression, their relevance is questionable. Attempts were made to deal with the possible serial correlation problem through the introduction of time variables and the use of first differences.

These statistically significant correlations between local economic conditions and crime are strong for all crime aggregations, while for the disaggregated crime models, the economic crimes of theft and robbery have especially high correlations.

Measure Construction

These results are all based on a database of annual county level data from 1985-2001 for Clallam, Jefferson, King, Pierce, Snohomish, and Thurston counties in Washington state. Clallam and Jefferson counties are rural counties on the Olympic Peninsula that felt the greatest impact due to the preservation policy related to the Northern Spotted Owl. In contrast, King, Pierce, Snohomish and Thurston counties are urban counties in the I-5 corridor in and around Seattle. In constructing the model, the variables of interest were first standardized by subtracting the mean for all counties over all years and then dividing by the standard deviation. To deal with first level autocorrelation, all the variables were then differenced.

Crime Model

Total reported index crimes, which are summations of reported murder, rape, robbery, aggravated assault, arson, burglary, theft, and motor vehicle theft, were taken as the dependent variable. A measure of the proportion of young to total population was constructed by dividing the number of people between 15 and 29 in a given county by the total population in said county. This measure was standardized and differenced in the same manner as all the other variables. Total reported index crimes were modeled as a function of the above measure of the proportion of young to total population, taxable retail sales, and total population.

An alternative specification was also tried, wherein total population was removed from the model and the proportion of young to total population was replaced with total young population. This was attempted in order to ascertain the sensitivity of the model to

the specification of population. The results for this specification are reported after the results for the original specification above.

Taxable Retail Sales Model

Taxable retail sales in turn were regressed on total reported index crimes, per capita income, and the old growth harvest. Recall, that in this simultaneous equation model, using seemingly unrelated regression, total reported index crimes is an independent variable for taxable retail sales, but it is the dependant variable in the other simultaneous equation.

Seemingly Unrelated Regression

Seemingly unrelated regression (SUR) is a technique for analyzing a system of multiple equations with correlated error terms and parameter restrictions.[1] The two equations used herein have different dependent variables and some different independent variables. Since the two equations are using the same data, the errors may be correlated. SUR is an extension of the linear regression model that allows correlated errors between equations. Rather than estimating the system of equations individually by least squares, the SUR method is applied.[2]

Results

In Table 4.1 a-d, seemingly unrelated regression is used to simultaneously estimate the model for three aggregate measures of crime and eight individual measures of crime.

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[1] Parameter restrictions are not present in this model.
[2] Zellner, 348-368.

Each of these estimates is attempted both with the original specification and the alternative specification discussed above. On each page the top half contains results for the original specification, while the bottom half contains results for the alternative specification. In bold at the top of each column is the measure of crime used for computing the results in that column. Thus there are eleven columns reporting 22 simultaneous regression results including adjusted R-squared, Durbin-Watson statistics, t-statistics for the slope coefficients and the individual slope coefficients. Following the summary table, detailed analysis of each simultaneous regression and its alternative specification will be discussed.

Table 4.1a: Summary of Results

Original Specification

	Total Crimes	**NonViolent Crime**	**Violent Crime**
	Adj R-Sq (D-W)	Adj R-Sq (D-W)	Adj R-Sq (D-W)
Crime Model	0.9493	0.9454	0.8744
	(1.65)	(1.67)	(1.50)
Taxable Retail Sales Model	0.8807	0.8807	0.8815
	(1.78)	(1.78)	(1.79)
Coefficient	Estimate (t value)	Estimate (t value)	Estimate (t value)
Proportion Young to Total	0.145504	0.151696	0.072302
	(-5.21)	(5.20)	(1.69)
Taxable Retail Sales	-0.10568	-0.08681	-0.3148
	(-1.67)	(-1.31)	(-3.24)
Total Population	0.95327	0.938091	1.097949
	(12.62)	(11.88)	(9.47)
Crime	0.740758	0.740628	0.708504
	(15.08)	(15.08)	(14.34)
Per Capita Income	0.416914	0.417072	0.431887
	(14.83)	(14.84)	(15.23)
Total Old Growth Harvest	0.122538	0.122835	0.140119
	(3.83)	(3.85)	(4.29)

Alternative Specification

	Total Crimes	**Non-Violent Crime**	**Violent Crime**
	Adj R-Sq (D-W)	Adj R-Sq (D-W)	Adj R-Sq (D-W)
Crime Model	0.9483	0.9445	0.8652
	(1.67)	(-1.69)	(1.38)
Taxable Retail Sales Model	0.8805	0.8808	0.8324
	(1.77)	(1.77)	(1.67)
Coefficient	Estimate (t value)	Estimate (t value)	Estimate (t value)
Total Young Population	0.966364	0.964964	0.876997
	(27.17)	(26.02)	(16.79)
Taxable Retail Sales	-0.06226	-0.0545	-0.05187
	(-2.08)	(-1.74)	(-1.18)
Crime	0.744474	0.741752	0.784209
	(15.17)	(15.27)	(13.59)
Per Capita Income	0.413173	0.411181	0.417835
	(14.75)	(14.70)	(13.50)
Total Old Growth Harvest	0.123274	0.122368	0.130433
	(3.88)	(3.86)	(3.85)

