THE IMPACT ON WAGES OF
WILDERNESS DESIGNATION IN MONTANA

A PROFESSIONAL PAPER

SUBMITTED TO

DR. TERRY ANDERSON,

DR. SUSAN CAPALBO,

AND

DR. DOUGLAS YOUNG

14 MAY 1992

BY

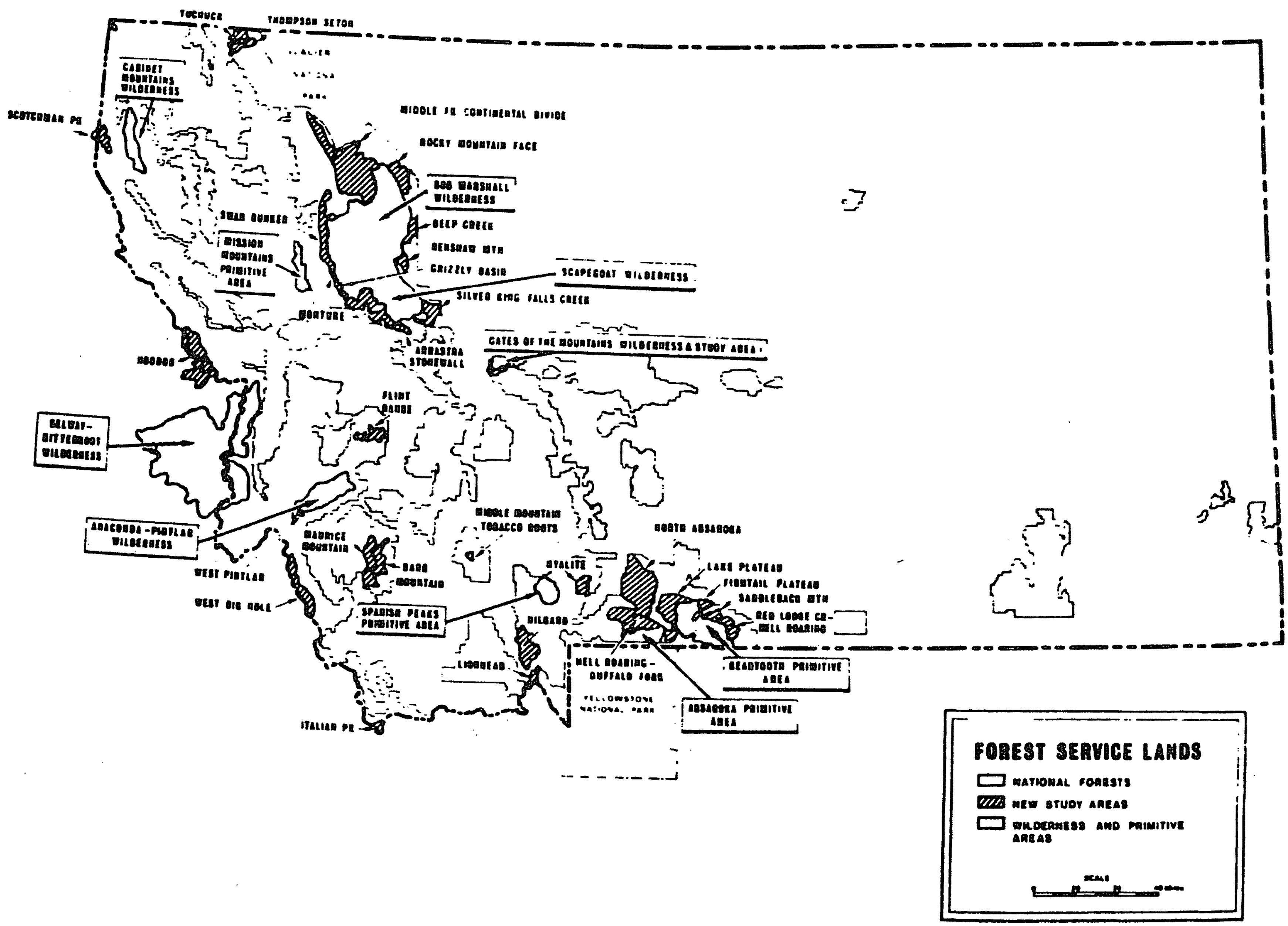
LESLIE KERR

I. Introduction

Few issues have been as controversial in recent Montana history as wilderness designation. The controversy centers around what activities are and are not allowed in wilderness areas. Wilderness areas are roadless areas in which motorized vehicles are prohibited, although horses are allowed. While activities such as timber cutting, mining, and oil and gas exploration are prohibited, livestock grazing is permitted. The main uses of wilderness areas are primitive recreational uses such as hiking, camping, hunting, fishing, and cross-country skiing. Wilderness areas are mainly managed by the United States Forest Service (USFS), although the Bureau of Land Management and the Park Service also oversee small portions of wilderness. In contrast to land designated as wilderness, the USFS manages multiple-use lands where mining and timber production are allowed as is motorized recreation in certain areas. Because different types of activities allowed on multiple-use and wilderness land are often at odds with one another, comprehensive wilderness legislation has not been passed for Montana.

The wilderness debate has largely been polarized into two main factions: the environmentalists, including groups such as the Montana Wilderness Society, which favors land preservation, and industrial groups, such as the Montana Wood Products Association, which favors extractive activities on public land. The debate includes both philosophical and economic considerations. The philosophical debate centers around the ethically correct use of public land, while the economic debate focuses on which type of land use provides the highest level of economic well-being to the citizens in adjacent areas. Historically, both sides have claimed that their particular land-use alternative provides the highest level of economic well-being, while neither side has convincing evidence to support its claim. One of the more important aspects of the economic debate has focused on jobs and which alternative provides more of them. An additional concern is how each alternative affects the wage rate in adjacent areas. The primary goal of this investigation is to estimate the effect, if any, of wilderness designation on the wages in areas adjacent to wilderness.

The legislative history of Montana wilderness began in 1964 with the designation of 1,479,599 acres of Montana land as wilderness. Additional designations were made in 1972, 1975, 1978, 1980, and 1983, bringing the total to 3,375,559 acres (see the attached map and Table 1). The latest event in the Montana wilderness saga occurred in 1991 when Montana Senators Max Baucus and Conrad Burns introduced a comprehensive wilderness bill in the U.S. Senate. This bill passed the Senate on March 26, 1992.



