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THE EFFECTS OF FEDERAL LAND ON RURAL POPULATION, EMPLOYMENT, AND INCOME IN THE ROCKY MOUNTAIN WEST

Stephen Michael Cleverdon
The University of Montana

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By

STEPHEN MICHAEL CLEVERDON

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Approved by:

Perry Brown, Associate Provost for Graduate Education
Graduate School

Dr. Douglas Dalenberg, Chair
Economics

Dr. Kay Unger
Economics

Dr. Christiane von Reichert
Geography

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The Effects of Federal Land on Rural Population, Employment, and Income in the Rocky Mountain West

Chairperson: Douglas Dalenberg

There is controversy over the role that federal land plays in shaping rural counties in the Western United States. Some argue that the restrictive policies imposed on federal lands harm rural economies because the extractive industry is not allowed to operate at its potential. Others believe that those restrictions benefit rural economies because households and firms are attracted to beautiful areas with minimal industry. A lagged adjusted model is used to estimate the effects of Bureau of Land Management (BLM), United States Forest Service (USFS), and National Parks Service (NPS) lands on population, employment, and income. The study focuses on the Rocky Mountain West States during the 1990s.

The equations are estimated simultaneously using 2SLS, 3SLS, and reduced form OLS procedures. The presence of USFS land was found to have a positive impact on employment, and the presence of NPS land positively impacted income. However, the magnitude of both effects was quite small. The argument that federal land harms rural economies was not verified, but federal land did not have a strong positive impact either.

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CHAPTER ONE: INTRODUCTION

The Federal Government owns millions of acres across the Rocky Mountain West and manages the development and resource extraction of these lands. In a region that was once, and to some extent still heavily dependent on extractive industries (lumber, mining, ranching), the presence of federally owned lands may retard growth, if lumber and mining companies face greater restrictions on these lands. However, federally protected lands offer outdoor recreational opportunities, which may fuel industries that serve tourists (hotels, restaurants, outfitters, etc.) and improve growth. To determine which effect is greatest I will estimate the effect that federally owned land has on income, employment, and population in 2000. Income, employment, and population will be determined simultaneously with a model that allows for feedback between these three key variables.

Duffy-Deno (1988) found that federally designated land had no impact on population or employment densities in 1990, so it will be interesting to see if that result holds in 2000 as well. If income responds to federal land designation, then the question of whether development or conservation leads to greater growth will be more easily addressed.

Historical Overview

The Rocky Mountain West is a vast and diverse region of the United States. Made up of Montana, Idaho, Wyoming, Utah, Colorado, Nevada, New Mexico, and Arizona, it spans from Mexico to Canada and is home to natural extremes ranging from alpine glaciers to desert expanse. Early settlers crossed this area amid fears of starvation and attacks from bandits and Natives on their way to the Pacific Coast. It was the rugged independent type that was willing to carve out a living here with their bare hands and quick wit. Trappers and fur traders quickly followed the Lewis and Clark expedition and were among the first Europeans to settle this wild region. Prospectors searching for precious metals made land claims and soon mining towns were springing up from the mountain valleys of Montana to the desert's edge in Arizona. Ranchers flocked to the region to take advantage of wide open graze lands. Far from the reaches of state and federal law enforcement, towns' people had to rely on county sheriffs and often just themselves for protection.

So the image of the West was born. Its icons and legends remain in the American sub-conscience: Wyatt Earp, Jessie James, cowboys, mining towns, and the six-shooter. Although civilization eventually came to the West, many of its descendants still made a living off the land. For decades they toiled in the mines, fought fatigue and trees as lumberjacks, and raised the nation's beef on cattle ranches. It should come as no surprise then that many think of the West with those quintessential Western images in mind, and would resist change when and if it comes.

Change did come and suddenly with the collapse of the very industries that built the West. During the 1980s tens of thousands of jobs in the lumber, agriculture, mining, and smelting industries were lost due to a national recession, drought, and commodities price collapse (Power and Barrett, 2001). These jobs never quite returned and a conflict erupted between those who wish to extract resources from wilderness areas and those who wish to attract tourist by protecting federal land from resource extraction. Thus federally protected areas have become the first line of battle over resource development and the source of ire by those who say too much land has been designated off limits to unrestricted mining, farming, timber activities.

There are two opposing views concerning land use and its subsequent protection. One view, supported by proponents of wilderness designation and conservation, believe migrants and tourists are attracted to communities near protected wilderness. Migrants and tourists demand goods and services which local communities supply. This influx of money will expand the economy and employment will rise accordingly. This rise in employment will ripple through the economy leading to even greater demand and increased employment, which offsets job loss from a weakened resource extraction industries.

The opposition to this view believes that wilderness protection reduces resource employment because it limits resource extraction. Support industries, such as smelters or lumber mills will be forced to close, reducing employment even further. Proponents argue that resource dependent employment is the driving force of rural economies, so supporters of this view believe rural communities must take advantage of its resources in order to survive and thrive.

Study Outline

If employment gains from the presence of federal land through increased in migration and tourism exceeds employment losses suffered by the extractive industries, then employment will increase. If these gains are insufficient, then employment will fall. However, only taking into consideration changes in employment alone provides only a narrow view of the impact of federal land.

The relationship between income and federal land reveals more about the overall well being of households. For example, a rise in employment, coupled with a decrease in income in response to federal land can mean that low paying jobs are formed in those counties.

Therefore both employment and income will be analyzed to discern the impact of federal land on rural economies.

Duffy-Deno (1998) found that federal land designation had little effect on employment density or population density in rural counties during the 1980s. Federal land designation was not found to harm or benefit employment levels. The implication of this finding is that the lack of resource extractive opportunies created by federal land designation is not harming rural economies.

One purpose of this study is to determine if the relationship between federal land and rural economies during the 1980s as studied by Duffy-Deno (1998), and others remained the same during the 1990s. The 1980s was a time of economic restructuring in the Rocky Mountain West. Resource industries suffered heavy layoffs and the average pay per job fell steadily throughout the decade. Although still below the national average, real pay per job finally began to climb during the 1990s (Power and Barrett, 2001). In this climate of improving wages, the role of federal land may have changed.

The author will adopt the simultaneously determined lagged adjustment model used by Duffy-Deno and apply it to the 1990s. Using similar data sources, 1990s data will be used to discern any trends in shaping recent population and employment densities. Inspired by a model introduced by Deller et al. (2001), the author will expand upon the simultaneously determined lagged adjustment model by introducing income per capita to the simultaneous system of equations. By adding the income per capita equation we will be able to gain a better understanding of the economies of rural communities of the Rocky Mountain West.

The presence of U.S. Forest Service (USFS) and National Parks Service (NPS) managed land was found to have a positive impact on employment, and there is no evidence of a negative relationship between federal land and population, employment, or income. These results suggest that the presence of federal land has a more significant impact on rural counties in the Rocky Mountain West during the 1990s than during the 1980s. In conjunction with Duffy-Deno's findings, the results also suggest that federal land has had no net negative impact on rural counties from 1980 through 2000. There is no evidence supporting the argument that communities are harmed by presence of federal land, as some have claimed. If there is a negative impact on extractive industries, the losses are recouped by the expansion of other industries since the some federal land has a positive impact on employment, and no apparent impact on income.

CHAPTER TWO: LITERATURE REVIEW

Introduction

Carlino and Mills (1987) observed several migration patterns in the United States that were persistent throughout the 1970s. People and jobs moved from cities to suburbs, from urban to rural areas, and from the Frostbelt region to the Sunbelt region. There are three explanations of this migration. Were people following jobs, or jobs following people, and what factors were enticing the movement of people and jobs? In their influential paper, Carlino and Mills answered these questions by simultaneously estimating population and employment at the county level throughout the United States.

Households are assumed to maximize utility; therefore Carlino and Mills estimated population using local fiscal and amenity variables such as crime rates, tax rates, and median family income. Because firms maximize profits, the employment equation includes fiscal and market variables such as union membership, the value of state issued industrial revenue bonds, and tax rates. To account for immeasurable differences, dummy variables also set counties apart by region. The authors did not have access to any climatic data; therefore they used these regional dummies as a proxy for temperature and precipitation differences.

Carlino and Mills calculated elasticities at the sample means in order to determine which effect on migration is greatest: the pull of population or the pull of employment. They found that the pull of employment on population is stronger than the pull of population on employment. They concluded that governments have little impact on population and employment growth in the form of tax rates, crime rate reduction, and values of state issued industrial revenue bonds.

As in the 1970s employment and population increased during the 1980s the most in the West and South. Some migration patterns at the national level changed during the 1980s. Metropolitan population and employment growth rates grew faster than in non-metropolitan areas (Clark and Murphy, 1996).

Clark and Murphy (1996) estimate population and employment growth for the 1980s using the lagged adjustment model developed by Carlino and Mills in which population and employment are determined simultaneously. They improved upon the empirical model used by Carlino and Mills (1987) by introducing a host of exogenous variables to both the employment and population growth equations. They found that the largest determinants of population growth were the amenity variables; such as sunshine, small temperature extremes, coastlines, and the presence of professional sports teams. Few of these factors can be changed by public policy. Employment growth was moved by fiscal variables and government expenditure, while amenity variables were insignificant. Contrary to the previous findings by Carlino and Mills (1987), they determined that population density has a larger impact on employment density than the impact of employment density on population density (Clark and Murphy, 1996).

High growth rates in the West continued throughout the 1990s, with the Rocky Mountain West growing faster than any region in the United States. Rural population growth rates increased, but not to the historically high levels of the 1980s. The growth of the Mountain West states, however, is different.

In the Rocky Mountain West, by the end of the 1990s, the once all important resource extraction industry had been diminished from over 10% of total employment in the late 1960’s to below 4% (Power and Barrett, 2001). Despite this, population exploded in many counties throughout the Rocky Mountain West. One plausible explanation for massive growth is that in an increasingly urban environment, households have begun to place a higher value on natural amenities. Since so much land in the region is owned by the Federal Government and those lands retain much of their natural beauty, perhaps their access to federal lands and natural beauty amenities are the driving force behind much of the growth.

The Effects of Federal Land

Several studies have tied population and employment growth to the presence of natural amenities (Frentz, et al. 2004; Lewis, et al., 2003; Rudzitis, 1999; Ruspasingha and Goetz, 2004). Natural amenity driven growth seems to benefit households in the affected counties, as evidence suggests that per capita and total personal incomes are higher in those counties (Deller et al., 2001 and Rasker, 2006). An understanding of what exactly constitutes a natural amenity is essential to understanding their relationship to population, employment, and income.

There are several definitions of natural amenities. Many authors used the presence of federally managed public lands as a measure of natural amenities. Some used only fully protected federal land, while most used both fully protected and multiple use federally owned public land. Fully protected federal land is defined as wilderness areas and National Parks that bar industry. Those studies that focused on fully protected land did so because those lands completely bar extractive industries, and presumably would have the greatest value as an amenity. There is little evidence that protected land has any significant effect on population, employment, or income. Fully protected land has no effect on wages, employment, or population in the northern forest region[1] (Lewis, et al., 2003). In the West, fully protected land was found to have no effect on total personal income (Rasker, 2006), and Duffy-Deno (1998) found that wilderness area had no effect on population and employment in the Rocky Mountain West. However, wilderness land was found to have a positive relationship with resource employment during the 1980s (Duffy-Deno, 1998). Duffy-Deno includes grazing, mining, and lumber industries as providers of resource employment. Taken at face value, this finding is difficult to understand and is actually the exact opposite of what is expected. That result probably does not mean that wilderness causes an increase in resource employment per se, but that wilderness tends to be in counties with higher levels of logging and mining. Since most wilderness areas are heavily forested, it is likely that there are unprotected heavily forested areas nearby that are open to logging.

Even though little evidence shows that fully protected land has any positive impact on rural economies, it is important to note that there is no evidence of any negative impact. This is significant because that lack of evidence refutes the claim that restrictions or outright banning of extractive industries damages local economies.

Although some land managed by the BLM and USFS in the Rocky Mountain West is designated wilderness, a vast majority is managed as multiple use. This means the BLM and USFS must carefully weigh the interests of many and often times conflicting parties. They must protect endangered species, provide recreation, decide appropriate levels of extraction, and promote rural economic development. While some extraction is permitted within the non-

[1] The Northern Forest region consists of: northern Minnesota, northern Wisconsin, the upper peninsula of Michigan, upstate New York, Vermont, northern New Hampshire, and most of Maine.

wilderness borders, it is restricted because both the BLM and USFS are committed to preserving the health of forests and protecting wildlife. The impact of Federal land (wilderness and non-wilderness alike) is another appropriate gauge which to measures the impact of natural amenities on rural economies, since it is widespread and effects so many communities.

Empirical evidence indicates that the effects of federal lands are similar to those of wilderness areas. Only Duffy-Deno (1998) reported any negative impact of federal land on rural economies. He found that the presence of BLM and USFS managed land had a negative impact on resource employment, but has no effect on net employment. He also showed that the presence of U.S. Forest Service managed land had a negative effect on population. Duffy-Deno's findings that resource based employment is harmed by the presence of BLM and USFS administered land, and that BLM and USFS managed land has no impact on total employment are curious. It may reveal that although the presence of those lands harms resource employment, they attract employment in other sectors, hence recovering those lost resource based jobs and breaking even. However, there is no evidence that the presence of federal land has any impact on income, net employment, or land development in the Rocky Mountain West or the West (Duffy-Deno, 1998; Rasker, 2006; Vias and Carruthers, 2005). One study purports that multiple use federal land positively impacts migration in the northern forest region, but has no effect on employment or wages (Lewis, et al., 2003). It appears that the restrictive land management policy of federal agencies has not had a negative impact on rural economies, whether measured by incomes, wages, or net employment levels.

The Role of Resource Extractive Industries

Evidence from other studies add credence to the case that that any jobs lost in the resource industry due to the presence of federal land are recouped by gains in other industries. Total personal income is unaffected by the presence of federal land in the West (Rasker, 2006), which can mean that even if federal land harms the resource industry, the net effect is neutral. A study on a separate region reveals that multiple use federal land does not depress wages or employment in the northern forest (Lewis, et al., 2003). Although their study is of a different region, there are some similarities between the Rocky Mountain West and the Northern Forest Region. Both are rural with heavily forested areas and a historical reliance on resource employment. Therefore the results add credence to the assertion that the restrictive practices on federal land do not have a negative net effect on economies.

The presence of federal land may harm the resource extraction industry, since resource extraction is either banned or restricted on those lands. How much concern, if any, should this cause residents of rural counties and policy makers? The answer is, not much since the net effect on employment appears to be neutral. Resource employment has been steadily falling as a percentage of total employment across the past few decades (Power and Barrett, 2001). As the extractive industries become smaller, losses in these industries harm their economies by less. Not only is resource employment falling in terms of a percentage of total employment, there is evidence that non-extractive industries are the driver of population growth.

