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Private land-use decisions can have important effects on private and public welfare. Market-based policies to regulate land use have the potential to move the privately-optimal allocation of land closer to what is socially optimal. To implement these policies in the Rocky Mountain states, it is necessary to understand the effects of private net returns on landowner choices. Two types of models are estimated to investigate these effects. The first is a conditional logit model. Here, parcel-level land-use choices are modeled in response to net returns, land quality, and other variables. The second is an area base model estimated using county aggregate land-use data. A generalized least squares model is estimated to adjust for heteroskedasticity that results from the specification. Land-use shares and transitions are dependent variables, while net returns, land quality, temperature, elevation, precipitation, and hospitality sector sales are the independent variables. For the aggregate land-use transition model, a specification that normalized net returns on range net returns returned all of the expected results. Results for both types of models suggest that it is necessary to control for land-use heterogeneity in this region by adding variables such as temperature, precipitation, and elevation. The Rocky Mountain region has more heterogeneous conditions than most other regions of the United States. With its vast areas of relatively low-value range land, this region offers promise for low-cost land conversion policies, but further research is necessary to understand the influence of a heterogeneous environment on land-use decisions.

Land Use and Land-Use Change in the Rocky Mountain West

by
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I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Christine T. Broniak, Author

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Chapter 1: Introduction

Motivation for Land-Use Regulation

Private land-use patterns have widespread consequences for both landowners and for the public welfare. Private landowners might be concerned with economic returns and private amenities of land use. For the public, land-use decisions can impact the aesthetics of the land, urban sprawl, habitat, species diversity, water quality, the uptake of atmospheric carbon, and many other environmental factors. Members of the general public therefore hold a stake in the composition of the landscape which private landowners will not fully take into account in their choices. The investigation of factors that influence these private land-use decisions will inform policy decisions and allow for a more socially optimal allocation of land.

Policies to achieve the desired land use through landowner incentives include the Conservation Reserve Program (CRP), which offers incentives to owners of croplands to convert their land into grassland or forest for ten years. The purpose of this program is to reduce soil erosion and to provide other environmental benefits such as habitat creation. The program, started in 1985, pays landowners nationwide $1.7 billion per year to retire environmentally sensitive cropland area. Currently, more than thirty million acres of cropland are retired for a period of 10 to 15 years (USDA ERS 2000). Environmental benefits of the CRP for retiring marginal cropland have been documented in Lubowski, et. al. (2006).

Policy objectives may be to grow or maintain areas of cropland, forest, or wetlands. Other examples of land use policies are the Environmental Quality Incentives Program, the Wetlands Reserve Program, the Water Bank Program, Swampbuster, Section 404 of the Clean Water Act, and the Forestry Incentives Program. Studies of land use inform these policies, and allow for a projection of the effectiveness of financial incentives in

landowner decision-making. The study here is prospective, rather than retrospective in that it evaluates or informs potential programs.

Another important policy issue is global climate change. The Kyoto Protocol to the United Nations Convention on Climate Change has been ratified by all major nations in attendance except for the United States and Australia. It calls for varying reductions in carbon emissions of its member nations. Although it was not ratified, the United States commitment under Kyoto would be to reduce greenhouse gas emissions to 1990 levels by the year 2012. Strategies such as the adoption of alternative fuels and improvements in energy efficiency will likely be a part of U.S. efforts to reduce GHG emissions. Currently, efforts to reduce emissions are conducted mostly at the regional level. Examples include the Regional Greenhouse Gas Initiative (RGGI) program and recent legislation in California to reduce emissions.

Forests have the ability to convert atmospheric CO_2 to biomass through photosynthesis. Afforestation has been suggested as a relatively inexpensive means to meet U.S. emissions goals, competitive with energy-based strategies (Lubowski, Plantinga, and Stavins, 2006). Private land-use decisions affect the amount of land converted to and from forest uses. It is possible to influence private land-use decisions through incentives to augment the uptake of CO_2 by forests. In order to evaluate such policies, we need to understand how private landowners respond to incentives they face in the market.

Building on Previous Research

This study examines the determinants of land-use change in the eight Rocky Mountain states. These are Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming. Here, parcel-level data from the United States Department of Agriculture Natural Resources Inventory (NRI) for 1982, 1987, 1992, and 1997 are examined to determine the influence of net returns, land quality, climate, elevation, and hospitality sales levels on decisions to convert between five categories of land-use. These categories

are cropland/Conservation Reserve Program (CRP), pasture, range, forest, and urban. Other land-uses, such as barren or rocky land, are omitted from the study. State and federal lands are also not included because the use of these lands is not responsive to market incentives.

The data in the Rocky Mountain region are examined at the individual level, and then aggregated by county. At the individual level, this study follows the method of Lubowski (2002) for a subset of the data used in that study. Net returns and land quality variables are examined as determinants of land-use change. In agricultural, range, and forest uses, the net returns represent the total revenues from the particular land use less the variable costs of production. For urban uses, net returns are the annual rent to land recently developed for residential housing. Here, additional variables such as elevation and climate are added to control for this region's land heterogeneity. Because the net returns are measured only in areas of the county where a particular land use is possible and observed, the county net returns might not be representative of all land area in a county. There might be topographic or climatic reasons for land use to be restricted in certain areas of a county. In this way, heterogeneity may cause problems with the modeling of a particular plot of land. Results for the parcel-level model are reported, focusing on the parcels starting in rangeland. This focus is motivated by the large areas of rangeland in this region, and the sizeable transitions from range to forest that have been observed recently. This suggests that costs for afforestation of range lands are low.

Lubowski is the first to model plot-level land-use change in a comprehensive study of private land uses in the contiguous United States. The conditional logit model is applied to individual-level panel data to consider the influence of returns and other land attributes on land-use transitions. In this model, the dependent variable of land-use choice is measured at the parcel level, while independent variables are measured at the county level.

Since the independent variables are averages for the county, they might be more effective in explaining aggregate rather than parcel-level dependent variables. The dependent variable is therefore aggregated to a county level according to the share of the county moving to each particular land use. A log odds ratio model is applied by using the method of Generalized Least Squares to examine determinants of transitions. In the transition model, the dependent variable is the log of the share moving to each land use divided by the log of the share of the county moving to the reference category. For the land-use share model, the dependent variable is the log of the absolute county share in each land use divided by the log of the absolute county share of land in a reference category. Finally, aggregate data are used to examine the drivers of shares in a particular land-use for each of the four years. Using this data, this study can follow the area-base model developed by White and Fleming(1980). The method is similar to the modified conditional logit model used on the aggregate county transition data.

Land-Use Heterogeneity and Preferences

In this study, models that produce net returns coefficients most consistent with economic expectations and results from previous research include variables beyond net returns and land quality. One or all of the following variables are added to the specification of each model: elevation, temperature, precipitation, and hotel and restaurant sales. Even with these variables included, results for net returns are not always consistent with expectations of landowner behavior. Studies of land use in other regions have found that land-use transitions are positively impacted by net returns to each particular land use. However, the Rocky Mountain area has some of the most heterogeneous land in the United States. Net returns for each type of land use may not indicate the returns to that land use in a particular county because a land use may not be feasible in many areas of that county. In short, county average net returns to a land use are calculated where that land use is practiced, and may not be representative of that county. Although variables are added to control for this heterogeneity, results are not perfectly consistent with

economic expectations. To fully model the effects of net returns in this area, parcel-level independent variables might be more effective than county-level independent variables.

In some models, the sales of hotels and restaurants are included as a proxy for the importance of the tourist industry. The prominence of the tourist industry may affect landowner preferences if tourists prefer certain land uses. For example, a resort might keep forest land for its aesthetic benefit to tourists. Local land-use regulations might seek to preserve the "special" character of an area through forestry or the preservation of farmland or open space. Here, the effect of variables on land uses is examined.

Chapter 2: Literature Review

There exists a diverse body of literature on land use in the United States. While land-use outcomes explored by each study differ, all previous work in this area is based on the assumption that landowners seek the profit-maximizing solution. Many studies utilize some measure of land quality. Ricardian theory dating back to the 19th century posits that land quality characteristics such as soil fertility have a direct effect on the rents derived from that land. Intuitively, fertile soil will produce a higher yield of crops, livestock, or trees for a given amount of input expenditure. Land quality, therefore, has an effect on the land rents derived from agricultural and forest uses. Often, other attributes of a land area, such as population change or distance to markets have an effect on landowner's choices.

There are many land-use studies that use data aggregated at the county level. Occasionally, data are aggregated to a larger, multicounty geographic region. Authors may specify shares in a particular land use at a single point in time, or they may specify the shares shifting into a land use category over a transition period. Land uses studied are usually exhaustive or nearly exhaustive of all land in a county, with one type of land use not explicitly modeled. Shares are most often specified as a logistic function of county-level independent variables and parameters.

Studies that estimate these land-use share models on a cross-sectional sample include Hardie and Parks (1997), Plantinga, Mauldin, and Alig (1999), Alig (1986), Parks and Murray (1994), and Mauldin, Plantinga, and Alig (1999). Hardie and Parks (1997) focus on the southeastern United States, modeling county shares in land uses in Florida, Georgia, North Carolina, South Carolina, and Virginia. Land-use categories include irrigated and non-irrigated cropland, forest, and urban. The categories are observed as cross-sectional samples for 1982 and 1987. Because of the correlated error structure in this type of share model, a Seemingly Unrelated Regression (SUR) model is estimated.

In this model, the proportion of land of higher quality and agricultural crop revenues have a positive effect on the log odds ratio of irrigated farmland. Crop costs, timber planting costs, landowner age, population density, and per capita income have a negative effect on the odds ratio of irrigated farmland to urban. Since the share in forest diminishes the share to agriculture, one would expect timber planting costs to have a positive correlation with irrigated cropland, as they decrease the returns to forestry. The authors explain this effect through the correlation between these planting costs and the costs of farming. When these costs are high, the landowner is likely to choose the forest land use with its less intensive input requirements. Variables that have a significant negative effect on the log odds ratio of forest include percentage of county in LCC's 1 and 2, population density, and per capita income. The owner's age has a significant positive effect on this log odds ratio. This study demonstrates that land characteristics are important as determinants of land use.

Two studies conducted on specific land areas are Mauldin, Plantinga, and Alig (1999) and Plantinga, Mauldin, and Alig (1986). These focus on the Wisconsin region and Maine, respectively. They are similar to the work by Hardie and Parks in that they use the SUR In both Maine and Wisconsin, higher forest rents contributed to a greater share of land in forest, while decreasing the shares in urban and agricultural uses. Also, greater

agricultural rents shift the share of land toward agricultural uses, and greater urban rents shift the share of land toward urban uses. Counties with higher land quality tended to have more land in agricultural uses and less in forest. This conforms to expectations because agricultural land has higher land quality requirements than forest. Projections of the returns to land use for the period 2000 to 2050 are then applied to results to simulate future Maine and lake states land-use shares. Both of these studies aggregate data to the level of the county. It is also possible to aggregate on a larger geographic scale.

Alig (1986) focuses on multicounty sampling units for the southeastern U.S. As in the previous studies, he applies a S.U.R. model to predict land shares in cropland, pasture/range, urban, and forest outcomes. Incomes derived from various land uses have the expected effect on shares in these uses. Additionally, population and income variables are significant in all but the forest industry outcome. Increasing urban population and incomes contribute to a decrease in cropland and farm forest land because of purchase of land for miscellaneous private uses.

For the county aggregate land-use shares modeled here, I apply a similar methodology as previous studies on aggregate county data. A cross-section is taken in 1982, 1987, 1992 and 1997 of the shares in all counties in the Rocky Mountain states. In addition to the net return and land quality variables modeled by others, I add measures of climate, elevation characteristics, and hospitality sector sales. In general, the models which include these variables perform better than more basic county aggregate share models which do not return the expected sign on profit coefficients.

While it is informative to model the county aggregate shares in a particular land use at a given time, these models do not give information about the transition shares to various land uses. Studies such as Plantinga and Ahn (2002) and Stavins and Jaffe (1990) take into account land-use transitions on the aggregate county level. Here, I apply this type of model to aggregate county transitions for the periods 1982 to 1987, 1987 to 1992, and

1992 to 1997. Often data availability restrictions make it necessary to use this level of aggregation. One disadvantage of this approach is that it only captures net changes in land uses for a particular county, rather than tracking the gross changes in land-use categories. To model these gross changes, individual-level data are necessary.

The conditional logit model applied here most closely follows the method of Lubowski, Plantinga, and Stavins (2006) in modeling land use changes for the periods 1982 to 1987, 1987 to 1992, and 1992 to 1997. This study focuses on a sample of individual data points on land-use transitions for the 48 contiguous U.S. states and applies a conditional logit model to analyze the effect of net returns, land quality dummy variables, and land quality interaction terms with net return dummies on individual land use decisions. Data are collected for each starting use, and the model is run on these points to analyze transitions. Increases in the return variables for each land use are found to raise the probability of that land use in all but seven cases out of the sixty modeled. None of these seven negative elasticities are significant.

In this study, I expand upon this method to run a conditional logit model, while adding climate, population, and elevation variables. Population variables have been shown to be significant in other studies (i.e. Alig, 1986) and the additional variables used are significant here. I apply this model to a subset of the data used by Lubowski, et al that encompasses the Rocky Mountain region only.

Chapter 3: Data

The models estimated in this study rely on several sources of data. Parcel-level information on land quality and land-use decisions is available from the United States Department of Agriculture's Natural Resources Inventory (NRI). County-level net returns to various uses have been compiled by Lubowski (2002). Other data sources are at the county level, including precipitation and temperature data from Mendelsohn, et al.

(1994), population data from the Bureau of the Census, and elevation data from a digital elevation model adapted by Scott Walker at Oregon State University.

Natural Resources Inventory

The Natural Resources Inventory (NRI) is conducted by the USDA Natural Resources Conservation Service (NRCS) in cooperation with the Iowa State University Statistical Laboratory. At five-year intervals from 1982 to 1997, a plot-level sample is conducted of non-federal lands in the contiguous United States. The attributes recorded include land use, the Land Capability Class (LCC), soil characteristics, erosion, and conservation practices. This data set is obtained using a random two-stage sampling scheme. Each NRI plot is assigned an acreage weight depending on the density of sampling in that area. Although the exact locations of the sample plots are confidential, the county in which the plot is found is identified.

The categories of land cover that I use for this study are cropland, pasture, range, forest, urban, and Conservation Reserve Program (CRP). The NRI defines crop areas as row and close-grown crops, fallow croplands, pasture and haylands on which crops are sometimes grown, vineyards, fruit trees, and tree nurseries. CRP lands are those under a CRP contract. Pasture lands are those used for livestock grazing and intensively managed through the application of fertilizer, weed-control, reseeding, and control of grazing. Range lands support livestock grazing, but without intensive management practices. Range may include chaparral, mesquite, pinyon-juniper, and other forms of low shrubs.

The NRI defines a forest as an area greater than one acre, and at least 100 feet wide which is 10% covered with trees of any size. This is equivalent to a 25% aerial canopy of leaves and branches. The trees must reach at least 13 feet at maturity to be considered forest. Abandoned agricultural lands with natural forest regeneration are also considered forest, as long as they are not being used for other purposes.

Urban areas are measured according the specific use of land, and can be found in both predominantly rural and urban areas. Any piece of land in a commercial, residential, industrial, or institutional use is considered urban. These include water treatment plants, cemeteries, airports, and small parks that are entirely surrounded by urban uses. Rural roads and transportation areas are ignored here as they are determined by public sector decisions. Also excluded are streams, water bodies, marshes, and barren lands. Private lands which are categorized by the NRI as "miscellaneous/minor" are also excluded.

Net Returns Variables

Net returns variables are calculated by Lubowski (2002) for each year from 1978 to 1997 at the county level. Each transition period uses a lagged five-year average measure of these net returns variables. The reason for averaging the returns over the years is to mitigate the effect of net returns outliers. Lagged net returns are appropriate because landowners observe historical returns in making choices.

Crop net returns are a weighted average of the net returns for each type of crop in a given year. The following major crop types as categorized by the National Agricultural Statistics Service (NASS) are wheat, rye, rice, corn, oats, barley, sorghum, cotton, sugarcane, sugar beets, tobacco, flaxseed, peanuts, soybeans, sunflowers, all dry edible beans, hay, and potatoes. Prices from the USDA Economic Research Service (ERS) are multiplied by the county-level yields of each type of crop. Yield information comes from the NASS. The weights are the proportion that the acreage in each type of crop represented of the total county's crop acreage in a given year. The state or regional-level costs from the ERS and the Census of Agriculture are used to calculate costs as a percentage of total returns from a particular crop. County-level returns for that type of crop are then multiplied by one minus this percentage to obtain net returns for this particular crop. Additionally, estimates for all direct government payments per acre were added to the return data to obtain county-level cropland returns.

For pasture returns, the county-level average of annual pasture yields for different soil types from the National Cooperative Soil Survey (NCSS) are weighted for the different soil types according to NRI acreage information for each county. These yields were converted from tons of forage and multiplied by the state price for "other hay" from the ERS. The assumption is that pasture management costs are equivalent to state-level costs for hay production from the Census of Agriculture.

For a measure of range net returns, Lubowski uses the county-level average of range yields for each soil type as provided by the NCSS. Again, this is weighted by the NRI data on soil type acreages. The forage yield is then multiplied by the state per-head grazing rates for private lands from the ERS database on cash rents.

Forestry net returns are computed using a weighted county-level measure of the net present value of sawtimber revenues from different forest types by using state-level stumpage prices for different timer species gathered from a variety of state and federal agencies and private sources. State-level sawtimber production volumes from the Forest Inventory Analysis (FIA) Timber Product Output database for 1996 are used to weight the prices. The net present value of an infinite stream of forestry revenues for each forest type is then calculated with a discount rate of 5%. Regional estimates of planting and management costs are then subtracted to obtain state-level net present value measures for each forest group. These are multiplied by county acreages from the FIA to obtain net returns to forestry for each county and the returns to forest are multiplied by the interest rate to obtain the annual equivalent return.

For urban net returns, a county-level annual measure of developed lot prices is obtained by taking county-level data on individual combined home and land prices from the the decennial Census of Population and Housing Public Use Microdata Samples (PUMS 5% sample) and backing out the price of the land. Data for home prices in the years between

1980 and 1999 are extrapolated using the Office of Federal Housing Enterprise Oversight (OFHEO) House Price Index. This index tracks state-level quarterly changes in the price of a single-family home for the United States. The trend is then scaled up or down for each county to fit the change in home prices between census periods.

Other Variables

I now turn to a discussion of other potential determinants of land use. These include plot-level land quality, elevation measures, climate variables, and hospitality sales variables. The LCC is a measure of the potential of the land for producing agricultural crops. Each plot is assigned an LCC measure, ranging from 1 for the highest quality land to 8 for the lowest quality land. Factors that determine the land quality rating include climate, erosion, and soil characteristics such as drainage, rockiness, and fertility. This measure has important implications for the land rents from agricultural, forest, and range uses. Better quality land has higher returns. Three dummy variables for the groupings of LCC classes 1,2,3, and 4, 5 and 6, and 7 and 8, are used in this study. This grouping was chosen because it most evenly distributed the LCC categories in the data set. Interaction terms between these LCC category dummies and net returns are included as a way to allow the plot-level return to deviate from the county-level average return. This specification allows for a parcel to have a higher return to agricultural land uses than the average return for the county if it has a higher land quality. The interaction term is a proxy for parcel-level land rents where no direct information is available.

This study uses a measure of the maximum elevation, minimum elevation, elevation range, and mean elevation for each county. These data have been extracted from a global view of an ArcView GIS digital elevation model by Scott Walker at Oregon State University. Population estimates for 1980, 1990, and 2000 have been obtained from the 1980, 1990, and 2000 U.S. Census data.

Temperature and precipitation data for January, April, July, and October have been obtained by Mendelsohn, *et al* (1994) for the county level. To obtain county-level data

from measurements at each weather station, a spatial statistical analysis was conducted to examine the determinants of the climate of each county. Every weather station within a 500-mile radius around the geographical center of the state was considered. Regressions are run with the temperatures and precipitation amounts for each of the four months as dependent variables. Independent variables include latitude, longitude, altitude, and the distance from the closest shoreline. The regression is fit with a second-order polynomial with interaction terms and an intercept term. From these results, a value for each climate variable is calculated for the geographic center of the county. This is the value used for the climate variables.

Information on the importance of the accommodation and restaurant industry was obtained from the U.S. Department of the Census County and City Data Book. Data on the sales of the accommodation and foodservice industry in each county in 1997 are used to proxy the importance of tourism in the county.

Chapter 4: Methods

The Underlying Behavioral Model

There are, however, several other considerations aside from net returns that might affect a landowner's utility from a given land use. One is the non-pecuniary benefits that the landowner derives from a particular land use. For example, a resort owner might keep forest land to increase the value of the resort to guests through their enjoyment of the property. Net return variables to forest, based only on the value of harvest, would not capture this effect.

Another reason that landowners might not respond to net returns to a particular land use is that some landowners might consider their land use a part of their lifestyle that could be passed down over generations. For example, many farmers, ranchers, and foresters feel connected to their land use in a way that is beyond the monetary benefits they receive from such land uses. Such a person might not be as responsive to changing net

returns of alternate land uses, because there would be a significant personal cost to lose an identity associated with a particular land use in addition to the capital and learning costs of starting a new land use. In all of the models here, an intercept term is specified for each type of land use-conversion and land use that can account for both monetary and personal costs but only to the extent that these effects are constant across observations.

Landowners might also keep a particular land use or convert to another because of liquidity constraints. For example, if the net returns to cropland increase in a county, a person might not be able to convert to cropland if they do not have the money or credit available to plant a field. Another example would be a person who has a forest cut to get immediate returns, without regard for long-term net returns. If the landowner is in a situation where s/he needs the money immediately, and does not have complete access to credit markets, maximizing long term net returns might not be an option.

Despite controlling for conversion costs through an intercept term, some of these behavioral factors might result in coefficients different from those expected for net returns according to the assumptions of landowner behavior. It is possible that a negative or zero coefficient could indicate that other factors than net returns are important to the landowner when deciding how to allocate land.

Descriptive Statistics for the Study Area

Preliminary investigation of the data reveals some patterns about land use and its changes over the study period. The total amount of land in forest and range in the area over the study period is relatively stable. The period from 1982 to 1997 sees a marked decrease in cropland acreage, starting in 1982 with approximately 43 million acres, and ending in 1997 with only 37 million acres (Tables 4.1 and 4.3). Acreage in pasture increases slightly over the relevant period. By far, the fastest growing category is urban, increasing

from 2.9 million acres in 1982 to 4.7 million acres in 1997. This reflects a trend of increasing urbanization in the Rocky Mountain region.

The acreage in forest remains fairly steady throughout the study period, staying close to the 1982 value of 25.6 million acres. Of the non-forest land that changes into forest, the greatest share comes from range. In the 1982 to 1987 period, range contributes 89,400 acres to the 25.4 million acres of forest. This constitutes 0.35% of all forest lands. In the 1987 to 1992 period, land coming from range constitutes a 1.43% increase of all forest land. From 1992 to 1997, 3.20% of all forest land originates in range.

Because there are approximately 186 million acres of rangeland in the study area, this land changing from range to forest represents only a small portion of total range land. The majority of the models run here focus on the range starting use because (1) range lands are the largest outside contributors to forest land and (2) range lands represent 69.4% of the land in the Rocky Mountain states. Thus, the greatest possibilities for afforestation in this area come from range lands.

Throughout the study period, the amount of land in range remains relatively steady. In the 1982 to 1987 and 1987 to 1992 periods, a greater amount of rangeland changes to cropland uses than to any other non-range use. The percentages of rangeland moving to crops are 0.67% and 0.34% respectively. From 1992 to 1997, more rangeland transforms to forest than to any other non-range use. Cropland and forest are the greatest non-rangeland contributors to rangeland over each of the three study periods.

During the period of observation, the net amount of cropland decreased by more than 6 million acres. From 1982 to 1987, 8.25% of cropland, 3.55 million acres, moved to the Conservation Reserve Program (CRP) category. In 1987 to 1992, 2.67 million acres of cropland transition to CRP. This constitutes 6.67% of all 1987 cropland. From 1992 to

1997, only 0.97% of cropland moves to CRP. Interestingly, this coincides with a 1992 change in the enrollment criteria for the CRP.

In the states studied, pasture land increased from 7.3 million acres in 1982 to 8.3 million acres in 1997. In all three periods, pasture loses the greatest share of its land to cropland. Cropland contributes the most acreage to pasture of any non-pasture use in each case. In short, the flux between pasture and cropland displays a consistent pattern in this period, with more land changing to pasture from cropland than moving from cropland to pasture.

As expected, the acreage in urban land has been expanding. Between 1982 and 1997, the urban acreage in the Rocky Mountain states has increased by 62.1% from 2.9 million acres to 4.8 million acres. This increase in urban land may be fueled by environmental amenities in this area which attract migration from less amenity-rich areas (Cromartie and Wardwell, 1999).

Table 1

Transition Summary 1982-1987 (100's of Acres)

		1987						
		Cropland	Range	Pasture	Forest	Urban	CRP	Total
1982	Cropland	382699	2551	8133	6	1735	35520	430644
	Range	12740	1863392	2754	894	3055	1316	1884151
	Pasture	5772	1310	65194	77	494	613	73460
	Forest	105	1558	130	253442	606	18	255859
	Urban	0	0	0	0	29363	0	29363
	CRP	0	0	0	0	0	0	0
	Sum	401316	1868811	76211	254419	35253	37467	2673477

Percentage of Beginning Use Moving to End Use

		1987						
		Cropland	Range	Pasture	Forest	Urban	CRP	Total
1982	Cropland	88.867	0.592	1.889	0.001	0.403	8.248	100
	Range	0.6767	98.898	0.146	0.047	0.162	0.070	100
	Pasture	7.857	1.783	88.748	0.105	0.672	0.834	100
	Forest	0.041	0.609	0.051	99.055	0.237	0.007	100
	Urban	0	0	0	0	100	0	100

Percentage of End Use Originating from Beginning Use

		1987					
		Cropland	Range	Pasture	Forest	Urban	CRP
1982	Cropland	95.361	0.137	10.672	0.002	4.922	94.803
	Range	3.175	99.710	3.6142	0.351	8.666	3.512
	Pasture	1.438	0.070	85.544	0.030	1.401	1.636
	Forest	0.026	0.083	0.171	99.616	1.719	0.0480
	Urban	0	0	0	0	83.292	0
	CRP	0	0	0	0	0	0
	Total	100	100	100	100	100	100

Table 2

Transition Summary 1987-1992 (100's of Acres)

		1992						
		Cropland	Range	Pasture	Forest	Urban	CRP	Total
1987	Cropland	361869	2197	8649	11	1198	26704	400628
	Range	6453	1854705	1728	3616	2567	229	1869298
	Pasture	4200	817	70698	58	631	339	76743
	Forest	19	4681	106	248676	711	0	254193
	Urban	0	0	0	0	35505	0	35505
	CRP		0	0	0	0	37520	37520
	Total	372541	1862400	81181	252361	40612	64792	2673887

Percentage of Beginning Use Moving to End Use

		1992						
		Cropland	Range	Pasture	Forest	Urban	CRP	Total
1987	Cropland	90.325	0.548	2.1591	0.003	0.2991	6.666	100
	Range	0.345	99.219	0.092	0.193	0.137	0.012	100
	Pasture	5.4732	1.065	92.123	0.0756	0.822	0.442	100
	Forest	0.007	1.842	0.042	97.830	0.280	0	100
	Urban	0	0	0	0	100	0	100
	CRP	0	0	0	0	0	100	100

Percentage of End Use Originating from Beginning Use

		1992					
		Cropland	Range	Pasture	Forest	Urban	CRP
1987	Cropland	97.135	0.118	10.654	0.004	2.950	41.215
	Range	1.732	99.587	2.129	1.433	6.321	0.353
	Pasture	1.127	0.044	87.087	0.023	1.554	0.523
	Forest	0.005	0.254	0.131	98.540	1.751	0
	Urban	0	0	0	0	87.425	0
	CRP	0	0	0	0	0	57.908
	Total	100	100	100	100	100	100

Table 3

Transition Summary 1992-1997 (100's of Acres)

		1997						
		Cropland	Range	Pasture	Forest	Urban	CRP	Total
1992	Cropland	355103	3527	8496	49	1765	3644	372584
	Range	6202	1852313	1060	8203	3455	16	1871249
	Pasture	5939	1975	71888	134	775	82	80793
	Forest	37	3896	0	248035	633	54	252655
	Urban	3	0	0	0	40975	0	40978
	CRP	2737	1172	1128	7	0	59460	64504
	Total	370021	1862883	82572	256428	47603	63256	2682763

Percentage of Beginning Use Moving to End Use

		1997						
		Cropland	Range	Pasture	Forest	Urban	CRP	Total
1992	Cropland	95.308	0.947	2.281	0.013	0.474	0.978	100
	Range	0.331	98.988	0.057	0.438	0.185	0.001	100
	Pasture	7.351	2.445	88.978	0.166	0.959	0.101	100
	Forest	0.015	1.542	0	98.171	0.251	0.021	100
	Urban	0.007	0	0	0	99.993	0	100
	CRP	4.243	1.817	1.749	0.011	0	92.180	100

Percentage of End Use Originating from Beginning Use

		1997					
		Cropland	Range	Pasture	Forest	Urban	CRP
1992	Cropland	95.968	0.189	10.289	0.019	3.708	5.761
	Range	1.676	99.433	1.284	3.199	7.258	0.025
	Pasture	1.605	0.106	87.061	0.052	1.628	0.130
	Forest	0.010	0.209	0	96.727	1.330	0.085
	Urban	0.001	0	0	0	86.077	0
	CRP	0.740	0.063	1.366	0.003	0	93.999
	Total	100	100	100	100	100	100

A state-level division of the transitions between range and forest gives a greater understanding of these patterns. Montana, New Mexico, and Utah have more land moving from range to forest than from forest to range. New Mexico has the greatest amount of range land moving to forest.

County-level data show that from 1982 to 1997, the counties with the highest shares of land in the range to forest transition are McKinley County, NM, Navajo County, AZ, Torrance County NM, Rio Arriba County, NM, Santa Fe County, NM, and Union County NM. While all the counties with land parcels starting in range in 1982 have an average forest net return of $0.49/acre with a standard deviation of $1.81/acre, the average for these six counties is only -$0.15/acre. If there is a relationship between net returns and the probability of land-use change, it is likely to be more complicated than one where land-use change is simply driven by net returns.

Patterns of transitions from range to forest do not seem to be responding to the average forest net returns. Once again, it is possible that individual landowners in counties with smaller county-wide average net returns face higher than average county net returns, and they are driving this transition. This is further evidence that there is not a simple relationship between net returns and land-use change. Other variables are important, as the later analysis will show. In the 1982 to 1997 period, for all parcels starting in range, none of the top 25 counties in forest net returns have any acreage moving from range to forest. One might think that this is because the ratio of forest returns to range returns is low for these counties. However, these 25 counties have an average range net return of $6.56/acre. The average net return to range of all counties is $6.03/acre with a standard deviation of $3.00/acre. There is not much evidence here that relative net returns to forest are low in these counties. Interestingly, all of these top 25 counties are in Montana and Idaho. This motivates a modeling method outlined below, where a dummy variable is added for these states as an attribute on the forest outcome to account for the effect of a location in these states for a parcel.

Table 4

1982 to 1997 Land Transition between Range and Forest by State (1000's of Acres)		
State	**Range To Forest**	**Forest to Range**
AZ	124.7	254.3
CO	42.8	252.5
ID	24.8	28.0
MT	91.5	86.0
NV	11.3	71.6
NM	775.3	146.5
UT	143.7	56.7
WY	28.4	45.6
Total Rockies	1242.5	941.2

Econometric Modeling

In this study I take several approaches to modeling the determinants of land use change in the area. The first is the conditional logit model, which models the effect of independent variables on plot-level land-use changes. These independent variables are county average net returns, land quality dummy variables, and interaction terms between the two. Previous work on land-use change has focused on similar basic variables. Examples include Alig (1986) and Hardie and Parks (1997). This specification is similar to that of Lubowski (2002.) In addition to Lubowski's independent variables additional variables were added to control for within-county heterogeneity that may affect the feasibility of certain land uses. These included elevation, temperature, and precipitation. Additionally, sales in foodservice and accommodation were added to account for the importance of tourism in a county because this might affect preferences for land use. For example, a tourism-based area might have landowners who find it desirable to have forest or open space of some sort to attract tourists. While Lubowski's work focuses on the lower 48 states, I focus on eight of the Rocky Mountain States, a subset of the NRI data used by Lubowski. Next, I focus on two types of aggregate models. The first of these is an

aggregate transition model in which I estimate the log odds ratio of the share of land in each county ending in each type of land use. County-level data on net returns, land quality, temperature, precipitation, elevation, and hospitality sales are specified as independent variables. The second type of aggregate model specifies the log odds ratio of the absolute share of each type of land use in a county as the dependent variable. In a similar manner to the transition model, county-level data on net returns, land quality, temperature, precipitation, elevation and hospitality sales are specified as independent variables. Land use data are in five-year increments from 1982 to 1997. In both the aggregate and parcel-level transition models, the dependent variable is the land use in time t+5. Variables measured in time t are used to explain changes in land use between t and t+5.

Previous studies of land use in other regions have often found positive effects of net returns on the decision to choose a particular land use. Here, it assumed that landowners maximize the net benefits from their land, including net returns, amenity values, and other benefits. Land quality measures are meant to provide more information on the profitability of a given parcel of productive land. For that reason, land quality variables are included in the specification. Since the LCC is meant to measure the suitability of a parcel of land for crop production, it is expected that a low LCC (higher quality land) will have a positive coefficient for the cropland outcome.

Since this region is highly heterogeneous, the models might be heteroskedastic, with larger error terms in counties that are more heterogeneous in nature. The predictions from the set of independent variables will be further from the observed value of the dependent variable in these more heterogeneous counties. This could result in inefficient estimates of coefficients in all three models outlined below.

The Conditional Logit Model

The landowner is assumed to follow a decision rule in which the use yielding the highest expected present discounted value of an infinite stream of net returns minus conversion costs is chosen. The net benefit to individual i for use k given starting use j at time t is

$$NB_{ijkt} = R_{ikt} - rC'_{ijkt} = \beta_{tk}' x_{ijkt} + \varepsilon_{ijkt}$$

where R_{ikt} is the annual value of the net returns for allocating parcel i to use k in time t, r is an annual interest rate, and C'_{ijkt} is the total cost of converting parcel i from use j to use k in time t. For land remaining in the original use, this term is equal to 0. The vector of observed variables on the net benefit is x_{ijkt} and β_{tk} is a vector of parameters on each of these variables. Because the researcher cannot observe all factors that affect the net benefit of each individual, ε_{ijkt} is added as a random error term. This term is observed by the landowner, but not by the researcher.

A separate net benefit function applies for each type of starting and ending use. The specification of x_{ijkt} allows for net returns to be modeled as a separate attribute for each ending use (i.e., the coefficient on profit for land ending in cropland is not the same as the coefficient on profit for land ending in range-pasture, so β should be indexed by k. The probability that a landowner will convert parcel i from use j to use k during time t is

$$Pr(\beta_{tk}' x_{ijkt} + \varepsilon_{ijkt} \geq \beta_{tl}' x_{ijlt} + \varepsilon_{ijlt})$$

for l=1,…J. In other words, l takes on the values of all J possible land uses. This means that the utility for use k is at least as large as the utility for any other use. For this study, we assume that the error terms are independently and identically distributed with type I extreme value distribution. This allows the probability that parcel i changes from use j to use k between t and t+5 to be expressed as:

$$P_{ijkt} = \frac{\exp(\beta_{tk}' x_{ijkt})}{\sum_{l=1}^{J} \exp(\beta_{tk}' x_{ijlt})}$$

Recall that the dependent variable is the land use in period t+5, as data are available in five-year increments. There are several desirable properties to the probability function (Train 2003). First, the probabilities of all the alternatives will sum to 1. The decision-

maker will necessarily choose one of the alternatives. Second, an improvement in the utility for a given choice will raise the probability of that choice.

