AN ABSTRACT OF THE DISSERTATION OF

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Title: Three Essays on the Effectiveness of Oregon's Land-Use Planning System: Economic Analysis with Quasi-Experimental Methods

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Oregon's land use planning system is often recognized as having been successful in its goals of limiting urban sprawl and protecting resource lands from development. However, it is difficult to quantify the impact of these regulations, because we cannot observe what would have happened in the absence of land use planning. The three essays in this dissertation explore the effects of Oregon's land use planning regulations on development patterns in the state, and also examine how the land use regulations are administered at the local level.

The first essay in this dissertation asks if Oregon's land use regulations have successfully restricted sprawl outside of urban areas. Urban containment policies, including Urban Growth Boundaries (UGBs), are a common tool used by city planners to

promote compact development. We analyze how well UGBs do in containing development using fine-scale GIS data on cities in Oregon. Earlier studies on UGBs yield mixed results, with some authors finding no effects of UGBs on housing market variables and urbanization rates and others finding significant effects. A challenge in measuring these effects is that the location of the UGB is unlikely to be an exogenous determinant of a land parcel's value for development. The panel structure of our dataset allows us to estimate the UGB's effect on the probability of development using a difference-in-difference estimator. This estimator controls for time-invariant unobservable variables and common temporal effects among parcels, thereby mitigating the potential for biased estimates due to the endogeneity of the UGB's location. We also pursue a novel approach to controlling for time-varying factors inspired by regression discontinuity design. We find that UGBs are effective in containing development in many of the Oregon cities we examine, although there are some cities in which development rates are the same inside and outside of the UGB. Our results show that we would greatly overstate the effects of the UGBs were we to evaluate cross-sectional differences in development rates, as is common in previous studies.

Besides the creation of UGBs, another goal of Oregon's land use regulations is to encourage citizen involvement in the planning process. The second essay in this dissertation examines the use of voter annexation as a form of citizen involvement. More specifically, this paper addresses the following two questions. First, does voter annexation cause changes in city demographics and characteristics? Second, assuming that a city votes for amendments and annexations to the UGB and city limits, what factors impact the outcome of the vote? We analyze the first question using the method of propensity score matching, which has not previously been used to explore this topic. This allows us to account for the endogeneity that stems from the fact that cities with certain characteristics may be more likely to use voter annexation in the first place. The second question, which is only evaluated for cities that employ voter annexation, is analyzed with the use of the logit model. Oregon's land use regulations must be approved at the state level, but are administered locally. Therefore, unlike past studies, we are able to isolate specific differences in the way the program is administered, and are not evaluating the stringency of the program itself. Previous studies have found that voter-approved annexation causes developers to provide more public goods and increase the scale of development, thereby shifting community demographics. Once a land use decision is on the ballot, it is also noted that cities that are whiter, wealthier, and more liberal are more likely to pass referenda that promote preservation and restrict development. For the first question, we compare specific demographic indicators between the two groups of cities. Contrary to the results of previous studies, we find no effect of voter annexation on these indicators. Our results for the second question indicate that the characteristics of the voting process itself impact the outcome more than community characteristics, which also differs from the results of previous analyses.

The third essay in this dissertation is an extension of the first essay, and focuses on the impact of Oregon's land use regulations on the protection of land in riparian corridors and land that has been designated for exclusive farm use (EFU). Riparian corridors are protected with the use of Oregon Goal 5, which focuses on development of natural resource lands inside of UGBs, while EFU land is protected with the use of Oregon Goal 3, which focuses on protection of agricultural land at the county level. The LCT dataset that was used in the first essay is also used in this essay. EFU land by definition has no probability of development in the initial period. Land located in riparian corridors may also face different initial levels of protection than other land. We deal with this endogeneity, and also account for location inside or outside of a UGB, with the use of the difference -in-difference-in-differences estimator. This is an approach that has not been used to explore the effect of Oregon's land use regulations on these land categories. Most of the past studies that have examined the impact of land use planning on development of agricultural land in Oregon have relied on analysis of general trends and indicators, and have concluded that land use regulations have been successful in protecting this land. Previous research on riparian zone protection has focused on protection of aquatic wildlife, and for the most part has not examined the protection of riparian corridors inside of UGBs. The limited studies that have studied the effect of these regulations in UGBs have determined them to be effective in slowing, but not stopping, development in these areas. Overall, we find that Oregon's land use regulations have been successful in protecting both county level agricultural land and riparian corridors located inside of UGBs from development. It is less clear whether these regulations have protected riparian corridors located inside of UGBs from other anthropogenic uses.

Three Essays on the Effectiveness of Oregon's Land-Use Planning System: Economic Analysis with Quasi-Experimental Methods

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

Judith Dempsey, Author

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TABLE OF CONTENTS

Page

TABLE OF CONTENTS (Continued)

Page

LIST OF FIGURES

LIST OF TABLES

Three Essays on the Effectiveness of Oregon's Land-Use Planning System: Economic Analysis with Quasi-Experimental Methods

CHAPTER ONE

INTRODUCTION AND OVERVIEW

Oregon Senate Bill 100 was approved on May 29, 1973. This bill provides protection of farm and forest lands, conservation of natural resources, orderly and efficient development, coordination among local governments, and citizen involvement. At the same time, Senate Bill 101 was passed with the intention of strengthening farmland protection in the state. In order to enforce the requirements of Senate Bill 100, the Land Conservation and Development Commission (LCDC) and the Department of Land Conservation and Development (DLCD) were established. LCDC’s first major task was the creation and adoption of the Statewide Planning Goals. There were originally 14 goals, now 19. The goals express the state's policies on land use and related topics, including natural resource protection. Each county and city must create a comprehensive land use plan which outlines the methods they intend to use to comply with the planning goals, and which must be accompanied by local ordinances to enforce the goals. Goal 14 specifies that every incorporated city must establish an Urban Growth Boundary (UGB). Land inside these boundaries is zoned for specific urban uses, such as residential or commercial development, and land outside of UGBs is designated for rural uses, such as forest or farmland. Although most of the UGBs in Oregon surround a single incorporated city, some UGBs contain multiple cities, such as the Portland Metro UGB, which currently contains 25 cities over three counties, or the Salem/Keizer combined UGB. Whether a UGB includes one city or multiple cities, each one is locally managed and enforced. This dissertation's three essays evaluate whether the statewide planning goals have been successful in limiting sprawl and protecting resource lands in Oregon.

Specifically, the first essay (Chapter 2), *How well do Urban Growth Boundaries Contain Development? Results for Oregon using a Difference-in-Difference Estimator,* asks whether UGBs have been successful at containing development inside these boundaries in 17 cities within Oregon's Willamette Valley. This essay contributes to the current literature by using difference-in-differences (DID) estimation to analyze the effect of Oregon's UGBs on the probability that a land parcel is developed during the study period. The DID estimator addresses the two main challenges encountered in previous studies when measuring treatment effects of land use regulations. First, estimates of the probability of development inside and outside of an established UGB in a single time period are likely to be biased due to unobservable factors that make development inside the UGB more likely even in the absence of land use regulations. The DID estimator controls for these unobserved factors, and thus mitigates the endogeneity problem discussed above. Second, if estimation is based on the change in development before and after the UGB was put in place, all changes would be attributed to the UGB, when some portion of the change may be due to unrelated factors. Thus, with observations of treated and untreated parcels before and after application of the treatment, we can obtain a DID estimate of the average treatment effect (ATE). For our application, the ATE equals the percentage point difference in the probability of land development associated with being inside instead of outside the UGB. Land use in this study is measured using the U.S. Geological Survey (USGS) Land Cover Trends (LCT) data. Out of 17 cities examined, we find that the UGB has no impact on development for five cities, whereas for the remaining 12 cities we find an increased development probability for parcels within the UGB. Based on these results, it appears that, overall, UGBs have been effective in containing development.

The second essay (Chapter 3), *A Study of Voter Annexation in Oregon: Direct Democracy in Action*, analyzes the use of voter annexation as a method of citizen involvement in Oregon cities. Citizen involvement is a required element of every comprehensive plan. This essay addresses two specific questions. First, does voter annexation cause changes in city demographics and characteristics? Second, assuming that a city votes for amendments and annexations to the UGB and city limits, what factors impact the outcome of the vote? The first question is studied with the use of propensity score matching, and also with a set of manually matched cities. Data from all incorporated cities across the state are used to analyze this question. The second question is evaluated with the use of a logit model. The matching methods used in this paper are an important advance in understanding the effects of voter-approved annexation. Previous papers have not been able to completely separate the characteristics that cause a city to use direct democracy for land use decisions from the effect that direct democracy has on these same characteristics. The matching techniques allow us to compare cities that had the same initial likelihood of adopting the method of voter annexation, and study the differences that develop between cities that ultimately adopted this technique and cities that did not. In addition, much of the literature compares urban areas across multiple states, or urban areas that are within the same state but are subject to varying land use regulations. The cities in this study are all subject to the same set of land use regulations, however each city is able to determine the specific methods that will be used to enforce these regulations at a local level. Therefore, the differences that arise between cities in that use direct democracy for land use decisions, and the cities that do not, can be more clearly attributed to the method with which these regulations are enforced at the local level, instead of to the stringency of the regulation itself. Although the methods used to address the second question are similar to those used in previous research, I have a particularly rich data set on annexation and amendment votes in Oregon. There are currently 31 cities in Oregon that vote for annexations, and each city has held multiple annexation and amendment votes. Data includes characteristics of individual cities as well as the characteristics of the vote itself. In the analysis of the first question, I find that voter annexation does not impact city demographics or characteristics. The analysis of the second question indicates that the characteristics of the voting process itself impact the outcome more than community characteristics.

The third essay (Chapter 4), *Curbing development in Oregon's EFU zones and riparian corridors: How well have Oregon's Land Use Regulations protected resource lands from development?*, evaluates how well Oregon's planning goals have restricted development in exclusive farm use (EFU) zones, and also how well the goals have restricted development and other disturbances in riparian corridors. This analysis focuses on LCT blocks that are located within Oregon's Willamette Valley. In addition, individual results are estimated for each city and county in the study area. The protection of agricultural land in EFU zones is focused on land outside of UGBs, while the protection of land in riparian corridors is of greater importance inside of UGBs. EFU land by definition has no probability of development in the initial period. Land located in riparian corridors may also face different initial levels of protection than other land. We deal with this endogeneity, and also account for location inside or outside of a UGB, with the use of the difference -in-difference-in-differences (DIDID) estimator. This is an approach that has not been used to explore the effect of Oregon's land use regulations on these land categories. Most of the past studies that have examined the impact of land use planning on development of agricultural land in Oregon have relied on analysis of general trends and indicators, and have generally concluded that land use regulations have been successful in protecting this land. Previous research on riparian zone protection has focused on protection of aquatic wildlife, and generally has not examined the protection of riparian corridors inside of UGBs. The limited studies that have studied the effect of these regulations in UGBs have determined them to be effective in slowing, but not stopping, development in these areas. Overall, we find that Oregon's land use regulations have been successful in protecting both county level agricultural land and riparian corridors located inside of UGBs from development. It is less clear whether these regulations have protected riparian corridors located inside of UGBs from other anthropogenic uses.

The three essays together allow us to explore the impact of Oregon's land use regulations on development decisions and decision-making, while accounting for the endogeneity that is inherent in this type of study. Results allow us to evaluate the success of specific planning goals. This has important implications on future land-use policies, both in Oregon and in states that may use Oregon's land use planning system as a model for their own regulations.

CHAPTER TWO

HAVE URBAN GROWTH BOUNDARIES REDUCED URBAN SPRAWL IN OREGON?

2.1. Introduction

With its comprehensive statewide land-use planning system, the State of Oregon is recognized as a leader in growth management. In an attempt to limit sprawled patterns of urban development[1], the Oregon Legislative Assembly passed Senate Bill 100 in 1973, requiring every city and county in the state to create comprehensive land use plans and zoning ordinances. A crucial function of each city's comprehensive plan is the establishment of an Urban Growth Boundary (UGB) for the city (DLCD, 2010), whose purpose is to "provide land for urban development needs and to identify and separate urban and urbanizable land from rural land." Parcels within the boundary are zoned for intensive uses, such as high-density residential housing, whereas those outside are zoned for less intensive uses such as agriculture, forestry, and in limited cases, low-density residential development. Buildings that support agricultural and forestry operations, including homesteads, are also allowed, and small, unincorporated communities are not required to develop growth management plans. Because some development is allowed

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[1] The Oregon Department of Land Conservation and Development (DLCD) defines urban sprawl as areas of low-density development, commercial development with large parking lots extending along highways, separation of different kinds of land uses, and a lack of public open space (DLCD, 2000).

outside of UGBs, it is unclear how effective Oregon's UGBs have been in containing urban development. This paper will evaluate the effect of UGBs on urban development in Oregon's Willamette Valley. The Willamette Valley contains the largest cities in Oregon (Portland, Salem, and Eugene) and most of the state's population.

Nechyba and Walsh (2004) summarize economic theories of urban sprawl. These include the monocentric city model, the Tiebout (1956) flight from blight model, and models of edge cities. The monocentric city model assumes that the central business district (CBD) of a city is located on a featureless plane, and that the city's residents face tradeoffs between commuting and housing costs. Assuming that the income elasticity of land is sufficiently large, households will substitute land for proximity to the urban center as their income increases, increasing the radial extent of the city. Wu and Plantinga (2003) and Wu (2006) relaxed the assumption of the featureless plain in the monocentric city model and found that the distribution of amenities across the landscape can lead to dispersed development. The Tiebout flight from blight model suggests that higher income residents leave city centers to escape the social problems associated with these areas, and to avoid subsidizing the public services of lower income households. Mieszkowski and Mills (1993) point out that once this income segregation takes place, land controls and zoning may divide income groups even more by setting restrictions on lot size. Furthermore, building requirements may prevent lower income residents from living in suburban neighborhoods. Theories of edge cities explain the polycentric cities that develop as the workforce and employment centers move to the suburbs, further expanding the reaches of the city (Anas and Small, 1998).

Brueckner and Fansler (1983) suggest that sprawl is the result of an orderly market process, and is not necessarily an inefficient urban structure. However, Brueckner (2000) returned to this issue, pointing out hidden sources of market failure associated with urban sprawl. These include the failure to account for the social costs of freeway congestion and the loss of open space, and also the failure to fully account for the infrastructure costs of new development. Brueckner went on to evaluate several tools to control urban sprawl, including UGBs. He concluded that although UGBs can control sprawl, there is a risk that they may needlessly restrict the size of the city, since policy makers cannot gauge the exact extent of urban over-expansion when setting these boundaries. Anas and Pines (2008) evaluated the case of two heterogeneous monocentric cities, and found that the effect of UGBs on total land use is ambiguous. When the elasticity of substitution between housing and other consumption is sufficiently small, population is simply shifted, so that increased sprawl in one city is not compensated by decreased sprawl in another.

Empirical studies of the efficacy of growth management policies have found mixed results. Boarnet et al. (2011) examined whether Florida's growth management program changed economic growth patterns, using a simultaneous equation model (SEM) with population density and employment density as endogenous variables. They conclude that Florida's land use regulations, which require all counties and municipalities to create comprehensive land use plans with the goal of limiting future growth, caused a shift of development from urban to suburban counties. The overall benefit of the policy was unclear because of the possibility that urban growth could simply be displaced to a different area. Jun (2004) compared development in Portland, Oregon to development patterns in similar metropolitan areas and also examined indicators of urban growth inside and outside of the Portland UGB. In addition, Jun analyzed a housing supply model that included a UGB indicator variable to compare development inside and outside of the boundary, ultimately concluding that the UGB was not effective in reducing sprawl.

In the empirical papers discussed above, the authors do not account for the potential endogeneity of land-use regulations, a problem first discussed by Davis (1963). Land parcels are likely to have characteristics, including proximity to the city center, elevation, and slope, that influence both the likelihood of development and the decision by planning authorities to include them within the UGB. Failure to control for such parcel characteristics induces correlation between the regulations applied to the parcel and the error terms in the development model. Kline and Alig (1999) evaluated the impact of Oregon's land use planning laws on the development of land designated for forest or agricultural use, concluding that development tended to be concentrated within UGBs. However, their results also suggest that lands that are located within a UGB were always more likely to be developed, due to their proximity to city centers and other characteristics, and therefore any effects attributed to the UGB may have happened even without land use regulations. In related work, Wallace (1988) determined that zoning tends to follow the path that the market would take in the absence of the zoning regulation, and Cho et al. (2003) found that while land use regulations decrease land development, they are more likely to be adopted in counties facing greater development pressures. Cho et al. (2006) considered the impacts of the UGB surrounding Knoxville, Tennessee, concluding that the Knoxville UGB is effective at concentrating development within the city limits. This study examined the probability that undeveloped land parcels would be developed, and included indicator variables for location inside and outside of the UGB. Cho et al. (2007) also recognized the self-selection issue and repeated their 2006 analysis, this time accounting for the endogeneity of land prices and the likelihood of development within a SEM. In contrast to their original findings, the authors concluded that the Knoxville UGB has exacerbated urban sprawl.

This paper contributes to the current literature by using difference-in-difference (DID) estimation to analyze the effect of Oregon's UGBs on the probability of development. This estimator addresses the two main challenges encountered in previous studies when measuring treatment effects of land use regulations. First, estimates of the probability of development inside and outside of an established UGB in a single time period are likely to be biased due to unobservable factors that make development inside the UGB more likely even in the absence of land use regulations. The DID estimator controls for these unobserved factors, and thus mitigates the endogeneity problem discussed above. Second, if estimation is based on the change in development before and after the UGB was put in place, all changes would be attributed to the UGB, when some portion of the change may be due to unrelated factors. The DID estimator controls for temporal factors that are constant across the parcels used in the estimation. Our model has a similar structure to Cho et al. (2006), however our DID estimator explicitly accounts for unobservable time-invariant effects, as well as common time effects.

Another related paper is Grout et al. (2011), which uses a regression discontinuity design (RDD) model to analyze the effects of Portland's UGB on land prices. In the spirit of RDD, we focus on land parcels that are located within one-half of a kilometer of the UGB, helping to isolate the impact of the UGB on development patterns.

We estimate the effects of UGBs on development decisions using a linear probability DID model. To implement this estimator, observations are needed for both the treated and untreated group, and before and after the treatment is applied. Land use in this study is measured using the U.S. Geological Survey (USGS) Land Cover Trends (LCT) data, which provides a repeated sample of 10 kilometer (km) by 10 km blocks within which land use is measured at a 60 meter scale. The data set provides observations in 1973 and 2000, which spans the years during which all UGBs in the Willamette Valley were originally implemented. We focus on the cases in which LCT blocks straddle all or portions of the UGBs of cities in the Willamette Valley. The intersection of LCT blocks with the McMinnville UGB is shown in Figure 1. LCT land use categories are presented in Table 1. The probability of treatment is conditioned on covariates, including factors such as soil quality, distance from the city center, and elevation, which represent characteristics that affect the net return to development by private landowners. Some of these covariates are also interacted with the time variable, to account for the possibility that in the absence of this land use regulation, the treated and untreated groups would have different changes in probability of development over time. In addition, we divide the study area for each UGB into 1 km by 1 km blocks, allowing us to control for unobserved covariates with the use of block-specific indicator variables. These blocks are presented in Appendix 2.1.

2.2 Methods

The DID estimator is used to evaluate treatment effects when the treatment is not randomly assigned to experimental units. In general, the average treatment effect (ATE) is given by Imbens and Wooldridge (2009) as:

$$ATE = E[Y_i(1)] - E[Y_i(0)] = (E[Y_i|G_i = 1, T_i = 1, X_i] - E[Y_i|G_i = 1, T_i = 0, X_i]) - (E[Y_i|G_i = 0, T_i = 1, X_i] - E[Y_i|G_i = 0, T_i = 0, X_i]) \quad (1)$$

where $Y_i(1)$ refers to the outcome of interest for unit i if it is treated, $Y_i(0)$ refers to the outcome when unit i is untreated, and X_i is a vector of covariates. Additionally, $T_i = 1$ ($T_i = 0$) refers to the time period after (before) treatment, and $G_i = 1$ ($G_i = 0$) refers to the treated (untreated) group. In the standard DID model, the following linear relationship is assumed:

$$Y_i = \beta_0 + \beta_1 T_i + \beta_2 G_i + \beta_3 T_i G_i + X_i \gamma + \varepsilon_i$$

which, following (1), gives ATE=β_3. In our application, we also include time-varying covariates in the model. As discussed by Wooldridge (2002), although these additional terms do not vanish with differencing, the coefficient β_3 still has the same interpretation as the ATE[2].

[2] The DID estimator accounts for heterogeneity between the treated group and the untreated group. Therefore, the calculation of the treatment effect is not affected by the group specific characteristics that impact the probability of treatment. This simulates a random treatment assignment. Based on the discussion in Heckman and Vytlacil (2005), this implies that the ATE also represents the average treatment effect of the treated (ATT), as well as the average treatment effect of the untreated (ATU).

For our application, a land parcel is considered treated if it is located inside the city's original UGB. To apply the DID estimator, we must observe two groups of parcels, one that receives the treatment, and one that does not. Additionally, data must be available for two time periods, one before the treatment has been applied, and one after. The dependent variable in this analysis is a binary variable indicating whether or not a parcel is developed. We estimate a linear probability model that explains the probability that a parcel is developed at a particular point in time, conditional on a set of covariates. To calculate the average treatment effect (ATE), the average change over time in the development probability for the untreated group is then subtracted from the average change over time for the treated group. The ATE represents the change in probability of development for a land parcel if that parcel was contained within the UGB, compared to the probability of development of the parcel if the UGB had never been created.

Figure 2 demonstrates the calculation of the ATE with the DID estimator. In this graph, the vertical axis represents the expected probability of development for a group of parcels. The horizontal axis represents time. The lower (red) line in this graph represents the untreated group, and the upper (blue) line represents the treated group. In terms of equation 1, the point at which the lower line crosses the axis is the expected probability of development of a parcel in the untreated group before the treatment was implemented (β_0), and the point at which the upper line crosses the axis is the expected probability of development of a parcel in the treated group before the treatment was implemented ($\beta_0 + \beta_2$). The difference in the initial probability of development between the two groups is equal to β_2. There is a dashed horizontal line for each group, which shows the projection of the probability of development during the initial period into the second period, after UGBs were implemented. In reality, there is a change in the probability of development over time, which is represented on this graph by the positive slope of both lines. Both lines end at a point that represents the expected probability of development for a parcel in each group, after the land use regulations were implemented. The DID estimator is based on the assumption that in the absence of the treatment, conditional on covariates, all parcels would experience the same change in the probability of development over time (β_1). Due to the treatment, the treated group experiences a different change in the probability of development over time, ($\beta_1 + \beta_3$). We can, thus, isolate the effect of the treatment on the probability of development as β_3.

We assume that private landowners seek to maximize the net return to development, accounting for the opportunity cost of the land in alternative uses. The net return to development for parcel i (y_{it}*) is specified:

$$y_{it}^{*} = \beta_0 + \beta_1 T + \beta_2 G_i + \beta_3 G_i T + X_{it}\gamma + \varepsilon_{it} \qquad (2)$$

where i=1,…,n indexes individual parcels and t indexes time. As above, T is an indicator variable for the time period, and G_i is an indicator variable for the treated group, where $G_i = 1$ indicates that parcel i is located inside the UGB. X_{it} is a vector of time-invariant and time-varying covariates that affect the net benefits of development. β and γ are parameters, and assumptions on the distribution of ε_{it} are discussed below. The net return to development, y_{it}^{*}, is not observed, but it is known whether or not parcel i is developed, which is indicated by the binary variable Y_{it}. Therefore, we write:

$$Y_{it} = 1\ if\ y_{it}^{*} > 0$$

$$Y_{it} = 0\ if\ y_{it}^{*} \leq 0$$

The probability that parcel i is developed in time t is then:

$$P(Y_{it} = 1 | G_{i,} T, X_{it}) = F(G_i, T, X_{it}, \beta, \gamma) \quad (3)$$

where F takes a linear form:

$$Y_{it} = \beta_0 + \beta_1 T + \beta_2 G_i + \beta_3 G_i T + X_{it}\gamma + \varepsilon_{it} \quad (4)$$

The advantage of the linear probability model in a DID context is the ease of estimating the ATE, which likely explains its use in recent DID applications (Conley and Taber 2011, Abrevaya and Hamermesh 2012). In contrast, in a probit or logit model the ATE is a nonlinear function of all independent variables and estimated parameters, including any time-invariant terms that would drop out of the expression in (2). The usual argument against the use of the linear probability model is that it can produce predicted probabilities that are outside of the unit interval. We are primarily interested in the central tendency of the data (i.e., the regression surface), therefore this does not impact the interpretation of our results, although it can affect the estimation method, as discussed below. Furthermore, failure to control for spatially-correlated errors can result in biased coefficient estimates in probit and logit models. In our application, if development decisions are made for groups of contiguous parcels, rather than individual parcels, we might expect the error terms to be spatially correlated. Estimation of spatial probit and logit models is computationally difficult and requires strong assumptions about the structure of underlying spatial relationships. In a linear model, spatially-correlated errors have implications only for the efficiency of the estimates[3].

The dependent variable in the linear probability model equals 1 or 0, which implies that the model error exhibits heteroskedasticity of a known form: $Var[\varepsilon|\boldsymbol{x}] = \boldsymbol{x}'\beta(1-\boldsymbol{x}'\beta)$ (Greene, 1999). The model can then be estimated using Feasible Generalized Least Squares (FGLS). However, if predicted probabilities are outside of the unit interval, the use of FGLS may require us to take the square root of a negative number, and therefore we may not be able to calculate the weight. This is commonly dealt with by dropping the offending observations. An alternate method is to keep all of the observations and use heteroskedasticity-robust standard errors. We estimate the model using three different methods to deal with possible heteroskedasticity: FGLS; heteroskedasticity-robust standard errors; and cluster robust standard errors. For the cluster robust standard errors, the clusters are defined by the 1 km by 1 km blocks defined within each buffer.