Table 4.1 b: Summary of Results

Original Specification

	Murder	Rape	Robbery
	Adj R-Sq (D-W)	Adj R-Sq (D-W)	Adj R-Sq (D-W)
Crime Model	0.6011	0.7624	0.8947
	(2.69)	(2.14)	(2.08)
Taxable Retail Sales Model	0.8815	0.8815	0.8815
	(1.79)	(1.79)	(1.79)
Coefficient	Estimate (t value)	Estimate (t value)	Estimate (t value)
Proportion Young to Total	0.093268	0.004544	0.122474
	(0.93)	(0.07)	(2.86)
Taxable Retail Sales	-0.55113	-0.88401	-0.26461
	(-2.41)	(-5.95)	(-2.71)
Total Population	1.372808	1.642198	1.116831
	(5.03)	(9.27)	(9.61)
Crime	0.70666	0.705304	0.711591
	(14.30)	(14.28)	(14.41)
Per Capita Income	0.432877	0.433607	0.430377
	(15.27)	(15.29)	(15.19)
Total Old Growth Harvest	0.141458	0.142101	0.13902
	(4.33)	(4.35)	(4.26)

Alternative Specification

	Murder	Rape	Robbery
	Adj R-Sq (D-W)	Adj R-Sq (D-W)	Adj R-Sq (D-W)
Crime Model	0.5824	0.7372	0.8893
	(2.59)	(2.09)	(2.00)
Taxable Retail Sales Model	0.7328	0.7255	0.8526
	(2.18)	(1.99)	(1.84)
Coefficient	Estimate (t value)	Estimate (t value)	Estimate (t value)
Total Young Population	1.139859	1.179521	0.997001
	(9.57)	(14.67)	(18.87)
Taxable Retail Sales	-0.1804	-0.35594	-0.08827
	(-1.78)	(-5.24)	(-1.98)
Crime	0.519896	0.577287	0.711196
	(10.40)	(9.32)	(14.04)
Per Capita Income	0.487937	0.513243	0.427566
	(13.36)	(13.80)	(14.40)
Total Old Growth Harvest	0.186014	0.184846	0.130919
	(4.63)	(4.51)	(3.91)

Table 4.1c: Summary of Results

Original Specification

	Aggra Assault	Arson	Burglary
	Adj R-Sq (D-W)	Adj R-Sq (D-W)	Adj R-Sq (D-W)
Crime Model	0.7636	0.6504	0.7437
	(1.48)	(2.64)	(2.61)
Taxable Retail Sales Model	0.8815	0.8814	0.8812
	(1.79)	(1.79)	(1.79)
Coefficient	Estimate (t value)	Estimate (t value)	Estimate (t value)
Proportion Young to Total	0.049651	0.210351	0.43173
	(0.87)	(2.45)	(4.98)
Taxable Retail Sales	-0.23224	0.319059	-0.45628
	(-1.79)	(1.64)	(-2.32)
Total Population	0.956537	0.486904	1.198179
	(6.19)	(2.09)	(5.11)
Crime	0.706343	0.716907	0.727489
	(14.30)	(14.56)	(14.80)
Per Capita Income	0.43299	0.4292	0.423795
	(15.27)	(15.22)	(15.05)
Total Old Growth Harvest	0.141458	0.137629	0.128664
	(4.33)	(4.27)	(4.01)

Alternative Specification

	Aggra Assault	Arson	Burglary
	Adj R-Sq (D-W)	Adj R-Sq (D-W)	Adj R-Sq (D-W)
Crime Model	0.7471	0.6374	0.7487
	(1.39)	(2.64)	(2.64)
Taxable Retail Sales Model	0.798	0.7717	0.7672
	(1.58)	(2.29)	(1.95)
Coefficient	Estimate (t value)	Estimate (t value)	Estimate (t value)
Total Young Population	0.705266	0.692914	1.712902
	(10.54)	(7.11)	(15.99)
Taxable Retail Sales	0.073866	0.274473	-0.75123
	(1.30)	(3.26)	(-8.30)
Crime	0.835601	0.689834	0.426606
	(13.67)	(14.03)	(9.22)
Per Capita Income	0.393466	0.357901	0.581578
	(12.12)	(10.60)	(16.42)
Total Old Growth Harvest	0.132609	0.123447	0.216693
	(3.90)	(3.57)	(5.24)

Table 4.1d: Summary of Results

Original Specification

	Theft	Motor Veh Theft
	Adj R-Sq (D-W)	Adj R-Sq (D-W)
Crime Model	0.9523	0.9187
	(1.32)	(2.22)
Taxable Retail Sales Model	0.8814	0.8814
	(1.78)	(1.79)
Coefficient	Estimate (t value)	Estimate (t value)
Proportion Young to Total	0.122281	-0.16715
	(4.52)	(-3.69)
Taxable Retail Sales	-0.1334	0.75978
	(-2.17)	(7.39)
Total Population	0.967317	0.242441
	(13.18)	(1.97)
Crime	0.716982	0.717829
	(14.53)	(14.60)
Per Capita Income	0.427555	0.429394
	(15.10)	(15.25)
Total Old Growth Harvest	0.135729	0.139359
	(4.17)	(4.34)