Assuming that each decision maker's choice is independent of that of other decision makers, the probability that each individual i in the sample with a particular each starting use k will choose a particular alternative j is P_{ikj} and the likelihood function is:

$$L(\beta) = \prod_{i=1}^{I} \prod_{j=1}^{J} (P_{ijk})^{y_j}$$

where $y_i = 1$ if person i chooses alternative j, and zero otherwise. Thus if the person does not choose alternative j, the probability of that alternative will not enter into the likelihood function. The log-likelihood function is

$$LL(\beta) \sum_{i=1}^{I} \sum_{j=1}^{J} y_{ij} \ln P_{ijk}$$

The values for β that make the derivative of this log-likelihood function zero are the maximum likelihood estimates. Let $\overline{X}_i = \sum_{j=1}^{J} P_{ij} X_{ij}$. The first order condition is

$$\frac{\partial LL(\beta)}{\partial \beta} = \sum_{i=1}^{I} \sum_{j=1}^{J} y_{ij} (X_{ij} - \overline{X}_i) = 0$$

The second order condition is

$$\frac{\partial^2 LL(\beta)}{\partial \beta} = -\sum_{i=1}^{I} \sum_{j=1}^{J} P_{ij} (X_{ij} - \overline{X}_{ij})(X_{ij} - \overline{X}_{ij})' < 0$$

Since the term P_{ij} is constrained to be between 0 and 1, the second order condition is always satisified.

Limitations of the Conditional Logit Model: Panel Data

Including all three time periods in a pooled set would increase efficiency by using all of the available observations. However, unobserved characteristics of each parcel are likely to be correlated over time. This would violate the assumption of independently and identically distributed errors in the random utility function (Train, 2003).

There are complicated methods that allow for estimation of logit models in a panel data context. Here, I use a simpler approach and estimate separate cross-sectional models. The data are separated into three cross-sections so that each transition period is estimated separately. These are 1982 to 1987, 1987 to 1992 and 1992 to 1997. Maximum likelihood procedures are applied to data in each of three starting uses. These are: cropland, forest, range, pasture, and range-pasture. The model is estimated with the range and pasture uses combined because there might be some difficulty in separating range and pasture net returns since both are tied to livestock prices. The urban starting use is not modeled, as there are very few parcels changing to other uses from urban. The dependent variable in each case is the land-use decision in the period t + 5, or five years from the starting use and each observation is weighted according to the NRI's acreage weight. This measure, related to the sampling density for a county, assigns an "importance" to each parcel as a sample point.

Independence of Irrelevant Alternatives

One property of the conditional logit model is that the data exhibit independence of irrelevant alternatives (IIA) (Train, 2003). This means that the ratio of the probabilities for two alternatives remains the same regardless of whether other alternatives are introduced. It also means that the ratio of the two probabilities is unaffected by changes in the probabilities of other alternatives. In practice, this property may not hold for the data.

Tests for IIA were first proposed by McFadden *et al.* (1978). In the first type of test, the model is estimated on a subset of the alternatives, then on the entire set of choices. A test statistic is then applied to determine whether the parameters from the two models are significantly different. Another possibility to test for IIA is to estimate the model with cross-alternative variables. Suppose there are three alternatives, i, j, and k. If the variables from alternative k enter into the utility of alternative i or j, then the ratio of the

probabilities for alternatives i and j is affected by the attributes of alternative k, and IIA is violated.

If IIA is not found to hold in a dataset, a nested logit model can be applied that partially relaxes the constraint that alternatives must be independent. The choices are grouped or "nested" into larger categories. The model requires that IIA hold within but not among nests. Because the models here do not always return the expected signs on net returns for the conditional logit model, I move on to estimate some models on land-use outcomes aggregated at the county level rather than estimate nested logit models.

Specification of the Conditional Logit Model

The development of the conditional logit model specification involved estimation of separate models for each starting use, and in all three transition periods. The basic specification involves variables reflecting the effect of net returns on each of the uses, an interaction term of these net returns with dummy variables for Land Capability Class (LCC) categories 5 and 6 and 7 and 8, where 5 and 6 are grouped, and 7 and 8 are grouped as well. These interaction terms were added to allow for plot-level deviation from the county average return. Net returns interaction terms with LCC's 1, 2, 3, and 4 were omitted to avoid multicollinearity. Dummy variables were also included for combined LCC categories 5-6 as well as for 7-8. Once again, the dummy for LCC's 1, 2, 3, and 4 was omitted to avoid multicollinearity. More extensive specification includes temperature, precipitation, elevation, and population variables. Each of these variables is modeled individually first with an interaction term, and then without an interaction term. Finally, a full model which includes all of these variables together is modeled with and without an interaction term. Log-likelihood ratio tests are performed using the following statistic:

$$LR=-2[\text{Log-Likelihood}_R - \text{Log-Likelihood}_U] \sim \chi^2_j$$

Here, Log-Likelihood_R is the value of the log-likelihood function for the restricted model, or the one which excludes all of a category of variables. Log-likelihood_U is the value of

the log-likelihood function for the model including all of these variables. The number of variables omitted indicates the degrees of freedom on the test statistic.

Since more positive signs on net return variables came from grouping the range-pasture starting use, I aggregated these together as an outcome. An assumption of the model is that larger net returns will increase the utility of a particular land use to an individual. Here, I estimate models with interaction terms and without interaction terms for each of the following additional categories: basic model (as specified above), temperature, precipitation, population, sales from accommodation and foodservices, and full (including all variables). Starting uses modeled were cropland, range-pasture, and forest. As mentioned earlier, urban land was not modeled as starting uses because of the lack of urban land changing to other uses.

Several experiments were developed to observe whether negative coefficients on net returns could be reversed. One of these was the omission of all observations from counties that did not have any land converting from range to forest in the range starting use model. This did not yield significantly different results for the range starting use, and the method was abandoned. Another model involved dividing the sample by states, and estimating the model on individual states. This was done only for the range-pasture and range starting use. The method was abandoned as it did not yield many more positive coefficients on net returns. Yet another model involved specifying relative net returns and interaction terms rather than absolute net returns and interaction terms. To obtain these relative numbers, net returns to each land use are divided by the weighted average of net returns to the range and pasture category. Finally, another model involved adding a dummy variable as a forest attribute for the parcels in Idaho and Montana and a dummy variable as a range-pasture attribute for the parcels in New Mexico and Arizona. As mentioned above, Idaho and Montana display the highest forest net returns, yet have the smallest portion of total parcels moving from range to forest. New Mexico and Arizona have the most acreage moving from range to forest, but do not have significantly higher

forest net returns. However, this model did not significantly improve results and was abandoned.

Area Base Model

The area base model is a modified multinomial logit model. I apply this model to both the aggregate data on county shares in each land use as well as aggregate proportions ending in each type of land use for a given starting use for each county. The rationale for estimating this type of model is that the aggregate independent variables used for the conditional logit model may not be adequate to explain plot-level outcomes. Instead, these aggregate independent variables might be better suited to explaining aggregate-level outcomes. Earlier aggregate studies have yielded expected results for net returns. Examples include Hardie and Parks (1997) and Plantinga and Ahn (2002). One limitation to this type of model is that parcel-level NRI data may not provide accurate county-level land-use statistics.

The multinomial logit formulation ensures that aggregate land-use shares remain between zero and one, and sum to one. In the aggregate shares model, when land is allocated to use j, the probability of the outcome j is

$$P_j = \frac{e^{\beta_j x}}{1 + \sum_{j=1}^{J-1} e^{B_j x}}$$

In the aggregate transition model, a similar probability is calculated for each starting use k.

$$P_{kj} = \frac{e^{\beta_j x}}{1 + \sum_{j=1}^{J-1} e^{B_j x}}$$

Here, j=1 for cropland, 2 for pasture, 3 for forest, and 4 for urban. The omitted Jth category is range. The probabilities are expressed in terms of the unknown β_j parameters. For identification, the values of β for the range use (j=5) are normalized to 0 in the above expression, and exp(0)=1. This is the reference category that I discuss below.

It is possible to estimate the parameters β_j for each outcome through a generalized least squares regression with the log odds equation as a dependent variable. Here, i denotes the county or unit of aggregation. In the aggregate land use shares model, the dependent variable is the log odds ratio of the absolute shares of each land use in a county. In the aggregate land use transitions model, the dependent variable is the log odds ratio of the share of land in the initial use that moves to a given ending use to the total share of land in the initial use. This log-odds ratio can be written with the proportions p_{ij} for a given ending land use and p_{i5} for an ending land use in the reference category.

$$\ln\left(\frac{p_{ij}}{p_{i5}}\right) = x_i'\beta_j + u_{ij}$$

The variance of u_{ij} can be written as

$$\sigma^2{}_i = \frac{1}{n_i}\left(\frac{1}{P_{ij}}\right)\left(\frac{1}{P_{i5}}\right)$$

In the aggregate shares model, n_i denotes the number of NRI plots in county i. This expression comes from Hardie and Parks (1997). In the aggregate transition model, the variance is written as

$$\sigma^2{}_{ki} = \frac{1}{n_{ki}}\left(\frac{1}{P_{ikj}}\right)\left(\frac{1}{P_{ik5}}\right)$$

Here, n_{ki} denotes the number of NRI plots in county i starting in land use k.

I use the generalized least squares (G.L.S.) approach because the errors are heteroscedastic. Each of the J-1 outcomes is modeled separately using G.L.S. Following the development in Hardie and Parks (1997), I use the following covariance matrix when modeling each of J-1 outcomes in the aggregate shares model:

$$\Omega_j = \begin{bmatrix} \frac{1}{n_1}\left(\frac{1}{P_{j1}}+\frac{1}{P_{51}}\right) & 0 & 0 & 0 \\ 0 & \frac{1}{n_2}\ \frac{1}{P_{j2}}+\frac{1}{P_{52}} & 0 & 0 \\ 0 & 0 & \ldots & \ldots \\ 0 & 0 & \ldots & \frac{1}{n_T}\ \frac{1}{P_{jI}}+\frac{1}{P_{5I}} \end{bmatrix}$$

The covariance matrix is multivariate normal with mean 0. Here, n_i is the number of plots in the county used to calculate this proportion and I is the total number of counties. In the aggregate transition model, I use the following covariance matrix for each starting use k

$$\Omega_{kj} = \begin{bmatrix} \frac{1}{n_{k1}}\left(\frac{1}{P_{kj1}}+\frac{1}{P_{k51}}\right) & 0 & 0 & 0 \\ 0 & \frac{1}{n_{k2}}\ \frac{1}{P_{kj2}}+\frac{1}{P_{k52}} & 0 & 0 \\ 0 & 0 & \ldots & \ldots \\ 0 & 0 & \ldots & \frac{1}{n_{kT}}\ \frac{1}{P_{kjI}}+\frac{1}{P_{k5I}} \end{bmatrix}$$

The covariance matrix is also multivariate normal with mean 0. Here, n_{ki} is the number of plots in the county used to calculate this proportion and I is the total number of counties with a starting land use k.

A separate G.L.S. model for each outcome is expressed by the following equation.

$$\beta_{j\ GLS} = (X'\Omega_j^{-1}X)^{-1}X'\Omega_j^{-1}Y_j$$

To estimate this, Ω must be known. However, it is not known, so the model must be estimated with feasible G.L.S. using the above covariance matrices to approximate Ω. The reason Ω is not known is that β is not known. So the first stage will allow us to find consistent estimates of β so Ω can be consistently estimated. We parameterize Ω as a function of the variables, coefficients, and parcels in each county or starting use. The function Ω hat=$\Omega(X_i,B_j,n_i)$ takes the forms above for all counties i in the aggregate share model. In the aggregate transition model, i indexes all counties in a particular starting use.

This is a two-step procedure. In the first step, ordinary least squares regression is estimated on the log odds ratio of each of J-1 outcomes for the shares model, and on the log odds ratio of each of J-1 outcomes for each starting use in the transitions model.

These ordinary least squares coefficients are then used to produce the above covariance matrices for each type of model. Feasible G.L.S. coefficients are estimated using the following equation:

$$\beta_{j\ GLS} = (X'(\Omega\ hat)_j^{-1}X)^{-1}X'(\Omega\ hat)_j^{-1}Y_j$$

Specification of the Area Base Model

Parcel-level data for a given starting use were aggregated for each of the three transition periods. For the subset of a county starting in each land use, the dependent variable is specified as the log of the ratio of share of that subset of land ending in each land use to the share of land ending in the reference category. It was modeled with combinations of

the following independent variables: The weighted average LCC for the county, net returns for each outcome, an interaction term between the weighted average LCC and these net returns, temperature, precipitation, hospitality sector sales, and elevation data. This was modeled with the range starting use, and separate range and pasture outcomes. It was also modeled with range and pasture combined as a starting use and as a combined outcome.

The model with the range starting use used the log of the share of range remaining in range as a reference category, or the denominator in the log odds expression. The numerator is the log of the county acreage share moving to each other type of land use. The model was also estimated with the range and pasture starting use combined. Here, the transition outcomes for range and pasture were also combined, and used as the reference category.

In some cases, a county has an undefined value for the log odds dependent variable because of 0 acres in an ending land use. When this happens the following alternatives are considered: 1) a set of models with the value for ln(0.005) or -5.298 replacing the undefined values 2) a set of models with the value for ln(0.0001) or -9.210 replacing the undefined values 3) a set of models with the undefined observations omitted.

I estimate each set of models with and without interaction terms. Here, I define a set of models as the following specifications: 1) basic variables (profit and weighted average LCC) 2) basic variables and temperature 3) basic variables and precipitation 4) basic variables and elevation 5) basic variables and sales from accommodation and foodservices 6) basic variables and all temperature, precipitation, elevation, and hospitality sales variables 7) basic variables and all extra variables except the hospitality variables. As mentioned in the conditional logit section, basic net returns and land quality variables have been included in many other land use studies. To account for county characteristics that might affect the feasibility of certain land uses, I add

temperature, precipitation, and elevation variables. The tourism volume of a county might also affect land use outcomes, and is specified through the accommodation and foodservices sales. Also, as an alternative specification designed to capture explicitly the importance of relative returns to alternative uses, net returns were normalized by dividing by the range net returns for the model where range and pasture are separate. In the model where range and pasture net returns are combined, all net returns are divided by the weighted average of range and pasture net returns. The transition model with range and pasture combined yielded many more positive net returns coefficients than the model with absolute net returns. For both this and the county shares model, it is assumed that landowners make allocation decisions based on relative returns. Therefore, the distribution of the error terms is not affected by this transformation.

The method for specification of the county share models is very similar. The only difference is that the dependent variable is the ratio of the absolute share of the county in a particular land use in a given year to the share of that county in a reference category. Models were estimated with both a separate range outcome and range and pasture combined as an outcome. Values of 0 for a share were treated exactly the same as above. A set of the four models, as defined before, is estimated with 1) ln(0.005) or -5.298 replacing the undefined values, 2) ln(0.0001) or -9.210 replacing the undefined values, and 3) undefined values omitted. The independent variables for each of these three categories of models is exactly as described above for the transition models.

In many cases, the number of undefined values for the dependent variable was far too large, resulting in too few degrees of freedom for the omitted 0 models. If -5.298 or -9.210 were included for the 0 values, the method would amount to modeling the effect of the variables on these values rather than true transition shares.

An experiment with this type of model involves the normalization of county net returns on the net returns of the reference category for that county. The reference category is

either range or range and pasture combined. As mentioned earlier, the motivation behind this is the possibility that a decision-maker might consider the relative net returns in a county rather than the absolute net returns in that county. This method was applied to the best-performing aggregate share models to determine if it yielded more positive net returns coefficients than the other models. In contrast to the aggregate transition models, this method did not yield significantly more positive net returns coefficients than the model using absolute net returns.

Chapter 5: Results

As outlined in previous sections, I take two main approaches to estimating the models here. The first approach is to estimate a conditional logit model on parcel-level land-use transitions. The second approach is to estimate aggregate transition models on land-use changes and shares aggregated to the county level. While in each model a different approach is taken to estimating the coefficients and marginal effects on net returns, the expectations for the signs on the net returns variables are always the same. According the the underlying behavioral model, net returns should increase the net benefit of a land use and the probability that a particular land use will be chosen. This translates to a positive value for the coefficients and marginal effects of net returns. Previous studies conducted in other regions of the United States find results for effects of net returns that conform considerably more to expectations than the results here. Examples include Alig (1986), Lubowski, et al (2006), and Hardie and Parks (1997).

There are four types of models reported here. The first is a conditional logit model estimated with parcel-level data. The specification includes temperature, precipitation, and elevation variables. The aggregate shares model includes elevation variables and an interaction term. This model omitted counties that have no parcels of land in each particular outcome. Next, in the aggregate transition model, I report the basic specification with interaction terms and temperature variables. This model also omits counties with zero values for each land use estimated. The final type of model I report

here uses relative net returns by dividing them by the range net returns. The signs of the coefficients on net returns are all positive for six specifications of the transition model. While all of these are listed in the appendix, the one with the most significant net returns coefficients is reported in this section. The specification is a grouping of range and pasture, with an interaction term between net returns and LCC, and temperature variables. Values of Ln (0) for the dependent variable are replaced by Ln (0.005). Of the four models, only the relative net returns model has 100% of the expected signs and marginal effects for net return coefficeints. The models included in the text are the ones that fit most closely to the underlying behavioral model's assumption of positive net returns coefficients. The results of previous studies have tended to support this finding. . Other criteria to evaluate models include goodness of fit measures and significance. Significance measures are relied upon heavily here, as goodness of fit measures have a limited interpretation for Generalized Least Squares models.

Negative coefficients for net returns seem problematic, as they do not conform to economic theory. However, if one considers the heterogeneous nature of the land in the Rocky Mountain region, the results can make more sense. For example, consider that crop net returns information for each county comes from the areas of the county where crops are grown. However, the county might be highly heterogeneous, with most of the land unsuitable for crops. Average net returns do not reflect the actual returns to cropland for the entire county, and it is possible to observe very little county acreage in crops despite high crop net returns in one area. This heterogeneity could plausibly explain negatively-signed and insignificant crop net returns coefficients.

A similar explanation can be applied to the pasture land use. A further complication involving pasture net returns is that it might be difficult to differentiate between pasture and range net returns because both are tied to the market price of livestock. In fact, in the conditional logit model on individual parcels, the model with the most net returns coefficients conforming to expectations was specified by aggregating the range and

pasture starting use and outcome. Net returns in this case are a weighted average of range and pasture net returns.

Another reason for a lack of positive or significant results for net returns might be that net returns are genuinely not important in a landowner's decision. Other factors such as climatic, topographic, or soil makeup of a region might truly be the most important determinants of land use change in some areas.

Here, models that return values for net returns coefficients and marginal effects which are closer to expectations include variables in their specification beyond those for net returns and land quality. These include temperature, precipitation, and elevation variables to capture characteristics of the county beyond land-use net returns and land quality. In each case, these variables give information about the county that could be tied to the land use possibilities for various areas of that county. For example, a very low precipitation value could indicate that a county is made up of largely desert. If a small area of the county is not desert, and is fertile, crop net returns could be very high in this small area. So, county crop net returns will be observed to be high. However, crops might be crowded out of the large desert area in that county. The precipitation would give information about this county's desert composition, and help to account for the low share of cropland. In this way, the primary purpose of the climate and elevation variables is to control for heterogeneity in the model.

The Conditional Logit Model

The conditional logit model net returns coefficients are mixed in signs. Of the three periods, 1982 to 1987, 1987 to 1992, and 1992 to 1997, the coefficients and marginal effects are all positive in the 1987 to 1992 phase. Coefficient results are given in Table 5, and marginal effects are in Table 6. For 1982 to 1987 and 1992 to 1997 two of the four net returns coefficients are of the expected sign. All of the net returns coefficients and marginal effects are significant at the 5% level regardless of sign. Net returns

coefficients in this model are not altogether consistent with the behavioral model, with results mixed in signs for crops, forest, range, and pasture categories. Throughout the transition periods, the signs on the urban net returns coefficients are completely consistent with expectations and significant to the 1% level. In all three periods, the coefficients on the forest intercept and urban intercepts are negative and significant. Inclusion in Land Capability Class (LCC) categories 5, 6, 7, or 8 increases a parcel's probability of allocation to urban, range-pasture, or forest land. In other words, lower quality land is more likely to be put into these uses rather than cropland.

The coefficient of January temperatures is positive and significant at the 5% level on forest, range-pasture, and urban land for all three transition periods. It is possible that warmer winters might occur in desert areas. These areas might have lower soil quality more suited to forest, range, and pasture uses. Many desert areas are also more likely to be urban, reflectly recent human migration patterns. While April temperatures display no clear effect, the coefficients and marginal effects of October temperature on forest, urban, and range-pasture are negative and significant to the 1% level on all three transition periods except for urban, where the coefficients and marginal effects are positive and significant at 1%.

The effect of precipitation on the range-pasture outcome is difficult to derive. The only consistently positive and significant precipitation variable is that of July rainfall on the range-pasture outcome. It is positive and significant to 1% in all three periods. Areas with wetter summers are more likely to remain in range and pasture from the range and pasture from the combined range-pasture starting use.

The marginal effects and coefficients on July and October precipitation are all positive for the forest outcome and significant at the 1% level while April precipitation is negative and significant at the 1% level.. The effects of winter precipitation on forest are not as clear, but spring, summer, and fall precipitation is important in explaining the probability

of a forest outcome. The effects of precipitation on the urban outcome are mixed for all three time periods.

For elevation variables, the effect of the maximum county elevation is mixed for each outcome and transition period. No clear pattern is apparent. This might be due to the difficulty of modeling parcel-level data by using variables such as elevation aggregated at the county level.

Table 5

Conditional Logit Results for Range-Pasture Starting Use, Full Model, No Interaction Terms[1]			
Transition Period	**1982-1987**	**1987-1992**	**1992-1997**
Crop-CRP Net Returns	0.00176*** (0.00022)	0.00430*** (0.00035)	-0.00179*** (0.00038)
Forest Net Returns	-0.94047*** (0.10890)	0.20443*** (0.01458)	0.17634*** (0.01156)
Urban Net Returns	0.00089*** (0.00002)	0.00042*** (0.00001)	0.00051*** (0.00001)
Range-Pasture Net Returns	-0.02950*** (0.00106)	0.00433** (0.00182)	-0.02120*** (0.00146)
Forest Intercept	-3.26489* (1.90251)	-4.47873*** (1.17509)	-6.34589*** (0.84059)
Urban Intercept	-18.27839*** (0.09332)	-3.50863*** (0.84092)	-14.60807*** (0.79468)
Range-Pasture Intercept	2.01652*** (0.30550)	6.78058*** (0.40188)	-0.04857 (0.36914)
Forest Dummy for LCC 5 & 6	2.58373*** (0.13769)	1.18098*** (0.06899)	1.19439*** (0.04877)
Forest Dummy for LCC 7 & 8	3.35201*** (0.14431)	3.38188*** (0.06722)	2.40083*** (0.05132)
Urban Dummy for LCC 5 & 6	0.35429*** (0.05895)	0.55563*** (0.05711)	1.37105*** (0.02448)
Urban Dummy for LCC 7 & 8	1.77989*** (0.06277)	1.36088*** (0.06189)	2.05956*** (0.03088)
Range-Pasture Dummy for LCC 5 & 6	1.00251*** (0.01749)	1.54311*** (0.02587)	0.79984*** (0.05394)
Range-Pasture Dummy for LCC 7 & 8	2.19219*** (0.02788)	2.31561*** (0.03356)	1.72055*** (0.05632)
January Temperature (on Forest)	0.07586*** (0.02307)	0.43907*** (0.01380)	0.41173*** (0.01161)
January Temperature (on Urban)	0.02784** (0.01240)	0.10417*** (0.01233)	0.14408*** (0.01151)
January Temperature (on Range-Pasture)	0.08646*** (0.00412)	0.10068*** (0.00511)	0.05647*** (0.00486)
April Temperature (on Forest)	-0.11080*** (0.04100)	-0.29089*** (0.02446)	-0.86840*** (0.02080)
April Temperature (on Urban)	-0.00323 (0.02523)	-0.08818*** (0.02462)	0.18893*** (0.02045)
April Temperature (on Range-Pasture)	-004471*** (0.01012)	-0.07983*** (0.01213)	-0.01901 (0.01177)
July Temperature (on Forest)	0.27080*** (0.04740)	0.74488*** (0.03268)	0.54246*** (0.02285)

July Temperature (on Urban)	0.26606*** (0.02607)	-1.4689*** (0.02460)	0.24030*** (0.02412)
July Temperature (on Range-Pasture)	0.28156*** (0.00882)	0.10047*** (0.01146)	0.1681*** (0.01047)
October Temperature (on Forest)	-0.46239*** (0.05732)	-1.24406*** (0.04198)	-0.15240*** (0.03095)
October Temperature (on Urban)	-0.19858*** (0.03319)	0.18695*** (0.03342)	-0.44885*** (0.03113)
October Temperature (on Range-Pasture)	-0.38776*** (0.01318)	-0.18597*** (0.01697)	-0.19219*** (0.01605)
January Precipitation (on Forest)	0.38131*** (0.11900)	0.11637 (0.08843)	-1.31603*** (0.07016)
January Precipitation (on Urban)	0.00456*** (0.06530)	-0.58368*** (0.05575)	0.26515*** (0.05355)
January Precipitation (on Range-Pasture)	-0.68124 (0.02058)	-0.71404*** (0.02666)	-0.12342*** (0.02730)
April Precipitation (on Forest)	-2.26705*** (0.16278)	-3.58365*** (0.10943)	-2.48223*** (0.07144)
April Precipitation (on Urban)	-1.06858*** (0.08835)	1.26520*** (0.08449)	0.23856*** (0.07591)
April Precipitation (on Range-Pasture)	-1.00071*** (0.03710)	-0.15508*** (0.04730)	-0.05876 (0.04477)
July Precipitation (on Forest)	1.47207*** (0.10918)	2.80160*** (0.06981)	0.43122*** (0.04924)
July Precipitation (on Urban)	0.30138*** (0.04967)	-0.07842 (0.04956)	0.38181*** (0.04613)
July Precipitation (on Range-Pasture)	0.27163*** (0.01808)	0.36219*** (0.02479)	0.55323*** (0.02397)
October Precipitation (on Forest)	3.98767*** (0.16092)	2.42156*** (0.14029)	4.20561*** (0.10477)
October Precipitation (on Urban)	0.61546*** (0.13569)	0.75339*** (0.13323)	0.36887*** (0.11960)
October Precipitation (on Range-Pasture)	1.73154*** (0.05211)	1.02987*** (0.06449)	-0.29190*** (0.06166)
Maximum Elevation (on Forest)	0.00049* (0.00029)	-0.00204*** (0.00016)	0.00381*** (0.00014)
Maximum Elevation (on Urban)	-0.00223*** (0.00016)	-0.00075*** (0.00017)	0.00233*** (0.00015)
Maximum Elevation (on Range-Pasture)	-0.00243*** (0.00008)	-0.00079*** (0.00010)	0.00019** (0.00009)
Elevation Range (on Forest)	0.00080*** (0.00025)	0.00175*** (0.00013)	-0.00348*** (0.00012)
Elevation Range (on Urban)	0.00272*** (0.00014)	0.00106*** (0.00014)	-0.00174*** (0.000130

Elevation Range (on Range-Pasture)	0.00278*** (0.00007)	0.00121*** (0.00008)	0.00016** (0.00007)
Mean Elevation (on Forest)	-0.00087*** (0.00029)	0.00221*** (0.00017)	-0.00230*** (0.00014)
Mean Elevation (on Urban)	0.00365*** (0.00016)	0.00100*** (0.00017)	-0.00094*** (0.00016)
Mean Elevation (on Range-Pasture)	0.00213*** (0.00008)	0.00021** (0.00010)	0.00018** (0.00009)

1 - *, **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

Table 6

Marginal Effects for the Range-Pasture Starting Use, Full Model, No Interaction Terms [1]			
Transition Period	**1982-1987**	**1987-1992**	**1992-1997**
Crop-CRP Net Returns	0.00044*** (0 .00006)	0.00092*** (0.00007)	-0.00041*** (0.00008)
Forest Net Returns	-0.23440*** (0 .02724)	0.4928** (0.00299)	0.04020*** (0.00238)
Urban Net Returns	0.00022*** (0.00000)	0.00009*** (0.00000)	0.00011*** (0.00000)
Range-Pasture Net Returns	0.00735*** (0 .00027)	0.00124*** (0.00039)	-0.00461*** (0.00031)
Forest Intercept	-0.62840*** (0.21154)	-0.41946*** (0.09877)	-0.91463*** (0.01192)
Urban Intercept	-0.99081*** (0.00207)	-0.61245*** (0.06603)	-0.95889*** (0.00468)
Range-Pasture Intercept	0.43233*** (0.05003)	0.66534*** (0.01871)	-0.36189*** (0.02258)
Forest Dummy for LCC 5 & 6	0.45190*** (0.01366)	0.20527*** (0.00875)	0.19979*** (0.00600)
Forest Dummy for LCC 7 & 8	0.51588*** (0.01066)	0.37415*** (0.00491)	0.31234*** (0.00415)
Urban Dummy for LCC 5 & 6	0.08692*** (0.01411)	0.10707*** (0.00990)	0.14661*** (0.00800)
Urban Dummy for LCC 7 & 8	0.36460*** (0.00901)	0.22472*** (0.00715)	0.26028*** (0.00528)
Range-Pasture Dummy for LCC 5 & 6	0.23044*** (0.00361)	0.24479*** (0.00338)	0.21920*** (0.00310)
Range-Pasture Dummy for LCC 7 & 8	0.41736*** (0.00418)	0.31441*** (0.00355)	0.28793*** (0.00312)
January Temperature (on forest)	0.01891*** (0.00575)	0.09147*** (0.00308)	0.08926*** (0.00255)
January Temperature (on Urban)	0.00694** (0.00309)	0.02227*** (0.00248)	0.03521*** (0.00237)
January Temperature (on Range-Pasture)	0.02155*** (0.00102)	0.02086*** (0.00103)	0.01517*** (0.00091)
April Temperature (on Forest)	-0.02762*** (0.01022)	-0.06498*** (0.00535)	-0.18479*** (0.00479)
April Temperature (on Urban)	-0.00080 (0.00629)	-0.02038*** (0.00529)	-0.03806*** (0.00431)
April Temperature (on Range-Pasture)	-0.01114*** (0.00252)	-0.01745*** (0.00262)	-0.00395 (0.00249)
July Temperature (on Forest)	0.06749*** (0.01181)	0.18447*** (0.00620)	0.12077*** (0.00413)
July Temperature (on Urban)	0.06631*** (0.00650)	-0.03514*** (0.00459)	0.03305*** (0.00432)
July Temperature (on Range-Pasture)	0.07017*** (0.00218)	0.02425*** (0.00236)	0.03027*** (0.00210)
October Temperature (on Forest)	-0.11524*** (0.01431)	-0.27613*** (0.00954)	-0.03935*** (0.00641)
October Temperature (on Urban)	-0.04949*** (0.00827)	0.04430*** (0.00717)	-0.08866*** (0.00629)

October Temperature (on Range-Pasture)	-0.09664*** (0.00326)	-0.04003*** (0.00359)	-0.04314*** (0.00332)
January Precipitation (on Forest)	0.09504*** (0.02968)	0.05303*** (0.01869)	-0.28789*** (0.01470)
January Precipitation (on Urban)	0.00114 (0.01627)	-0.13243*** (0.01105)	0.1668* (0.01005)
January Precipitation (on Range-Pasture)	-0.16979*** (0.00514)	-0.15059*** (0.00565)	-0.04329*** (0.00530)
April Precipitation (on Forest)	-0.56503*** (0.04066)	-0.75521*** (0.02501)	-0.52674*** (0.01513)
April Precipitation (on Urban)	-0.26633*** (0.02200)	0.26549*** (0.01854)	0.04199*** (0.01604)
April Precipitation (on Range-Pasture)	-0.24941*** (0.00921)	-0.03210*** (0.01014)	-0.02228** (0.00926)
July Precipitation (on Forest)	0.36689*** (0.02727)	0.63012*** 0.01628)	0.10121*** (0.00981)
July Precipitation (on Urban)	0.07512*** (0.01238)	-0.02441*** (0.00998)	0.06109*** (0.00917)
July Precipitation (on Range-Pasture)	0.06770*** (0.00451)	0 .08129*** (0.00533)	0.11327*** (0.00503)
October Precipitation (on Forest)	0.99387*** (0.04008)	0 .52100*** (0.03020)	0.89841*** (0.02378)
October Precipitation (on Urban)	0.15340*** (0.03382)	0 .17666*** (0.02876)	0.09440*** (0.02522)
October Precipitation (on Range-Pasture)	0.43156*** (0.13000)	0.21460*** (0.01389)	-0.05229*** (0.01293)
Maximum Elevation (on Forest)	0.00012* (0.00007)	-0.00041*** (0.00003)	0.00081*** (0.00003)
Maximum Elevation (on Urban)	-0.00056*** (0.00004)	-0.00015*** (0.00004)	0.00048*** (0.00003)
Maximum Elevation (on Range-Pasture)	-0.00061*** (0.00002)	-0.00017*** (0.00002)	0.00003 (0.00002)
Elevation Range (on Forest)	-0.00020*** (0.00006)	0.00035*** (0 .00003)	-0.00074*** (0.00003)
Elevation Range (on Urban)	0.00068*** (0.00003)	0.00022*** (0.00003)	-0.00036*** (0.00003)
Elevation Range (on Range-Pasture)	0.00069*** (0.00002)	0 .00027*** (0.00002)	0.00004*** (0.00002)
Mean Elevation (on Forest)	-0.00022*** (0.00007)	0 .00054*** (0.00004)	-0.00048*** (0.00003)
Mean Elevation (on Urban)	0.00091*** (0.00004)	0.00020*** (0.00004)	-0.00026*** (0.00003)
Mean Elevation (on Range-Pasture)	0.00053*** (0.00002)	0.00006*** (0 .00002)	0.00002 (0.00002)

1 - *, **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

Aggregate County Share Model

Now, I turn to the county aggregate models. Both the dependent and independent variables are aggregated to the county level. Because the dependent variables are the log odds ratios of the proportion in each land use to the proportion in a range land use, a negative coefficient for the range net returns is expected in each model. The first aggregate model reported here is used to estimate county shares in each land use as a function of independent variables; most of the net returns are of the expected signs, and elevation is significant in many cases. Of all the aggregate land-use shares models estimated, this model returned the most expected net returns coefficients. The specification omits the interaction terms between net returns and land capability class (LCC) and includes elevation variables. Results for coefficients can be found in Table 7, and marginal effects are in Table 8.

Net return coefficients for cropland and pasture are mixed. Forest net returns conform to expectations, with positive and significant coefficients and marginal effects for the forest share in all four years. Urban net returns coefficients and marginal effects are positive and significant for all four years for the urban outcome, in accordance with expectations. The marginal effects of range net returns on the probability of range are positive and significant in all four periods, as anticipated.

In the crop outcome, results for coefficients and marginal effects are both positive and negative for the range net returns coefficient, but coefficients are only negative and significant in 1987. Marginal effects of range net returns on the probability of a crop outcome are negative and significant in 1982 and 1987. In the pasture outcome, results for range net returns are mixed in signs, with only one significant negative coefficient in 1982. The marginal effects of range net returns on the probability of a pasture outcome are negative in all periods and significant in 1982 and 1987. For the urban outcome, the coefficient on range net returns is negative and significant in 1992, while marginal effects of range net returns on the probability if urban outcome are mixed.