Studies of non-extractive driven growth include a study by Vias and Mulligan (1999) that showed basic sector[2] employment did not attract migrants in the Rocky Mountain West. Non-basic employment, which includes: service, finance, retail and wholesale trade, health care, and educational services were the driver of Rocky Mountain Western growth. Although basic employment adds other industries to resource employment, their finding is still relevant because the growth driving industries are extractive industries. Manufacturing and construction employment have fallen as a portion of total employment just as resource employment has (Power and Barrett, 2001), so it is not likely those industries are replacing jobs lost in the resource extraction sector. It is likely that the relationship between households and manufacturing/construction employment is similar to their relationship with resource employment.

Vias and Mulligan (1999) disaggregated employment into basic and non-basic employment, and used the model developed by Carlino and Mills (1987) to simultaneously estimate population and non-basic employment. In addition to a strong relationship between non-basic employment and population, they found a negative relationship between basic and non-basic employment. That means that non-basic employment is replacing basic employment and driving growth not just in counties with a high portion of federal land, but across the Rocky Mountain West.

Since resource extractive jobs make up less and less a portion of total employment and are not the driver of population growth, a policy to improve rural economies by expanding that

[2] Basic employment includes agriculture, mining, construction, manufacturing, transportation, utilities, and public administration, while non-basic employment includes all other sectors in Vias and Mulligan (1999).

declining industry seems unlikely to be successful. Such a policy would expand logging and mining activities to the detriment of natural landscapes and scenic beauty. Since incomes have not fallen off, it appears that households in the Rocky Mountain West are no worse off as a result of the decline of the resource extraction industries. Evidence discussed below suggests that firms and migrants are attracted to the scenic landscapes and quality of life made possible by the properties of federal land.

Unbalanced Growth

Counties of the Rocky Mountain West are far from homogenous. Demographically, geographically, and economically they differ not just across the region but within each state. The changes to the region spurred by massive population growth then has not been uniform or solely concentrated in one area, but spread out across the region sweeping up some counties, while leaving others behind. Vias and Carruthers (2005) divided land into separate categories to determine the characteristics of the counties in which most growth was occurring in the Rocky Mountain West. Based on the work of Shumway and Otterstrom (2001), Vias and Carruthers (2005) divided the counties into four broad categories. The four county types they used are: Metropolitan, Old West, New West, and Diversified Service. Old West counties are non-metropolitan with employment dominated by farming, mining, and manufacturing. New West counties contain more natural amenities than Old West, have a high amount of service employment, a high percentage of federal land ownership, and are major retirement and recreation destinations. Diverse Service counties are non-metropolitan with a diverse mix of employment or government dominated employment.

An analysis of those four subgroups makes it clear that growth in rural counties is by far concentrated in the New West counties. From 1982 to 1997 developed land in New West counties grew by 40.7%, and population grew by 36.3%, while Old West counties grew 15.9% and 6.7% respectively. Diversified Service counties experienced only slightly higher growth of 18.1% for developed land and 12.3% for population. These numbers back up Vias and Mulligan's (1999) finding that non-basic employment is the driver of growth. Those rural counties with the basic sector as a dominant provider of employment (Old West counties) experienced the lowest levels of development and population growth. Some may argue that growth in New West counties may not necessarily benefit its inhabitants if many of the jobs created are in the service industry. That is not the case however, as demonstrated by the New West county's highest median income rank in 1995 (Shumway and Otterstrom, 2001).

Much of the income growth in the New West counties is attributed to high income earning migrants flooding those counties. Migrants choose by a huge margin to settle in New West counties, and the per capita income level of those migrants was much higher than in any other rural category. The high volume of higher income earning migrants contributes to the staggering concentration of new wealth in New West counties. From 1994 to 1997, 87% of aggregate income gain in rural counties occurred in those New West counties. A portion of the growth is likely spill over from metropolitan centers since 32% of New West counties are adjacent to a metropolitan county. That still leaves 68% of those counties that are not adjacent, so surely much of the growth must be attributed to the high natural amenity nature of New West counties.

Not all counties in the Rocky Mountain West should implement the same growth policy. Evidence suggests that economic gains attained from the attraction power of natural amenities is concentrated to a subgroup of counties. This subgroup is likely the New West counties. New West counties have moved towards a more natural amenity based economic structure. Poverty reduction in New West counties can be achieved much differently than in some other county types. It is important that policy makers understand what drives growth in their area, so they can properly divert resources.

Amenities Unique to the West Attract All Types

Federal land may play a role in shaping the Rocky Mountain West because as an amenity it may attract in migrants, many of whom have high incomes. Amenities may also attract small high tech companies that don't face traditional location constraints. These firms, known as "footloose" firms use telecommunication technology to conduct business. The presence of natural amenities may impact employment because it attracts tourists and boosts tourism employment or by attracting "footloose" firms. Several studies discussed next explore these possibilities using surveys and detailed regression analysis.

Several studies have revealed that businesses and migrants alike strongly consider "quality of life" and outdoor recreation when deciding where to locate. Rudzitis and Johnson (2000) found that migrants placed the most importance on scenery, environmental quality, pace of life, and outdoor recreation when deciding a location. Twice as many respondents reported that outdoor recreation was an important "pull" factor as those that cited employment opportunity as important. Rudzitis and Johnson found that in a 100 county contiguous area comprising parts of Washington, Oregon, Montana, Wyoming, Utah, and

Nevada, twenty-eight percent of migrants said they moved first, then looked for a job. They chose those 100 counties because they are covered with Federal land and awe-inspiring landscape that would presumably attract natural amenity seeking migrants. Since so many migrants to those counties were willing to move first and find a job later, Rudzitis and Johnson theorize that many of those may have moved for the amenities.

Firms also take “quality of life” factors into consideration. Advances in telecommunication, travel, delivery service, and networked computers have reduced constraints on a firm’s location decision. A national survey of producer service businesses located in rural areas conducted by Beyers and Lindahl (1996) split firms into one group that generated at least 40% of its revenue from outside the local area, and another group that did not. Of the 240 firms surveyed, 136 are locally oriented and 104 are export oriented. Most of the firms were very small, only fifteen locally oriented firms employed more than eleven people, while ten locally oriented firms employed eleven people or more. More than half of the export oriented firms cited a high quality of life as an important factor in selecting a location, and only about a quarter of all firms cited proximity to major clients as highly important. These firms could fall into the category labeled by many as “footloose” firms because they don’t face traditional location constraints and may locate based on personal tastes. Clearly certain firms have the flexibility to locate almost anywhere in the United States. Those firms will choose a location based upon owners and managers personal tastes. New West counties stand to gain the most from “footloose” firms because they tend to be rich in amenities.

Survey data shows that migrants and certain firms place a high value on amenities such as scenery for migrants or “pace of life” for firms. Those amenities are valued by others and attract more than permanent dwellers. Visitors come to the Rocky Mountain West to explore national parks, ski at world class resorts, hike in its wilderness, or catch trout in its many streams. Tourists bring money into rural communities which fuel the expansion of service jobs, as well as entrepreneurs such as lodging and restaurant owners and recreational guides. English et al. (2000) studied the effects that man-made and natural amenities have on tourist spending in three regions of the United States: North, South, and West. As part of a full vacation experience, tourists go to local shops and restaurants to buy goods and dine out. The presence of Forest Service land had a positive impact on food and retail trade in the West, all else being equal. This finding may imply that tourists value forests and mountains as amenities and are willing to travel to enjoy recreation and scenic beauty. Rural counties in the West rely on tourists to buy their goods and services. Jobs serving tourists accounted for 5% of employment, twice the national percentage in those rural counties. Such a high percentage suggests that tourism is indeed a very important component of the economy in the West. Tourists are drawn to the West to experience some unique characteristic shared by its rural counties. Since the presence of USFS managed land positively impacts two tourist oriented industries; retail and food, it is likely that tourists are drawn to the mountains, forests, and rivers that dot Forest Service land. It appears that the same natural amenities and “quality of life” unique to the West that attracts some firms and migrants is attracting visitors too.

Deller et al. (2001) estimate the effects of these amenities and “quality of life” attributes on population growth, employment growth, and income growth. To achieve this they used principal component analysis to compress fifty-three variables into five indices of amenity and quality of life. The five indices are: climate, land, water, winter recreation, and developed recreational infrastructure (Deller el al., 2001). For example the land variable includes among others, the number of guided services, BLM public domain areas, total rail-trail miles, and acres of mountains. The land variable was significant and positive in the population growth and employment growth equations. This supports the survey data from Rudzitis and Johnson (2000) and Beyers and Lindahl (1996) that some firms and migrants most heavily weigh natural amenities in their decision. The positive impact of natural land amenities on employment growth likely captured both the effects of tourism and "quality of life" seeking "footloose" firms.

Surveys reveal that migrants, jobs, and tourists are attracted to natural amenities and the quality of life found in the West and Rocky Mountain West. There are however inherent dangers to using forests as amenities and a rural slow pace of life to attract migrants and businesses. Development within rural counties also may act to destroy the very amenities that made them attractive in the first place (Vias and Carruthers, 2005). Development may bring good paying jobs and amenities such as theaters and restaurants, but it also causes pollution, congestion, and a detachment with nature.

Households Attract Jobs vs. Jobs Attract Households

There is debate over whether the pull of employment growth on population is greater or weaker than the pull of population growth on employment. If the effect of population growth on employment is the stronger of the two, than a growth strategy that attracts migrants using amenities may be a very effective tool in promoting employment growth.

The evidence is mixed as to whether jobs follow people or people follow jobs. Carlino and Mills (1987) and Duffy-Deno (1998) conclude that the pull of employment on population is strongest. Clark and Murphy (1996) and Vias and Mulligan (1999) show that the pull of population on employment is greater. Hoogstra, Florx, and Dijk (2005) recognized that empirical evidence differed and analyzed thirty-seven studies that used the Carlino and Mills model to determine which employment-population interaction was most prevalent. They found that more studies determine that jobs follow people, but a simple count of previous studies does little to determine reasons for the disparity of evidence.

A meta-regression model was used to determine if the way a study is conducted affects the outcome the employment-population interaction. The authors looked into the sample size and area of the study, year of study, and the form and number of endogenous variables. They concluded that the way a study was conducted can have an impact on the interaction of employment and population and helps to explain why there is so much variance in the literature. They found that a model using actual levels as opposed to changes is more likely to reveal no interaction between population and employment. They also determined studies of the 1990s are most likely to reveal a jobs follow people causality. Studies of the 1980s are more likely to show that same causality than those of the 1970s. This implies that households may be increasingly migrating for reasons other than employment opportunity and a strategy of boosting employment through attracting migrants may prove more effective today than any other time in recent history.

Partridge and Rickman (2003) analyzed the impact of labor demand shocks and migration labor supply innovations on state employment growth. They determined that labor demand shocks play a larger role in shaping state employment levels. That finding leads to the conclusion that people are more likely to follow jobs. Although a region by region analysis revealed that jobs are more likely to follow people in the Sunbelt and West Coast regions. However, there is evidence that the likelihood of finding a people follow jobs causality is more likely when large observation units are used, such as states (Hoogstra, Florx, and Dijk, 2001).

Based on the empirical results from multiple studies, the employment-population interaction seems to vary across different regions and time periods. A reason for the differential is likely due to the dynamic nature of the employment-population relationship.

The preferences of households differ as much as the different regions they inhabit across the United States. Migrants will be drawn to the strengths of each region, in some cases that will be employment opportunities while it might be climate and amenities in others. Therefore determining a direction of causality between employment and population may be a difficult endeavor because the interaction varies from region to region and even likely within regions themselves.

CHAPTER THREE: THEORETICAL MODEL

The model used to estimate the effects of federal land on population, employment, and income is based on a model developed by Carlino and Mills (1987). They used a lagged adjustment model to estimate population and employment simultaneously. Carlino and Mills assumed households and firms are perfectly mobile. In making their location decision, households seek to maximize utility. Consumer utility depends on the consumption mix of goods and services as well as local amenities. Firms on the other hand, seek to maximize profits by locating to regions with low production costs and high consumer demand. Under such a framework, firms flow in and out of regions until profits are equalized across all regions, and households migrate until utility is equalized across all regions as well (Carlino and Mills, 1987). Although firms and households base their location decisions on different factors, they are heavily interdependent. That interdependency is why population and employment must be estimated using a simultaneous model.

Carlino and Mills (1987) drew from two models developed in separate studies to generate their model. The first, is the general equilibrium model (equations 1 & 2):

(1) $$E^* = \beta_E P + \sigma_E S$$

(2) $$P^* = \beta_P E + \sigma_P T$$

where E represents actual employment and P represents actual population, and S and T are exogenous factors that influence equilibrium employment and population respectively. E^* and P^* are equilibrium employment and population levels respectively. Equilibrium employment depends on endogenous population and exogenous variables thought to affect firms' location decision. Similarly, equilibrium population depends on endogenous employment and exogenous variables.

The next model used by Carlino and Mills is a simple lagged adjustment model expressing true values of employment and population as dependent variables. This model is illustrated by equations (3) and (4):

(3) $$E = E_{-1} + \lambda_E (E^* - E_{-1})$$

(4) $$P = P_{-1} + \lambda_P (P^* - P_{-1})$$

where E and P are employment and population and E_{-1} and P_{-1} are lagged employment and population respectively. Each dependent variable depends upon the lagged variable of itself, and a speed of adjustment coefficient. λ_E and λ_P are speed of adjustment coefficients[3]. Neither the lagged adjustment model nor the general equilibrium model can be empirically estimated due to the presence of unobserved equilibrium values. Equations (1) and (2) can be substituted into (3) and (4), and after rearranging terms, yielded equations (5) and (6) below:

(5) $$E = E_{-1}(1 - \lambda_E) + \lambda_E \beta_E P + \lambda_E \sigma_E S$$

(6) $$P = P_{-1}(1 - \lambda_P) + \lambda_P \beta_P E + \lambda_P \sigma_P T$$

The resulting equations make up a lagged adjustment model in which actual employment and actual population are determined simultaneously. Each dependent variable depends on the observed value of the other dependent variable, its own lagged variable and a vector of exogenous variables.

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[3] $0 \le \lambda_k \le 1$. The faster population and employment move toward equilibrium, the closer λ_P and λ_E will be to 1. If for example λ_E is 1, actual employment levels are already at equilibrium, but if λ_E is 0, employment makes no move to equilibrium and will be stay at E_{-1}.