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[3] Spatial correlation can be addressed with the use of a spatial weighting matrix, W. However, the true form of the spatial interdependence is not known with certainty, therefore a structure must be assigned to the W matrix. If the matrix is mis-specified, we have introduced an additional form of uncertainty into our model. We partially account for spatial dependence with the use of distance variables in our model, including the distance to the city center, the distance to the city limits, and the distance to the closest highway. In addition, the model is estimated using three different error structures, including cluster robust errors.

Four specifications are estimated for each city, based on the estimator presented in (4). We will call these Models I, II, III, and IV. Model I is the most basic, and assumes that γ=0. It can be written as follows:

$$Y_{it} = \beta_0 + \beta_1 T + \beta_2 G_i + \beta_3 G_i T + \varepsilon_{it} \qquad (5)$$

Model I is a useful benchmark for other specifications because it is saturated (the regressors are dummy variables for mutually exclusive and exhaustive categories), which implies that all of the predicted values of Y_{it} lie within the unit interval (Wooldridge 2010). Therefore, the results are the same whether the model is estimated using FGLS or heteroskedasticity-robust errors.

Model II is the general estimator presented in (4). This model includes time-varying covariates to account for possible differences in the change in probability of development over time between the two groups, as well as time-invariant covariates. These variables are presented and described in the data section of this paper.

Model III is similar to Model I, with the addition of indicator variables for each block along the UGB, allowing us to account for unobservable time invariant and time-varying parcel-specific characteristics. These blocks are presented in Appendix 2.1. We assume that within each block there are no cross-sectional differences among parcels. Thus, if we denote these unobservable factors by B_{it}, we can write:

$$\tilde{\gamma} B_{it} = \tau_j + \alpha_j \qquad (6)$$

where *j* indexes the block and τ_j and α_j are block-specific parameters, where τ_j varies with time and α_j does not. The full specification of Model III is then:

$$Y_{it} = \beta_0 + \beta_1 T + \beta_2 G_i + \beta_3 G_i T + \tau_j + \alpha_j + \varepsilon_{it} \qquad (7)$$

Finally, we add the observable covariates back into Model III, and estimate Model IV:

$$Y_{it} = \beta_0 + \beta_1 T + \beta_2 G_i + \beta_3 G_i T + X_{it}\gamma + \tau_j + \alpha_j + \varepsilon_{it} \qquad (8)$$

As stated earlier, these models are estimated separately for each city. In addition, each model is estimated using FGLS, robust standard errors, and cluster robust standard errors.

2.3. Data and Analysis

The binary development variable is measured using the LCT data. As noted above, the LCT data do not provide a continuous dataset for the entire region, but rather a random sample of 10 km by 10 km blocks. Each LCT block consists of a raster image of pixels, measured at the 60 meter scale, indicating developed and non-developed uses.[4] Any parcels in water or wetlands and all publicly-owned parcels were dropped from the sample since development is typically prohibited or infeasible in these cases. UGBs across Oregon were originally assigned in about 1980. We used LCT observations on land use from 1973 and 2000 to span the period before and after the adoption of the

[4] We adopt these pixels as our unit of analysis and, henceforth, refer to them as land parcels.

UGBs. The latter observations also allow sufficient time to pass so that land-use patterns can be affected by the UGB.

We focus on cities in Oregon's Willamette Valley because this is the most urbanized and fastest growing region in Oregon (ODFW, 2006). There are 20 urban areas within the Willamette Valley for which one or more LCT blocks significantly overlaps a city's UGB. The city of Scappoose and two separate sites along the edge of the Portland UGB were dropped from the analysis because the LCT data in each of these areas overlap a portion of the UGB that was significantly expanded during the study period, which implies that the treatment status of some parcels changed between 1973 and 2000, complicating the interpretation of the ATE. These expansions are listed in Table 2. As indicated in Table 2, there have been only small adjustments to the UGBs of other cities in the Willamette Valley that overlap the LCT data. Most cities were examined separately; however, Philomath and Corvallis and Stayton and Sublimity were analyzed together due to the proximity of their UGBs and because these cities collaborate in land-use planning, as documented in their comprehensive plans.

In order to isolate the effects of the UGB, we only included parcels that were located within 500 meters of each UGB, creating a buffer with a width of one kilometer. The restricted size of the study area allows us to focus on parcels that are likely to be similar to each other, except for their location inside or outside of the UGB. To evaluate Models III and IV, the buffers for each city were divided into non-overlapping blocks approximately one square kilometer in area. The buffers and the blocks for each of our cities are illustrated in Appendix 2.1.

Descriptions and data sources for additional covariates used in this analysis are listed in Table 3. Time-invariant variables include elevation, slope, soil quality, distance to the closest highway, distance to the city center, the square of the distance to the city center, and the distance to the city limit as measured in 1990. These variables represent characteristics that impact the net return of land in its different uses. As stated by Capozza and Helsley (2000), land is developed when its rent in urban use equals the foregone rent in its current use, plus the opportunity cost of the capital needed to convert the land. Soil quality, elevation, and slope all contribute to the agricultural quality of a land parcel, while distance to the city center impacts the urban rent gradient as described in the monocentric city model. All time-invariant variables vanish when we calculate the ATE, but we include them in our study in order to reduce the model variance. Distance to the closest highway, distance to the city limits, distance to the city center, and the square of the distance to the city center were also interacted with the time variable. Although the DID estimator controls for any time effects that are common to all parcels, such as a city-wide rise in the value of developed land, we expect that changes in the urban rent gradient will not necessarily be uniform across the city. For example, population and transportation infrastructure changes may occur in particular parts of a city. We capture this potential heterogeneity by allowing the effects of distance to the city center to vary over time. A separate time-varying control for distance to the city limit is included. Land inside the city limit is more likely to be zoned for development than land outside the city limit, and to have access to public utility services. This difference is not always captured by the distance to the city center because many cities are irregularly shaped, or else the center is located towards the edge of the city. These irregularities are also captured with the time varying portion of the block indicator variables in Models III and IV.

2.4. Results

2.4.1 McMinnville

This section discusses in detail the results for McMinnville. The next section summarizes the results of all the cities in the analysis. The full set of regression results for McMinnville is presented in Table 4[5]. For Model I, we found that the UGB had a significant effect on the likelihood of development. The coefficient for the group/time interaction (equivalent to the ATE) is positive, with a value of 0.1267, or 12.67%, and a p-value of 0.000. This indicates that the effect of the UGB was to increase the probability of development inside the boundary by an additional 12.67 percentage points. Thus, the probability of development of the treated parcels increased at a greater rate than the probability of development of the untreated parcels, which was the intended effect of the UGB. The coefficient on the group indicator variable is equal to 0.2195, with a p-value of 0.000. This implies that even in the absence of Oregon's land use regulations, the treated group was 21.95% more likely to be developed than the treated group. The coefficient on the time indicator variable has a value of 0.0131, however this coefficient is not significant, indicating that there was no change in development probability over

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[5] The value of R-squared for the McMinnville analysis ranged from 0.13 for Model I to 0.40 for Model 4.

time that was common to parcels in both groups. As stated previously, because the model is saturated, no observations are dropped, and all three standard error options provide the same coefficient estimates for Model I. Although the cluster robust standard errors are more conservative, the same coefficients are significant for all three standard error options.

The ATE estimates from Model II corroborate the value of the ATE estimated using Model I. When the model is calculated using robust or cluster robust standard errors, the estimated ATE is 0.1115, or 11.15%, and the model calculated with FGLS estimates an ATE of 0.1095, or 10.95%. However, the FGLS option also dropped 1476 observations from the analysis because the estimated probabilities were negative, and the weights could not be calculated. In fact, a significant number of observations were dropped from Models II, III, and IV for all cities in this analysis. Therefore, for the remainder of the paper we will only discuss the estimates calculated using the robust and the cluster robust variance covariance matrices[6].

The Model II estimates for the group and time variables were also in agreement with the Model I estimates. The coefficient on the group indicator variable is positive and significant, with a value of 0.1996, or 19.96%, and the coefficient on the time indicator variable is not significant. The effects of the distance variables are consistent

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[6] In the McMinnville FGLS analysis, negative probability predictions cause 1,476 observations to be dropped from Model II, 1,504 observations to be dropped from Model III, and 1,732 observations to be dropped from Model IV. There are a total of 8,772 observations for McMinnville.

with a declining urban rent gradient. The distance to the city center has a significant negative effect, implying that the probability of development decreases as we move further from the city center. The coefficient on the interaction between time and the distance to the city center is not significant. The coefficient on the square of the distance to the city center has a significant positive coefficient, implying that although the probability of development decreases as we move further from the city center, this effect weakens with distance. The time interaction with the square of the distance to the city center is not significant. The distance to the city boundary also has a negative effect on the probability of development, which does not change over time. The probability of development decreases with the distance to the closest highway. The coefficient on the interaction term between time and the distance to the closest highway is positive and significant, therefore this effect weakens over time.

There is no significant difference between the probability of development of parcels with the most productive soils (the omitted category) and parcels with less productive soils (soil_2 and soil_3).[7] In other cities, soils have a significant influence, with the most common finding being that the probability of development falls as soil productivity declines. Although agricultural returns rise with soil productivity, building costs are likely to fall since highly productive fields are level and well drained. Elevation

[7] No parcels in the McMinnville buffer are classified as the type 4, and so the soil_4 variable is omitted.

has a positive effect on development, perhaps reflecting the value of scenic views. However, slope does not significantly impact the probability of development.

Model III is specified as Model I, with the addition of indicator variables that control for unobservable characteristics at the block level. Similarly, Model IV is specified as Model II, with the addition of these same indicator variables. McMinnville's buffer is divided into 16 non-overlapping blocks, which are displayed in Figure 3. The addition of the block specific variables causes the coefficients on the intercept and the time indicator variable to measure these impacts for the omitted block, therefore these variables cannot be directly compared between Models I and II and Models III and IV. For Models III and IV, the group indicator variable is positive and significant, similar to the previous models. The ATE calculated in Model III has a value of 10.94%, with a p-value of 0.000 for the robust calculations and a p-value of 0.001 for the cluster robust calculations, and the ATE estimated in Model IV has a value of 9.21% with p-values of 0.000 and 0.014, respectively. Therefore we see that the different specifications produce remarkably similar results.

The Model IV results for the soil, slope, and elevation variables are insignificant, just as they were in Model II. In addition, the coefficients on the highway and city boundary distance variables, including these variables interacted with time, have the same sign and significance in both models. The square of the distance to the city center is positive and significant in both models, however in Model II, the time interaction with this variable is not significant, and in Model IV it is positive and significant. The coefficient on city center distance remains negative, but is no longer significantly different from zero at the 5 percent level. Similar to the square of the distance to the city center, the time interaction of this variable is not significant in Model II, but is positive and significant. With the block-specific controls included in the model, these coefficients measure only the effects of within-block variation in the distance variables on the probability of development. The block variables remove the average effect of distance for each block, which appears to sharpen the local effect of the city center distance variable on the likelihood of development.

All of the time invariant block effects for the robust and the cluster robust estimation in Model III, and for the robust estimation in Model IV are significant, while five of the time invariant block effects in the cluster robust estimation of Model IV are significant. Four of the time interactions with the block-specific variables are significant in the robust estimates of Models II and IV, three are significant in the cluster robust estimates of Model IV, and all are significant in the cluster robust estimates of Model II. In two-thirds of the other cities, at least one of the block-time interaction coefficients is significantly different from zero.

2.4.2 All Cities

The results for all of the cities are summarized in Table 5, and the complete results for Model I are summarized in Table 6. The complete results for all Models are presented in Appendix 2.2. This analysis will focus on the results of Model I[8]. In five of the cities (Brownsville, Carlton, Estacada, Newberg, and St. Helens), the ATE estimate is not significantly different from zero, indicating that development was just as likely to occur outside as inside the UGB. For Brownsville and Estacada, this result is due to very low development pressures in these cities. The coefficients on the time indicators are zero, indicating that there was no development inside or outside the UGB. In the other cities, the results indicate that the share of the buffer in developed use increased in each city between 1973 and 2000: by 2.8 percentage points in Carlton, 11.9 in Newberg, and 6.3 in St. Helens. In all cases, this development was evenly split between the portions of the buffer inside and outside the UGB.

Twelve cities have a significant, positive ATE (Corvallis/Philomath, Dallas, Dayton, Donald, Harrisburg, Lafayette, Lebanon, Lowell, McMinnville, Newberg, Sheridan, and Stayton/Sublimity). There are two subgroups within the set of cities with positive ATEs. In the first group of cities, the ATE estimate is significantly different from zero but relatively small. These include Corvallis/Philomath (4.1 percentage points), Dallas (4.3), Dayton (5.9), Dundee (5.6) [9], Harrisburg (8.5), and Lebanon (2.6). The second subgroup of cities with positive ATE has estimates that exceed 10 percentage points. These include: Donald (25.7), Lafayette (15.9), Lowell (15.6), McMinnville

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[8] The majority of the R-squared values were in the range of 0.2 to 0.5. As expected, the goodness of fit increased as the covariate vector and the block effects were added to the analysis.
[9] The ATE estimate for Dundee is significantly different from zero at the 6.8 percent level.

(12.7), Sheridan (31.2), and Stayton/Sublimity (12.1). In these cases, there were significant development pressures, and most of the development was contained within the UGB. With the exception of Lowell and Sheridan, there were negligible increases in development outside the UGB. Overall, the magnitude of the ATEs ranged from less than 3 percentage points in Lebanon to 34 percentage points in Sheridan.

Figure 4 illustrates the distribution of ATEs throughout the Willamette Valley. To the southwest of Portland there is a cluster of cities with large ATEs, however the cities that are closest to Portland have insignificant ATEs. As we move south in the valley, there are cities with smaller positive ATEs, such as Corvallis/Philomath, as well as Brownsville, which has an insignificant ATE. Lowell is the most southern city in our study, and has relatively large positive ATE.

2.5. Discussion and Conclusions

Out of 17 cities examined, we find no impact from the UGB for five areas, whereas for 12 areas we find an increased development probability for parcels within the UGB. Based on these results, it appears that, overall, UGBs have been effective in containing development. In addition, we control for the possibility that there are unobservable time varying and time invariant effects within the cross-sectional data contained within each 1 km by 1 km block.

Although the purpose of a UGB is to contain urban development, there are several ways for “untreated” land outside of a UGB to be developed after the initial implementation of the UGB. It is possible that land that was zoned for development before the UGB was in place can still be developed after implementation of the UGB. Unincorporated communities and low-density development may also exist outside of the UGB. In addition, each city in Oregon develops and enforces its own comprehensive land-use plan, and therefore there is some variation in the implementation of the UGB from city to city. This includes the density of zoning inside the UGB. Finally, although we did not consider such cases, a UGB can be amended to include more land if it is determined that the city does not have enough land contained within the boundary to accommodate the 20 year population forecast. The stringency with which each city manages land along the edge of the boundary may impact future growth of the boundary, which can influence the effectiveness of a city's UGB.

In addition to defining areas for future development, UGBs support the development of public transportation and bike-friendly, pedestrian-friendly neighborhoods by limiting the spatial extent of the city. The presence of public transportation and emphasis on walkable, bikeable neighborhoods that integrate residential and commercial development may decrease sprawl that is related to automobile use, and may also limit the sprawl that is associated with the existence of edge cities. It should be noted that many of the negative and inconclusive ATE values occurred in urban areas that can be considered to be secondary employment centers for the Portland Metro area. This is similar to the results found by Anas and Pines (2008) and Boarnet et al. (2011), who found that less developed, more suburban areas can become more developed with the implementation of growth controls. The remaining UGBs with negative or inconclusive ATEs are more isolated cities, located relatively far from any urban center.

Future research is planned to evaluate the development probabilities on agricultural lands and in riparian corridors (this research is presented in chapter 4 of this dissertation). We will examine the increase in development in these areas over time, compared with lands in other uses and areas. This will allow us to explore the effect of Oregon's land use legislation on specific resource areas, and consider whether agricultural lands and riparian corridors were actually protected as described in the State Goals and Senate Bill 100.

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2.8. Tables and Figures

Table 2-1: LCT Categories.

LCT code	Land Use Category	Associated Color
1	Water	blue
2	Developed	red
3	Mechanical Disturbed/Transitional	magenta
4	Mining	black
5	Natural Barren	gray
6	Forest	green
7	Grassland/Shrubland	yellow
8	Agriculture	orange
9	Wetland	cyan
10	Non-Mechanical Disturbed/Transitional	purple
11	Snow/Ice	white

Table 2-2: UGB Amendments.

City	Additions			Area of Original UGB (acres)	(Area of Addition)/(Area of original UGB)
	Year	Area (acres)	In study area? (yes/no)		
Brownsville	1989	2.01	yes	924.92	0.002
Dallas	1996	1.26	yes	3,861.56	0.000
Dundee	1987	0.96	yes	751.63	0.001
	1993	1.36	yes	751.63	0.002
	1994	5.60	yes	751.63	0.007
Harrisburg	1990	20.88	no	1,094.50	0.019
Newberg	1993	9.59	yes	4,070.59	0.002
Scappoose	1991	89.18	yes	1,674.05	0.053
	1991	76.53	no	1,674.05	0.046
	1991	613.39	yes	1,674.05	0.366
	1995	2.94	no	1,674.05	0.002
	1998	2.58	yes	1,674.05	0.002
Sheridan	1989	8.25	yes	1,522.00	0.005
	1989	18.87	yes	1,522.00	0.012
	1998	15.95	yes	1,522.00	0.010
	1998	1.36	yes	1,522.00	0.001
Stayton	1994	9.73	yes	3,079.76	0.003

	Year	Area (acres)	Jurisdiction
Metro NE*	1981	21.02	CTROUTD
	1983	70.30	CPORTL
	1985	17.53	CGRESH
	1990	6.59	CGRESH
	1993	70.69	CPORTL
	1998	1,382.19	CGRESH
	1998	123.37	ZMETRO
Metro SW*	1983	186.94	ZMETRO
	1988	4.48	CLAKEO
	1988	1.22	CLAKEO
	1989	15.18	CORCIT
	1997	16.70	CWESTL
	1998	36.65	ZMETRO
	1998	4.72	ZMETRO
	1998	2.66	ZMETRO
	1998	6.54	CLAKEO

*The list of additions to the metro UGB only include those that overlap the LCT data

Table 2-3: Data Sources.

Data	Source	Details	Data Format
Elevation	Elevation data was downloaded from National Elevation Dataset (NED). This dataset is available on the USGS Seamless Server.	Elevation data used for this analysis is in 1 arcsecond resolution. The vertical distance is measured in meters.	Raster Dataset
Slope	Slope was calculated from the elevation data using ArcGIS.	Slope is in units of degrees.	Raster Dataset
Highways	An Oregon Department of Transportation (ODOT) generated shapefile of state-owned highways was downloaded from the Oregon Geospatial Enterprise Office. http://gis.oregon.gov/DAS/EISPD/GEO/alphalist.shtml	The highway data used in this analysis is the 2008 ODOT data representing State-owned highways.	Shapefile
Land Ownership	The shapefile representing public and private land ownership was developed by the Oregon Department of Forestry (ODF), and downloaded from the Oregon Geospatial Office. http://gis.oregon.gov/DAS/EISPD/GEO/alphalist.shtml	This 2008 dataset defines public and private lands, in addition to listing the agency in charge of any public lands.	Shapefile
Soil	Soils data was provided by Dave Helmers at the University of Wisconson. This dataset is primarily composed of data from The Soil Survey Geography (SSURGO) database. SSURGO data is collected and processed by the Natural Resource Conservation Service (NRCS) at the county level for all states in the U.S. In any location where SSURGO data was not available, the coarser State Soil Geographic Database (STATSGO) was used.	This data is available in 30 m Arc grids for each state, and represents the Non-Irrigated Capability Class (NICC). Although the original NICC values in SSURGO ranged from 1-8,they were condensed and generalized as follows (the values range from 1 to 4, where 1 equals most suitable for development and 4 means almost completely unsuitable for development). SSURGO -> condensed scale; (1-2) -> 1; (3-4) ->2; (5-6) ->3; (7-8) ->4	Raster Dataset
City Centers	The location of each city center was downloaded from Google Maps. A cross-section of these city centers were compared with the central business district (CBD) as defined in each city's comprehensive plan.	This data represents the approximate central business district for a given urban area. The data frame coordinate system used by Google Maps is WGS 1984 Web Mercator. This data was used to calculate the distance to the city center from each LCT parcel in the analysis of a given city.	points referenced by a coordinate system
Urban Growth Boundaries	Maps presenting the progression of Oregon's UGBs between 1980-2000 were provided by Angela Lazarean at the Oregon DLCD	This dataset contains all versions of Oregon's UGBs from 1980-2000.	Shapefile, Excel spreadsheet
City Boundaries	City boundaries were downloaded from the US Census Bureau. This data was projected to match the coordinates of the UGB shapefile. http://www.census.gov/geo/www/cob/bdy_files.htm	This data includes the boundary of all cities in Oregon as measured during the 1990 census. We only include incorporated cities.	Shapefile, Excel spreadsheet

Table 2-4: Results for McMinnville[10]

	Model I								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
	total observations: 8772; number of negative weights: 0								
constant	0.0707	*	0.000	0.0707	*	0.000	0.0707	*	0.030
time	0.0131		0.103	0.0131		0.103	0.0131		0.275
group	0.2195	*	0.000	0.2195	*	0.000	0.2195	*	0.001
interaction	**0.1267**	*	**0.000**	**0.1267**	*	**0.000**	**0.1267**	*	**0.000**

	Model II								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
	total observations: 8772; number of negative weights: 1476								
constant	0.5425	*	0.000	0.5535	*	0.000	0.5535	*	0.026
time	0.2963	*	0.000	0.1059		0.207	0.1059		0.452
group	0.1898	*	0.000	0.1996	*	0.000	0.1996	*	0.009
interaction	**0.1095**	*	**0.000**	**0.1115**	*	**0.000**	**0.1115**	*	**0.001**
1.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	0.0131		0.095	0.0146		0.166	0.0146		0.695
3.soil	-0.0006		0.945	0.0017		0.911	0.0017		0.961
slope	0.0040	*	0.000	0.0014		0.508	0.0014		0.840
elevation	0.0083	*	0.000	0.0070	*	0.000	0.0070	*	0.019
highway distance	-0.0001	*	0.000	-0.0001	*	0.000	-0.0001	*	0.045
time*highway distance	0.0000	*	0.014	0.0000	*	0.033	0.0000		0.205
city center distance	-0.0004	*	0.000	-0.0004	*	0.000	-0.0004	*	0.002
time*city center distance	-0.0001	*	0.007	0.0000		0.889	0.0000		0.936
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.001
time * city center distance squared	0.0000		0.094	0.0000		0.663	0.0000		0.786
city limit distance	0.0000	*	0.000	0.0000	*	0.000	0.0000		0.195
time* city limit distance	0.0000		0.870	0.0000		0.771	0.0000		0.915

[10] A p-value of 0.05 or below is indicated by an asterisk (*)

	Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
	total observations: 8772; number of negative weights: 1504								
constant	-0.2793	*	0.000	-0.1245	*	0.000	-0.1245	*	0.002
time	-0.0235		0.616	-0.0022		0.884	-0.0022		0.842
group	0.2855	*	0.000	0.2236	*	0.000	0.2236	*	0.001
interaction	**0.1275**	*	**0.000**	**0.1094**	*	**0.000**	**0.1094**	*	**0.001**
1.soil									
2.soil									
3.soil									
slope									
elevation									
highway distance									
time*highway distance									
city center distance									
time*city center distance									
city center distance squared									
time * city center distance squared									
city limit distance									
time* city limit distance									
block 1 (base)	0.0000		.	0.0000		.	0.0000		.
block 2	-0.0062		0.856	0.0230	*	0.025	0.0230	*	0.004
block 3	0.3877	*	0.000	0.2112	*	0.000	0.2112	*	0.000
block 4	0.3942	*	0.000	0.2852	*	0.000	0.2852	*	0.000
block 5	0.2826	*	0.000	0.1486	*	0.000	0.1486	*	0.000
block 6	0.2779	*	0.000	0.1470	*	0.000	0.1470	*	0.000
block 7	0.2780	*	0.000	0.1451	*	0.000	0.1451	*	0.000
block 8	0.3814	*	0.000	0.2811	*	0.000	0.2811	*	0.000
block 9	0.3904	*	0.000	0.2580	*	0.000	0.2580	*	0.000
block 10	0.2066	*	0.000	0.1185	*	0.000	0.1185	*	0.000
block 11	0.2769	*	0.000	0.1346	*	0.000	0.1346	*	0.000
block 12	0.5297	*	0.000	0.3852	*	0.000	0.3852	*	0.000
block 13	0.7653	*	0.000	0.6156	*	0.000	0.6156	*	0.000
block 14	0.3335	*	0.000	0.2169	*	0.000	0.2169	*	0.000
block 15	0.0263		0.433	0.0281	*	0.025	0.0281	*	0.000
block 16	-0.0062		0.854	0.0310	*	0.002	0.0310	*	0.003
time*block 1	0.0441		0.428	0.0244		0.304	0.0244	*	0.000
time*block 2	-0.1040		0.082	-0.0474	*	0.015	-0.0474	*	0.000
time*block 3	0.0244		0.637	-0.0221		0.556	-0.0221	*	0.000
time*block 4	0.0491		0.381	0.0349		0.323	0.0349	*	0.000
time*block 5	0.2034	*	0.000	0.1957	*	0.000	0.1957	*	0.000
time*block 6	-0.1168	*	0.043	-0.0494		0.099	-0.0494	*	0.000
time*block 7	-0.1012		0.087	-0.0391		0.198	-0.0391	*	0.000
time*block 8	0.1265	*	0.018	0.1116	*	0.002	0.1116	*	0.000
time*block 9	0.0636		0.234	0.0691		0.083	0.0691	*	0.000
time*block 10	0.0959		0.087	0.0514		0.120	0.0514	*	0.000
time*block 11	0.0248		0.609	0.0294		0.345	0.0294	*	0.000
time*block 12	0.0177		0.747	0.0071		0.864	0.0071	*	0.000
time*block 13	-0.0352		0.529	-0.0524		0.151	-0.0524	*	0.000
time*block 14	0.0024		0.963	-0.0422		0.221	-0.0422	*	0.000
time*block 15	0.1887	*	0.003	0.0947	*	0.001	0.0947	*	0.000
time*block 16 (base)	0.0000		.	0.0000		.	0.0000		.

	Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
	total observations: 8772; number of negative weights: 1732								
constant	-0.1903		0.089	-0.0741		0.548	-0.0741		0.911
time	0.0288		0.857	-0.2817		0.106	-0.2817		0.623
group	0.2107	*	0.000	0.1701	*	0.000	0.1701	*	0.001
interaction	**0.0755**	*	**0.000**	**0.0921**	*	**0.000**	**0.0921**	*	**0.014**
1.soil	0.0000		.	0.0000		.	0.0000		.
2.soil	0.0013		0.881	0.0034		0.738	0.0034		0.896
3.soil	0.0222		0.070	0.0224		0.147	0.0224		0.585
slope	0.0031		0.076	-0.0004		0.845	-0.0004		0.951
elevation	0.0100	*	0.000	0.0078	*	0.000	0.0078	*	0.005
highway distance	-0.0002	*	0.000	-0.0001	*	0.000	-0.0001		0.189
time*highway distance	-0.0001	*	0.000	-0.0001	*	0.000	-0.0001		0.058
city center distance	-0.0001	*	0.009	-0.0001		0.065	-0.0001		0.785
time*city center distance	0.0001		0.233	0.0002	*	0.050	0.0002		0.517
city center distance squared	0.0000	*	0.004	0.0000	*	0.034	0.0000		0.776
time * city center distance squared	0.0000		0.076	0.0000	*	0.043	0.0000		0.426
city limit distance	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.000
time* city limit distance	0.0000		0.417	0.0000		0.169	0.0000		0.554
block 1 (base)	0.0000		.	0.0000		.	0.0000		.
block 2	0.0792	*	0.020	0.0674	*	0.000	0.0674		0.317
block 3	0.2919	*	0.000	0.1494	*	0.000	0.1494		0.237
block 4	0.3262	*	0.000	0.2314	*	0.000	0.2314		0.059
block 5	0.2297	*	0.000	0.1053	*	0.000	0.1053	*	0.008
block 6	0.5111	*	0.000	0.3504	*	0.000	0.3504	*	0.001
block 7	0.4438	*	0.000	0.3295	*	0.000	0.3295	*	0.000
block 8	0.4083	*	0.000	0.3319	*	0.000	0.3319		0.052
block 9	0.3604	*	0.000	0.2920	*	0.000	0.2920	*	0.006
block 10	0.3903	*	0.000	0.2907	*	0.000	0.2907	*	0.003
block 11	0.3553	*	0.000	0.2361	*	0.000	0.2361		0.095
block 12	0.5105	*	0.000	0.4104	*	0.000	0.4104		0.165
block 13	0.7916	*	0.000	0.6458	*	0.000	0.6458		0.106
block 14	0.3498	*	0.000	0.1949	*	0.001	0.1949		0.613
block 15	0.2674	*	0.000	0.1666	*	0.000	0.1666		0.302
block 16	0.0714	*	0.041	0.0907	*	0.000	0.0907		0.111
time*block 1	0.0694		0.172	0.1242	*	0.000	0.1242	*	0.002
time*block 2	-0.1362	*	0.006	-0.0064		0.806	-0.0064		0.850
time*block 3	-0.1284	*	0.005	-0.0640		0.166	-0.0640		0.467
time*block 4	0.0132		0.786	0.0529		0.248	0.0529		0.503
time*block 5	0.1912	*	0.000	0.2514	*	0.000	0.2514	*	0.000
time*block 6	0.0446		0.372	0.0445		0.311	0.0445		0.452
time*block 7	-0.0112		0.812	0.0473		0.220	0.0473		0.460
time*block 8	0.1294	*	0.045	0.2252	*	0.000	0.2252		0.259
time*block 9	-0.0593		0.230	0.0668		0.173	0.0668		0.527
time*block 10	-0.0948	*	0.020	0.0043		0.907	0.0043		0.891
time*block 11	-0.0766		0.063	-0.0287		0.478	-0.0287		0.745
time*block 12	0.0164		0.801	0.0114		0.864	0.0114		0.924
time*block 13	0.0653		0.397	0.0354		0.672	0.0354		0.797
time*block 14	0.1669	*	0.020	0.1193		0.160	0.1193		0.358
time*block 15	0.2471	*	0.000	0.1955	*	0.000	0.1955	*	0.032
time*block 16 (base)	0.0000		.	0.0000		.	0.0000		.

Table 2-5: Results Summary[11]

	Model I								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
Brownsville	0.0000		1.000	0.0000		1.000	0.0000		.
Carlton	-0.0174		0.611	-0.0174		0.611	-0.0174		0.619
Corvallis/Philomath	0.0405	*	0.007	0.0405	*	0.007	0.0405		0.094
Dallas	0.0430	*	0.015	0.0430	*	0.015	0.0430	*	0.034
Dayton	0.0591	*	0.013	0.0591	*	0.013	0.0591	*	0.030
Donald	0.2574	*	0.000	0.2574	*	0.000	0.2574	*	0.000
Dundee	0.0561		0.068	0.0561		0.068	0.0561	*	0.044
Estacada	0.0011		0.958	0.0011		0.958	0.0011		0.356
Harrisburg	0.0846	*	0.005	0.0846	*	0.005	0.0846		0.332
Lafayette	0.1588	*	0.000	0.1588	*	0.000	0.1588		0.128
Lebanon	0.0262	*	0.027	0.0262	*	0.027	0.0262		0.150
Lowell	0.1562	*	0.000	0.1562	*	0.000	0.1562		0.118
McMinnville	0.1267	*	0.000	0.1267	*	0.000	0.1267	*	0.000
Newberg	0.0340		0.127	0.0340		0.127	0.0340		0.644
Sheridan	0.3433	*	0.000	0.3123	*	0.000	0.3123	*	0.009
Stayton/Sublimity	0.1211	*	0.000	0.1211	*	0.000	0.1211	*	0.016
St. Helens	-0.0137		0.801	-0.0137		0.801	-0.0137		0.538

[11] A p-value of 0.05 or below is indicated by an asterisk (*)

	Model II								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
Brownsville	0.0000		1.000	0.0000		1.000	0.0000		.
Carlton	-0.0138		0.634	-0.0108		0.746	-0.0108		0.655
Corvallis/Philomath	0.0235		0.143	0.0328	*	0.025	0.0328		0.150
Dallas	0.0644	*	0.001	0.0483	*	0.010	0.0483	*	0.032
Dayton	0.0270		0.159	0.0426		0.096	0.0426		0.068
Donald	0.3938	*	0.000	0.3437	*	0.000	0.3437		0.064
Dundee	0.0267		0.208	0.0406		0.109	0.0406		0.309
Estacada	-0.0032		0.854	0.0020		0.921	0.0020		0.243
Harrisburg	0.1672	*	0.000	0.1060	*	0.003	0.1060		0.054
Lafayette	0.1562	*	0.000	0.1902	*	0.000	0.1902		0.080
Lebanon	0.0905	*	0.000	0.0179	*	0.043	0.0179		0.197
Lowell	0.0007		0.984	0.0307		0.474	0.0307		0.410
McMinnville	0.1095	*	0.000	0.1115	*	0.000	0.1115	*	0.001
Newberg	0.0630	*	0.000	0.0387		0.053	0.0387		0.546
Sheridan	0.2428	*	0.000	0.2128	*	0.000	0.2128		0.063
Stayton/Sublimity	0.1391	*	0.000	0.1138	*	0.000	0.1138		0.059
St. Helens	0.1061		0.234	-0.0288		0.733	-0.0288		0.764

	Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
Brownsville	0.0000		1.000	0.0000		1.000	0.0000		.
Carlton	-0.0906	*	0.038	-0.0142		0.677	-0.0142		0.657
Corvallis/Philomath	0.0302		0.085	0.0400	*	0.005	0.0400		0.108
Dallas	0.0539		0.134	0.0449	*	0.008	0.0449	*	0.029
Dayton	0.0570		0.130	0.0655	*	0.003	0.0655	*	0.026
Donald	0.2367	*	0.000	0.2572	*	0.000	0.2572	*	0.022
Dundee	0.0585		0.090	0.0535	*	0.030	0.0535		0.080
Estacada	0.0013		0.974	0.0014		0.939	0.0014		0.337
Harrisburg	-0.1281	*	0.002	0.0948	*	0.001	0.0948		0.201
Lafayette	0.2532	*	0.000	0.1576	*	0.000	0.1576		0.129
Lebanon	0.0853	*	0.000	0.0329	*	0.001	0.0329		0.159
Lowell	-0.0294		0.577	0.1391	*	0.000	0.1391		0.112
McMinnville	0.1275	*	0.000	0.1094	*	0.000	0.1094	*	0.001
Newberg	0.0605	*	0.006	0.0376	*	0.049	0.0376		0.615
Sheridan	0.3702	*	0.000	0.2874	*	0.000	0.2874	*	0.017
Stayton/Sublimity	0.2398	*	0.000	0.1277	*	0.000	0.1277	*	0.016
St. Helens	0.0034		0.952	-0.0041		0.937	-0.0041		0.846

	Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
Brownsville	0.0000		1.000	0.0000		1.000	0.0000		1.000
Carlton	-0.0273		0.298	-0.0093		0.780	-0.0093		0.560
Corvallis/Philomath	0.0464	*	0.001	0.0443	*	0.004	0.0443		0.113
Dallas	0.0414		0.086	0.0335		0.151	0.0335	*	0.036
Dayton	-0.0402		0.075	0.0369		0.172	0.0369		0.098
Donald	0.3952	*	0.000	0.3431	*	0.000	0.3431		0.063
Dundee	0.0569	*	0.005	0.0360		0.149	0.0360		0.408
Estacada	0.0175		0.595	0.0006		0.981	0.0006		0.437
Harrisburg	-0.0921	*	0.018	-0.0128		0.776	-0.0128		0.736
Lafayette	0.1388	*	0.000	0.1238	*	0.002	0.1238		0.112
Lebanon	0.0160	*	0.048	0.0133		0.200	0.0133		0.255
Lowell	0.1025	*	0.003	0.0337		0.494	0.0337		0.354
McMinnville	0.0755	*	0.000	0.0921	*	0.000	0.0921	*	0.014
Newberg	-0.0944	*	0.000	0.0447		0.056	0.0447		0.481
Sheridan	0.1968	*	0.000	0.1701	*	0.000	0.1701	*	0.021
Stayton/Sublimity	0.0995	*	0.000	0.0984	*	0.000	0.0984		0.052
St. Helens	-0.0475		0.568	-0.0424		0.619	-0.0424		0.603

Table 2-6: Estimation Results for All Cities (Model I).

	Brownsville		Carlton		Corvallis/Philomath	
Variable	coefficient	p-value	coefficient	p-value	coefficient	p-value
constant	0.1506	0.000	0.0361	0.000	0.1220	0.000
time	0.0000	1.000	0.0283	0.021	0.0335	0.000
treatment group	0.2417	0.000	0.3427	0.000	0.1477	0.000
ATE	**0.0000**	**1.000**	**-0.0174**	**0.611**	**0.0405**	**0.007**
	Dallas		Dayton		Donald	
Variable	coefficient	p-value	coefficient	p-value	coefficient	p-value
constant	0.0911	0.000	0.0079	0.003	0.0546	0.000
time	0.0042	0.635	0.0061	0.159	0.0171	0.230
treatment group	0.3019	0.000	0.2671	0.000	0.4111	0.000
ATE	**0.0430**	**0.015**	**0.0591**	**0.013**	**0.2574**	**0.000**
	Dundee		Estacada		Harrisburg	
Variable	coefficient	p-value	coefficient	p-value	coefficient	p-value
constant	0.1208	0.000	0.0305	0.000	0.0098	0.025
time	0.0168	0.290	0.0000	1.000	0.0411	0.000
treatment group	0.4206	0.000	0.1748	0.000	0.5814	0.000
ATE	**0.0561**	**0.068**	**0.0011**	**0.958**	**0.0846**	**0.005**
	Lafayette		Lebanon		Lowell	
Variable	coefficient	p-value	coefficient	p-value	coefficient	p-value
constant	0.0423	0.000	0.0077	0.001	0.0736	0.000
time	0.0013	0.899	0.0064	0.085	0.0683	0.000
treatment group	0.2028	0.000	0.0974	0.000	0.1535	0.000
ATE	**0.1588**	**0.000**	**0.0262**	**0.027**	**0.1562**	**0.000**
	McMinnville		Newberg		Sheridan	
Variable	coefficient	p-value	coefficient	p-value	coefficient	p-value
constant	0.0707	0.000	0.2998	0.000	0.0310	0.000
time	0.0131	0.103	0.1192	0.000	0.0000	.
treatment group	0.2195	0.000	0.1025	0.000	0.0252	0.010
ATE	**0.1267**	**0.000**	**0.0340**	**0.127**	**0.3433**	**0.000**
	Stayton/Sublimity		Saint Helens			
Variable	coefficient	p-value	coefficient	p-value		
constant	0.0420	0.000	0.1333	0.000		
time	0.0069	0.427	0.0633	0.037		
treatment group	0.1038	0.000	0.3501	0.000		
ATE	**0.1211**	**0.000**	**-0.0137**	**0.801**		

Figure 2.1: LCT blocks and the McMinnville UGBs.

Figure 1: LCT blocks and the McMinnville UGBs

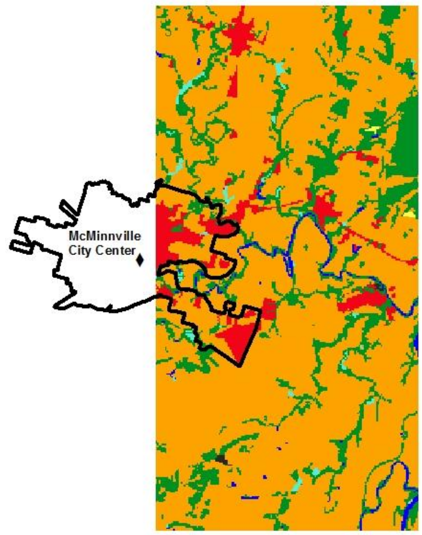


Figure 1a. LCT data and the McMinnville UGB in 1973.

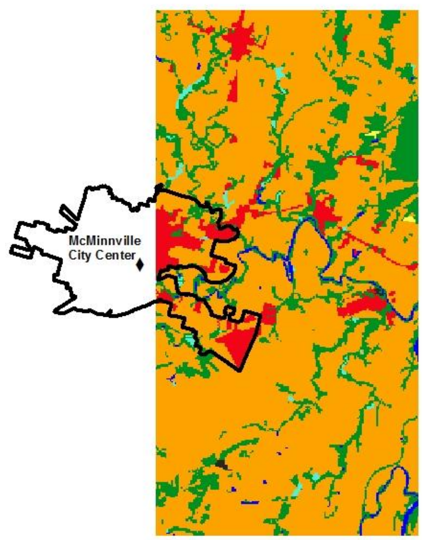


Figure 1b LCT data and the McMinnville UGB in 2000

Figure 1 shows the overlap of LCT data with the McMinnville UGB. Land use categories are presented in Table 1.

Figure 2.2: Treatment Effects.

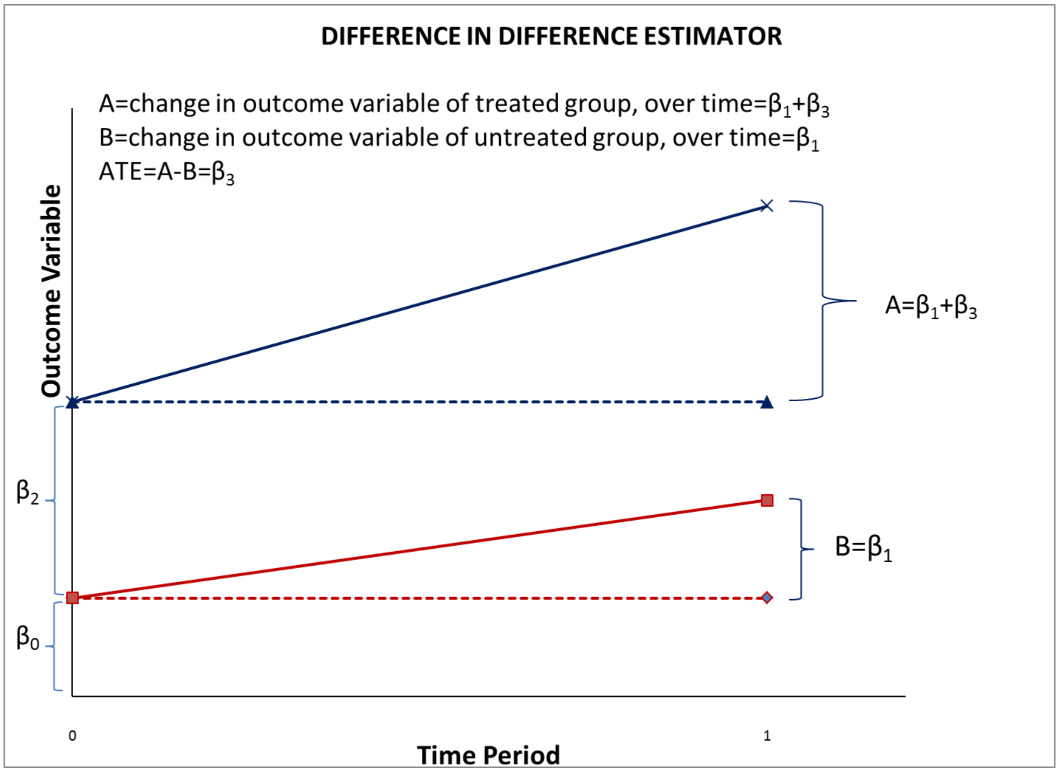


Figure 2.3: The Urban Growth Boundary Buffer for the McMinnville Urban Growth Boundary Divided into 1-Square Kilometer Blocks

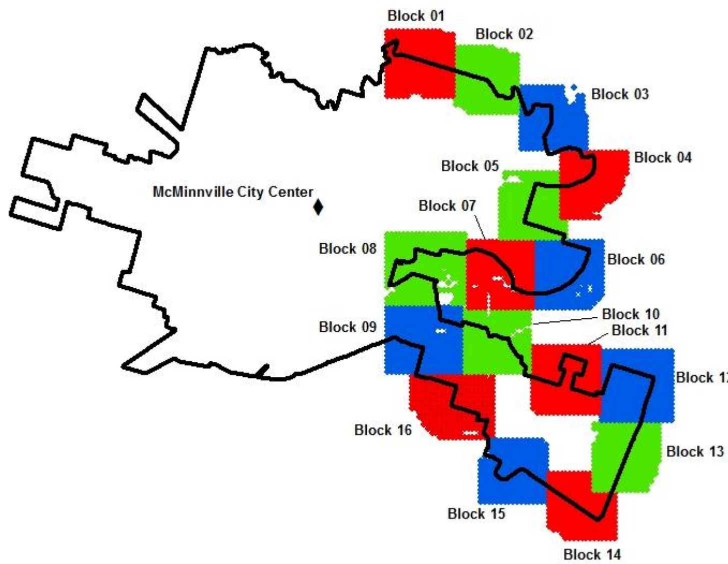
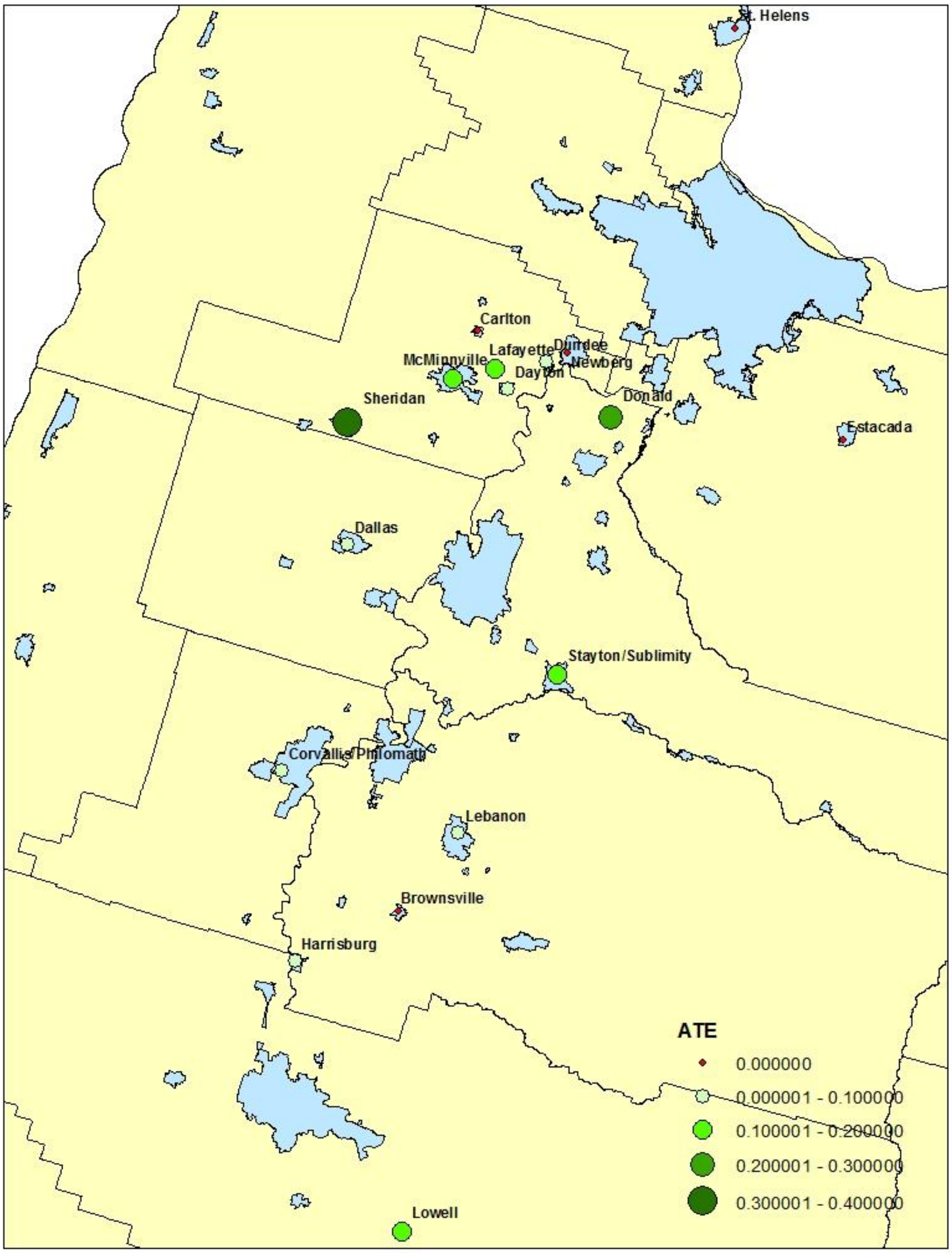


Figure 2.4: Results Map.



CHAPTER THREE

A STUDY OF VOTER ANNEXATION IN OREGON: DIRECT DEMOCRACY IN ACTION.

3.1. Introduction

The state of Oregon has a rich history of land use planning, dating back to the 1800s. In 1969, the Oregon Legislative Assembly passed Senate Bill 10, which asserted that every city and county in the state should have a comprehensive land use plan and zoning ordinance in place by 1971. However, this bill was ineffectual because there was no way to enforce its requirements. In response to these problems, Senate Bill 100 was passed in 1973, establishing a well-defined system to enforce the statewide creation of both city and county comprehensive plans. One of the goals of each city's comprehensive plan is to manage urban development with the use of an Urban Growth Boundary (UGB). Land inside these boundaries is zoned for specific urban uses, such as residential or commercial development. Although most of the UGBs in Oregon surround a single incorporated city, some UGBs contain multiple cities, such as the Portland Metro UGB, which currently contains 25 cities over three counties, or the Salem/Keizer combined UGB. Whether a UGB includes one city or multiple cities, each one is locally managed and enforced.

In addition to land that is currently developed or zoned for development, every city must maintain enough undeveloped land within the UGB to accommodate 20 years of projected growth. To accomplish this goal, a UGB may be expanded to include new lands, or undeveloped lands inside the UGB may be re-zoned to allow for development in previously un-developable areas. Because each urban area is in charge of administering its own UGB, the method used to make these changes depends on the local jurisdiction. In addition, each city must coordinate with the surrounding county. Although land at the edge of a UGB is generally developed at a lower density than land closer to the city center, the minimum lot size varies by city and county. These procedures are outlined in city and county comprehensive plans. Land may also be annexed to a UGB or the associated city for other reasons, such as access to public services.