TUCHUCK
THOMPSON SETON
CABINET MOUNTAINS WILDERNESS
SCOTCHMAN PK
MIDDLE FK CONTINENTAL DIVIDE
ROCKY MOUNTAIN FACE
BOB MARSHALL WILDERNESS
SWAN BUNKER
DEEP CREEK
MISSION MOUNTAINS PRIMITIVE AREA
RENSHAW MTN
GRIZZLY BASIN
SCAPEGOAT WILDERNESS
SILVER KING FALLS CREEK
MONTURE
GATES OF THE MOUNTAINS WILDERNESS & STUDY AREA
HOODOO
ARRASTRA
STONEWALL
FLINT RANGE
SELWAY-BITTERROOT WILDERNESS
MIDDLE MOUNTAIN TOBACCO ROOTS
NORTH ABSAROKA
ANACONDA-PINTLAR WILDERNESS
MAURICE MOUNTAIN
BARB MOUNTAIN
WEST PINTLAR
LAKE PLATEAU
FISHTAIL PLATEAU
SADDLEBACK MTN
RED LODGE CR-HELL ROARING
WEST BIG HOLE
SPANISH PEAKS PRIMITIVE AREA
HILGARD
LIONHEAD
HELL ROARING-BUFFALO FORK
BEARTOOTH PRIMITIVE AREA
YELLOWSTONE NATIONAL PARK
ABSAROKA PRIMITIVE AREA
ITALIAN PK
FOREST SERVICE LANDS
NATIONAL FORESTS
NEW STUDY AREAS
WILDERNESS AND PRIMITIVE AREAS
SCALE

TABLE 1: MONTANA WILDERNESS DESIGNATION BY COUNTY AND YEAR[1]

(in acres)

YEAR	1964	1972	1975	1978	1980	1983	Total
COUNTY							
Beaverhead	19,520						19,520
Carbon				167,819			167,819
Deerlodge	53,017						53,017
Flathead	371,916			286,700			658,616
Gallatin						81,510	81,510
Granite				28,135			28,135
Lake			13,120				13,120
Lewis & Clark	235,808	213,056		41,400			490,264
Lincoln	49,952						49,952
Madison	44,175					167,434	211,609
Missoula	50,012		60,757		32,844		143,613
Park				518,326			518,326
Pondera	5,400			1,800			7,200
Powell	253,422	26,240					279,662
Ravalli	286,285						286,285
Sanders	44,320						44,320
Stillwater				132,059			132,059
Sweetgrass				102,123			102,123
Teton	67,680			16,800			84,480
							=========
							3,375,559

II. Survey of Literature

Wilderness Literature

To date little research has been done on the economic effect of wilderness areas. That which has been done has focused mainly on wilderness recreation and the demographic trends in wilderness counties. The following studies most directly address the economic impact of wilderness designation.

In "The Rocky Mountain Front: Wilderness or Nonwilderness?" Maxine C. Johnson studied the present and potential economic contributions of wilderness and nonwilderness land use. The three Montana wilderness counties Johnson studied were Glacier, Pondera, and Teton. From 1980 to 1986 the population of these three counties increased two percent entirely due to natural increase. During the same time period there was net out-migration in the three counties. The economies of these three counties are based primarily on agriculture and oil and gas production. The third most important economic sector in these counties is the federal government. The fourth is nonresident travel, a sector which is particularly important in Glacier County, adjacent to Glacier National Park. Johnson (3) concluded in the first part of her study that "Wilderness is simply not a vehicle for economic growth."

Johnson's conclusion may be valid for these three counties given the relative importance of oil and gas production. Any additional wilderness designation in or near these counties would entail foregone petroleum exploration and production. However, it should be noted that the poor economic performance of these three counties from 1980 to 1986 may be attributed partially to the poor overall economic conditions of rural Montana and the deteriorating economies of both the agricultural and oil and gas sectors. Indeed, if the nonresident travel sector had not increased in importance between 1980 and 1986, the economies of these three counties would have deteriorated even more. Also, the 6-year length of Johnson's study may be too short to draw any strong conclusions about the economic importance of wilderness over an extended period of time. One final criticism of Johnson's article is that she did not include the fourth Rocky Mountain Front County, Lewis and Clark, in her study. If she had, the economic importance of oil and gas production probably would have declined.

In "The Wealth of Nature: New Economic Realities in the Yellowstone Region" by Ray Rasker, Norma Tirrell and Deanne Kloepfer, the results of a Wilderness Society study similiar to Johnson's above are reported. The counties scrutinized in the study were the twenty counties surrounding Yellowstone National Park. The counties studied in Montana were Carbon, Gallatin, Madison, Park, Stillwater, and Sweet Grass; in Idaho, Bear Lake, Bonneville, Caribou, Clark, Franklin, Fremont, Madison, and Teton; and in Wyoming, Freemont, Hot Springs, Lincoln, Park, Sublette, and Teton. Since five wilderness areas (Absaroka-Beartooth, North Absaroka, Washakie, Teton, and Red Rock Lake) are encompassed in the Greater Yellowstone Ecosystem, the study is relevant to the question at hand.

As evidence of economic growth in the region, the Wilderness Society study cited population growth. Between 1969 and 1980, the population of the Greater Yellowstone Area increased by 32 percent (2.6% annually). Between 1980 and 1989, the population increased 10 percent (1% annually). These figures were somewhat higher than the same figures for the states of Montana, Wyoming and Idaho. However, the study's only population statistic was the increase in population in these counties. The figures were not broken down into categories such as natural increase and net migration, therefore it is invalid to imply that all the population increase in these counties was due to in-migration associated with the amenities of the area.

The results of the Wilderness Society study show that extractive industries, manufacturing, and agriculture have been declining in relative and absolute importance in these counties since 1969. In 1989 these sectors combined were responsible for one-sixth of the income and one-seventh of the jobs in these counties. At the same time, the local service sector increased in importance, accounting for nearly 80 percent of all new jobs and one-third of total personal income between 1969 and 1989.

An additional category of economic importance in the Greater Yellowstone Area, according to the Wilderness Society study, is nonlabor income which accounts for 35 percent of total personal income in the study counties. The U.S. Department of Commerce breaks nonlabor income into two categories, transfer payments and dividend, rent, and interest income. The authors speculated that a large portion of the nonlabor income in the Greater Yellowstone counties is retirement income generated by retirees moving to the area for the amenities. However, this speculation is without any direct evidence because nonlabor income also includes unemployment compensation and income maintenance programs. Given the seasonal employment trends in economies with significant recreational sectors, these components of nonlabor income could be quite large. A breakdown of the nonlabor income statistics is needed before any strong conclusions may be drawn.

The main conclusion and recommendation of the Wilderness Society (41) is that we should

> Preserve the principal income-generating capital assets of the region: its unique scenic vistas and thermal features, vast open space, a rich array of biological diversity, and numerous recreational opportunities. As this study shows, these qualities are stimulating--not hindering--economic diversity and growth in the region.

While the study showed that the economies of the Greater Yellowstone counties have indeed changed since 1969, the study does not show any cause and effect relationship between amenities and increases in employment and income. The authors cited increases in self-employment and the service sector as evidence that the amenities of the region are responsible for economic growth. However, they provided few data on how much either of these trends is either directly or indirectly related to the environment of the region. Without this link, the recommendation cited above is unwarranted.