The coefficients and marginal effects of Land Capability Class (LCC) vary by outcome. LCC coefficients and marginal effects on the crop outcome are negative and significant in all periods. LCC coefficients on pasture are negative, but not significant in all four years, with mixed marginal effects results. For forest, coefficients and marginal effects are positive and significant in all four years. In the urban outcome, coefficients and marginal effects are both positive and negative for the weighted average LCC.

The coefficient on maximum elevation for the cropland outcome is positive and significant in 1992 and 1997, but the marginal effects of maximum elevation on the probability of cropland are negative and significant for all four years. Results of maximum elevation on pasture and forest are less pronounced, while the coefficient and marginal effects are negative and significant in all four years for the urban outcome. The marginal effect of maximum elevation is positive and significant for all periods on the range outcome. It is possible that counties with very high elevation points might have land use constraints that allow for nothing but range use. Perhaps, there are areas where the terrain is too steep for forestry or cropland.

While the marginal effects of maximum elevation on cropland are negative and significant in all four years, the marginal effects of the range in elevation for cropland are positive in all four years, and significant in 1987, 1992, and 1997. The coefficients of elevation range on the pasture outcome are positive and significant for all four years. The marginal effects are all positive but only significant in 1982 and 1987. Marginal effects and coefficients for elevation range on the forest outcome are all positive. The coefficients are significant in 1987, 1992, and 1997, while the marginal effects are significant in 1982 and 1987. The coefficient and marginal effects on the urban outcome of the elevation range are positive and significant in most periods. For the range outcome, marginal effects of elevation range are negative and significant in all four periods.

While mean elevation coefficients are not significant for the cropland outcome, the marginal effects are positive and significant in 1982, 1987, and 1997. For pasture, forest, and urban outcomes, the coefficients and marginal effects for mean elevation are positive and significant in all periods. In the range outcome, the marginal effects are negative and significant in all four years.

Table 7

Generalized Least Squares Results for 1982 Aggregate County Shares in Land Use, Ln (0)'s Omitted [1]				
Dependent Variable	**Ln (Share in Crop-CRP/Share in Range)**	**Ln (Share in Pasture/Share in Range)**	**Ln (Share in Forest/Share in Range)**	**Ln (Share in Urban/Share in Range)**
Crop Net Returns	-0.00583 (0.00522)	-0.02409*** (0.00729)	-0.01082 (0.00807)	-0.00339 (0.00475)
Pasture Net Returns	0.00253 (0.00651)	0.00798 (0.00915)	-0.00048 (0.00725)	-0.00637 (0.00476)
Forest Net Returns	0.41077** (0.15342)	0.73959*** (0.17847)	2.19236*** (0.38332)	0.72679*** (0.15407)
Urban Net Returns	0.00013 (0.00026)	0.00020 (0.00033)	0.00072* (0.00040)	0.00152*** (0.00013)
Range Net Returns	-0.16075* (0.08344)	-0.15204* (0.08985)	-0.11579 (0.10458)	-0.06564 (0.08942)
Weighted Average LCC	-1.38817*** (0.31754)	-0.28293 (0.40312)	1.06495* (0.59267)	1.23911*** (0.32735)
Constant	7.08798*** (1.97314)	-1.36172 (2.63442)	-10.86929** (4.21795)	-13.79218*** (2.27864)
Maximum Elevation	-0.00137 (0.00133)	-0.00192 (0.00135)	-0.00201 (0.00148)	-0.00337*** (0.00129)
Elevation Range	0.00145 (0.00113)	0.00188* (0.00111)	0.00169 (0.00116)	0.00202** (0.00100)
Mean Elevation	0.00091 (0.00125)	0.00226* (0.00127)	0.00295** (0.00129)	0.00337*** (0.00114)

Generalized Least Squares Results for 1987 Aggregate County Shares in Land Use, Ln (0)'s Omitted [1]				
Dependent Variable	**Ln (Share in Crop-CRP/Share in Range)**	**Ln (Share in Pasture/Share in Range)**	**Ln (Share in Forest/Share in Range)**	**Ln (Share in Urban/Share in Range)**
Crop Net Returns	-0.00557 (0.00513)	-0.00443 (0.00680)	-0.00469 (0.00804)	0.00365 (0.00473)
Pasture Net Returns	0.00639 (0.00500)	0.01066* (0.00597)	0.01365** (0.00703)	0.00936** (0.00421)
Forest Net Returns	0.35716*** (0.12586)	0.40658*** (0.13461)	1.56952*** (0.39052)	0.37403*** (0.12738)
Urban Net Returns	0.00011 (0.00013)	-0.00007 (0.00017)	0.00037 (0.00022)	0.00097*** (0.00006)
Range Net Returns	-0.12973* (0.06849)	0.00716 (0.07244)	-0.09655 (0.11370)	-0.11047 (0.08531)
Weighted Average LCC	-1.41592*** (0.25492)	-0.33121 (0.33691)	1.28616** (0.55423)	1.14014*** (0.26203)
Constant	6.78118*** (1.44753)	-1.77304 (1.90820)	-9.1804** (3.65708)	-12.30309*** (1.76606)
Maximum Elevation	-0.00137	-0.00223**	-0.00282 *	-0.00274**

	(0.00106)	(0.00107)	(0.00146)	(0.00106)
Elevation Range	0.00150 (0.00011)	0.00194** (0.00087)	0.00197* (0.00117)	0.00135 (0.00085)
Mean Elevation	0.00088 (0.00098)	0.00257*** (0.00096)	0.00274** (0.00124)	0.00267*** (0.00092)

Generalized Least Squares Results for 1992 Aggregate County Shares in Land Use, Ln (0)'s Omitted [1]

Dependent Variable	**Ln (Share in Crop-CRP/Share in Range)**	**Ln (Share in Pasture/Share in Range)**	**Ln (Share in Forest/Share in Range)**	**Ln (Share in Urban/Share in Range)**
Crop Net Returns	-0.00097 (0.00303)	-0.00400 (0.00449)	-0.01025** (0.00437)	-0.00932** (0.00428)
Pasture Net Returns	0.00618** (0.00246)	-0.00298 (0.00381)	-0.00906** (0.00430)	-0.00465 (0.00358)
Forest Net Returns	0.06443* (0.03415)	0.38741*** (0.05840)	0.58376*** (0.09104)	0.42291*** (0.07182)
Urban Net Returns	0.00017*** (0.00006)	0.00005 (0.00009)	0.00026** (0.00011)	0.00083*** (0.00005)
Range Net Returns	0.03765 (0.03335)	-0.01583 (0.04285)	-0.09723* (0.05470)	-0.17336*** (0.05189)
Weighted Average LCC	-1.41611*** (0.13265)	-0.14270 (0.22060)	1.34222*** (0.33568)	1.14031*** (0.25797)
Constant	4.98534*** (0.78134)	-5.24757*** (1.49743)	-13.86199*** (2.40116)	-13.37602*** (1.92071)
Maximum Elevation	-0.00085 (0.00059)	-0.00126* (0.00074)	-0.00094 (0.00088)	-0.00243** (0.00095)
Elevation Range	0.00102** (0.00051)	0.00109* (0.00061)	0.00125* (0.00069)	0.00133* (0.00074)
Mean Elevation	0.00048 (0.00056)	0.00260*** (0.00065)	0.00228*** (0.00075)	0.00312*** (0.00081)

Generalized Least Squares Results for 1997 Aggregate County Shares in Land Use, Ln(0)'s Omitted [1]

Dependent Variable	**Ln (Share in Crop-CRP/Share in Range)**	**Ln (Share in Pasture/Share in Range)**	**Ln (Share in Forest/Share in Range)**	**Ln (Share in Urban/Share in Range)**
Crop Net Returns	-0.00154 (0.00181)	-0.00315 (0.00277)	-0.00210 (0.00296)	0.02190*** (0.00680)
Pasture Net Returns	0.00049 (0.00098)	-0.00224 (0.00178)	-0.00145 (0.00166)	-0.00369 (0.00288)
Forest Net Returns	0.06337*** (0.02020)	0.21752*** (0.03189)	0.25558*** (0.04829)	-0.14659 (0.09493)
Urban Net Returns	0.00014*** (0.00005)	0.00005 (0.00007)	0.00018** (0.00008)	0.00147*** (0.00013)
Range Net Returns	-0.04107 (0.02855)	-0.02011 (0.03489)	-0.06858 (0.04650)	-1.00787*** (0.11249)
Weighted Average LCC	-1.53873*** (0.13412)	-0.20830 (0.21973)	0.99616*** (0.32417)	-2.56009*** (0.68743)

Constant	5.92129*** (0.79755)	-4.75606*** (1.41056)	-11.00159*** (2.38052)	13.25670*** (4.45076)
Maximum Elevation	-0.00098 (0.00061)	-0.00116 (0.00072)	-0.00164* (0.00087)	-0.01279*** (0.00212)
Elevation Range	0.00104* (0.00053)	0.00110* (0.00059)	0.00146** (0.00067)	0.00564*** (0.00174)
Mean Elevation	0.00086 (0.00057)	0.00233*** (0.00064)	0.00262*** (0.00075)	0.01391*** (0.00178)

1 - *, **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

Table 8

Generalized Least Squares Marginal Effects Results for 1982 Aggregate County Shares in Land Use, Ln (0)'s Omitted [1]

Outcome	On Crops	On Pasture	On Forest	On Urban	On Range
Crop Net Returns	-0.00034*** (0.00005)	-0.00099*** (0.00006)	-0.00106*** (0.00001)	0.00000 (0.00001)	0.00239*** (0.00008)
Pasture Net Returns	0.00032*** (0.00006)	0.00036*** (0.00007)	-0.00018*** (0.00001)	-0.00006*** (0.00000)	-0.00044*** (0.00009)
Forest Net Returns	-0.00673*** (0.00146)	0.01421*** (0.00117)	0.26691*** (0.00045)	0.00226*** (0.00020)	-0.27664*** (0.00189)
Urban Net Returns	-0.00000* (0.00000)	0.00000 (0.00000)	0.00009*** (0.00000)	0.00001*** (0.00000)	-0.00010*** (0.00000)
Range Net Returns	-0.01865*** (0.00073)	-0.00481*** (0.00071)	-0.00951*** (0.00015)	-0.00010 (0.00009)	0.03306*** (0.00001)
Weighted Average LCC	-0.2274*** (0.00205)	-0.00981*** (0.00330)	0.17572*** (0.00045)	0.01075*** (0.00081)	0.05079*** (0.00395)
Constant	1.34067*** (0.02078)	-0.03687* (0.01953)	-1.57127*** (0.00426)	-0.10720*** (0.00675)	0.37467*** (0.29138)
Maximum Elevation	-0.00012*** (0.00001)	-0.00006*** (0.00001)	-0.00206*** (0.00000)	-0.00002*** (0.00000)	0.00041*** (0.00002)
Elevation Range	0.00014 (0.00128)	0.00006*** (0.00001)	0.00016*** (0.00000)	0.00001*** (0.00000)	-0.00038*** (0.00001)
Mean Elevation	0.00003** (0.00001)	0.00007*** (0.00001)	0.00034*** (0.00000)	0.00002*** (0.00000)	-0.00046*** (0.00001)

Generalized Least Squares Marginal Effects Results for 1987 Aggregate County Shares in Land Use, Ln (0)'s Omitted [1]

Outcome	On Crops	On Pasture	On Forest	On Urban	On Range
Crop Net Returns	-0.00060*** (0.00004)	-0.00012*** (0.00002)	-0.00045*** (0.00010)	0.00005*** (0.00002)	0.00111*** (0.00011)
Pasture Net Returns	0.00043*** (0.00003)	0.00153*** (0.00001)	0.00153*** (0.00009)	0.00005*** (0.00001)	-0.00231** (0.00009)
Forest Net Returns	0.00648*** (0.00085)	0.19136*** (0.00032)	0.19136*** (0.00511)	0.00049 (0.00049)	-0.20221*** (0.00515)
Urban Net Returns	0.00000*** (0.00000)	0.00004*** (0.00000)	0.00004*** (0.00000)	0.00000*** (0.00000)	-0.00005*** (0.00000)
Range Net Returns	-0.01465*** (0.00044)	-0.00931*** (0.0016)	-0.00931*** (0.00170)	-0.00632*** (0.00021)	0.02278*** (0.00175)
Weighted Average LCC	-0.21582** (0.00127)	0.20061*** (0.00035)	0.20061*** (0.00664)	0.00986*** (0.00066)	0.01823*** (0.00671)
Constant	1.13654*** (0.00774)	-1.32077*** (0.00281)	-1.32077*** (0.04317)	-0.09941*** (0.00646)	0.33672*** (0.04393)
Maximum Elevation	-0.00009*** (0.00000)	-0.00032*** (0.00000)	-0.00032*** (0.00002)	-0.00002*** (0.00000)	0.00049*** (0.00002)

Elevation Range	0.00014*** (0.00001)	0.00020*** (0.00000)	0.00020*** (0.00001)	0.00001*** (0.00000)	-0.00040*** (0.00002)
Mean Elevation	0.000038** (0.00001)	0.00031*** (0.00000)	0.00031*** (0.00001)	0.00002*** (0.00000)	-0.00044*** (0.00002)

Generalized Least Squares Marginal Effects Results for 1992 Aggregate County Shares in Land Use, Ln (0)'s Omitted $_1$

Outcome	On Crops	On Pasture	On Forest	On Urban	On Range
Crop Net Returns	0.00000 (0.00016)	-0.00013 (0.00018)	-0.00055** (0.00026)	-0.00008* (0.00005)	0.00075* (0.00040)
Pasture Net Returns	0.00083 (0.00054)	-0.00054 (0.00016)	-0.00045** (0.00026)	-0.00005 (0.00004)	-0.00011 (0.00035)
Forest Net Returns	0.00009 (0.00185)	0.03067*** (0.00219)	0.03067*** (0.00593)	0.00353*** (0.00081)	-0.04795*** (0.00601)
Urban Net Returns	0.00002 (0.00001)	0.00000 (0.00000)	0.00001** (0.00001)	0.00001*** (0.00000)	-0.00004*** (0.00001)
Range Net Returns	0.00557 (0.00682)	-0.00556 (0.00177)	-0.00556 (0.00338)	-0.00167*** (0.00061)	0.00221 (0.00454)
Weighted Average LCC	-0.17935* (0.10494)	0.08568 (0.00903)	0.08568*** (0.01581)	0.01229*** (0.00268)	0.08277*** (0.02232)
Constant	0.75136* (0.75136)	-0.78909*** (0.05402)	-0.78909*** (0.10832)	-0.12665*** (0.02037)	0.36525*** (0.13945)
Maximum Elevation	-0.00008*** (0.00002)	-0.00004 (0.00003)	-0.00004 (0.00005)	-0.00002** (0.00001)	0.00019** (0.00008)
Elevation Range	0.00010** (0.00004)	0.00006 (0.00003)	0.00006 (0.00004)	0.00001 (0.00001)	-0.00021*** (0.00007)
Mean Elevation	0.00002 (0.00002)	0.00011*** (0.00003)	0.00011** (0.00005)	0.00003*** (0.00001)	-0.00026*** (0.00007)

Generalized Least Squares Marginal Effects Results for 1997 Aggregate County Shares in Land Use, Ln (0)'s Omitted $_1$

Outcome	On Crops	On Pasture	On Forest	On Urban	On Range
Crop Net Returns	-0.00016*** (0.00001)	-0.00011 (0.00010)	-0.00013 (0.00020)	0.00016 (0.00010)	0.00024 (0.00026)
Pasture Net Returns	0.00008*** (0.00001)	-0.00008 (0.00006)	-0.00010 (0.00011)	-000003 (0.00002)	0.00011 (0.00014)
Forest Net Returns	0.00835** (0.00029)	0.00697*** (0.00120)	0.01622*** (0.00355)	-0.00130 (0.00098)	-0.02573*** (0.00362)
Urban Net Returns	0.00001*** (0.00000)	0.00000 (0.00000)	0.00001* (0.00001)	0.00001** (0.00000)	-0.00003*** (0.00001)
Range Net Returns	-0.00300 (0.00320)	-0.00006 (0.00130)	-0.00367 (0.00331)	0.00001** (0.00358)	0.01386*** (0.00480)
Weighted Average LCC	-0.18343*** (0.01368)	-0.00192 (0.00818)	0.08459*** (0.01958)	-0.01732 (0.01161)	0.11808*** (0.02479)
Constant	0.80050*** (0.05940)	-0.17698*** (0.05182)	-079876*** (0.13706)	0.09631 (0.06943)	0.07893 (0.15938)
Maximum Elevation	-0.00008** (0.00003)	-0.00003 (0.00003)	-0.00009 (0.00006)	-0.00009* (0.00002)	0.00029** (0.00009)

Elevation Range	0.00009*** (0.00001)	0.00003 (0.00002)	0.000088 (0.00005)	0.00004* (0.00002)	-0.00025*** (0.00007)
Mean Elevation	0.00005*** (0.00000)	0.00007*** (0.000026)	000016*** (0.00006)	0.00010* (0.00005)	-0.00037*** (0.00008)

1 - *, **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

Aggregate County Transition Model

Now, I discuss the results of the land use transition model aggregated to the county level. In general, the results are not as consistent over time periods or as significant as the previous aggregate model. Of all the aggregate transition models that were estimated, the model including net returns interaction terms with LCC and temperature returned the most expected results for net returns. These results were adjusted for the interaction term by adding the coefficient on net returns to the product of the weighted average LCC and the interaction term coefficient. The model also included temperature variables in the specification. Coefficient results can be found in Table 9 and marginal effects in Table 10.

None of the net returns coefficients or marginal effects, adjusted for the interaction term was positive and significant in all periods. In the following text, net returns refers to the adjusted net returns, a number obtained by adding the net returns coefficient to the product of the weighted average LCC and the interaction term between net returns and LCC. Crop net returns coefficients were all positive but only significant in 1987-1992. The marginal effects of crop net returns were all positive, and significant in 1987-1992 and 1992-1997. The results for pasture net returns coefficients are mixed with both positive and negative coefficients over the three transition periods, and the marginal effects for pasture net returns on the pasture outcome are all positive, but not significant. Forest net returns coefficients and marginal effects are all positive, and only significant in 1987-1992. Urban net returns coefficients are all positive, but not significant and marginal effects are mixed with both positive and negative values, and not significant in any period. The marginal effects of range net returns on the range outcome are not

significant and mixed in signs. The crop outcome has the most positive significant coefficients for its own net returns of any land use.

As in the previous model, range net returns in the crop, pasture, forest, and urban outcomes are expected to be negative. Once again, net returns are adjusted for the interaction term as described above. Range net returns coefficients and marginal effects for the crop and pasture outcome are mixed in signs. Range net returns coefficients are negative in the forest outcome, with both positive and negative marginal effects that are not significant in any period. Range net returns coefficients are mixed in the urban outcome, but the marginal effects are all negative, but only significant in 1982-1987.

The strongest results for LCC are for the cropland outcome, where the coefficients and marginal effects are all negative. However, the coefficients are not significant and the only marginal effect that is significant is in 1992-1997. For the other outcomes, the coefficients and marginal effects are mixed. The marginal effects of the constant terms are the most definitive for the urban outcome. They are all positive, and significant in 1982 to 1987. The coefficients for the constant on the urban outcome are mixed. For the other outcomes, there are both positive and negative coefficients and marginal effects for the intercept term in the three periods.

If the behavioral model is true, the model worked best for net returns results when the temperature variables were included. These are values of temperature for the exact center of the county for January, April, July, and October. Here, I will divide the results by land use, as the seasons affect each differently. Crops exhibit negative coefficients and marginal effects for the January temperature variable. However, the coefficients are not significant, and the marginal effect is only significant in 1992-1997. Results for April temperature include positive and negative coefficients and marginal effects for the crop outcome. None of the coefficients are significant, and the only significant marginal effect is April temperature for 1992-1997. July temperatures have negative coefficients

and marginal effects for all periods. No coefficients are significant, and marginal effects are only significant in 1992-1997. For October temperature, the coefficients for the cropland outcome are positive. Coefficients are not significant in any period, and marginal effects are only significant in 1992-1997

The pasture outcome exhibits positive coefficients and marginal effects for January temperatures. None of the marginal effects are significant, but the coefficients are significant in 1987-1992. For April temperature, the coefficients and marginal effects have both positive and negative values for the three periods. However, both the coefficients and the marginal effects are positive and significant in 1992-1997. July temperature results are mixed on pasture for both coefficients and marginal effects. Coefficients and marginal effects for October temperature are negative. No marginal effects are significant, and the coefficients are significant in 1987-1992 and 1992-1997. For forest, temperature coefficients and marginal effects are mixed with positive and negative results, and rarely significant. Similarly, the range outcome has mixed positive and negative marginal effects for temperature which are rarely significant. It does not appear that temperature is an important variable for any outcomes, but it captures heterogeneity the best of all attempted variables.

For the urban outcome, January temperature coefficients and marginal effects are all negative, with significant coefficients in 1987-1992 and 1992-1997, and significant marginal effects in 1982-1987. April temperature coefficients and marginal effects are both positive and negative over the three periods in the urban outcome. July and October temperature coefficients and marginal effects for the urban outcome are negative in all three periods. The coefficients on both temperature variables are significant in all three periods, and the marginal effects are significant in 1982-1987, and 1987-1992. The transition from range to urban is more likely to be made in areas with milder summers and falls.

Table 9

GLS Results for Aggregate County Transitions, Range Starting Use, Ln(0)'s Omitted, Temperature Model [1, 2]

Transition Period	**1982-1987**				**1987-1992**				**1992-1997**			
Dependent Variable	Ln (Prob. C-CRP/ Prob. Range)	Ln (Prob. Pasture/ Prob. Range)	Ln (Prob. Forest/ Prob. Range)	Ln (Prob. Urban/ Prob. Range	Ln (Prob. C-CRP/ Prob. Range)	Ln (Prob. Pasture/ Prob. Range)	Ln (Prob. Forest/ Prob. Range)	Ln (Prob. Urban/ Prob. Range	Ln (Prob. C-CRP/ Prob. Range)	Ln (Prob. Pasture/ Prob. Range)	Ln (Prob. Forest/ Prob. Range)	Ln (Prob. Urban/ Prob. Range
Crop Net Returns	-0.02906	0.03291	0.37920	0.0657941	0.15891**	0.82691***	-0.17534	-0.40523***	0.04332	-0.22373	-0.24368	-1.22667***
	(0.02577)	(0.07997)	(0.28634)	(0.05210)	(0.07683)	(0.24464)	(0.20252)	(0.06519)	(0.03684)	(0.15149)	(0.15832)	(0.20078)
Crop Interaction Term	0.00601	-0.00428	-0.06204	-0.01234	-0.02553*	-0.14108***	0.02845	0.06169***	-0.00583	0.03805	0.036876	0.17908***
	(0.00434)	(0.01360)	(0.04660)	(0.00807)	(0.01293)	(0.04115)	(0.03497)	(0.01014)	(0.00629)	(0.02417)	(0.02365)	(0.03039)
Adjusted Crop Coefficient	0.00672	N/A	N/A	N/A	0.00697	N/A	N/A	N/A	0.00866	N/A	N/A	N/A
Pasture Net Returns	0.00155	-0.08480	0.54750	0.2296971***	-0.03623	-0.69324***	-0.05590	0.03403	-0.01892	-0.14721	-0.11073	-0.43148**
	(0.03432)	(0.11358)	(0.75673)	(0.06080)	(0.08500)	(0.18959)	(0.14872)	(0.07817)	(0.04471)	(0.10080)	(0.12339)	(0.21526)
Pasture Interaction Term	-0.00222	0.01269	-0.10652	-0.035709***	0.00662	0.11667***	0.00802	-0.00624	0.00544	0.02800*	0.01548	0.06561**
	(0.00609)	(0.01844)	(0.12981)	(0.00920)	(0.01362)	(0.03125)	(0.02487)	(0.01146)	(0.00749)	(0.01616)	(0.01909)	(0.03246)
Adjusted Pasture Coefficient	N/A	-0.00927	N/A	N/A	N/A	0.00105	N/A	N/A	N/A	0.01943	N/A	N/A
Forest Net Returns	-1.30317**	1.05256	-61.85292	-2.859563	-2.53747***	2.58032	18.36401**	-3.49966	-1.08560**	-2.65928*	0.55591	-6.64709*
	(0.57270)	(1.63848)	(29.06510)	(1.95990)	(0.93726)	(9.64296)	(7.98810)	(2.87903)	(0.45139)	(1.38565)	(3.06869)	(3.66969)
Forest Interaction Term	0.27183***	-0.17022	10.63295	0.5483636*	0.45595***	-0.53081	-2.94966**	0.67375	0.18377**	0.47614**	-0.06910	1.29189**
	(0.09536)	(0.27518)	(5.02840)	(0.32534)	(0.16024)	(1.69767)	(1.32405)	(0.56436)	(0.07641)	(0.23054)	(0.50694)	(0.60856)
Adjusted Forest Coefficient	N/A	N/A	1.42277	N/A	N/A	N/A	0.81085	N/A	N/A	N/A	0.14472	N/A
Urban Net Returns	0.00059	-0.00393	-0.00353	0.00197	-0.00203	0.00627	-0.00265	-0.00002	0.00000	-0.00130	0.00515	0.00221
	(0.00114)	(0.00441)	(0.01256)	(0.00134)	(0.00138)	(0.00541)	(0.00279)	(0.00094)	(0.00083)	(0.00297)	(0.00322)	(0.00352)
Urban Interaction Term	-0.00003	0.00063	0.00066	-0.000088	0.00034	-0.00108	0.00045	0.00011	0.00003	0.00021	-0.00075	-0.000231
	(0.00021)	(0.00072)	(0.00190)	(0.00021)	(0.00025)	(0.00088)	(0.00046)	(0.00015)	(0.00014)	(0.00051)	(0.00052)	(0.00056)
Adjusted Urban Coefficient	N/A	N/A	N/A	0.0014458	N/A	N/A	N/A	0.00065	N/A	N/A	N/A	0.00084
Range Net Returns	0.39647	-1.31028*	4.27955	2.0501477***	0.17805	5.66143**	-2.99308	-0.28189	-0.38378	1.51815	-3.37539	-5.31666***
	(0.32495)	(0.72301)	(1.53893)	(0.33545)	(0.75852)	(2.40201)	(1.72256)	(0.68021)	0.53366	(1.2918)	(2.10315)	(1.79762)
Range Interaction Term	-0.04688	0.21302*	-0.72358	-0.331664***	-0.03953	-0.94743**	0.40686	0.02166	0.06682	-0.14984	0.53345	0.54684*
	(0.05758)	(0.11953)	(0.27579)	(0.05432)	(0.12767)	(0.39914)	(0.26554)	(0.11310)	(0.09368)	(0.19728)	(0.34647)	(0.30060)
Adjusted Range Coefficient	0.11750	-0.04263	-0.02639	0.0764452	-0.05719	0.02337	-0.57192	-0.15302	0.01388	0.62644	-0.20085	-2.06245
Weighted Average LCC	-0.55022	-3.98348**	15.32030	5.40125***	-1.43602	9.83624**	-4.93234	-1.90852	-1.23696	-1.39266	-0.68693	-13.22095***
	(0.73269)	(1.72402)	(13.85036)	(1.31883)	(1.34715)	(4.28243)	(3.09950)	(1.35130)	(0.92379)	(2.21331)	(2.22696)	(4.36200)

Constant	-7.00560	30.23951***	-51.65326	-39.25491***	8.28999	-60.94030*	37.91890	9.73547	7.09211	-5.25340	-9.51569	135.01201***
	(4.50593)	(10.54814)	(41.51873)	(10.05110)	(8.97984)	(29.55705)	(23.97780)	(9.16622)	(6.21245)	(19.76885)	(13.67706)	(29.22179)
January Temp.	-0.01662	0.12846	-0.89211	-0.518952***	-0.04968	0.43832***	0.26122	-0.07785	-0.09777	0.15524	0.16518	-1.03540***
	(0.05104)	(0.11672)	(0.49218)	(0.092493)	(0.06338)	(0.12740)	(0.15561)	(0.09299)	(0.06097)	(0.18699)	(0.16704)	(0.26753)
April Temp.	0.09136	0.36859	2.35561	0.56302***	-0.12469	-0.21256	-0.45927	-0.61909***	0.07870	1.91302**	-0.89706**	1.49810***
	(0.09980)	(0.24559)	(2.63193)	(0.14108)	(0.15929)	(0.36564)	(0.29498)	(0.17982)	(0.19748)	(0.68928)	(0.42809)	(0.45660)
July Temp.	-0.06149	-0.12683	-1.78833	-0.78919***	-0.18943	0.93197**	0.20107	-0.24333*	-0.18404	0.09911	0.42518	-2.54685***
	(0.09936)	(0.20274)	(1.11812)	(0.11557)	(0.12093)	(0.32132)	(0.24973)	(0.12536)	(0.11200)	(0.45497)	(0.34345)	(0.39637)
October Temp.	0.08441	-0.44166	0.02808	0.79135***	0.31830	-1.41414**	-0.20277	0.84172***	0.13087	-1.93040**	0.31870	1.84485**
	(0.15320)	(0.33056)	(2.23779)	(0.20002)	(0.21026)	(0.58944)	(0.40052)	(0.21673)	(0.25056)	(0.81366)	(0.50669)	(0.71708)

1-***, **, and * denote the 1%, 5% and 10% levels of significance, respectively
2-The adjusted coefficients are equal to the sum of the net returns coefficient and the product of the average LCC and the interaction term

Table 10

Generalized Least Squares Marginal Effects Results for 1982-1987 Aggregate County Shares Moving to Each Land Use, Ln (0)'s Omitted [1]

Outcome	On Crops	On Pasture	On Forest	On Urban	On Range
Crop Net Returns	-0.00024 (0.00021)	0.00018 (0.00047)	0.00253 (0.00712)	0.00009 (0.00008)	-0.00257 (0.00704)
Pasture Net Returns	-0.00002 (0.00027)	-0.00053 (0.00253)	0.000366 (0.00701)	0.00034*** (0.00012)	-0.00345 (0.00694)
Forest Net Returns	-0.00664 (0.00788)	0.00878 (0.01089)	-0.41290 (0.83505)	-0.00363 (0.00316)	0.41439 (0.82245)
Urban Net Returns	0.00000 (0.00001)	-0.00002 (0.00003)	-0.00002 (0.00013)	0.00000 (0.00001)	0.00004 (0.000140
Range Net Returns	0.00279 (0.00253)	-0.00795* (0.00462)	0.02858 (0.06799)	0.00301*** (0.00090)	-0.02643 (0.06719)
Crop Interaction Term	0.00005 (0.00003)	-0.00002 (0.00008)	-0.00041 (0.00116)	-0.00002 (0.00001)	0.00041 (0.00114)
Pasture Interaction Term	-0.00001 (0.00005)	0.00008 (0.00011)	-0.00071 (0.00140)	-0.00005** (0.00002)	0.00070 (0.00137)
Forest Interaction Term	0.00150 (0.00136)	-0.00145 (0.00185)	0.07098 (0.14495)	0.00071 (0.00053)	-0.07174 (0.14276)
Urban Interaction Term	-0.00000 (0.00000)	0.00000 (0.00001)	0.00000 (0.00002)	-0.00000 (0.00000)	0.00001 (0.00002)
Range Interaction Term	-0.00032 (0.00045)	0.00129* (0.00076)	-0.00483 (0.01125)	0.00049*** (0.00015)	0.00435 (0.01112)
Weighted Average LCC	-0.00478 (0.00574)	-0.02418* (0.01260)	0.10242 (0.19690)	0.00792*** (0.00197)	-0.08137 (0.19464)
Constant	-0.05079 (0.03561)	0.18146** (0.07469)	-0.34532 (0.85358)	0.05803*** (0.01545)	0.27267 (0.84582)
January Temperature	-0.00008 (0.00037)	0.00080 (0.00072)	-0.00596 (0.01392)	-0.00076*** (0.00026)	0.00600 (0.001375)
April Temperature	0.00054 (0.00080)	0.002208 (0.00171)	0.01570 (0.02875)	0.00081** (0.00037)	-0.01913 (0.02834)
July Temperature	-0.00036 (0.00077)	-0.00067 (0.00126)	-0.01192 (0.02365)	-0.00115*** (0.00037)	0.01410 (0.02330)
October Temperature	0.00064 (0.00115)	-0.00262 (0.00200)	0.00019 (0.01523)	0.00118*** (0.00039)	0.00061 (0.01521)

Generalized Least Squares Marginal Effects Results for 1987-1992 Aggregate County Shares in Land Use, Ln (0)'s Omitted [1]

Outcome	On Crops	On Pasture	On Forest	On Urban	On Range
Crop Net Returns	0.00088* (0.00045)	0.00106 (0.00077)	-0.00196 (0.04075)	-0.00074** (0.00030)	0.00076 (0.00295)
Pasture Net Returns	-0.00019 (0.00047)	-0.00088 (0.00068)	-0.00061 (0.00283)	0.00007 (0.00015)	0.00162 (0.00177)
Forest Net Returns	-0.01509** (0.00586)	0.00306 (0.01140)	0.20378*** (0.00159)	-0.00675 (0.00705)	-0.18500* (0.10977)
Urban Net Returns	-0.00001 (0.00001)	0.00001 (0.00001)	--0.00003 (0.10972)	0.00000 (0.00000)	0.00003 (0.00003)
Range Net Returns	0.00113 (0.00423)	0.00727 (0.00708)	-0.03327 (0.02239)	-0.00047 (0.00130)	0.02534 (0.02368)
Crop Interaction Term	-0.00014* (0.00007)	-0.00018 (0.00013)	0.00032 (0.00048)	0.00011** (0.00005)	-0.00011 (0.00050)
Pasture Interaction Term	0.00004 (0.00007)	0.00015 (0.00011)	0.00009 (0.00027)	-0.00001 (0.00002)	-0.00026 (0.00030)
Forest Interaction Term	0.00269*** (0.00100)	-0.00064 (0.00197)	-0.03274* (0.01704)	0.00129 (0.00139)	0.02940* (0.01710)
Urban Interaction Term	0.00000 (0.00000)	-0.00000 (0.00001)	0.00001 (0.00001)	0.00000 (0.00000)	-0.00001 (0.00001)

Range Interaction Term	-0.00024 (0.00072)	-0.00122 (0.00119)	0.00453 (0.00342)	0.00003 (0.00021)	-0.00311 (0.00365)
Weighted Average LCC	-0.00765 (0.00712)	0.01264 (0.01189)	-0.05470 (0.29088)	-0.00339 (0.00280)	0.05310 (0.04276)
Constant	0.04360 (0.04878)	-0.07839 (0.07571)	0.42054 (0.29088)	0.01706 (0.01853)	-0.40282 (0.30242)
January Temperature	-0.00029 (0.00036)	0.00056 (0.00045)	0.00289 (0.00249)	-0.00015 (0.00017)	-0.00301 (0.00254)
April Temperature	-0.00065 (0.00089)	-0.00026 (0.00048)	-0.00507 (0.00375)	-0.00112** (0.00050)	0.00710* (0.00387)
July Temperature	-0.00106 (0.00074)	0.00119 (0.00098)	0.00223 (0.00334)	-0.00045* (0.00024)	-0.00191 (0.00353)
October Temperature	0.00177 (0.00125)	-0.00181 (0.00158)	-0.00227 (0.00491)	0.00154*** (0.00055)	0.00076 (0.00529)

Generalized Least Squares Marginal Effects Results for 1992-1997 Aggregate County Shares in Land Use, Ln (0)'s Omitted [1]

Outcome	On Crops	On Pasture	On Forest	On Urban	On Range
Crop Net Returns	0.00036*** (0.00000)	-0.00077 (0.00061)	-0.00149 (0.00617)	-0.00817 (0.00618)	0.01007 (0.00618)
Pasture Net Returns	-0.00010*** (0.00000)	-0.00052 (0.00036)	-0.00068 (0.00257)	-0.00287 (0.00273)	0.00416 (0.00273)
Forest Net Returns	-0.00686*** (0.00000)	-0.00939 (0.00761)	0.00392 (0.03651)	-0.04423 (0.04101)	0.05656 (0.04101)
Urban Net Returns	-0.00000*** (0.0000)	-0.00001 (0.00001)	0.00003 (0.00003)	0.00001 (0.00003)	-0.00004 (0.00003)
Range Net Returns	-0.00220*** (0.00023)	0.00568 (0.00549)	-0.02124 (0.02938)	-0.03533* (0.03123)	0.05308* (0.03123)
Crop Interaction Term	-0.00005*** (0.00000)	0.00013 (0.00010)	0.00023 (0.00090)	0.00119* (0.00090)	-0.00150* (0.00090)
Pasture Interaction Term	0.00003*** (0.00000)	0.00010 (0.00006)	0.00009 (0.00039)	0.00044 (0.00041)	-0.00066 (0.00041)
Forest Interaction Term	0.00115*** (0.00000)	0.00168 (0.00130)	-0.00051 (0.00679)	0.00860 (0.00746)	-0.01092 (0.00746)
Urban Interaction Term	0.00000*** (0.00000)	0.00000 (0.00001)	-0.00000 (0.00002)	-0.00000 (0.00002)	0.00001 (0.00002)
Range Interaction Term	0.00040*** (0.00000)	-0.00057 (0.00081)	0.00337 (0.00341)	0.00362* (0.00389)	-0.00682* (0.00389)
Weighted Average LCC	-0.00755*** (0.00000)	-0.00464 (0.00865)	-0.00371 (0.07687)	-0.08804 (0.07743)	0.10394 (0.07743)
Constant	0.04153*** (0.00000)	-0.02212 (0.06687)	-0.06643 (0.72611)	0.90046 (0.72618)	-0.85344 (0.72618)
January Temperature	-0.00061*** (0.00006)	0.00058 (0.00103)	0.00109 (0.00544)	-0.00691 (0.00550)	0.00585 (0.00550)
April Temperature	0.00045*** (0.00000)	0.00686* (0.00031)	-0.00581 (0.00770)	0.00998 (0.00937)	-0.01148 (0.00937)
July Temperature	-0.00113*** (0.00000)	0.00041 (0.00279)	0.00282 (0.01241)	-0.01700 (0.01264)	0.01489 (0.01264)
October Temperature	0.00082*** (0.00000)	-0.00700 (0.00312)	0.00198 (0.01022)	0.01233 (0.01144)	-0.00813 (0.01144)

1 - *, **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

Aggregate County Transition Model: Relative Range-Pasture Net returns

For the aggregate transition model, the net returns coefficients are more often positive than in other models when they are normalized by dividing by the range-pasture net returns. The net returns coefficients reported here are adjusted also by adding the product of the interaction term and the average LCC. Results for coefficients can be found in Table 11, and results for marginal effects in Table 12. For cropland, the coefficients are all positive, and significant in 1982-1987 and 1992-1997. The marginal effects of crop net returns for the cropland outcome are mixed in signs over the three periods, but significant and positive in 1982-1987 and 1992-1997. For forest, they are significant in 1982-1987, with no significant marginal effects. Urban net returns coefficients are all positive, and significant in 1982-1987 and 1992-1997. For the urban net returns on the urban outcome, marginal effects are mixed in signs. As expected, the weighted average LCC coefficients and marginal effects are negative for cropland, but only significant in 1982-1987 and 1992-1997. LCC does not have a discernible effect on either the forest or the urban outcomes. The marginal effects of weighted average LCC are all positive on range, but only significant in 1982-1987.