Besides the creation of UGBs, another goal of Senate Bill 100 is to encourage citizen involvement in the planning process. Citizen involvement was not always an important aspect of land use planning. The first comprehensive zoning ordinance in the United States was adopted by New York City in 1916 (Jorden and Hentrich, 2003), and served as a model for other cities as they began to develop their own zoning ordinances. Public participation was incorporated into the implementation of these ordinances. Any time a new regulation was proposed, the affected landowners were given notice of the time and location of the associated public hearing. However, these hearings usually occurred simultaneously with or just before adoption of the proposed regulation, such that landowners had little real say in the process. As time has passed, the right of the public to have significant input in land use decisions has increased.

Oregon Senate Bill 100 represented a step forward in citizen involvement. Through this bill, ORS 197.160 established the state´s Citizen Involvement Advisory Committee (CIAC) to advise the Land Conservation and Development Commission and local governments on matters pertaining to citizen involvement. Every city and county comprehensive plan in Oregon includes a citizen involvement chapter, which describes how the public can participate in each phase of the planning process. Local governments periodically evaluate their efforts to involve citizens, and, if necessary, update these programs. Each city also has a Committee for Citizen Involvement (CCI) which is responsible for assisting the governing body with a program that promotes and enhances citizen involvement in land-use planning[12]. Because each comprehensive plan and therefore each UGB is administered locally, the specific methods of incorporating citizen involvement vary from city to city. At the same time, the goals and statutes used to enforce this legislation are constant throughout the state. Citizen involvement can take the form of public meetings and comments, involvement with the local CCI and Citizen Advisory Committee (CAC), or possibly the requirement that all amendments or annexations to the city and UGB (that are not required for reasons of public health or safety) be approved by a public vote (CIAC, 2008). Currently, 31 Oregon cities require a public vote for this type of land use decision.

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[12] As a component, the program for citizen involvement shall include an officially recognized CCI, which is broadly representative of geographic areas and interests related to land use and land use decisions. Committee members shall be selected by an open, well publicized public process. The committee for citizen involvement shall be responsible for assisting the governing body with the development of a program that promotes and enhances citizen involvement in land-use planning, assisting in the implementation of the citizen involvement program, and evaluating the process being used for citizen involvement. If the LCDC allows a planning commission to be used in lieu of an independent CCI, its members shall be selected by an open, well-publicized public process.

This paper will analyze voter annexation in Oregon[13]. More specifically, this paper will address the following two questions. First, does voter annexation cause changes in city demographics and characteristics? Second, assuming that a city votes for amendments and annexations to the UGB and city limits, what factors impact the outcome of the vote?

The first question explores the differences between Oregon cities that vote for UGB and city limit annexations and amendments, and those cities that do not vote for these changes. Previous studies that have examined this topic find that cities that choose to place land use decisions on a ballot tend to be whiter, wealthier, and more liberal than those that do not. Once a land use decision is on the ballot, it is also noted that cities with these same demographics are more likely to pass referenda that promote preservation and restrict development. The appearance of land use decisions on a public ballot may also lead to increased provision of public goods, as developers seek endorsements from special interest groups, which can show up as arguments in favor of an annexation vote. Alternatively, zoning restrictions can reduce the supply of housing, thereby reducing the availability of low income housing and shifting the demographics within a city.

[13] Oregon is not the only state with this type of decision-making process. One significant example is Florida, where Amendment 4 was placed on the November 2010 ballot in an attempt to require public votes for annexation decisions. Controversy followed this amendment throughout its campaign. Some claimed that it would restrict growth and encourage better urban planning, as it was designed to do. On the other hand, others predicted that it would make the annexation process slower and more expensive, ultimately wasting taxpayer dollars. In the end, this amendment did not pass, and in 2011 it actually inspired a backlash of bills that reduced the requirements to annex land into urban areas across Florida.

Building on these findings, I will examine the following questions:

- Question 1a: Does the presence of voter-approved annexation slow the population growth of a community?
- Question 1b: Does the presence of voter-approved annexation increase housing prices?
- Question 1c: Does the presence of voter-approved annexation restrict development / does voter-approved annexation reduce the number of housing starts per year?
- Question 1d: Does the population of school age children in a community drop with voter-approved annexation?
- Question 1e: Does the area within the city limit increase more rapidly in a community with voter-approved annexation?
- Question 1f: Does voter-approved annexation cause an increase in the proportion of a community that is white?

I examine this set of questions using two matching techniques. First, I use the method of propensity score matching, which has not previously been used to explore this topic. Second, I will manually match cities that vote for land use annexation and amendments to cities that do not vote for these changes. This was done by Dr. Greg Perry, using his historical knowledge and understanding of social, economic, political, demographic, and geographic trends in Oregon. There may be certain characteristics that cause one group of cities to use voter annexation, and another group of cities not to vote for these land use changes. If we simply compared randomly selected cities within each of these groups, we could mistakenly conclude that the underlying differences between the groups were actually caused by the process of voter annexation. Similarly, if we restrict the study to cities that employ voter annexation, and evaluate the changes in these cities over time, it is impossible to know if these changes are caused by the annexation process itself, or if they are due to other factors that influence the cities' development. The same factors that lead a city to hold a public vote to determine land use decisions may also lead the city to develop differently over time. The matching methods that are used in this paper help us to construct a counterfactual, and therefore provide more accurate estimates of the differences that arise between cities that use voter annexation and those that do not.

The matching techniques used in this paper are an important advance in understanding the effects of voter-approved annexation. I match cities based on their underlying propensity to use the method of voter annexation. This propensity is estimated using characteristics of each city, measured before voter annexation was adopted. Compared to previous papers, we are therefore able to identify the effect that direct democracy has on the characteristics of a city, and to separate these effects from the underlying differences that exist between cities that choose to use this process and cities that do not. In addition, much of the literature compares urban areas across multiple states, or urban areas that are within the same state but are subject to varying land use regulations[14]. The cities in our sample are all subject to the same set of land use regulations, however each city is able to determine the specific methods that will be used to enforce these regulations at a local level. Therefore, the differences that arise between cities in our sample that use direct democracy for land use decisions, and the cities that do not, can be more clearly attributed to the method with which these regulations are enforced at the local level, instead of to the stringency of the regulation itself. The cities are matched based on information from 1990, and the effects are observed in 2000. Therefore, we isolate the characteristics of cities after voter annexation was able to impact the behavior of both developers and the voting public.

The second question, which is only evaluated for cities that employ voter annexation, asks whether annexation and amendment vote approvals in Oregon are random events, or if they can be explained by characteristics of the city and of the voting process itself. This second question will be evaluated by considering which variables are significant in a regression with the dependent variable indicating the proportion of "yes" votes. Based on a review of the literature, the independent variables in these regressions include information on the vote itself, such as the size of the annexation and the number

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[14] Although UGBs are used for land management in other states, these programs are not as centralized or uniformly enforced as in Oregon. For example, Washington requires Urban Growth areas around its incorporated cities, however the land use regulations in this state are more decentralized and less stringent than in Oregon, and this legislation was not passed until 1990. Land use planning in California is also often discussed in the literature. While many cities across California have UGBs, they are both designed and implemented on a local basis. Some cities in California employ direct democracy in the implementation of their UGBs, however there is so much other local variation that it is difficult to separate the impact of direct democracy from the other unique aspects of a given UGB.

of arguments for or against the annexation in the voter pamphlet. They include demographic variables, such as school enrollment and age. They also include economic indicators such as income, tax, and employment data.

Although the methods used to address the second question are similar to those used in previous research, I have a particularly rich data set on annexation and amendment votes in Oregon. There are currently 31 cities in Oregon that vote for annexations, and each city has held multiple annexation and amendment votes. Therefore, I can observe the impacts of the characteristics of individual cities as well as the characteristics of the vote itself. For each vote, all voters have access to a voter pamphlet, therefore I am able to assume that the voter base has complete information. Finally, the time frame of the voting events is long enough so that voters are able to adjust their behavior based on past experience.

This paper is organized as follows: The second section contains the literature review, the third section describes the data used in the analysis, and the fourth section outlines the methods used in this paper. The remaining sections contain results, discussion, and conclusions.

3.2. Literature Review

There are many factors that impact a city's decision to annex new land or rezone existing lands to either encourage or restrict development. When land is annexed into a city, the city must then provide municipal public services to residents of and properties on this land, creating a new financial burden to the city and the taxpayers. Although this type of expansion is usually associated with a population increase, and therefore an increase in the tax base, it turns out that in most cases the added cost to the city is greater than any increase in income that may come from this new tax base. Dubin, Kiewiet, and Noussair (1992) noted that municipal services are not pure public goods, therefore the cost of their provision can rise rapidly when populations become larger and more heterogeneous, since the infrastructure requirements of these goods do not allow them to be completely non-rival or non-excludable. It can also be especially expensive to expand this type of public infrastructure into newly annexed land. The added population associated with an annexation may also shift the demographics of a city, thereby changing the preferences of the voters. Feiock (2004) found that zoning can be used as a mechanism to manipulate the voter base in a community. When city annexations and amendments are not approved, less land is available for development. This can reduce the housing opportunities of low-income households, either by artificially inflating the cost of housing or by restricting the types of housing available. This, in turn, may lead to income segregation within and between urban areas. Austin (1999) reviewed annexation decisions in the 1950s and found that most city officials claimed that tax revenues from newly annexed areas would not cover the costs of new structures and services. He concluded that many annexations were designed to shift the voter base with the addition of a wealthier, whiter suburban population. Population growth and economic development can also produce negative externalities, including traffic congestion, environmental degradation, and a decline in the amenities that contribute to the overall quality of life.

There may be certain characteristics that cause one group of cities to use voter annexation, and another group of cities not to vote for these land use changes. The first question in this paper uses matching techniques to account for this possibility. Kotchen and Powers (2006) examined the impact of community growth and demographics on open space referenda that occurred in New Jersey and Massachusetts between 1998 and 2003, as well as performing a nation-wide analysis during this time, and concluded that greater population growth, greater household incomes, greater home values, and greater home ownership rates all increase the likelihood of the appearance of an open space initiative on a ballot. Romero and Liserio (2002) and Howell-Moroney (2004) also determined that community characteristics are a significant predictor of whether or not a community will choose to add a ballot measure geared towards preserving open space, with smaller, whiter, and wealthier areas more likely to provide open space preservation measures. Based on a study of open space ballot measures in Massachusetts, Hawkins (2011) stated that support for growth management tends to be more prevalent in affluent and predominantly white homeowner suburban communities. Nelson, Uwasu, and Polasky (2007) found that municipalities with highly educated and environmentally-concerned residents were more likely to hold open space referenda. Nguyen (2007) agreed that growth controls are more likely to appear on the ballots in cities that are wealthier and whiter, and which have greater residential stability and higher homeownership rates.

In addition to community characteristics, development pressures may impact a city's decision to use direct democracy for land use decisions. Hawkins found that when there is competition for development across communities, it is less likely that there will be ballot measures to preserve open spaces, while communities that face conflict over residential development are more likely to propose a ballot measure vote for land preservation and growth management policies. Howell-Moroney concluded that the appearance of a referendum is responsive to patterns of land use, with low population density and loss of open space increasing the probability of an open space referendum. Nelson, Uwasu, and Polasky also found that larger populations, low population density, and rapid growth of the surrounding area increased the likelihood of an open space ballot measure. Gerber and Phillips (2003) looked at land use decisions in California, focusing on San Diego, which requires voter approval for all development in the city's "future urbanizing areas", or FUA. They point out that many proponents of slow growth feel that current residents have different incentives regarding growth than elected representatives do, and will therefore be less tolerant of new development. Residents of a community may receive few of the direct benefits from development, while paying substantial costs in the forms of traffic, congestion, environmental degradation, loss of open space, strain on infrastructure, invasion of privacy, and depression of existing housing values. Therefore anti-growth interests believe that voter-approved development will ultimately slow the rate of urban development. However, pro-growth interests think that voters will oppose the negative consequences of growth restrictions, such as increased densities, limitations on property rights, and increased housing prices, and will support the purported advantages of growth, including job creation and enhanced service provision. After conducting a multivariate analysis at the precinct level, Gerber and Phillips (2003) found evidence in support of both arguments. Voters in many communities do not appear to have strong and consistent anti- or pro-growth preferences, but rather favor growth under some circumstances and oppose growth under others.

The first set of questions in this paper explores whether city characteristics are impacted by the use of direct democracy in zoning decisions. Gerber and Phillips (2005) used a series of difference of means tests and a multivariate regression analysis to examine policy differences between cities in California that adopted their UGBs by citizen initiative, and those who used legislative means. Specifically, they asked whether these differences were caused by direct democracy itself, or if they reflected an underlying difference between cities that choose to employ direct democracy and those that do not. Based on their analysis, they concluded that direct democracy results in stricter land use legislation. Voter annexation can also impact the provision of public goods to a community. Gerber and Phillips (2004) studied a group of 21 cities in California, including San Diego, all of which require a public vote to approve new development within the FUA. These land use rules were created locally. Gerber and Phillips (2004) recognized that the placement of development referenda on the ballot requires developers to seek approval from voters as well as from public officials. Based on a study of ballot measures for development restrictions in these cities in 2000, they found that developers may provide two categories of public goods to gain voter approval. The first category includes public services and facilities, which benefit the voters that are directly impacted by the proposed development. The second category includes environmental amenities, which benefit the entire voting base. These public goods may attract the endorsement of pivotal special interest groups, which in turn impact the behavior of voters at the ballot box. Therefore, although voting requirements might slow growth initially, developers can compensate by shifting their energy and resources from lobbying elected representatives to negotiating with the unelected interest group representatives of the voting public. Because of this, introducing land use decisions to the ballot may change the public goods that are available to a community. Hawkins (2011) studied the impacts of public voting on open-space legislation, finding that endorsements of specific ballot measures by environmental organizations positively influence voter acceptance. However, he found no statistically significant relationship between pro-growth interests and support for growth management.

In addition to impacting the characteristics of the city itself, Gerber and Philips (2004) find that a public vote may also change the scale of development. When developers must provide expensive public goods and services in exchange for interest group endorsements, the ability to compete may be limited to developers with sufficient capital to cover the cost of these goods, cutting out smaller developers. On the other hand, smaller developments may not attract as much public attention, and therefore may not be forced to provide public good amenities. Another possible consequence is an increase in housing costs. By restricting supply, zoning restrictions can increase the costs of housing. Housing prices may also go up as developers pass their increased costs (of lobbying voters and providing public goods) on to future residents. In addition, Staley (2001) finds that the fact that a community is willing to place land use decisions on the ballot appears to be a signal to developers that their projects will face higher levels of uncertainty and delay compared to cities that resolve land use decisions through a legislative or administrative process. This type of restricted development may cause a given jurisdiction to become a less attractive place to live. For example, restrictions on commercial or industrial development may stunt employment growth. Using a model based on Wu and Plantinga (2003), Warziniack (2010) compared open space decisions made under a majority rules voting scheme to the welfare-maximizing outcome. He found that requiring referenda for amenity decisions can lead to inefficient outcomes, because people may vote based on their location in relationship to the amenity, and not based on net benefits across the entire population. In order to gain the support of more than half of the voting population, the amenities that are provided are larger than what is needed to achieve the social optimum.

The process of voter annexation may also allow the voting public to affect the demographics of their community through land use decisions. Nguyen (2007) found that placing development on the ballot could be used as a tool to economically segregate neighborhoods. Nguyen points out that growth controls can inflate housing prices by restricting supply, raising costs for developers, increasing demand, and encouraging improvements in housing or community amenities. This may limit the types of housing units that are available to low-income residents and minorities, and can have exclusionary consequences by shifting the type of housing development and, consequently, the socio-demographic composition of cities. She also found that cities that held annexation decisions to public vote had greater growth in housing, higher densities, and increasingly longer commutes to work over time. However, in this case the causality is not clear, as she states that cities that experience rapid growth and its negative externalities, such as longer commute times, are more likely to adopt growth control policies at the ballot box in the first place. Finally, Nguyen states that demand for housing in a growth control jurisdiction may increase for a variety of reasons, most relating to improvements in housing structure or neighborhood quality.

The second question in this paper asks what factors can impact the passage of a land use measure once it is on the ballot. The current literature focuses on the socioeconomic and demographic characteristics of a community, and also on the development pressures and patterns that a community faces. Kotchen and Powers (2006) determined that open space is a normal good, and that jurisdictions with greater household income are more likely to vote in favor of an open space referendum. Kline and Armstrong (2001) concluded that support for a measure to restrict clear-cut logging and herbicide and pesticide use in forests across Oregon was positively correlated with population density, income, education, and proportion of county voters who are registered as democrats. Feoick (2004), on the other hand, found no evidence that education, income levels, poverty populations, percentage white, or Democratic party registration influenced the restrictiveness of growth management plans. Nelson, Uwasu, and Polasky (2006) determined that, for cities holding an open space referendum, those with low unemployment rates and highly educated residents, and with no new taxes associated with the open space were more likely to pass these referenda, and conserve open space.

Existing levels of development can also impact the outcome of these land use measures. Feoick found that counties that contain more industrial land apply more growth restrictions than counties with less industrial land, which may be a response to the encroachment of this type of development into residential areas. Nelson, Uwasu, and Polasky (2006) included rapid growth of a community on their list of factors that increase the likelihood that an open space referendum will pass. Kline and Wilchens (1994) considered referenda focused on farmland preservation in Pennsylvania and Rhode Island, and found that this type of referendum has stronger support in counties and towns with increasing population and increasing land and house values. Nguyen (2007) outlined two main factors that appear to be associated with the adoption of growth controls at the ballot box. First, cities experiencing rapid growth and the negative externalities associated with growth, such as longer commute times, are more likely to adopt growth control policies at the ballot box. Second, voters in communities with more resources and capacity are better able to utilize the ballot initiative process to adopt growth control policies. In addition to the characteristics of a community, the design of the ballot itself may impact the outcome. For example, Kotchen and Powers noted that the number of amendments on the ballot may also impact the outcome of the vote, and Gerber and Phillips (2003) concluded that that voter choice is impacted by endorsements of community planning boards, as well as the provision of public goods by developers.

In summary, the findings of previous studies suggest that voter-approved annexation will:

- slow the population growth within a community;

- increase housing prices;
- reduce the number of housing starts per year;
- change the population of school-aged children, due to the resulting population shift, and
- limit expansions of the city limits.

Because all cities in Oregon were already predominantly white prior to the adoption of voter-approved annexation, we do not expect to see a significant change in the racial breakdown of any city as a result of voter-approved annexation.

In addition, if voter behavior in Oregon is consistent with voter behavior in the other studies cited, the literature review leads us to believe that cities with a higher median income and a more educated population will be less likely to approve annexation and amendment votes. Public endorsements, which are expressed in the arguments for and against an annexation or amendment vote, are also expected to have a strong impact.

3.3. Data

To answer the questions that we pose in this paper, we need to collect both city-specific data and vote-specific data. The city-specific data will be used in both questions. For the first question, these data will be used to match cities that vote for land use changes with those that do not. City-specific data will then be used to examine the differences that result when a city adopts the process of voter annexation. The second question, which is only evaluated for cities that use voter annexation, asks whether annexation and amendment vote approvals in Oregon are random events, or if they can be explained by characteristics of the city and of the voting process itself. The city-specific variables were chosen based on the literature review above, and include demographic and other descriptive variables for each city. Based on the voting process in Oregon, the vote-specific data are able to reflect not only the number of votes for and against a given annexation, but also other descriptive variables, such as the number of arguments for and against the measure in the voters' pamphlet.

The complete list of available data, with the exception of vote-specific data, is listed in table 1. This table is organized by data source and category. The variables in this table were collected for 1990 and 2000. The first column contains the variable name, and the second column contains a description of the variable. Most of the data come from the US Census, including statistics for school enrollment, marital status, educational attainment, population age breakdown, race, household and housing statistics, income, home value, and total population. Because Census data categories did not exactly match between 1990 and 2000, some categories (for example, education, age, and race) were combined to create a consistent data set. Employment data are from the Bureau of Labor Statistics (BLS), violent and property crime data are from the Federal Bureau of Investigation (FBI), and tax data are from the Oregon Department of Revenue. Only larger cities had data available from these last three sources[15]. It was assumed that the characteristics of smaller cities were similar to the characteristics of the surrounding

[15] Data was available from the BLS for cities with population greater than 25,000. Data was available from the FBI for local reporting agencies with population coverage of greater than 10,000. Data was available from the Oregon Department of Revenue for 84 large cities in Oregon.

county, while the populations and characteristics of larger cities could not be represented by the characteristics of the surrounding county. For example, violent crime rates in a small town or city are likely to be similar to those in the surrounding area, while larger cities may have higher crime rates than the surrounding county. For data that were not available at the city level, county level data were scaled to reflect the population of each small city. Tax data from 1990 were not available, therefore 1995 data were used. City boundary data for 1990 and 2000 were obtained from the US Census, while UGB data for all years were obtained from the Oregon Department of Land Conservation and Development (DLCD). Political party registration data was only available at the county level.

Some of the variables in table 1 are used directly in the analysis, and some are used to create other variables. For example, the number of students enrolled in kindergarten through 12th grade may not be as important as the proportion of the population that is enrolled in these grades. Also, some variables are not used in the analysis because they are very similar between cities. One example of this is the percentage of the total population that is female, which is fairly consistent throughout the state. Finally, some variables may be collinear and are therefore dropped. An example of this is the number of students in kindergarten through 12th grade, compared with the population under age 18.

To explore the first question in this paper, the method of propensity score matching is used to pair cities that vote and do not vote for annexation and amendment decisions. The propensity score is calculated using two different specifications. The data sources for the independent variables are listed in table 1, while the variables used in each specification are presented in table 2.

In addition to the data listed in table 1, data were also collected on each voting event in Oregon through 2009, to be used in the analysis of the second research question. These variables are presented in table 3. A given city may have several separate annexation or amendment ballot measures during the same election, and there may be multiple elections during a single year. Conversely, the same city may have no annexation or amendment ballot measures during some other election event. Therefore, this panel data set provides us with repeat observations for each city, but not at constant intervals. Each vote for an annexation or amendment to a city limit or UGB is held at the city level, and administered through the appropriate county elections office. There are four types of elections: district, special, primary, and general. General elections are held in November of even years, and every other general election is a presidential election. Primary elections are held in May of even years. The other election types are held more often. A dummy variable was created to represent election type. Vote specific data include election year, election type, area of land under consideration (in acres), total votes for and against each ballot item, number of arguments in the voter pamphlet for and against the ballot item, number of years since the city began to vote for annexation and amendment decisions, and number of items on the ballot. The number of arguments for and against a ballot item in the voter pamphlet can represent the number of groups and individuals that choose to endorse or oppose a particular ballot measure. As mentioned previously, these endorsements and oppositions can signify the provision of public and environmental goods by developers, in an attempt to elicit support from environmental organizations and other respected groups, and persuade the voting public to approve their development projects.

Some of the annexation and amendment ballot items that did not pass the public vote were placed back on the ballot in later elections. Among this group, some ultimately passed, while others did not. An indicator variable has been created that is equal to one for any annexation or amendment decision that appears during multiple elections, and is equal to zero otherwise. An indicator variable was also created that is equal to one when there is no information on the size of the annexation. Although it would seem that this variable would mirror the indicator variable for missing voter pamphlet data, this is not always the case. While many counties list a complete description of the properties in question, including address and size, in the ballot title, others do not.

There is vote-specific data for every year that an annexation or amendment vote occurred. However, the list of covariates presented in table 1 is only available for the years 1990 and 2000. To estimate the values of these covariates during the other years, we linearly interpolate the values between 1990 and 2000, and extrapolate the values before and after this time period. While this may not be exactly representative of the data in each year, it allows us to approximate the characteristics of each city at a given point in time.

3.4. Methods

The first question in this paper is evaluated by comparing cities that vote for amendments and annexations to cities that do not vote for these changes. The first method that is used to compare these two groups of cities is propensity score matching. As a robustness check, cities are also matched using institutional knowledge of Oregon's urban areas.

The propensity score, as introduced by Rosenbaum and Rubin (1983), is the calculated probability of receiving a treatment, given a vector of pretreatment characteristics. This can also be thought of as the underlying propensity for a jurisdiction to hold a referendum:

$$e(X) = pr(z = 1|X) = E(z|X) \quad (1)$$

Where $z_i = 1$ if unit i is treated, and $z_i = 0$ if unit i is untreated.

The actual propensity for a city to hold a public vote, z_i^*, cannot be observed. However, we can observe whether or not a given urban area chooses to hold a public vote to approve this type of land use decision. If $z_i^* > 0$, the city chooses to hold a public vote for final decision of UGB and city annexation and amendment decisions, and therefore $z_i = 1$. If $z_i^* \leq 0$, the city does not hold a public vote for these decisions, therefore $z_i = 0$

The propensity score is a balancing score, which is a function of the observed covariates, *X*, such that the conditional distribution of *X* given the balancing score, which in this case is *e(X),* is the same for the treated units ($z_i = 1$) and control units ($z_i = 0$) (Dawid, 1979), (Rosenbaum and Ruben. 1983):

$$X \perp z|e(X) \quad (2)$$

In other words, for a given propensity score, we assume that exposure to treatment is random, and therefore treated and control units should be, on average, observationally identical (Becker and Ichino, 2002)

The key assumption needed to derive a treatment effect using the propensity score is strong ignorability, which consists of two parts (Rosenbaum and Rubin 2003), (Imbens and Wooldridge 2008). The first assumption of strong ignorability is unconfoundedness. This states that treatment assignment and response are conditionally independent, given the vector of covariates, X. We let $Y_{i,1}$ indicate the potential outcome if unit i is treated (if city i chooses to vote for annexation and amendment decisions), and $Y_{i,0}$ indicate the potential outcome if unit i is untreated (if city i does not vote for amendment and annexation decisions). The outcomes will correspond to each of the sub-questions under the first question in this paper. Therefore, we assume that assignment to treatment is unconfounded given the vector of covariates, X:

$$\left(Y_{i,1}, Y_{i,0}\right) \perp z_i | X \qquad (3)$$

This implies that the assignment to treatment is also unconfounded given the propensity score:

$$\left(Y_{i,1}, Y_{i,0}\right) \perp z_i | e(X) \qquad (4)$$

The assumption of unconfoundedness states that, conditional on the propensity score, there are no unobserved factors that are associated both with the treatment assignment and with the potential outcomes (Imbens and Wooldridge, 2008). If this assumption is not met, our results will be biased. The assumption of unconfoundedness implies that we have included all relevant variables in the estimation of the propensity score. While this is a very strong assumption, and is unlikely to be the case, we are assisted by the relative homogeneity of the study area. Statewide laws and regulations are normalized across the cities in our sample.