In an article entitled "Wilderness, Timber Supply and the Economy of Western Montana," Thomas Power examined the economy of Western Montana. Power used population figures almost exclusively as the indicator of economic growth and found that 9 Western Montana counties (Flathead, Gallatin, Lewis and Clark, Ravalli, Missoula, Lake, Lincoln, Stillwater, and Glacier) accounted for more than the total population gain in Montana between 1980 and 1987. Power assertd that retirees make up a significant portion of this population gain. This assertion is supported in many of the 19 Montana wilderness counties as well. According to 1980 Census data, 14 of the 19 wilderness counties had higher percentages of retired people than the state as a whole.

Several studies have examined wilderness recreation. One such study is Kim Christy's 1988 master's thesis from Utah State University entitled "Benefit/Cost Variables and Comparative Recreation Use Patterns of Wilderness and Non-Wilderness Areas." In his research, Christy compared wilderness and nonwilderness primitive recreation patterns in Utah, U.S. Forest Service Region 4, with the national patterns from 1967 to 1986. In general terms, Christy found that between 1967 and 1986 wilderness/primitive recreation grew at a faster rate than nonwilderness/primitive recreation. In order to obtain a measure of marginal recreational use, Christy also compared growth rates of wilderness and nonwilderness primitive recreation on a per acre basis for two time periods, 1967 to 1976 and 1977 to 1986. In all three of his study areas, nonwilderness/primitive recreation growth rates and wilderness/primitive recreation growth rates were substantially lower in the second time period than the first. Wilderness/primitive recreation growth rates were positive in the first time period and negative in the second time period in all three study areas. In addition, nonwilderness/primitive recreation growth rates were higher on a per acre basis than the wilderness/primitive recreation growth rates in nearly every category and both time periods. The only exception to this was during 1967-1976 when the national wilderness/primitive recreation growth rate exceeded the national nonwilderness/primitive growth rate by 1.246%. The decrease in wilderness recreation growth rates per acre may be partially explained by the increase in wilderness acreage over the time period studied. The conclusion Christy (101) drew from his research was that "from a recreational perspective, adding wilderness areas to the National Wilderness Preservtion System is unjustified."

The most serious problem with Christy's work is that of the 50 regressions done in the study, 20 had statistically insignificant results. These insignificant results were reported as such in the body of the thesis but still used to validate the conclusion. In addition, Christy's statistics would be more meaningful if he had adjusted them for demographic changes. For example, Christy could have considered population changes and changes in the population age structure as possible explanatory variables in the recreation patterns. This seems particularly important since the age structure is such an important factor in outdoor recreation patterns (McCool and Frost, 22).

In "Wilderness in Montana: Putting Things into Perspective," Paul E. Polzin conducted a study of wilderness recreation in Montana. Like Christy, Polzin used recreational visitor days as reported by the Forest Service to measure recreation activity. Montana wilderness recreation trends were similar to national wilderness trends. In general, during the 1970s there was a large increase in Montana wilderness recreation. However, between 1980 and 1986 wilderness recreation generally levelled off or decreased slightly. Next, using the amount spent by nonresident visitors as calculated by the Montana Department of Commerce, Polzin estimated that nonresident travel accounted for 6.4% of Montana's economic base in 1985. From this figure he calculated the labor income associated with nonresident wilderness users to be $9.5 million in 1985 or approximately 10% of nonresident travel. This amounts to one-half of 1% of the total for all Montana basic industries.

A problem associated with both Polzin's and Johnson's research is that they use economic base models to analyze the importance of wilderness to their respective study areas. According to Lloyd C. Irland (126), economic base models are helpful in determining impacts in industries already in existence (e.g. determining the impact of increasing oil prices in an economy, such as in Glacier County, where oil is already a predominant industry), but they are not very effective at determining the effect of a major shift in the existing economic base (e.g. a predominantly agricultural economy shifting to a predominantly tourism-oriented economy).

This is because, the multipliers for such things as employment and income used in economic base models are derived given an existing economic structure, and these multipliers might be very different for different economies. Therefore using an old economic base model for an economy in transition, such as one where the importance of nonresident travel is increasing relative to other economic sectors, may produce inaccurate results.

In "Outdoor Recreation Participation in Montana: Trends and Implications," Stephen F. McCool and Jeffrey E. Frost used a 1985 survey of 1200 Montana residents to estimate participation rates in outdoor recreation. They based their estimates on trends in age because "age is the only one [social-demographic variable] with a strong association with outdoor recreation participation patterns" (22). On the basis of this variable, McCool and Frost predict that there will be little expansion of outdoor recreation by Montana residents by the year 2000. This conclusion should not be interpreted to mean that outdoor recreation in Montana as a whole will decline. Nonresident recreation could increase even if resident recreation does not. If this were the case, total outdoor recreation could actually increase.

Migration Literature

Another body of literature that pertains to the question of how wilderness areas affect the economies in adjacent areas is that concerning migration. Gundars Rudzitis contributed to this literature in a series of articles based on his research on the question of why people are moving to wilderness counties. During the 1970s, nonmetropolitan areas grew faster than metropolitan areas for the first time since the national census began. Wilderness counties grew two to three times faster than metropolitan and nonmetropolitan counties during this time. Today this trend appears to continue in wilderness counties even though surveys indicate that metropolitan areas are once again growing faster than nonmetropolitan areas.

In "Migration into Western Wilderness Counties: Causes and Consequences," Rudzitis and Harley E. Johansen studied six Western wilderness counties which they classified as "high amenity" counties. The authors surveyed recent in-migrants of these counties and found that 69% of them were between the ages of 21 and 50 and only 10% of the migrants were over 65, a fact which contradicts the speculation that wilderness counties are particularly attractive to retirees. Migrants also had higher incomes and more education than long-term residents of the counties.

When asked for the most important consideration in deciding to move to a wilderness county, 27% of the respondents to their survey cited employment opportunities, while 42% cited environmental amenities associated with wilderness counties. In addition, 47% reported lower incomes after moving.

The most serious problem with the Rudzitis-Johansen study is it considers information only on in-migrants. Out-migrants were not surveyed and the average length of residence of a migrant was not reported. These figures are important because, as Greenwood reported (see discussion below), areas with high in-migration rates are also often areas of high out-migration rates. Finally, they did not report how much of the population increase in these counties was a result of natural increase and how much was a result of net in-migration.