Alternative Specification

	Theft	Motor Veh Theft
	Adj R-Sq (D-W)	Adj R-Sq (D-W)
Crime Model	0.9495	0.9008
	(1.25)	(2.21)
Taxable Retail Sales Model	0.8881	0.9004
	(1.64)	(2.21)
Coefficient	Estimate (t value)	Estimate (t value)
Total Young Population	0.921282	-0.01219
	(26.87)	(-0.39)
Taxable Retail Sales	-0.04019	1.009881
	(-1.39)	(28.98)
Crime	0.774129	0.992186
	(15.73)	(32.70)
Per Capita Income	0.407775	0.002082
	(14.90)	(0.12)
Total Old Growth Harvest	0.120256	0.006085
	(3.86)	(0.49)

In Table 4.2, seemingly unrelated regression is used to simultaneously estimate the original crime model and the taxable retail sales model, such that

Tot Rep Index Crimes =
Proportion of young to Total Pop + Taxable retail sales + Total Population

Taxable Retail Sales =
Total Reported Index Crimes + Per Capita Income + Total Old Growth Harvest

Proportion of young to total population, total population, total reported index crimes, per capita income, and total old growth harvest are all significant at the 1 percent level, while taxable retail sales is significant at the 10 percent level. Given the positive sign on total old growth harvest, it can be seen that the decrease in the cutting of old growth hurt the local economy, which in turn increased crime, as seen in the negative sign on taxable retail sales in the crime model. This suggests a powerful social effect that may not have been anticipated when the Northwest Forest Plan was constructed.

Table 4.2: Original Specification for Total Reported Index Crimes

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Index Crimes Model	3	98	0.5354	0.00546	0.0739	0.9503	0.9493
Taxable Retail Sales Model	3	98	2.0367	0.0208	0.1442	0.8831	0.8807

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Proportion Young to Total Pop	0.145504	0.0279	5.21	<.0001
Taxable Retail Sales	-0.10568	0.0632	-1.67	0.0978
Total Population	0.95327	0.0755	12.62	<.0001
Total Reported Index Crimes	0.740758	0.0491	15.08	<.0001
Per Capita Income	0.416914	0.0281	14.83	<.0001
Total Old Growth Harvest	0.122538	0.0320	3.83	0.0002

Number of Observations		Statistics for System	
Used	101	Objective	1.9037
Missing	1	Objective*N	192.2711

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Index Crimes Model	1	1.65	0.0460	0.9540
Taxable Retail Sales Model	1	1.78	0.1516	0.8484

In Table 4.3, seemingly unrelated regression is used to simultaneously estimate the alternative crime model and the taxable retail sales model. As previously discussed the alternative specification is reported in order to elucidate the model's sensitivity to the specification of population. In this model, the coefficient of total young population was used as opposed to the proportion of young to total population used in the original specification shown in Table 4.2. Additionally, the coefficient of total population is omitted as total population was removed from the crime model. This results in equations of the following form:

Tot Rep Index Crimes = Total Young Population + Taxable retail sales

Taxable Retail Sales =
Total Reported Index Crimes + Per Capita Income + Total Old Growth Harvest

Although this specification has similar results, it suggests that the model of crime is somewhat sensitive to the specification of population. It still shows the surprising and significant social impacts of the cessation of the old growth harvest. However, the t statistic for the independent variable taxable retail sales is substantially improved, making it significant at the five-percent level in the crime model. In order to determine if the impact was specific to certain crimes, the regression was run with several subsets of total reported index crimes.

Table 4.3: Alternative Specification for Total Reported Index Crimes

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Index Crimes Alt Model	2	99	0.5520	0.00558	0.0747	0.9488	0.9483
Taxable Retail Sales Model	3	98	2.0401	0.0208	0.1443	0.8829	0.8805

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Total Young Population	0.966364	0.0356	27.17	<.0001
Taxable Retail Sales	-0.06226	0.0300	-2.08	0.0405
Total Reported Index Crimes	0.744474	0.0491	15.17	<.0001
Per Capital Income	0.413173	0.0280	14.75	<.0001
Total Old Growth Harvest	0.123274	0.0318	3.88	0.0002

Number of Observations		Statistics for System	
Used	101	Objective	1.9299
Missing	1	Objective*N	194.9156

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Index Crimes Alt Model	1	1.67	0.0562	0.9438
Taxable Retail Sales Model	1	1.77	0.1412	0.8588

In Table 4.4, seemingly unrelated regression is used to simultaneously estimate the original crime model and the taxable retail sales model. However, in this model, the specification of crime is changed such that total reported index crimes are replaced with total reported non-violent crimes, where total reported non-violent crime includes arson, burglary, theft, and motor vehicle theft. Taxable retail sales cease to be significant even at the ten percent level, although the magnitudes of the coefficients remain similar and of the same sign. This implies that the major effect on crime of the preservation policy related to the Northern Spotted Owl was not well represented in this aggregation.