The coefficients and effects of January and April temperature are mixed in signs over the three periods for each land use. July temperature coefficients and marginal effects are positive and significant in all three periods for cropland. This is in contrast to the previous transition model without adjusted net returns where July temperature coefficients on cropland were negative. The signs of the coefficients of July temperature on urban are all negative, and significant in 1982-1987 and 1992-1997. The marginal effects of July temperature on this outcome are mixed in signs over the three periods. The coefficients and marginal effects of October temperature are mixed in signs for the cropland and forest outcomes. For the urban outcome, the coefficients are positive in all three periods, and significant in 1987-1992 and 1992-1997.

Table 11

Generalized Least Squares Results for Aggregate County Transitions, Range-Pasture Starting Use, Relative Net Returns, Temperature Model, Ln (0)'s Replaced with Ln (0.005) [1 2]

Period	**1982 to 1987**			**1987 to 1992**			**1992 to 1997**		
Dependent Variable	Ln (Prob. Crop-CRP /Prob. Range-Pasture)	Ln (Prob. Forest /Prob. Range-Pasture)	Ln (Prob. Urban /Prob. Range-Pasture)	Ln (Prob. Crop-CRP /Prob. Range-Pasture)	Ln (Prob. Forest /Prob. Range-Pasture)	Ln (Prob. Urban /Prob. Range-Pasture)	Ln (Prob. Crop-CRP /Prob. Range-Pasture)	Ln (Prob. Forest /Prob. Range-Pasture)	Ln (Prob. Urban /Prob. Range-Pasture)
Adjusted Crop Net Returns	0.32796** (0.16579)	-0.00266 (0.02885)	0.43517** (0.17441)	0.01324 (0.08192)	-0.00897 (0.03608)	-0.03013 (0.10150)	0.30191* (0.15956)	-0.09800** (0.04757)	-2.85798*** (0.65246)
Adjusted Crop Interaction Term	-0.04988** (0.02460)	0.00054 (0.00427)	-0.07217*** (0.02523)	-0.00182 (0.01199)	0.00136 (0.00521)	0.00466 (0.01470)	-0.04884** (0.02434)	0.01504** (0.00722)	0.42154*** (0.09610)
Adjusted Crop Coefficient	0.03899	N/A	N/A	0.00267	N/A	N/A	0.01896	N/A	N/A
Adjusted Forest Net Returns	-28.40767*** (6.07820)	-2.20392* (1.30112)	14.14607** (5.73324)	13.30571*** (2.41852)	0.23692 (1.50148)	12.43320*** (3.00281)	-4.20026*** (1.58106)	-1.09803 (0.83744)	-25.04365*** (7.28813)
Adjusted Forest Interaction Term	4.88716*** (1.13304)	0.39122* (0.22227)	-2.12740** (0.99507)	-2.06227*** (0.40591)	-0.01469 (0.23800)	-1.90226*** (0.49102)	0.61320** (0.29282)	0.19634 (0.14812)	3.58896*** (1.30689)
Adjusted Forest Coefficient	N/A	0.06240	N/A	N/A	0.15183	N/A	N/A	0.03938	N/A
Adjusted Urban Net Returns	-0.03395*** (0.00453)	-0.00099 (0.00082)	-0.00772* (0.00404)	0.00081*** (0.00028)	-0.00006 (0.00015)	0.00058* (0.00035)	-0.00271* (0.00143)	0.00180*** (0.00054)	0.05461*** (0.00509)
Adjusted Urban Interaction Term	0.00498*** (0.00065)	0.00014 (0.00012)	0.00155*** (0.00058)	-0.00013** (0.00005)	0.00001 (0.00003)	-0.00009 (0.00006)	0.00056** (0.00022)	-0.00026*** (0.00008)	-0.00812*** (0.00076)
Adjusted Urban Coefficient	N/A	N/A	0.00124	N/A	N/A	0.00007	N/A	N/A	0.00756
January Temperature	-0.04670 (0.05217)	-0.00675 (0.00964)	-0.03514 (0.05025)	0.11645*** (0.03484)	0.03039 (0.02024)	0.12954*** (0.04668)	0.03735 (0.04005)	0.01959 (0.01631)	0.05743 (0.20260)
April Temperature	-0.31107*** (0.10555)	-0.00861 (0.01994)	0.21797** (0.10290)	-0.25973*** (0.07882)	0.11702*** (0.03717)	-0.48057*** (0.09325)	0.18976** (0.08904)	0.01736 (0.03590)	0.38604 (0.36137)
July Temperature	0.34384*** (0.10931)	-0.01463 (0.01711)	-0.39477*** (0.09118)	0.27590*** (0.07230)	0.01868 (0.03418)	-0.05051 (0.07745)	0.25390*** (0.07956)	0.06084** (0.02884)	-1.50958*** (0.31191)
October Temperature	0.12600 (0.13844)	0.02623 (0.02237)	0.09024 (0.10695)	-0.13606 (0.10435)	-0.18841*** (0.04974)	0.41048*** (0.10911)	-0.60245*** (0.10108)	-0.10891*** (0.03934)	1.19802*** (0.37931)

Weighted Average LCC	-1.57418*** (0.15987)	-0.02839 (0.03313)	-0.29012* (0.15454)	-0.03246 (0.12618)	0.06465 (0.05924)	-0.42412*** (0.13957)	-0.69108*** (0.14110)	0.09160 (0.06091)	0.05841 (0.53771)
Constant	-9.28531*** (2.04408)	-4.78130*** (0.36030)	9.38565*** (1.69813)	-8.53620*** (1.36582)	-3.71721*** (0.73081)	-1.62385 (1.56504)	1.11658 (1.62095)	-5.99631*** (0.66699)	23.23659*** (6.80510)

1 - *,**, and *** denote the 10%, 5%, and 1% levels of significance, respectively

2 -The adjusted coefficient is the product of the weighted average LCC and the interaction term, added to the net returns coefficient

Table 12

Generalized Least Squares Marginal Effects for Aggregate County Transitions, Range-Pasture Starting Use, Temperature, Ln (0)'s Replaced with Ln (0.005)$_{1, 2}$

Period	**1982 to 1987**				**1987 to 1992**				**1992 to 1997**			
Outcome	Crops	Forest	Urban	Range-Pasture	Crops	Forest	Urban	Range-Pasture	Crops	Forest	Urban	Range-Pasture
Adjusted Crop Net Returns	0.00285* (0.00152)	-0.000003 (0.00014)	0.00132** (0.00059)	-0.00413** (0.00162)	0.00010 (0.00063)	-0.00005 (0.00019)	-0.00008 (0.00027)	0.00023 (0.00070)	0.00263** (0.00124)	-0.00022 (0.00030)	-0.05770** (0.02574)	0.05529** (0.02544)
Adjusted Crop Interaction Term	-0.00043* (0.00022)	0.00001 (0.00002)	-0.00022** (0.00009)	0.00065*** (0.00024)	-0.00001 (0.00009)	0.00001 (0.00003)	0.00001 (0.00004)	-0.00001 (0.00010)	-0.00042** (0.00019)	0.00036 (0.00045)	0.00851** (0.00380)	-0.00813** (0.00376)
Adjusted Forest Net Returns	-0.24816*** (0.06712)	-0.00973 (0.00637)	0.04384** (0.01782)	0.21404*** (0.06881)	0.10199*** (0.01874)	0.00052 (0.00778)	0.03233*** (0.00800)	-0.13485*** (0.02165)	-0.02676** (0.01195)	-0.00296 (0.00479)	-0.50458* (0.27158)	0.53429** (0.26801)
Adjusted Forest Interaction Term	0.04268*** (0.01191)	0.00173 (0.00109)	-0.00661** (0.00310)	-0.03780*** (0.01224)	-0.01581*** (0.00315)	0.00003 (0.00123)	-0.00495*** (0.00131)	0.02072*** (0.00361)	0.00391* (0.00217)	0.00063 (0.00084)	0.07230* (0.04168)	-0.07685* (0.04116)
Adjusted Urban Net Returns	-0.00030*** (0.00005)	-0.00000 (0.00000)	-0.00002* (0.00001)	0.00032*** (0.00005)	0.00001*** (0.00000)	0.00000 (0.00000)	0.00000 (0.00000)	-0.00001*** (0.00000)	-0.00003*** (0.00001)	-0.00000 (0.00000)	0.00110** (0.00052)	-0.00108** (0.00051)
Adjusted Urban Interaction Term	0.00004*** (0.00001)	0.00000 (0.00000)	0.00000*** (0.00000)	-0.00005*** (0.00001)	-0.00000** (0.00000)	0.00000 (0.00000)	-0.00000 (0.00000)	0.00000** (0.00000)	0.00001*** (0.00000)	-0.00000 (0.00000)	-0.00016** (0.00008)	0.00016** (0.00008)
January Temperature	-0.00041 (0.00046)	-0.00003 (0.00005)	-0.00011 (0.00016)	0.00054 (0.00049)	0.00089*** (0.00027)	0.00150 (0.00010)	0.00034*** (0.00012)	-0.00138*** (0.00031)	0.00026 (0.00029)	0.00098 (0.00009)	0.00115 (0.00396)	-0.00151 (0.00392)
April Temperature	-0.00272*** (0.00094)	-0.00003 (0.00010)	0.00067* (0.00034)	0.00208** (0.00100)	-0.00199** (0.00065)	0.00062*** (0.00019)	-0.00126*** (0.00027)	0.00262*** (0.00072)	0.00132* (0.00067)	0.00004 (0.00020)	0.00776 (0.00846)	-0.00913 (0.00837)
July Temperature	0.00301*** (0.00105)	-0.00008 (0.00008)	-0.00121*** (0.00031)	-0.00172 (0.00109)	0.00212*** (0.00062)	0.00009 (0.00018)	-0.00014 (0.00020)	-0.00207*** (0.00069)	0.00207*** (0.00067)	0.0049*** (0.00018)	-0.03051** (0.01461)	0.02794* (0.01446)
October Temperature	0.00110 (0.00121)	0.00012 (0.00011)	0.00027 (0.00033)	-0.00149 (0.00124)	-0.00105 (0.00080)	-0.00098*** (0.00026)	0.00108** (0.00032)	0.00094 (0.00089)	-0.00456*** (0.00093)	-0.00070*** (0.00023)	0.02428* (0.13521)	-0.01902 (0.01342)

Weighted Average LCC	-0.01373*** (0.00200)	-0.00007 (0.00016)	-0.00084* (0.00046)	0.01463*** (0.00204)	-0.00024 (0.00097)	0.00034 (0.00031)	-0.00111*** (0.00038)	0.00101 (0.00107)	-0.00504*** (0.00103)	0.00052 (0.00034)	0.00127 (0.01100)	0.00326 (0.01092)
Constant	-0.08107*** (0.02378)	-0.02304*** (0.00195)	0.02888*** (0.00523)	0.07522*** (0.02423)	-0.06542** (0.01463)	-0.01890*** (0.00426)	-0.00403 (0.00435)	0.08834*** (0.01572)	0.00486 (0.11695)	-0.03504*** (0.00435)	0.46938** (0.18509)	-0.43919** (0.18326)

1-*,**, and *** denote the 10%, 5%, and 1% levels of significance, respectively
2-The adjusted coefficient is the product of the weighted average LCC and the interaction term, added to the net returns coefficient

Comparison and Contrast of the Four Models

In all three models, the coefficients and marginal effects of crop net returns on the cropland and CRP outcome are mixed in signs, with the exception of the aggregate transition model. Although the coefficients and marginal effects for crop net returns are positive, they are not all significant. Similar results are found for pasture net returns, with results mixed in sign in the conditional logit and aggregate share models. There are positive marginal effects in the aggregate transition model, but the estimates are not significantly different from zero.

In comparison with crops and pasture, the forest net returns have considerably more positive coefficients and marginal effects. The most positive and significant coefficients and marginal effects can be found in the aggregate county shares model, and both aggregate models return more positive coefficients and marginal effects on forest net returns than the parcel-level model. As mentioned earlier, the aggregate-level independent variables might be more appropriate for explaining aggregate-level outcomes, rather than parcel-level outcomes, although the NRI sampling procedure is not intended to produce county-level statistics. Coefficients and marginal effects on forest land might be more consistent with expectations, because forest land is less limited in its location than crop or pasture. It does not require the high-quality land that is necessary for crops, and forestry might be an option in more area in a county than cropland. So the heterogeneity of the county might not affect forest net returns as much as crops or pasture.

Urban net returns coefficients and marginal effects are positive and significant at the 1% level for the conditional logit model and the aggregate shares model. The marginal effects for the aggregate transition model are mixed in signs, while the coefficients are positive but not significant. Altogether, it appears that the parcel-level conditional logit

model and the aggregate shares model have urban net returns coefficients that are more consistent with expectations than the aggregate transition model.

The only model with positive marginal effects of range net returns on the probability of the range outcome is the aggregate share model. In this model, all periods have positive marginal effects, and these are significant in 1982, 1987, and 1997. For the parcel-level conditional logit model, the coefficients are mixed in signs. This could be due to the coupling of range and pasture as described before, with the problems of heterogeneity applying to pasture. In the aggregate transition model, the lack of positive marginal effects of range net returns can be due to the difficulty of separating pasture net returns from range net returns as described earlier. In the aggregate models, the dependent variable includes the proportion of the land in range as the denominator. In these cases, range net returns coefficients and marginal effects should be negative in the regressions for other land uses. This is rarely the case, and the results are mixed in signs. Again this could be due to the difficulty of separating range and pasture net returns.

Land capability class (LCC) information is collected at the NRI sample point. Recall that this is a measure of the suitability of land for growing crops, or land quality. In the parcel-level model, dummy variables are assigned for parcels in LCC's 5 and 6, and for 7 and 8. Because the scale for LCC's is 1 through 8, with 1 representing the highest-quality land, these dummies are for the two lowest land quality categories. Acreage weighted LCC aggregates are calculated for the entire county and enter the aggregate model as an independent variable. Results are very consistent with expectations for land capability class. In the parcel-level model, the LCC dummies for the cropland outcome are omitted for identification. In the aggregate models, the coefficients on LCC in the crop outcome are negative. Growing crops requires high-quality land, so counties with lower average land quality will have little high-quality land, and thus, low cropland shares.

Pasture requires better quality land than range, but not as high quality as crops. In the parcel-level conditional logit model, the pasture dummies for the lowest quality land are positive and significant in all periods. This means that being in a lower quality category makes a parcel more likely to be in a pasture land use. In the aggregate models, the coefficients and marginal effects are mixed in signs in the pasture outcome. Results in the parcel-level model are similar to the pasture outcome for forest; lower quality land is more likely to be used as forest. For the aggregate share model, the coefficients and marginal effects for weighted average LCC in the forest outcome are positive and significant for all four years. This conforms to expectations because forestry does not require the highest-quality land. In the aggregate transition model, results are mixed in signs for the effect of weighted average LCC on the forestry outcome. Range is another land use that does not require high-quality land. The dummies on the lowest quality land are positive in the parcel-level model. The marginal effects of land quality on the probability of the range outcome in the aggregate shares model are positive and significant for all four years, conforming to expectations.

As mentioned before, net returns sometimes do not exhibit the expected signs in the iteration of the model for their own land use. This could be due to heterogeneity in the land that makes some land uses infeasible so that net returns do not apply to the entire county. In the parcel-level transition model with the most expected signs for net returns coefficients, temperature, precipitation, and elevation variables are added to control for the effect of this heterogeneity on land uses. In the aggregate share model, elevation might be an indicator of this heterogeneity, because the inclusion of the elevation variables results in the most expected signs on net returns. The aggregate transition model with the most expected signs for net returns is specified with temperature variables to control for heterogeneity.

Elevation is included in both the parcel-level and the aggregate shares models. The effects of maximum elevation on range and urban are opposite. For range, they are

positive and significant in all four years. For urban, they are negative and significant in all four years. Intuitively, this makes sense, as mountainous areas might be less likely to be urbanized, due to terrain issues. For example, it might be difficult to construct buildings and roads on hill or mountainsides. If constructed, the roads might be less convenient or safe than those on less mountainous regions. Steep ravines might make the construction of bridges necessary in order to urbanize an area. Also, range might be the only feasible land use in very high-elevation areas. Parcel-level results for maximum elevation on the range and urban outcomes are less conclusive, with signs mixed over the three years.

In the aggregate shares model, larger elevation ranges and mean elevations increase the probability of the cropland, pasture, forest, and urban outcomes, while decreasing the probability of range land use. The results are not as clear for the parcel-level model, and elevation range and mean elevation have the opposite effect on the range outcome as in the aggregate model. Perhaps counties with greater mean elevations and more elevation range have more land that can be used for crops, pasture, and forest.

Temperature is another variable used to control for heterogeneity in two of the three models. For the pasture outcome, January temperature coefficients are significant and positive in the parcel-level model, while they are all positive in the aggregate transition model, they are only significant in 1987-1992. The July temperature coefficients for pasture are positive and significant in all three periods in the parcel-level model, and mixed in signs for the aggregate model, with a positive and significant value in 1987-1992. In both models, coefficients and marginal effects of October temperature on the pasture model are negative and mostly significant. Both models show that the utility of the pasture land use is increased by cooler falls.

In the aggregate transition model, there are not strong results for temperature on the forest outcome. The parcel-level model exhibits significant results that show forest is

more likely in areas with warm winters, cooler springs, warm summers, and cooler falls. The results for climate on the forest land use are similar to those for the pasture land use. For the urban and range outcomes, temperature results differ largely between the two types of models. It is quite possible that, by including elevation and precipitation variables, the parcel-level model exhibits different results for temperature than the aggregate transition model.

The parcel-level model also includes precipitation variables. The cropland outcome is omitted for identification purposes, but the results for range and pasture indicate that the range-pasture use is more likely in areas with less precipitation in the winter and spring, and more in the summer and fall. This seems to contradict the idea that pasture is more likely in desert counties, since deserts tend to get their rain in the late winter and spring. Forest is more likely in areas with drier springs and wetter summers and falls, while results for precipitation on the urban outcome are mixed in signs, and less conclusive. Range land uses are more likely in areas with dryer winters and springs, and more precipitation in the summer. Results for the fall are mixed in signs.

By using relative net returns on the range and pasture weighted average net returns, the aggregate transition model yields significantly more positive signs on net returns. This might reflect landowner's decisions that are based on relative net returns in a particular county. For example, a decision-maker might have family or occupational ties to a particular county, and might not be responsive to far away net returns in other counties.

In the aggregate transition specification which includes temperature variables and net returns x LCC interaction terms, net returns are all positive, and significant where outlined in the previous section. Interestingly, the effects of July and October temperature on the urban outcome are consistent with the previous analysis of aggregate transitions using absolute net returns. For July temperature, the relative net return model

yields positive coefficients for cropland, while the previous aggregate transition model yielded negative coefficients using absolute net returns.

In conclusion, these temperature, precipitation, and elevation variables are included to capture some of the heterogeneity in the sample. With the exception of the aggregate transition model, results for net returns are not as strong as those in studies in other geographic regions of the United States. As outlined here, this is likely due to restrictions on land use from land heterogeneity in this area. Since there is a high degree of within-county variation in land characteristics, a study which utilizes parcel-level net returns rather than county-level net returns may find net returns results more consistent with economic theory. Data on this level are currently not available, but future efforts in this direction might be in order.

Chapter 5: Conclusions

There are various reasons why policy to influence land use is desirable. There are a multitude of environmental effects resulting from land allocation to various uses. Policy incentives might be used to encourage or discourage certain land uses. This might be achieved through subsidies or taxes to achieve socially optimal allocations of land. To set these market incentives at an optimal level, it is necessary to know how decision-makers respond to these incentives. Observation of responses to net returns are one way to measure these reactions. A desired level of a particular land use can be achieved by an understanding of the effect of incentives. One example of a land use program that changes the use of land through market incentives is the Conservation Reserve Program. It pays landowners to move cropland into forest or grassland for the purposes of species conservation. In the future, similar incentives aimed solely at transforming land to forest might prove cost-effective means to sequester atmospheric carbon.

The Rocky Mountain region provides ample opportunity for afforestation because of the abundance of range land. Portions of these vast tracts of range provide a key opportunity

for relatively low-cost reforestation. To evaluate the potential effects of economic incentives in this direction, it is important to understand the dynamics of land-use responses to net returns. An added benefit of such an economic incentive is that those landowners with the lowest gains from their land in other uses will be the ones who choose to change their land to forest. The cost to society will therefore be minimized. This study seeks to understand landowner responses to profit incentives given other attributes of their county.

Here, the study starts with a basic specification including land-use net returns and land quality variables. Following the method of Lubowski (2002), a parcel-level conditional logit model was the first effort toward exploring the effects of these variables. County aggregate climate, elevation, and hotel and restaurant sales were added to account for other characteristics that might affect the parcel land use choices. Other methods were tried such as omitting observations from counties that have no land changing to forest from range over the transition period, dividing the parcels by state, and specifying relative net returns as independent variables. For the conditional logit model, none of these additional methods yielded significantly more positive net returns coefficients.

Except for Land Capability Class, all of the independent variables are county aggregates. The NRI sampling methodology is not intended to produce county-level statistics, so it might not be informative to model parcel-level data on aggregate independent variables. For this reason, it was worthwhile to aggregate the land-use parcel shares by county. Two types of models were developed from this aggregation. The first is the aggregate share model, which specifies county shares of land uses as dependent variables at four points in time. The next is an aggregate transition model, which includes portions of land moving to each land use from the range or range-pasture starting use. Both of these types of models were specified with relative net returns. Both transition models with the most expected results on net returns aggregate range and pasture net returns.

This result shows that range and pasture net returns are linked. Future work would take into account the connection between these net returns through livestock prices. It might be prudent to take measures to further separate the two types of net returns. This would contribute to an understanding of the effects of both range and pasture net returns on land-use decisions.

Of all the model specifications estimated, those which were the most successful included variables beyond basic net returns and land quality measures. Temperature, precipitation, and elevation were added to the parcel-level conditional logit model. The county aggregate land-use share model with the most net returns of the expected sign included elevation variables. The best-performing aggregate land-use transition model includes temperature variables. These are measures of heterogeneity in the land, and have proven to be very important in the study region. Other areas of the United States have had successful land-use studies that do not include these variables in their specification, but this region is different.

Furthermore, results for net returns are much closer to expectations when net returns are normalized on the combined range-pasture category. This specification resulted in 100% of the expected coefficients on net returns in many specifications of the aggregate transition model. For future work, relative net returns might be examined to quantify their effect on land use.

So, from the results of this study, it is clear that any effort to quantify the effect of net returns on land uses in the Rocky Mountain region will need to take into account heterogeneity of the land. Because some net returns information might be lost when data are aggregated to the county level, It might also be helpful to find net returns variables at a resolution smaller than the county level. The ideal study might take into account land heterogeneity as well as more localized net returns variables.

It might be possible to estimate this model on more homogeneous areas of the Rocky Mountain region. Eastern Colorado, Wyoming, and Montana are all relatively homogeneous compared to the western parts of these states. If the model were restricted to these areas alone, it might be possible that net returns coefficients would be positive and consistent with the behavioral model.

Since there has been considerable difficulty in understanding the motivations for land-use change in this region, it might also be possible to introduce an economic incentive as a policy experiment. The reactions of landowners to the incentive might allow the response to monetary incentives to be measured. It might be possible to apply this incentive to a portion of the study area, or to a randomly selected group of landowners. From observation of responses to these incentives, it may be possible to glean the effect of monetary incentives on land-use change without a full investment in the incentive at first. After a more complete understanding is gained from the experiment, the financial incentive could be applied to the entire region at the level that will result in the desired outcome of land-use change.

In summary, the Rocky Mountain region represents a unique set of challenges and opportunities for market-based land-use policy. On one hand, the region has vast areas of relatively low-value range land with great potential for land-use policy incentives, particularly afforestation. On the other, the area poses unique modeling challenges because of its heterogeneous nature.

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Appendices

Appendix A. Tables of Parcel-Level Conditional Logit Model Results

Conditional Logit Results for Range Starting Use_1			
Transition Period	**1982-1987**	**1987-1992**	**1992-1997**
Crop-CRP Net Returns	-0.00104** (0.00044)	-0.00440*** (0.00084)	-0.01891*** (0.00114)
Crop Net Returns Interaction with Dummy for LCC=5 & 6	0.01193*** (0.00057)	-0.00283* (0.00150)	0.01354 (0.00140)
Crop Net Returns Interaction with Dummy for LCC=7 & 8	-0.00059 (0.00092)	-0.00177 (0.00134)	0.01676*** (0.00141)
Pasture Net Returns	-0.01279*** (0.00177)	-0.01637*** (0.00123)	-0.37844*** (0.00360)
Pasture Net Returns Interaction with Dummy for LCC=5 & 6	0.01510*** (0.00188)	0.02609*** (0.00223)	0.04675*** (0.00383)
Pasture Net Returns Interaction with Dummy for LCC=7 & 8	0.00381* (0.00217)	0.02520*** (0.00242)	0.03618*** (0.00451)
Forest Net Returns	-1.24989*** (0.23542)	-1.35524*** (0.14059)	-6.16150*** (0.26373)
Forest Net Returns Interaction with Dummy for LCC=5 & 6	0.16834 (0.25588)	-2.59540*** (0.25475)	3.28470*** (0.28106)
Forest Net Returns Interaction with Dummy for LCC=7 & 8	-5.45725*** (0.44949)	-1.30143*** (0.16883)	6.16705*** (0.26390)
Urban Net Returns	0.00141*** (0.00005)	0.00075*** (0.00002)	0.00056*** (0.00003)
Urban Net Returns Interaction with Dummy for LCC=5 & 6	-0.00023*** (0.00005)	0.00001*** (0.00003)	0.00003 (0.00003)
Urban Net Returns Interaction with Dummy for LCC=7 & 8	-0.00041*** (0.00005)	-0.00022*** (0.00003)	-0.00004 (0.00003)
Range Net Returns	-0.20235 (0.00511)	-0.13741*** (0.00693)	-0.00173 (0.00525)
Range Net Returns Interaction with Dummy for LCC=5 & 6	0.01547** (0.00654)	0.10628*** (0.01002)	0.02535*** (0.00672)
Range Net Returns Interaction with Dummy for LCC=7 & 8	0.18201*** (0.00795)	0.23453*** (0.01007)	0.10329*** (0.00701)
Pasture Intercept	-1.84490*** (0.05035)	-1.35907*** (0.03407)	-2.25464*** (0.05410)
Forest Intercept	-4.76545*** (0.14646)	-2.63467*** (0.07129)	-4.56897*** (0.17629)
Urban Intercept	-7.42383*** (0.19356)	-4.81630*** (0.11400)	-4.71172*** (0.13659)
Range Intercept	5.46770*** (0.04755)	5.40816*** (0.05160)	4.37639*** (0.05194)

Pasture Dummy for LCC 5 & 6	1.28125*** (0.06911)	0.16778** (0.06915)	0.62540*** (0.08841)
Pasture Dummy for LCC 7 & 8	0.95744*** (0.09842)	-0.19849** (0.09069)	0.13838 (0.13880)
Forest Dummy for LCC 5 & 6	3.13665*** (0.15826)	0.47500*** (0.14241)	3.63489*** (0.18875)
Forest Dummy for LCC 7 & 8	0.68382*** (0.25584)	2.42412*** (0.09299)	6.00544*** (0.18135)
Urban Dummy for LCC 5 & 6	3.17239*** (0.22163)	1.35733*** (0.15449)	1.77463*** (0.16161)
Urban Dummy for LCC 7 & 8	4.76859*** (0.21103)	3.11330*** (0.14124)	3.32505*** (0.15319)
Range Dummy for LCC 5 & 6	1.44245*** (0.06381)	1.02951*** (0.07028)	1.32452*** (0.06622)
Range Dummy for LCC 7 & 8	0.80683*** (0.07462)	0.90252*** (0.06555)	1.76840*** (0.06814)

1 - *, **, and *** denote the10%, 5%, and 1% levels of significance, respectively

Conditional Logit Results for Range-Pasture Starting Use			
Transition Period	**1982-1987**	**1987-1992**	**1992-1997**
Crop-CRP Net Returns	0.00254*** (0.00024)	0.00789*** (0.00038)	-0.00429*** (0.00050)
Crop Net Returns Interaction with Dummy for LCC=5 & 6	0.00030 (0.00039)	-0.00949*** (0.00075)	0.00132 (0.00085)
Crop Net Returns Interaction with Dummy for LCC=7 & 8	-0.00475*** (0.00073)	-0.00937*** (0.00082)	-0.00055 (0.00090)
Forest Net Returns	-1.11664*** (0.23315)	-0.19140*** (0.02122)	-0.63048*** (0.03685)
Forest Net Returns Interaction with Dummy for LCC=5 & 6	0.59028** (0.24359)	-0.69741*** (0.08582)	-1.33346*** (0.08816)
Forest Net Returns Interaction with Dummy for LCC=7 & 8	-5.31182*** (0.44963)	0.14858*** (0.02499)	0.59765*** (0.03802)
Urban Net Returns	0.00092*** (0.00003)	0.00067*** (0.00001)	0.00057*** (0.00002)
Urban Net Returns Interaction with Dummy for LCC=5 & 6	0.00021*** (0.00004)	-0.00003 (0.00002)	0.00001 (0.00002)
Urban Net Returns Interaction with Dummy for LCC=7 & 8	0.00011*** (0.00004)	-0.00020*** (0.00002)	-0.00005** (0.00002)
Range-Pasture Net Returns	-0.03918*** (0.00109)	-0.02050*** (0.00163)	-0.04469*** (0.00144)
Range-Pasture Net Returns Interaction with Dummy for LCC=5 & 6	-0.02048*** (0.00172)	-0.02001*** (0.00309)	0.00369 (0.00277)
Range-Pasture Net Returns Interaction with Dummy for LCC=7 & 8	-0.00790** (0.00321)	0.09390*** (0.00475)	0.11890*** (0.00385)
Forest Intercept	-5.21846*** (0.14553)	-2.42209*** (0.05516)	-1.96606*** (0.03870)
Urban Intercept	-5.36611*** (0.10779)	-4.31062*** (0.07772)	-4.41660*** (0.08283)
Range-Pasture Intercept	3.94656*** (0.01452)	4.40946*** (0.01976)	4.24646*** (0.01848)
Forest Dummy for LCC 5 & 6	3.08932*** (0.15357)	1.26593*** (0.07964)	1.26543*** (0.06593)
Forest Dummy for LCC 7 & 8	0.97423*** (0.25447)	2.94048*** (0.06837)	2.94410*** (0.05241)
Urban Dummy for LCC 5 & 6	0.65073*** (0.14804)	0.77612*** (0.12048)	1.20164*** (0.11497)
Urban Dummy for LCC 7 & 8	2.40034*** (0.13443)	2.45363*** (0.11038)	2.57317*** (0.10496)
Range-Pasture Dummy for LCC 5 & 6	1.51507*** (0.02616)	1.51804*** (0.03842)	1.46890*** (0.03578)

Range-Pasture Dummy for LCC 7 & 8	2.23135*** (0.04651)	1.56100*** (0.04484)	0.11890*** (0.00385)

1 - * and ** denote the 5% and 1% levels of significance, respectively

Conditional Logit Results for 1982-1987 Range-Pasture Starting Use, State-by-State [1 3]