The second assumption of strong ignorability is overlap. This states that for all possible values of the propensity score, there are both treated and control units.

$$0 < pr(z_i = 1|e(X)) < 1 \qquad (5)$$

The overlap assumption implies that the support of the conditional distribution of *e(X)* for treated units overlaps the distribution of *e(X)* for untreated units (Imbens and Wooldridge 2008, Rosenbaum and Rubin 2003). In other words, the overlap assumption states that for each possible value of the propensity score, there must be a positive probability of finding both a treated and an untreated unit, to ensure that each treated unit can be matched with an untreated unit. If some units in the treatment group have estimated propensity scores that cannot be matched by those units in the comparison group, it is not possible to construct a counterfactual, and therefore, the impact for this subgroup cannot be accurately estimated

Once the propensity score is calculated, treated and untreated units are matched and the average treatment effect is calculated. This paper uses the average treatment effect on the treated (ATT), which is defined by Imbens and Wooldridge as the average treatment effect over the subpopulation of treated units:

$$\tau = E[Y_{i,1} - Y_{i,0}|z_i = 1] \qquad (6)$$

The assumption of strong ignorability allows us to estimate the ATT[16] in the following manner:

$$\tau = E[E\{Y_{i,1} - Y_{i,0} | z_i = 1, e(X_i)\}] \quad (7a)$$

$$\tau = E[E\{Y_{i,1} | z_i = 1, e(X_i)\} - E\{Y_{i,0} | z_i = 0, e(X_i)\} | z_i = 1] \quad (7b)$$

where the outer expectation is over the distribution of $(e(X_i)|z_i = 1)$ (Becker and Ichino, 2002). The property of unconfoundedness allows us to move from equation 7a to equation 7b, since $E[Y_{i,z}|z_i = z, e(X_i)]$ does not depend on treatment assignment ($z_i = 1$ or $z_i = 0$). In addition, the overlap assumption allows us to estimate both terms in the second line, and therefore to estimate the treatment effect, τ.

The propensity score and ATT were calculated in Stata using the pscore code written and presented by Becker and Ichino (2002). We use a logit model to estimate the propensity score. The dependent treatment variable is equal to 1 if the city voted for UGB and city annexation and amendment decisions in 2010, and is equal to 0 if these decisions were made using some other process. Two different specifications are used to calculate the propensity score. In addition, each specification is used separately for each hypothesis in question one. This is to ensure that the propensity score calculation does not include the variables that are used to measure the ATT for a given hypothesis. A list of the variables used in each propensity score calculation, as well as the estimated coefficients and the significance of these coefficients are presented in table 2. The pscore

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[16]By using the ATT, we isolate the impact of voter annexation on the cities that have chosen to implement this system.

program allows the option of only calculating treatment effects in the region of common support, where the propensity scores of treated and untreated units completely overlap, or calculating the propensity score regardless of the region of common support, which can increase the overall number of matches. This paper only includes matches that are in the region of common support, in order to improve the quality of the matches. The pscore program also automatically checks that the propensity score is a balancing score, by ensuring that the propensity score can be broken into distinct intervals such that each interval has the same average propensity score and covariate values for treated and untreated units.

Once the propensity score is calculated, treated and untreated units must be matched. This provides us with the counterfactual, or the estimated outcome for each treated unit in the absence of treatment. The propensity score is defined to be a balancing score, so any set of treated and untreated units with the same balancing score are observationally identical, with the exception of the treatment itself. Because the propensity score is a continuous variable, the probability of observing a treated and untreated unit with the same propensity score is zero. Several methods are available to match treated and untreated units based on the propensity score. The techniques used in this paper include stratification/interval matching, nearest neighbor matching, caliper/radius matching, and kernel matching. The stratification method calculates the ATT by dividing the propensity score into intervals, and matching the average of the treated and the average of the untreated units in each interval, then taking the overall ATT of all the blocks. These intervals are calculated so that the treated and untreated units have the same average propensity score, similar to the test of the balancing property used for calculation of the propensity score itself. Any treated unit that does not have a propensity score in one of these intervals will not be included in the ATT calculation. Nearest neighbor matching calculates an ATT for each treated unit by comparing it to the untreated unit with the propensity score that is closest to its own. This is done with replacement. The downfall to this method is that, although all treated units are matched to untreated units, some of these matches are not very close[17]. With radius matching, each treated unit is matched to its "nearest neighbor", or propensity score that is closest to its own, but only if a match falls within a pre-specified interval. This paper uses the default interval, which is 0.10[18]. Kernel matching matches each treated unit with a weighted average of all controls, with weights that are inversely proportional to the distance between the propensity scores of the treated unit and each control. Kernel matching is therefore able to include all treated units in the calculation of the ATT.

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[17] There are two methods that can be used to perform nearest neighbor matching in the pscore program. To save on computing time, nearest neighbors are not determined by comparing treated observations to every single control, but rather by first sorting all records by the estimated propensity score, and then searching forward and backward for the closest control unit(s). If, for a treated unit, forward and backward matches happen to be equally good, there are two computationally feasible options. One option is to assign an equal weight to the groups of forward and backward matches. The other option randomly draws either the forward or backward match. In practice, the case of multiple nearest neighbors is very rare. This paper uses the first matching method. As a robustness check, treatment effects were also estimated using the second method. Results are identical between the two methods.

Treatment effects were estimated in Stata using the programs outlined in Becker and Ichino (2002).

The propensity score requires that treated and untreated units must be matched based on their pre-treatment characteristics. The ATT is then calculated using data that was generated after the treatment took effect. Data are currently available for the years 1990 and 2000. Therefore, only cities that began to vote for annexation and amendment decisions between these years are included in the analysis. They are matched based on data from 1990, and the ATT are calculated based on data from 2000.

The pscore code, written by Becker and Ichino (2002), includes calculations for the standard error of the ATT when nearest neighbor and radius matching is used. In addition, the bootstrap method is used to calculate the standard error for each of the matching techniques. Abadie and Imbens (2006) stated that the bootstrap is not a valid estimator for the standard error of the treatment effect for matching estimators, and provide alternative standard errors. However, these standard error calculations are developed for treatment effects that are calculated by matching on covariates, and not for treatment effects that are calculated via propensity score matching. Abadie and Imbens (2009) return to this issue and derive estimates of the standard error for use with propensity score matching. But, these estimates have not been widely adopted in the literature, and are not currently available for Stata. This analysis uses the standard errors

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[18] As a robustness check, radius matching was also performed and evaluated using a radius of 0.2 and a radius of 0.05. Results were consistent with all three values. Extended tables with the results of the additional analysis are available upon request.

that are provided in the pscore program by Becker and Ichino, and also include bootstrap standard errors, which are still used in the literature to estimate standard errors in this type of analysis (Liu and Lynch, 2011). Confidence intervals are estimated using each one of these standard errors.

In addition to propensity score matching, this paper also relies on Dr. Greg Perry's knowledge of Oregon cities to compare cities that use voter annexation to cities that do not vote for land use changes. A list of cities that vote for annexation and amendment decisions, along with their untreated "matches" are presented in table 4. To calculate the treatment effect with this method, I simply calculated the difference in the treatment variable for each set of matched cities, and then calculated the overall average of these treatment effects:

$$ATT = \frac{1}{N_T}\sum_{i=1}^{N_T}[Y_{i,1} - Y_{i,0}] \qquad (8)$$

Where N_T is the number of cities that employ voter annexation. For voter annexation city i, $Y_{i,1}$ is the outcome of the treatment variable, and $Y_{i,0}$ is the outcome of the treatment variable for the matched city that does not use voter annexation.

To answer the second question, I use the logit model, and then examine the significance of each of the covariates. This is estimated using the panel data set described earlier, with multiple voting events observed for each city. In an attempt to address the challenges of estimating individual demands for collective (public) goods, Deacon and Shapiro (1975) developed a model that begins with individual preferences and aggregates up to collective voting results. This model divides voters into groups based on their characteristics, and then evaluates voting outcomes based on the behavior of each group. The logit specification used in our paper is a simplified version of their model, and has become the primary method used to investigate factors that can impact a public vote. This micro foundation implies that aggregate voting results can be used to make inferences about individual voter preferences (Kotchen and Powers, 2006). Fischel (1979) provided empirical support for this type of voter aggregation, when he found little difference in a comparison between aggregate voting results and individual preferences for an environmental referendum in New Hampshire. Kline and Wilchens (1994) also used the logit model in their analysis. However, they were not able to use the full Deacon and Shapiro model because that framework requires knowledge of how many voters abstain from voting, which was not available in their data set. Instead, Kline and Wilchens focused on the logit transformation of the percent of voters approving the referendum, which they estimated using Ordinary Least Squares (OLS).

Nelson, Uwasu, and Polasky (2006) and Kotchen and Powers (2006) both used the Heckman two-step estimator in their analyses of the impacts of voting for land use decisions. In both papers, the first step employed a probit model to evaluate which community characteristics lead a city to hold an open space referendum. The second stage used the logarithm of the odds of a “yes” vote during a given referendum to evaluate what characteristics lead to a passing vote. Nelson, Uwasu, and Polasky estimated this second stage using OLS, with the addition of the estimated inverse Mills ratio. Kotchen and Powers (2006) estimated the second stage using Weighted Least Squares (WLS), with the weights implemented using the minimum chi-squared estimator (Greene, 1999). Although Kotchen and Powers used the Heckman estimator in their analysis of Massachusetts and New Jersey data, they did not use this procedure in their analysis of national data. The national analysis did not evaluate what characteristics lead a community to hold a public vote, focusing instead on the factors that contribute to the outcome of a referendum. The minimum chi-squared estimator was also used in the national study. Many other papers have chosen to only investigate the outcome of the vote, and do not include the use of the Heckman estimator. The majority of these papers, including Kline and Armstrong (2001), Dubin, Kiewiet, and Noussair (1992) and Kahn and Matsusaka (1997) use the logit model estimated with WLS, where the weights are estimated with the use of the minimum chi-squared estimator.

To employ the logit model, we assume that the probability of a passing vote takes the logistic form, so that:

$$P_{ibt} = \frac{e^{f(x_{ibt},\beta)}}{1+e^{f(x_{ibt},\beta)}} \text{ and } (1 - P_{ibt}) = \frac{1}{1+e^{f(x_{ibt},\beta)}} \quad (9)$$

where P_{ibt} is the proportion of "yes" votes for city i, ballot measure b, in time t, and $(1 - P_{ibt})$ is the proportion of "no" votes. These proportions are measured separately for each ballot measure. By taking the log of the ratio of the two equations, we obtain $\ln\left(\frac{P_{ibt}}{1-P_{ibt}}\right) = f(x_{ibt}, \beta)$, where $f(x_{ibt}, \beta) = x_{ibt}'\beta$. This model is estimated in Stata, using WLS. The weight for each observation i is calculated using a two-step process. First, we estimate the logit model to generate the predicted proportion of "yes" votes, $P_{ibt,}$, for each ballot measure in each city, during each time period. These values are then used to create the weight matrix. More specifically,

$$W_{ibt} = (n_{ibt}P_{ibt}(1 - P_{ibt}))^{1/2} \quad (10)$$

where n_i=total number of votes cast in city i for ballot measure b at time t (Greene, 1999).

The minimum chi-squared logit model will be estimated using both least squares (LS) and the generalized linear model (GLM) with a logit link. The method of LS is straightforward to apply, once we construct the natural log of the proportion of votes for and against each annexation or amendment. The GLM allows us to include the observations in which the proportion of "yes" votes is equal to either one or zero, which must be dropped in the LS analysis, or the dependent variable would be undefined. The GLM is also estimated without the weights described above. All of the model specifications will use the same covariates. To calculate each of these models, the data was pooled, and a city-specific fixed effect was added to the analysis.

3.5. Results and Discussion

The analysis for the first question did not reveal any significant differences between cities that vote for annexation and amendment decisions and those that do not. This is in contrast to most of the research cited above, which found that voter-approved annexation causes developers to provide more public goods and increase the scale of development, thereby shifting community demographics. These results were consistent for both specifications of the propensity score and the manual matching of cities, and can be seen in table 5.

As a robustness check, each sub-part of question 1 was evaluated using two different specifications of the propensity score. The ATT was then estimated for each specification using the four different matching techniques described earlier. Each hypothesis was also evaluated using manual matching. Therefore, there are nine estimated ATTs for each part of question 1. The bootstrap method is used to estimate the 95% confidence interval for each of the ATTs estimated with propensity score matching. There are three different bootstrap confidence intervals that are estimated in the pscore program: the normal confidence interval, the percentile based confidence interval, and the bias corrected confidence interval. The pscore program also calculates a t-score and a standard error for the ATTs estimated using nearest neighbor matching and radius matching, therefore we are able to calculate confidence intervals using these values. Finally, a 95% confidence interval is calculated for the ATT estimated using manual matching. Overall, almost all of the confidence intervals calculated for each part of question contain zero. While some of the bootstrap intervals did not contain zero, this only occurs in isolated circumstances. All of the calculated 95% confidence intervals contain zero within the interval. Thus we conclude that voter annexation does not impact community development, characteristics, or demographics. I did not estimate an ATT that was significantly different from zero for any of the following questions:

- Question 1a asks whether the presence of voter-approved annexations and amendments slows the population growth of a community. The treatment effect in this question measures the percent change of the city's population between the years 1990 and 2000.
- Question 1b asks whether voter-approved annexations increase prices for existing houses. This was evaluated by comparing the percent change in home prices between 1990 and 2000 (in 2010 dollars).

- Question 1c asks whether there is more construction of new housing in cities that vote for annexation and amendment decisions. The treatment variable, which is compared across cities, is the number of housing starts in 1999 and 2000, divided by the total number of housing units.
- Question 1d asks whether the population of school age children in a community drops with voter-approved annexation. This is done by comparing the proportion of the population that is registered for kindergarten through 12th grade, in cities that vote compared to those that do not.
- Question 1e asks whether voter-approved annexations and amendments reduce expansions of the city boundary. This was measured by directly comparing the percent increase of acreage inside a city boundary from 2003 to 2010 in cities that vote to cities that do not vote.
- Question 1f asks if the proportion of a community that is white increases with voter approved annexation. This was measured by comparing the percent change over time of the proportion of the population that is white.

As stated earlier, by setting this study in Oregon we are able to evaluate the impact of direct democracy on land use decisions by comparing cities that are subject to one statewide land use regulation, yet are able to enforce this regulation locally. Public participation is required in all land use decisions across the state. Therefore, although direct democracy allows the final decision to be made by the public, we may conclude that maintaining a high level of citizen involvement throughout the process impacts city characteristics more than the actual act of holding a public vote.

Two specifications were used to calculate the propensity of a city to use voter annexation. The following variables were significant for all subsets of question one in the first specification: ratio of the population that is African American, average rental household size, rental vacancy rate, acres contained within the city limits, ratio of the acres within the city limits to the acres within the UGB, unemployment rate, and population density. All of these variables had negative coefficients. In the second specification, the ratio of the population with some college education and the ratio of the population that was between the ages of 18 to 24 had significant positive coefficients, while the rental vacancy rate had a significant negative coefficient. For both specifications, there were additional covariates that were significant for some subsets, but not all.

The second question in this paper explores the factors that lead to a passing annexation or amendment vote. The estimated models measure the proportion of votes in favor of the annexation or amendment in question, and therefore a positive coefficient indicates that the variable causes the proportion of votes for the annexation or amendment to increase. In other words, a significant positive coefficient indicates that the variable is associated with an increase in the probability of a passing vote, while a negative coefficient implies that as the variable increases, the probability of a passing vote decreases. The regression results for the first question are presented in table 6.

The indicator variable for multiple elections has a significant negative relationship to the proportion of “yes” votes. This variable was highly significant. The negative relationship is to be expected because this variable is restricted to annexation or amendment decisions that failed at least one vote. However, this can also be interpreted to indicate that more controversial land-use decisions are less likely to pass in a public vote. Another variable that may indicate the level of controversy associated with a particular vote is the number of arguments for and against the annexation or amendment in the voter pamphlet. Our analysis shows that arguments in favor of the ballot measure have the desired outcome. The coefficients on this variable are significant for both of the minimum chi squared estimators. The number of arguments against a ballot measure has less of an impact. Although all of the calculated coefficients are negative, only the coefficient calculated in the un-weighted GLM equation is significant. An indicator variable that is equal to one when information from the voting pamphlet was not available was also shown to have a significantly positive relationship with the proportion of passing votes for the regressions using the minimum chi squared estimator. Voter pamphlet data is more likely to be missing in elections from the 1990's or earlier, implying that as time goes on, voters may be less likely to pass annexation and amendment ballot items. This could be caused by an increase in provision of public goods by developers as they adjust to the system of voter annexation.

The size of the annexation has a negative impact on the outcome of the vote, so that larger plots of land are less likely to be annexed into a city, or rezoned for development. The indicator variable that is equal to one when there is no information on the size of the annexation also has a negative relationship with the proportion of "yes" votes. Other characteristics of the ballot and the annexation or amendment itself have mixed impacts on the outcome. The total number of land use initiatives on the ballot is only significant for the GLM model calculated without the weight matrix (with a negative estimated coefficient). The total number of votes cast has a consistently negative effect on the total proportion of "yes" votes. Coefficients of the election type indicator variable show that district elections have a marginally positive relationship with the proportion of "yes votes", and special elections have a marginally negative relationship with a passing vote. Otherwise, these election indicator variables were not significant. A visual examination of the data suggests that the total number of votes may also be related to the election type, with more votes cast in primary and general elections. This is because there is a greater voter return during an election with multiple important issues, such as presidential and senatorial elections, than during an election that is held to vote for very specific ballot items.

The impact of education on the outcome of a land use vote is mixed. The proportion of yes votes decreases as the share of the population ages 25 and over that has less than a 9^{th} grade education increases. On the other end of the spectrum, the proportion of yes votes also decreases as the ratio of the population aged 3 and over that is enrolled in college increases. The ratio of the population (25 years and over) that completed some high school but did not graduate has a positive effect. The ratio of the population (25 years and over) that has a graduate degree does not impact the outcome of a vote.

The average homeowner vacancy rate was not significant. Tax due as a percent of Average Gross Income (AGI) had a negative impact. None of the race variables had a significant impact, nor did the political leaning of the county. Age of the population also did not significantly impact the outcome of the vote. Population density had a strong positive relationship with the outcome of the vote. Variables that measured population and employment change were dropped from the analysis, due to collinearity.

3.6. Conclusions

Within Oregon, there are mixed opinions regarding the effectiveness of voter annexation. During the data collection process for this paper, one county employee stated that there had never been an annexation or amendment vote in her precinct that did not pass, and that she believes the process of voter annexation is a waste of taxpayers' time and money. At the same time, organizations such as Oregon Communities for a Voice in Annexations (OCVA) fight for the right of the voter to participate in these types of land use decisions.

The first set of questions in this paper explores the impacts of direct democracy on community characteristics and demographics, and finds no significant differences between cities that vote for annexation and amendment decisions and those that do not. This is in contrast to past research on this topic. The matching techniques used in this paper allowed us to mitigate the endogeneity that occurs in natural experiments by comparing cities that had similar initial likelihoods of adopting the method of voter annexation, and studying the resulting change in the characteristics of cities that ultimately adopted this technique. Previous papers have not been able to separate the characteristics that cause a city to use direct democracy for land use decisions from the effect that direct democracy has on these same characteristics. In addition, Oregon's statewide land use regulations allowed us to focus on the method with which these regulations are enforced at the local level, instead of the stringency of the regulation itself. Therefore we may hypothesize it is the land use regulation, and not the method of implementation, that guides the characteristics of a city.

In addition to the land use regulation, there is also a requirement throughout Oregon that all cities incorporate public participation in the planning process. Therefore, we must consider the possibility that other types of citizen involvement, if implemented correctly, may cause developers, legislators, and tax payers to behave similarly as they would under a system of voter annexation. It is also possible that cities that employ voter annexation are not as vigilant with other tools of public participation, such as public meetings, or that voters in these cities are less likely to participate in earlier stages of the annexation or amendment process, since they know that they will ultimately voice their opinion at the ballot box. If we can conclude that all methods of public participation have the same result, then an important next step would be to compare the cost of voter annexation to the costs of public participation that occurs earlier in the annexation process.

With regard to the second question examined in this paper, we find that the characteristics of the voting process itself impact the outcome more than community characteristics. Overall, the results from our analysis did not completely agree with the results of previous analyses. Past studies found that more educated communities are more likely to pass ballot items that restrict development, either through the preservation of open space, or similar to our study, through additional barriers to annexation and development. We found that cities with higher levels of college enrollment were less likely to pass annexation and amendment measures, and cities with more adults with a high school education (but no higher degree) were more likely to approve annexations. At the same time, we found that cities with higher numbers of adults with less than 9th grade educations were also less likely to pass these measures. It could be hypothesized that towns with low education rates also tend to house a more permanent population base, due to the types of economic opportunities that may exist in these areas. Tax rates and population density were the only other variables that were not directly related to the voting process, and that we found to have an impact of the outcome of the vote. One might expect that cities with higher tax rates tend to house a wealthier population. Both of these variables are consistent with results found in the literature. Annexations of larger plots of lands are less likely to be approved in a public vote, as are elections with a greater number of voters. Arguments in favor of an annexation vote have more importance than arguments against an annexation vote.

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3.8. Tables and Figures

Table 3-1: Data Sources.