The model will henceforth be referred to as the Carlino and Mills lagged adjustment model. The Carlino and Mills lagged adjustment model is good for estimating the effects of federal land on population and employment, but lacks a third income equation. Deller et al. (2001) expanded the Carlino and Mills lagged adjustment model by adding an income equation to the system and estimating the effects of various amenities on population, employment, and income. Drawing from Carlino and Mills (1987), Deller et al. (2001) manipulated the general form model (equations (1) and (2)) by adding an income equation to the system, which necessitated the introduction of an income variable to the right hand side of the population and employment equations below:

(7) $$E^* = \beta_E P + \alpha_E I + \sigma_E S$$

(8) $$P^* = \beta_P E + \alpha_P I + \sigma_P T$$

(9) $$I^* = \beta_I P + \alpha_I E + \sigma_I V$$

Next, assuming income adjusts with lags, as with employment and population, Deller et al. (2001) added an income equation to the simple lagged adjustment set of equations (equations (3) and (4)):

(10) $$E = E_{-1} + \lambda_E (E^* - E_{-1})$$

(11) $$P = P_{-1} + \lambda_P (P^* - P_{-1})$$

(12) $$I = I_{-1} + \lambda_I (I^* - I_{-1})$$

They substituted the general form model into the simple lagged adjustment model, and simplified and reduced the terms to yield the following equations:

(13) $$E = E_{-1}(1-\lambda_E) + \lambda_E \beta_E P + \lambda_E \alpha_E I + \lambda_E \sigma_E S$$

(14) $$P = P_{-1}(1-\lambda_P) + \lambda_P \beta_P E + \lambda_P \alpha_P I + \lambda_P \sigma_P T$$

(15) $$I = I_{-1}(1-\lambda_I) + \lambda_I \beta_I E + \lambda_I \alpha_I P + \lambda_I \sigma_I V$$

Just as in the employment and population equations, the dependent income variable, denoted by I, is its observed value. V is a vector of fiscal/market and amenity variables that are believed to affect income.

The expanded Carlino and Mills lagged adjustment model is used in this paper to estimate the effects of federal land on employment, population, and income. An explanation of the components of each equation and an intuitive rational for their inclusion is detailed in the following chapter.

CHAPTER FOUR: EMPIRICAL MODEL

There is a strong positive relationship between population, employment, and income. That relationship is illustrated in the three plots below. Such a relationship is fully expected since firms employ households and wage income is the largest component of aggregate income. The equations must be estimated simultaneously due to this strong correlation between each endogenous variable.   Therefore the Carlino and Mills lagged adjustment model will be used to estimate the population, employment, and income relationships.

Figure 4.1: Plot of employment and income

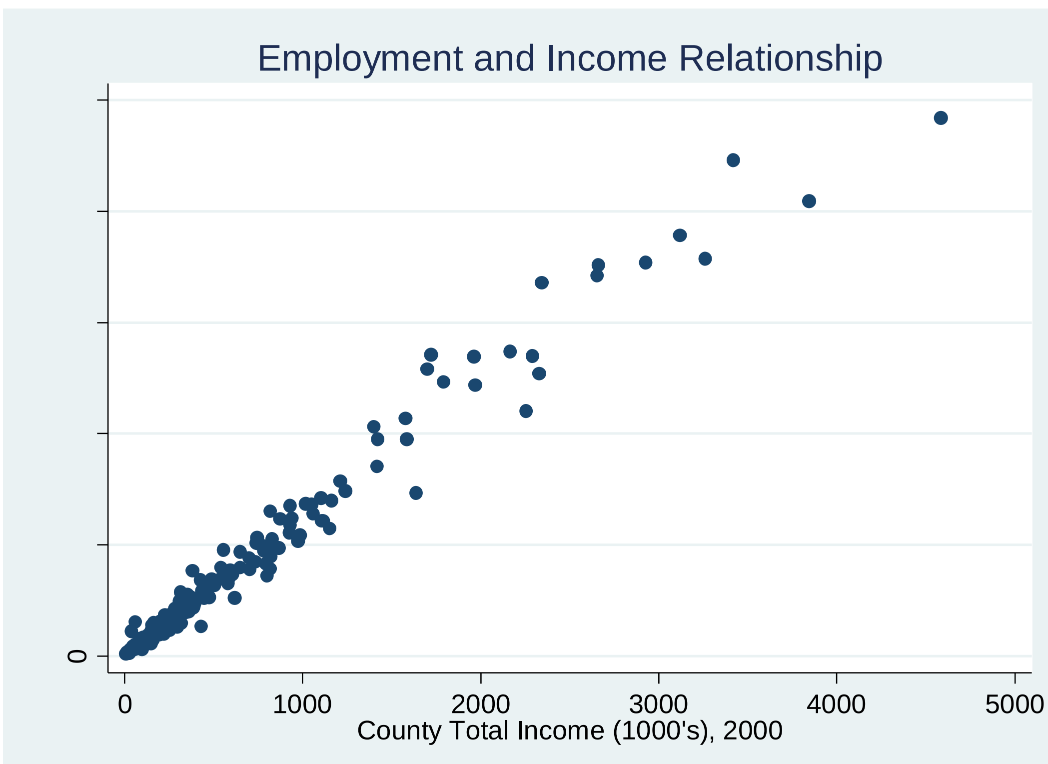


Figure 4.2: Plot of population and income

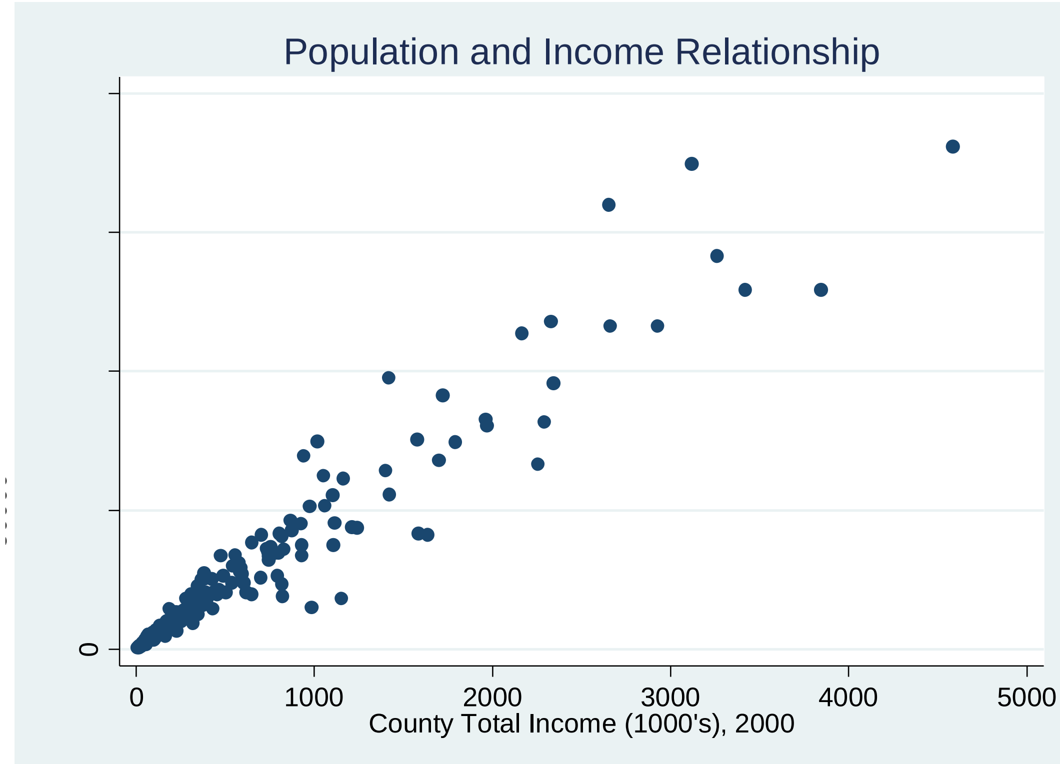
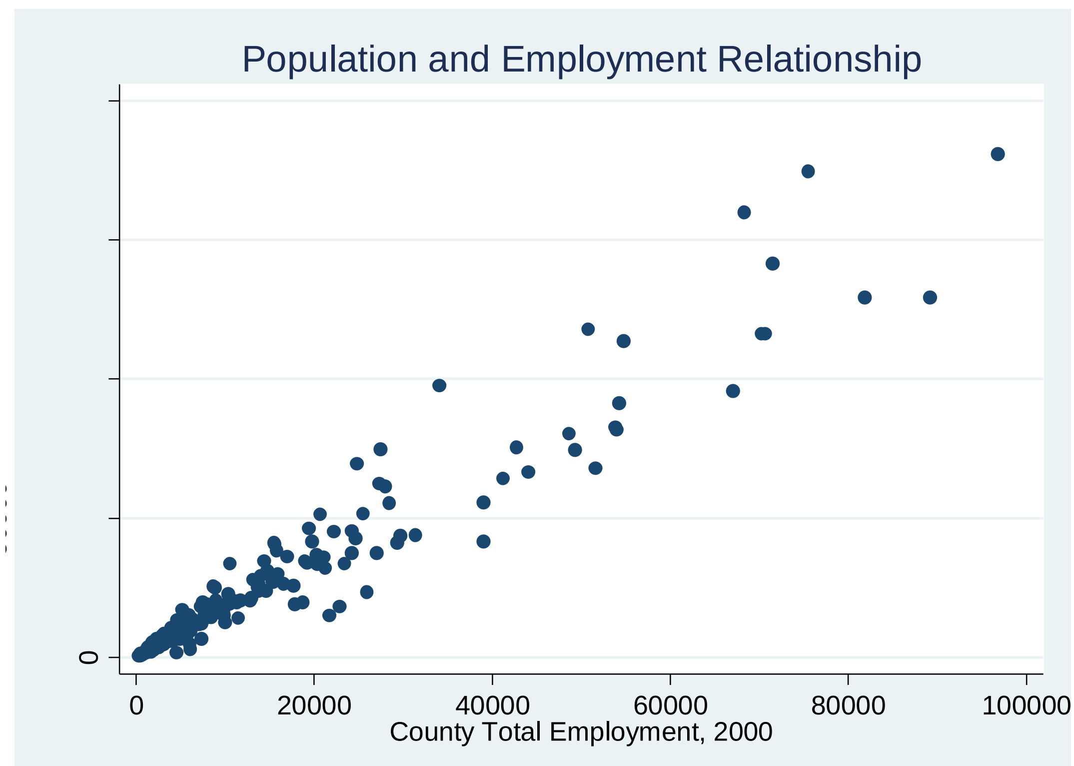


Figure 4.3: Plot of population and employment



The Carlino and Mills lagged adjustment model has been implemented successfully by many researchers to estimate the determinants of population and employment, (Clark and Murphy, 1996; Duffy-Deno, 1998; Vias and Mulligan, 1999) and for population, employment, and income (Deller et al., 2001). Most often the focus of these authors was on the role of amenities, but the type and measurements of amenities varied from study to study. In one such study, Duffy-Deno (1998) estimated the effects of federal wilderness on employment and population. His focus on wilderness, which is a sub-group of federal land, is very similar to the focus of this study. Although he only includes two equations in his model, the similarity between this study and his mean that the exogenous variables used in those equations can serve as a guide for the exogenous variables used in the population and employment equations in this study.

Duffy-Deno did not include an income equation to his system, so inspiration for the exogenous variables in that equation came from elsewhere. Deller et al. (2001) reveals that they used the same exogenous variables in their employment, population, and per capita income equations. Lewis, et al. (2003) estimated migration, employment, and wages simultaneously using a model similar to the Carlino and Mills lagged adjustment model. Although wages and income differ, they are similar enough to employ some of their exogenous variables in this study. They used, less one variable, the same set of exogenous variables in the employment and wage equations. Both Deller et al. (2001) and Lewis, et al. (2003) used either the same or almost the same set of exogenous variables in their employment equations as they did in their income or wage equations. Drawing from this, the exogenous variables in the income equation for this study strongly mirror the employment equation based on Duffy-Deno (1998). In creating the list of exogenous variables for the income equation, a few variables were added and dropped from the vector of employment exogenous variables so as to make intuitive sense and to differentiate and identify the two equations.

In determining which specification is most appropriate for the model, a specification test and a quick survey of the literature served as a guide. The specification test was designed and published by MacKinnon, White, and Davidson and will be referred to as the MWD test (Gujarati, 1978). The results from the MWD test were inconclusive. For the income and employment equations it revealed that neither a linear nor log regression model is appropriate, and suggest a log-linear model may be most appropriate for the population equation[4]. A look at the work of other researchers that used the Carlino and Mills adjustment lagged model showed that the vast majority used linear models. Since the literature supports using a liner model and the specification test does not suggest otherwise, a linear Carlino and Mills adjustment model is used to estimate the effects of federal land on population, employment, and income.

Population

Equation (16) shows total population is determined by lagged population, total employment, total personal income, and exogenous factors. The variables that make up the exogenous variables can be broken into four broad categories: economic/market, amenity, federal land and structural variables. The variables that make up the four categories of exogenous variables are all taken from the empirical model used by Duffy-Deno (1998).

[4] For a detailed explanation of the MWD test, see Appendix A: The MWD Test.

(16)

$$\text{Population}_{i,2000} = \beta_1\text{Population}_{i,1990} + \beta_2\text{Employment}_{i,2000} + \beta_3\text{Income}_{i,2000} + \beta_4\text{Economic}_{i,1990} + \beta_5\text{BusinessConditions}_{i,1990} + \beta_6\text{Amenities}_{i,1990} + \beta_7\text{FederalLand}_{i,1990} + \beta_8\text{Structural}_{i,1990} + u_{i,2000}$$[5]

Lagged Population, Employment, and Income

Lagged population is included because population today, is function of past levels of population. Households are likely attracted to areas where there are greater employment opportunities, so the endogenous variable employment is included. Utility maximizing households should be attracted to counties with more high paying employment opportunities. Total personal income should be higher in counties with higher paying jobs, which would imply a positive relationship between income and population. For this reason an exogenous income variable is added.

Economic

This category includes variables that directly affect households' income. Since households seek to maximize utility, these variables measure tax rates because higher taxes will reduce incomes.

Business Conditions

This category includes the percent of home ownership variable. Migrants may prefer a community with a higher rate of home ownership.

Amenities

Some amenity variables measure services provided by local governments and others are natural amenities unique to each county. Amenities have an effect on households' utility, since

[5] i represents county

households value a higher quality of life and hence factor into a decision of where to migrate. The non-natural amenities are those variables that measure some of the services that tax dollars pay for, such as the size of the police force and the number of teachers. Natural amenity variables are different measures of climate that will likely attract or repel migrants.

Federal Land

Federal Land variables are measured by the presence of land that is administered by the National Parks Service (NPS), the United States Forest Service (USFS), or the Bureau of Land Management (BLM). Lands administered by these government agencies are considered amenities by many, but are not included in the amenity category because of their unique place in the debate that hotly surrounds land use and its role in shaping economies across the Rocky Mountain West. Industrial activity is either restricted or barred on these lands, so federal land will provide households with open space, scenic views, and outdoor recreation. However, such restrictions reduce opportunities for extractive industries to operate, and might therefore hamper a community's ability to expand economically. A conundrum is that federal land can boost households' utility as it increases an areas amenity value and attracts migrants and tourists, but might hurt some resource dependent industries, which could lower employment opportunities, hence reducing utility.

Industrial regulations and restrictions differ across the three federal land types and even vary within their own borders. National Parks Service administered land enjoys the toughest land use restrictions of the three; however there are some portions of U.S. Forest Service and Bureau of Land Management administered land that face stiffer restrictions. Logging is banned within National Parks boundaries, as are new mining leases. Some areas of USFS and BLM managed land are designated as wilderness areas per the Wilderness Act of 1964. Regulations in wilderness areas take the form of a ban on logging, mining, and road building activity, plus a ban on motorized and mechanical machinery use. The focus of this study is on the effects of federal land because it is more widespread than wilderness and affects many more communities. Although the effects of Federal Wilderness are not examined in this study, an awareness of wilderness areas and an understanding of their contribution to the three federally managed land areas are necessary to properly interpret results. Compared with the BLM, a higher percentage USFS land is designated wilderness, but an even greater portion of NPS managed land is considered wilderness.