"Research on Internal Migration in the United States: A Survey" by Michael J. Greenwood provides a useful overview of the contribution economists have made to research concerning the determinants and the consequences of migration. Greenwood discussed several migration theories that seem particularly relevant to wilderness counties. First, he stated that "employment growth and migration are jointly dependent"(410). Thus, the large number of wilderness county in-migrants found in studies such as Rudzitis' may imply a corresponding, reinforcing growth in employment in these counties. Second, models of gross migration are based on migrant utility maximization theory; therefore amenities such as scenery may be modeled in migration theory in addition to the more traditional economic determinants of migration. Third, migration often occurs at the end of investment in human capital (e.g. such as college graduation). This trend may partially explain Rudzitis' finding that the in-migrants in his study were relatively young and well-educated. Fourth, people "are more likely to move to places about which they have at least some information" (405). Thus, wilderness designation may provide information about a previously relatively unknown area thus causing the in-migration.

One of the consequences of net in-migration into wilderness counties, according to Greenwood, may be more tax revenue for the destination county. This is due to the relatively higher education levels of the in-migrants which in turn lead to higher taxable incomes. It should be noted, however, that net in-migration also puts more pressure on public services such as schools.

Several studies (Hsieh and Liu, Liu, and Porell) deal mainly with quality of life as a determinant of migration. Because factors associated with a better quality of life (e.g. higher environmental quality and lower crime rates) are often cited as reasons for moving to wilderness counties, these studies are relevant to the topic of the economic well-being of wilderness counties.

In their studies, Liu and Porell found that the pursuit of a better quality of life was the most important determinant of migration while economic considerations were secondary. These studies are different from studies such as Rudzitis' in that they utilized actual net migration rates, quality of life indexes, and actual, adjusted income figures, rather than survey results. Therefore, they may be less biased even though there may be some problems in indexing quality of life factors. Unlike Rudzitis' study, the statistical nature of these studies allows signficance tests to be performed, and thus allows stronger conclusions to be drawn.

Liu's findings show that the net migration rate was approximately 24.1% higher among all migrants and 17.5% higher among nonwhite migrants for every 1% increase in the quality of life index. In addition, Liu found that five quality of life indicators (individual status, living conditions, agriculture production, educational development, and health and welfare) explained 43% of total variation in all net migration rates and 69% of the variation of nonwhite net migration rates. Only two percentage points were added to these figures when income and employment variables were included in the model.

Finally, Hseih and Liu found that environmental quality (i.e. those qualities often associated with wilderness areas) was the dominant determinant of migration in the short run while in the long run the quality of social life was the most important factor. This study would infer that wilderness counties should be successful at attracting in-migrants, but the quality of social life in these counties will be partially responsible for retaining these migrants.

Compensating Differential Literature[2]

The final body of literature to be surveyed here, that concerning compensating differentials, provides the theoretical basis for my research. While Adam Smith (111-123) is credited with being the first economist to write about compensating differentials, it was not until the 1970s that economists began using the theory of compensating differentials to analyze the role amenities play in regional economies. A compensating wage differential is defined as the extra wage that must be paid to attract workers to jobs with undesirable working conditions. Similarly, those who wish to work in relatively more pleasant conditions must "pay" for those conditions by accepting a lower wage.

Prior to the use of compensating differentials as a means of evaluating amenities, the theory was used to evaluate on-the-job characteristics such as risk of death. In Modern Labor Economics, Ronald G. Ehrenberg and Robert S. Smith provide a useful overview of the theory of compensating differentials in this context.[3] One assumption that is required for compensating differentials to arise is that workers maximize utility rather than money income. If this were not the case, workers would choose the job with the highest income regardless of the characteristics of the job, and a compensating wage differential would not arise. A second assumption is that workers are mobile so that they may move to the job which maximizes their utility. Finally, it is assumed that workers have knowledge of the characteristics of the various jobs available to them.

Other assumptions apply to employers. First, it is assumed that it is costly for employers to reduce unpleasant working conditions. Second, the firm seeks to maximize profits in a competitive market (i.e. The firm operates at the zero-profit level.). With these assumptions, a firm must decrease the wages it offers to remain competitive if it reduces unpleasant job characteristics. In such a labor market, employers and employees are matched along a continuum with varying job characteristics and wage rates.

Robert S. Smith wrote a survey article entitled "Compensating Wage Differentials and Public Policy: A Review" consisting of studies similar to Ehrenberg and Smith's described above. Smith reported results from 25 studies in which wage differentials were calculated for various unpleasant job characteristics, including risk of death, physical work, repetitive work, hard or stressful work, job or income insecurity, and machine work. Smith reported that all the studies that included a "risk of death" variable found that variable to have a positive and statistically significant coefficient. This implies that the wage rate increases as the risk of death increases. Thus, the empirical results with respect to this variable support the theory of compensating differentials. However, the risk of death variable was the only one in all the studies Smith surveyed which provided definitive support for the theory. Smith speculated that this was because risk of death was the only variable which could unambiguously be thought of as an unpleasant job characteristic by rational people. Thus, it is the only variable that can be signed a priori. This led Smith to conclude that "tests of the theory of compensating differentials, to date, are inconclusive with respect to every job characteristic except the risk of death" (347).

One of the first studies to utilize the theory of compensating differentials in analyzing the role of amenities in regional economies was "Wages, Climate, and the Quality of Life" by

Irving Hoch with Judith Drake.[4] To determine the effect of climate change on real wages, Hoch and Drake regressed a vector of climate variables, including summer temperature, winter temperature, precipitation and average wind velocity, and a vector of nonclimate variables, including population density, regional dummy variables and regional racial composition, on the real wage rate. They conducted their empirical tests for three different samples, each from a different year and within a different occupational class. Hoch and Drake found that summer temperature was the strongest climate variable, although wind velocity was also often statistically significant in their equations. The coefficient for the summer tempreature variable was generally negative in sign which implies that as summer temperature increases, wages decrease. The coefficient for wind velocity was generally positive which implies wages must increase as wind velocity increases.

In "A Hedonic Model of Interregional Wages, Rents, and Amenity Values," John P. Hoehn, Mark C. Berger and Glenn C. Blomquist explored interaction between rents and amenities. Simply put, rents and amenities are hypothesized to be positively related. That is, an increase in amenities in an area leads to higher rents in the area and gives rise to a rent differential which works in the opposite direction as the wage differential. Under different sets of assumptions, the value of amenities may be bid into wage differentials, rent differentials, or both. To test their hypothesis, the authors estimated differentials in both the housing and the labor markets for 16 amenity variables based on data from the 1980 Decennial Census of Population and Housing. The 16 amenity variables included school quality, crime, air and water quality, and climate. Of the 16 estimated coefficients, eight were statistically significant in the rent differential estimation, and 11 were statistically significant in the wage differential estimation. In addition, 12 of the estimated coefficients had opposite signs in the two estimations, as predicted by the theory. Thus, the authors had relatively good support for their theory. One important result of this study was that the authors found that had they evaluated any of the amenities solely on the basis of either a wage differential or a rent differential, the estimated value of the amenity would have been biased.