State	AZ	CO	ID	MT_2	NV	NM_2	UT	WY_2
Crop-CRP Net Returns	-0.10966*** (0.03326)	N/A	0.00509*** (0.00041)	-0.01064*** (0.00089)	0.02140*** (0.00242)	-0.00810*** (0.00162)	0.00366* (0.00209)	0.01103*** (0.00061)
Crop Net Returns Interaction with Dummy for LCC=5 & 6	0.13055*** (0.03375)	N/A	0.00589*** (0.00069)	N/A	0.03353*** (0.00587)	N/A	-0.02121*** (0.00305)	N/A
Crop Net Returns Interaction with Dummy for LCC=7 & 8	0.08774*** (0.03333)	N/A	0.00004 (0.00159)	-0.01247*** (0.00345)	-0.01829*** (0.00350)	0.02101*** (0.00361)	-0.01270*** (0.00410)	0.00674*** (0.00147)
Forest Net Returns	-1.22197 (8.40674×10^{7})	N/A	-0.77641 (0.77300×10^{6})	-0.85851*** (0.25278)	0.81718 (0.82739×10^{8})	8.77250*** (0.38368)	-216.93232*** (82.20810)	2.13071*** (0.37105)
Forest Net Returns Interaction with Dummy for LCC=5 & 6	1.56056 (0.61795×10^{9})	N/A	0.05160 (0.98967×10^{6})	N/A	1.75375 (0.91246×10^{8})	N/A	194.71785** (83.27300)	N/A
Forest Net Returns Interaction with Dummy for LCC=7 & 8	0.38935 (0.12201×10^{9})	N/A	0.00653 (0.13110×10^{7})	0.98082 (0.16186×10^{7})	-1.15864 (0.84254×10^{8})	-5.47800*** (1.11680)	201.88611** (82.27509)	-1.19089* (0.71172)
Urban Net Returns	-0.067191 (58.36310)	N/A	0.00173*** (0.00012)	0.00123*** (0.00017)	0.00074*** (0.00026)	0.00160** (0.00005)	0.00067*** (0.00016)	0.00086*** (0.00006)
Urban Net Returns Interaction with Dummy for LCC=5 & 6	0.067209 (53.36310)	N/A	-0.00030* (0.00016)	N/A	0.00002 (0.00047)	N/A	0.00001 (0.00030)	N/A
Urban Net Returns Interaction with Dummy for LCC=7 & 8	0.067927 (58.36310)	N/A	-0.00162* (0.00091)	-0.00200 (0.00180)	0.00003 (0.00026)	-0.00033*** (0.00007)	0.00041** (0.00018)	-0.00161*** (0.00043)
Range-Pasture Net Returns	-0.16535 (0.314204)	N/A	-0.03108*** (0.00141)	0.03758*** (0.00500)	1.12210*** (0.12050)	-0.78157*** (0.01546)	0.01030 (0.00834)	-0.03215*** (0.00458)
Range-Pasture Net Returns Interaction with Dummy for LCC=5 & 6	-1.96340*** (0.35859)	N/A	0.01627*** (0.00249)	N/A	0.33480 (0.24959)	N/A	0.11374*** (0.02152)	N/A
Range-Pasture Net Returns Interaction with Dummy for LCC=7 & 8	0.61019* (0.31936)	N/A	-0.01041 (0.00713)	-0.17610*** (0.01499)	0.56317*** (0.15290)	0.63301*** (0.05627)	-0.08875*** (0.00961)	-0.03206*** (0.01179)

Forest Intercept	-65.68256 ($6.968712x10^6$)	N/A	-35.24954 ($2.536737x10^6$)	-4.15829*** (0.32411)	-35.89618 ($3.09384x10^7$)	0.39675*** (0.09903)	-122.20236*** (46.02405)	-1.26013*** (0.17990)
Urban Intercept	97.92641 ($8.75610x10^4$)	N/A	-5.68649*** (0.30608)	-7.44599*** (0.38782)	-4.18315*** (1.01152)	-5.86480*** (0.18154)	-3.27153*** (0.52997)	-3.90293*** (0.24023)
Range-Pasture Intercept	-0.34923 (1.31856)	N/A	3.93694*** (0.06179)	3.01725*** (0.05003)	0.99894*** (0.30213)	8.65391*** (0.11815)	3.45483*** (0.18477)	5.77975*** (0.05977)
Forest Dummy For LCC 5 & 6	9.16151 ($4.66105x10^7$)	N/A	1.29004 ($3.48120x10^6$)	N/A	5.60013 ($3.37785x10^7$)	N/A	105.50513** (46.54139)	N/A
Forest Dummy For LCC 7 & 8	5.25984 ($8.60473x10^6$)	N/A	2.33664 ($3.68326x10^6$)	-31.19408 ($2.89770x10^6$)	2.64221 ($3.15145x10^7$)	1.28973*** (0.38383)	113.32851** (46.05670)	0.92880*** (0.35555)
Urban Dummy For LCC 5 & 6	-96.43791 ($8.75610x10^4$)	N/A	1.27747*** (0.48207)	N/A	2.04230 (1.96286)	N/A	-2.03524** (0.87419)	N/A
Urban Dummy for LCC 7 & 8	-100.74775 ($8.75610x10^4$)	N/A	3.84991** (1.82454)	3.78927 (3.36028)	2.90502 (1.05359)	5.41726*** (0.35963)	-0.28528 (0.64970)	6.21528*** (1.25328)
Range-Pasture Dummy for LCC 5 & 6	15.25297*** (1.48104)	N/A	1.17738*** (0.11078)	N/A	4.31902*** (0.58120)	N/A	-0.87111*** (0.28644)	N/A
Range-Pasture Dummy for LCC 7 & 8	3.94995*** (1.33123)	N/A	2.61536*** (0.22260)	3.22071*** (0.16398)	2.99389*** (0.39643)	0.83053** (0.37144)	2.79467*** (0.30661)	2.12031*** (0.17545)

1 - Colorado is not included here because the model did not work with any combination of LCC's

2 - To more evenly divide the sample, LCC's 1,2,3,4,5, and 6 were categorized together, and the Net Returns coefficient reflects the effect of Net Returns on land in this group

3 - * ,**,*** denote the 10%, 5%, and 1% levels of significance, respectively

Conditional Logit Results for 1982-1987 Range-Pasture Starting Use, State-by-State, Omitted Range-Pasture Net Returns, No Interaction Terms[2]

State	AZ	CO	ID	MT[1]	NV	NM[1]	UT	WY
Crop-CRP Net Returns	-0.01808*** (0.00203)	0.00746*** (0.00058)	0.00811*** (0.00032)	-0.01190*** (0.00086)	0.02526*** (0.00136)	-0.03092*** (0.00146)	-0.00546*** (0.00132)	0.01201*** (0.00055)
Forest Net Returns	0.16262 (3.01850×10^{7})	-2716.49164 (5.64117×10^{5})	0.00075 (4.45969×10^{5})	-0.77282*** (0.24446)	-0.09976 (8.97964×10^{6})	4.95818*** (0.44177)	-22.14728*** (3.19472)	1.54461*** (0.32153)
Urban Net Returns	0.00065*** (0.00003)	0.00120*** (0.00003)	0.00147*** (0.00008)	0.00118*** (0.00016)	0.00090*** (0.00004)	0.00122*** (0.00003)	0.00095*** (0.00008)	0.00070*** (0.00006)
Forest Intercept	-37.35309 (2.05073×10^{7})	-1770.49901 (4.66598×10^{5})	-35.10641 (2.08183×10^{6})	-4.30284*** (0.31530)	-35.22547 (6.69078×10^{6})	-1.57132*** (0.09423)	-15.78678*** (1.75637)	-1.43211*** (0.17503)
Urban Intercept	-0.80868** (0.32906)	-6.65958*** (0.16114)	-4.72371*** (0.22533)	-7.34744*** (0.38051)	-4.46972*** (0.37345)	-6.03348*** (0.13663)	-4.79018*** (0.32240)	-3.28894*** (0.22046)
Range-Pasture Intercept	3.42317*** (0.30174)	3.43967*** (0.03143)	3.71584*** (0.05123)	3.35435*** (0.01935)	3.57566*** (0.11623)	3.99525*** (0.04519)	2.91012*** (0.10999)	5.59161*** (0.04397)
Forest Dummy For LCC 5 & 6	2.43401 (2.05379×10^{7})	31.75471 (4.70780×10^{5})	0.63321 (2.48064×10^{6})	N/A	2.76910 (6.30039×10^{6})	N/A	-0.040235 (0.76897)	N/A
Forest Dummy For LCC 7 & 8	1.16600 (2.05044×10^{7})	32.96447 (4.70780×10^{5})	2.39510 (2.66840×10^{6})	-29.60991 (1.506548×10^{6})	4.29658 (6.01392×10^{6})	1.34918*** (0.19374)	3.58269*** (0.59945)	0.82508*** (0.23850)
Urban Dummy For LCC 5 & 6	-1.40759*** (0.33117)	2.41066*** (0.09924)	-0.25032 (0.16774)	N/A	0.01554 (0.60832)	N/A	-0.51780* (0.27395)	N/A
Urban Dummy for LCC 7 & 8	-1.47297*** (0.30731)	2.50992*** (0.13281)	0.32844 (0.32291)	0.00560 (0.46615)	4.23565*** (0.35240)	3.52352*** (0.16484)	1.85847*** (0.22001)	0.83169*** (0.16176)
Range-Pasture Dummy for LCC 5 & 6	2.72333*** (0.29775)	1.92987*** (0.03971)	0.73517*** (0.04366)	N/A	3.05961*** (0.13971)	N/A	1.22331*** (0.08961)	N/A
Range-Pasture Dummy for LCC 7 & 8	1.42101*** (0.28252)	2.12518*** (0.06202)	2.63411*** (0.10320)	1.73859*** (0.04580)	4.57966*** (0.14208)	2.79239*** (0.13676)	2.98489*** (0.11020)	1.40825*** (0.08492)

1- To more evenly divide the sample, LCC's 1,2,3,4,5, and 6 were categorized together
2 - * ,**,*** denote the 10%, 5%, and 1% levels of significance, respectively

Conditional Logit Results for 1987-1992 Range-Pasture Starting Use, State-by-State [3]								
State	**AZ_2**	**CO_1**	**ID**	**MT_2**	**NV_1**	**NM**	**UT_2**	**WY_1**
Crop-CRP Net Returns	0.007047 (0.00575)	0.00810*** (0.00140)	0.01167** (0.00097)	-0.02737*** (0.00191)	-0.01269*** (0.00330)	0.01303*** (0.00109)	0.03228*** (0.00115)	0.01667*** (0.00192)
Crop Net Returns Interaction with Dummy for LCC=5 & 6	N/A	-0.01385*** (0.00243)	-0.02394** (0.00176)	0.02967*** (0.00397)	0.05456*** (0.00476)	-0.00257 (0.00212)	N/A	-0.02753*** (0.00433)
Crop Net Returns Interaction with Dummy for LCC=7 & 8	-0.06655*** (0.00915)	N/A	0.0004271 (0.00307)	-0.00772 (0.00679)	N/A	0.00068 (0.00176)	-0.04408*** (0.00245)	N/A
Forest Net Returns	-6.71155*** (1.44824)	-11.29573*** (2.52273)	-0.10372 (0.08726)	-0.42761*** (0.08257)	76.73139 (0.29217×10^7)	-46.45359*** (6.12943)	-38.10579*** (3.28254)	-1.65302** (0.80832)
Forest Net Returns Interaction with Dummy for LCC=5 & 6	N/A	-2975.11258 (0.27535×10^7)	-0.02315 (0.46107×10^6)	0.02647 (0.15081)	-77.67147 (0.11309×10^8)	18.52602*** (7.05831)	N/A	1.71401 (0.88180×10^7)
Forest Net Returns Interaction with Dummy for LCC=7 & 8	100.84665 (0.44588×10^7)	N/A	0.63706** (0.09773)	0.47938*** (0.10098)	N/A	42.18085*** (6.13308)	32.11618*** (4.44481)	N/A
Urban Net Returns	0.00009 (0.00008)	0.00059*** (0.00002)	0.00089** (0.00009)	0.00097*** (0.00005)	0.00060** (0.00005)	-0.00318*** (0.00054)	0.00167*** (0.00009)	0.00064*** (0.00012)
Urban Net Returns Interaction with Dummy for LCC=5 & 6	N/A	0.00004 (0.00003)	-0.00016 (0.00021)	-0.00019 (0.00010)	-0.00013 (-0.00019)	0.00385*** (0.00054)	N/A	-0.00023*** (0.00020)
Urban Net Returns Interaction with Dummy for LCC=7 & 8	0.00010 (0.00008)	N/A	0.00006 (0.00029)	-0.00020 (0.00016)	N/A	0.00372*** (0.00054)	-0.00176*** (0.00015)	N/A
Range-Pasture Net Returns	-0.45324*** (0.17285)	-0.11411*** (0.01015)	-0.01662** (0.00244)	0.05452** (0.00519)	0.07335** (0.01881)	-0.17869** (0.08514)	0.09252*** (0.00989)	-0.27256*** (0.01477)
Range-Pasture Net Returns Interaction with Dummy for LCC=5 & 6	N/A	0.11775*** (0.01684)	-0.03223** (0.00499)	0.08294** (0.00760)	0.07495* (0.03211)	0.42318*** (0.16088)	N/A	0.23001*** (0.03310)

Range-Pasture Net Returns Interaction with Dummy for LCC=7 & 8	1.20370*** (0.19462)	N/A	-0.02968** (0.00633)	-0.13708** (0.00993)	N/A	-0.09718 (0.09968)	-0.09921*** (0.01318)	N/A
Forest Intercept	-0.59219 (0.48936)	-10.78781*** (1.82155)	-1.41683** (0.58469)	-2.06202*** (0.36244)	26.83242 (1.08102×10^6)	-31.13649*** (4.25715)	-23.40646*** (2.07981)	-1.93273*** (0.14754)
Urban Intercept	1.50735*** (0.34664)	-3.88845*** (0.14758)	-4.61242*** (0.43559)	-5.64108*** (0.17919)	-2.71668*** (0.32369)	6.00842*** (1.33913)	-6.75589*** (0.42402)	-4.26288*** (0.45690)
Range-Pasture Intercept	9.50227*** (0.47637)	5.48689*** (0.09536)	4.60042*** (0.08306)	3.21306*** (0.04761)	5.99321*** (0.15565)	5.70910*** (0.22094)	4.60619*** (0.11443)	8.28310*** (0.15233)
Forest Dummy For LCC 5 & 6	N/A	-2228.89117 (2.06513×10^6)	-31.74992 ($3.31501) \times 10^6$)	0.99682 (0.61265)	-58.81443 (4.82669×10^6)	14.09590** (4.91514)	N/A	-32.25096 (2.03034×10^6)
Forest Dummy For LCC 7 & 8	-6.14838 (1.33762×10^5)	N/A	-2.00464*** (0.75026)	1.12092** (0.46469)	N/A	31.79742*** (4.26176)	17.61198*** (2.67761)	N/A
Urban Dummy For LCC 5 & 6	N/A	-0.15854 (0.23313)	-1.55569 (0.98823)	1.50994*** (0.38048)	-0.50661 (1.00706)	-8.48895*** (1.37419)	N/A	1.14371 (0.69711)
Urban Dummy For LCC 7 & 8	-2.50293*** (0.38136)	N/A	-0.41011 (1.38178)	0.56988 (0.63947)	N/A	-6.45415*** (1.35231)	5.86287*** (0.65333)	N/A
Range-Pasture Dummy For LCC 5 & 6	N/A	-0.73863*** (0.15914)	0.15687 (0.13463)	1.01970*** (0.07988)	-0.70291** (0.31053)	1.67748*** (0.36627)	N/A	-2.08155*** (0.30660)
Range-Pasture Dummy For LCC 7 & 8	-5.44552*** (0.51843)	N/A	2.52161*** (0.24311)	1.00968*** (0.10240)	N/A	2.51416*** (0.28042)	0.40412*** (0.14189)	N/A

1 - To more evenly divide the sample, LCC's 1,2,3,4,7, and 8 were categorized together, and the Net Returns coefficient reflects the effect of Net Returns on land in this group

2 - To more evenly divide the sample, LCC's 1,2,3,4,5,and 6 were categorized together, and the Net Returns coefficient reflects the effect of Net Returns on land in this group

3 -*, **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

Conditional Logit Results for 1987-1992 Range-Pasture Starting Use, State-by-State, Omitted Range-Pasture Net Returns, No Interaction Terms[1]

State	AZ	CO_2	ID	MT	NV_2	NM	UT	WY_2
Crop-CRP Net Returns	-0.04211*** (0.00555)	0.00273** (0.00116)	0.00700*** (0.00080)	-0.23288*** (0.00167)	0.01346*** (0.00229)	0.01198*** (0.00069)	0.1769*** (0.00090)	0.00614*** (0.00172)
Forest Net Returns	-3.83534*** (1.01320)	-25.29303*** (5.65719)	0.46220*** (0.03119)	-0.22753*** (0.04247)	75.46462 (2.59264×10^6)	-5.68308*** (0.19317)	-23.97209*** (1.97723)	-1.63516* (0.85689)
Urban Net Returns	0.00028*** (0.00002)	0.00061*** (0.00002)	0.00084*** (0.00008)	0.00089*** (0.00004)	0.00066*** (0.00004)	0.00055*** (0.00002)	0.00092*** (0.00007)	0.00057*** (0.00009)
Forest Intercept	-32.44124 (7.56760×10^5)	-21.19789*** (4.14836)	-6.15803*** (0.35813)	-2.89655*** (0.22488)	26.99641 (9.59277×10^5)	-3.22031*** (0.14719)	-47.05338 (7.90886×10^5)	-2.20352*** (0.14413)
Urban Intercept	-0.75679*** (0.28401)	-4.15480*** (0.119416)	-4.7500*** (0.37273)	-5.33616*** (0.15081)	-2.29336*** (0.32349)	-4.33961*** (0.23252)	-4.75305*** (0.31934)	-4.25880*** (0.36453)
Range-Pasture Intercept	3.02870*** (0.24397)	4.46497*** (0.04261)	3.97660*** (0.06480)	3.70379*** (0.02167)	7.10652*** (0.14381)	5.28877*** (0.06179)	2.89833*** (0.06109)	5.82516*** (0.05924)
Forest Dummy For LCC 5 & 6	32.79603 (7.56760×10^5)	0.55468*** (0.19674)	-31.44694 (1.60425×10^6)	0.97554*** (0.19685)	-31.55559 (1.33586×10^6)	1.80665*** (0.12125)	34.02420 (7.90886×10^5)	-31.34328 (1.62292×10^6)
Forest Dummy For LCC 7 & 8	27.04249 (7.46760×10^5)	N/A	3.39423*** (0.23700)	3.32378*** (0.14902)	N/A	2.79344*** (0.10530)	31.72946 (7.90886×10^5)	N/A
Urban Dummy For LCC 5 & 6	1.26847*** (0.39095)	0.43607*** (0.08235)	-0.83944*** (0.23343)	0.56585*** (0.11961)	-2.69758*** (0.39789)	2.62261*** (0.25414)	2.00730*** (0.18928)	1.08160*** (0.23755)
Urban Dummy for LCC 7 & 8	-0.39553 (0.26667)	N/A	-0.16695 (0.33877)	-0.17999 (0.21189)	N/A	3.71992*** (0.22829)	0.74985*** (0.13597)	N/A
Range-Pasture Dummy for LCC 5 & 6	5.54113*** (0.35935)	0.56037*** (0.04247)	1.04889*** (0.07078)	1.35308*** (0.04360)	-1.67297*** (0.15489)	2.60955*** (0.09739)	3.81623*** (0.12943)	0.50744*** (0.08136)

Range-Pasture Dummy for LCC 7 & 8	2.76603*** (0.23516)	N/A	2.17436*** (0.12114)	2.04786*** (0.06344)	N/A	2.36860*** (0.08448)	3.00368*** (0.06568)	N/A

1 - * ,**,*** denote the 10%, 5%, and 1% levels of significance, respectively
2 - To more evenly divide the sample, LCC's 1,2,3,4,7, and 8 were categorized together

Conditional Logit Results for 1992-1997, Range-Pasture Starting Use, State-by-State$_3$

State	**AZ_1**	**CO_2**	**ID_1**	**MT**	**NV_1**	**NM**	**UT**	**WY**
Crop-CRP Net Returns	-0.00130 (0.00239)	0.01185*** (0.00114)	-0.00103 (0.00079)	-0.02633*** (0.00169)	-0.01646*** (0.00290)	0.02050*** (0.00205)	0.00755*** (0.00229)	0.01489*** (0.00236)
Crop Net Returns Interaction with Dummy for LCC=5 & 6	0.00550 (0.00651)	N/A	-0.00588*** (0.00145)	-0.03546*** (0.00486)	0.00964* (0.00513)	-0.04275*** (0.00284)	-0.00810* (0.00436)	-0.00804** (0.00355)
Crop Net Returns Interaction with Dummy for LCC=7 & 8	N/A	0.035011*** (0.00399)	N/A	0.03175*** (0.00285)	N/A	-0.01657*** (0.00252)	-0.00153 (0.00848)	0.00500 (0.00521)
Forest Net Returns	-6.29231*** (0.29942)	-9.01027*** (2.10563)	-0.78889*** (0.10705)	-0.42438*** (0.08496)	81.11886 (0.13559×10^7)	-24.44080*** (1.01807)	-22.32186*** (4.45401)	9.91518*** (1.13802)
Forest Net Returns Interaction with Dummy for LCC=5 & 6	2.81482 (0.88244×10^7)	N/A	-878.95377 (0.15818×10^7)	-0.06028 (0.12775)	-78.77883 (0.18721×10^8)	6.22445*** (1.50183)	-0.19055 (4.60518)	-10.18701 (0.91378×10^7)
Forest Net Returns Interaction with Dummy for LCC=7 & 8	N/A	8.80167 (0.15839×10^8)	N/A	-0.31754*** (0.09122)	N/A	16.17133*** (1.07578)	18.68481*** (4.51882)	-11.86544*** (1.24380)
Urban Net Returns	0.00053*** (0.00003)	0.00070*** (0.00002)	0.00069*** (0.00007)	0.00069*** (0.00007)	0.00039 (0.00004)	-0.00360*** (0.00056)	0.00146*** (0.00013)	0.00013 (0.00010)
Urban Net Returns Interaction with Dummy for LCC=5 & 6	0.00034*** (0.00010)	N/A	-0.00007 (0.00011)	-0.00006 (0.00012)	0.00085 (0.00015)	0.00406*** (0.00057)	0.00042** (0.00020)	0.00026* (0.00014)
Urban Net Returns Interaction with Dummy for LCC=7 & 8	N/A	-0.00047*** (0.00007)	N/A	0.00013 (0.00015)	N/A	0.00419*** (0.00056)	0.00115*** (0.00018)	-0.00018 (0.00021)

Range-Pasture Net Returns	0.61296*** (0.06039)	-0.09563*** (0.00898)	-0.03956*** (0.00195)	0.06688*** (0.00467)	-0.11375 (0.00905)	-2.51237*** (0.07106)	-0.03220** (0.00470)	0.08538*** (0.02893)
Range-Pasture Net Returns Interaction with Dummy for LCC=5 & 6	-3.23870*** (0.27762)	N/A	-0.00697 (0.00382)	-0.01474 (0.00993)	-0.00678 (0.01852)	2.74555*** (0.09561)	0.00430 (0.00707)	0.02644 (0.04016)
Range-Pasture Net Returns Interaction with Dummy for LCC=7 & 8	N/A	-0.01306 (0.03850)	N/A	0.01582* (0.00921)	N/A	2.62465*** (0.08834)	0.42414*** (0.01710)	-0.56842*** (0.03717)
Forest Intercept	-0.24174** (0.10700)	-9.60660*** (1.49232)	2.44389*** (0.55942)	-2.36767*** (0.37257)	29.54268 (5.01697×10^5)	-13.00203*** (0.65554)	-14.65654*** (2.68972)	-4.17670*** (0.45648)
Urban Intercept	-2.11485*** (0.17067)	-4.58086*** (0.14949)	-4.34568*** (0.29327)	-5.56014*** (0.24797)	-1.80435*** (0.23966)	8.87606*** (1.59016)	-7.01988*** (0.66158)	-1.80669*** (0.32162)
Range-Pasture Intercept	4.86299*** (0.13883)	5.58868*** (0.08422)	4.43785*** (0.05899)	2.87670*** (0.04257)	6.79384*** (0.11956)	12.18103*** (0.25072)	3.82669*** (0.11510)	5.01204*** (0.24349)
Forest Dummy For LCC 5 & 6	-31.29103 (2.28759×10^6)	N/A	3808.79239 (6.84927×10^6)	1.48446*** (0.52372)	-62.55691 (8.00221×10^6)	1.97636* (1.01314)	2.99649 (2.78355)	-29.80433 (2.05176×10^6)
Forest Dummy For LCC 7 & 8	N/A	8.80167 (1.58395×10^7)	N/A	5.33549*** (0.39548)	N/A	10.18550*** (0.70871)	16.80827*** (2.74448)	4.97629*** (0.49660)
Urban Dummy For LCC 5 & 6	1.28400** (0.51923)	N/A	0.07139 (0.51436)	1.13208*** (0.42537)	-5.79027*** (0.98708)	-11.07408*** (1.59595)	-1.29653 (1.01684)	-0.06888 (0.45627)
Urban Dummy For LCC 7 & 8	N/A	-0.00047*** (0.00007)	N/A	-0.02040 (0.57540)	N/A	-8.72003*** (1.59671)	-1.10800 (0.91101)	1.62825** (0.67487)
Range-Pasture Dummy For LCC 5 & 6	10.95635*** (0.77808)	N/A	0.19319* (0.10735)	1.30164*** (0.09115)	-0.71432*** (0.22628)	-6.95036*** (0.28571)	2.09276*** (0.19272)	0.24994 (0.33435)
Range-Pasture Dummy For LCC 7 & 8	N/A	3.56229*** (0.36192)	N/A	1.53032*** (0.09038)	N/A	-5.10609*** (0.29547)	2.58789*** (0.34931)	6.47467*** (0.39450)

1 - To more evenly divide the sample, LCC's 1,2,3,4,7, and 8 were categorized together, and the Net Returns coefficient reflects the effect of Net Returns on land in this group

2 - To more evenly divide the sample, LCC's 1,2,3,4,5,and 6 were categorized together, and the Net Returns coefficient reflects the effect of Net Returns on land in this group
3 - * and ** denote the 5% and 1% levels of significance, respectively

Conditional Logit Results for 1992-1997 Range-Pasture Starting Use, State-by-State, Omitted Range-Pasture Net Returns, No Interaction Terms[2]

State	**AZ[3]**	**CO[1]**	**ID[3]**	**MT**	**NV[3]**	**NM**	**UT**	**WY**
Crop-CRP Net Returns	-0.00064 (0.00222)	0.01395*** (0.00110)	-0.00143** (0.00072)	0.02367*** (0.00144)	-0.00801*** (0.00206)	-0.00717*** (0.00092)	0.00823*** (0.00169)	0.01267*** (0.00162)
Forest Net Returns	-5.84810*** (0.28746)	-8.56093*** (2.05801)	-1.01202*** (0.12499)	-0.69757*** (0.02935)	80.89471 (1.84154×10^6)	-11.19269*** (0.28196)	-15.17315*** (0.55617)	0.59270 (0.46191)
Urban Net Returns	0.00065*** (0.00003)	0.00065*** (0.00002)	0.00063*** (0.00005)	0.00069*** (0.00005)	0.00033*** (0.00004)	0.00055*** (0.00001)	0.00163*** (0.00007)	0.00023*** (0.00006)
Forest Intercept	-0.14663 (0.10467)	-9.24872*** (1.45907)	3.40247*** (0.63126)	-1.26444*** (0.15983)	29.50429 (6.81369×10^5)	-6.47272*** (0.20142)	-10.20747*** (0.37507)	-2.88495*** (0.23829)
Urban Intercept	-2.60039*** (0.16093)	-4.21712*** (0.13675)	-4.13935*** (0.23856)	-5.52945*** (0.18636)	-1.49485*** (0.22305)	-3.94965*** (0.15082)	-7.97297*** (0.35509)	-2.17026*** (0.22962)
Range-Pasture Intercept	6.16377*** (0.06477)	4.92417*** (0.04264)	3.76296*** (0.04729)	3.45982*** (0.01918)	5.93445*** (0.08601)	4.72582*** (0.05726)	3.42909*** (0.09102)	5.59692*** (0.06447)
Forest Dummy For LCC 5 & 6	-32.48064 (1.38803×10^6)	N/A	-0.56879*** (0.21858)	1.35732*** (0.17224)	-32.45646 (1.33222×10^6)	0.87181*** (0.09304)	3.15880*** (0.21339)	-31.04810 (1.62350×10^6)
Forest Dummy For LCC 7 & 8	N/A	-29.06113 (1.27029×10^6)	N/A	3.79458*** (0.13000)	N/A	1.02668*** (0.10424)	6.02354*** (0.30898)	3.24212*** (0.28085)
Urban Dummy For LCC 5 & 6	2.17883*** (0.27038)	N/A	0.14265 (0.13442)	1.14619*** (0.13384)	-1.56446*** (0.27550)	1.87897*** (0.16475)	1.13485*** (0.19520)	0.94056*** (0.16941)

Urban Dummy for LCC 7 & 8	N/A	1.08665*** (0.16549)	N/A	0.12051 (0.19064)	N/A	3.63131*** (0.16335)	4.02880*** (0.28538)	1.04762*** (0.21908)
Range-Pasture Dummy for LCC 5 & 6	2.72361*** (0.24753)	N/A	0.40952*** (0.05929)	1.39144*** (0.03933)	-0.90599*** (0.12614)	1.37598*** (0.08212)	2.51819*** (0.12063)	0.61590*** (0.07624)
Range-Pasture Dummy for LCC 7 & 8	N/A	1.92725*** (0.10495)	N/A	1.33352*** (0.04109)	N/A	1.88218*** (0.09360)	5.32932*** (0.25832)	1.60585*** (0.11155)

1 - To more evenly divide the sample, LCC's 1,2,3,4,5, and 6 were categorized together
2 - * ,**,*** denote the 10%, 5%, and 1% levels of significance, respectively
3 - To more evenly divide the sample, LCC's 1,2,3,4,7, and 8 were categorized together

Conditional Logit Results for Cropland Starting Use[1]			
Transition Period	**1982-1987**	**1987-1992[2]**	**1992-1997**
Crop-CRP Net Returns	0.11170*** (0.00037)	N/A	0.14906*** (0.00054)
Crop Net Returns Interaction with Dummy for LCC=5 & 6	-0.03054*** (0.00085)	N/A	-0.03438*** (0.00126)
Crop Net Returns Interaction with Dummy for LCC=7 & 8	-0.07376*** (0.00082)	N/A	-0.08076*** (0.00158)
Urban Net Returns	0.00141*** (0.00002)	N/A	0.00081*** (0.00001)
Urban Net Returns Interaction with Dummy for LCC=5 & 6	-0.00061*** (0.00009)	N/A	-0.00021*** (0.00004)
Urban Net Returns Interaction with Dummy for LCC=7 & 8	-0.00045*** (0.00012)	N/A	-0.00024*** (0.00009)
Range-Pasture Net Returns	0.04789*** (0.00050)	N/A	0.03654*** (0.00063)
Range-Pasture Net Returns Interaction with Dummy for LCC=5 & 6	-0.02644*** (0.00098)	N/A	0.00795*** (0.00121)
Range-Pasture Net Returns Interaction with Dummy for LCC=7 & 8	-0.03134*** (0.00147)	N/A	-0.00859*** (0.00189)
Urban Intercept	-6.21065*** (0.06394)	N/A	-6.34745*** (0.06788)
Range-Pasture Intercept	-1.89306*** (0.01605)	N/A	-1.96810*** (0.01361)
Urban Dummy for LCC 5 & 6	-0.00135 (0.29789)	N/A	0.58830*** (0.19616)
Urban Dummy for LCC 7 & 8	0.69828** (0.35569)	N/A	0.37844 (0.41192)
Range-Pasture Dummy for LCC 5 & 6	0.59324*** (0.03552)	N/A	1.08135*** (0.02736)
Range-Pasture Dummy for LCC 7 & 8	0.87817*** (0.04846)	N/A	0.46107*** (0.05186)

1 - *, ** and *** denote the 10%, 5%, and 1% levels of significance, respectively
2 - In the 1987-1992 transition period, there were not enough observations in urban and forest to estimate this model

Conditional Logit Results for Forest Starting Use$_1$			
Transition Period	**1982-1987$_3$**	**1987-1992$_2$**	**1992-1997$_3$**
Crop-CRP Net Returns	0.01131*** (0.00346)	0.00676*** (0.00155)	-0.05745*** (0.00816)
Forest Net Returns	1.04716*** (0.04022)	1.51045*** (0.22513)	-0.02838*** (0.00642)
Urban Net Returns	0.00049*** (0.00005)	0.00066*** (0.00002)	0.00063*** (0.00002)
Range-Pasture Net Returns	0.07641**** (0.00214)	-0.04388*** (0.00940)	0.07542*** (0.00750)
Forest Intercept	-11.53989*** (2.62984)	-1.87037 (1.54212)	27.525708** (2.52577)
Urban Intercept	1.16856 (2.85959)	-11.09888*** (1.05651)	14.51864*** (2.76322)
Range-Pasture Intercept	-16.90374*** (2.71491)	5.57382*** (0.79615)	1.26138 (2.55784)
Forest Dummy for LCC 5 & 6	1.07352*** (0.09483)	-32.91828 (1.09192×10^6)	0.64957*** (0.081573)
Forest Dummy for LCC 7 & 8	2.60821*** (0.24760)	N/A	1.12765*** (0.22579)
Urban Dummy for LCC 5 & 6	-0.11175 (0.19816)	1.10932*** (0.11504)	0.01128 (0.21957)
Urban Dummy for LCC 7 & 8	2.20115*** (0.29112)	N/A	0.34785 (0.26076)
Range-Pasture Dummy for LCC 5 & 6	N/A	1.23727*** (0.09108)	N/A
Range-Pasture Dummy for LCC 7 & 8	1.96489*** (0.24300)	N/A	1.43408*** (0.21957)
January Temperature (on forest)	0.17027*** (0.05743)	-0.13943*** (0.04022)	-0.025353*** (0.061877)
January Temperature (on urban)	0.26699*** (0.06434)	0.14735*** (0.03354)	-0.13176* (0.06759)
January Temperature (on range-pasture)	0.37520*** (0.06100)	0.03282 (0.02332)	-0.19202*** (0.06266)
April Temperature (on forest)	-0.72842*** (0.09335)	1.18812*** (0.05439)	0.89553*** (0.13452)
April Temperature (on urban)	-0.41855*** (0.10140)	0.01263 (0.04679)	1.09534*** (0.13888)
April Temperature (on range-pasture)	-0.33321*** (0.09519)	0.12896*** (0.03443)	0.58655*** (0.13530)
July Temperature (on forest)	0.37595***	0.28009***	-0.83383***

	(0.10616)	(0.07032)	(0.09482)
July Temperature (on urban)	-0.03030 (0.11387)	0.49333*** (0.05084)	-0.48977*** (0.10663)
July Temperature (on range-pasture)	0.61691*** (0.11014)	0.15382*** (0.03858)	-0.28803*** (0.09636)
October Temperature (on forest)	0.42609*** (0.10063)	-1.39736*** (0.07489)	0.06552 (0.16089)
October Temperature (on urban)	0.26848** (0.11362)	-0.62159*** (0.06383)	-0.56718*** (0.17267)
October Temperature (on range-pasture)	-0.37471*** (0.10813)	-0.34461*** (0.04323)	-0.02358 (0.16324)

1 - *, **, and *** denote the 10%, 5%, and 1% levels of significance, respectively
2 - To more evenly divide the sample, LCC's 1, 2, 3, 4, 7, and 8 have been grouped together
3 – Due to a lack of range-pasture observations in LCC's 5 and 6, this category have been eliminated

Appendix B: Tables Of County Land-Use Share Models

Generalized Least Squares Results for Aggregate County Shares in Land Use, Range-Pasture Combined, Ln (0.0001) replaces Ln (0) [1 2]

Period	1982			1987			1992			1997		
Dependent Variable	**Ln (Share in Crop-CRP /Share in Range)**	**Ln (Share in Forest /Share in Range)**	**Ln (Share in Urban /Share in Range)**	**Ln (Share in Crop-CRP /Share in Range)**	**Ln (Share in Forest /Share in Range)**	**Ln (Share in Urban /Share in Range)**	**Ln (Share in Crop-CRP /Share in Range)**	**Ln (Share in Forest /Share in Range)**	**Ln (Share in Urban /Share in Range)**	**Ln (Share in Crop-CRP /Share in Range)**	**Ln (Share in Forest /Share in Range)**	**Ln (Share in Urban /Share in Range)**
Crop Net Returns	-0.01313 (0.01182)	-0.01329 (0.06605)	0.04362** (0.01999)	0.00093 (0.01578)	0.08070 (0.08443)	-0.01276 (0.02142)	-0.00681 (0.01677)	-0.09668 (0.06621)	0.04204 (0.03142)	0.01607 (0.01325)	-0.09986*** (0.03272)	-0.09595*** (0.02828)
Crop Interaction Term	0.00313 (0.00237)	0.00023 (0.01071)	-0.00863** (0.00342)	-0.00000 (0.00316)	-0.01332 (0.01330)	0.00336 (0.00363)	0.00153 (0.00321)	0.01445 (0.01060)	-0.00760 (0.00501)	-0.00422 (0.00259)	0.01480*** (0.00528)	0.01295*** (0.00479)
Adjusted Crop Coefficient	0.00415	N/A	N/A	0.00092	N/A	N/A	0.00165	N/A	N/A	-0.00725	N/A	N/A
Forest Net Returns	-0.38906 (0.29624)	2.64238* (1.51749)	-0.28811 (0.76568)	-1.07152*** (0.31526)	2.50086 (2.43746)	-1.23528** (0.58007)	-0.42657** (0.16693)	-0.69284 (0.56484)	-0.58773 (0.40192)	-0.23921** (0.11251)	-0.82467** (0.32491)	0.72105** (0.36297)
Forest Interaction Term	0.08696 (0.06570)	-0.39280 (0.26471)	0.08342 (0.14718)	0.25990*** (0.07255)	-0.35411 (0.40047)	0.30995*** (0.11197)	0.09518*** (0.03401)	0.15812 (0.09792)	0.11402 (0.07291)	0.05907** (0.02408)	0.17269*** (0.05454)	-0.08340 (0.06809)
Adjusted Forest Coefficient	N/A	0.04750	N/A	N/A	0.54946	N/A	N/A	0.18027	N/A	N/A	0.12854	N/A
Urban Net Returns	0.00131* (0.00075)	0.01486*** (0.00266)	0.00091 (0.00086)	0.00092* (0.00054)	0.01053*** (0.00202)	-0.00018 (0.00039)	0.00039 (0.00037)	0.00653*** (0.00137)	-0.00091** (0.00038)	0.00063 (0.00046)	-0.00318*** (0.00097)	-0.00057 (0.00071)
Urban Interaction Term	-0.00024* (0.00014)	-0.00254*** (0.00039)	0.00004 (0.00013)	-0.00015 (0.00010)	-0.00170*** (0.00030)	0.00020*** (0.00006)	-0.00005 (0.00007)	-0.00111*** (0.00020)	0.00029*** (0.00006)	-0.00019** (0.00009)	0.00053*** (0.00016)	0.00009 (0.00012)
Adjusted Urban Coefficient	N/A	N/A	0.00112	N/A	N/A	0.00091	N/A	N/A	0.00067	N/A	N/A	-0.00007
Range-Pasture Net Returns	-0.01603 (0.05566)	0.07178 (0.15074)	0.08505 (0.09564)	0.15087* (0.07836)	0.37173 (0.44402)	0.53061*** (0.13540)	-0.01286 (0.05194)	0.23224 (0.18941)	0.20906*** (0.07248)	0.01783 (0.02620)	0.14259** (0.06556)	0.07031 (0.05905)
Range-Pasture Interaction Term	0.01514 (0.01114)	0.01132 (0.02583)	-0.00381 (0.01658)	-0.02988* (0.01530)	-0.03581 (0.07282)	-0.08358*** (0.02140)	0.01159 (0.01023)	-0.01768 (0.03182)	-0.03281** (0.01300)	-0.00185 (0.00535)	-0.01820 (0.01140)	-0.01471 (0.01083)

Adjusted Range-Pasture Coefficient	0.06751	0.13422	0.06402	-0.01376	0.17439	0.07003	0.05112	0.13463	0.02792	0.00762	0.04213	-0.01090
Weighted Average LCC	-1.32151*** (0.35649)	7.87275*** (1.12137)	1.84652*** (0.62631)	-0.95885*** (0.35335)	7.23646*** (1.14531)	0.85535* (0.46352)	-1.73497*** (0.26502)	5.48184*** (0.91258)	0.37083 (0.48340)	-0.45747 (0.40767)	-1.34914 (0.85907)	0.44281 (1.02790)
Constant	4.42500** (1.81311)	-49.07676*** (7.28218)	-18.26682*** (3.86798)	3.08810* (1.81995)	-47.31533*** (7.55336)	- 12.83257*** (2.94508)	6.35221*** (1.32913)	-35.66586*** (5.87194)	-9.17869*** (3.01879)	2.30657 (2.05644)	5.61747 (5.28856)	-4.71448 (6.16892)

1 - * , **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

2 - The adjusted coefficients are the sum of the coefficient on net returns and the coefficient on the interaction term multiplied by the average LCC in all counties.