Data Label	**Description**
US Census: http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=DEC&_submenuId=datasets_0&_lang=en	
School enrollment for the population 3 years and older	
total_school_enrollment	Total population ages 3 and older
enrolled_preprimary	enrolled in preprimary school
enrolled_k_12	enrolled in k-12
enrolled_college	enrolled in college
not_enrolled	not enrolled in school
Marital status for the population 15 years and older	
total_marriage_stats	Total population 15 years and older
never_married	never married
married_spouse_present	now married, spouse present
married_spouse_absent	now married, spouse absent
married_separated	now married, separated
married_other	now married, other
widowed	widowed
divorced	divorced
Educational Attainment for the population 25 years and older	
total_educational_attainment	Total population 25 years and older
education_less_9th	less than a 9th grade education
education_9th_12th	9th to 12th grade education but no high school diploma
education_high_school	high school graduates (includes equivalency)
education_some_college	some college education but no degree
education_associate	have obtained an Associates degree
education_bachelor	have obtained a Bachelor's degree
education_grad_school	have obtained a graduate or professional degree
Age	
age_under_5	Total population under the age of 5 years
age_under_18	Total population under the age of 18 years
age_over_18	Total population ages 18 and over
age_18_24	Total population ages 18 through 24
age_25_44	total population ages 25 through 44
age_45_54	Total population ages 45 through 54
age_55_59	Total population ages 55 through 59
age_60_64	Total population ages 60 through 64
age_65_74	Total population ages 65 through 74
age_75_84	Total population ages 75 through 84
age_65_up	Total population 65 years and older
age_85_up	Total population 85 years and older
Race - total population that identifes as:	
race_white	caucasian
race_black	African American

race_native_american	American Indian and Alaska Native
race_asian_PI	Asian or Pacific Islander
race_other	another race not listed above
hispanic	having hispanic origin (of any race)
Households and Housing	
total_households	Total number of households (see http://www.census.gov/prod/2001pubs/c2kbr01-8.pdf for household definitions)
family_households	Total number of family households (families)
married_family_households	Total number of married-couple families
nonfamily_households	Total number of nonfamily households
householder_alone	Total number of householders living alone
householder_65_up	Total number of householders 65 years or older
avg_household_size	Average household size
occupied_housing	Numer of occupied housing units
vacant_housing	Number of vacant housing units
seasonal_housing	For seasonal, recreational, or occasional use
homeowner_vacancy_rate	Homeowner vacancy rate (percent)
rental_vacancy_rate	Rental vacancy rate (percent)
avg_household_size_own	Average household size of owner-occupied unit
avg_household_size_rent	Average household size of renter-occupied unit
total_housing_units	Total number of housing units
total_housing_units	Total number of housing units
housing_units_1999_2000	Total number of housing units built in 1999, 2000
housing_units_1995_1998	Total number of housing units built in 1995-1998
housing_units_1990_1994	Total number of housing units built in 1990-2004
housing_units_1980_1989	Total number of housing units built in 1980-1989
housing_units_1970_1979	Total number of housing units built in 1970-1979
housing_units_1960_1969	Total number of housing units built in 1960-1969
housing_units_1950_1959	Total number of housing units built in 1950-1959
housing_units_1940_1949	Total number of housing units built in 1940-1949
housing_units_pre1939	Total number of housing units built 1939 and before
Income and Home value	
median_home_value_1990	median home value: 1990
median_home_value_2000	median home value: 2000
median_income	Median household income (dollars)
median_home_value	median home value
Total Population	
total_population	Total population
total_population_male	Total population: Male
total_population_female	Total population: Female
city_population_1990	city population: 1990
city_population_2000	city population: 2000
city_population_2010	city population: 2010
Local Area Unemployment Statistics: http://www.bls.gov/lau/data.htm	
Employment	

county_data_used_employment	Indicator variable, equal to 1 if county data was used for employment data, equal to 0 if local data was available. Note that city-level data was only available for cities with population greater than 25,000. Otherwise, county data was used. Emplyment rate was not seasonally adjusted. If city data not available, used (county data*city population/county population)
labor_force	Total labor force
employment	Total employment
employment_change	Employment change from 1990 to 2000. This is a calculated value (employment 2000-employment 1990)/employment1990; same number for 2000, 1990
unemployment	Total unemployment
unemployment_rate	unemployment rate
Uniform Crime Reporting Statistics - UCR Data Online: http://www.ucrdatatool.gov/	
Crime Data	
county_data_used_crime	Indicator variable, equal to 1 if county data was used for crime data, equal to 0 if local data was available.
violent_crime	Total number of violent crime reports. If city data not available, used (county data*city population/county population)
property_crime	Total number of property crime reports. If city data not available, used (county data*city population/county population)
Oregon Department of Revenue, Oregon Personal Income Tax Statistics (150-101-406): http://www.oregon.gov/DOR/STATS/statistics.shtml	
Tax Data	
tax_AGI	Tax Due as percent of AGI. This represents net tax as percent of adjusted gross income. 1995 data used for 1990.
county_data_tax	Indicator variable, equal to 1 if county data was used for tax data, equal to 0 if local data was available. If city data was not available, used (county data*city population/county population). This variable is always equal to 1 in 1990
Oregon Communities For a Voice In Annexations: http://www.ocva.org/annex/cities.html	
Voter Annexation Data	
vote_initiated_day; vote_initiate_month; vote_initiated_year	date the city started voting for amendments
initiated	calculated value: (2011) - (year that the city started voting for amendments)
vote_annex_2010	this variable=1 if city made amendment/annexation decisions via public vote in 2010, 0 otherwise
vote_annex	this variable=1 if city made amendment/annexation decisions via public vote in the year of observation, 0 otherwise
City and UGB Area (two sources)	
US Census GISData: http://www.census.gov/geo/www/cob/bdy_files.html	
city_acres	Total acres of city (1990, 2000). Census data is used to define city limits for 2000 and 1990. A GIS file including all incorporated city boundaries was downloaded from the census website, then any parcel not defined as a city was removed from the dataset.
Oregon Geospatial Enterprise Office (GEO), Oregon DLCD: http://gis.oregon.gov/DAS/EISPD/GEO/alphalist.shtml	

city_acres	Total acres of city. File name: City limits and city annexations for the State of Oregon.
UGB Acres	UGB Acres
city_UGB_ratio	City/UGB acre ratio. This is a calculated value (area of city in acres/area of UGB in acres).
CPI: ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt; http://www.bls.gov/cpi/tables.htm	
current values/ CPI data (CPI April 1989: 123.10; CPI April 2000: 171.3; CPI April 2010: 218.009: multiply by 2010 CPI and divide by current year CPI)	
median_income_2010_dollars	Median household income (dollars) [adjusted to 2010 dollars]
median_home_value_2010_dollars	Median home value (dollars) [adjusted to 2010 dollars]
median_home_value_1990_2010_dollars	Median home value [1990 dollars adjusted to 2010 dollars]
median_home_value_2000_2010_dollars	Median home value [2000 dollars adjusted to 2010 dollars]
Atlas of US Presidential Elections: 2008 data from http://www-cdn.npr.org/news/specials/election2008/presCounty.php?state=Oregon; 1960-2004 data from http://www.uselectionatlas.org/RESULTS/compare.php?year=2004&fips=41&f=0&off=0&elect=0&type=statehttp://www.uselectionatlas.org/RESULTS/compare.php?year=2004&fips=41&f=0&off=0&elect=0&type=state	
political party	
politics	county political leaning (1 if blue, 0 if red, County level data only). Most cities reflect the political leaning of the county in which the majority of the city is located. Albany is the county seat of Linn county, therefore Albany reflects the political leaning of Linn county. When extrapolating data for H1, Clackamas county switched back and forth each election years, so the following values were assigned based on the closest election year: 1999=0, 2005=0, 2006=1, 2007=1, 2009=1

Table 3-2: Propensity Score Matching.

Table 3-2a: Specification 1

Propensity score calculations for Question 1: specification 1												
	Q 2a		Q 2b		Q 2c		Q 2d		Q 2e		Q 2f	
variable (calculated variable)	coefficient	P>|z|	coefficient	P>|z|	coefficient	P>|z|	coefficient	P>|z|	coefficient	P>|z|	coefficient	P>|z|
education												
proportion of school aged population enrolled in k-12	10.902	0.795	10.298	0.801	10.902	0.795			6.496	0.874	11.266	0.788
proportion of school aged population enrolled in college	-4.978	0.865	-5.409	0.858	-4.978	0.865	-5.895	0.840	-1.760	0.954	-4.449	0.877
proportion of adult population that has completed some high school	-23.285	0.148	-26.368	0.099	-23.285	0.148	-22.776	0.157	-8.884	0.476	-23.750	0.126
proportion of adult population that has attained at least a bachelor's degree	-13.118	0.493	-7.683	0.666	-13.118	0.493	-12.695	0.511	-7.785	0.645	-13.879	0.430
age												
proportion of total population that is less than 5 years old	30.347	0.658	26.822	0.693	30.347	0.658	17.770	0.714	16.018	0.808	30.765	0.652
proportion of total population that is under 18	-29.500	0.715	-19.284	0.811	-29.500	0.715	*		-35.413	0.642	-29.517	0.714
proportion of total population that is between 18 and 24 years old	75.095	0.271	81.068	0.240	75.095	0.271	95.482 *	0.036	60.813	0.364	73.804	0.268
proportion of total population that is between 25 and 44 years old	29.839	0.632	33.827	0.590	29.839	0.632	48.374	0.355	21.125	0.725	28.636	0.639
proportion of total population that is between 45 and 54 years old	-57.774	0.463	-41.558	0.597	-57.774	0.463	-40.968	0.438	-42.084	0.517	-57.997	0.462
proportion of total population that is between 55 and 59 years old	-42.138	0.644	-41.007	0.653	-42.138	0.644	-20.780	0.797	-37.774	0.679	-44.926	0.606
proportion of total population that is 65 or older	-2.961	0.961	2.692	0.965	-2.961	0.961	15.541	0.663	-7.026	0.903	-3.525	0.953
race												
proportion of total population that is black	-4040.942 *	0.009	-4090.216 *	0.010	-4040.942 *	0.009	-4035.555 *	0.009	-2892.513 *	0.021	-4049.951 *	0.008
proportion of total population that is native american	62.846	0.619	72.593	0.617	62.846	0.619	64.814	0.605	-9.074	0.941	61.391	0.624
proportion of total population that is hispanic	100.522	0.127	125.996 *	0.047	100.522	0.127	104.065	0.114	56.698	0.273	96.804	0.074
proportion of total population that is white	3.785	0.920	8.927	0.814	3.785	0.920	4.668	0.903	5.524	0.864	*	

Propensity score calculations for Question 1: specification 1												
	Q 2a		Q 2b		Q 2c		Q 2d		Q 2e		Q 2f	
variable (calculated variable)	coefficient	P>|z|	coefficient	P>|z|	coefficient	P>|z|	coefficient	P>|z|	coefficient	P>|z|	coefficient	P>|z|
crime												
number of violent crimes	0.008	0.380	0.007	0.430	0.008	0.380	0.008	0.399	0.010	0.390	0.008	0.381
number of property crimes	-0.001	0.784	-0.001	0.749	-0.001	0.784	-0.001	0.771	-0.002	0.453	-0.001	0.788
property crimes per thousand residents	0.025	0.441	0.039	0.199	0.025	0.441	0.025	0.443	0.010	0.712	0.025	0.446
marriage and households												
total households	-0.011	0.376	-0.012	0.262	-0.011	0.376	-0.011	0.383	-0.002	0.942	-0.011	0.383
ratio of family households to total households	54.458	0.184	60.951	0.143	54.458	0.184	57.170	0.157	57.433	0.114	53.033	0.166
average household size (for homeowners)	-10.743	0.169	-12.044	0.128	-10.743	0.169	-11.017	0.157	-8.600	0.182	-11.007	0.136
average household size (for renters)	-7.926	0.082	-9.358 *	0.049	-7.926	0.082	-8.076	0.078	-4.828	0.142	-7.938	0.079
rental vacancy rate	-1.483 *	0.007	-1.750 *	0.001	-1.483 *	0.007	-1.489 *	0.008	-0.889 *	0.008	-1.481 *	0.007
homeowner vacancy rate	-0.243	0.694	-0.300	0.621	-0.243	0.694	-0.264	0.662	-0.282	0.632	-0.227	0.704
ratio of total population that is married	12.060	0.624	7.263	0.762	12.060	0.624	10.372	0.661	6.343	0.767	13.094	0.557
total housing units	0.010	0.292	0.012	0.159	0.010	0.292	0.010	0.290	0.003	0.868	0.010	0.298
seasonal housing units	-0.044	0.308	-0.036	0.266	-0.044	0.308	-0.044	0.338	-0.053	0.329	-0.043	0.303
total population	0.001	0.629	0.000	0.708	0.001	0.629	0.001	0.664	-0.001	0.527	0.001	0.637
employment, tax, politics, other city data												
city acres	-0.002 *	0.027	-0.002 *	0.011	-0.002 *	0.027	-0.002 *	0.028			-0.002 *	0.027
ratio of city acres to UGB acres	-5.335	0.098	-4.714	0.137	-5.335	0.098	-5.540	0.084	-4.007	0.145	-5.319	0.098
taxes paid per AGI	-3.475	0.249	-3.815	0.190	-3.475	0.249	-3.446	0.253	-3.305	0.225	-3.410	0.247
employment change	0.006	0.987	0.017	0.966	0.006	0.987	-0.006	0.987	-0.207	0.625	0.003	0.993
unemployment rate	-1.779 *	0.020	-1.848 *	0.016	-1.779 *	0.020	-1.816 *	0.017	-1.700 *	0.012	-1.771 *	0.020
median income (2010 dollars)	0.000	0.794	0.000	0.439	0.000	0.794	0.000	0.825	0.000	0.583	0.000	0.779
median home value (2010 dollars)	0.000	0.351			0.000	0.351	0.000	0.353	0.000	0.145	0.000	0.339
politics (1 if blue, 0 if red)	0.099	0.934	0.635	0.544	0.099	0.934	0.140	0.907	0.063	0.957	0.090	0.940
total population/city acres	-1.594 *	0.011	-1.592 *	0.008	-1.594 *	0.011	-1.622 *	0.009	-0.656	0.149	-1.598 *	0.011
constant	46.597	0.469	47.139	0.468	46.597	0.469	27.833	0.635	28.626	0.628	49.613	0.385

* indicates a p-value of 0.05 or below

Table 3-2b Specification 2

Propensity score calculations for Question 1: specification 2												
	Q 2a		Q 2b		Q 2c		Q 2d		Q 2e		Q 2f	
	coefficient	P>|z|	coefficient	P>|z|	coefficient	P>|z|	coefficient	P>|z|	coefficient	P>|z|	coefficient	P>|z|
education												
proportion of school aged population enrolled in k-12	6.212	0.929	24.049	0.611	6.212	0.929	6.212	0.929	6.212	0.929	20.090	0.697
proportion of adult population that has less than a 9th grade education	53.732	0.338	52.494	0.164	53.732	0.338	53.732	0.338	53.732	0.338	105.944	0.052
proportion of adult population that has completed some high school	-31.988	0.494	2.239	0.942	-31.988	0.494	-31.988	0.494	-31.988	0.494	-1.790	0.956
proportion of school aged population that has completed some college but no degree	148.940	0.077	70.781	0.068	148.940	0.077	148.940	0.077	148.940	0.077	95.306 *	0.050
proportion of school aged population that has an associates degree	63.975	0.254	15.016	0.671	63.975	0.254	63.975	0.254	63.975	0.254	46.537	0.289
proportion of adult population that has attained at least a bachelor's degree	-146.663	0.204	-58.429	0.297	-146.663	0.204	-146.663	0.204	-146.663	0.204	-41.764	0.301
proportion of school aged population that has completed graduate school	160.134	0.157	104.782	0.124	160.134	0.157	160.134	0.157	160.134	0.157	77.903	0.159
proportion of school aged population enrolled in college	-73.959	0.391	15.596	0.767	-73.959	0.391	-73.959	0.391	-73.959	0.391	-48.682	0.465
age												
proportion of total population that is under 18	237.462	0.145	88.482	0.287	237.462	0.145	237.462	0.145	237.462	0.145	94.649	0.222
proportion of total population that is between 18 and 24 years old	417.891	0.081	147.468	0.072	417.891	0.081	417.891	0.081	417.891	0.081	267.770 *	0.034
proportion of total population that is between 25 and 44 years old	-149.341	0.122	-71.628	0.172	-149.341	0.122	-149.341	0.122	-149.341	0.122	-47.200	0.288
proportion of total population that is between 45 and 54 years old	-195.302	0.228	-11.339	0.891	-195.302	0.228	-195.302	0.228	-195.302	0.228	-44.722	0.517
proportion of total population that is between 55 and 59 years old	-303.072	0.117	-169.098	0.154	-303.072	0.117	-303.072	0.117	-303.072	0.117	-278.215	0.077
proportion of total population that is between 60 and 64 years old	-419.971	0.230	-102.715	0.440	-419.971	0.230	-419.971	0.230	-419.971	0.230	-47.461	0.694

Propensity score calculations for Question 1: specification 2												
	Q 2a		Q 2b		Q 2c		Q 2d		Q 2e		Q 2f	
	coefficient	P>|z|	coefficient	P>|z|	coefficient	P>|z|	coefficient	P>|z|	coefficient	P>|z|	coefficient	P>|z|
race												
proportion of total population that is white	-269.806	0.162	-134.219	0.174	-269.806	0.162	-269.806	0.162	-269.806	0.162		
proportion of total population that is native american	-0.141	0.312	-0.176	0.171	-0.141	0.312	-0.141	0.312	-0.141	0.312	-0.080	0.400
proportion of total population that is asian or pacific islander	-0.062	0.698	-0.100	0.368	-0.062	0.698	-0.062	0.698	-0.062	0.698	0.015	0.889
proportion of total population that is "other"	-0.257	0.134	-0.195	0.092	-0.257	0.134	-0.257	0.134	-0.257	0.134	-0.154	0.110
proportion of total population that is hispanic	0.087	0.373	0.101	0.165	0.087	0.373	0.087	0.373	0.087	0.373	0.058	0.299
crime												
number of violent crimes	0.319	0.116	0.112	0.211	0.319	0.116	0.319	0.116	0.319	0.116	0.205	0.052
number of property crimes	-0.016	0.237	-0.005	0.514	-0.016	0.237	-0.016	0.237	-0.016	0.237	-0.006	0.331
property crimes per thousand residents	69.192	0.459	17.969	0.726	69.192	0.459	69.192	0.459	69.192	0.459	-21.140	0.659
marriage and households												
total households	0.032	0.145	0.016	0.133	0.032	0.145	0.032	0.145	0.032	0.145	0.012	0.108
family households	0.081	0.107	0.036	0.053	0.081	0.107	0.081	0.107	0.081	0.107	0.035 *	0.031
ratio of family households to total households	107.342	0.252	50.394	0.392	107.342	0.252	107.342	0.252	107.342	0.252	130.308	0.065
average household size	-117.019	0.238	-20.668	0.523	-117.019	0.238	-117.019	0.238	-117.019	0.238	-31.880	0.422
average household size (for homeowners)	15.362	0.706	-14.229	0.539	15.362	0.706	15.362	0.706	15.362	0.706	-3.217	0.896
average household size (for renters)	4.119	0.781	-8.550	0.393	4.119	0.781	4.119	0.781	4.119	0.781	-7.860	0.398
rental vacancy rate	-3.064	0.087	-1.952	0.053	-3.064	0.087	-3.064	0.087	-3.064	0.087	-1.276 *	0.036
homeowner vacancy rate	0.436	0.738	-0.994	0.241	0.436	0.738	0.436	0.738	0.436	0.738	-0.431	0.596
ratio of total population that is married	64.980	0.366	41.769	0.351	64.980	0.366	64.980	0.366	64.980	0.366	0.674	0.983
ratio of total population that is divorced	-164.100	0.181	-40.681	0.457	-164.100	0.181	-164.100	0.181	-164.100	0.181	-76.380	0.227
seasonal housing	-0.003	0.858	0.005	0.677	-0.003	0.858	-0.003	0.858	-0.003	0.858	-0.003	0.879
total populaiton	-0.033	0.111	-0.015	0.051	-0.033	0.111	-0.033	0.111	-0.033	0.111	-0.014 *	0.024
employment, tax, politics, other city data												
city acres	0.000	0.974	0.000	0.988	0.000	0.974	0.000	0.974	0.000	0.974	0.001	0.452
ratio of city acres to UGB acres	-0.070	0.987	0.092	0.976	-0.070	0.987	-0.070	0.987	-0.070	0.987	-0.659	0.790
taxes paid per AGI	-5.320	0.333	-3.012	0.437	-5.320	0.333	-5.320	0.333	-5.320	0.333	-4.234	0.283
employment change	-0.182	0.686	-0.256	0.502	-0.182	0.686	-0.182	0.686	-0.182	0.686	-0.214	0.593
unemployment rate	-4.828	0.109	-1.954 *	0.036	-4.828	0.109	-4.828	0.109	-4.828	0.109	-2.707 *	0.023
median income (2010 dollars)	0.000	0.657	0.000	0.887	0.000	0.657	0.000	0.657	0.000	0.657	0.000	0.279
median home value (2010 dollars)	0.001	0.102			0.001	0.102	0.001	0.102	0.001	0.102	0.000	0.067
politics (1 if blue, 0 if red)	0.309	0.932	3.523	0.075	0.309	0.932	0.309	0.932	0.309	0.932	2.273	0.336
constant	259.315	0.164	112.879	0.168	259.315	0.164	259.315	0.164	259.315	0.164	7.898	0.837

* indicates a p-value of 0.05 or below

Table 3-3: Variable Descriptions.

Data Label	Description	Source
date_month	election month	county websites
date_day	election day	county websites
date_year	election year	county websites
election_type	categories: district, general, primary, special, special district	county websites
presidential_election_year	This variable is equal to 1 if the vote was held in a presidential election year, 0 otherwise.	
city_stata	city name	
City	city name	
Ballot number	ballot number	county websites
Description (Address/Acres)	Description of annexation on ballot. This may include the address of the annexation and the size of the annexation in acres.	county websites
repeat_amendment	Was the amendment on the ballot more than once? If yes, this variable= 1. This applies to each appearance of the amendment, whether or not it passed.	
acres_stata	acres to be annexed	county websites
acres	acres to be annexed	county websites
vote_yes	number of "yes" votes	county websites
vote_no	number of "no" votes	county websites
pass	Did the measure pass? If yes, this variable= 1.	county websites
percent_yes	percentage of "yes" votes	county websites
arguments_for_stata	Number of arguments for the annexation in the voter pamphlet	county websites
arguments_against_stata	Number of arguments against the annexation in the voter pamphlet	county websites
arguments_for	Number of arguments for the annexation in the voter pamphlet	county websites
arguments_against	Number of arguments against the annexation in the voter pamphlet	county websites
County_1	County in which geographic majority of the city is located	http://bluebook.state.or.us/
County_2	Second county in which city is located, if applicable.	http://bluebook.state.or.us/
acres missing	This variable is equal to 1 if area of the annexation in acres was not available, 0 otherwise	
arguments missing	This variable is equal to 1 if information on number of arguments is not available, 0 otherwise. This is equal to 0 if this data was available, and there were no arguments.	
ecoregion dummy variables	This is an indicator variable for each of the Level II ecoregions in oregon. The base region is ecoregion 11.	OR Geospatial Enterprise Office http://gis.oregon.gov/

Table 3-4: Manual Matches

Manual Matches [1]		
Voter Annexation City (2000 population, median family income)	Date Adopted	Paired Non-Voter Annex City
Albany (40,852; $46,094)	Mar-98	Springfield (52,864; $38,399)
Banks (1,286; $61,932)	Nov-98	Durham (1,382; $54,531)
Canby (12,790; $49,690)	Nov-97	Wilsonville (13,991; $65,172)
Corvallis (49,322; $35,236)[2]	May-77	Bend (52,029; $40,857)[2]
Culver (802; $34,063)	Nov-98	Metolius (635; $34,028)
Estacada (2,371; $46,445)	Nov-98	Molalla (5,647; $46,915)
Grants Pass (23,003; $36,284)	1-Nov	Roseburg (20,017; $40,172)
Happy Valley (4,519; $95,922)	Sep-98	
Jefferson (2,487; $42,647)	Nov-95	Aumsville (3,003; $41,316)
Lake Oswego (35,278; $94,587)	Nov-98	
Mt. Angel (3,121; $46,650)	5-Nov	Hubbard (2,483; $42,552)
McMinnville (26,499; $44,013)	May-96	Forest Grove (17,708; $47,733)
Monmouth (7,741; $48,600)	Mar-99	Independence (6,035; $40,466)
Newberg (18,064; $51,084)	Jul-99	Gladstone (11,438; $52,500)
North Plains (1,605; $55,156)	Sep-99	King City (1,949; $49,444)
Oregon City (25,754; $51,597)	May-99	Tigard (41,223; $61,656)
Philomath (3,838; $42,578)	May-95	Junction City (4,721; $43,875)
Phoenix (4,060; $38,176)	Aug-98	Eagle Point (4,797; $40,598)
Rivergrove (350; $93,212)	Mar-99	
Rogue River (1,847; $34,583)	Sep-96	Gold Hill (1,073; $35,438)
Salem (152,239; $38,881)[2]	May-00	Eugene (137,893; $35,850)[2]
Sandy (5,385; $52,543)	Nov-98	Clackamas (5,177; $50,507)[3]
Scappoose (4,976; $55,616)	May-99	Vernonia (2,228; $48,563)
Sherwood (11,791; $67,277)	Mar-98	Troutdale (13,777; $62,303)
Sisters (959; $43,977)	Nov-96	Terrebonne (1,469; $49,375)[3]
St. Helens (10,019; $45,548)	Mar-99	Astoria (9,813; $41,446)
St. Paul (354; $55,000)	Nov-97	Donald (608; $50,227)
Talent (5,589; $33,333)	Jul-98	White City (5,466; $30,743)[3]
Turner (1,199; $43,906)	Nov-98	Gervais (2,009; $44,188)
West Linn (22,261; $83,252)	May-98	Tualatin (22,791; $68,165)
Wheeler (391; $31,161)	8-Aug	

(1) Only cities with matches were included in the ATT calculation for this matching technique.

(2) Median household income

(3) Unincorporated Census-designated place.