Most land administered by USFS in the Rocky Mountain West takes the form national forests, and as the name implies, is home to forests and woodlands. BLM administered land on the other hand are, "characterized predominantly by extensive grassland, forest, high mountain, arctic tundra, and desert landscapes" (Bureau of Land Management, 2009). Households will likely place a higher amenity value on the forests managed by the USFS than they will the typically sparsely treed lands that are managed by the BLM. That preference coupled with the fact that more USFS land is protected wilderness means that it is likely that those lands will attract and retain households.

The primary focus of the study is on the effects of U.S. Forest Service land, even though land area managed by the National Parks Service is heavily protected and home to some of the most striking natural sites in the country. National Parks are unique in that they draw millions of visitors per year and have undoubtedly affected their surroundings, witnessed by the communities that have sprung up around them that service the needs of those visitors.

However, they are far and few between, and whether their presence contributes to nearby economies is not in question. The impact of U.S. Forest Service administered land is in question however, and since those lands are widespread across the Rocky Mountain West, any potential impact on growth can have vast implications.

Structural

This final group of variables controls for the individual state effects, counties with a city, and counties adjacent to those with a city. Also included are variables specifying counties located in the Great Plains, the number of ski resorts in a county, and a dummy specifying which state the county is located.

Employment

Profit maximizing firms are attracted to counties where input costs are low and there is demand for their products. Therefore, employment is a function of a lagged value of employment, endogenous income and population, plus exogenous variables that are divided into five categories (equation (17)). Just as in the population equation, the variables that make up the Production Costs, Business Conditions, Amenities, Federal Land, and Structural categories are based on the exogenous variables used by Duffy-Deno (1998).

(17)

$$Employment_{i,2000} = \beta_1 Employment_{i,1990} + \beta_2 Population_{i,2000} + \beta_3 Income_{i,2000} + \beta_4 Economic_{i,1990} + \beta_5 BusinessConditions_{i,1990} + \beta_6 Amenities_{i,1990} + \beta_7 FederalLand_{i,1990} + \beta_8 Structural_{i,1990} + u_{i,2000}$$ [6]

[6] i represents county

Lagged Employment, Population, and Income

Employment depends on a lagged value of itself, so lagged employment variable is included in the equation. Many firms, particularly those in the retail and service industries must locate in areas with a larger population because they need households to consume their products. Also, a firm locating to a county with a larger population might experience greater competition among workers to fill their labor force, which drives down wages. Therefore, endogenous population is included in the equation. If a firm must locate to a county with a relatively larger population so to have a large enough consumer base, then those same firms might take the wealth of the county into consideration, since wealthier consumers can buy more goods and services. For that reason endogenous income is included in the equation.

Economic

Firms must not only sell enough goods and services to be profitable, but they also strive to keep production costs at a minimum. This can be achieved by locating to areas with lower taxes and lower wages. Variables measuring each of these factors affecting production costs are included in the equation.

Business Conditions

Firms might take the economic and industrial makeup of an area into consideration before making a location decision. Exogenous injections of money can flow into areas if there are a high number of Federal employees or a higher potion of income being earned from investments. Variables measuring those effects are included under the Economic category.

Amenities

The amenity variables used in the employment equation are strictly climatic variables. Entrepreneurs and other “foot loose” firms may prefer areas with desirable weather conditions, necessitating the need for the climatic variables.

Federal Land

The same variables that are used to measure federal land in the population equation are used in the employment equation as well. There is evidence that many entrepreneurs strongly consider “quality of life” when deciding on a location (Beyers and Lindahl, 1996). Since land owned and administered by the federal government face tougher industrial restrictions than most private lands, those lands are usually more pristine and have a larger amenity value. Such natural amenities can certainly improve the “quality of life” for its residence and might just attract entrepreneurs and “footloose” firms.

Structural

The same group of structural variables used in the population equation is included in the employment equation as well, to control for the individual state effects, counties with a city, and counties adjacent to those with a city. Also included are variables specifying counties located in the Great Plains, the number of ski resorts in a county, and a dummy specifying which state the county is located.

Income

Regional and urban economists are certainly curious about the factors that attract firms and migrants, but both measures tell us little about the well being of the inhabitants living in the areas under study. An income equation (equation (18)) is included to measure the economic effects that the movement of households and firms has on the residents of the affected counties. Income depends on the lagged value of income, endogenous population and employment, and exogenous variables. Five categories of variables make up the exogenous set: Economic, Business Conditions, Amenities, Federal Land, and Structural. Following Deller et, al. (2001) and Lewis, et al. (2003), the exogenous variables included are similar to those in the employment equation. The vector of exogenous variables from the employment equation was altered to create the vector in the income equation.

(18)

$$Income_{i,2000} = \beta_1 Income_{i,1990} + \beta_2 Population_{i,2000} + \beta_3 Employment_{i,2000} + \beta_4 Economic_{i,1990} + \beta_5 BusinessConditions_{i,1990} + \beta_6 Amenities_{i,1990} + \beta_7 FederalLand_{i,1990} + \beta_8 Structural_{i,1990} + u_{i,2000}$$ [7]

<u>Lagged Income, Population, and Employment</u>

Just as with population and employment, income depends on a lagged value of itself, so a lagged income variable is included. Some empirical evidence shows that jobs follow people (Hoogstra, Florax, and Dijk, 2005). Since wages make up a large portion of income, and employment correlates with population, an endogenous population variable is included. As noted above, wages make up a significant portion of income, so an endogenous employment variable is added because employment levels will affect income.

<u>Economic</u>

High tech companies, “footloose” firms, and entrepreneurs are thought to face fewer location constraints than their service and retail counterparts. Service and retail firms are constrained by the need to locate near consumers, while other firms may have more freedom

[7] i represents county

to choose where to locate. High tech and "footloose" firms, along with entrepreneurial enterprises likely pay higher wages than the service industry, and certainly more than retail firms. Because of that pay discrepancy, a county that attracts higher paying firms might see higher personal income levels. Variables that measure effects that might attract or repeal business are included in the Economic category. These variables measure conditions such as tax rates and those affecting wage rates.

Business Conditions

Wages make up only a portion of total personal income. Other variables are included to control for income sources other than wages, such as the percent federal employment, percent resource employment, and percent of income derived from dividends, interest, and rent variables. Education variables are included as well.

Amenities

The amenity variables used in the income equation are the same climatic variables used in the employment equation. Higher paying "footloose" firms' management and owners may make a personal decision to locate in an area with favorable weather condition.

Federal Land

The same variables measure the presence of federal land in the income equation as in the employment and population equations. Since "foot loose" firms have greater freedom to pick a location, they very well may choose to locate in an area with beautiful landscapes. Also, wealthy retirees could migrate to counties with a large presence of federal land, bring their high incomes with them.

Structural

The same group of structural variables used in the population and employment equations such as dummies for counties with a city and counties adjacent to counties with cities are included in the employment equation. Also included are variables specifying counties located in the Great Plains, the number of ski resorts in a county, and a dummy specifying which state the county is located.

CHAPTER FIVE: DATA

The data for the study primarily comes from a number of government sources. The study uses cross section data, with observations from 1990 and 2000, with the exception of a few that are from 1992. The observations are of rural counties in states that make up the Rocky Mountain West. There are 244 county observations used to execute the empirical model. The specific sources and years for the data are listed in table 5.1.

Non-metropolitan county level data is used for the empirical model from states that make up the Rocky Mountain West. Those states are: Montana, Wyoming, Idaho, Colorado, Utah, Nevada, New Mexico, and Arizona. Thirty-two metropolitan and high density counties are dropped from the dataset to maintain a focus on non-metropolitan areas[8]. Four counties are dropped because no data was available for the average hourly manufacturing wage rate[9]. Forces shaping metropolitan and non-metropolitan counties differ, as there are different employment opportunities and amenities, providing justification to drop those counties.

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[8]There are six counties are dropped from the sample due to high population densities (greater than 80 persons per square mile): Carson City, El Paso, Los Alamos, Kootenai, and Larimer in Colorado. Yavapai in Arizona, Sandoval in New Mexico, and Summit in Utah are dropped because they are part of a Metropolitan Statistical Area. Washington County in Utah is an extremely high growth county, and was removed it from the sample. All told, thirty-two metropolitan and high growth counties are dropped from the sample. Twenty-three counties that are assigned a beale code of 0, 1, and 2 are dropped from the sample because they are a metropolitan area of more than 250,000 people: Maricopa, Mohave, Pima, and Pinal in Arizona; Adams, Arapahoe, Boulder, Denver, Douglas, Elbert and Jefferson in Colorado; Ada and Canyon in Idaho; Clark, Nye, and Washoe in Nevada; Bernalillo, San Miguel, and Valencia in New Mexico; Davis, Salt Lake, Utah and Weber in Utah.

[9] The four dropped counties are: Treasure and Petroleum in Montana; Crowley in Colorado; and Clark in Idaho.

Table 5.1: Variable definitions and sources

Variable	Variable Definition	Source
Employment	Total county employment, 2000	A
Population	Total county population, 2000	A
Income	Total county personal income (1000's), 2000	B
PCT NPS	Percent of county land area managed by the NPS, 1990	A, H
PCT USFS	Percent of county land area managed by the USFS, 1990	A, H
PCT BLM	Percent of county land area managed by the BLM, 1990	A, H
PCT Prop	Share of PC Tax from property tax, 1992	A
PC Tax	Per capita local government taxes, 1992	A
Unemp. Rate	Unemployment rate, 1990	A
Prod-Worker Wage	Average hourly manufacturing wage rate, 1990	A, E
PCT Educ	Percent over 25 with a high school degree, 1990	A
PCT Bachelors	Percent over 25 with at least a bachelors degree, 1990	A
% > 65	Percent of population that is 65 or older, 1990	A
PCT Fed Emp	Percent employment provided by the federal gov't, 1990	A
PCT Dividends	Percent of Income from dividends, rent, and interest, 1990	B
PCT Resource Emp	Percent of employment by the resource industry, 1990	F
PCT Own	Percent of homes that are owned, 1990	A
PP Teachers	K-12 teachers per pupil, 1990	A, D
PC Cops	Per capita police officers, 1990	A, C
Rain	Average annual precipitation, average from 1971-2000	G
Heat Days	Number of heating degree days, average from 1971-2000	G
Cool Days	Number of cooling degree days, average from 1971-2000	G
City	Indicates if a county has a city of 25,000 or more, 1990	A
Adjacent City	Indicates if a county is adjacent to one with a city, 1990	A

Code	Source
A	U.S. Census Bureau, *County and City Data Book*
B	Bureau of Economic Analysis, *Regional Economic Accounts*
C	U.S. Federal Bureau of Investigation, *Uniform Crime Reports*
D	U.S. Census Bureau, *Census of Population*
E	U.S. Dept of Labor, *Bureau of Labor Statistics*
F	Bureau of Economic Analysis, Regional Economic Accounts
G	National Climatic Data Center, *National Environmental Satellite, Data, and Information Service*
H	U.S. Department of the Interior, *Payments in Lieu of Taxes (PILT) County Payments and Acres*

The left hand side variables used for this study are total population, total employment, and total personal income. Personal income is the sum of net earnings by place of residence, rental income of persons, personal dividend income, personal interest income, and personal current transfer receipts (Bureau of Economic Analysis, 2008). Employment is comprised by "estimates of the number of jobs, full-time plus part-time, by place of work. Full-time and part-time jobs are counted at equal weight. Employees, sole proprietors, and active partners are included, but unpaid family workers and volunteers are not included" (Bureau of Economic Analysis, 2008). Population is a complete count of all residence based on the census count (United States Census Bureau, 2007). All of the endogenous variables are from the year 2000, while most of the exogenous variables are from 1990, and in some cases 1992. Observations for a few exogenous variables were unavailable for 1990, so the missing gaps were filled using data from different years when it was available[10]. The exogenous variables used in the employment, population, and income equations will be laid out in the next part of the data section, with an explanation for their inclusion and predicted signs.

<u>Population Equation</u>

Per capita taxes (PC Local Tax) and percentage of taxes in the form of property taxes (PCT Property Tax) are included because they affect income. One component of household utility is income, so utility maximizing migrants will likely be attracted to counties with low levels of each tax variable, so to maximize utility. However, these households may be willing to pay higher taxes if the services in return are desirable. Households may be attracted to counties with higher tax rates due to the amenities that taxes fund. Low crime rates and high

[10] For detail of data substitution see Appendix B: Specific Data Sources.

quality public schools are amenities governments should be able to affect through services paid for with local taxes. Per capita police officers (PC Cops) and the number of teachers per pupil (PP Teachers) are two variables used to measure positive outcomes through higher tax rates, and should correlate positively with population. Also included is a variable measuring the percentage of home ownership (PCT Own), which serves as a proxy for community involvement since renters tend to move in and out of neighborhoods, while owners stay put for years, hence are more likely to be involved in the community. Households would likely prefer areas with higher rates of home ownership. Several non-economic variables may also influence a household's decision where to locate. There is evidence that some households take into consideration climate conditions in making location decisions (Clark and Murphy, 1996). Two variables are added whose values indicate the temperature of an area; the number of heating days (Heat Days) and cooling days (Cool Days) from 1971-2000. An average annual precipitation (Rain) variable is also included (with the average being from 1971-2000). Households are likely attracted to areas with more cooling days, fewer heating days, and less precipitation. A heating day is defined as a day in which homes are heated, and a cooling day is a day which homes use air conditioning. Variables measuring temperature extremes may not serve as the best measure. Migrants are likely attracted to mild climates, so a variable that captures average temperature may be best. Just as households may be attracted to milder climates, they may also be drawn towards areas of scenic beauty.

Variables measuring the percentage of county land owned by the Bureau of Land Management (PCT BLM), the U.S. Forest Service (PCT USFS), and the National Parks Service (PCT NPS) are included to measure to impact of natural landscapes on population. Households' likely place a value on the presence of the amenities that come with living near lands managed by the federal government, such as clean watersheds, maintained hiking trails, clean air, and beautiful scenery. Since the three governmental agencies manage different types of land, and place different restrictions on those lands, the impact of the three are not expected to be the same. NPS administered lands have to toughest restrictions, and are typically home to areas of majestic beauty, are expected to have the strongest positive impact on population. Next, the presence of USFS managed land is expected to have the second strongest positive correlation with population of the three agencies. Compared with land managed by the BLM, a greater percentage of USFS land is protected wilderness, and is more likely to contain the high amenity valued forested areas. The presence of land administered by the BLM is expected to positively affect population, just not as strongly as the presence of USFS and NPS administered lands

Employment Equation

Firms will find counties desirable that offer low production costs, whether it is low taxes, low transportation costs, or low labor costs. Just as households prefer lower tax rates, employers too are expected to locate to counties with lower tax rates. The same tax variables from the population equation are used (PC Local Tax, PCT Property Tax), and they are expected to have a negative relationship with employment as well. Wages tend to be lower in areas with higher unemployment rates due to greater competition for jobs among would be workers. Firms will most likely be attracted to such counties so a variable measuring the unemployment rate (Unemployment Rate) is used, and a positive relationship is expected. Firms will have to pay higher wages to attract skilled workers if they are located in a county where other employers of skilled workers pay high wages. Therefore a variable measuring the average hourly manufacturing wage rate (Production Worker Wage) is used, and the relationship will likely be negative. The production worker wage variable is the average hourly wage rate of manufacturing workers. A variable measuring the percentage of adults that graduated from high school (PCT Educ) is included because a more educated population will likely translate to a better and more productive work force, which will attract firms.