The final author to be included in this literature survey is Jennifer Roback, who wrote two articles on wage and rent differentials arising from amenities. In her 1982 article, "Wages, Rents, and the Quality of Life," Roback set out her basic model. Unlike previous studies surveyed here, Roback added firms to the basic compensating differential model. In her 1988 article, "Wages, Rents, and Amenities: Differences Among Workers and Regions," Roback extended her basic model to allow for two types (skilled and unskilled) of workers rather than assuming all workers are identical. In addition to extending her basic model, Roback (1988) also tested the hypothesis that accounting for regional cost-of-living variations in empirical work actually causes regional wage differences to increase rather than decrease. The reasoning behind this hypothesis is that variances in amenities across regions generate both wage and rent differentials which are of opposite signs. Since rent differences across regions make up a large portion of cost-of-living differences, adjusting wages for regional cost-of-living differences increases regional wage disparities.

Roback's empirical results largely support her hypotheses. In her first study, Roback (1982) found empirical support for the hypothesis that regional earnings differentials are actually proxies for different regional amenity levels. To test this hypothesis, she estimated two equations with wages as the dependent variable. In the first equation, regional dummy variables, whose coefficients were all statistically significant, were the only independent variables. In the second equation, Roback included regional dummy variables and amenity variables, such as crime level, heating degree days, and population density, as independent variables. In this case, all but one regional dummy variable became insignificant and five out of seven amenity variables were significant, which provided support for her hypothesis.

In her second study, Roback (1988) tested the hypothesis that cost-of-living adjustments exacerbate rather than alleviate regional earnings differentials. First, she found that including cost-of-living indexes in a regression of regional dummies on wages made the regional earnings differences even more significant. Next, she found that including amenity variables in the regression caused all but one regional dummy to become insignificant while the majority of the amenity variables were significant. These results provided strong support for her hypothesis. They also suggested that it is "mistaken to conclude that people in low wage areas are worse off than people in high wage areas" (31).

III. Theory Discussion[5]

The problem of how land designated as wilderness affects the wage rate in adjacent areas has not been addressed in the theoretical framework of compensating differentials. As defined above, a compensating wage differential is the extra wage that must be paid to attract workers to jobs with undesirable working conditions. Similarly, those who wish to work in more pleasant conditions must "pay" for those conditions by accepting a lower wage. This theory is relevant to the problem at hand because wilderness is considered to be an amenity by many people. On the other hand, extractive industries (such as logging) which are not permitted in wilderness areas are considered disamenities by many people. Thus, if wilderness is indeed an amenity, people will accept a lower wage in order to work in areas adjacent to wilderness.

A fundamental assumption in the theory of compensating differentials is that the correct measure of income is "utility income." This means that people derive utility from monetary income as well as other factors such as amenities. It is the entire set of factors which contribute to utility (i.e. utility income) that must be used to measure well-being. Assuming that people maximize their utility income and that this utility income will be equal across all locations in a competitive equilibrium, it is differences in utility income across locations that drives migration.

A second assumption in the theory of compensating differentials is that workers are aware of job characteristics, including location-specific characteristics. If people were unaware that a job in a Montana wilderness county had local amenities, they might not take the job, because the wage would be too low in comparison with wages for the same job in less amenable areas. Even if people are not aware of all job characteristics prior to taking a job, they would become aware of these characteristics relatively quickly and make adjustments to maximize their utility.

The third assumption implicit in the theory of compensating differentials is that workers are mobile. Hence a set of job offers is available with a variety of wages and characteristics, and the worker may choose the job which maximizes his or her utility income.

Keeping these assumptions in mind, regional wage differentials are hypothesized to be generated by regional differences in amenities. If a worker derives utility from an amenity (wilderness, in this case), he or she is willing to accept a lower wage if the amenity is present. This tradeoff between wages and amenities is made until utility income is equal in all locations.

For example, if a worker who derives positive utility from mountain scenery has the choice between a $10 per hour wage rate in an area without it and a $10 per hour wage rate in an area with it, the worker will choose the latter. Other workers who also derive utility from the mountains will choose to work in the area until, in equilibrium, the wage rate declines enough in the area with the amenity to equalize utility income.

A related hypothesis is that the same amenities that generate regional wage differentials also generate rent differentials that are of the opposite sign as the wage differences. For example, an owner of a location-specific asset can charge more rent when amenities are present than when they are not. Rent will increase in those areas with amenities relative to those areas without amenities until utility income is equal in all locations.

Between wage differentials and rent differentials there are three possible ways the value of amenities may be capitalized. First, it is possible that amenities could be capitalized only in rent. Second, it is possible that the value of amenities could be capitalized only in the wage rate.[6] Third, their value could be capitalized in a combination of wages and rent. My empirical investigation will focus on how amenities, or more specifically wilderness, affects the wage rate. If the first possibility above reflects reality, the data will show no correlation between wilderness and wage rates. If the second possibility is correct, the wage differential shown to be created by wilderness would represent a full valuation of wilderness. Finally, if the third possibility is correct, the calculated wage differential would understate the value of wilderness because some of wilderness' value is capitalized in rent.

Returning to the theory of amenity effects in the labor market, it is hypothesized that the wage rate is a function of both wilderness and nonwilderness variables in the following equation:

$$(1) \quad W = f(X, Z)$$

where W is the wage rate, X is a vector of wilderness variables, and Z is a vector of nonwilderness variables. If wilderness is indeed an amenity, the theory of compensating differentials predicts that X and W are negatively related; that is, as wilderness increases, wages decrease, and vice versa.

Implicit in the discussion above is the assumption that preferences toward wilderness are homogeneous. However, it is likely that these preferences are heterogeneous with wilderness being an amenity for some and a disamenity for others. Heterogeneity of preferences may cause the compensating wage differential with respect to wilderness to be zero or positive rather than negative. Because the wage rate and therefore any compensating wage differential arise in the market at the margin, a compensating differential will be negative only if the marginal worker considers wilderness an amenity. If wilderness is a disamenity for the marginal worker, the compensating wage differential will be positive. Similarly, if the marginal worker is indifferent to wilderness, no compensating wage differential with respect to wilderness will arise.

IV. Econometrics

To test the hypothesis that wilderness and wages in adjacent areas are negatively related, various versions of the following equation were estimated using the 19 Montana counties which contain wilderness for the years 1970 through 1988 as the sample:

$$(2) \quad W_{it} = f(X_{it}, Z_{it}) + u_{it} \ .$$

Note that Equation (2) is the empirical form of Equation (1) where u is a disturbance term, i denotes the 19 different counties, and t denotes the years 1970 through 1988. The various versions of Equation (2) which were estimated included several linear forms, quadratic forms, and a semi-log form. The linear forms, of which there are three, performed the best and are presented here. Note that the theory presented above provides no guidance as to which functional form is theoretically correct. Thus the linear forms were chosen based upon their statistical performance.[7] Given this choice of functional form, Equation (2) becomes:

$$(3) \quad W_{it} = a + bX_{it} + cZ_{it} + u_{it}.$$

The vector of wilderness variables, X, and the dependent variable, W, remain the same in all three linear models. The wage rate, W, is the average annual wage per full-time job (U.S. Department of Commerce, 1990). Part-time jobs are aggregated into full-time equivalent figures and then included in the wage rate. Next, the nominal wage is converted to a real wage rate with the Consumer Price Index (Economic Report of the President, 359). This real wage figure is the one used to estimate Equation (3).