Table 4.4: Original Specification for Non-Violent Crime

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Non-Viol Crime Model	3	98	0.5858	0.00598	0.0773	0.9465	0.9454
Taxable Retail Sales Model	3	98	2.0365	0.0208	0.1442	0.8831	0.8807

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Proportion Young to Total Pop	0.151696	0.0292	5.20	<.0001
Taxable Retail Sales	-0.08681	0.0661	-1.31	0.1919
Total Population	0.938091	0.0790	11.88	<.0001
Total Reported Non-Violent Crimes	0.740628	0.0491	15.08	<.0001
Per Capita Income	0.417072	0.0281	14.84	<.0001
Total Old Growth Harvest	0.122835	0.0319	3.85	0.0002

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Non-Viol Crime Model	1	1.67	0.0532	0.9468
Taxable Retail Sales Model	1	1.78	0.1517	0.8483

In Table 4.5, seemingly unrelated regression is used to simultaneously estimate the alternative non-violent crime model and the taxable retail sales model. In this model, the coefficient of total young population is used as opposed to the proportion of young to total population in the original specification shown in Table 4.2. Additionally, the coefficient of total population is omitted as total population was removed from the crime model. All the instances of total reported index crimes were changed to total reported non-violent crimes, which includes arson, burglary, theft, and motor vehicle theft.

In this specification Taxable Retail Sales is significant at the ten percent level as an indicator of crime. These results suggest that the impact of the Northwest Forest Plan on non-violent crime is substantial, which the other specification does not suggest. These different results suggest that the specification of population should be examined in greater detail.

Table 4.5: Alternative Specification for Non-Violent Crime

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Non-Viol Crime Alt Model	2	99	0.6015	0.00608	0.0779	0.9451	0.9445
Taxable Retail Sales Model	3	98	2.0361	0.0208	0.1441	0.8831	0.8808

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Total Young Population	0.964964	0.0371	26.02	<.0001
Taxable Retail Sales	-0.0545	0.0313	-1.74	0.0844
Total Reported Non-Violent Crimes	0.741752	0.0486	15.27	<.0001
Per Capita Income	0.411181	0.0280	14.70	<.0001
Total Old Growth Harvest	0.122368	0.0317	3.86	0.0002

Number of Observations		Statistics for System	
Used	101	Objective	1.9279
Missing	1	Objective*N	194.7221

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Non-Viol Crime Alt Model	1	1.69	0.0724	0.9276
Taxable Retail Sales Model	1	1.77	0.1432	0.8568

In Table 4.6, seemingly unrelated regression is used to simultaneously estimate the original crime model and the taxable retail sales model. However, in this model the specification of crime is changed such that total reported index crimes are replaced with total reported violent crimes, which includes murder, rape, robbery, and aggravated assault.

Compared to non-violent crime, these results make the proportion of young to total population insignificant, while taxable retail sales become significant at the one percent level. These results are expected as the hypothesis was that those most impacted by the preservation policy related to the Northern Spotted Owl were older people working family wage jobs.

Table 4.6: Original Specification for Violent Crime

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Violent Crime Model	3	98	1.1792	0.0120	0.1097	0.8769	0.8744
Taxable Ret Sales Model	3	98	2.0233	0.0206	0.1437	0.8839	0.8815

Nonlinear SUR Parameter Estimate

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Proportion Young to Total Pop	0.072302	0.0427	1.69	0.0937
Taxable Retail Sales	-0.3148	0.0972	-3.24	0.0016
Total Population	1.097949	0.1160	9.47	<.0001
Total Reported Violent Crimes	0.708504	0.0494	14.34	<.0001
Per Capita Income	0.431887	0.0284	15.23	<.0001
Total Old Growth Harvest	0.140119	0.0327	4.29	<.0001

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Violent Crime Model	1	1.50	0.0064	0.9936
Taxable Ret Sales Model	1	1.79	0.1629	0.8371

In Table 4.7, seemingly unrelated regression is used to simultaneously estimate the alternative violent crime model and the taxable retail sales model. In this model, total young population is used instead of the proportion of young to total population in the original specification shown in Table 4.2. Additionally, total population is omitted from the crime model. Note, that the specification of crime is changed such that total reported index crimes are replaced with total reported violent crimes, which include murder, rape, robbery, and aggravated assault.

One can clearly see that the shifting of the specification has resulted in dramatic change in the significance of taxable retail sales. This shows the model's sensitive to the specification of population, and suggests that further research is needed.

Table 4.7: Alternative Specification for Violent Crime

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Violent Crime Alt Model	2	99	1.2788	0.0129	0.1137	0.8665	0.8652
Taxable Retail Sales Model	3	98	2.8623	0.0292	0.1709	0.8357	0.8324

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Total Young Population	0.876997	0.0522	16.79	<.0001
Taxable Retail Sales	-0.05187	0.0439	-1.18	0.2405
Total Reported Violent Crimes	0.784209	0.0577	13.59	<.0001
Per Capita Income	0.417835	0.0310	13.50	<.0001
Total Old Growth Harvest	0.130433	0.0338	3.85	0.0002

Number of Observations		Statistics for System	
Used	101	Objective	1.8576
Missing	1	Objective*N	187.6193

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Violent Crime Alt Model	1	1.38	0.0010	0.9990
Taxable Retail Sales Model	1	1.67	0.0557	0.9443

The results of further disaggregating the crime data and running regressions on individual reported index crimes are reported in Tables 4.8-4.23. In Table 4.8, seemingly unrelated regression is used to simultaneously estimate the original crime model and the taxable retail sales model. However, in this model, the specification of crime is changed such that total reported index crimes are replaced with total reported murders.