As non-wage income makes up more and more a portion of total income, it plays an even more vital role in the economy. Thus, a variable denoting the portion of income that is made up of dividend, rent, and interest payment (PCT Dividend) is included. Such non-wage income will have a positive effect on employment, as it provides an injection into the economy, which increases demand and expands employment due to the multiplier effect. The percent of workers that are federally employed (PCT Fed Emp) is included as a variable because a high percentage will lead to large injections of federal money and can stimulate growth. Hence, a positive relationship is expected. A variable measuring the percentage of those employed working in resource industries (PCT Res Emp) is included in the equation. This variable serves two purposes. One is to control for counties with a higher dependence on extractive industries. Since resource employment as a share of total employment has fallen, counties with a higher percentage will likely have lower levels of employment. It will also provide some understanding into the role that resource employment plays in shaping employment levels. If this variable is negative, then one could infer that the declining importance of resource employment has hurt counties that rely heavily on these industries. This variable is expected to be negative.

The climatic variables used are the same that are used in the population equation. Again, these include: the number of heating days and cooling days, and the average annual precipitation. "Foot loose" firms have more flexible location constraints and may choose a location based on managers personal climatic tastes. Therefore, employment may have a negative relationship with the number of heating days and average annual precipitation, and a positive relationship with the number of cooling days.

Variables measuring the percent of county land that is owned by the National Parks Service, U.S. Forest Service, and Bureau of Land Management are included in the employment equation as well. Just as in with the climatic variables, certain firms with looser location constraints may select a location because of its proximity to outdoor amenities. The three federal land variables will therefore likely have a positive relationship with employment.

Income Equation

The same two tax variables (PC Local Tax, PCT Property Tax) found in the employment and population equations are included in the income equation as well. Higher paying "footloose" and high-tech firms may take into account tax rates as they search for a desirable location to set up shop. The two variables are expected to have a negative relationship with income. These higher paying mobile firms may also locate in communities where wages are lower to maximize profits. Such communities will likely have a higher unemployment rate and lower hourly manufacturing wages. Two variables, Unemployment Rate &Production Worker Wage respectively, are used to measure these effects. On average high school graduates earn more than non-graduates and college graduates tend to earn more still, so two variables are included: the percent of adults with a high school diploma (PCT Educ) and the percentage of those with at least a bachelors degree (PCT College). Both education variables should have a positive effect on income. A higher percentage of the workforce employed by resource industries[11] (PCT Res Emp) and the federal government (PCT Fed Emp) will distort the labor market and are controlled for. A significant portion of non-wage income is contributed by rent, dividend, and interest payments. A variable controlling for these payments (PCT Dividend) is added, and should have a positive sign. A large portion of those over the age of sixty-five receive much if not all of their income from non-wage sources. Many payments are in the form of dividend payments, sale of investments, and social security payments. Therefore a variable measuring the percentage of the population that is over sixty-five (PCT 65+) is included, and is expected to have a positive sign.

The same climatic variables used in the population and employment equations are used in the income equation as well. Higher paying "foot loose" firms and high income retirees may heavily weigh the climate of a location before deciding where to locate. These groups and firms will likely prefer less precipitation, fewer heating days, and more cooling days.

The presence of protected federal land might attract high income and higher paying "foot loose" companies. Variables measuring the percent of county land that is owned by the National Parks Service, U.S. Forest Service, and Bureau of Land Management are included in the in the income equation. The three variables are expected to have a positive sign.

Structural Variables

Several structural variables are included in the population, employment, and income equations. A dummy variable is used for counties that contain a city with a population of 25,000 or greater (City)[12]. The presence of a city will not only create more employment

[11] Mining, farming, agricultural services, forestry, and fishing are the industries that make up the resource industry catergory.

[12] For a list of counties with a city see table C.1 in Appendix C: Structural Variable Specifics.

opportunities in and around the city, but could drive up income, as many better paying jobs require a more urban environment to operate. Naturally this variable is expected to have a positive sign in all three equations. These positive effects are widespread and will be felt in neighboring counties as well. A dummy variable for counties adjacent to ones containing a city (Adj UC)[13] is included, and is expected to have a positive sign in the three equations. Commuters may choose to live in such counties and firms may locate and employ workers commuting from the urban county. There will be some immeasurable differences from state to state, so a variable indicating the state each county belongs to is included. Lastly, a dummy indicating whether a county lies mostly in the Great Plains (Great Plain)[14] is included. The socio-economic and geographic makeup of the Great Plains is so vastly different from the rest of the Mountain West that population, employment and income growth trends may differ substantially (Duffy-Deno 1998). Lastly, a variable denoting the number of major ski resorts is included (Ski). Ski resorts and industries catering to skiers might have a large effect on employment, income and population. Places like Vail, Colorado and Lake Tahoe on the Nevada/California border come to mind with the many restaurants and lodges. The presence of a ski resort is expected to have a positive effect on employment, population, and income.

The data for this study are from reliable source since they are mostly from the government. The variables used in this study represent a wide range of factors that could potentially have an impact on population, employment, and income. However, some variables

[13] For a list of counties adjacent to those with a city see table C.2 in Appendix C: Structural Variable Specifics.
[14] For a list of counties in the Great Plains see table C.3 in Appendix C: Structural Variable Specifics.

may have been inadvertently left out. It is impossible to account for all factors that are part of a households' or firms' location decision. Another potential problem with the data are with its observation size. Counties are large entities and households in remote areas may have very little in common with households in more urban areas. A smaller unit might lead to more accurate results.

There is great variation within each variable. For example, there are some counties with no federal land, and others that are almost entirely covered by federal land. There are small counties with only a few thousand people and larger counties home to 100,000 people or more. This disparity can be viewed in the table of descriptive statistics below.

Table 5.2: Descriptive statistics

	Mean	Std. dev	Min.	Max.
Simultaneous Variables				
Total Employment 2000	12829.090	17173.990	408	96814
Total Population 2000	23083.590	31080.970	558	180936
Total Income (1000's) 2000	512.161	714.231	13.608	4586.448
Lagged Variables				
Total Employment 1990	9775.008	12794.900	313	70484
Total Population 1990	19065.810	24910.730	467	135510
Total Income (1000's) 1990	283.885	379.390	8.344	2075.564
Federal Land Variables				
% Land Managed by NPS	.945	4.155	0	45.682
% Land Managed by USFS	20.985	23.138	0	93.650
% Land Managed by BLM	18.235	21.718	0	95.048
Economic Variables				
% Taxes that are Property Tax	84.406	15.660	36.625	99.852
Per Capita Local Tax	856.028	645.073	191.953	5598.039
Unemployment Rate	6.991	3.376	1.300	28.600
Average Hourly Manufacturing Wages	10.391	4.070	2.019	29.703
Business Conditions Variables				
% High School Diploma	76.910	7.647	54.700	95.500
% Bachelors Degree	15.945	6.610	6.100	49.800
% Population Over 65	13.346	4.492	2.329	31.527
% Employed by the Federal Gov't	3.152	3.746	.141	36.649
% Income Dividends, Rent, & Interest	22.574	6.332	10.943	44.990
% Employed Resource Extraction Sector	20.225	13.555	1.319	89.248
% Homes Owned	70.807	6.768	48.536	85.746

Amenity Variables				
Teachers Per Pupil	.096	.041	.018	.554
Police Per Capita	2.090	1.403	.355	10.343
Average Annual Precipitation	14.464	5.427	3.51	42.320
Heating Days	238.085	62.004	45.367	380.600
Cooling Days	17.831	17.979	0	142.033
Structural Variables				
Destination Ski Resorts	.242	.618	0	5
Counties With Cities	.102	.304	0	1
Counties Adjacent to Counties With Cities	.475	.500	0	1
Counties in Great Plains	.201	.401	0	1
Arizona	.041	.199	0	1
Colorado	.217	.413	0	1
Idaho	.164	.371	0	1
Montana	.221	.416	0	1
Nevada	.053	.225	0	1
New Mexico	.115	.319	0	1
Utah	.094	.293	0	1
Wyoming	.094	.293	0	1
Observations	244			

CHAPTER SIX: RESULTS

In order to properly interpret the results, one must recall the theory and reasons for this study. Recall that the resource extractive industry has been declining, and many blame that decline on the restrictive activities of the federal government on government owned land. Those critics go further to claim that rural economies suffer due to employment and income lost from the decline of extractive industries. Keeping that in mind, they would expect to see negative coefficients on federal land variables, particularly the percent USFS variable. Therefore, statistically insignificant federal land variables do not support a negative impact on population, employment, or income.

Estimates were produced using Stata (2007), version 10. First the results from standard ordinary least squares (OLS) estimation will be discussed. Next, results from two types of instrumental variables estimation, two stage least squares (2SLS) and three stage least squares (3SLS) are reported. Lastly, the results from reduced-form equations using ordinary least squares (OLS) will be discussed.

Ordinary Least Squares (OLS)

Each equation was estimated using ordinary least squares estimation, and the results are displayed in the table below. The equations were estimated in their structural form, so there is a danger that the estimators will be biased.

Table 6.1: Ordinary Least Squares Results

	Employment	Population	Income
Simultaneous Variables			
Total Employment 2000		0.193	0.021***
		(1.93)	(9.24)
Total Population 2000	0.078***		0.000
	(4.33)		(0.24)
Total Income (1000's) 2000	7.810***	6.117**	

	(8.39)	(2.94)	
Lagged Variables			
Total Employment 1990	0.741***		
	(12.52)		
Total Population 1990		0.992***	
		(24.51)	
Total Income (1000's) 1990			1.010***
			(10.95)
Federal Land Variables			
% County Land Managed by NPS	16.730	-16.780	2.350
	(0.63)	(-0.31)	(1.71)
% County Land Managed by USFS	8.549	12.623	0.406
	(1.29)	(1.03)	(1.20)
% County Land Managed by BLM	-2.059	-13.455	0.366
	(-0.27)	(-0.87)	(0.95)
Economic Variables			
% Taxes that are Property Tax	23.165	58.177*	-1.508*
	(1.74)	(2.26)	(-2.17)
Per Capita Local Tax	-0.161	0.012	0.006
	(-0.74)	(0.02)	(0.53)
Unemployment Rate	-67.647		1.514
	(-1.59)		(0.69)
Average Hourly Manufacturing Wage Rate	-37.659		0.628
	(-1.28)		(0.42)
Business Conditions Variables			
% High School Diploma	43.870		-0.010
	(1.89)		(-0.01)
% Bachelors Degree			0.262
			(0.15)
% Population Over 65			-1.439
			(-0.60)
% Employed by the Federal Government	-103.018***		2.797
	(-3.46)		(1.79)
% Income Dividends, Rent, and Interest	-13.430		4.105**
	(-0.66)		(2.99)
% Employed Resource Extraction Sector	1.692		0.651
	(0.15)		(1.13)
% Homes Owned	-49.108*	60.840	3.219**
	(-2.41)	(1.54)	(2.79)
Amenity Variables			
Teachers Per Pupil		4693.665	
		(0.83)	
Police Per Capita		-49.253	
		(-0.22)	
Average Annual Precipitation	9.533	-42.061	-0.942

	(0.41)	(-0.91)	(-0.78)
Heating Days	-7.951*	17.029*	0.132
	(-2.00)	(2.12)	(0.62)
Cooling Days	-15.245	109.308***	-0.025
	(-1.18)	(4.12)	(-0.04)
Structural Variables			
Destination Ski Resorts	896.683***	446.070	-0.907
	(4.15)	(1.00)	(-0.08)
Counties With Cities	-1500.316*	-5934.377***	-144.763***
	(-2.41)	(-5.01)	(-4.61)
Counties Adjacent to Counties With Cities	-580.900*	1265.505**	40.489**
	(-2.35)	(2.62)	(3.22)
Counties in Great Plains	-359.871	-1314.151	4.144
	(-0.98)	(-1.80)	(0.22)
Arizona	-477.892	-307.103	16.037
	(-0.61)	(-0.20)	(0.40)
Colorado	343.980	-1038.459	73.325*
	(0.62)	(-0.95)	(2.45)
Idaho	-166.829	-2914.470*	29.829
	(-0.25)	(-2.23)	(0.85)
Montana	311.450	-3514.360*	14.762
	(0.44)	(-2.54)	(0.40)
Nevada	-1098.669	-917.799	90.782*
	(-1.43)	(-0.60)	(2.30)
Utah	802.492	-1109.627	-9.157
	(1.26)	(-0.92)	(-0.28)
Wyoming	-964.311	-4329.297**	31.143
	(-1.39)	(-3.32)	(0.86)
Constant	1655.768	-14201.765***	-345.756**
	(0.64)	(-3.61)	(-2.62)
Observations	244	244	244
R^2	0.993	0.991	0.989
Adjusted R^2	0.992	0.990	0.988
F	1017.317	933.451	624.029

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Land Variables

All of the federal land variables, which include the percent BLM, percent USFS, and percent NPS variables were insignificant in the population, employment, or income equations. The percent USFS variable had positive coefficients for all three equations. The coefficients for the percent BLM variable were negative for all but the income equation, and the percent NPS variable was positive in all but the population equation. The magnitude of the federal land variables was varied in each equation, but that variation is most prevalent in the income equation. The impact of the presence of USFS land on income was small and the effect of BLM land was even smaller. The effects of NPS land was by far the largest. NPS administered land is the most pristine and breathtaking of the three federal land types, so it may attract high income earners that want to live in beautiful areas.

Even though the magnitude of NPS managed land was largest in the income equation, it is still quite small. The coefficient is less than 1% of a deviation, but that value seems large compared to the magnitude of the NPS land variable in the population and employment equations. The magnitude of NPS managed land on population is also less than 1% of a standard deviation, and its magnitude on employment is about the same. The magnitudes of BLM and USFS managed lands are similar to one another and are even smaller than that of NPS managed land.

Other Variables

In the employment equation, both population and income were significantly positive, but the coefficients for the federal employment percent variable and percent home ownership variable were negative. The only statistically significant variables in the population equation were the income, lagged population, heating days, and cooling days variables . In the income equation the employment variable was statistically positive, as were the percent of home ownership. These results are disappointing since there are few significant variables from which to draw conclusions.

Economic theory states that population, employment, and income are all endogenous variables. Since each equation has two endogenous variables on the right hand side, the assumption of Ordinary Least Squares (OLS) that no right hand side variable may be correlated with the error term is violated. Therefore the estimates are biased and a different method of estimation should be used that does not violate this assumption.