The vector of wilderness variables, X, consists of three variables: WILD, PWILD, and WILDADJ. WILD is the number of acres (in thousands) designated as wilderness in each county; PWILD is the percentage of each county which is designated as wilderness; and WILDADJ is the number of acres of wilderness (in thousands) in counties adjacent to each individual wilderness county (see Table 2 for a summary of variables). PWILD is included as an independent variable in addition to WILD to control for the size of the various counties. In this way counties with equal proportions of wilderness will be weighted equally even if they are not equal in size. The number of acres in a county which are wilderness (WILD) is included because the absolute amount of wilderness may be important to those making decisions about accepting jobs in a county. For example, a very small county may be 30% wilderness while a very large county may be only 10% wilderness, but the larger county could still contain more acres of wilderness. If the absolute amount of wilderness is important to an individual, that person would locate in the county with the smaller percentage but larger absolute acreage of wilderness. Finally, the number of wilderness acres in adjacent counties (WILDADJ) is included because counties may not be an effective observation boundary. For example, the amount of wilderness in Park County may affect wages in Gallatin County if people are living in Park County for the wilderness amenities but are commuting to work in Gallatin County.

The vector of wilderness variables are the amenity variables which may, according to the theory discussed above, create a compensating wage differential. If wilderness is indeed an amenity, an increase in wilderness will cause a decrease in the wage rate. Thus the signs on WILD, PWILD, AND WILDADJ are predicted to be negative if wilderness is an amenity. However, as discussed in the previous section, if preferences are heterogeneous, and some do not consider wilderness to be an amenity, the sign on the wilderness coefficient may not be negative.

The vector of nonwilderness variables, Z, in Equation (3) above is a vector of control variables which account for the other factors which may affect the wage rate. Including these variables should serve to isolate the effects of the amenity variables and increase the amount of variability in the wage rate explained by the equation above. The following four variables make up the Z vector in the first model to be estimated: ED, FARM, GOVT, and OTHER. The education variable, ED, is the percentage of people over the age of 25 in a county with 12 or more years of education. Data for all the study years were not available, so the ED variable for the missing years was obtained by interpolation (U.S. Department of Commerce, 1972). ED is predicted to be positive because as education increases it is expected that the wage rate will increase as well. The next two variables, FARM and GOVT, are the percentage of total personal income from farming and from government and government enterprises, respectively. The variable OTHER is the percentage of total personal income of wholesale trade, retail trade, finance, insurance, real estate, and services combined (U.S. Department of Commerce, 1970). The three variables FARM, GOVT, and OTHER will pick up the effects of the economic composition of each county. For example, a county with a large percentage of income derived from agriculture will be adversely affected if there is a general economic downturn in agriculture. The farm variable will pick up the effects of this downturn on the wage rate.

The second form of Equation (3) which was estimated has a slightly different Z vector while the X vector of wilderness variables remains the same. In addition to the four previous variables of the Z vector, the second model includes 18 dummy time variables, T1 through T18. Each of these 18 variables assigns a value of one to its particular year and zero for the remaining years. For example, T1 assigns a value of one to the year 1970 and zeros to every other year. A dummy variable T19 for the year 1988 was not included in order to avoid linear dependence. The time dummy variables in this model will account for economic variables which are common across counties for a particular year. Thus, the addition of these variables should increase the variance explained by the model.

The third and final form of Equation (3) to be estimated includes the same wilderness variables as the previous two models, the four nonwilderness variables, the previous 18 time dummy variables, and 18 county dummy variables, D1 through D18. As with the time dummy variables, each county dummy variable assigns a value of one to its particular county and a value of zero to all other counties. Again, the last county is not assigned a dummy variable to avoid linear dependence. The addition of the county dummy variables to the Z vector accounts for economic variables which are constant for each county over time.

The first estimation of Model 1 was done using ordinary least squares. However, as shown in Table 3, the Durbin-Watson statistic for this estimation suggests that the error term is subject to positive first-order autoregression. Therefore, all three models were estimated in a pooled time-series cross-section with a generalized least squares method which allows for cross-sectional heteroskedasticity [$E(u_{it}^2) = \sigma_i^2$] and time-wise first-order autoregression [$u_{it} = \rho u_{it-1} + e_{it}$].[8]

Comparing the results for the three models as presented in Tables 3 and 4, the Buse R^2 increases from 0.079 in Model 1 to 0.4179 in Model 2 to 0.8491 in Model 3. Thus, based on the Buse R^2 only, Model 3 performs the best.

Looking at the signs on the estimated coefficients and the t-ratios, PWILD is the only wilderness variable in Models 1 and 2 which has the predicted negative sign on its coefficient. WILD and WILDADJ both have positive coefficients in the first two models. This situation is reversed in Model 3 where WILD and WILDADJ have negative coefficients and PWILD has a positive coefficient. However, neither PWILD or WILD is statistically significant in Model 3. The coefficient for WILDADJ in Model 3 is statistically significant at the 99% level, although the coefficient itself is relatively small. In constrast, the three wilderness variables in

Models 1 and 2 are all statistically significant. In Model 1, PWILD and WILDADJ are significant at the 98% level while WILD is significant at the 99% level. In Model 2, WILD is statistically significant at the 98% level, WILDADJ at the 95% level and PWILD at the 90% level.

The only other variable whose sign was predicted previously was the education variable, ED. It was predicted that ED would be positive so that as education rose, so did the wage rate. The only model in which the coefficient on ED is positive is Model 2. In Models 1 and 3, the ED coefficient is negative. The coefficient is statistically significant at the 99% level in Models 1 and 2 and at the 98% level in Model 3.

Of the remaining variables, FARM and GOVT are only significant in Model 3, and OTHER is not significant in any of the models. In Model 2, the time dummy variables all have positive estimated coefficients which get progressively smaller. This indicates that real wages have been trending downward, holding other things equal, over this time period. The variables T1 through T17 are all statistically significant at the 99% level. T18 is significant at the 90% level. In contrast, there is no apparent pattern to the time or county dummy coefficients in Model 3. In this model, five of the time dummies and eight of the county dummies are negative, while the rest are positive. In addition, only four of the time dummies are statistically significant at the 90% or greater level. Of the 18 county dummies, 15 are statistically significant at the 90% or greater level.