Table 4.8: Original Specification for Murder

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Murders Model	3	98	6.5176	0.0665	0.2579	0.6091	0.6011
Taxable Retail Sales Model	3	98	2.0232	0.0206	0.1437	0.8839	0.8815

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Prop Young to Total Pop	0.093268	0.1005	0.93	0.3556
Taxable Retail Sales	-0.55113	0.2288	-2.41	0.0179
Total Population	1.372808	0.2729	5.03	<.0001
Total Reported Murders	0.70666	0.0494	14.30	<.0001
Per Capita Income	0.432877	0.0284	15.27	<.0001
Total Old Growth Harvest	0.141458	0.0327	4.33	<.0001

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Murders Model	1	2.69	0.9999	0.0001
Taxable Retail Sales Model	1	1.79	0.1636	0.8364

In Table 4.9, seemingly unrelated regression is used to simultaneously estimate the alternative crime model and the taxable retail sales model. For this regression, total young population is used instead of the proportion of young to total population in the original specification shown in Table 4.2. Additionally, total population is omitted from the crime model. All the instances of total reported index crimes were changed to total reported murders.

Table 4.9: Alternative Specification for Murder

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Murders Alt Model	2	99	6.8935	0.0696	0.2639	0.5865	0.5824
Taxable Retail Sales Model	3	98	4.5628	0.0466	0.2158	0.7381	0.7328

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Total Young Population	1.139859	0.1191	9.57	<.0001
Taxable Retail Sales	-0.1804	0.1016	-1.78	0.0788
Total Reported Murders	0.519896	0.0500	10.40	<.0001
Per Capita Income	0.487937	0.0365	13.36	<.0001
Total Old Growth Harvest	0.186014	0.0402	4.63	<.0001

Number of Observations		Statistics for System	
Used	101	Objective	1.7875
Missing	1	Objective*N	180.5353

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Murders Alt Model	1	2.59	0.9992	0.0008
Taxable Retail Sales Model	1	2.18	0.8385	0.1615

In Table 4.10, seemingly unrelated regression is used to simultaneously estimate the original crime model and the taxable retail sales model. However, in this model the specification of crime is changed such that total reported index crimes are replaced with total reported rapes.

Table 4.10: Original Specification for Rape

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Rapes Model	3	98	2.7472	0.0280	0.1674	0.7671	0.7624
Taxable Retail Sales Model	3	98	2.0232	0.0206	0.1437	0.8839	0.8815

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Prop Young to Total Pop	0.004544	0.0653	0.07	0.9446
Taxable Retail Sales	-0.88401	0.1486	-5.95	<.0001
Total Population	1.642198	0.1772	9.27	<.0001
Total Reported Rapes	0.705304	0.0494	14.28	<.0001
Per Capita Income	0.433607	0.0284	15.29	<.0001
Total Old Growth Harvest	0.142101	0.0327	4.35	<.0001

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Rapes Model	1	2.14	0.7896	0.2104
Taxable Retail Sales Model	1	1.79	0.1646	0.8354

In Table 4.11, seemingly unrelated regression is used to simultaneously estimate the alternative crime model and the taxable retail sales model. In this model, total young population is used instead of the proportion of young to total population in the original specification shown in Table 4.2. Additionally, total population is omitted from the crime model. Note that the specification of crime is changed such that total reported index crimes are replaced with total reported rapes. The alternative specification yields similarly powerful results. However, it does suggest that one should be careful about drawing conclusions about which segment of the population was responsible, as shown by the significance of total young population at the 1% level.

Table 4.11: Alternative Specification for Rape

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Rapes Alt Model	2	99	3.0694	0.0310	0.1761	0.7398	0.7372
Taxable Retail Sales Model	3	98	4.6864	0.0478	0.2187	0.7310	0.7255

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Total Young Population	1.179521	0.0804	14.67	<.0001
Taxable Retail Sales	-0.35594	0.0679	-5.24	<.0001
Total Reported Rapes	0.577287	0.0620	9.32	<.0001
Per Capita Income	0.513243	0.0372	13.80	<.0001
Total Old Growth Harvest	0.184846	0.0410	4.51	<.0001

Number of Observations		Statistics for System	
Used	101	Objective	1.8058
Missing	1	Objective*N	182.3902

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Rapes Alt Model	1	2.09	0.7032	0.2968
Taxable Retail Sales Model	1	1.99	0.5228	0.4772

In Table 4.12, seemingly unrelated regression is used to simultaneously estimate the original crime model and the taxable retail sales model. However, in this model the specification of crime is changed such that total reported index crimes are replaced with total reported robberies.