Three Stage Least Squares (3SLS)

Three stage least squares (3SLS) and two stage least squares (2SLS) are two regression methods that through multiple regression steps remove the correlation between the error term and independent variables. Equations can be estimated in structural form without the danger of biased estimates from that correlation between right hand side variables and errors. The three equations were estimated in structural form using three stage least squares (3SLS) estimation, and the results are in the table below.

Table 6.2: Three Stage Least Squares Regression Results

Three Stage Least Squares Regression Results

	Employment	Population	Income
Simultaneous Variables			
Total Employment 2000		0.087	0.007*
		(0.74)	(2.17)
Total Population 2000	0.015		-0.003*
	(0.60)		(-2.26)
Total Income (1000's) 2000	-1.504	1.357	
	(-0.83)	(0.53)	
Lagged Variables			
Total Employment 1990	1.440***		
	(12.12)		
Total Population 1990		1.191***	
		(25.72)	
Total Income (1000's) 1990			1.875***
			(14.93)
Federal Land Variables			
% County Land Managed by NPS	53.189	18.231	3.015*
	(1.56)	(0.33)	(2.04)

% County Land Managed by USFS	19.456*	18.927	0.710*
	(2.38)	(1.53)	(2.02)
% County Land Managed by BLM	2.928	-16.845	0.316
	(0.30)	(-1.08)	(0.76)
Economic Variables			
% Taxes that are Property Tax	10.071	42.211	-0.762
	(0.61)	(1.63)	(-1.05)
Per Capita Local Tax	-0.244	0.498	0.006
	(-0.91)	(1.09)	(0.49)
Unemployment Rate	-113.626**		-1.386
	(-2.63)		(-0.76)
Average Hourly Manufacturing Wage Rate	-35.947		1.117
	(-1.19)		(0.90)
Business Conditions Variables			
% High School Diploma	27.883		-1.143
	(1.17)		(-1.00)
% Bachelors Degree			-0.388
			(-0.32)
% Population Over 65			-4.137**
			(-2.65)
% Employed by the Federal Government	-84.783**		-0.170
	(-2.76)		(-0.13)
% Income Dividends, Rent, and Interest	-33.270		2.842**
	(-1.55)		(2.67)
% Employed Resource Extraction Sector	3.928		-0.064
	(0.34)		(-0.14)
% Homes Owned	20.097	48.060	2.528*
	(0.75)	(1.19)	(2.21)
Amenity Variables			
Teachers Per Pupil		2061.754	
		(0.48)	
Police Per Capita		-204.827	
		(-1.20)	
Average Annual Precipitation	1.627	-41.765	-1.305
	(0.06)	(-0.89)	(-1.01)
Heating Days	-6.878	17.376*	0.008
	(-1.38)	(2.16)	(0.03)
Cooling Days	-18.707	114.034***	-0.117
	(-1.15)	(4.29)	(-0.16)
Structural Variables			
Destination Ski Resorts	1013.942***	984.708*	28.997*
	(3.73)	(2.14)	(2.30)
Counties With Cities	-3432.074***	-5421.673***	-178.803***
	(-4.13)	(-4.55)	(-5.31)
Counties Adjacent to Counties With Cities	167.608	1271.724**	35.299**
	(0.51)	(2.59)	(2.62)

Counties in Great Plains	-388.431	-1559.223*	-11.653
	(-0.84)	(-2.12)	(-0.58)
Arizona	815.414	-1320.390	24.764
	(0.82)	(-0.83)	(0.58)
Colorado	1342.716	558.950	80.117**
	(1.89)	(0.50)	(2.61)
Idaho	-411.216	-1517.866	1.170
	(-0.49)	(-1.15)	(0.03)
Montana	446.817	-2011.885	11.520
	(0.50)	(-1.45)	(0.30)
Nevada	-441.308	1533.451	29.639
	(-0.46)	(0.99)	(0.72)
Utah	285.829	-43.007	1.341
	(0.36)	(-0.04)	(0.04)
Wyoming	-1108.400	-2650.182*	-25.296
	(-1.28)	(-2.00)	(-0.67)
Constant	-1631.993	-13440.582***	-109.087
	(-0.52)	(-3.38)	(-0.85)
Observations	244		
R^2	0.987	0.989	0.983
F			

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Land Variables

The percent of county land that is managed by the USFS was found to have a positive impact on employment and income. The coefficient for that variable in the employment equation is 19.456, which means that a one percentage point increase of USFS managed land will lead to an increase of employment by 19.456. An increase of 19 jobs is a positive reaction to USFS land, but is very small when compared to the employment mean and standard deviation of the sample. 19.456 is far below 1% of the mean and standard deviation of employment. It would require hundreds of thousands of USFS land acres to make a large impact on employment. The percent NPS variable was significantly positive in the income, and has a coefficient of 3.015, which implies that a one percentage point increase of NPS managed land will lead to a $301.5 increase in income. Compared with the income standard deviation and mean, the impact of NPS managed land is small, but much larger than the effect of USFS land on employment. The percent NPS coefficient on income is about half the mean and less than half a standard deviation.

None of the federal land variables were statistically significant and negative, suggesting the theory of the negative effect of protected federal land on employment, population, or income has no support. The only statistically insignificant federal land variable was the percent BLM managed land variable in the population equation. This suggestive result is likely explained by the typical landforms found within BLM land. BLM administered land is typically arid and less likely to be forested and mountainous, and will probably not serve as a natural amenity to households. The statistically significant and USFS percent and insignificant percent NPS coefficients suggest that NPS lands may correlate much more strongly with employment and income than USFS land. The magnitude of their effect on population is about the same.

As expected, the presence of NPS managed land would have a positive impact on income since those lands undoubtedly attract tourists that spend money. They may also attract high income earning migrants. Celebrities living near the Tetons in Wyoming are an obvious example of high income earning migrants that are attracted to natural amenities present at National Parks. Surely high income earning retirees would be attracted to areas near other major national parks as well, such as the majestic Glacier and Yellowstone National Parks. The finding that USFS managed land is linked to higher employment and income might be related to greater recreational employment opportunity provided by forests and mountains. Since USFS managed land is typically forested, and often mountainous, it is likely that outdoor users will come to these counties creating a demand for guided services for fishing, hiking, rafting, or climbing. It is also possible that "footloose" firms are drawn to counties with a higher percent of USFS administered land for the scenic surroundings and "quality of life" offered by forests and mountains. The increased presence of those firms would increase employment.

Other Variables

In the employment equation the unemployment rate has a negative effect, as does the percent federal employment variable. It may be that counties with a high percent of federal employment have such a high percentage because they lack a strong private sector. That finding may just illustrate the importance of a strong private market in creating employment opportunities.

Population has a significantly negative impact on income and employment has positive effect on income. The percent of home ownership and percent dividends variables are both positive in the income equations, while the percent of those over sixty-five variable was negative. Low income earning individuals likely earn all or almost all of their income through wages, while the higher income earners are typically the ones with investments and a greater percent of their income comes from non-wage sources. One would therefore expect counties with a larger percent of total personal income coming from dividends, interest, and rent to have a higher total personal income. Both the number of heating days and the number of cooling days variables were statistically significant and positive in the population equation, but the magnitude of the number of cooling days is over six times stronger that the number of heating days. Perhaps this indicates the strong pull of warm western climates on retirees in states like Arizona and Nevada. The larger magnitude of the number of cooling days coefficient may indicate that westerners prefer harder cold winters.

The dummy variable for counties with a city was negative for all three equations. This is a surprising result since cities are believed to attract migrants that seek amenities typically located in larger population centers. Amenities such as more shopping options, greater school choice, parks, and restaurants are just some that are more prevalent in cities. Perhaps migrants and employers, all else equal, prefer either large metropolitan centers, or rural communities. The smaller cities with populations over 25,000 may not contain enough amenities to attract urban amenity seekers, and lack the open space and pace of life that natural amenity-seeking households and firms seek.

Although the three stage least squares (3SLS) estimation is an improvement over the standard OLS estimation, there are still some potential drawbacks to using 3SLS estimation. One problem with 3SLS estimation is that if one equation is miss-specified and the estimators are biased, that bias may spread to the other two equations. That is not a problem with two stage least squares (2SLS) estimation since bias in one equation remains isolated in that equation.

Two Stage Least Squares (2SLS)

The employment, population, and income equations were estimated in their structural form using 2SLS estimation, and the results are located in the table below. There is evidence of heteroskedasticity in the model so robust standard errors are used in each equation.

Table 6.3: Two Stage Least Squares Regression Results

	Employment	Population	Income
Simultaneous Variables			

Total Employment 2000		0.128	0.008
		(0.71)	(1.43)
Total Population 2000	0.029		-0.002
	(0.67)		(-0.91)
Total Income (1000's) 2000	-2.658	0.704	
	(-0.82)	(0.19)	
Lagged Variables			
Total Employment 1990	1.482***		
	(6.59)		
Total Population 1990		1.184***	
		(14.36)	
Total Income (1000's) 1990			1.763***
			(8.23)
Federal Land Variables			
% County Land Managed by NPS	49.957	16.485	2.840
	(1.91)	(0.40)	(1.69)
% County Land Managed by USFS	16.125*	17.996	0.511
	(2.07)	(1.68)	(1.72)
% County Land Managed by BLM	3.357	-16.396	0.330
	(0.40)	(-0.77)	(0.87)
Economic Variables			
% Taxes that are Property Tax	5.506	37.979	-0.747
	(0.25)	(1.43)	(-0.85)
Per Capita Local Tax	-0.268	0.372	0.006
	(-0.92)	(0.84)	(0.49)
Unemployment Rate	-60.550		0.918
	(-1.17)		(0.48)
Average Hourly Manufacturing Wage Rate	-65.459		0.120
	(-1.72)		(0.08)
Business Conditions Variables			
% High School Diploma	51.020		-1.390
	(1.77)		(-0.88)
% Bachelors Degree			2.662
			(1.47)
% Population Over 65			-2.865
			(-1.77)
% Employed by the Federal Government	-51.042		1.603
	(-1.89)		(0.92)
% Income Dividends, Rent, and Interest	21.314		4.434***
	(0.82)		(3.62)
% Employed Resource Extraction Sector	11.970		0.285
	(0.97)		(0.48)
% Homes Owned	17.576	52.570	2.909**
	(0.67)	(1.22)	(2.61)
Amenity Variables			
Teachers Per Pupil		1081.640	

		(0.25)	
Police Per Capita		-75.188	
		(-0.41)	
Average Annual Precipitation	-2.845	-44.196	-1.473
	(-0.11)	(-1.19)	(-1.58)
Heating Days	-7.037	16.893	0.010
	(-1.45)	(1.18)	(0.05)
Cooling Days	-19.533	111.607	-0.053
	(-1.24)	(1.49)	(-0.10)
Structural Variables			
Destination Ski Resorts	968.623*	939.669	20.106
	(2.34)	(1.62)	(1.07)
Counties With Cities	-3659.785**	-5538.537***	-178.884***
	(-2.58)	(-3.54)	(-3.53)
Counties Adjacent to Counties With Cities	257.524	1283.131**	37.852**
	(0.83)	(3.09)	(3.06)
Counties in Great Plains	-398.502	-1513.578	-5.418
	(-0.98)	(-1.64)	(-0.28)
Arizona	982.956	-1174.782	26.859
	(0.71)	(-0.66)	(0.49)
Colorado	1520.503*	642.642	80.404*
	(2.12)	(0.58)	(2.48)
Idaho	-48.723	-1435.741	22.100
	(-0.06)	(-1.31)	(0.72)
Montana	374.185	-1864.788	6.880
	(0.46)	(-1.74)	(0.23)
Nevada	75.300	1340.450	63.686*
	(0.08)	(0.82)	(1.97)
Utah	400.466	-18.245	11.131
	(0.53)	(-0.02)	(0.33)
Wyoming	-947.479	-2526.349*	-8.550
	(-1.08)	(-2.26)	(-0.25)
Constant	-4505.507	-13393.278*	-243.999*
	(-1.42)	(-1.98)	(-2.10)
Observations	244	244	244
R^2	0.987	0.989	0.985
F	306.872	437.701	436.486

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Land Variables

The percent of land managed by the USFS had a statistically significant impact on employment and has a coefficient of 16.125. The magnitude of that coefficient is extremely small just as it was in the OLS and 3SLS estimation. It less than 1% of the mean and the standard deviation. The magnitude of the NPS managed land variable was greatest in both the income and employment equations. That result has been consistent in the OLS, 3SLS, and 2SLS estimation. It is likely that the suggestive result that NPS managed lands have the greatest impact on employment and income is due to its strong restrictions and unique beauty. Visitors and households alike are likely drawn to counties home to the unique national treasures that are our national parks.

There were no other statistically significant federal land variables, and notably no negative ones. The only negative coefficient was the percent BLM variable in both the employment and population equations, but both coefficients are very small. The coefficients in the employment and population equations are both about 8% of the standard deviation of the variables.

The absence of any negative statistically significant federal land variables may imply that the argument that federal land has a net negative impact on rural counties cannot be definitively proven. It appears that counties with a higher percentage of federal land are either no worse off than those with a lower percentage of federal land or somewhat better off.

Other Variables

Employment was moved by its lagged value, but the income and population variables were insignificant. The lagged population variable had a positive impact on population. The lagged income variable had a significant positive effect on income, but neither population nor employment had any effect. Both the percent home ownership and percent dividend variables were positive in the income equation. The dummy for counties with a city was negative for all three equations.

Testing

Four tests were conducted on the 2SLS estimated model: the Wu-Hausman test, the Stock-Yogo Weak Identification test, the Sargan test, and the Pagan-Hall test[15].

The Wu-Hausman test for endogeniety was performed to verify whether 2SLS is an appropriate estimation method. This is an important test because OLS estimates would be more efficient if there was no endogeniety in the model. The null hypothesis of the Wu-Hausman test is all right hand side variables are exogenous and the alternative is that some are endogenous. The null hypothesis was rejected for the population ($\chi^2 = 59.5$, $p < .001$) employment ($\chi^2 = 25.2$, $p < .001$), and income ($\chi^2 = 64.6$, $p<.001$) equations. The implication of this test finding is that OLS estimators are biased and IV estimation can remove that bias.

Problems can arise with IV estimation even if endogeniety is verified through the Wu-Hausman test. If the model has weak instruments, the 2SLS estimation may not be the best estimation method. The Stock-Yogo test was performed to test for the presence of weak instruments in the model, which means that the instruments are poor predictors of the endogenous variables. If the instruments are weak, then there can be bias in the 2SLS estimation. Table D.1 in appendix D shows the null hypothesis stating that the instruments are weak was rejected for all three equations, leaving the alternative that the instruments are strong. Testing results indicate that the instruments are strong in each equation, which means

[15] See Appendix D: Test Results for the test statistics and critical values from the four tests.

they are good predictors. Another important assumption of 2SLS is that the excluded exogenous variables from each equation are both properly excluded and not correlated with the error term. The Sargan test is used to test if that assumption holds. The null hypothesis for the Sargan test is that the instruments are valid or properly excluded; while the alternative is that they are invalid and not properly excluded. Table D.1 in appendix D illustrates that the null hypothesis was rejected for all three equations, which implies that model has some problem with instruments. This result points to a potential problem with the model's specification. One such problem could be that excluded exogenous variables should appear in the model.