In comparing the three models, the results are mixed as to which one is the best. However, given Model 2's relatively high Buse R^2, the performance of the t-ratios, and the sign on the education variable, Model 2 seems to be the best model of the three.

As discussed above, two of the signs on the wilderness coefficients in Model 2 are not negative, as the theory predicted they would be. PWILD's coefficient is negative while the coefficients for WILD and WILDADJ are both positive. This result may indicate that people prefer a high percentage of wilderness in the county in which they reside as opposed to a high absolute number of wilderness acres.

Examining the derivative of wages with respect to WILD estimated from Model 2 sheds some light on what will happen to the real wage as the number of wilderness acres is changed by 1,000. This derivative is:

(4) $dW/dWILD = 3.625 - 51.632(100/\text{county land area})$,

where 3.625 and -51.632 are the estimated coefficients on WILD and PWILD respectively, and county land area is in thousands of acres. Evaluating this derivative at the average land area gives a value of 0.58. Testing whether this value is significantly different than zero gives a t-statistic of 1.143, which implies that the derivative evaluated for the average county is not significantly different from zero. However, given the large range in county sizes, this derivative could also be evaluated at the low and high ends of the range. Evaluated for the smallest county, the derivative gives a value of -7.27. The t-statistic associated with this value is -1.557, which is not statistically significant. Finally, evaluating Equation (4) for the largest county gives a value of 2.18 with a t-statistic of 2.744 which is significant at the 99% level. Thus only the largest county's wage rate will be significantly affected by a change in wilderness acreage. However, the direction of this change does not support the prediction that wilderness is an amenity and will consequently generate a negative wage differential. The derivative result for large counties may be interpreted to mean that a 1,000-acre increase in wilderness leads to a $2.18 annual increase in the wage. The theory predicts that increases in wilderness should cause wages to decrease rather than increase if wilderness is an amenity. However, an annual increase in real wages of $2.18 is a fairly small amount in comparison with the mean real wage of $13,632 for the time period and counties under study. Therefore, although the t-ratios for the wilderness variables indicate that wilderness does affect the wage rate in Montana's wilderness counties, this effect is negligible.

V. Conclusion

The empirical portion of this investigation provided only mixed support, at best, for the theory set forth earlier. The negative sign on the estimated coefficient for the percentage of wilderness in each county provided some support for the theory that wilderness is an amenity, and people are therefore willing to "pay" for this amenity by accepting a lower wage. However, the signs on the coefficients for the total number of wilderness acres and the total number of wilderness acres in adjacent counties were positive. These results, which contradict the theory above, may be consistent with one of several conclusions. The first possibility is that the theory is incorrect. A second possibility is that the theory is essentially correct, but WILD and WILDADJ are not considered amenities. A third possibility is that the effects of wilderness designation were not yet fully capitalized into a wage differential by 1988, the last year included in the study.[9] Finally, it is possible that while wilderness has negligible effects on the wage rate, it is creating a rent differential. Unfortunately, the data are not available to test this last possibility.

Thus, although this investigation presented a different approach for studying the problem of the economic impact of wilderness designation, the results did not provide a definitive answer. Further research on this problem is therefore necessary. Given the political importance of further wilderness designation in Montana, this research will no doubt be forthcoming.

Table 2: Summary of Variables

VARIABLE	DESCRIPTION
X	The vector of wilderness variables.
Z	The vector of nonwilderness variables.
W	The real average annual wage per full-time job in each county.
WILD	The number of wilderness acres (in thousands) in each county.
PWILD	The percentage of each county which is wilderness.
WILDADJ	The total number of wilderness acres (in thousands) in the counties adjacent to each wilderness county.
ED	The percentage of people over the age of 25 in a county with 12 or more years of education.
FARM	The percentage of total personal income from farming in each county.
GOVT	The percentage of total personal income from government and government enterprises in each county.
OTHER	The percentage of total personal income from wholesale trade, retail trade, finance, insurance, real estate, and services in each county.
T1 through T18	The 18 time dummy variables assigned to each year from 1970 through 1987.
D1 through D18	The 18 county dummy variables assigned to all but one county (Teton).

Table 3: Regression Results for Model 1

	Model 1	
	OLS	POOL
Estimated Coefficients and T-Ratios:		
PWILD	-62.452 (-2.529)	-86.635 (-2.537)
WILD	5.784 (4.825)	5.976 (3.293)
WILDADJ	0.9792 (3.954)	0.612 (2.347)
ED	-95.727 (-9.203)	-34.335 (-3.277)
FARM	-52.545 (-5.491)	4.391 (0.868)
GOVT	91.584 (5.335)	3.896 (0.203)
OTHER	38.260 (2.592)	0.703 (0.063)
Constant	17863 (23.455)	15044 (17.609)
Adjusted/ Buse R^2	0.4137	0.079
Rho		0.9004
Durbin-Watson	0.3094	

Table 4: Regression Results for Models 2 and 3

	Model 2	Model 3
Estimated Coefficients and T-Ratios:		
PWILD	-51.632 (-1.781)	52.208 (1.547)
WILD	3.625 (2.361)	-1.799 (-1.041)
WILDADJ	0.583 (2.108)	-0.793 (-2.653)
ED	62.631 (2.719)	-56.928 (-2.468)
FARM	-5.952 (-1.142)	-15.013 (-3.040)
GOVT	-20.625 (-1.074)	-54.087 (-2.896)
OTHER	4.663 (0.416)	-13.362 (-1.227)
T1	3031.8 (4.419)	-558.29 (-0.898)
T2	3093.1 (4.667)	-295.63 (-0.500)
T3	3384.6 (5.400)	196.05 (0.351)
T4	3557.6 (6.007)	543.97 (1.028)
T5	3151.2 (5.628)	300.50 (0.605)
T6	2994.1 (5.636)	382.76 (0.826)
T7	3046.9 (6.212)	542.15 (1.248)

Table 4 Continued

	Model 2	Model 3
T8	3080.6	674.81
	(6.800)	(1.663)
T9	2908.8	1049.0
	(7.156)	(2.910)
T10	2487.6	735.11
	(6.689)	(2.229)
T11	1716.2	178.16
	(5.219)	(0.611)
T12	1243.5	-97.149
	(4.188)	(-0.370)
T13	1015.8	-115.78
	(3.839)	(-0.500)
T14	992.60	91.227
	(4.296)	(0.452)
T15	870.84	123.46
	(4.416)	(0.716)
T16	781.36	245.74
	(4.772)	(1.723)
T17	453.03	85.249
	(3.631)	(0.763)
T18	145.82	-46.914
	(1.755)	(-0.613)
D1		832.24
		(2.022)
D2		-1915.9
		(-4.953)
D3		2293.5
		(3.687)
D4		3557.7
		(6.069)
D5		1431.5
		(2.520)

Table 4 Continued

	Model 2	Model 3
D6		-752.30 (-1.800)
D7		-215.79 (-0.637)
D8		4745.5 (7.984)
D9		4710.1 (8.579)
D10		-1533.7 (-3.564)
D11		3980.9 (7.819)
D12		1134.2 (2.332)
D13		-307.68 (-0.789)
D14		1825.3 (3.940)
D15		-574.33 (-1.197)
D16		739.06 (1.818)
D17		-911.03 (-1.716)
D18		-2607.6 (-6.801)
Constant	6722.6 (3.474)	18068 (9.271)
Buse R^2	0.4179	0.8491
Rho	0.9254	0.7024

END NOTES

1. Table 1 was compiled from the U.S. Forest Service Land Status Records on file at the USFS Northern Regional Headquarters in Missoula, MT.