Table 3-5: Question 1 Results

Question 1a: POPULATION GROWTH. The presence of voter-approved annexations slows the population growth of a community. Measure with pop_growth_1990_2010 = (city_population_2010- city_population_1990)/ city_population_1990

	ATE	SE	t	number treated units	number control units	bootstrap SE	bootstrap t	Bootstrap CI: Normal	Bootstrap CI: Percentile	Bootstrap CII: Bias Corrected	95% CI: lower bound (1)	95% CI: upper bound (1)
Question 1a: specification 1												
stratificaction/interval matching	0.0175	.	.	14	72	0.1259	0.1388	(-0.2324, 0.2673)	(-0.1319, 0.4096)	(-0.1339, 0.3143)		
nearest neighbor matching	-0.0116	0.1236	-0.0940	26	8	0.1798	-0.0646	(-0.3683, 0.3451)	(-0.3589, 0.4720)	(-0.6414, 0.2465)	-0.2663	0.2430
radius/caliper matching	0.1736	0.0899	1.9313	12	60	0.0943	1.8402	(-0.0136, 0.3608)	(-0.03669, 0.3385)	(-0.0428, 0.3258)	-0.0242	0.3715
kernal matching	-0.0123	.	.	26	60	0.1326	-0.0924	(-0.2753, 0.2508)	(-0.2044, 0.2980)	(-0.3569, 0.2398)		
Question 1a: specification 2												
stratificaction/interval matching	0.2190	.	.	7	63	0.1132	1.9344	(-0.0057, 0.4437)	(-0.0204, 0.4187)	(0.0408, 0.5334)		
nearest neighbor matching	0.1279	0.0965	1.3245	26	4	0.1193	1.0715	(-0.1090, 0.3648)	(-0.0540, 0.3831)	(-0.0580, 0.3498)	-0.0710	0.3267
radius/caliper matching	0.2552	0.1593	1.6019	6	36	0.1657	1.5404	(-0.0737, 0.5841)	(-0.0660, 0.4918)	(-0.0270, 0.5616)	-0.1543	0.6647
kernal matching	0.1273	.	.	26	44	0.1123	.	(-0.0956, 0.3502)	(-0.0225, 0.4027)	(-0.0897, 0.2892)		
manual matching:	0.0263	0.0661		24	24						-0.1105	0.1631

(1) calculated using t-distribution

Question 1b: HOME VALUES. Voter-approved annexations increase prices for existing houses/ Voter-approved annexations result in smaller declines in housing prices during current recession. To measure: calculate percent change in home prices between 1990 and 2000, in 2010 dollars. generate home_value_change= (median_home_value_2000_2010_doll-median_home_value_1990_2010_doll) / median_home_value_1990_2010_doll)

	ATE	SE	t	number treated units	number control units	bootstrap SE	bootstrap t	Bootstrap CI: Normal	Bootstrap CI: Percentile	Bootstrap CII: Bias Corrected	95% CI: lower bound (1)	95% CI: upper bound (1)
Question 1b: specification 1												
stratificaction/interval matching	0.0974	0.1037	0.9393	8	75	0.1141	0.8540	(-0.1290, 0.3239)	(-0.1301, 0.2952)	(-0.1296, 0.3224)		
nearest neighbor matching	-0.1358	0.2044	-0.6644	26	7	0.1955	-0.6947	(-0.5238, 0.2521)	(-0.4720, 0.3338)	(-0.4458, 0.3982)	-0.5569	0.2852
radius/caliper matching	0.1014	0.0763	1.3299	11	55	0.1074	0.9447	(-0.1116, 0.3145)	(-0.1285, 0.2945)	(-0.0822, 0.3078)	-0.0685	0.2714
kernal matching	-0.1294	.	.	26	57	0.1586	-0.8154	(-0.4441, 0.1854)	(-0.4733, 0.2849)	(-0.4741, 0.2317)		
Question 1b: specification 2												
stratificaction/interval matching	0.0630	0.0919	0.6851	6	80	0.0997	0.6318	(-0.1348, 0.2607)	(-0.1257, 0.2213)	(-0.1257, 0.2213)		
nearest neighbor matching	0.2296	0.3087	0.7437	26	6	0.0981	2.3399	(0.0348, 0.4243)	(-0.0510, 0.3352)	(0.1229, 0.3579)	-0.4062	0.8653
radius/caliper matching	0.0572	0.0819	0.6983	7	60	0.0980	0.5838	(-0.1372, 0.2516)	(-0.2205, 0.2362)	(-0.2205, 0.2362)	-0.1432	0.2576
kernal matching	0.1603	.	.	26	60	0.0762	2.1034	(0.0090, 0.3115)	(-0.0709, 0.2807)	(0.0425, 0.3597)		
manual matching:	0.1147	0.0691		24	24						-0.0283	0.2576

(1) calculated using t-distribution

Question 1c: HOUSING STARTS. Voter-approved annexations restrict development / Voter-approved annexations reduce the number of housing starts per year. To measure, directly compare housing starts at the end of the study period (1999 and 2000). Calculate as: generate housing_starts = (housing_units_1999_2000 /total housing units)

	ATE	SE	t	number treated units	number control units	bootstrap SE	bootstrap t	Bootstrap CI: Normal	Bootstrap CI: Percentile	Bootstrap CII: Bias Corrected	95% CI: lower bound [1]	95% CI: upper bound [1]
Question 1c: specification 1												
stratificaction/interval matching	0.0374	.	.	14	72	0.0691	0.5407	(-0.0997, 0.1744)	(-0.0442, 0.2027)	(-0.0425, 0.2146)		
nearest neighbor matching	0.0133	0.0469	0.2836	26	8	0.0342	0.3894	(-0.0545, 0.0811)	(-0.0494, 0.0846)	(-0.0640, 0.0729)	-0.0833	0.1099
radius/caliper matching	0.0710	0.0634	1.1191	12	60	0.0770	0.9222	(-0.0817, 0.2237)	(-0.0220, 0.2604)	(-0.0193, 0.2833)	-0.0686	0.2106
kernal matching	0.0196	.	.	26	60	0.0311	0.6296	(-0.0421, 0.0813)	(-0.0309, 0.0927)	(-0.0393, 0.0650)		
Question 1c: specification 2												
stratificaction/interval matching	0.0008	.	.	7	63	0.0174	0.0465	(-0.0337, 0.0353)	(-0.0230, 0.0415)	(-0.0268, 0.0356)		
nearest neighbor matching	0.0599	0.0344	1.7408	26	4	0.0411	1.4561	(-0.0218, 0.1416)	(0.0074, 0.1738)	(-0.0257, 0.1497)	-0.0110	0.1308
radius/caliper matching	-0.0008	0.0153	-0.0501	6	36	0.0155	-0.0494	(-0.0316, 0.0301)	(-0.0267, 0.0368)	(-0.0376, 0.0254)	-0.0401	0.0386
kernal matching	0.0584	.	.	26	44	0.0333	1.7535	(0.1245, -0.0077)	(0.0052, 0.1373)	(-0.0026, 0.1065)		
manual matching:	0.0402	0.0344		24	24						-0.0311	0.1114
(1) calculated using t-distribution												

Question 1d: SCHOOL AGE CHILDREN. population of school age children in a community drops with voter-approved annexation. To measure, compare proportion of children in grades k_12 to total population. Calculate as generate k_12= enrolled_k_12/total_population

	ATE	SE	t	number treated units	number control units	bootstrap SE	bootstrap t	Bootstrap CI: Normal	Bootstrap CI: Percentile	Bootstrap CII: Bias Corrected	95% CI: lower bound [1]	95% CI: upper bound [1]
Question 1d: specification 1												
stratificaction/interval matching	0.0007	.	.	14	72	0.0226	0.0307	(-0.0442, 0.0456)	(-0.0255, 0.0598)	(-0.0772, 0.0357)		
nearest neighbor matching	-0.0255	0.0287	-0.8907	26	7	0.0283	-0.9011	(-0.0818, 0.0307)	(-0.0394, 0.0643)	(-0.0508, -0.0004)	-0.0846	0.0335
radius/caliper matching	0.0148	0.0144	1.0286	12	60	0.0157	0.9385	(-0.0165, 0.0460)	(-0.0135, 0.0473)	(-0.0135, 0.0473)	-0.0168	0.0464
kernal matching	-0.0146	.	.	26	60	0.0223	-0.6546	(-0.0587, 0.0296)	(-0.0349, 0.0598)	(-0.0406, 0.0335)		
Question 1d: specification 2												
stratificaction/interval matching	0.0059	.	.	8	73	0.0222	0.2671	(-0.0381, 0.0500)	(-0.0273, 0.0529)	(-0.0273, 0.0529)		
nearest neighbor matching	-0.0145	0.0215	-0.6767	26	5	0.0170	-0.8569	(-0.0482, 0.0191)	(-0.0336, 0.0281)	(-0.0441, 0.0249)	-0.0587	0.0297
radius/caliper matching	0.0089	0.0181	0.4935	8	50	0.0286	0.3122	(-0.0478, 0.0656)	(-0.0435, 0.0730)	(-0.0283, 0.1271)	-0.0338	0.0517
kernal matching	-0.0151	.	.	26	55	0.0153	-0.9850	(-0.0455, 0.0153)	(-0.0280, 0.0229)	(-0.0300, 0.0145)		
manual matching:	0.0042	0.0162		24	24						-0.0293	0.0376
(1) calculated using t-distribution												

Question 1e: CITY SIZE. Voter-approved annexations restricts increases in the city boundary. To measure, directly compare the percent increase of acreage inside a city boundary from 2003 to 2010, in cities that vote compared to those that do not.												
	ATE	SE	t	number treated units	number control units	bootstrap SE	bootstrap t	Bootstrap CI: Normal	Bootstrap CI: Percentile	Bootstrap CII: Bias Corrected	95% CI: lower bound (1)	95% CI: upper bound (1)
Question 1e: specification 1												
stratificaction/interval matching	-0.0905	.	.	18	69	0.0646	-1.4005	(-0.2188, 0.0377)	(-0.2036, 0.0626)	(-0.2267, -0.0074)		
nearest neighbor matching	-0.0929	0.0823	-1.1283	26	10	0.0940	-0.9879	(-0.2794, 0.0937)	(-0.2186, 0.1348)	(-0.3201, 0.0700)	-0.2624	0.0767
radius/caliper matching	0.0355	0.0598	0.5939	18	58	0.0590	0.6022	(-0.0815, 0.1525)	(-0.0852, 0.1616)	(-0.0279, 0.1754)	-0.0906	0.1616
kernal matching	-0.0860	.	.	26	61	0.0829	-1.0381	(-0.2505, 0.0784)	(-0.1511, 0.1302)	(-0.1794, 0.0567)		
Question 1e: specification 2												
stratificaction/interval matching	-0.0044	.	.	7	63	0.0565	-0.0773	(-0.1165, 0.1078)	(-0.1330, 0.1047)	(-0.0792, 0.1564)		
nearest neighbor matching	0.0347	0.0766	0.4524	26	4	0.0508	0.6830	(-0.0661, 0.1354)	(-0.0462, 0.1514)	(-0.0650, 0.1461)	-0.1232	0.1925
radius/caliper matching	0.0197	0.0643	0.3062	6	37	0.0732	0.2688	(-0.1256, 0.1650)	(-0.1107, 0.1511)	(-0.1263, 0.1464)	-0.1455	0.1849
kernal matching	0.0326	.	.	26	44	0.0479	.	(-0.0624, 0.1277)	(-0.0533, 0.1490)	(-0.0346, 0.2185)		
	-0.0149	0.0407		24	24						-0.0990	0.0692
(1) calculated using t-distribution												

Question 1f: PERCENT WHITE. The proportion of a community that is white increases with voter approved annexation. To measure compare the change over time in proportion of the population that is white/ generate change_population_white = ((white_2000/city_population_2000)-(white_1990/city_population_1990))/												
	ATE	SE	t	number treated units	number control units	bootstrap SE	bootstrap t	Bootstrap CI: Normal	Bootstrap CI: Percentile	Bootstrap CII: Bias Corrected	95% CI: lower bound (1)	95% CI: upper bound (1)
Question 1f: specification 1												
stratificaction/interval matching	0.0195	.	.	14	72	0.0176	1.1126	(-0.0153, 0.0544)	(-0.0143, 0.0530)	(-0.0032, 0.0817)		
nearest neighbor matching	0.0234	0.0434	0.5391	26	8	0.0500	0.4678	(-0.0759, 0.1227)	(-0.0089, 0.1485)	(-0.0028, 0.1558)	-0.0660	0.1129
radius/caliper matching	0.0161	0.0108	1.4816	12	60	0.0124	1.2960	(-0.0085, 0.0407)	(-0.0097, 0.0384)	(-0.0047, 0.0389)	-0.0078	0.0399
kernal matching	0.0219	.	.	26	60	0.0404	0.5427	(-0.0583, 0.1021)	(-0.0034, 0.1240)	(0.0002, 0.1450)		
Question 1f: specification 2												
stratificaction/interval matching	0.0176	0.0133	1.3266	7	74	0.0144	1.2204	(-0.0110, 0.0462)	(-0.0076, 0.0532)	(-0.0058, 0.0571)		
nearest neighbor matching	0.0097	0.0200	0.4825	26	6	0.0180	0.5366	(-0.0261, 0.0454)	(-0.0251, 0.0483)	(-0.0252, 0.0437)	-0.0316	0.0509
radius/caliper matching	0.0063	0.0124	0.5104	6	55	0.0135	0.4677	(-0.0205, 0.0332)	(-0.0159, 0.0321)	(-0.0132, 0.0483)	-0.0255	0.0382
kernal matching	0.0195	.	.	26	55	0.0143	.	(-0.0088, 0.0478)	(-0.0039, 0.0449)	(-0.0285, 0.0429)		
manual matching:	0.0315	0.0217		24	24						-0.0134	0.0765
(1) calculated using t-distribution												

Table 3-6: Question 2 Results

		Logit model calculated using OLS with the minimum chi squared estimator and a robust variance/covariance matrix		Logit model calculated using GLM with the minimum chi squared estimator and a robust variance/covariance matrix		Logit model calculated using GLM with a robust variance/covariance matrix	
Variable name	Variable Description	coefficient	*p - value*	coefficient	*p - value*	coefficient	*p - value*
repeat_amendment	repeat amendment, yes or no	-0.60299 *	*(0.000)*	-0.58377 *	*(0.000)*	-0.44906 *	*(0.000)*
acres_stata	acres of annexation	-0.00065 *	*(0.001)*	-0.00065 *	*(0.001)*	-0.00037 *	*(0.039)*
total_votes	total votes (yes+no)	-0.00002 *	*(0.016)*	-0.00002 *	*(0.001)*	-0.00001 *	*(0.001)*
arguments_for_stata	arguments for	0.05218 *	*(0.030)*	0.05100 *	*(0.021)*	0.00061	*(0.975)*
arguments_against_stata	arguments against	-0.13560	*(0.107)*	-0.12414	*(0.103)*	-0.23342 *	*(0.000)*
total_population_expand	total population	0.00451	*(0.454)*	0.00276	*(0.611)*	-0.00210	*(0.680)*
k_12_expand	ratio of population (3 years and over) enrolled in k_12 /total population 3 years and over	401.92761	*(0.051)*	353.73340	*(0.063)*	-29.82826	*(0.820)*
college_expand	ratio of population (3 years and over) enrolled in college/total population 3 years and over	-36.48489 *	*(0.000)*	-41.82054 *	*(0.000)*	-16.82508	*(0.757)*
ratio_less_9	ratio of population (25 years and over) with less than 9th grade education	-277.00000 *	*(0.000)*	-270.00000 *	*(0.000)*	63.24338	*(0.519)*
ratio_9_12	ratio of population (25 years and over) with 9th-12th grade education	268.49449 *	*(0.042)*	272.75731 *	*(0.025)*	163.14782 *	*(0.022)*
ratio_grad_school	ratio of population (25 years and over) with graduate degree	271.96449	*(0.304)*	281.14875	*(0.254)*	72.03420	*(0.593)*
divorced_expand	number of divorced people in population 15 years and over	0.00903	*(0.381)*	0.00864	*(0.366)*	0.00081	*(0.935)*
avg_household_size_expand	average household size	-2.72072	*(0.928)*	-2.59752	*(0.922)*	-10.60456	*(0.620)*
avg_homeowner_vac_rate_expand	average homeowner vacancy rate	1.55738	*(0.096)*	1.55119	*(0.092)*	1.26418	*(0.176)*
avg_rent_vac_rate_expand	average renter vacancy rate	-0.02195	*(0.972)*	-0.01748	*(0.977)*	-0.32875	*(0.505)*
total _households_expand	total households	-0.00658	*(0.092)*	-0.00633	*(0.093)*	-0.00254	*(0.358)*
ratio_family_households_expand	ratio of family households	-203.00000	*(0.106)*	-181.00000	*(0.159)*	290.53318 *	*(0.014)*
ratio_less_18_expand	ratio of population that is under 18	-425.00000	*(0.140)*	-414.00000	*(0.117)*	-258.00000	*(0.156)*
ratio_45_54_expand	ratio of population that is 45-54	-98.86693	*(0.672)*	-60.81707	*(0.780)*	335.88508	*(0.068)*
ratio_55_59_expand	ratio of population that is 55-59	-242.00000	*(0.499)*	-274.00000	*(0.413)*	3.43722	*(0.988)*
ratio_65_up_expand	ratio of population that is 65 and up	-87.62393	*(0.756)*	-93.38530	*(0.725)*	-34.99647	*(0.811)*
race_black_expand	number of african americans in population	0.03242	*(0.663)*	0.04422	*(0.504)*	0.11015 *	*(0.007)*
hispanic_expand	number of hispanics in population	-0.00169	*(0.767)*	0.00009	*(0.986)*	0.00417	*(0.366)*
med_income_2010dol_expand	median income in 2010 dollars	-0.00007	*(0.829)*	-0.00001	*(0.960)*	0.00022	*(0.358)*
med_homevalue_2010dol_expand	median home value in 2010 dollars	-0.00014	*(0.091)*	-0.00014	*(0.067)*	-0.00004	*(0.466)*
employment_change_expand	employment change	0.00000	.	0.00000	.	0.00000	.
unemployment_rate_expand	unemployment rate	-6.31010	*(0.174)*	-6.45498	*(0.121)*	-2.46943	*(0.356)*

		Logit model calculated using OLS with the minimum chi squared estimator and a robust variance/covariance matrix			Logit model calculated using GLM with the minimum chi squared estimator and a robust variance/covariance matrix			Logit model calculated using GLM with a robust variance/covariance matrix		
property_crime_expand	property crime									
violent_crime_expand	violent crime									
property_crime_per_mil_expand	property crime per 1000 residents									
city_ugb_ratio_expand	ratio of city acres/ugb acres	0.68508		*(0.122)*	0.70911		*(0.082)*	0.24402		*(0.370)*
tax_agi_expand	Tax Due as percent of AGI	-32.17839	*	*(0.045)*	-30.98517	*	*(0.035)*	-6.00971		*(0.444)*
politics_expand	county red/blue (1 if blue, 0 if red)	-0.10979		*(0.263)*	-0.09029		*(0.317)*	-0.04373		*(0.689)*
city_acres_expand	area within city limits (acres)	0.00219		*(0.501)*	0.00260		*(0.363)*	0.00022		*(0.944)*
population_density_expand	population density	8.93381	*	*(0.016)*	8.25425	*	*(0.018)*	1.94309		*(0.571)*
acre_missing	acres of annexation: indicator for missing data	-0.39015	*	*(0.001)*	-0.38127	*	*(0.000)*	-0.19311		*(0.086)*
argument_missing	number of arguments: indicator for missing data	0.50393	*	*(0.000)*	0.47753	*	*(0.000)*	0.15549		*(0.217)*
pop_change_1990_2000	absolute population change 1990-2000	0.00000		.	0.00000		.	0.00000		.
percent_pop_change_1990_2000	percent population change 1990 to 2000	0.00000		.	0.00000		.	0.00000		.
race_white_expand	number of whites in population	-0.00437		*(0.350)*	-0.00287		*(0.504)*	0.00135		*(0.710)*
ratio_white_expand	ratio of population that is white	136.74955		*(0.174)*	139.00076		*(0.145)*	225.16100	*	*(0.007)*
initiated	number of years since the city began voting for annexation and amendment decisions	0.00000		.	0.00000		.	0.00000		.
ballot_count	total number of land use initatives on the ballot	0.00171		*(0.759)*	-0.00109		*(0.847)*	-0.01140	*	*(0.000)*
district election	indicator variable for each election type. Base = "primary"	0.35480		*(0.084)*	0.38535	*	*(0.045)*	0.59189	*	*(0.000)*
general election	indicator variable for each election type. Base = "primary"	0.03341		*(0.761)*	0.05724		*(0.539)*	0.00866		*(0.872)*
primary election	indicator variable for each election type. Base = "primary"	0.00000		.	0.00000		.	0.00000		.
special election	indicator variable for each election type. Base = "primary"	-0.11651		*(0.095)*	-0.12760	*	*(0.041)*	-0.01664		*(0.780)*
special district election	indicator variable for each election type. Base = "primary"	0.04042		*(0.743)*	0.05066		*(0.656)*	-0.00742		*(0.951)*
constant		288.496		*(0.365)*	270.047		*(0.367)*	-292.000		*(0.235)*
City Fixed Effects		Not Shown								

CHAPTER FOUR

CURBING DEVELOPMENT IN OREGON'S EFU ZONES AND RIPARIAN CORRIDORS: HOW WELL HAVE OREGON'S LAND USE REGULATIONS PROTECTED RESOURCE LANDS FROM DEVELOPMENT?

4.1 Introduction

Oregon Senate Bill 100 was approved on May 29, 1973. This bill provides protection of farm and forest lands, conservation of natural resources, orderly and efficient development, coordination among local governments, and citizen involvement. At the same time, Senate Bill 101 was passed with the intention of strengthening farmland protection in the state (this bill is codified in ORS 215). This paper will explore how effective Oregon's land use regulations have been in preventing development of agricultural lands, and also in protecting land which is located in riparian corridors.

In order to enforce the requirements of Senate Bill 100, the Land Conservation and Development Commission (LCDC) and the Department of Land Conservation and Development (DLCD) were established. LCDC's first major task was the creation and adoption of the statewide planning goals. There were originally 14 goals, now 19. The goals express the state's policies on land use and related topics, including natural resource protection. Each county and city must create a comprehensive land use plan which outlines the methods they intend to use to comply with the planning goals, and which must be accompanied by local ordinances to enforce the goals. Goal 14 specifies that every incorporated city must establish an Urban Growth Boundary (UGB) to separate land that is designated for urban use from land that is designated for rural uses, such as farming. UGBs generally extend past the city limits, and contain land that is allocated for future development. City comprehensive plans control the land within the city limits, and county comprehensive plans control the land outside of the UGBs. The land that is located inside of a UGB but outside of the city limits is designated for possible future development, and is jointly managed by the county and the city.

Statewide interest groups and agencies are able to influence the content of local land use plans, but no similar process enables them to influence plan implementation. Implementation takes place on a piecemeal, long-term, day-to-day basis, as local governments construct roads, extend sewers, approve subdivisions, enforce zoning ordinances, and grant building permits. State interest groups and agencies cannot, therefore, possibly participate in all the land use decisions involved in the process of plan implementation. Depending on the local population, some locales may be very pro-development, therefore it is unclear how successful these regulations have been in achieving their goals (Pease, 1994). This paper will explore the following questions, focusing on land within Oregon's Willamette Valley:

1. How successful have Oregon's land use regulations been in preventing development in agricultural land outside of UGBs?

2. How successful have Oregon's land use regulations been in reducing development and other anthropogenic uses of land within riparian corridors inside of UGBs?

4.1.1. Agricultural land preservation

Agricultural lands are specifically discussed in Oregon Planning Goal 3 and also in Senate Bill 101, which is now ORS chapter 215. The protection of agricultural lands, specifically within Oregon's Willamette Valley, was one of the primary motivations behind the adoption of Oregon's land use program (Gustafson et al., 1982, Daniels and Nelson, 1986, Nelson, 1992). Even before the existence of Senate Bill 100, a push by Willamette Valley farmers in the 1960s led to the categorization of land based on its agricultural productivity, leading to designation of Exclusive Farm Use (EFU) zones (Abbot Adler and Howe, 2003). Agricultural lands are identified by their soil class, existing use and infrastructure, and other characteristics that impact farming. Farm use is defined in ORS 215 as "land that is employed for the primary purpose of obtaining a profit in money by raising, harvesting and selling crops, or the feeding, breeding, management and sale of, or the produce of, livestock, poultry, fur-bearing animals or honeybees or for dairying and the sale of dairy products or any other agricultural or horticultural use or animal husbandry or any combination thereof". These lands are required to be inventoried and then preserved by designating EFU zones as defined in ORS Chapter 215 and Planning Goal 3. In addition, Goal 3 specifies that all agricultural land which is not contained within a UGB, and is not specifically designated for nonfarm use, must be zoned for EFU (Gustafson et al., 1982). Because Goal 3 is directed at land located outside of UGBs, our analysis will focus on agricultural lands governed by county land-use plans. The first question addressed in this paper will ask whether land that was used for agriculture in 1973 was less likely to be developed over time than other land.

Urbanization can have varying effects on agricultural producers. Wu, Fisher, and Pascual (2011) evaluated the effect of urbanization on the viability of farm-supporting sectors, such as input suppliers and output processors, and on the costs and profitability of agriculture. They found that while urbanization may increase farmers' production costs, it also creates new opportunities for farmers, such as markets for high-value crops and off-farm employment prospects. Their results suggest that initially, farm income increases with urbanization. However, in farming regions that have already experienced a high degree of urbanization, urban sprawl can threaten the viability of agriculture, as businesses that support the farm sector are no longer located nearby. Nelson (1992) also considered the impact of urbanization on agriculture, stating that when farmers become uncertain about the future viability of agriculture in their area, farmland production falls, along with farming income. This can ultimately cause the critical mass of farming production needed to sustain the local farming community to collapse.

The private allocation of land for agriculture may be inefficient, thus providing justification for farmland preservation policies. Potential market failures in land allocation may arise for at least two reasons (Wu and Cho, 2007). First, many land uses generate externalities, which may distort market returns to alternative land uses. For example, farmland provides both agricultural commodities and open space. Households may value but not pay for open space. As a result, market prices of farmland may be below the social values. A second market failure arises when developers do not bear all public infrastructure costs generated by their projects. Because of government subsidies for development, for example mortgage interest deductions and road and sewer construction, private costs of land development are often below the social costs.

4.1.2. Previous studies on the effects of Oregon's land use planning system on agriculture

Since the implementation of Oregon's land use laws, there have been many studies that examine whether these laws have successfully restricted development on agricultural lands. In an early study, Furuseth (1981) compared the 1978 census of agriculture with the previous two census periods to examine land use trends. He concluded that a slowing in the rate of agricultural land loss, in addition to agricultural land expansion in some areas, provided empirical evidence of the early effects of Oregon's land use planning program. Daniels and Nelson (1986) expanded on Furuseth's analysis. They analyzed cross sectional census data from 1978 and 1982, comparing both percentage change and absolute change in farmland area within the following four geographic areas: Oregon, Washington, Oregon's Willamette Valley, and the entire United States. The authors concluded that while Oregon's land use program appears to have been successful in keeping the state's farmland from being converted to nonfarm uses, the proliferation of small hobby farms raises concerns about the future of commercial farming operations, which must compete for the same farmland. However, data for these studies were collected before Oregon's land use planning laws were able to take effect; therefore, the validity of these results is questionable.

Similar to the analysis by Furuseth, a number of studies have evaluated the impact of Oregon's land use regulations on agricultural land by examining development rates and patterns, as well as farm and forest land retention. For example, Moore and Nelson (1994) found that between 1985 and 1989, substantial development occurred on rural lands that were originally developed at a low density, as well as on agriculture and forest lands. Similarly, Nelson and Moore (1996) studied development in different regions throughout the state, and found that except in the Portland area, a large percentage of residential development occurred outside of UGBs. However, because these studies do not formally control for the other factors that may also influence development, it is difficult to identify from the analyses the effect that land use regulations had in causing these changes (Gosnell et al., 2010). There are also many studies (Furuseth 1980, 1981; Gustafson et al. 1982; Daniels and Nelson 1986; Nelson 1992, 1999; Kline 2000, among others) which tend to be descriptive, relying on anecdotal evidence or examining historical trends in a single land-use category, such as farmland area reported by the U.S. Agricultural Census. Evaluating land-use planning effectiveness in this way ignores other factors that can influence development patterns, such as existing population densities, regional economic growth, new industries, personal income, household sizes, housing tastes and preferences, the availability of land for redevelopment, topography, and regional comparative advantages of land in different uses. It is important to attempt to account for these factors when conducting a rigorous analysis of land-use policy and program effects (Kline 2005, Gosnell et al. 2010).