The Pagan-Hall test for heteroskedasticity was applied to each equation. The null hypothesis is that there is no heteroskedasticity and the alternative is that there is heteroskedasticity. Table D.1 shows that the null hypothesis was rejected for every equation indicating that heteroskedasticity is present in each equation. Therefore, robust standard errors were used for the 2SLS estimation. The robust standard errors correct for biased standard errors that may result from the presence of heteroskedasticity.

Reduced Form

Reduced form estimation is useful because it reveals the net effect of federal land on employment, population, and income. 2SLS and 3SLS reveal the direct effect and don't take into account the interplay between those three endogenous variables. For instance, the presence of federal land has some kind of effect on population, and income, which in turn have an effect on employment. That link is uncovered through reduced form estimation, and is important because the net effect is the true interaction.

Due to the results from the Pagan-Hall test on the 2SLS estimation, robust standard errors were used in the reduced form regression. The results of reduced form estimation are displayed in the table below.

Table 6.5: Reduced Form Regression Results

	Employment	Population	Income
Lagged Variables			
Total Employment 1990	1.463^{***}	0.229	0.010
	(7.80)	(0.76)	(1.16)
Total Population 1990	0.051	1.255^{***}	-0.002
	(0.95)	(12.37)	(-0.61)
Total Income (1000's) 1990	-5.351	-4.501	1.738^{***}
	(-0.98)	(-0.53)	(6.34)
Federal Land Variables			
% County Land Managed by NPS	47.871^{*}	9.521	3.137
	(2.11)	(0.21)	(1.81)
% County Land Managed by USFS	14.188	10.960	0.580
	(1.97)	(0.82)	(1.72)
% County Land Managed by BLM	2.045	-18.061	0.334
	(0.25)	(-0.84)	(0.74)
Economic Variables			
% Taxes that are Property Tax	11.914	41.130	-0.786
	(0.58)	(1.36)	(-0.81)
Per Capita Local Tax	-0.237	0.537	0.006
	(-0.59)	(0.90)	(0.32)
Unemployment Rate	-56.798	140.207	0.582
	(-1.15)	(0.90)	(0.30)
Average Hourly Manufacturing Wage Rate	-61.885	-79.863	-0.353
	(-1.69)	(-1.29)	(-0.20)
Business Conditions Variables			
% High School Diploma	20.437	19.538	-1.109
	(0.59)	(0.32)	(-0.60)
% Bachelors Degree	96.465	101.100	3.241
	(1.74)	(1.30)	(1.62)
% Population Over 65	66.340	2.692	-1.888
	(1.41)	(0.03)	(-0.94)
% Employed by the Federal Government	-44.311	94.334	1.130
	(-1.93)	(1.30)	(0.67)
% Income Dividends, Rent, and Interest	-18.705	144.306^{**}	3.992^{**}
	(-0.54)	(2.92)	(2.70)
% Employed Resource Extraction Sector	11.361	23.414	0.314
	(0.90)	(0.98)	(0.47)
% Homes Owned	28.502	64.777	2.834^{*}
	(1.04)	(1.32)	(2.12)

Amenity Variables			
Teachers Per Pupil	-1491.384	-3832.562	-165.907
	(-0.62)	(-0.90)	(-1.50)
Police Per Capita	82.082	-238.696	2.286
	(0.66)	(-1.19)	(0.35)
Average Annual Precipitation	-4.669	-57.893	-1.536
	(-0.18)	(-1.19)	(-1.38)
Heating Days	-6.151	17.385	-0.038
	(-1.17)	(1.14)	(-0.17)
Cooling Days	-13.932	122.337	-0.330
	(-0.84)	(1.65)	(-0.45)
Structural Variables			
Destination Ski Resorts	791.299	804.196	24.893
	(1.68)	(1.27)	(1.19)
Counties With Cities	-3580.224**	-6145.484**	-195.220**
	(-3.04)	(-3.20)	(-3.32)
Counties Adjacent to Counties With Cities	196.562	1539.732***	35.459*
	(0.74)	(3.36)	(2.58)
Counties in Great Plains	-229.974	-1528.639	-5.050
	(-0.56)	(-1.68)	(-0.23)
Arizona	833.258	-1187.966	33.565
	(0.62)	(-0.57)	(0.49)
Colorado	1255.542	1219.156	88.851*
	(1.83)	(0.95)	(2.38)
Idaho	92.067	-332.875	25.218
	(0.12)	(-0.22)	(0.71)
Montana	342.946	-2120.177	15.633
	(0.42)	(-1.78)	(0.44)
Nevada	322.310	3587.187	61.638
	(0.30)	(1.57)	(1.47)
Utah	612.989	506.063	16.293
	(0.80)	(0.33)	(0.42)
Wyoming	-706.532	-1897.692	-7.513
	(-0.84)	(-1.30)	(-0.19)
Constant	-5277.087	-21930.990*	-241.790
	(-1.78)	(-2.47)	(-1.71)
Observations	244	244	244
R^2	0.989	0.989	0.983
Adjusted R^2	0.987	0.988	0.980
F	312.694	365.168	309.345

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Land Variables

In the employment equation, the percent NPS variable was positive with a coefficient of 47.871. Just as in the other regressions, this result is relatively small. The coefficients for the other federal land variables are likewise quite small. The positive percent NPS coefficient may be the cause of “footloose” firms and recreational based outfits locating to these counties because of their uniquely beautiful landforms.

There is no evidence of a net negative effect of federal land on population, employment, or income. The notion that protecting forests in federally managed land harms rural communities through decreased extractive industrial activity is not proven by this study. There may be negative effects of the restrictive nature of the federal government on USFS managed land for instance, but any negative impact appears to be made up for by a positive impact on employment in other industries.

Other Variables

In all three equations, most of the explanatory power lies in the endogenous variable’s lagged variable. This was expected since the endogenous variables were expected to by highly correlated with their lagged value.

In the population equation the net effect of the percent dividend variable was positive. In the income equation, both the percent home ownership and percent dividend variables were positive. In each estimation method a positive link was displayed between income and both the percent dividend and percent home ownership variables. Reduced form estimation shows that the net effect of these variables is positive as well as the direct effect.

Summary

People, employment, income relationship

There is very little evidence of a relationship between population, employment, or income. There is no statistically significant interaction between any of the endogenous variables in the 2SLS or reduced form estimation. The only statistically significant interaction was in the income equation using 3SLS estimation. Employment correlates positively with income, and population correlates negatively. It makes intuitive sense that higher employment would lead to higher total personal income because an increase of employment usually increases wages. Population may correlate negatively with income because as population increases there is more competition for jobs, which would lower wages leading to lower total personal income. These results are merely suggestive however.

Policy Implications

Since there is evidence of a positive impact of USFS and NPS managed land on employment and no negative federal land variables, rural counties should embrace current resource extractive policy on federal land. It is not known what effect an increase in extracting resource activity from federal land at the expense of the natural environment would have on rural economies. Surely resource extractive employment would increase, but other employment sources would falter and the net effect remains unknown. It is only know that restrictive policy coupled with declines in resource extractive employment has not led to harmful consequences. A more comprehensive study that breaks down migrants and employers into subcategories would help to further an understanding of the role that federal land plays in shaping rural economies. As would a detailed decomposition of federal land variables to separate the effects of high value extractive multiple use land and protected high value amenity land. Only after more detailed studies are conducted can policy makers begin to hatch out a well thought out growth policy.

CHAPTER SEVEN: CONCLUSION

This paper examined the effects of federal land on population, employment, and income in the eight states that make up the Rocky Mountain West. The purpose was to determine if the extractive restrictions on federal land harmed, benefited, or had no impact on rural counties. Two movements have mobilized across the Rocky Mountain West concerning the management practices on public federal land. One group believes that restrictive policy is beneficial to rural economies and households because by protecting the natural landscape, the areas are attractive to migrants, tourists, and small business owners. The opposing group believes that the positive impact of protecting land is minimal at best and creates mostly low paying service jobs at the expense of high paying resource extractive jobs. This group argues that rural economies must tap into the unused resources that are being protected by the federal government.

Population, employment, and income were estimated simultaneously using a lagged adjustment model developed by Carlino and Mills (1987). The exogenous variables were based on a study by Duffy-Deno (1998) in which he estimated the effects of wilderness and federal land on population and employment for the 1980s. He determined that there was no impact of USFS, NPS, or BLM managed land on population or employment. This paper is important because it studies whether that same relationship is true during the 1990s. The economic well being of the nation was different during the 1980s then it was during the 1990s. There was a deep recession during the 1980s and a long boom during the 1990s, which may have caused a set of circumstances that altered the relationship between households and firms with federal land.

In addition to determining if the role of federal land in shaping population and employment has changed, this study measures its impact on the well being of households and firms by estimating income. The simultaneously determined lagged adjustment model that includes income provides a “three dimensional” look at rural economies. Instead of viewing the economy through a narrower people versus jobs lens; a broader people versus jobs versus income view is taken (Deller et al. 2001).

Two stage least squares (2SLS), three stage least squares (3SLS), and reduced form equations were all estimated. The emphasis is on the 2SLS estimation results because that method corrects for simultaneity and uses robust standard errors to correct for heteroskedasticity. A heavy emphasis is also placed on reduced form results because it captures the net effect which is important in a complicated three endogenous variable relationship. There is evidence that the presence of USFS managed land has a positive effect on employment and that the presence of NPS administered land has a positive net effect on employment. Duffy-Deno (1998) did not report any positive impact of any federal land variable on employment. Perhaps during the booming 1990s entrepreneurs were more likely to open businesses and tourists had more money to spend. Both effects could have lead to increased employment in the Rocky Mountain West.

The magnitude of the direct effect and net effect of federal land on population, employment, and income was very small. Never was the effect more than half a standard deviation of the endogenous variable, and often it was around 10%. This finding implies that a growth strategy of highlighting the attributes of federal land may not be very successful. Its important that federal land does not appear to harm rural counties, but any positive impact is minimal.

The presence of federal land either has a positive effect on rural economies, or no net effect at all. If resource extractive industries are harmed by the restrictive policies on public federal land, then those negative impacts are offset by positive gains in employment. There is no evidence of any effect of federal land on income, which means that households in counties with a higher portion of federal land are no worse off in terms of income. These finding support the theory that protecting forests and wilderness are beneficial, and certainly do not support the argument that the restrictive practices of federal land managers harm rural economies.

There are some deficiencies in this paper that should be mentioned and areas to improve this study. Federal land could be subcategorized into more specific groups beyond BLM land or USFS land. For example, there may be areas that allow some resource industries to operate, while others may exist for recreational purposes only. Separating multiple use land from strictly conservation land would help to make this study more applicable. Accounting for spatial dependence would improve the model as well. Spatial dependence can occur because economic zones are not clearly defined and certainly do not end at the county line (Rupasingha and Goetz, 2004). Migrants may be attracted to a broad geographic area that lies within three separate counties because of amenities unique to that community. An amenity that exists in areas outside the desired community but within the three county range could be irrelevant to the migrants. There are clearly some limitations of using county level data.

Migrants do not only take into account the positive elements of an area. They will also be deterred from counties with negative attributes. With the possible exception of the number of heating days variable, there are no disamenity variables used in this study. Variables measuring factors such as the crime rate, presence of mines or superfund sites, or air quality might have improved the findings.

The availability of health care and presence of airports are a couple of amenity variables whose inclusion may have improved the study. Most if not all metropolitan areas have airports and access to health care, but that is not the case in rural areas. Households and firms may take into consideration the presence of both amenities. Families probably would want to live near health care installations in case of emergency, and certain firms might need airports to connect with clients. This study uses a very simple group of amenity variables. An amenity scale has been used by researchers and tied to population growth. Such a scale might improve the study as it would capture more factors entering into household and firm location decisions.

There are some pitfalls in using police per capita as an amenity variable. Assuming that a relatively large police force is an amenity may be an incorrect assumption. The size of the police force may be a function of the crime rate, so perhaps replacing the per capita police variable with a crime rate variable would have been appropriate. Amenities such as the number of public parks or government funded public transit may be more attractive use of local tax dollars to households.

Although it is encouraging that protecting wildlife and wilderness at most may benefit rural counties and at the least pose no threat, there are shortcomings in taking the view that population and employment growth are beneficial to rural residents. People live in rural areas for their own reasons and may eschew growth. Some people may place a higher value on keeping their town small and quiet than on improving their standard of living and purchasing power. A fine line must be walked when it comes to protecting the small town life style and improving the lives of rural residents. Growth and development often destroys the very amenities that attract such growth. A policy that promotes natural amenities to attract migrants and spur growth could have long-run detrimental consequences. Any policy prescription should take into account the opinions of rural residents, as they are the ones that must live with the changes.

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APPENDIX A: THE MWD TEST

The MWD test tests whether a log-linear or linear specification is appropriate for estimation. Two instruments are created and included in linear and log-linear regressions, and their significance or insignificance reveals which specification should be used. One variable is created by subtracting the predicted Y values from the log-linear model from the natural log of the predict Y values from the linear model. The second instrument is created by subtracting the predicted Y values from the linear model from the anti-log of the predicted Y values from the log-linear model. The first instrument is included as an exogenous variable in the linear model, and if it is significant then the hypothesis that the linear model should be used is rejected. The second instrument is included as an exogenous variable in the log-linear model and if it is statistically significant, then the hypothesis that the log-linear model is appropriate is rejected. The first instrument is Z1, C1, and R1 for the population, income, and employment respectively. Likewise, the second instrument is Z2, C2, and R2. Z1, C1, R1, C2, and R2 are all statistically significant. Therefore the results are contradictory for the employment and income equations, and suggest that a log-linear model is appropriate in estimating the employment equation.