Generalized Least Squares Results for Aggregate County Shares in Land Use, Range-Pasture Combined, Ln (0)'s Omitted [1 2]

Period	1982			1987			1992			1997		
Dependent Variable	Ln (Share in Crop-CRP /Share in Range)	Ln (Share in Forest /Share in Range)	Ln (Share in Urban /Share in Range)	Ln (Share in Crop-CRP /Share in Range)	Ln (Share in Forest /Share in Range)	Ln (Share in Urban /Share in Range)	Ln (Share in Crop-CRP /Share in Range)	Ln (Share in Forest /Share in Range)	Ln (Share in Urban /Share in Range)	Ln (Share in Crop-CRP /Share in Range)	Ln (Share in Forest /Share in Range)	Ln (Share in Urban /Share in Range)
Crop Net Returns	-0.01091 (0.00881)	0.03232 (0.03631)	0.03134 (0.01920)	0.00591 (0.01234)	0.05055 (0.04790)	-0.02322 (0.02035)	-0.00372 (0.01312)	-0.01993 (0.04155)	0.01630 (0.03002)	0.00150 (0.00689)	-0.00298 (0.02131)	0.01302 (0.01341)
Crop Interaction Term	0.00261 (0.00177)	-0.00602 (0.00600)	-0.00674 (0.00326)	-0.00101 (0.00245)	-0.00875 (0.00773)	0.00527 (0.00347)	0.00070 (0.00251)	0.00270 (0.00673)	-0.00367 (0.00477)	-0.00040 (0.00134)	-0.00029 (0.00348)	-0.00204 (0.00222)
Adjusted Crop Coefficient	0.00340	N/A	N/A	0.00038	N/A	N/A	0.00014	N/A	N/A	-0.00071	N/A	N/A
Forest Net Returns	-0.32020 (0.21619)	-1.28368 (0.92465)	-0.22602 (0.66443)	-0.86547*** (0.25730)	-1.22138 (1.21449)	-1.11359** (0.53920)	-0.28964** (0.12360)	-0.98842** (0.40762)	-0.23945 (0.36414)	-0.14563*** (0.05418)	-0.56107** (0.22513)	-0.27156* (0.15499)
Forest Interaction Term	0.07183 (0.04764)	0.26912 (0.16701)	0.07322 (0.12707)	0.21366*** (0.05946)	0.27830 (0.21942)	0.26945** (0.10957)	0.06738*** (0.02490)	0.20674*** (0.07076)	0.05654 (0.06603)	0.03340*** (0.01148)	0.11692*** (0.03856)	0.05113* (0.02870)
Adjusted Forest Coefficient	N/A	0.23568	N/A	N/A	0.34642	N/A	N/A	0.17824	N/A	N/A	0.09922	N/A
Urban Net Returns	-0.00056 (0.00061)	-0.00177 (0.00211)	0.00059 (0.00075)	-0.00008 (0.00043)	0.00041 (0.00126)	-0.00061* (0.00036)	-0.00017 (0.00031)	-0.00028 (0.00104)	-0.00097** (0.00038)	-0.00031 (0.00023)	-0.00077 (0.00072)	0.00068** (0.00032)
Urban Interaction Term	0.00013 (0.00012)	0.00034 (0.00034)	0.00008 (0.00012)	0.00005 (0.00008)	-0.00002 (0.00021)	0.00026*** (0.00006)	0.00006 (0.00006)	0.00007 (0.00017)	0.00029 (0.00006)	0.00008* (0.00004)	0.00016 (0.00012)	-0.00004 (0.00006)
Adjusted Urban Coefficient	N/A	N/A	0.00104	N/A	N/A	0.00085	N/A	N/A	0.00067	N/A	N/A	0.00044
Range-Pasture Net Returns	0.00806 (0.03812)	0.24311* (0.13499)	0.11577 (0.08701)	0.12321** (0.06230)	0.52628** (0.25012)	0.47344*** (0.11960)	0.03064 (0.04023)	0.46309*** (0.14870)	0.20819*** (0.07636)	0.00993 (0.01250)	0.16411*** (0.05184)	0.07323*** (0.02638)
Range-Pasture Interaction Term	0.00736 (0.00740)	-0.02366 (0.02298)	-0.01263 (0.01516)	-0.02059* (0.01201)	-0.07171* (0.04059)	-0.07550*** (0.01888)	0.00046 (0.00770)	-0.07049*** (0.02543)	-0.03314** (0.01351)	0.00039 (0.00251)	-0.02388*** (0.00905)	-0.00988** (0.00480)

Adjusted Range-Pasture Coefficient	0.04844	0.10954	0.04523	0.01042	0.12232	0.05170	0.03319	0.06533	0.02264	0.10209	0.02924	0.01800
Weighted Average LCC	-1.77449 (0.27794)	1.26868 (0.95730)	1.51744*** (0.52942)	-1.31985*** (0.28425)	1.98143** (0.84493)	0.23365 (0.42225)	-1.66944*** (0.21510)	1.55965** (0.76354)	0.20254 (0.44812)	-1.85848*** (0.21598)	1.05140 (0.70008)	1.52108*** (0.44832)
Constant	6.97291 (1.42469)	-10.65924 (5.85886)	-15.69502 (3.24386)	4.84344*** (1.46175)	-14.81437*** (5.10624)	-8.76359*** (2.64367)	6.30360*** (1.07555)	-11.92197** (4.61241)	-7.92928*** (2.75006)	7.40980*** (1.06224)	-9.07130** (4.28464)	-15.02806*** (2.67752)

1 - * , **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

2 - The adjusted coefficients are the sum of the coefficient on Net Returns and the coefficient on the interaction term multiplied by the average LCC in all counties.

Generalized Least Squares Results for Aggregate County Shares in Land Use, Range-Pasture Combined, Relative Net Returns, Ln (0.0001) replaces Ln (0) [1 2]

Period	1982			1987			1992			1997		
Dependent Variable	**Ln (Share in Crop-CRP /Share in Range)**	**Ln (Share in Forest /Share in Range)**	**Ln (Share in Urban /Share in Range)**	**Ln (Share in Crop-CRP /Share in Range)**	**Ln (Share in Forest /Share in Range)**	**Ln (Share in Urban /Share in Range)**	**Ln (Share in Crop-CRP /Share in Range)**	**Ln (Share in Forest /Share in Range)**	**Ln (Share in Urban /Share in Range)**	**Ln (Share in Crop-CRP /Share in Range)**	**Ln (Share in Forest /Share in Range)**	**Ln (Share in Urban /Share in Range)**
Relative Crop Net Returns	0.09376 (0.08584)	-1.29504*** (0.42529)	0.27429* (0.14050)	0.06029* (0.03580)	-0.08783 (0.15887)	-0.16059* (0.08736)	0.05864 (0.13354)	-0.48355 (0.30988)	-0.11381 (0.13274)	0.19043 (0.19744)	-0.68957* (0.38449)	-0.16218 (0.19978)
Relative Crop Interaction Term	-0.01436 (0.01471)	0.19331*** (0.06469)	-0.04815** (0.02181)	-0.00966* (0.00529)	0.00853 (0.02312)	0.02524** (0.01271)	-0.00935 (0.02187)	0.07399 (0.04750)	0.01413 (0.02055)	-0.02905 (0.03409)	0.09582 (0.05816)	0.02303 (0.03111)
Adjusted Crop Coefficient	0.01055	N/A	N/A	0.00435	N/A	N/A	0.00445	N/A	N/A	0.02214	N/A	N/A
Relative Forest Net Returns	-2.29840 (3.76696)	26.41204 (16.28884)	3.93656 (8.76721)	3.38256* (1.99086)	43.34108*** (7.68734)	-9.78730* (5.82701)	-1.73811 (1.72022)	-1.04725 (5.63840)	-10.64256** (4.48965)	-3.54593 (3.15106)	-5.23953 (7.01052)	-11.55011* (6.80324)
Relative Forest Interaction Term	0.49702 (0.80656)	-4.34912* (2.61949)	-0.78949 (1.49267)	-0.77952** (0.39248)	-7.66583*** (1.23416)	2.11754** (0.92861)	0.34910 (0.33541)	0.55161 (0.92114)	1.85130** (0.74180)	0.89960 (0.66108)	1.35542 (1.17162)	2.37981** (1.14524)
Adjusted Forest Coefficient	N/A	1.21760	N/A	N/A	-1.06707	N/A	N/A	2.14823	N/A	N/A	2.61243	N/A
Relative Urban Net Returns	0.00242 (0.00201)	-0.00052 (0.01033)	-0.00725* (0.00376)	0.00109* (0.00057)	0.00872*** (0.00108)	-0.00266*** (0.00083)	0.00235 (0.00150)	-0.01647*** (0.00602)	-0.00243** (0.00117)	0.00236 (0.00397)	-0.02235** (0.00908)	0.00267 (0.00365)
Relative Urban Interaction Term	-0.00057 (0.00037)	-0.00072 (0.00150)	0.00106* (0.00056)	-0.00021** (0.00011)	-0.00153*** (0.00018)	0.00051*** (0.00014)	-0.00050* (0.00028)	0.00219** (0.00093)	0.00049*** (0.00017)	-0.00070 (0.00075)	0.00322** (0.00138)	-0.00030 (0.00058)
Adjusted Urban Coefficient	N/A	N/A	-0.00114	N/A	N/A	0.00030	N/A	N/A	0.00043	N/A	N/A	0.00094
Hotel and Restaurant Sales	0.00000*** (0.00000)	0.00000*** (0.00000)	0.00000*** (0.00000)	0.00000 (0.00000)	0.00000 (0.0000)	0.00000*** (0.00000)	0.00000* (0.00000)	0.00000 (0.00000)	0.00000 (0.00000)	0.00000** (0.00000)	0.00000 (0.00000)	0.00000*** (0.00000)
Weighted Average LCC	-1.30458*** (0.14393)	1.67605*** (0.51908)	1.48358*** (0.28206)	-1.58098*** (0.11326)	1.21850*** (0.34051)	1.52187*** (0.24785)	-1.36351*** (0.15367)	1.32539** (0.54068)	0.44128* (0.23780)	-1.54176*** (0.28098)	0.80036 (0.60695)	1.07853*** (0.34426)
Constant	5.33520*** (0.75569)	-9.81974*** (3.28535)	-12.63106*** (1.71556)	6.60679*** (0.59414)	-9.61178*** (2.15995)	-13.21952*** (1.51845)	5.70049*** (0.80374)	-8.47147** (3.36074)	-6.77649*** (1.45488)	5.98924*** (1.43310)	-5.70748 (3.79031)	-10.76835*** (2.01862)

1 - *, **, and *** denote the 10%, 5%, and 1% significance levels, respectively

2 - The adjusted net returns coefficient is obtained by adding the product of the interaction term and the average LCC to the net returns coefficient

Generalized Least Squares Results for 1982 Aggregate County Shares in Land Use, Ln (0.005) replaces Ln (0)$_{1\ 2}$

Dependent Variable	Ln (Share in Crop-CRP / Share in Range)	Ln (Share in Pasture / Share in Range)	Ln (Share in Forest / Share in Range)	Ln (Share in Urban / Share in Range)
Crop Net Returns	0.01945 (0.02513)	0.01776 (0.04219)	-0.15873** (0.06495)	0.03274 (0.03014)
Crop Interaction Term	-0.00487 (0.00491)	-0.00831 (0.00797)	0.02290** (0.01081)	-0.00665 (0.00489)
Adjusted Crop Coefficient	-0.00740	N/A	N/A	N/A
Pasture Net Returns	0.04718 (0.03786)	0.09969 (0.07197)	0.34936*** (0.08300)	0.13348** (0.05784)
Pasture Interaction Term	-0.00756 (0.00688)	-0.01402 (0.01263)	-0.05914*** (0.01358)	-0.02370** (0.00928)
Adjusted Pasture Coefficient	N/A	0.02231	N/A	N/A
Forest Net Returns	-2.20890*** (0.57352)	-3.44864*** (0.81970)	0.31321 (1.75129)	-2.93802*** (0.81855)
Forest Interaction Term	0.57916*** (0.13386)	0.89158*** (0.17659)	0.19528 (0.31792)	0.76461*** (0.16825)
Adjusted Forest Coefficient	N/A	N/A	1.39073	N/A
Urban Net Returns	-0.00007 (0.00150)	0.00057 (0.00186)	0.00676** (0.00264)	-0.00053 (0.00113)
Urban Interaction Term	0.00005 (0.00028)	-0.00006 (0.00032)	-0.00117*** (0.00040)	0.00033* (0.00018)
Adjusted Urban Coefficient	N/A	N/A	N/A	0.00132
Range Net Returns	-0.42308 (0.37359)	-2.03457*** (0.63371)	-3.06681*** (0.73914)	-0.23633 (0.54964)
Range Interaction Term	0.05532 (0.06840)	0.32808*** (0.10800)	0.51889*** (0.11941)	0.05425 (0.09033)
Adjusted Range Coefficient	-0.11784	-0.22427	-0.20361	0.06304
Weighted Average LCC	-1.47374 (1.04949)	-1.71340 (1.45387)	2.19582 (1.53147)	1.33064 (1.10200)
Constant	6.95321 (5.71902)	8.40773 (8.55309)	-12.85919 (9.86635)	-13.76071** (6.97265)

Generalized Least Squares Results for 1987 Aggregate County Shares in Land Use, Ln (0.005) replaces Ln (0)$_{1\ 2}$

Dependent Variable	Ln (Share in Crop-CRP/Share in Range)	Ln (Share in Pasture/Share in Range)	Ln (Share in Forest/Share in Range)	Ln (Share in Urban/Share in Range)
Crop Net Returns	-0.01460 (0.02890)	-0.03264 (0.04177)	0.03098 (0.07480)	-0.02841 (0.03476)
Crop Interaction Term	0.00172 (0.00540)	0.00524 (0.00758)	-0.00575 (0.01213)	0.00474 (0.00581)
Adjusted Crop Coefficient	-0.00513	N/A	N/A	N/A
Pasture Net Returns	0.05132* (0.03006)	0.10496** (0.05116)	0.03536 (0.07436)	0.06426 (0.04556)

Pasture Interaction Term	-0.00893* (0.00508)	-0.01698** (0.00831)	-0.00467 (0.01148)	-0.0072 (0.00682)
Adjusted Pasture Coefficient	N/A	0.01138	N/A	N/A
Forest Net Returns	-1.99328*** (0.44101)	-4.46816*** (0.72756)	0.27406 (1.85509)	-2.91292*** (0.68731)
Forest Interaction Term	0.56728*** (0.10777)	1.21304*** (0.17095)	0.21021 (0.35342)	0.85000*** (0.16096)
Adjusted Forest Coefficient	N/A	N/A	1.43246	N/A
Urban Net Returns	0.00032 (0.00080)	0.00086 (0.00115)	0.00250 (0.00167)	-0.00033 (0.00058)
Urban Interaction Term	-0.00003 (0.00015)	-0.00012 (0.00021)	-0.00045* (0.00025)	0.00021** (0.00009)
Adjusted Urban Coefficient	N/A	N/A	N/A	0.00084
Range Net Returns	-0.80958** (0.37612)	-1.92862*** (0.57636)	-1.26771 (0.84331)	-0.43337 (0.63817)
Range Interaction Term	0.13122* (0.07014)	0.34795*** (0.10111)	0.24135* (0.13829)	0.06954 (0.10661)
Adjusted Range Coefficient	-0.08646	-0.01118	0.06230	-0.05015
Weighted Average LCC	-2.10875*** (0.78565)	-1.37872 (1.09392)	2.23842* (1.35133)	0.18404 (0.92768)
Constant	10.25234** (4.27120)	4.93214 (6.30339)	-14.65767* (8.52301)	-7.09758 (5.70826)

Generalized Least Squares Results for 1992 Aggregate County Shares in Land Use, Ln (0.005) replaces Ln (0)$_{1, 2}$

Dependent Variable	**Ln (Share in Crop-CRP/Share in Range)**	**Ln (Share in Pasture/Share in Range)**	**Ln (Share in Forest/Share in Range)**	**Ln (Share in Urban/Share in Range)**
Crop Net Returns	0.00553 (0.01794)	0.02304 (0.02636)	-0.05298 (0.05458)	0.03593 (0.03167)
Crop Interaction Term	-0.00113 (0.00328)	-0.00586 (0.00483)	0.00735 (0.00887)	-0.00744 (0.00502)
Adjusted Crop Coefficient	-0.00071	N/A	N/A	N/A
Pasture Net Returns	0.00706 (0.01703)	0.04091 (0.02766)	0.08692* (0.04663)	0.07453** (0.03218)
Pasture Interaction Term	0.00046 (0.00301)	-0.00590 (0.00478)	-0.01502** (0.00752)	-0.01341*** (0.00495)
Adjusted Pasture Coefficient	N/A	0.00832	N/A	N/A
Forest Net Returns	-0.35168** (0.17500)	-0.41285 (0.28629)	1.06634* (0.61856)	-0.04459 (0.39703)
Forest Interaction Term	0.09285** (0.03642)	0.13385** (0.05431)	-0.14378 (0.11218)	0.04872 (0.07362)
Adjusted Forest Coefficient	N/A	N/A	0.27241	N/A
Urban Net Returns	0.00021 (0.00041)	0.00096 (0.00064)	0.00284*** (0.00103)	-0.00023 (0.00049)
Urban Interaction Term	-0.000001 (0.00008)	-0.00014 (0.00011)	-0.00049*** (0.00016)	0.00016** (0.00008)

Adjusted Urban Coefficient	N/A	N/A	N/A	0.00067
Range Net Returns	-0.03693 (0.18332)	-0.15996 (0.28015)	-0.70235 (0.47250)	0.48693 (0.37752)
Range Interaction Term	0.01664 (0.03450)	0.04824 (0.04878)	0.14746* (0.07669)	-0.08820 (0.06156)
Adjusted Range Coefficient	0.05497	0.10640	0.11190	-0.00009
Weighted Average LCC	-1.60316*** (0.45661)	0.35743 (0.73352)	3.00082*** (1.03315)	1.48115* (0.81391)
Constant	5.59491** (2.44144)	-6.41810 (4.24271)	-20.37834*** (6.51097)	-14.81138*** (5.05456)

Generalized Least Squares Results for 1997 Aggregate County Shares in Land Use, Ln (0.005) replaces Ln (0)$_{1, 2}$

Dependent Variable	**Ln (Share in Crop-CRP / Share in Range)**	**Ln (Share in Pasture / Share in Range)**	**Ln (Share in Forest / Share in Range)**	**Ln (Share in Urban / Share in Range)**
Crop Net Returns	0.00747 (0.01684)	0.01660 (0.02145)	-0.12983*** (0.04142)	0.16327*** (0.04728)
Crop Interaction Term	-0.00287 (0.00319)	-0.00549 (0.00400)	0.02034*** (0.00674)	-0.02232*** (0.00795)
Adjusted Crop Coefficient	-0.00835	N/A	N/A	N/A
Pasture Net Returns	0.01458** (0.00755)	0.00419 (0.01313)	0.09429*** (0.02371)	-0.16141*** (0.03538)
Pasture Interaction Term	-0.00194 (0.00123)	0.00024 (0.00229)	-0.01635*** (0.00379)	0.02253*** (0.00572)
Adjusted Pasture Coefficient	N/A	0.00553	N/A	N/A
Forest Net Returns	-0.22936** (0.10783)	-0.33452** (0.15658)	0.93452** (0.45091)	-0.78940* (0.43161)
Forest Interaction Term	0.06557*** (0.02310)	0.11242*** (0.03055)	-0.11849 (0.07907)	0.14073* (0.08471)
Adjusted Forest Coefficient	N/A	N/A	0.28047	N/A
Urban Net Returns	0.00024 (0.00051)	-0.00036 (0.00070)	-0.00283** (0.00127)	0.00290** (0.00129)
Urban Interaction Term	-0.00008 (0.00009)	0.00007 (0.00013)	0.00048** (0.00020)	-0.00025 (0.00022)
Adjusted Urban Coefficient	N/A	N/A	N/A	0.00152
Range Net Returns	-0.08348 (0.24254)	-0.70423** (0.32498)	-1.02513** (0.46582)	-4.24210*** (1.00969)
Range Interaction Term	0.02128 (0.04594)	0.13202** (0.05701)	0.18194** (0.07654)	0.57053*** (0.17112)
Adjusted Range Coefficient	0.03397	0.02449	-0.02086	-1.09289
Weighted Average LCC	-1.06083 (0.77760)	-1.60732* (0.95638)	-0.86498 (1.26927)	-4.26367** (2.24861)

Constant	4.30796 (4.17988)	4.94276 (5.52448)	2.69205 (8.10613)	21.50499 (14.18421)

1 - * , **, and *** denote the 10%, 5%, and 1% levels of significance, respectively
2 - The adjusted coefficients are the sum of the coefficient on net returns and the coefficient on the interaction term multiplied by the average LCC in all counties.

Generalized Least Squares Results for 1982 Aggregate County Shares in Land Use, Ln (0)'s Omitted [1]

Dependent Variable	Ln (Share in Crop-CRP/Share in Range)	Ln (Share in Pasture/Share in Range)	Ln (Share in Forest/Share in Range)	Ln (Share in Urban/Share in Range)
Crop Net Returns	0.01108 (0.02174)	0.01160 (0.03718)	-0.08324 (0.05579)	0.03283 (0.02745)
Crop Interaction Term	-0.00271 (0.00429)	-0.00631 (0.00713)	0.01116 (0.00923)	-0.00641 (0.00448)
Adjusted Crop Coefficient	-0.00377	N/A	N/A	N/A
Pasture Net Returns	0.05301 (0.03237)	0.10070 (0.06124)	0.30923*** (0.07941)	0.11094** (0.05401)
Pasture Interaction Term	-0.00935 (0.00591)	-0.01680 (0.01083)	-0.05281*** (0.01308)	-0.02019** (0.00867)
Adjusted Pasture Coefficient	N/A	0.00828	N/A	N/A
Forest Net Returns	-1.70968*** (0.52618)	-3.04842*** (0.77740)	3.74131* (2.18791)	-2.07333*** (0.76265)
Forest Interaction Term	0.44504*** (0.12493)	0.78011*** (0.17402)	-0.40656 (0.39207)	0.56060*** (0.16365)
Adjusted Forest Coefficient	N/A	N/A	1.44603	N/A
Urban Net Returns	-0.00129 (0.00152)	-0.00146 (0.00227)	0.00199 (0.00328)	-0.00059 (0.00105)
Urban Interaction Term	0.00029 (0.00029)	0.00035 (0.00042)	-0.00026 (0.00054)	0.00035** (0.00016)
Adjusted Urban Coefficient	N/A	N/A	N/A	0.00135
Range Net Returns	-0.32756 (-0.31937)	-2.23273*** (0.60569)	-3.49863*** (0.77062)	-0.09682 (0.50973)
Range Interaction Term	0.04826 (0.05861)	0.36992*** (0.10267)	0.58629*** (0.12531)	0.03343 (0.08384)
Adjusted Range Coefficient	-0.06280	-0.19793	-0.18870	0.09020
Weighted Average LCC	-1.88291** (0.92971)	-2.89806** (1.44692)	-0.18748 (1.77566)	1.02499 (0.99880)
Constant	8.60793* (5.02927)	14.56411* (8.30684)	-0.22057 (11.02248)	-13.33981** (6.34851)

Generalized Least Squares Results for 1987 Aggregate County Shares in Land Use, Ln (0)'s Omitted [1]

Dependent Variable	Ln (Share in Crop-CRP/Share in Range)	Ln (Share in Pasture/Share in Range)	Ln (Share in Forest/Share in Range)	Ln (Share in Urban/Share in Range)
Crop Net Returns	0.00098 (0.01848)	0.02896 (0.02831)	-0.01333 (0.04119)	0.03286 (0.02081)
Crop Interaction Term	0.00013 (0.00376)	-0.00805 (0.00554)	0.00098 (0.00684)	-0.00619* (0.00369)
Adjusted Crop Coefficient	0.00171	N/A	N/A	N/A
Pasture Net Returns	0.04356 (0.02710)	0.08602** (0.04334)	0.17772*** (0.06031)	0.05484 (0.03982)

Pasture Interaction Term	-0.00780 (0.00517)	-0.01537* (0.00781)	-0.03020*** (0.00968)	-0.01005 (0.00641)
Adjusted Pasture Coefficient	N/A	0.00170	N/A	N/A
Forest Net Returns	-1.03100** (0.45518)	-2.33844*** (0.62131)	3.46272* (1.97959)	-1.12373** (0.55026)
Forest Interaction Term	0.27915 (0.10964)	0.63086*** (0.14726)	-0.45329 (0.36591)	0.34148** (0.13403)
Adjusted Forest Coefficient	N/A	N/A	0.90911	N/A
Urban Net Returns	-0.00010 (0.00127)	-0.00131 (0.00200)	0.00256 (0.00257)	-0.00123 (0.00101)
Urban Interaction Term	0.00023 (0.00025)	0.00034 (0.00038)	-0.00036 (0.00042)	0.00046*** (0.00016)
Adjusted Urban Coefficient	N/A	N/A	N/A	0.00133
Range Net Returns	-0.15279 (0.25923)	-1.28775*** (0.48750)	-1.67799*** (0.60065)	-0.07396 (0.44275)
Range Interaction Term	0.02823 (0.04909)	0.23251*** (0.08465)	0.29859*** (0.09735)	0.02241 (0.07578)
Adjusted Range Coefficient	0.00186	-0.01226	0.00408	0.05121
Weighted Average LCC	-1.70415** (0.78098)	-1.53667 (1.23885)	1.41909 (1.41518)	0.18494 (0.97140)
Constant	7.01696* (4.07456)	5.22502 (6.89248)	-11.17740 (8.75712)	-8.49105 (5.86731)

Generalized Least Squares Results for 1992 Aggregate County Shares in Land Use, Ln (0)'s Omitted [1]

Dependent Variable	**Ln (Share in Crop-CRP/Share in Range)**	**Ln (Share in Pasture/Share in Range)**	**Ln (Share in Forest/Share in Range)**	**Ln (Share in Urban/Share in Range)**
Crop Net Returns	0.00486 (0.01773)	0.01561 (0.02654)	-0.01352 (0.05334)	0.01685 (0.03638)
Crop Interaction Term	-0.00121 (0.00318)	-0.00432 (0.00481)	0.00079 (0.00853)	-0.00419 (0.00574)
Adjusted Crop Coefficient	-0.00178	N/A	N/A	N/A
Pasture Net Returns	0.01883 (0.01705)	0.04660 (0.02850)	0.13089*** (0.04857)	0.08707** (0.03463)
Pasture Interaction Term	-0.00174 (0.00298)	-0.00698 (0.00498)	-0.02302*** (0.00779)	-0.01504*** (0.00530)
Adjusted Pasture Coefficient	N/A	0.00823	N/A	N/A
Forest Net Returns	-0.32838** (0.17112)	-0.42712 (0.27616)	0.90703 (0.62716)	0.08069 (0.41386)
Forest Interaction Term	0.08651** (0.03602)	0.12510** (0.05287)	-0.11415 (0.11499)	0.02515 (0.07660)
Adjusted Forest Coefficient	N/A	N/A	0.26288	N/A
Urban Net Returns	0.00006 (0.00045)	0.00081 (0.00070)	-0.00016 (0.00123)	-0.00026 (0.00051)
Urban Interaction Term	0.00002 (0.00009)	-0.00012 (0.00013)	0.00007 (0.00020)	0.00017** (0.00008)

Adjusted Urban Coefficient	N/A	N/A	N/A	0.00069
Range Net Returns	0.05792 (0.18739)	-0.24776 (0.29654)	-0.36900 (0.57197)	0.55284 (0.42070)
Range Interaction Term	-0.00097 (0.03497)	0.06490 (0.05213)	0.07569 (0.09305)	-0.09455 (0.06791)
Adjusted Range Coefficient	0.05259	0.10927	0.05812	0.02346
Weighted Average LCC	-1.41820*** (0.45995)	0.03136 (0.74353)	1.72069 (1.09029)	1.53524* (0.85676)
Constant	4.69392* (2.50560)	-4.47174 (4.29538)	-13.28226** (6.83090)	-15.43431*** (5.38237)

Generalized Least Squares Results for 1997 Aggregate County Shares in Land Use, Ln (0)'s Omitted [1]

Dependent Variable	**Ln (Share in Crop-CRP/Share in Range)**	**Ln (Share in Pasture/Share in Range)**	**Ln (Share in Forest/Share in Range)**	**Ln (Share in Urban/Share in Range)**
Crop Net Returns	0.00661 (0.00977)	-0.00376 (0.01536)	-0.04047 (0.02800)	0.20089*** (0.05294)
Crop Interaction Term	-0.00160 (0.00186)	-0.00001 (0.00286)	0.00610 (0.00455)	-0.02785*** (0.00885)
Adjusted Crop Coefficient	-0.00218	N/A	N/A	N/A
Pasture Net Returns	0.01014** (0.00507)	0.01576 (0.01020)	0.07979*** (0.01656)	-0.16519*** (0.03608)
Pasture Interaction Term	-0.00163* (0.00089)	-0.00265 (0.00184)	-0.01363*** (0.00265)	0.02336*** (0.00576)
Adjusted Pasture Coefficient	N/A	0.00118	N/A	N/A
Forest Net Returns	-0.14092** (0.06302)	-0.10461 (0.10759)	0.31475 (0.29086)	-0.75291* (0.43107)
Forest Interaction Term	0.03933*** (0.01399)	0.04568** (0.02163)	-0.03934 (0.05358)	0.11590 (0.08827)
Adjusted Forest Coefficient	N/A	N/A	0.09258	N/A
Urban Net Returns	-0.00018 (0.00029)	0.00042 (0.00046)	-0.00073 (0.00082)	0.00235* (0.00132)
Urban Interaction Term	0.00007 (0.00005)	-0.00005 (0.00008)	0.00015 (0.00014)	-0.00017 (0.00023)
Adjusted Urban Coefficient	N/A	N/A	N/A	0.00143
Range Net Returns	0.18823 (0.13831)	-0.21367 (0.25893)	-0.20955 (0.41465)	-3.23960*** (1.03398)
Range Interaction Term	-0.03805 (0.02627)	0.04604 (0.04523)	0.04342 (0.06876)	0.41900** (0.17444)
Adjusted Range Coefficient	-0.02084	0.03954	0.03567	-0.89678
Weighted Average LCC	-1.15737*** (0.44508)	-0.01695 (0.73335)	1.38691 (0.96368)	-3.66014 (2.36808)
Constant	3.73201 (2.37682)	-3.94216 (4.21566)	-10.86109* (6.10327)	17.27789 (14.85711)