Table 4.12: Original Specification for Robbery

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Robberies Model	3	98	1.1898	0.0121	0.1102	0.8968	0.8947
Taxable Retail Sales Model	3	98	2.0236	0.0206	0.1437	0.8839	0.8815

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Prop Young to Total Pop	0.122474	0.0428	2.86	0.0052
Taxable Retail Sales	-0.26461	0.0975	-2.71	0.0078
Total Population	1.116831	0.1163	9.61	<.0001
Total Reported Robberies	0.711591	0.0494	14.41	<.0001
Per Capita Income	0.430377	0.0283	15.19	<.0001
Total Old Growth Harvest	0.13902	0.0326	4.26	<.0001

Number of Observations		Statistics for System	
Used	101	Objective	1.9372
Missing	1	Objective*N	195.6540

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Robberies Model	1	2.08	0.6811	0.3189
Taxable Retail Sales Model	1	1.79	0.1606	0.8394

In Table 4.13, seemingly unrelated regression is used to simultaneously estimate the alternative crime model and the taxable retail sales model. In this model, total young population is used instead of the proportion of young to total population in the original specification shown in Table 4.2. Additionally, total population is omitted from the crime model. Note the specification of crime is changed such that total reported index crimes are replaced with total reported robberies.

Table 4.13: Alternative Specification for Robbery

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Robberies Alt Model	2	99	1.2638	0.0128	0.1130	0.8904	0.8893
Taxable Retail Sales Model	3	98	2.5173	0.0257	0.1603	0.8555	0.8526

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Total Young Population	0.997001	0.0528	18.87	<.0001
Taxable Retail Sales	-0.08827	0.0445	-1.98	0.0500
Total Reported Robberies	0.711196	0.0507	14.04	<.0001
Per Capita Income	0.427566	0.0297	14.40	<.0001
Total Old Growth Harvest	0.130919	0.0335	3.91	0.0002

Number of Observations		Statistics for System	
Used	101	Objective	1.8964
Missing	1	Objective*N	191.5351

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Robberies Alt Model	1	2.00	0.5397	0.4603
Taxable Retail Sales Model	1	1.84	0.2389	0.7611

In Table 4.14, seemingly unrelated regression is used to simultaneously estimate the original crime model and the taxable retail sales model. However, in this model the specification of crime is changed such that total reported index crimes are replaced with total reported aggravated assault.

Table 4.14: Original Specification for Aggravated Assault

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Aggra Assault Model	3	98	2.0880	0.0213	0.1460	0.7683	0.7636
Taxable Retail Sales Model	3	98	2.0232	0.0206	0.1437	0.8839	0.8815

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Prop Young to Total Pop	0.049651	0.0569	0.87	0.3851
Taxable Retail Sales	-0.23224	0.1296	-1.79	0.0762
Total Population	0.956537	0.1546	6.19	<.0001
Total Reported Aggravated Assault	0.706343	0.0494	14.30	<.0001
Per Capita Income	0.43299	0.0284	15.27	<.0001
Total Old Growth Harvest	0.141458	0.0327	4.33	<.0001

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Aggra Assault Model	1	1.48	0.0050	0.9950
Taxable Retail Sales Model	1	1.79	0.1639	0.8361

In Table 4.15, seemingly unrelated regression is used to simultaneously estimate the alternative crime model and the taxable retail sales model. In this model, total young population is used instead of the proportion of young to total population in the original specification shown in Table 4.2. Additionally, total population is omitted from the crime model. Note the specification of crime is changed such that total reported index crimes are replaced with total reported aggravated assault.

Table 4.15: Alternative Specification for Aggravated Assault

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Aggra Assault Alt Model	2	99	2.2570	0.0228	0.1510	0.7496	0.7471
Taxable Retail Sales Model	3	98	3.4488	0.0352	0.1876	0.8021	0.7980

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Total Young Population	0.705266	0.0669	10.54	<.0001
Taxable Retail Sales	0.073866	0.0568	1.30	0.1962
Total Reported Aggravated Assault	0.835601	0.0611	13.67	<.0001
Per Capita Income	0.393466	0.0325	12.12	<.0001
Total Old Growth Harvest	0.132609	0.0340	3.90	0.0002

Number of Observations		Statistics for System	
Used	101	Objective	1.7669
Missing	1	Objective*N	178.4529

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Aggra Assault Alt Model	1	1.39	0.0012	0.9988
Taxable Retail Sales Model	1	1.58	0.0181	0.9819

In Table 4.16, seemingly unrelated regression is used to simultaneously estimate the original crime model and the taxable retail sales model. However, in this model the specification of crime is changed such that total reported index crimes are replaced with total reported arson.

Table 4.16: Original Specification for Arson

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Total Reported Arson Model	3	98	4.9607	0.0506	0.2250	0.6574	0.6504
Taxable Retail Sales Model	3	98	2.0244	0.0207	0.1437	0.8838	0.8814

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Prop Young to Total Pop	0.210351	0.0860	2.45	0.0162
Taxable Retail Sales	0.319059	0.1951	1.64	0.1052
Total Population	0.486904	0.2330	2.09	0.0392
Total Reported Arson	0.716907	0.0282	15.22	<.0001
Total Old Growth Harvest	0.137629	0.0322	4.27	<.0001

Number of Observations		Statistics for System	
Used	101	Objective	1.9210
Missing	1	Objective*N	194.0163

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Total Reported Arson Model	1	2.64	0.9996	0.0004
Taxable Retail Sales Model	1	1.79	0.1604	0.8396

The Durbin-Watson statistic suggests there are substantial problems with this regression. However, this is unimportant as arson is not posited as driven by taxable retail sales or old growth harvests.