2. A related body of literature is that concerning hedonic pricing techniques. For a discussion of this and further references see Freeman.

3. Brown and Scully provide theoretical discussions and empirical investigations that relate to the discussion in Ehrenberg and Smith.

4. A related body of literature focuses on migration and amenities. See Graves, Evans, and Knapp and Graves.

5. The Theory Discussion borrows heavily from Hoch and Drake and Ehrenberg and Smith.

6. This possibility will occur if there is a perfectly elastic supply of land in the region under study.

7. One drawback of using a linear form is that the derivative is a constant. Therefore any change in wages caused by a change in wilderness is constant no matter how large or small the magnitude of the change in wilderness. An additional drawback is that using a linear form makes it impossible to derive a demand curve for wilderness.

8. For details of the model and method of estimation see Kmenta, 618-622.

9. Implicit in the theory discussed previously is the assumption that the economies of the counties under study were in equilibrium during the study period. If the economies were not in equilibrium, the effects of wilderness designation would not be fully capitalized into a compensating differential. One source of evidence that could suggest disequilibrium is migration into or out of the study counties.

WORKS CITED

Brown, Charles. "Equalizing Differences in the Labor Market." The Quarterly Journal of Economics (February 1980): 605-620.

Christy, Kim S. Benefit/Cost Variables and Comparative Recreation Use Patterns of Wilderness and Non-Wilderness Areas. Logan, UT: Utah State University, 1988.

Economic Report of the President. Washington, D.C.: U.S. Government Printing Office, 1990.

Ehrenberg, Ronald G., and Robert S. Smith. Modern Labor Economics. 4th ed. New York: Harper-Collins Publishers, 1991.

Evans, Alan W. "The Assumption of Equilibrium in the Analysis of Migration and Interregional Differences: A Review of Some Recent Research." Journal of Regional Science 30 (1990): 515-531.

Freeman, A. Myrick, III. The Benefits of Environmental Improvement. Washington, D.C.: Resources for the Future, Inc., 1979.

Graves, Philip E. "Migration With A Composite Amenity: The Role of Rents." Journal of Regional Science 23 (1983): 541-546.

Greenwood, Michael J. "Research on Internal Migration in the United States: A Survey." Journal of Economic Literature. (June 1975): 397-433.

Hoch, Irving with Judith Drake. "Wages, Climate, and the Quality of Life." Journal of Environmental Economics and Management 1 (1974): 268-295.

Hoehn, John P., Mark C. Berger, and Glenn C. Blomquist. "A Hedonic Model of Interregional Wages, Rents, and Amenity Values." Journal of Regional Science 27 (1987): 605-620.

Hsieh, Chang-Tseh, and Ben-Chieh Liu. "The Pursuance of Better Quality of Life: In the Long Run, Better Quality of Social Life is the Most Important Factor in Migration." American Journal of Economics and Sociology 42 (1983): 431-440.

Irland, Lloyd C. Wilderness Economics and Policy. Lexington, Mass.: Lexington Books, 1979.

Johnson, Maxine C. "The Rocky Mountain Front: Wilderness or Nonwilderness?" Montana Business Quarterly (Autumn 1987): 2-14.

Kmenta, J. Elements of Econometrics. 2d ed. New York: Macmillan Publishing Company, 1986.

Knapp, Thomas A., and Philip E. Graves. "On the Role of Amenities in Models of Migration and Regional Development." Journal of Regional Science 29 (1989): 71-87.

Liu, Ben-Chieh. "Differential Net Migration Rates and the Quality of Life." The Review of Economics and Statistics (August 1975): 329-337.

McCool, Stephen, and Jeffrey E. Frost. "Outdoor Recreation Participation in Montana: Trends and Implications." Montana Business Quarterly (Autumn 1987): 22-24.

Polzin, Paul E. "Wilderness in Montana: Putting Things into Perspective." Montana Business Quarterly (Autumn 1987): 15-21.

Porell, Frank W. "Intermetropolitan Migration and Quality of Life." Journal of Regional Science 22 (1982): 137-158.

Power, Thomas M. "Wilderness, Timber Supply and the Economy of Western Montana." Wild Montana (May 1989): 1-11.

Rasker, Ray, Norma Tirrell, and Deanne Kloepfer. The Wealth of Nature: New Economic Realities in the Yellowstone Region. Bozeman, MT: Color World Printers, 1992.

Roback, Jennifer. "Wages, Rents, and the Quality of Life." Journal of Political Economy 90 (1982): 1257-1278.

________. "Wages, Rents, and Amenities: Differences Among Workers and Regions." Economic Inquiry 26 (January 1988): 23-41.

Rudzitis, Gundars. "How Important is Wilderness? Attitudes of Migrants and Residents in Wilderness Counties." Moscow, ID: Univerity of Idaho.

________. "Why are People Moving to Wilderness Counties." Presented to the Assocation of American Geographers. April 24, 1987.

________, and Harley E. Johansen. "Migration into Western Wilderness Counties: Causes and Consequences." Western Wildlands (Spring 1989): 19-23.

Scully, Gerald W. "Interstate Wage Differentials: A Cross Section Analysis." The American Economic Review (December 1969): 757-773.

Smith, Adam. An Inquiry into the Nature and Causes of the Wealth of Nations. Chicago: The University of Chicago Press, 1976.

Smith, Robert S. "Compensating Wage Differentials and Public Policy: A Review." Industrial and Labor Relations Review 32 (April 1979): 339-352.

U.S. Department of Agriculture, U.S. Forest Service. USFS Land Status Records. Missoula, MT: USFS Northern Region Headquarters, 1991.

U.S. Department of Commerce, Bureau of the Census. County and City Data Book. 2 vols. Washington, D.C.: U.S. Government Printing Office, 1972, 1983.

U.S. Department of Commerce, Bureau of Economic Analysis. Local Area Personal Income. 5 vols. Springfield, VA: National Technical Information Service, 1970-1988.

U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Measurement Division. Average Wage Per Job. 1969-1989. Washington, D.C., December 1990.