1 - * , **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

Generalized Least Squares Results for 1982 Aggregate County Shares in Land Use, Ln (0)'s Omitted [1]

Dependent Variable	Ln (Share in Crop-CRP/Share in Range)	Ln (Share in Pasture/Share in Range)	Ln (Share in Forest/Share in Range)	Ln (Share in Urban/Share in Range)
Crop Net Returns	-0.00583 (0.00522)	-0.02409*** (0.00729)	-0.01082 (0.00807)	-0.00339 (0.00475)
Pasture Net Returns	0.00253 (0.00651)	0.00798 (0.00915)	-0.00048 (0.00725)	-0.00637 (0.00476)
Forest Net Returns	0.41077** (0.15342)	0.73959*** (0.17847)	2.19236*** (0.38332)	0.72679*** (0.15407)
Urban Net Returns	0.00013 (0.00026)	0.00020 (0.00033)	0.00072* (0.00040)	0.00152*** (0.00013)
Range Net Returns	-0.16075* (0.08344)	-0.15204* (0.08985)	-0.11579 (0.10458)	-0.06564 (0.08942)
Weighted Average LCC	-1.38817*** (0.31754)	-0.28293 (0.40312)	1.06495* (0.59267)	1.23911*** (0.32735)
Constant	7.08798*** (1.97314)	-1.36172 (2.63442)	-10.86929** (4.21795)	-13.79218*** (2.27864)
Maximum Elevation	-0.00137 (0.00133)	-0.00192 (0.00135)	-0.00201 (0.00148)	-0.00337*** (0.00129)
Elevation Range	0.00145 (0.00113)	0.00188* (0.00111)	0.00169 (0.00116)	0.00202** (0.00100)
Mean Elevation	0.00091 (0.00125)	0.00226* (0.00127)	0.00295** (0.00129)	0.00337*** (0.00114)

Generalized Least Squares Results for 1987 Aggregate County Shares in Land Use, Ln (0)'s Omitted [1]

Dependent Variable	Ln (Share in Crop-CRP/Share in Range)	Ln (Share in Pasture/Share in Range)	Ln (Share in Forest/Share in Range)	Ln (Share in Urban/Share in Range)
Crop Net Returns	-0.00557 (0.00513)	-0.00443 (0.00680)	-0.00469 (0.00804)	0.00365 (0.00473)
Pasture Net Returns	0.00639 (0.00500)	0.01066* (0.00597)	0.01365** (0.00703)	0.00936** (0.00421)
Forest Net Returns	0.35716*** (0.12586)	0.40658*** (0.13461)	1.56952*** (0.39052)	0.37403*** (0.12738)
Urban Net Returns	0.00011 (0.00013)	-0.00007 (0.00017)	0.00037 (0.00022)	0.00097*** (0.00006)
Range Net Returns	-0.12973* (0.06849)	0.00716 (0.07244)	-0.09655 (0.11370)	-0.11047 (0.08531)
Weighted Average LCC	-1.41592*** (0.25492)	-0.33121 (0.33691)	1.28616** (0.55423)	1.14014*** (0.26203)
Constant	6.78118*** (1.44753)	-1.77304 (1.90820)	-9.1804** (3.65708)	-12.30309*** (1.76606)

Maximum Elevation	-0.00137 (0.00106)	-0.00223** (0.00107)	-0.00282 * (0.00146)	-0.00274** (0.00106)
Elevation Range	0.00150 (0.00091)	0.00194** (0.00087)	0.00197* (0.00117)	0.00135 (0.00085)
Mean Elevation	0.00088 (0.00098)	0.00257*** (0.00096)	0.00274** (0.00124)	0.00267*** (0.00092)

Generalized Least Squares Results for 1992 Aggregate County Shares in Land Use, Ln (0)'s Omitted [1]

Dependent Variable	**Ln (Share in Crop-CRP/Share in Range)**	**Ln (Share in Pasture/Share in Range)**	**Ln (Share in Forest/Share in Range)**	**Ln (Share in Urban/Share in Range)**
Crop Net Returns	-0.00097 (0.00303)	-0.00400 (0.00449)	-0.01025** (0.00437)	-0.00932** (0.00428)
Pasture Net Returns	0.00618** (0.00246)	-0.00298 (0.00381)	-0.00906** (0.00430)	-0.00465 (0.00358)
Forest Net Returns	0.06443* (0.03415)	0.38741*** (0.05840)	0.58376*** (0.09104)	0.42291*** (0.07182)
Urban Net Returns	0.00017*** (0.00006)	0.00005 (0.00009)	0.00026** (0.00011)	0.00083*** (0.00005)
Range Net Returns	0.03765 (0.03335)	-0.01583 (0.04285)	-0.09723* (0.05470)	-0.17336*** (0.05189)
Weighted Average LCC	-1.41611*** (0.13265)	-0.14270 (0.22060)	1.34222*** (0.33568)	1.14031*** (0.25797)
Constant	4.98534*** (0.78134)	-5.24757*** (1.49743)	-13.86199*** (2.40116)	-13.37602*** (1.92071)
Maximum Elevation	-0.00085 (0.00059)	-0.00126* (0.00074)	-0.00094 (0.00088)	-0.00243** (0.00095)
Elevation Range	0.00102** (0.00051)	0.00109* (0.00061)	0.00125* (0.00069)	0.00133* (0.00074)
Mean Elevation	0.00048 (0.00056)	0.00260*** (0.00065)	0.00228*** (0.00075)	0.00312*** (0.00081)

Generalized Least Squares Results for 1997 Aggregate County Shares in Land Use, Ln(0)'s Omitted [1]

Dependent Variable	**Ln (Share in Crop-CRP/Share in Range)**	**Ln (Share in Pasture/Share in Range)**	**Ln (Share in Forest/Share in Range)**	**Ln (Share in Urban/Share in Range)**
Crop Net Returns	-0.00154 (0.00181)	-0.00315 (0.00277)	-0.00210 (0.00296)	0.02190*** (0.00680)
Pasture Net Returns	0.00049 (0.00098)	-0.00224 (0.00178)	-0.00145 (0.00166)	-0.00369 (0.00288)
Forest Net Returns	0.06337*** (0.02020)	0.21752*** (0.03189)	0.25558*** (0.04829)	-0.14659 (0.09493)

Urban Net Returns	0.00014*** (0.00005)	0.00005 (0.00007)	0.00018** (0.00008)	0.00147*** (0.00013)
Range Net Returns	-0.04107 (0.02855)	-0.02011 (0.03489)	-0.06858 (0.04650)	-1.00787*** (0.11249)
Weighted Average LCC	-1.53873*** (0.13412)	-0.20830 (0.21973)	0.99616*** (0.32417)	-2.56009*** (0.68743)
Constant	5.92129*** (0.79755)	-4.75606*** (1.41056)	-11.00159*** (2.38052)	13.25670*** (4.45076)
Maximum Elevation	-0.00098 (0.00061)	-0.00116 (0.00072)	-0.00164* (0.00087)	-0.01279*** (0.00212)
Elevation Range	0.00104* (0.00053)	0.00110* (0.00059)	0.00146** (0.00067)	0.00564*** (0.00174)
Mean Elevation	0.00086 (0.00057)	0.00233*** (0.00064)	0.00262*** (0.00075)	0.01391*** (0.00178)

1 - * , **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

Appendix C: Tables of Aggregate Transition Models

Generalized Least Squares Results for Aggregate County Shares in Land Use, Range-Pasture Combined, Ln (0.0001) replaces Ln (0) [12]

Period	1982 to 1987			1987 to 1992			1992 to 1997		
Dependent Variable	**Ln (Share Ending in Crop-CRP /Share Ending in Range-Pasture)**	**Ln (Share Ending in Forest /Share Ending in Range-Pasture)**	**Ln (Share Ending in Urban /Share Ending in Range-Pasture)**	**Ln (Share Ending in Crop-CRP /Share Ending in Range-Pasture)**	**Ln (Share Ending in Forest /Share Ending in Range-Pasture)**	**Ln (Share in Urban /Share in Range-Pasture)**	**Ln (Share Ending in Crop-CRP /Share Ending in Range-Pasture)**	**Ln (Share Ending in Forest /Share Ending in Range-Pasture)**	**Ln (Share Ending in Urban /Share Ending in Range-Pasture)**
Crop Net Returns	0.13897*** (0.01730)	0.00338 (0.00984)	0.08092*** (0.01331)	0.10024** (0.04224)	-0.09946*** (0.03735)	-0.01245 (0.03266)	-0.09275*** (0.03346)	-0.06047** (0.02937)	-0.38678*** (0.13870)
Crop Interaction Term	-0.02194 (0.00364)	-0.00053 (0.00175)	-0.01335*** (0.00231)	-0.01732** (0.00801)	0.01474** (0.00599)	0.00319 (0.00512)	0.02226*** (0.00677)	0.01064** (0.00469)	0.04272* (0.02260)
Adjusted Crop Coefficient	0.01187	N/A	N/A	-0.00021	N/A	N/A	0.03638	N/A	N/A
Forest Net Returns	-5.15874*** (0.52863)	-0.10152 (0.27690)	-0.57504 (0.72312)	0.21618 (0.75967)	0.65525 (0.76792)	-0.60173 (0.88169)	-0.50298 (0.31609)	-0.86136*** (0.25573)	-8.53751*** (2.77460)
Forest Interaction Term	0.95854*** (0.09926)	0.01151 (0.05274)	0.09930 (0.13768)	0.05492 (0.14015)	-0.13483 (0.15069)	0.10786 (0.16900)	0.08744 (0.06171)	0.16168*** (0.04669)	1.49051*** (0.51696)
Adjusted Forest Coefficient	N/A	-0.03484	N/A	N/A	-0.12681	N/A	N/A	0.07650	N/A
Urban Net Returns	-0.00105 (0.00227)	0.00099* (0.00052)	-0.00912*** (0.00089)	0.00351** (0.00153)	-0.00002 (0.00098)	0.00043 (0.00051)	0.00495*** (0.00118)	0.00030 (0.00074)	-0.02523*** (0.00309)
Urban Interaction Term	0.00021 (0.00040)	-0.00016* (0.00008)	0.00183*** (0.00014)	-0.00049* (0.00026)	4.88020×10^{-7} (0.00016)	0.00003 (0.00009)	-0.00089*** (0.00021)	-0.00007 (0.00013)	0.00484*** (0.00053)
Adjusted Urban Coefficient	N/A	N/A	0.00151	N/A	N/A	0.00062	N/A	N/A	0.00286
Range-Pasture Net Returns	0.09530*** (0.03381)	0.00220 (0.01773)	-0.34043*** (0.05802)	-0.25722 (0.17976)	-0.19273*** (0.05997)	-0.16434** (0.07364)	0.25920*** (0.05714)	0.13731*** (0.04991)	0.27790 (0.56233)

Range-Pasture Interaction Term	-0.01341 (0.00919)	-0.00114 (0.00414)	0.06800*** (0.01124)	0.03976 (0.03453)	0.03866*** (0.01214)	0.01728 (0.01404)	-0.03662*** (0.01222)	-0.02494** (0.01002)	0.08493 (0.10238)
Adjusted Range-Pasture Coefficient	0.01764	-0.00442	0.05347	-0.02658	0.03150	-0.06411	0.04678	-0.00735	0.77054
Weighted Average LCC	-1.28465 (1.09598)	0.34634 (0.26200)	-5.94114*** (0.58754)	1.43693 (0.91939)	-0.99117* (0.59556)	-1.47292*** (0.53700)	2.80915*** (0.98061)	0.11815 (0.50206)	-23.73624*** (2.86739)
Constant	0.03153 (5.90579)	-11.04068*** (1.56660)	22.81336*** (3.73681)	-17.39400*** (5.19006)	-2.49656 (3.54267)	-0.12302 (3.23183)	-23.97872*** (5.26562)	-9.05505*** (2.95272)	120.90872*** (17.46290)

1 - *, **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

2- The adjusted net returns coefficient is the sum of the net returns coefficient and the product of the interaction term and the weighted average LCC

Generalized Least Squares Results for Aggregate County Shares in Land Use, Range-Pasture Combined, Ln (0.0001) Replaces Ln (0) [1]

Period	1982 to 1987			1987 to 1992			1992 to 1997		
Dependent Variable	**Ln (Share Ending in Crop-CRP /Share Ending in Range-Pasture)**	**Ln (Share Ending in Forest /Share Ending in Range-Pasture)**	**Ln (Share Ending in Urban /Share Ending in Range-Pasture)**	**Ln (Share Ending in Crop-CRP /Share Ending in Range-Pasture)**	**Ln (Share Ending in Forest /Share Ending in Range-Pasture)**	**Ln (Share in Urban /Share in Range-Pasture)**	**Ln (Share Ending in Crop-CRP /Share Ending in Range-Pasture)**	**Ln (Share Ending in Forest /Share Ending in Range-Pasture)**	**Ln (Share Ending in Urban /Share Ending in Range-Pasture)**
Crop Net Returns	-0.00121	0.00177	0.01009***	0.00826*	-0.0056	-0.00183	0.01948***	0.00071	-0.03478***
	(0.00347)	(0.00217)	(0.00343)	(0.00473)	(0.00551)	(0.00463)	(0.00478)	(0.00360)	(0.00747)
Forest Net Returns	-0.44265***	-0.10073*	0.46140***	0.33081***	0.15173	-0.13884	0.10748	0.01666	-0.46961***
	(0.08033)	(0.05476)	(0.10184)	(0.07580)	(0.11426)	(0.10180)	(0.06648)	(0.05774)	(0.14276)
Urban Net Returns	0.00016	0.00001	0.00239***	0.00033*	0.00005	0.00058***	0.00005	0.00001	0.00249***
	(0.00034)	(0.00008)	(0.00015)	(0.00020)	(0.00015)	(0.00009)	(0.00011)	(0.00006)	(0.00015)
Range-Pasture Net Returns	0.06862***	-0.00798	-0.02797*	-0.06087***	-0.01545	-0.05192**	0.10423***	-0.00159	0.14952***
	(0.01581)	(0.00771)	(0.01513)	(0.02095)	(0.01936)	(0.02271)	(0.01415)	(0.01414)	(0.03439)
Weighted Average LCC	-1.18783***	-0.08831	-0.32450	-0.74230**	0.43489*	-2.21347***	1.04617***	0.54716**	3.50648***
	(0.40288)	(0.13918)	(0.27903)	(0.33036)	(0.25630)	(0.23404)	(0.33166)	(0.22975)	(0.70776)
Constant	4.16920	-12.88452***	-25.61300***	-21.10686***	12.01576***	-2.78746	-26.10687***	-4.64073	-52.95789***
	(5.80188)	(2.68894)	(6.10475)	(5.15876)	(4.06824)	(3.97809)	(5.85615)	(3.97089)	(11.37327)
January Temperature	0.18344**	-0.07555*	-0.27553***	0.00312	0.10298	-0.27839***	0.15909*	0.13284**	0.19808
	(0.08968)	(0.03899)	(0.10045)	(0.07426)	(0.07985)	(0.08446)	(0.08506)	(0.06232)	(0.20647)
April Temperature	-1.01888***	0.03942	-0.24990	-0.68762***	0.34390**	-0.20370	-0.30993	-0.25266**	-0.75190**
	(0.21792)	(0.08580)	(0.18522)	(0.19925)	(0.15225)	(0.16271)	(0.19433)	(0.12657)	(0.36617)
July Temperature	0.39788**	0.02929	0.23539	0.62529***	-0.26024*	-0.65934***	1.30566***	0.12984	2.16106***
	(0.17439)	(0.08747)	(0.21399)	(0.17515)	(0.14619)	(0.16331)	(0.16727)	(0.12754)	(0.38689)
October Temperature	0.37999*	0.02237	0.28103	0.12123	-0.46585**	1.36318***	-1.45490***	-0.11477	-2.04809***
	(0.20725)	(0.09499)	(0.18410)	(0.24329)	(0.20131)	(0.18689)	(0.23366)	(0.13773)	(0.39942)
January Precipitation	0.32274	0.47379**	2.47837***	-0.045561	0.20958	0.27251	-0.31956	-0.92285**	2.94196***
	(0.48328)	(0.18296)	(0.37121)	(0.44460)	(0.34624)	(0.29259)	(0.45979)	(0.30247)	(0.72633)
April Precipitation	-0.79385	-0.00476	-3.60028***	-1.47455**	0.26944***	0.84358**	-1.50415**	-0.63624*	-8.06265***
	(0.81762)	(0.22035)	(0.43220)	(0.71344)	(0.50955)	(0.37656)	(0.64961)	(0.35704)	(0.82060)

July Precipitation	1.40036***	0.21076	1.50544***	-0.56148	1.09782***	-1.69750***	1.75949***	-0.46227	6.66338***
	(0.51408)	(0.19757)	(0.41787)	(0.41104)	(0.36966)	(0.38616)	(0.46507)	(0.31414)	(0.90900)
October Precipitation	-2.65707**	-0.31229	-0.45916	1.65746*	-1.01909	0.65851	1.23469	1.72128***	5.04296***
	(1.23879)	(0.33898)	(0.77177)	(0.99260)	(0.63213)	(0.61864)	(1.03887)	(0.55133)	(1.60711)
Maximum Elevation	0.00021	0.00120**	-0.00202*	0.00078	0.00600***	0.00273***	0.00537***	0.00025	-0.00849***
	(0.00147)	(0.00050)	(0.00116)	(0.00123)	(0.00099)	(0.00097)	(0.00106)	(0.00082)	(0.00236)
Elevation Range	-0.00057	-0.00071	0.00119	-0.00120	-0.00395***	-0.00248***	-0.00248***	0.00028	0.00294
	(0.00127)	(0.00044)	(0.00091)	(0.00102)	(0.00084)	(0.00079)	(0.00091)	(0.00070)	(0.00199)
Mean Elevation	-0.00215*	-0.00080*	0.00287***	-0.00028	-0.00672***	-0.00097	-0.00651***	-0.00171**	0.00354*
	(0.00127)	(0.00045)	(0.00106)	(0.00115)	(0.00087)	(0.00086)	(0.00096)	(0.00076)	(0.00210)

1 - * , **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

Generalized Least Squares Results for Aggregate County Shares in Land Use, Range-Pasture Combined, Ln (0)'s Omitted [1] [2]

Period	1982 to 1987			1987 to 1992			1992 to 1997		
Dependent Variable	**Ln (Share in Crop-CRP /Share in Range)**	**Ln (Share in Forest /Share in Range)**	**Ln (Share in Urban /Share in Range)**	**Ln (Share in Crop-CRP /Share in Range)**	**Ln (Share in Forest /Share in Range)**	**Ln (Share in Urban /Share in Range)**	**Ln (Share in Crop-CRP /Share in Range)**	**Ln (Share in Forest /Share in Range)**	**Ln (Share in Urban /Share in Range)**
Crop Profit	-0.00251 (0.01578)	-0.35529*** (0.10637)	0.01270 (0.01243)	-0.04478* (0.02559)	0.07689 (0.07781)	-0.05235* (0.02963)	-0.00501 (0.01547)	-0.42931*** (0.11672)	-0.45963** (0.18562)
Crop Interaction Term	0.00039 (0.00311)	0.05541** (0.01800)	-0.00344 (0.00211)	0.00845* (0.00482)	-0.01305 (0.01383)	0.00835* (0.00445)	0.00111 (0.00309)	0.06597*** (0.01775)	0.05452* (0.02870)
Adjusted Crop Coefficient	-0.00028	N/A	N/A	0.00376	N/A	N/A	0.00132	N/A	N/A
Forest Profit	-0.29957 (0.48156)	-50.71766*** (7.00281)	1.33857** (0.67512)	0.24282 (0.43777)	25.79809*** (3.15210)	-0.32597 (0.80272)	0.66656*** (0.14208)	0.66797 (1.59485)	-2.80220 (6.07549)
Forest Interaction Term	0.06269 (0.08924)	8.15214*** (1.14205)	-0.24527** (0.12378)	-0.01057 (0.08231)	-4.46407*** (0.60136)	0.06025 (0.14933)	-0.11229*** (0.02764)	-0.11020 (0.25905)	0.51093 (1.09187)
Adjusted Forest Coefficient	N/A	-1.95449	N/A	N/A	-0.41091	N/A	N/A	-0.00054	N/A
Urban Profit	-0.00228 (0.00171)	-0.00623* (0.00311)	-0.00723 (0.00094)	-0.00247*** (0.00082)	0.00140 (0.00107)	0.00045 (0.00050)	0.00143** (0.00059)	0.00778** (0.00346)	-0.01963*** (0.00453)
Urban Interaction Term	0.00046 (0.00031)	0.00087 (0.00053)	0.00138*** (0.00015)	0.00046*** (0.00014)	-0.00020 (0.00018)	0.00001 (0.00009)	-0.00021** (0.00011)	-0.00125** (0.00054)	0.00395*** (0.00077)
Adjusted Urban Coefficient	N/A	N/A	0.00100	N/A	N/A	0.00052	N/A	N/A	0.00377
Range-Pasture Profit	-0.12361*** (0.01878)	2.83159*** (0.64529)	-0.13980* (0.07615)	0.10573 (0.12817)	-2.47495*** (0.37509)	0.17952 (0.14501)	-0.08173*** (0.02098)	-2.00846* (1.13791)	0.04540 (0.94037)
Range-Pasture Interaction Term	0.03422*** (0.00453)	-0.37581*** (0.10142)	0.02540* (0.01463)	-0.00652 (0.02526)	0.37936*** (0.06288)	-0.02127 (0.02590)	0.01869*** (0.00431)	0.32838 (0.17828)	0.08948 (0.16897)
Adjusted Range-Pasture Coefficient	0.07081	0.58366	0.01159	0.06829	-0.24769	0.05289	0.02486	-0.01630	0.57583
Weighted Average LCC	-3.03654*** (0.76388)	1.76793 (2.03776)	-4.10368*** (0.63442)	-1.56147*** (0.54885)	-2.67323*** (0.85003)	-0.13752 (0.50609)	0.12612 (0.48260)	1.64151 (1.64303)	-20.31639*** (4.93183)
Constant	11.33664*** (4.07373)	-16.93820 (12.79484)	16.47993*** (3.84783)	3.36278 (3.08392)	11.79948** (5.03969)	-7.16565** (2.86495)	-6.48644** (2.54934)	-14.02889 (10.21285)	99.99422*** (29.16331)

1 - * , **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

2 - The adjusted coefficients are the sum of the coefficient on profit and the coefficient on the interaction term multiplied by the average LCC in all counties.

GLS Results for Aggregate County Transitions, Range Starting Use, Ln (0.0001) replaces Ln (0) [1 2]

Transition Period	1982-1987				1987-1992				1992-1997			
Dependent Variable	**Ln (Share in C-CRP / Share in Range)**	**Ln (Share in Pasture / Share in Range)**	**Ln (Share in Forest / Share in Range)**	**Ln (Share in Urban / Share in Range**	**Ln (Share in C-CRP / Share in Range)**	**Ln (Share in Pasture / Share in Range)**	**Ln (Share in Forest / Share in Range)**	**Ln (Share in Urban / Share in Range**	**Ln (Share in C-CRP / Share in Range)**	**Ln (Share in Pasture / Share in Range)**	**Ln (Share in Forest / Share in Range)**	**Ln (Share in Urban / Share in Range**
Crop Net Returns	-0.10639*** (0.03664)	0.13230*** (0.04471)	-0.01741 (0.01959)	-0.01542 (0.04884)	-0.00945 (0.07207)	0.05597 (0.03778)	0.02112 (0.04159)	0.07714 (0.06891)	0.13783 (0.11348)	0.16633 (0.10517)	-0.34224* (0.18636)	-0.37846** (0.15600)
Crop Interaction Term	0.02149*** (0.00637)	-0.02106*** (0.00735)	0.00311 (0.00318)	0.00001 (0.00752)	0.00051 (0.01162)	-0.00958 (0.00597)	-0.00279 (0.00654)	-0.00819 (0.01042)	-0.02293 (0.01789)	-0.02573 (0.01636)	0.05279* (0.02882)	0.05850** (0.02413)
Adjusted Crop Coefficient	0.02152	N/A	N/A	N/A	-0.00643	N/A	N/A	N/A	0.00082	N/A	N/A	N/A
Pasture Net Returns	0.11696** (0.05104)	-0.30484*** (0.04737)	0.02384 (0.01986)	0.18502*** (0.05876)	-0.08232 (0.06612)	0.03980 (0.03243)	-0.09305** (0.03678)	-0.02764 (0.08352)	0.03583 (0.10513)	-0.09301 (0.10151)	0.17810 (0.20755)	0.04661 (0.20288)
Pasture Interaction Term	-0.02349** (0.00917)	0.04591*** (0.00753)	-0.00340 (0.00307)	-0.02573*** (0.00869)	0.01333 (0.01040)	-0.00608 (0.00490)	0.01373** (0.00561)	-0.00023 (0.01225)	-0.00677 (0.01592)	0.01419 (0.01523)	-0.02720 (0.03132)	-0.00300 (0.03028)
Adjusted Pasture Coefficient	N/A	-0.03165	N/A	N/A	N/A	0.00301	N/A	N/A	N/A	-0.00822	N/A	N/A
Forest Net Returns	0.46010 (0.78719)	3.83157*** (0.92526)	-0.06092 (0.50999)	-2.71177* (1.62175)	1.38646* (0.83345)	-0.91236 (0.77735)	0.69523 (0.87209)	-0.99625 (1.88477)	12.98784 (15.88167)	7.24532 (14.99691)	8.26744 (25.15722)	-34.80231 (28.57062)
Forest Interaction Term	-0.01869 (0.13734)	-0.63945*** (0.15393)	0.00034 (0.08376)	0.47872* (0.26398)	-0.18255 (0.14369)	0.14083 (0.12868)	-0.12473 (0.14441)	0.12234 (0.30866)	-1.81561 (2.49603)	-1.20456 (2.32979)	-1.35371 (3.90479)	5.51704 (4.41099)
Adjusted Forest Coefficient	N/A	N/A	-0.05889	N/A	N/A	N/A	-0.04935	N/A	N/A	N/A	0.17730	N/A
Urban Net Returns	0.00483*** (0.00143)	-0.00208 (0.00164)	0.00097 (0.00059)	-0.00590*** (0.00098)	0.00099 (0.00124)	-0.00039 (0.00058)	0.00081 (0.00063)	0.00085 (0.00065)	-0.00044 (0.00205)	-0.00294 (0.00194)	-0.00211 (0.00385)	0.00402 (0.00277)
Urban Interaction Term	-0.00078*** (0.00026)	0.00032 (0.00025)	-0.00014 (0.00009)	0.00132*** (0.00015)	-0.00014 (0.00018)	0.00006 (0.00009)	-0.00012 (0.00009)	-0.00014 (0.00010)	0.00003 (0.00035)	0.00049 (0.00031)	0.00034 (0.00062)	-0.00057 (0.00045)
Adjusted Urban Coefficient	N/A	N/A	N/A	0.00197	N/A	N/A	N/A	0.00003	N/A	N/A	N/A	0.00062
Range Net Returns	2.58256*** (0.40039)	-4.14869 (0.34377)	0.42731 (0.16788)	1.84474*** (0.52045)	0.46943 (0.59395)	0.19170 (0.28610)	-0.93405** (0.41227)	-0.70840 (0.67300)	-1.14473 (0.82216)	-0.36938 (0.79845)	-0.96579 (1.60498)	0.77053 (1.60862)
Range Interaction Term	-0.43292*** (0.07849)	0.64817*** (0.05952)	-0.06232 (0.02848)	-0.28766*** (0.08300)	-0.10586 (0.10448)	-0.02604 (0.04749)	0.13097** (0.06716)	0.16641 (0.10750)	0.16398 (0.13174)	0.05971 (0.12379)	0.11385 (0.24816)	-0.09068 (0.24783)
Adjusted Range Coefficient	0.00628	-0.29146	0.05648	0.13293	-0.16250	0.06592	-0.15216	0.28501	-0.16477	-0.01255	-0.28538	0.22857

Weighted Average LCC	3.05190***	-5.69714***	0.52863	-1.64905*	-0.14752	-0.20301	-0.83740	-0.71902	-0.92550	-2.27737	-3.52140	2.06962
	(0.88921)	(0.73917)	(0.34038)	(0.88901)	(0.88598)	(0.42807)	(0.52507)	(0.94886)	(1.78244)	(1.56486)	(2.72704)	(2.77726)
Constant	-27.24905***	28.88031***	-12.95343***	-4.51860	-6.87971	-7.70244***	-3.11455	-5.01690	0.68335	4.85071	15.19722	-23.22612
	(4.71567)	(4.44681)	(2.05659)	(5.80028)	(5.61823)	(2.75879)	(3.40054)	(6.36666)	(10.85558)	(9.75926)	(17.13004)	(17.83329)

1 - * , **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

2 - The adjusted coefficients are the sum of the coefficient on Net Returns and the coefficient on the interaction term multiplied by the average LCC in all counties.

GLS Results for Aggregate County Transitions, Range Starting Use, Ln(0)'s Omitted [1 2]

Transition Period	1982-1987				1987-1992				1992-1997			
Dependent Variable	**Ln (Prob. C-CRP/ Prob. Range)**	**Ln (Prob. Pasture/ Prob. Range)**	**Ln (Prob. Forest/ Prob. Range)**	**Ln (Prob. Urban/ Prob. Range**	**Ln (Prob. C-CRP/ Prob. Range)**	**Ln (Prob. Pasture/ Prob. Range)**	**Ln (Prob. Forest/ Prob. Range)**	**Ln (Prob. Urban/ Prob. Range**	**Ln (Prob. C-CRP/ Prob. Range)**	**Ln (Prob. Pasture/ Prob. Range)**	**Ln (Prob. Forest/ Prob. Range)**	**Ln (Prob. Urban/ Prob. Range**
Crop Net Returns	-0.02584	0.06878	0.13087	0.04046	0.16057**	0.31146	0.01689	-0.29134***	0.04464	-0.18584	-0.16445	-0.93926***
	(0.02504)	(0.07046)	(0.17438)	(0.05784)	(0.07367)	(0.23073)	(0.15599)	(0.06371)	(0.03621)	(0.15511)	(0.15917)	(0.22285)
Crop Interaction Term	0.00549	-0.01055	-0.01776	-0.00908	-0.02547**	-0.05981	-0.00376	0.04370***	-0.00636	0.03170	0.02623	0.13412***
	(0.00426)	(0.01190)	(0.02773)	(0.00885)	(0.01242)	(0.04074)	(0.02701)	(0.00984)	(0.00624)	(0.02437)	(0.02377)	(0.03363)
Adjusted Crop Coefficient	0.00567	N/A	N/A	N/A	0.01305	N/A	N/A	N/A	0.00810	N/A	N/A	N/A
Pasture Net Returns	0.00406	-0.09033	-0.50992**	0.19532***	0.03009	-0.24592	-0.05116	0.15557**	-0.03001	-0.08670	-0.17411	-0.02389
	(0.03756)	(0.09130)	(0.16848)	(0.06925)	(0.07048)	(0.18108)	(0.12710)	(0.07799)	(0.04212)	(0.10309)	(0.12577)	(0.21140)
Pasture Interaction Term	-0.00256	0.01263	0.07698**	-0.02934***	-0.00374	0.04750	0.00848	-0.02349**	0.00685	0.01940	0.02674	0.00010
	(0.00666)	(0.01523)	(0.02705)	(0.01035)	(0.01137)	(0.03095)	(0.02117)	(0.01136)	(0.00706)	(0.01670)	(0.01907)	(0.03202)
Adjusted Pasture Coefficient	N/A	-0.01507	N/A	N/A	N/A	0.03366	N/A	N/A	N/A	0.02568	N/A	N/A
Forest Net Returns	-1.33079**	-0.99517	-24.47287	-1.01112	-1.95287**	-1.03355	21.99329***	0.63560	-0.87461**	-3.40015**	1.82816	-6.32339*
	(0.52844)	(1.19790)	(12.86488)	(2.06679)	(0.77737)	(10.84237)	(6.27928)	(2.35815)	(0.40258)	(1.34531)	(2.43236)	(3.62759)
Forest Interaction Term	0.26530***	0.17304	3.92843	0.24950	0.35328***	0.10069	-3.74961***	-0.13651	0.15575**	0.59680**	-0.30504	1.13826*
	(0.08925)	(0.20277)	(2.39092)	(0.33945)	(0.13332)	(1.92442)	(1.04549)	(0.46251)	(0.06884)	(0.22635)	(0.39097)	(0.60008)
Adjusted Forest Coefficient	N/A	N/A	-0.91370	N/A	N/A	N/A	-0.37843	N/A	N/A	N/A	-0.06231	N/A
Urban Net Returns	0.00000	-0.00691	-0.01494**	-0.00098	-0.00219*	0.00866	0.00058	0.00106	-0.00028	-0.00349	0.00496	0.00067
	(0.00120)	(0.00445)	(0.00403)	(0.00145)	(0.00130)	(0.00612)	(0.00188)	(0.00083)	(0.00085)	(0.00291)	(0.00352)	(0.00387)
Urban Interaction Term	0.00006	0.00111	0.00208**	0.00039*	0.00036*	-0.00137	-0.00008	-0.00007	0.00006	0.00060	-0.00079	-0.00002
	(0.00022)	(0.00073)	(0.00067)	(0.00022)	(0.00021)	(0.00099)		(0.00014)	(0.00015)	(0.00049)	(0.00056)	(0.00062)
Adjusted Urban Coefficient	N/A	N/A	N/A	0.00145	N/A	N/A	N/A	0.00066	N/A	N/A	N/A	0.00054
Range Net Returns	0.48894	-2.21264***	2.47872**	1.78508***	0.32093	5.45781*	-2.48693**	-0.36955	-0.23420	0.75855	-3.51360	-5.71986***
	(0.32040)	(0.45445)	(0.70064)	(0.41996)	(0.71654)	(2.69788)	(0.97679)	(0.65563)	(0.53953)	(1.23096)	(2.11025)	(1.55884)
Range Interaction Term	-0.08740	0.34350***	-0.33340**	-0.26481***	-0.04693	-0.91734*	0.36903**	0.05690	0.06235	-0.08099	0.56369	0.63794***
	(0.05723)	(0.08268)	(0.12348)	(0.06530)	(0.11961)	(0.45869)	(0.16320)	(0.10552)	(0.09336)	(0.20253)	(0.34158)	(0.25643)
Adjusted Range Coefficient	-0.012206	-0.16501	0.47930	0.15602	0.04909	0.05793	-0.28515	-0.02066	0.12400	0.28944	-0.02008	-1.82045

Weighted Average LCC	-0.60700 (0.74263)	-5.86041*** (1.59409)	-5.08769 (3.05732)	3.58856** (1.45140)	-1.47125 (1.35045)	9.92338* (5.24422)	-3.12184 (1.91079)	-1.10408 (1.18457)	-1.26681 (0.98975)	-3.51403* (2.04143)	-0.65620 (2.16208)	-14.36004*** (4.53548)
Constant	-1.94962 (4.10727)	32.22812*** (9.49094)	29.80071 (18.25880)	-32.90487*** (9.55631)	3.30439 (8.12581)	-65.52751* (31.96357)	15.22523 (11.51430)	-1.38356 (7.41737)	0.95787 (5.86701)	11.70079 (12.95857)	0.10411 (13.27715)	99.34577*** (28.49682)

1 - * , **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

2 - The adjusted coefficients are the sum of the coefficient on Net Returns and the coefficient on the interaction term multiplied by the average LCC in all counties.