In Table 4.17, seemingly unrelated regression is used to simultaneously estimate the alternative crime model and the taxable retail sales model. In this model, total young population is used instead of the proportion of young to total population in the original specification shown in Table 4.2. Additionally, total population is omitted from the crime model. Note the specification of crime is changed such that total reported index crimes are replaced with total reported arson. These results are not as important as arson is not viewed as related to the impact of the Northwest Forest Plan, but are included for completeness.

Table 4.17: Alternative Specification for Arson

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Total Reported Arson Alt Model	2	99	5.1966	0.0525	0.2291	0.6411	0.6374
Taxable Retail Sales Model	3	98	3.8986	0.0398	0.1995	0.7762	0.7717

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Total Young Population	0.692914	0.0974	7.11	<.0001
Taxable Retail Sales	0.274473	0.0843	3.26	0.0015
Total Reported Arson	0.689834	0.0492	14.03	<.0001
Per Capita Income	0.357901	0.0338	10.60	<.0001
Total Old Growth Harvest	0.123447	0.0346	3.57	0.0006

Number of Observations		Statistics for System	
Used	101	Objective	1.6773
Missing	1	Objective*N	169.4045

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Total Reported Arson Alt Model	1	2.64	0.9997	0.0003
Taxable Retail Sales Model	1	2.29	0.9392	0.0608

In Table 4.18, seemingly unrelated regression is used to simultaneously estimate the original crime model and the taxable retail sales model. However, in this model the specification of crime is changed such that total reported index crimes are replaced with total reported burglaries.

Table 4.18: Original Specification for Burglary

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Burglaries Model	3	98	5.1052	0.0521	0.2282	0.7489	0.7437
Taxable Retail Sales Model	3	98	2.0287	0.0207	0.1439	0.8836	0.8812

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Prop Young to Total Pop	0.43173	0.0866	4.98	<.0001
Taxable Retail Sales	-0.45628	0.1963	-2.32	0.0222
Total Population	1.198179	0.2345	5.11	<.0001
Total Reported Burglaries	0.727489	0.0492	14.80	<.0001
Per Capita Income	0.423795	0.0282	15.05	<.0001
Total Old Growth Harvest	0.128664	0.0321	4.01	0.0001

Number of Observations		Statistics for System	
Used	101	Objective	1.9120
Missing	1	Objective*N	193.1144

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Burglaries Model	1	2.61	0.9993	0.0007
Taxable Retail Sales Model	1	1.79	0.1597	0.8403

In Table 4.19, seemingly unrelated regression is used to simultaneously estimate the alternative crime model and the taxable retail sales model. In this model, total young population is used instead of the proportion of young to total population in the original specification shown in Table 4.2. Additionally, total population is omitted from the crime model. Note the specification of crime is changed such that total reported index crimes are replaced with total reported burglaries.

Table 4.19: Alternative Specification for Burglary

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Burglaries Alt Model	2	99	5.0579	0.0511	0.2260	0.7512	0.7487
Taxable Retail Sales Model	3	98	3.9747	0.0406	0.2014	0.7719	0.7672

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Total Young Population	1.712902	0.1071	15.99	<.0001
Taxable Retail Sales	-0.75123	0.0905	-8.30	<.0001
Total Reported Burglaries	0.426606	0.0463	9.22	<.0001
Per Capita Income	0.581578	0.0354	16.42	<.0001
Total Old Growth Harvest	0.216693	0.0413	5.24	<.0001

Number of Observations		Statistics for System	
Used	101	Objective	1.9101
Missing	1	Objective*N	192.9176

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Burglaries Alt Model	1	2.64	0.9997	0.0003
Taxable Retail Sales Model	1	1.95	0.4499	0.5501

In Table 4.20, seemingly unrelated regression is used to simultaneously estimate the original crime model and the taxable retail sales model. However, in this model the specification of crime is changed such that total reported index crimes are replaced with total reported theft.

Table 4.20: Original Specification for Theft

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Total Reported Theft Model	3	98	0.4767	0.00486	0.0697	0.9532	0.9523
Taxable Retail Sales Model	3	98	2.0247	0.0207	0.1437	0.8838	0.8814

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Prop Young to Total Pop	.122281	0.0270	4.52	<.0001
Taxable Retail Sales	-0.1334	0.0615	-2.17	0.0326
Total Population	0.967317	0.0734	13.18	<.0001
Total Reported Theft	0.716982	0.0494	14.53	<.0001
Per Capita Income	0.427555	0.0283	15.10	<.0001
Total Old Growth Harvest	0.135729	0.0326	4.17	<.0001

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Total Reported Theft Model	1	1.32	0.0003	0.9997
Taxable Retail Sales Model	1	1.78	0.1581	0.8419

In Table 4.21, seemingly unrelated regression is used to simultaneously estimate the alternative crime model and the taxable retail sales model. In this model, total young population is used instead of the proportion of young to total population in the original specification shown in Table 4.2. Additionally, total population is omitted from the crime model. Note the specification of crime is changed such that total reported index crimes are replaced with total reported theft.