Table A.1: Population equation MWD test results

	Log-linear Model	Linear Model
Z1		-2981.9***
		(-4.72)
Z2	0.00000134	
	(0.44)	
lnpop90	0.552***	
	(15.29)	
lninc00	0.387***	
	(9.54)	

lnemp00	0.0770*	
	(2.16)	
ln%proptax	0.159**	
	(2.85)	
lnpercapitatax	-0.0816***	
	(-4.19)	
lnpccops	0.0210	
	(1.15)	
lnppteacher	0.0230	
	(0.93)	
ln%homeown	0.178*	
	(2.10)	
lnrain	-0.0264	
	(-1.10)	
lncool	-0.0227	
	(-1.41)	
lnheat	-0.0947	
	(-1.53)	
ln%nps	-0.00511	
	(-1.25)	
ln%blm	0.00129	
	(0.32)	
ln%usfs	0.000902	
	(0.29)	
ski	0.00825	587.6
	(0.59)	(1.36)
gplain	-0.0606*	-1969.8**
	(-2.52)	(-2.76)
city	-0.0755**	-6227.6***
	(-2.80)	(-5.49)
adjacent	0.0415**	1725.7***
	(2.76)	(3.64)
Arizona	-0.0104	-1394.2
	(-0.21)	(-0.92)
Colorado	-0.0295	-1067.2
	(-0.77)	(-1.01)
Idaho	-0.129**	-3743.5**
	(-3.07)	(-2.93)
Montana	-0.105*	-4828.1***
	(-2.34)	(-3.52)
Nevada	-0.174***	80.26
	(-3.56)	(0.05)
Utah	-0.0128	-1829.0
	(-0.32)	(-1.53)

Wyoming	-0.179***	-5007.1***
	(-3.90)	(-3.88)
pop90		1.003***
		(25.56)
inc00		0.00501*
		(2.49)
emp00		0.234*
		(2.43)
%proptax		7773.5**
		(3.12)
%percapitatax		-0.118
		(-0.25)
pccops		-155415.6
		(-0.68)
ppteacher		8773.6
		(1.57)
%homeown		8027.3*
		(2.07)
rain		-54.65
		(-1.23)
cool		138.1***
		(5.30)
heat		23.04**
		(2.95)
%nps		743.5
		(0.15)
%blm		-2612.5
		(-1.74)
%usfs		1269.2
		(1.09)
constant	0.302	-18854.8***
	(0.76)	(-4.74)
N	238	238
R^2	0.994	0.992
adj. R^2	0.993	0.991
F	1256.2	969.0

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.2: Employment equation MWD test results

	Log-linear Model	Linear Model
r1		2858.2***
		(5.84)
r2	-0.0000233***	
	(-4.00)	
lnemp90	0.458***	
	(11.93)	
lnpop00	0.265***	
	(3.65)	
lninc00	0.243***	
	(3.76)	
ln%proptax	-0.0407	
	(-0.53)	
lnpercapitatax	0.0396	
	(1.65)	
lnunemploymentrate	-0.0832**	
	(-2.75)	
lnmanuearnings	0.00518	
	(0.19)	
ln%education	0.370*	
	(2.52)	
ln%fedemployment	-0.0457***	
	(-3.59)	
ln%dividend	0.0627	
	(1.53)	
ln%resourseemp	-0.0858***	
	(-4.84)	
ln%homeown	-0.0474	
	(-0.40)	
lnrain	0.0186	
	(0.61)	
lncool	0.0182	
	(0.89)	
lnheat	0.0112	
	(0.14)	
ln%nps	0.0160**	
	(3.08)	
ln%blm	0.00210	

	(0.42)	
ln%usfs	0.00584	
	(1.37)	
ski	-0.0103	762.6***
	(-0.59)	(3.71)
gplain	-0.0352	-660.8
	(-1.13)	(-1.83)
city	-0.0374	-1645.3**
	(-1.07)	(-2.81)
adjacent	-0.0123	-833.6***
	(-0.62)	(-3.46)
Arizona	0.0326	-387.0
	(0.51)	(-0.52)
Colorado	0.0461	594.4
	(0.90)	(1.07)
Idaho	0.0406	191.0
	(0.69)	(0.28)
Montana	0.00693	817.0
	(0.11)	(1.12)
Nevada	-0.0787	-972.6
	(-1.22)	(-1.27)
Utah	0.0149	1488.7*
	(0.28)	(2.36)
Wyoming	-0.0435	-754.6
	(-0.72)	(-1.10)
emp90		0.733***
		(13.01)
pop00		0.105***
		(5.87)
inc00		0.00694***
		(7.76)
%proptax		2167.7
		(1.65)
Percapitatax		-0.191
		(-0.91)
unemploymentrate		-127.8**
		(-2.69)
manuearnings		-66.25*
		(-2.09)
%education		5131.1*
		(2.25)
%fedemployment		-17314.1***
		(-5.58)
%dividend		-2980.3

		(-1.43)
%resourseemp		-150.9
		(-0.13)
%homeown		-7256.0***
		(-3.54)
rain		17.47
		(0.78)
cool		-13.42
		(-1.10)
heat		-8.119*
		(-2.13)
%nps		1581.8
		(0.67)
%blm		-177.2
		(-0.24)
%usfs		2082.2**
		(3.19)
Constant	-0.932	3636.7
	(-1.75)	(1.39)
N	228	228
R^2	0.989	0.994
adj. R^2	0.988	0.993
F	615.5	1094.3

Table A.3: Income equation MWD test results

	Log-linear Model	Linear Model
c1		51041.1***
		(4.72)
c2	-0.000000277*	
	(-2.23)	
lninc90	0.396***	
	(7.94)	
lnemp00	0.0428	
	(0.81)	
lnpop00	0.584***	
	(9.70)	
ln%proptax	-0.180*	
	(-2.56)	
lnpercapitatax	0.0428	
	(1.74)	
lnunemployment	0.00648	

	(0.23)	
lnmanuearnings	0.00994	
	(0.40)	
ln%education	0.585***	
	(3.89)	
ln%college	0.0622	
	(1.28)	
ln%over65	-0.0718	
	(-1.58)	
ln%resourseemp	-0.0328*	
	(-1.99)	
ln%federalemp	-0.000807	
	(-0.07)	
ln%dividends	0.124*	
	(2.47)	
ln%homeown	0.397***	
	(3.38)	
lnrain	0.0242	
	(0.86)	
lncool	-0.00491	
	(-0.26)	
lnheat	-0.0566	
	(-0.76)	
lpctnps	0.00411	
	(0.85)	
ln%blm	0.00190	
	(0.41)	
ln%usfs	-0.00262	
	(-0.68)	
ski	0.0377*	-7686.1
	(2.37)	(-0.67)
gplain	0.00385	8507.0
	(0.13)	(0.43)
city	-0.0376	-142236.5***
	(-1.15)	(-4.63)
adjacent	0.0251	54130.1***
	(1.37)	(4.19)
Arizona	0.0575	28560.7
	(0.97)	(0.72)
Colorado	0.170***	102162.5**
	(3.45)	(3.27)
idaho	0.137*	56554.9
	(2.56)	(1.54)
Montana	0.0585	29256.4

	(0.98)	(0.73)
Nevada	0.193**	122143.0**
	(3.26)	(2.95)
Utah	0.00740	-8508.5
	(0.15)	(-0.25)
Wyoming	0.164**	45837.4
	(2.93)	(1.22)
inc90		1.014***
		(11.12)
emp00		20.85***
		(9.01)
pop00		0.521
		(0.52)
%proptax		-179669.1*
		(-2.52)
percapitatax		8.171
		(0.70)
unemploymentrate		1263.3
		(0.49)
manuearnings		1143.4
		(0.68)
%education		-17209.0
		(-0.12)
%college		421.9
		(0.24)
%over65		-343089.7
		(-1.39)
%resoureemp		40631.1
		(0.68)
%federalemp		308361.4*
		(1.98)
%dividend		601519.1***
		(4.07)
%homeown		406745.1***
		(3.41)
rain		-1171.0
		(-0.98)
cool		100.4
		(0.15)
heat		185.0
		(0.86)
%nps		289977.8*
		(2.27)
%blm		51738.6

		(1.28)
%usfs		63263.4
		(1.82)
constant	1.773**	-442214.1**
	(3.31)	(-3.13)
N	228	228
R^2	0.992	0.990
adj. R^2	0.991	0.989
F	748.8	620.9

APPENDIX B: SPECIFIC DATA SOURCES

Not all of the counties in the sample reported the number of police officers for the year 1990. Manufacturing earnings and employment reporting was sporadic as well, leading to missing observations for the average manufacturing wage rate variable. To fill in the missing observations, data was collected for different years as close to 1990 as was made available. All thirty of the missing observations for the number of police officers per county were filled in with observations from years other than 1990. Police officers per capita was calculated using the estimated population for the year corresponding to the year of the total police officer observation. Calculating the average manufacturing wage rate using data from years other than 1990 provided data for twenty-two observations, but data was unavailable for four counties. Average manufacturing wage rates are calculated using employment data and earnings data and due to data availability employment and earnings data was not always from the same year for each observation. Average manufacturing wage values for years other than 1990 are changed to 1990 dollars to account for inflation. The table below displays the data used in place of the missing cops per county missing observations, with the year of the replacing observation. Specific information about the data used to generate the missing average manufacturing wage rate observations is also displayed below.

Table B.1: Missing per capita police officer observations

State	County	Year of Observation	Total Cops in County	Estimated Population	Per Capita Cops
AZ	La Paz	91	49	14314	0.00342
AZ	Yuma	85	109	87581	0.00124
CO	Clear Creek	91	31	7852	0.00395
CO	Costilla	91	11	3262	0.00337
CO	Moffat	91	28	11518	0.00243
ID	Lemhi	93	9	7203	0.00125
ID	Lincoln	93	6	3557	0.00169
ID	Onieda	91	10	3477	0.00288
MT	Carter	91	3	1436	0.00209
MT	Garfield	88	3	1612	0.00186
MT	Glacier	88	12	11862	0.00101
MT	Golden Valley	89	2	919	0.00218
MT	Judith Basin	88	4	2376	0.00168
MT	Meagher	88	6	1851	0.00324
MT	Petroleum	87	1	533	0.00188
MT	Powell	88	9	6704	0.00134
MT	Prairie	91	5	1326	0.00377
MT	Wibaux	91	3	1155	0.00260
NV	Douglas	94	101	34413	0.00293
NM	Cibola	91	14	23251	0.00060
NM	Colfax	86	14	14276	0.00098
NM	De Baca	88	6	2241	0.00268
NM	Grant	89	40	27476	0.00146
NM	Guadalupe	89	10	4255	0.00235
NM	Hidalgo	92	26	5944	0.00437
NM	McKinley	88	39	59960	0.00065
NM	Rio Arriba	96	29	39178	0.00074
NM	Santa Fe	87	47	92327	0.00051
NM	Union	87	4	4558	0.00088
UT	Garfield	87	4	4055	0.00099

Table B.2: Missing average manufacturing wage rate observations

State	County	Earnings Data Year	Total Manu. Earnings	Employ. Year	Manu. Employ.	Average Hourly Wage	Inflation Adjusted
AZ	Apache	89	18317	89	901	9.77386	10.3321
AZ	Greenlee	89	2184	89	38	27.63158	29.2099
CO	Baca	92	610	92	48	6.10978	5.6917
CO	Cheyenne	92	160	92	11	6.99301	6.5145
CO	Dolores	96	251	96	11	10.97028	9.1384
CO	Hinsdale	94	235	94	11	10.27098	9.0581
ID	Butte	89	66133	89	1342	23.69204	25.0453
ID	Camas	88	487	88	26	9.00518	10.0014
MT	Garfield	96	655	96	21	14.99542	12.4914
MT	Golden Valley	92	216	92	15	6.92308	6.4494
MT	McCone	85	151	88	11	6.59965	7.3298
MT	Prairie	88	360	88	20	8.65385	9.6112
MT	Wibaux	91	410	95	11	17.91958	17.196
NV	Esmerelda	95	323	96	10	15.52885	13.3177
NV	Eureka	95	325	96	10	15.625	13.4002
NV	Lander	88	366	88	23	7.6505	8.4969
NM	Harding	92	247	92	17	6.98529	6.5073
NM	Sierra	92	404	92	33	5.88578	5.483
UT	Daggett	93	319	93	10	15.33654	13.8719
UT	Rich	91	54	91	10	2.59615	2.4913
WY	Niobrara	92	96	92	15	3.07692	2.8664
WY	Sublette	92	747	92	62	5.79249	5.3961

APPENDIX C: STRUCTURAL VARIABLE SPECIFICS

Following is a list of counties that are have cities with 25,000 people, counties adjacent to those counties, and a list of counties in the Great Plains.

Table C.1: Counties with a City of 25,000 People or More

Arizona

Cochise, Coconino, and Yuma

Colorado

Mesa, Pueblo, and Weld

Idaho

Bonneville, Nez Perce, and Twin Falls

Montana

Cascade, Lewis and Clark, Missoula, Silver Bow, and Yellowstone

New Mexico

Chaves, Dona Ana, Eddy, Lea, Otero, San Juan, and Santa Fe

Utah

Cache

Wyoming

Albany, Laramie, and Natrona

Table C.2: Counties Adjacent to Counties with a City of 25,000 People or More

Arizona

Cochise, Gila, Graham, Greenlee, La Paz, Navajo, Santa Cruz, and Yuma

Colorado

Clear Creek, Crowley, Custer, Delta, Fremont, Garfield, Gilpin, Grand, Huerfano, Jackson, La Plata, Las Animas, Lincoln, Logan, Montezuma, Montrose, Morgan, Otero, Park, Pueblo, Sedgwick, Teller, Washington, and, Weld

Idaho

Bingham, Boise, Caribou, Cassia, Clearwater, Elmore, Franklin, Gem, Gooding, Jefferson, Jerome, Latah, Lewis, Madison, Onieda, Owyhee, Payette, Power, and Teton

Montana

Beaverhead, Big Horn, Broadwater, Carbon, Cascade, Chouteau, Deer Lodge, Golden Valley, Granite, Jefferson, Judith Basin, Lake, Lewis and Clark, Madison, Meagher, Mineral, Musselshell, Powell, Ravalli, Sanders, Stillwater, Teton, and Treasure

Nevada

Churchill, Douglas, Lincoln, Lyon, Pershing, and Storey

New Mexico

Cibola, Curry, De Baca, Dona Ana, Eddy, Grant, Hidalgo, Lea, Lincoln, Luna, McKinley, Mora, Otero, and Quay

Utah

Box Elder, Cache, Carbon, Grand, Iron, Juab, Kane, Morgan, Rich, Sanpete, Tooele, and Wasatch

Wyoming

Albany, Carbon, Converse, Goshen, Laramie, and Platte

Table C.3: Counties in the Great Plains

Colorado

Baca, Bent, Cheyenne, Crowley, Kiowa, Kit Carson, Las Animas, Lincoln, Logan, Otero, Phillips, Prowers, Pueblo, Sedgwick, and Yuma

Montana

Blaine, Carter, Custer, Daniels, Dawson, Fallon, Fergus, Garfield, Hill, McCone, Musselshell, Petroleum, Phillips, Powder River, Prairie, Richland, Roosevelt, Rosebud, Sheridan, Toole, Treasure, Valley, and Wibaux

New Mexico

Eddy, Harding, Lea, Quay, Roosevelt, and Union

Wyoming

Campbell, Converse, Crook, Goshen, Laramie, Niobrara, Sheridan, and Weston

APPENDIX D: TEST RESULTS

The following table lists test statistics and critical values from the four tests on the 2SLS regression.

Table D.1: 2SLS Testing Results

Wu-Hausman

	Test Statistic	P-Value
Population	59.490	<.001
Employment	75.557	<.001
Income	98.701	<.001

Stock-Yogo Weak ID Test

	Cragg-Donald Wald F Statistic	Critical Value
Population	39.882	18.760
Employment	17.170	15.720
Income	61.075	11.040

Sargan Test

	Sargan statistic	Chi-sq P-Value
Population	24.522	0.002
Employment	6.809	0.146
Income	1.149	0.563

Pagan-Hall Test

	Pagan-Hall test Statistic	P-Value
Population	96.624	<.001
Employment	25.186	0.833
Income	64.581	0.001