GLS Results for Aggregate County Transitions, Range Starting Use, 0's Omitted, Temperature Model [1 2]

Transition Period	1982-1987				1987-1992				1992-1997			
Dependent Variable	**Ln (Prob. C-CRP/ Prob. Range)**	**Ln (Prob. Pasture/ Prob. Range)**	**Ln (Prob. Forest/ Prob. Range)**	**Ln (Prob. Urban/ Prob. Range**	**Ln (Prob. C-CRP/ Prob. Range)**	**Ln (Prob. Pasture/ Prob. Range)**	**Ln (Prob. Forest/ Prob. Range)**	**Ln (Prob. Urban/ Prob. Range**	**Ln (Prob. C-CRP/ Prob. Range)**	**Ln (Prob. Pasture/ Prob. Range)**	**Ln (Prob. Forest/ Prob. Range)**	**Ln (Prob. Urban/ Prob. Range**
Crop Net Returns	-0.02906	0.03291	0.37920	0.0657941	0.15891**	0.82691***	-0.17534	-0.405228***	0.04332	-0.22373	-0.24368	-1.22667***
	(0.02577)	(0.07997)	(0.28634)	0.0520976	(0.07683)	(0.24464)	(0.20252)	0.0651866	(0.03684)	(0.15149)	(0.15832)	(0.20078)
Crop Interaction Term	0.00601	-0.00428	-0.06204	-0.01234	-0.02553*	-0.14108***	0.02845	0.0616932***	-0.00583	0.03805	0.036876	0.17908***
	(0.00434)	(0.01360)	(0.04660)	0.0080727	(0.01293)	(0.04115)	(0.03497)	0.010137	(0.00629)	(0.02417)	(0.02365)	(0.03039)
Adjusted Crop Coefficient	0.00672	N/A	N/A	N/A	0.0069715	N/A	N/A	N/A	0.00866	N/A	N/A	N/A
Pasture Net Returns	0.00155	-0.08480	0.54750	0.2296971***	-0.03623	-0.69324***	-0.05590	0.0340254	-0.01892	-0.14721	-0.11073	-0.43148**
	(0.03432)	(0.11358)	(0.75673)	0.0608009	(0.08500)	(0.18959)	(0.14872)	0.078172	(0.04471)	(0.10080)	(0.12339)	(0.21526)
Pasture Interaction Term	-0.00222	0.01269	-0.10652	-0.035709***	0.00662	0.11667***	0.00802	-0.006244	0.00544	0.02800*	0.01548	0.06561**
	(0.00609)	(0.01844)	(0.12981)	0.0091989	(0.01362)	(0.03125)	(0.02487)	0.0114643	(0.00749)	(0.01616)	(0.01909)	(0.03246)
Adjusted Pasture Coefficient	N/A	-0.00927	N/A	N/A	N/A	0.0010529	N/A	N/A	N/A	0.0194336	N/A	N/A
Forest Net Returns	-1.30317**	1.05256	-61.85292	-2.859563	-2.53747***	2.58032	18.36401**	-3.499663	-1.08560**	-2.65928*	0.55591	-6.64709*
	(0.57270)	(1.63848)	(29.06510)	1.9598997	(0.93726)	(9.64296)	(7.98810)	2.879031	(0.45139)	(1.38565)	(3.06869)	(3.66969)
Forest Interaction Term	0.27183***	-0.17022	10.63295	0.5483636*	0.45595***	-0.53081	-2.94966**	0.6737526	0.18377**	0.47614**	-0.06910	1.29189**
	(0.09536)	(0.27518)	(5.02840)	0.3253417	(0.16024)	(1.69767)	(1.32405)	0.5643602	(0.07641)	(0.23054)	(0.50694)	(0.60856)
Adjusted Forest Coefficient	N/A	N/A	1.42277	N/A	N/A	N/A	0.8108466	N/A	N/A	N/A	0.1447206	N/A
Urban Net Returns	0.00059	-0.00393	-0.00353	0.0019678	-0.00203	0.00627	-0.00265	-0.000017	0.00000	-0.00130	0.00515	0.00221
	(0.00114)	(0.00441)	(0.01256)	0.0013414	(0.00138)	(0.00541)	(0.00279)	0.0009375	(0.00083)	(0.00297)	(0.00322)	(0.00352)
Urban Interaction Term	-0.00003	0.00063	0.00066	-0.000088	0.00034	-0.00108	0.00045	0.0001117	0.00003	0.00021	-0.00075	-0.000231
	(0.00021)	(0.00072)	(0.00190)	0.0002052	(0.00025)	(0.00088)	(0.00046)	0.0001493	(0.00014)	(0.00051)	(0.00052)	(0.00056)
Adjusted Urban Coefficient	N/A	N/A	N/A	0.0014458	N/A	N/A	N/A	0.0006479	N/A	N/A	N/A	0.0008372
Range Net Returns	0.39647	-1.31028*	4.27955	2.0501477***	0.17805	5.66143**	-2.99308	-0.28189	-0.38378	1.51815	-3.37539	-5.31666***
	(0.32495)	(0.72301)	(1.53893)	0.3354544	(0.75852)	(2.40201)	(1.72256)	0.6802079	0.53366	(1.20918)	(2.10315)	(1.79762)
Range Interaction Term	-0.04688	0.21302*	-0.72358	-0.331664***	-0.03953	-0.94743**	0.40686	0.0216558	0.06682	-0.14984	0.53345	0.54684*
	(0.05758)	(0.11953)	(0.27579)	0.054319	(0.12767)	(0.39914)	(0.26554)	0.1131044	(0.09368)	(0.19728)	(0.34647)	(0.30060)
Adjusted Range Coefficient	0.11750	-0.04263	-0.02639	0.0764452	-0.057185	0.02337	-0.571919	-0.153019	0.01388	0.62644	-0.200851	-2.062454
Weighted Average LCC	-0.55022	-3.98348**	15.32030	5.4012542***	-1.43602	9.83624**	-4.93234	-1.908524	-1.23696	-1.39266	-0.68693	-13.22095***
	(0.73269)	(1.72402)	(13.85036)	1.3188311	(1.34715)	(4.28243)	(3.09950)	1.3512965	(0.92379)	(2.21331)	(2.22696)	(4.36200)

Constant	-7.00560	30.23951***	-51.65326	-39.25491***	8.28999	-60.94030*	37.91890	9.7354706	7.09211	-5.25340	-9.51569	135.01201***
	(4.50593)	(10.54814)	(41.51873)	10.051104	(8.97984)	(29.55705)	(23.97780)	9.1662223	(6.21245)	(19.76885)	(13.67706)	(29.22179)
January Temp.	-0.01662	0.12846	-0.89211	-0.518952***	-0.04968	0.43832***	0.26122	-0.077852	-0.09777	0.15524	0.16518	-1.03540***
	(0.05104)	(0.11672)	(0.49218)	0.0924933	(0.06338)	(0.12740)	(0.15561)	0.0929938	(0.06097)	(0.18699)	(0.16704)	(0.26753)
April Temp.	0.09136	0.36859	2.35561	0.5630188***	-0.12469	-0.21256	-0.45927	-0.619092***	0.07870	1.91302**	-0.89706	1.49810***
	(0.09980)	(0.24559)	(2.63193)	0.141081	(0.15929)	(0.36564)	(0.29498)	0.1798202	(0.19748)	(0.68928)	**(0.42809)	(0.45660)
July Temp.	-0.06149	-0.12683	-1.78833	-0.78919***	-0.18943	0.93197**	0.20107	-0.243326*	-0.18404	0.09911	0.42518	-2.54685***
	(0.09936)	(0.20274)	(1.11812)	(0.11557)	(0.12093)	(0.32132)	(0.24973)	0.1253632	(0.11200)	(0.45497)	(0.34345)	(0.39637)
October Temp.	0.08441	-0.44166	0.02808	0.79135***	0.31830	-1.41414**	-0.20277	0.8417087***	0.13087	-1.93040**	0.31870	1.84485**
	(0.15320)	(0.33056)	(2.23779)	(0.20002)	(0.21026)	(0.58944)	(0.40052)	0.2167251	(0.25056)	(0.81366)	(0.50669)	(0.71708)

1 - * , **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

2 - The adjusted coefficients are the sum of the coefficient on Net Returns and the coefficient on the interaction term multiplied by the average LCC in all counties.

GLS Results for Aggregate County Transitions, Range Starting Use, Ln(0)'s Omitted, Temperature Model [1] [2]

Transition Period	1982-1987				1987-1992				1992-1997			
Dependent Variable	**Ln (Prob. C-CRP/ Prob. Range)**	**Ln (Prob. Pasture/ Prob. Range)**	**Ln (Prob. Forest/ Prob. Range)**	**Ln (Prob. Urban/ Prob. Range**	**Ln (Prob. C-CRP/ Prob. Range)**	**Ln (Prob. Pasture/ Prob. Range)**	**Ln (Prob. Forest/ Prob. Range)**	**Ln (Prob. Urban/ Prob. Range**	**Ln (Prob. C-CRP/ Prob. Range)**	**Ln (Prob. Pasture/ Prob. Range)**	**Ln (Prob. Forest/ Prob. Range)**	**Ln (Prob. Urban/ Prob. Range**
Crop Net Returns	-0.02906	0.03291	0.37920	0.0657941	0.15891**	0.82691***	-0.17534	-0.405228***	0.04332	-0.22373	-0.24368	-1.22667***
	(0.02577)	(0.07997)	(0.28634)	0.0520976	(0.07683)	(0.24464)	(0.20252)	0.0651866	(0.03684)	(0.15149)	(0.15832)	(0.20078)
Crop Interaction Term	0.00601	-0.00428	-0.06204	-0.01234	-0.02553*	-0.14108***	0.02845	0.0616932***	-0.00583	0.03805	0.036876	0.17908***
	(0.00434)	(0.01360)	(0.04660)	0.0080727	(0.01293)	(0.04115)	(0.03497)	0.010137	(0.00629)	(0.02417)	(0.02365)	(0.03039)
Adjusted Crop Coefficient	0.00672	N/A	N/A	N/A	0.0069715	N/A	N/A	N/A	0.00866	N/A	N/A	N/A
Pasture Net Returns	0.00155	-0.08480	0.54750	0.2296971***	-0.03623	-0.69324***	-0.05590	0.0340254	-0.01892	-0.14721	-0.11073	-0.43148**
	(0.03432)	(0.11358)	(0.75673)	0.0608009	(0.08500)	(0.18959)	(0.14872)	0.078172	(0.04471)	(0.10080)	(0.12339)	(0.21526)
Pasture Interaction Term	-0.00222	0.01269	-0.10652	-0.035709***	0.00662	0.11667***	0.00802	-0.006244	0.00544	0.02800*	0.01548	0.06561**
	(0.00609)	(0.01844)	(0.12981)	0.0091989	(0.01362)	(0.03125)	(0.02487)	0.0114643	(0.00749)	(0.01616)	(0.01909)	(0.03246)
Adjusted Pasture Coefficient	N/A	-0.00927	N/A	N/A	N/A	0.0010529	N/A	N/A	N/A	0.0194336	N/A	N/A
Forest Net Returns	-1.30317**	1.05256	-61.85292	-2.859563	-2.53747***	2.58032	18.36401**	-3.499663	-1.08560**	-2.65928*	0.55591	-6.64709*
	(0.57270)	(1.63848)	(29.06510)	1.9598997	(0.93726)	(9.64296)	(7.98810)	2.879031	(0.45139)	(1.38565)	(3.06869)	(3.66969)
Forest Interaction Term	0.27183***	-0.17022	10.63295	0.5483636*	0.45595***	-0.53081	-2.94966**	0.6737526	0.18377**	0.47614**	-0.06910	1.29189**
	(0.09536)	(0.27518)	(5.02840)	0.3253417	(0.16024)	(1.69767)	(1.32405)	0.5643602	(0.07641)	(0.23054)	(0.50694)	(0.60856)
Adjusted Forest Coefficient	N/A	N/A	1.42277	N/A	N/A	N/A	0.8108466	N/A	N/A	N/A	0.1447206	N/A
Urban Net Returns	0.00059	-0.00393	-0.00353	0.0019678	-0.00203	0.00627	-0.00265	-0.000017	0.00000	-0.00130	0.00515	0.00221
	(0.00114)	(0.00441)	(0.01256)	0.0013414	(0.00138)	(0.00541)	(0.00279)	0.0009375	(0.00083)	(0.00297)	(0.00322)	(0.00352)
Urban Interaction Term	-0.00003	0.00063	0.00066	-0.000088	0.00034	-0.00108	0.00045	0.0001117	0.00003	0.00021	-0.00075	-0.000231
	(0.00021)	(0.00072)	(0.00190)	0.0002052	(0.00025)	(0.00088)	(0.00046)	0.0001493	(0.00014)	(0.00051)	(0.00052)	(0.00056)
Adjusted Urban Coefficient	N/A	N/A	N/A	0.0014458	N/A	N/A	N/A	0.0006479	N/A	N/A	N/A	0.0008372
Range Net Returns	0.39647	-1.31028*	4.27955	2.0501477***	0.17805	5.66143**	-2.99308	-0.28189	-0.38378	1.51815	-3.37539	-5.31666***
	(0.32495)	(0.72301)	(1.53893)	0.3354544	(0.75852)	(2.40201)	(1.72256)	0.6802079	0.53366	(1.20918)	(2.10315)	(1.79762)
Range Interaction Term	-0.04688	0.21302*	-0.72358	-0.331664***	-0.03953	-0.94743**	0.40686	0.0216558	0.06682	-0.14984	0.53345	0.54684*
	(0.05758)	(0.11953)	(0.27579)	0.054319	(0.12767)	(0.39914)	(0.26554)	0.1131044	(0.09368)	(0.19728)	(0.34647)	(0.30060)
Adjusted Range Coefficient	0.11750	-0.04263	-0.02639	0.0764452	-0.057185	0.02337	-0.571919	-0.153019	0.01388	0.62644	-0.200851	-2.062454

Weighted Average LCC	-0.55022 (0.73269)	-3.98348** (1.72402)	15.32030 (13.85036)	5.4012542*** 1.3188311	-1.43602 (1.34715)	9.83624** (4.28243)	-4.93234 (3.09950)	-1.908524 1.3512965	-1.23696 (0.92379)	-1.39266 (2.21331)	-0.68693 (2.22696)	-13.22095*** (4.36200)
Constant	-7.00560 (4.50593)	30.23951*** (10.54814)	-51.65326 (41.51873)	-39.25491*** 10.051104	8.28999 (8.97984)	-60.94030* (29.55705)	37.91890 (23.97780)	9.7354706 9.1662223	7.09211 (6.21245)	-5.25340 (19.76885)	-9.51569 (13.67706)	135.01201*** (29.22179)
January Temp.	-0.01662 (0.05104)	0.12846 (0.11672)	-0.89211 (0.49218)	-0.518952*** 0.0924933	-0.04968 (0.06338)	0.43832*** (0.12740)	0.26122 (0.15561)	-0.077852 0.0929938	-0.09777 (0.06097)	0.15524 (0.18699)	0.16518 (0.16704)	-1.03540*** (0.26753)
April Temp.	0.09136 (0.09980)	0.36859 (0.24559)	2.35561 (2.63193)	0.5630188*** 0.141081	-0.12469 (0.15929)	-0.21256 (0.36564)	-0.45927 (0.29498)	-0.619092*** 0.1798202	0.07870 (0.19748)	1.91302** (0.68928)	-0.89706 **(0.42809)	1.49810*** (0.45660)
July Temp.	-0.06149 (0.09936)	-0.12683 (0.20274)	-1.78833 (1.11812)	-0.78919*** (0.11557)	-0.18943 (0.12093)	0.93197** (0.32132)	0.20107 (0.24973)	-0.243326* 0.1253632	-0.18404 (0.11200)	0.09911 (0.45497)	0.42518 (0.34345)	-2.54685*** (0.39637)
October Temp.	0.08441 (0.15320)	-0.44166 (0.33056)	0.02808 (2.23779)	0.79135*** (0.20002)	0.31830 (0.21026)	-1.41414** (0.58944)	-0.20277 (0.40052)	0.8417087*** 0.2167251	0.13087 (0.25056)	-1.93040** (0.81366)	0.31870 (0.50669)	1.84485** (0.71708)

1 - * , **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

2 – The adjusted coefficients are the sum of the coefficient on Net Returns and the coefficient on the interaction term multiplied by the average LCC in all counties.

Generalized Least Squares Results for Aggregate County Transitions, Range-Pasture Starting Use, Basic Model, Relative Net Returns, Ln (0)'s Omitted [1 2]

Period	1982 to 1987				1987 to 1992				1992 to 1997			
Dependent Variable	Ln (Prob. Crop-CRP /Prob. Range)	Ln (Prob. Pasture / Prob. Range)	Ln (Prob. Forest / Prob. Range)	Ln (Prob. Urban /Prob. Range)	Ln (Prob. Crop-CRP /Prob. Range)	Ln (Prob. Pasture / Prob. Range)	Ln (Prob. Forest / Prob. Range)	Ln (Prob. Urban /Prob. Range)	Ln (Prob. Crop-CRP /Prob. Range)	Ln (Prob. Pasture / Prob. Range)	Ln (Prob. Forest / Prob. Range)	Ln (Prob. Urban /Prob. Range)
Relative Crop Net Returns	0.03682 (0.09963)	0.58634 (0.36730)	2.23059 (1.90400)	0.34979* (0.26552)	0.35641 (0.31683)	3.02871** (1.40336)	-0.43891 (0.55388)	-1.05794*** (0.24705)	0.42893** (0.20637)	-1.21249 (0.81367)	-0.42420 (0.37713)	-1.08719*** (0.15484)
Relative Crop Interaction Term	-0.00279 (0.01556)	-0.08599 (0.06115)	-0.35968 (0.30131)	-0.06149** (0.02903)	-0.05254 (0.05011)	-0.48951** (0.22494)	0.07624 (0.09446)	0.15613*** (0.03563)	-0.06424** (0.03182)	0.19086 (0.12402)	0.06456 (0.05556)	0.16574*** (0.02267)
Adjusted Crop Coefficient	0.02024	N/A	N/A	N/A	0.04373	N/A	N/A	N/A	0.04662	N/A	N/A	N/A
Relative Pasture Net Returns	-0.21224 (0.16085)	-0.72734 (0.48214)	-1.67920 (0.94867)	0.30610 (0.26552)	0.06766 (0.35240)	-3.11234*** (0.98845)	-0.32528 (0.47017)	0.21798 (0.17895)	0.26485 (0.25101)	0.84172 (0.58964)	-0.08891 (0.32739)	-2.38637*** (0.25628)
Relative Pasture Interaction Term	0.02821 (0.02441)	0.10535 (0.07618)	0.25442 (0.14191)	-0.05161 (0.03883)	-0.00863 (0.05386)	0.48867*** (0.22494)	0.04493 (0.07368)	-0.03034 (0.02572)	-0.03107 (0.03900)	-0.11730 (0.09418)	0.00754 (0.05092)	0.35557*** (0.03796)
Adjusted Pasture Coefficient	N/A	-0.10038	N/A	N/A	N/A	-0.21604	N/A	N/A	N/A	0.14369	N/A	N/A
Relative Forest Net Returns	-13.92771*** (3.65448)	13.41714** (6.19661)	-52.30214 (126.69103)	-19.87151** (8.66605)	-9.78991* (5.86428)	-7.77633 (54.03293)	22..96776 (34.73106)	9.86910 (11.03041)	-5.90687* (3.17245)	-23.78083** (8.61466)	-5.23278 (16.69564)	13.07807** (5.04546)
Relative Forest Interaction Term	2.52678*** (0.60641)	-2.26984** (1.03935)	8.81268 (19.32475)	3.53242** (1.41415)	1.73596* (0.96823)	0.77123 (9.17392)	-3.52748 (5.62501)	-1.36798 (1.76723)	1.00920* (0.52446)	4.23520*** (1.44581)	1.00975 (2.73552)	-2.04516*** (0.78119)
Adjusted Forest Coefficient	N/A	N/A	0.14133	N/A	N/A	N/A	1.97602	N/A	N/A	N/A	0.77613	N/A
Relative Urban Net Returns	-0.00638 (0.00456)	0.01131 (0.00839)	-0.07960 (0.05908)	-0.00368 (0.00610)	-0.00519 (0.00523)	-0.02597 (0.02230)	0.00188 (0.00416)	0.01148*** (0.00250)	-0.00547 (0.00537)	-0.02367 (0.01502)	0.01053 (0.00633)	0.02874*** (0.00180)
Relative Urban Interaction Term	0.00101 (0.00067)	-0.00186 (0.00134)	0.01289 (0.00996)	0.00104 (0.00089)	0.00083 (0.00076)	0.00390 (0.00354)	-0.00030 (0.00066)	-0.00158*** (0.00038)	0.00077 (0.00084)	0.00322 (0.00241)	-0.00161 (0.00098)	-0.00422*** (0.00030)

Adjusted Urban Coefficient	N/A	N/A	N/A	0.00251	N/A	N/A	N/A	0.00207	N/A	N/A	N/A	0.00361
January Temperature	-0.02944 (0.04406)	0.10338 (0.08493)	-1.70847 (0.76621)	-0.35267*** (0.09696)	-0.03430 (0.07253)	0.26190** (0.12111)	0.37164** (0.16070)	0.08712 (0.08077)	-0.06787 (0.05727)	0.03573 (0.15061)	0.04385 (0.20196)	0.58364*** (0.16273)
April Temperature	-0.00461 (0.10375)	0.32953 (0.20529)	-2.99454 (1.50048)	0.33831* (0.18968)	-0.05577 (0.17298)	-0.03355 (0.36818)	0.14096 (0.19606)	-1.06226*** (0.16291)	0.10371 (0.16633)	0.78119 (0.75700)	-0.89880** (0.35254)	0.00245 (0.22692)
July Temperature	-0.05474 (0.08824)	-0.18233 (0.16616)	-1.26949 (0.58784)	-0.86838*** (0.12787)	-0.13444 (0.13368)	0.82625** (0.31772)	0.59906** (0.21255)	-0.10995 (0.11092)	-0.14572 (0.11841)	-0.17035 (0.33011)	0.06322 (0.38536)	-0.10592 (0.21263)
October Temperature	0.12522 (0.15169)	-0.31838 (0.23150)	7.01245* (2.77424)	0.89890*** (0.23450)	0.16671 (0.26782)	-1.36255** (0.54607)	-1.10732*** (0.28623)	1.00912*** (0.24224)	0.02265 (0.24711)	-0.49234 (0.81625)	0.85598 (0.65187)	-0.54259 (0.39041)
Weighted Average LCC	-1.27862*** (0.27616)	0.13383 (0.69183)	-4.75202 (3.93648)	0.66184 (0.59805)	-1.31614*** (0.48978)	-1.26009 (1.30504)	-0.16329 (0.54198)	-0.78131* (0.42277)	-0.47209 (0.44842)	-1.72464* (1.00027)	1.91501 (1.32781)	-0.51505 (0.61685)
Constant	1.57807 (3.11472)	5.24044 (7.40700)	-53.59081 (33.54620)	-1.02451 (6.40921)	7.33129 (6.04068)	7.63677 (11.43350)	-6.84970 (5.88568)	1.12976 (4.96327)	3.87837 (4.93479)	7.04740 (13.32344)	-27.84862*** (9.16608)	12.26992 (7.56888)

1 - * , **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

2 – The adjusted coefficients are the sum of the coefficient on Net Returns and the coefficient on the interaction term multiplied by the average LCC in all counties.

Generalized Least Squares Results for Aggregate County Transitions, Range-Pasture Starting Use, Relative Net Returns, Elevation Variables, Ln (0)'s Replaced with Ln(0.005) [1]

Period	1982 to 1987			1987 to 1992			1992 to 1997		
Dependent Variable	**Ln (Prob. Crop-CRP /Prob. Range-Pasture)**	**Ln (Prob. Forest /Prob. Range-Pasture)**	**Ln (Prob. Urban /Prob. Range-Pasture)**	**Ln (Prob. Crop-CRP /Prob. Range-Pasture)**	**Ln (Prob. Forest /Prob. Range-Pasture)**	**Ln (Prob. Urban /Prob. Range-Pasture)**	**Ln (Prob. Crop-CRP /Prob. Range-Pasture)**	**Ln (Prob. Forest /Prob. Range-Pasture)**	**Ln (Prob. Urban /Prob. Range-Pasture)**
Relative Crop Net Returns	0.01140 (0.01491)	-0.00059 (0.00198)	-0.07228*** (0.00655)	0.00281 (0.00302)	-0.00027 (0.00075)	0.00310 (0.00315)	0.00565 (0.01166)	0.00124 (0.00282)	-0.16913*** (0.03783)
Relative Forest Net Returns	-0.42487 (0.84492)	0.09569 (0.19760)	2.83140*** (0.96022)	0.46755*** (0.08420)	0.01359 (0.08615)	0.17909 (0.18121)	-0.32515 (0.24486)	0.03678 (0.10999)	-1.68170 (1.53569)
Relative Urban Net Returns	0.00027 (0.00037)	-0.00001 (0.00005)	0.00352*** (0.00022)	0.00010*** (0.00002)	-0.00000 (0.00002)	0.00034 (0.00004)	-0.00020 (0.00019)	-0.00001 (0.00005)	0.00392*** (0.00068)
Weighted Average LCC	-1.02526*** (0.13795)	0.00001 (0.02909)	-0.88237*** (0.14883)	-0.05478 (0.09319)	-0.08148* (0.04543)	-0.13208 (0.10925)	-0.79208*** (0.11264)	0.08531* (0.04835)	-3.04931*** (0.63225)
Constant	1.72488*** (0.56454)	-5.32748*** (0.13959)	-2.23134*** (0.70548)	-4.21098*** (0.42065)	-4.71522*** (0.21925)	-5.17203*** (0.51090)	-0.71603 (0.49030)	-5.64135*** (0.22427)	9.80234*** (2.92517)
Maximum Elevation	0.00133* (0.00072)	-0.00005 (0.00013)	-0.00175** (0.00072)	-0.00054 (0.00058)	0.00066*** (0.00025)	-0.00257*** (0.00063)	0.00237*** (0.00055)	0.00034 (0.00022)	-0.00039 (0.00317)
Elevation Range	-0.00181*** (0.00055)	0.00006 (0.00010)	0.00050 (0.00056)	-0.00038 (0.00046)	-0.00039* (0.00021)	0.00173*** (0.00051)	-0.00175*** (0.00043)	-0.00019 (0.00018)	-0.00322 (0.00246)
Mean Elevation	0.00093*** (0.00067)	0.00016 (0.00011)	0.00254*** (0.00063)	0.00023* (0.00052)	0.00056*** (0.00022)	0.00262*** (0.00056)	-0.00193*** (0.00049)	-0.00040** (0.00019)	0.00474* (0.00278)

1 - * , **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

1 - * , **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

Generalized Least Squares Results for Aggregate County Land Use Transitions, Range-Pasture Starting Use, Relative Net Returns, Hotel and Restaurant Sales Variables, Ln (0)'s Replaced with Ln(0.005) [1]

Period	1982 to 1987			1987 to 1992			1992 to 1997		
Dependent Variable	**Ln (Prob. Crop-CRP /Prob. Range-Pasture)**	**Ln (Prob. Forest /Prob. Range-Pasture)**	**Ln (Prob. Urban /Prob. Range-Pasture)**	**Ln (Prob. Crop-CRP /Prob. Range-Pasture)**	**Ln (Prob. Forest /Prob. Range-Pasture)**	**Ln (Prob. Urban /Prob. Range-Pasture)**	**Ln (Prob. Crop-CRP /Prob. Range-Pasture)**	**Ln (Prob. Forest /Prob. Range-Pasture)**	**Ln (Prob. Urban /Prob. Range-Pasture)**
Relative Crop Net Returns	0.01918 (0.01828)	-0.00151 (0.00223)	-0.05581*** (0.01083)	0.00131 (0.00300)	-0.00009 (0.00075)	0.00196 (0.00313)	0.00465 (0.01213)	0.00120 (0.00292)	-0.14172*** (0.03529)
Relative Forest Net Returns	-0.04041 (0.77443)	0.05951 (0.16711)	0.28076 (0.81514)	0.38640*** (0.08365)	0.05285 (0.08591)	0.13272 (0.16291)	-0.54497** (0.22884)	0.10644 (0.10126)	-4.41008*** (1.27655)
Relative Urban Net Returns	0.00033 (0.00040)	-0.00002 (0.00005)	0.00276*** (0.00022)	0.00008*** (0.00002)	0.00001 (0.00002)	0.00003 (0.00003)	-0.00014 (0.00021)	0.00002 (0.00005)	0.00223*** (0.00062)
Weighted Average LCC	-1.03027*** (0.11896)	0.01333 (0.02585)	-0.48727*** (0.13322)	-0.03064 (0.07648)	-0.09874*** (0.03708)	-0.10329 (0.09346)	-0.71875*** (0.09897)	0.04706 (0.03897)	-0.93174* (0.48342)
Constant	0.95570* (0.54039)	-5.34806*** (0.14167)	-3.07394*** (0.72199)	-4.76626*** (0.40509)	-4.60353*** (0.21430)	-5.19784*** (0.51889)	-0.64448 (0.50305)	-5.53002*** (0.22065)	1.97862 (2.69473)
Hotel and Restaurant Sales	-0.00000 (0.00000)	0.00000 (0.00000)	-0.00000 (0.00000)	-0.00000 (0.00000)	0.00000 (0.00000)	0.00000 (0.00000)	0.00000 (0.00000)	0.00000 (0.00000)	-0.00000*** (0.00000)

1 - * , **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

Generalized Least Squares Results for Aggregate County Transitions, Range-Pasture Starting Use, Relative Net Returnss Elevation Variables, Ln (0)'s Omitted [1]

Period	1982 to 1987			1987 to 1992			1992 to 1997		
Dependent Variable	**Ln (Share in Crop-CRP /Share in Range-Pasture)**	**Ln (Share in Forest /Share in Range-Pasture)**	**Ln (Share in Urban /Share in Range-Pasture)**	**Ln (Share in Crop-CRP /Share in Range-Pasture)**	**Ln (Share in Forest /Share in Range-Pasture)**	**Ln (Share in Urban /Share in Range-Pasture)**	**Ln (Share in Crop-CRP /Share in Range-Pasture)**	**Ln (Share in Forest /Share in Range-Pasture)**	**Ln (Share in Urban /Share in Range-Pasture)**
Relative Crop Net Returns	0.02221 (0.01727)	0.03433 (0.10989)	-0.08198*** (0.00890)	0.00267 (0.00368)	-0.00716 (0.05274)	0.00330 (0.00368)	0.00906 (0.02365)	-0.00006 (0.01282)	-0.14890*** (0.03779)
Relative Forest Net Returns	-1.39697* (0.76742)	2.13560 (8.71755)	5.60024*** (1.59644)	0.26024** (0.10017)	0.33315 (2.32226)	0.42905 (0.37174)	-0.00382 (0.34392)	0.09500 (1.08707)	-1.02212 (2.08235)
Relative Urban Net Returns	-0.00123** (0.00050)	-0.00432 (0.00250)	0.00418*** (0.00035)	0.00005** (0.00002)	0.00007 (0.00054)	0.00009 (0.00008)	-0.00140*** (0.00041)	0.00007 (0.00033)	0.00368*** (0.00076)
Weighted Average LCC	-0.83675*** (0.12739)	-0.01804 (1.29858)	-0.69155** (0.28421)	-0.72318*** (0.22671)	0.17793 (0.43955)	-0.03834 (0.21342)	-0.84043*** (0.12644)	0.10493 (0.55229)	-2.24878* (1.20181)
Constant	3.12443*** (0.55319)	-6.55093 (9.37509)	-3.22574** (1.42392)	-0.53207 (1.00463)	-1.69371 (1.88526)	-6.31494*** (1.06149)	0.58458 (0.52054)	-5.63638 (4.43684)	6.71573 (6.48279)
Maximum Elevation	0.00060 (0.00089)	-0.00319 (0.00490)	-0.00361*** (0.00112)	-0.00294*** (0.00107)	0.00444 (0.00301)	-0.00382*** (0.00108)	0.00069 (0.00080)	-0.00000 (0.00187)	-0.00704 (0.00464)
Elevation Range	-0.00053 (0.00068)	0.00424 (0.00468)	0.00148* (0.00084)	0.00172* (0.00089)	-0.00307 (0.00232)	0.00266*** (0.00090)	-0.00030 (0.00063)	0.00045 (0.00170)	-0.00084 (0.00369)
Mean Elevation	-0.00186** (0.00089)	0.00307 (0.00371)	0.00465*** (0.00093)	0.00336*** (0.00089)	-0.00686 (0.00278)	0.00400*** (0.00093)	-0.00062 (0.00072)	-0.000012 (0.00173)	0.01343*** (0.00404)

1 - * , **, and *** denote the 10%, 5%, and 1% levels of significance, respectively

Generalized Least Squares Results for Aggregate County Transitions, Range-Pasture Starting Use, Relative Net Returnss, Basic Model, Ln (0)'s Omitted [1]

Period	1982 to 1987			1987 to 1992			1992 to 1997		
Dependent Variable	Ln (Share in Crop-CRP /Share in Range-Pasture)	Ln (Share in Forest /Share in Range-Pasture)	Ln (Share in Urban /Share in Range-Pasture)	Ln (Share in Crop-CRP /Share in Range-Pasture)	Ln (Share in Forest /Share in Range-Pasture)	Ln (Share in Urban /Share in Range-Pasture)	Ln (Share in Crop-CRP /Share in Range-Pasture)	Ln (Share in Forest /Share in Range-Pasture)	Ln (Share in Urban /Share in Range-Pasture)
Relative Crop Net Returns	0.02221 (0.01727)	0.03433 (0.10989)	-0.08198*** (0.00890)	0.00267 (0.00368)	-0.00716 (0.05274)	0.00330 (0.00368)	0.00906 (0.02365)	-0.00006 (0.01282)	-0.14890*** (0.03779)
Relative Forest Net Returns	-1.39697* (0.76742)	2.13560 (8.71755)	5.60024*** (1.59644)	0.26024** (0.10017)	0.33315 (2.32226)	0.42905 (0.37174)	-0.00382 (0.34392)	0.09500 (1.08707)	-1.02212 (2.08235)
Relative Urban Net Returns	-0.00123** (0.00050)	-0.00432 (0.00250)	0.00418*** (0.00035)	0.00005** (0.00002)	0.00007 (0.00054)	0.00009 (0.00008)	-0.00140*** (0.00041)	0.00007 (0.00033)	0.00368*** (0.00076)
Weighted Average LCC	-0.83675*** (0.12739)	-0.01804 (1.29858)	-0.69155** (0.28421)	-0.72318*** (0.22671)	0.17793 (0.43955)	-0.03834 (0.21342)	-0.84043*** (0.12644)	0.10493 (0.55229)	-2.24878* (1.20181)
Constant	3.12443*** (0.55319)	-6.55093 (9.37509)	-3.22574** (1.42392)	-0.53207 (1.00463)	-1.69371 (1.88526)	-6.31494*** (1.06149)	0.58458 (0.52054)	-5.63638 (4.43684)	6.71573 (6.48279)
Maximum Elevation	0.00060 (0.00089)	-0.00319 (0.00490)	-0.00361*** (0.00112)	-0.00294*** (0.00107)	0.00444 (0.00301)	-0.00382*** (0.00108)	0.00069 (0.00080)	-0.00000 (0.00187)	-0.00704 (0.00464)
Elevation Range	-0.00053 (0.00068)	0.00424 (0.00468)	0.00148* (0.00084)	0.00172* (0.00089)	-0.00307 (0.00232)	0.00266*** (0.00090)	-0.00030 (0.00063)	0.00045 (0.00170)	-0.00084 (0.00369)
Mean Elevation	-0.00186** (0.00089)	0.00307 (0.00371)	0.00465*** (0.00093)	0.00336*** (0.00089)	-0.00686 (0.00278)	0.00400*** (0.00093)	-0.00062 (0.00072)	-0.000012 (0.00173)	0.01343*** (0.00404)

1 - * , **, and *** denote the 10%, 5%, and 1% levels of significance, respectively