Table 4.21: Alternative Specification for Theft

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Total Reported Theft Alt Model	2	99	0.5101	0.00515	0.0718	0.9500	0.9495
Taxable Retail Sales Model	3	98	1.9107	0.0195	0.1396	0.8903	0.8881

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Total Young Population	0.921282	0.0343	26.87	<.0001
Taxable Retail Sales	-0.04019	0.0289	-1.39	0.1678
Total Reported Theft	0.774129	0.0492	15.73	<.0001
Per Capita Income	0.407775	0.0274	14.90	<.0001
Total Old Growth Harvest	0.120256	0.0311	3.86	0.0002

Number of Observations		Statistics for System	
Used	101	Objective	1.9347
Missing	1	Objective*N	195.4073

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Total Reported Theft Alt Model	1	1.25	<.0001	0.9999
Taxable Retail Sales Model	1	1.64	0.0381	0.9619

In Table 4.22, seemingly unrelated regression is used to simultaneously estimate the original crime model and the taxable retail sales model. However, in this model the specification of crime is changed such that total reported index crimes are replaced with total reported motor vehicle theft. These results are at first glance somewhat surprising, since taxable retail sales have a positive rather than negative impact on crime. However, if one considers the nature of motor vehicle theft it seems reasonable that a lack of economic activity in an area would lead to a decrease. This is because such a decrease would reduce the desirability of cars in the area, which would in turn decrease the profits to be obtained from motor vehicle theft.

Table 4.22: Original Specification for Motor-Vehicle Theft

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Mot Veh Theft Model	3	98	1.3936	0.0142	0.1192	0.9203	0.9187
Taxable Retail Sales Model	3	98	2.0246	0.0207	0.1437	0.8838	0.8814

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Prop Young to Total Pop	-0.16715	0.0453	-3.69	0.0004
Taxable Retail Sales	0.75978	0.1028	7.39	<.0001
Total Population	0.242441	0.1228	1.97	0.0511
Tot Rep Mot Veh Theft	0.717829	0.0492	14.60	<.0001
Per Capita Income	0.429394	0.0282	15.25	<.0001
Total Old Growth Harvest	0.139359	0.0321	4.34	<.0001

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Mot Veh Theft Model	1	2.22	0.8852	0.1148
Taxable Retail Sales Model	1	1.79	0.1587	0.8413

In Table 4.23, seemingly unrelated regression is used to simultaneously estimate the alternative crime model and the taxable retail sales model. In this model, total young population is used instead of the proportion of young to total population in the original specification shown in Table 4.2. Additionally, total population is omitted from the crime model. Note the specification of crime is changed such that total reported index crimes are replaced with total reported motor vehicle theft. Changing the specification causes a dramatic shift in the significance of most of the variables. This suggests that the crime model is not robust and additional research is needed.

Table 4.23: Alternative Specification for Motor-Vehicle Theft

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
Tot Rep Mot Veh Theft Alt Model	2	99	1.7171	0.0173	0.1317	0.9018	0.9008
Taxable Retail Sales Model	3	98	1.7001	0.0173	0.1317	0.9024	0.9004

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
Total Young Population	-0.01219	0.0313	-0.39	0.6980
Taxable Retail Sales	1.009881	0.0348	28.98	<.0001
Tot Rep Mot Veh Theft	0.992186	0.0303	32.70	<.0001
Per Capita Income	0.002082	0.0181	0.12	0.9087
Total Old Growth Harvest	0.006085	0.0125	0.49	0.6270

Number of Observations		Statistics for System	
Used	101	Objective	1.0766
Missing	1	Objective*N	108.7382

Durbin-Watson Statistics

Equation	Order	DW	Pr < DW	Pr > DW
Tot Rep Mot Veh Theft Alt Model	1	2.21	0.8795	0.1205
Taxable Retail Sales Model	1	2.21	0.8709	0.1291

CHAPTER 5

CONCLUSION

Overall, the effects of the protection of the conservation policy related to the Northern Spotted Owl on the Olympic Peninsula can be seen as increasing crime. When the Northwest Forest Plan was being constructed, the related economic research focused on the value of the conservation policy related to the Northern Spotted Owl to the nation as a whole as compared to the economic impact of its protection locally. As previously discussed, it does not appear as though economists were able to rigorously determine the worth of this conservation policy to the nation as a whole. There was some effort to provide at least rough estimates of the total economic costs, where economic costs were defined in terms of forgone profits from not harvesting the old growth timber. In analyzing the impact for Oregon, there was research into the net impact on unemployment in the state due to the cessation of the harvest of old growth timber. Yet, none of the research even attempted to address the social implications of such a policy. All of the analysis and all of the research ignored the social costs of the elimination of old growth harvests. These results suggest that there have been social costs and that they were substantial.

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