In addition to analyzing development trends within Oregon, several studies compare land use in Oregon to land use in other states. Nelson (1992) evaluated land use trends in Oregon, Washington, Oregon’s Willamette Valley, and the entire United States.

The author found that Oregon lost some commercial farm acres during the study period, while Washington and the nation gained commercial farm acres. However, the proportion of commercial farms to all other farms rose faster in Oregon than in Washington, and actually decreased in the nation overall. This implies that Oregon's land use regulations were successful in protecting commercial farmland. Within the Willamette Valley, Nelson also found that farmland preservation policies slowed the loss of farmland and increased the proportion of commercial farms. Nelson (1998) compared indicators of sprawl in Oregon and Florida, both of which have statewide land use planning systems, and in Georgia, which does not have this type of land use regulation. The author concludes that the growth-management states of Oregon and Florida perform better than Georgia in containing urban sprawl, preserving farmland, and minimizing the negative externalities of sprawl.

As stated earlier, Gosnell et al. (2010) and Kline (2005) emphasize the benefits of using econometric analysis to evaluate the impact of land use regulations in Oregon. This type of analysis can account for factors other than land use planning that may influence development trends. Overall, econometric analysis have shown that Oregon's land use planning program has resulted in a measurable, if relatively small, amount of forest and farm land protection.

Kline and Alig (1999) constructed a probit regression model of forest and farm land development as a function of socioeconomic and topographic variables, as well as land use zoning. They make use of USDA Forest Service plot-level data, which describes broad land-use categories of private land over the period 1961 to 1994. The results of this study suggest that Oregon's land use laws have concentrated forest and farmland development within UGBs as intended. However, the authors point out that land which is now located inside a UGB has always been more likely to be developed, even before implementation of the land use law, due to its close proximity to existing cities. Forest and farmlands located outside of UGBs and within forest and farm use zones have always been less likely to be developed because of their location relative to cities. The analysis concluded that any statistically significant change in development rates within forest and farm use zones that could be attributed to Senate Bill 100 was minor, because there was minimal development in these zones relative to the total amount of land available even before the implementation of this regulation.

Kline (2005a) builds upon the work of Kline and Alig (1999) by re-examining Oregon's land-use planning program using newly available spatial land-use data describing building patterns in western Oregon. This dataset includes building densities and locations, and is supplied by the Oregon Department of Forestry and the USDA Forest Service's Forest Inventory and Analysis (FIA) program. Results from the empirical model, which describes building density changes in western Oregon from 1974 to 1994, suggest that Oregon's land use regulations have reduced development of lands located within forest and farm zones since implementation. Given the greater number of observations and greater spatial detail provided by building density data used in this analysis relative to data available to Kline and Alig (1999), these results seem to supplant their somewhat inconclusive results regarding the effectiveness of Oregon's land use laws. Thus, Kline (2005a) reaches the stronger conclusion that Oregon's land use regulations have been successful in preventing development in forest and agricultural lands. Kline (2005b) used his earlier (2005a) regression model to project the potential effects of land use planning in Oregon forward to 2024. Results suggested that significant conservation would result from continuation of the planning program. Supporting evidence is also provided by Wu and Cho (2007). They build upon models developed by Capozza and Helsley (1990) and Capozza and Li (1994) to estimate the effect of local land use regulations on land development in five western states of the United States (California, Idaho, Nevada, Oregon, and Washington). Wu and Cho assume that land is developed in response to increasing demand for houses at the edge of a city, which is generated by migration in response to rising local income. They found that development guidelines in Oregon had the desired effect of reducing the total supply of developed land in the state between 1982 and 1997.

4.1.3. Riparian Corridors

The second question addressed in this paper is whether Oregon's land use regulations have impacted land use within riparian corridors, particularly those that are located inside of UGBs. Oregon planning goal 5 outlines methods for the protection of open spaces, scenic and historic areas, and natural resources. While the original goal is vague, it was updated in 1996 to strengthen its protection of land located in riparian corridors. This includes a requirement that riparian corridors and wetlands should be inventoried and evaluated.

4.1.4. Definition of Riparian Corridors

We will define a riparian corridor as a strip of land that extends 100 meters from the edge of a stream or river. Castelle, Johnson, and Connolly (1994) define a buffer as a vegetated zone that is located between natural resources and adjacent areas that are subject to human alteration. There is rarely debate regarding the need for some buffering of aquatic and riparian resources. However, there is little agreement regarding the degree of buffering necessary or how best to achieve that measure of protection. One important factor is the width of the buffer. Buffers that are undersized may place aquatic resources at risk; however, buffers that are larger than needed may unnecessarily deny landowners the use of a portion of their land. Castelle, Johnson, and Connolly performed a review of the literature, and concluded that a scientific approach to determining buffer width would depend on the specific functions that a buffer needs to provide to a specific site. Overall, they find that adequate buffer sizes vary widely. In fact, depending on the goal of the buffer, the ideal size can range from 15 to 200 meters. Young (2000) comes to a more definite answer. The author discusses the ‘‘one tree height’’ approach as that most likely to maintain ecosystem function and ensure the regional distribution of targeted salmonid species. This approach specifies that full riparian functions can be provided within one tree height from the stream, which is approximately 100 meters. Therefore, riparian buffers should consist of no-harvest zones with a width of 70 to 100 meters, depending on site-specific conditions.

Burnett et al (2007) studied the management of stream reaches with high intrinsic potential for steelhead and for coho salmon relative to land ownership, land use, and land cover. This study focused on the coastal region of Oregon, and evaluated land use and cover within a buffer width of 100 meters from either side of the stream. This buffer width was intended to include the streamside zone most likely to influence the stream reaches evaluated in the study. The landscape conditions were also summarized within a 60 meter buffer, to compare with results obtained using 100 meter buffers. General patterns of current land use and land cover in buffers around high-intrinsic potential reaches appeared relatively insensitive to the width of the buffer. Ozawa and Yeakley (2006) evaluated the impact of policies aimed at protecting riparian corridors in three Oregon cities. They chose to evaluate land use with buffers of 7.5 meters, 15 meters, and 100 meters from stream edges, and found that the highest level of protection was within the 7.5 meter buffer.

The management of riparian habitats can be controversial because land use policies have historically emphasized economic values, such as timber harvest, at the expense of ecological and social values (Everest and Reeves, 2007). For example, Groffman et al. (2003) stated that the most obvious hydrologic changes associated with urbanization are the engineering of stream channels, in which natural features are replaced by concrete channels and stream bank stabilization efforts designed to limit high flood flows. While management of riparian ecosystems can provide many benefits (Everest and Reeves 2007), achievement of a socially acceptable balance among economic, ecological, and social uses of riparian areas does not have an easy solution. Our analysis will focus on the management of riparian corridors inside of UGBs, specifically on the impact of Oregon's land use planning goals on the protection of these lands. Everest and Reeves find that urban areas, although affecting only about two percent of the Northwest landscape, are usually located along major waterways, at the confluence of rivers, or in estuaries. Therefore, riparian and aquatic habitats are more highly altered by urban uses than other land use types in the Pacific Northwest, and streams within urban areas are more degraded than in agricultural and forested areas.

Besides the width of the buffer, it is also important to consider which streams and rivers require buffers. Small, or headwater, streams make up at least 80 percent of the nation's stream network (Meyers et al, 2003). The special physical and biological characteristics of intact small streams and wetlands provide natural flood control, recharge groundwater, trap sediments and pollution from fertilizers, recycle nutrients, create and maintain biological diversity, and sustain the biological productivity of downstream rivers, lakes, and estuaries. Therefore, it is important that current and future regulations protect these small stream systems. As urban land uses expand, preservation of ecosystem functions of small streams and their associated riparian buffers often are given lower priority than socially-defined demands for residential, industrial, and commercial uses, and roads (Ozawa and Yeakley, 2006). In addition, streams often fragment land holdings. Hence, historically, in the absence of regulatory requirements to do otherwise, landowners have cleared vegetation and filled or piped streams that appear inconsequential but may actually play an important ecological role within the watershed.

Based on the preceding discussion, as well as the resolution of our dataset, which we will discuss later, this paper will consider a riparian buffer to consist of all land that is contained within 100 meters from the edge of a stream or river. In addition to larger rivers and streams, we will include smaller, intermittent streams in our analysis. It should be noted that the definition of a Riparian Corridor that is used in this paper is not strictly enforced by Oregon's land use regulations. Therefore, unlike the analysis of land in EFU zones, we are also evaluating the stringency with which planning goal 5 is applied at the local level.

4.1.5. Current status of Riparian areas in Oregon

According to the Riparian Management Work Group[19] (2000), the present condition of riparian corridors across the Oregon landscape reflects a mixture of current regulations and current management practices, as well as past regulations and past practices. On any given site, one of these regimes is likely to be most in evidence. For example, the riparian corridor through an established subdivision will probably still reflect the practices and regulations related to streams and riparian areas that were in effect at the time of development, when trees were removed and understory vegetation was typically replaced with lawns and gardens. Stream corridors in agricultural areas today often reflect the past "clean farming" techniques used to remove vegetation along streams and fencerows. But at the same time, in many places one can see evidence of changing approaches to riparian area management. In new subdivisions, houses and roads are being built away from streams, and state law now requires that local ordinances

[19] The Riparian Management Work Group consists of representatives from the Oregon Department of Forestry, the Oregon Department of Agriculture, the Oregon Department of Land Conservation and Development, the Oregon Division of State Lands, the Oregon Department of Environmental Quality, and the Oregon Department of Fish and Wildlife. This group was assembled to assist in an effort to understand and consolidate riparian management policy in Oregon.

control riparian vegetation removal. Rules governing timber harvests now foster the protection and management of riparian areas, more closely emulating natural conditions. Water quality management plans and rules are being developed for agricultural areas throughout Oregon. Parts of these plans and rules address riparian conditions, including plant cover and stream bank integrity.

The Riparian Management Work Group also discusses the delineation of land uses in the Oregon landscape. The laws that govern the management of forests are separate and distinct from those which govern agricultural activities, and likewise from those which govern land used in urban areas. These three bodies of law have evolved independently of each another, in response to specific environmental problems, public perceptions, scientific understanding, and political circumstances. More specifically, the processes of adopting policies and practices to improve the protection of stream corridors has occurred at different speeds, so that Oregon now has different kinds and levels of protection for streams and riparian areas in forested areas (Forest Practices Program), agricultural areas (Agricultural Water Quality Management Program), and urban areas (Statewide land use planning program). As stated earlier, this paper focuses on riparian management as described in the statewide land use planning program.

The Corvallis Natural Features Inventory provides a specific example of riparian management within Oregon. This document outlines the inventory process for riparian corridors and other natural features, establishing preliminary criteria for ranking each site. Not all natural features identified in the inventories can or will be protected by the community. Therefore, it is necessary to establish criteria to determine which natural features are significant, including the safe harbor protections for riparian and wetland areas, which are outlined in Goal 5. Along with the natural features inventory, the city must consider buildable lands inventory data, population projections, and forecasts of other land use needs when deciding which lands to protect. This is done in an attempt to balance the community's need for adequate buildable land to serve anticipated growth, with protection of significant natural features and reduced risk from natural hazards.

4.1.6. Previous studies of riparian areas

There is some evidence that the management of land within a riparian corridor can be effective. Ozawa and Yeakley (2006) took a detailed look at the local riparian protection measures in Hillsboro, Oregon City, and Portland, during the years 1990-2002. These cities were chosen because they had similar urbanization and population growth patterns. At the same time, the three cities had different approaches to protection of riparian lands. While each of these cities lost considerable vegetative cover along stream corridors during the study period, the authors concluded that this loss had been reduced with the use of the local regulations. Most of the loss of vegetation within riparian zones was caused by relatively few large projects, leading the authors to conclude that the local riparian management measures were especially successful at limiting destructive actions by smaller projects. There has been limited research directed at land use within riparian corridors, other than studies of effects on water quality and riparian habitat. One important consideration is the financial implications to private landowners. Bin, Landry, and Meyer (2009) used a difference-in-differences (DID) estimator to explore the impact of a 50 foot vegetated riparian buffer rule on the value of properties adjacent to the Neuse

River in North Carolina. They found that the imposition of this rule in 1997 did not lower the riparian property values in the study area, when compared to a control group of non-riparian properties. Johnson et al. (1999) studied the behavior of non-industrial private forest (NIPF) landowners. A majority of landowners said they would alter the amount and timing of their harvest if it were necessary to maintain a healthy ecosystem. However, most owners would not be willing to give up their right to harvest timber altogether, even if offered a tax incentive. Many of the results differed between owners of large acreages and owners of small acreages. Kline, Alig, and Johnson (2000) also examined the willingness of NIPF landowners in the Pacific Northwest to forego harvesting within riparian areas to improve riparian habitat. An empirical model was developed describing owners' willingness to accept an economic incentive to adopt a 200-foot harvest buffer along streams as a function of their forest ownership objectives and socioeconomic characteristics. Results suggest that owners' willingness to forego harvest varies by their forest ownership objectives. Landowners with primarily timber objectives require higher mean incentive payments to forego harvest in riparian areas than landowners with both timber and non-timber objectives, or with primarily recreation objectives**.** Mooney and Eisgruber (2001) evaluated the impact of the Oregon Plan for Salmon and Watersheds on property values. This plan encourages residential property owners to plant riparian buffers in an effort to reduce stream temperature and thus improve fish habitat. Mooney and Eisgruber found that planting a riparian buffer reduced the market value of streamside residential properties in the study area.

4.1.7. Motivation for current study

Based on the discussion above, this paper addresses two questions:

1. How successful have Oregon's EFU zones been in preventing development in agricultural land?

2. How successful has Oregon's statewide planning goal 5 been in reducing development and other anthropogenic uses of land within Riparian Corridors inside of UGBs?

This analysis focuses on land within Oregon's Willamette Valley because this region contains most of the state's population, as well as its densest urban areas.

We obtain land-use data from the Land Cover Trends (LCT) project of the U.S. Geological Survey. The LCT data provide repeated observations of land use at a 60-meter scale. A detailed river and stream layer was obtained from the Pacific Northwest Ecosystem Research Consortium. Finally we obtained digitized maps of Oregon counties, as well as exact UGB locations through time, allowing us to categorize land in terms of location inside or outside the UGB, and by county. With this dataset, we are able to estimate the impacts of Oregon's land use regulations at the scale of the LCT data. The enabling legislation for Oregon's land-use planning program (Oregon Senate Bill 100) was passed in 1973. By 1986, all cities and counties in Oregon had state-approved comprehensive plans. We therefore observe land use in approximately 1973, before approval of any comprehensive plan, and in 2000, more than a decade after all comprehensive plans had been implemented.

The locations of the LCT blocks span the entire Willamette Valley, and are presented in Figure 1. For the first research question, we are interested in estimating the probability that land in EFU zones is developed between 1973 and 2000, when compared to land that is not located within these farm zones. This portion of the analysis focuses on a specific zoning designation, as specified in Oregon's land use planning goals. For the second research question, we are interested in estimating the probability that land in riparian corridors inside of UGBs is developed or otherwise altered, when compared to land that is not located within a riparian corridor. This portion of the analysis focuses on a land use category that is minimally defined in the land use planning goals. Therefore, we are not evaluating the enforcement of a specific land use class, but instead are examining the interpretation of planning goal 5 at the local level.

As discussed in the literature review above, it is important to separate the impact of land use planning from other factors that may impact development and other land use changes. Because of the unique panel structure of our dataset, we are able to apply the difference-in-difference-in-differences (DIDID) estimator to our analysis. This approach has not been previously used in this literature. This estimator is able to control for time-invariant unobservables, as well as common temporal effects. In addition, we are able to differentiate between agricultural land and riparian corridors that are located inside versus outside of UGBs. This is important because the protection of agricultural land is focused on rural land outside of UGBs, while protection of riparian corridors is focused on land inside of UGBs. We also allow the results to vary spatially by estimating expanded specifications of the model that allow for separate time-varying effects within each county and UGB.

The next section discusses the data used in our study. In the following sections we present the estimation approach and a discussion of our results. The final section offers concluding thoughts.

4.2. Data

The USGS LCT data provide observations of land cover in 1973 and 2000 (as well as three intervening years). These data are derived from multiple satellite images and historical aerial photographs, and were developed by USGS so that changes in land cover through time can be analyzed. The land cover images are rasterized, producing a sample of 10 kilometer by 10 kilometer blocks of 60 meter square pixels. Each pixel is classified according to land cover using the Anderson Level I system. These land-cover categories correspond closely to land-use categories (Anderson et al. 1976). LCT blocks are randomly placed throughout Oregon. We only include LCT blocks that are located within the Willamette Valley. As can be seen in Figure 1, the LCT blocks overlap many sections of the Portland Metro area UGB. Therefore, our results apply to the most urbanized region within the state. For the first question in this paper, we ask whether location within an EFU zone impacts the probability that an LCT pixel is "developed" during the study period. Developed land is defined in the LCT classification as: "Areas of intensive use with much of the land covered with structures or anthropogenic impervious surfaces (e.g., high-density residential, commercial, industrial, roads, etc.) or less intensive uses where the land cover matrix includes both vegetation and structures (e.g., low-density residential, recreational facilities, cemeteries, parking lots, utility corridors, etc.), including any land functionally related to urban or built-up environments (e.g., parks, golf courses, etc.)."

The second question in this paper asks how location within a riparian corridor affects land use. In addition to evaluating whether location within a riparian zone impacts the probability that a pixel is developed during the study period, the second question also considers whether location in a riparian corridor influences the probability that land is "disturbed" during the study period. We define disturbed land as land that is developed, in agricultural use, or mechanically disturbed. Agricultural land is defined as: "Land in either a vegetated or an unvegetated state used for the production of food and fiber. This includes cultivated and uncultivated croplands, hay lands, pasture, orchards, vineyards, and confined livestock operations. Note that forest plantations are considered forests regardless of the use of the wood products." Mechanically disturbed land is defined as: "Land in an altered and often unvegetated state that, due to disturbances by mechanical means, is in transition from one cover type to another. Mechanical disturbances include forest clear-cutting, earthmoving, scraping, chaining, reservoir drawdown, and other similar human-induced changes."

LCT data is also used to identify water and wetlands. All pixels that are classified as water or wetlands in either period are dropped from the analysis of agricultural lands, as development of these pixels was assumed to be infeasible or prohibited by environmental regulations. The riparian analysis includes land pixels that are classified as water or wetlands, because this may include most of the land in and around riparian corridors. As discussed in the previous section, riparian buffers are defined to include a 100 meter buffer of land on either side of a river or stream. Because the LCT data has a resolution of 60 meters, this provides a lower limit to the width of the buffer. Specifically, we define an LCT pixel to be located within the 100 meter buffer if the centroid of the pixel is located within the corridor.

The river and stream layer was obtained from the Pacific Northwest Ecosystems Research Consortium (PNERC). This data set does not completely overlap the LCT data, so the analysis only includes portions of LCT data that overlap the river layer. The loss of observations is minimal. It should be noted that there are no observations for Sublimity, Donald, Halsey, or Lyons that are located within both an LCT block and a riparian corridor.

This analysis also considers UGB and county boundaries. UGB data was provided by Angela Lazarean at the Oregon DLCD. This dataset consists of digitized maps which present the progression of Oregon's UGBs from 1980-2000. County boundaries as defined in 2007 were compiled by the Bureau of Land Management (BLM), and were available on the Oregon DLCD website. Finally, only private lands are considered in this analysis. The shapefile which represents public and private land ownership was developed by the Oregon Department of Forestry (ODF), and downloaded from the Oregon Geospatial Office. This 2008 dataset defines public and private lands, in addition to listing the agency in charge of any public lands.

4.3. Methods

This paper uses the DIDID model to estimate the impact of Oregon's land use laws on agricultural lands and riparian corridors. The DIDID model is an extension of the DID model. The DID model evaluates the effect of a treatment on two groups over time. In the initial period, neither group is exposed to the treatment. In the second period, one of the groups is exposed to the treatment, but the other is not. The average change over time in the outcome variable for the untreated group is then subtracted from the average change over time in the outcome variable for the treated group, to evaluate the impact of the treatment on the outcome variable. This removes biases in second period comparisons between the treatment and control group that could result from permanent differences between those groups, as well as biases from comparisons over time which may result from common time trends (Wooldridge 2010, Imbens and Wooldridge 2009). The DIDID model takes this a step further, and allows us to refine the definition of the treatment and control group (Wooldridge, 2010). The DIDID model is specified as:

$$Y_{it} = \beta_0 + \beta_1 G_{A,i} + \beta_2 G_{B,i} + \beta_3 G_{A,i} G_{B,i} + \beta_4 T + \beta_5 G_{A,i} T + \beta_6 G_{B,i} T + \beta_7 G_{A,i} G_{B,i} T + u_{it} \quad (1)$$

where Y_{it} is the outcome variable (in our analysis, this is either the probability that a pixel is developed, or the probability that a pixel is disturbed), *i* indexes pixels, and *t* indexes time. The time indicator variable, T, is equal to 0 in the initial time period (in our analysis, 1973), and 1 in the second time period (in our analysis, 2000). The "treated" group is represented by the indicator variable, $G_{A,i}$, which equals 1 if a pixel is in the treated group and 0 otherwise. For question 1, the treated group consists of pixels that are located in an EFU zone. For question 2, the treated group consists of pixels that are located within a riparian corridor. Finally, we use the variable $G_{B,i}$ to further refine the treatment and control groups. In our analysis, this variable will allow us to investigate the difference in the probability of development (or disturbance) on agricultural lands and riparian corridors inside and outside of UGBs. In addition to the covariates, β_0, β_1, β_2, β_3, β_4, β_5, β_6 and β_7 are parameters and u_{it} is a mean-zero disturbance term (Wooldridge, 2010). The DIDID estimator therefore controls for two potentially confounding trends. First, it accounts for differences in the probability of development inside and outside of the treated area (EFU zones or riparian corridors) which would have occurred even in the absence of Oregon's land use planning laws. Second, it accounts for any changes in the probability of development inside and outside of UGBs.

Once we estimate the DIDID model, we calculate the average treatment effect (ATE) using the estimate of β_7, which can be expressed as:

$$\beta_7 = \left(\bar{y}_{G_A=1,G_B=1,T=1} - \bar{y}_{G_A=1,G_B=1,T=0}\right) - \left(\bar{y}_{G_A=1,G_B=0,T=1} - \bar{y}_{G_A=1,G_B=0,T=0}\right) - \left(\bar{y}_{G_A=0,G_B=0,T=1} - \bar{y}_{G_A=0,G_B=0,T=0}\right) \qquad (2)$$

This result demonstrates the appeal of the DIDID estimator, which is that we can estimate the treatment effect simply by observing the coefficient on the triple interaction of the treated group, the second treated group, and the time indicator variable[20].

The DIDID model for agricultural lands is specified as follows:

$$Y_{it} = \beta_0 + \beta_1 T + \sigma_j AG_{ji} + \alpha_j County_{ji} + \delta_j County_{ji} AG_{ji} + \gamma_j AG_{ji} T + \theta_j County_{ji} T + \rho_j County_{ji} AG_{ji} T + \varepsilon_{it} \quad (3)$$

Where j indicates county, and i indicates plot, $Y_{it} = 1$ if plot i is developed in time t, 0 otherwise, T =1 in the second period (2000), 0 in the initial period (1973), and AG_{ji}=1 if the plot is in the treated group, 0 otherwise. For the analysis of agricultural lands, the treated group consists of pixels classified as agriculture in the 1973 LCT data. Finally, $County_{ji}$=1 if a pixel is located outside of a UGB, as defined in 1980, 0 otherwise. That is, $County_{ji}$=1 if a plot is under planning authority of a county.

We estimate two specifications of this model. In the first variation (variation 1), we define AG_{ji}=1 if a plot is in agricultural land in 1973, 0 otherwise, and $County_{ji}$= 1 if a plot is located outside a UGB, 0 otherwise. In the second variation (variation 2), we allow coefficients on agricultural land and land that is located outside of UGBs to vary by

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[20] The DIDID estimator accounts for heterogeneity between the treated group and the untreated group. Therefore, the calculation of the treatment effect is not affected by the group specific characteristics that impact the probability of treatment. This simulates a random treatment assignment. Based on the discussion in Heckman and Vytlacil (2005), this implies that the ATE also represents the average treatment effect of the treated (ATT), as well as the average treatment effect of the untreated (ATU).

county. There are a total of ten counties that overlap the LCT data in the Willamette Valley (J=10). A list of all counties and UGBs in the study area is presented in Table 1.

The coefficient on the time indicator variable, β_1, represents the underlying change in the probability of development from 1973 to 2000 for all land pixels in the study area. The difference between the general time trend and the change in probability of development for pixels that were used for agriculture in 1973 is given by the coefficient on the interaction term between the time and agriculture indicator variables, γ. Similarly, the difference between the general time trend and the change in the probability of development over time for pixels that are not contained within a UGB is represented by the coefficient on the interaction term between the time and county indicator variables, θ. Finally, the change in the probability of development for agricultural pixels that are located outside of a UGB, once we factor out all of the other time trends, is represented by the coefficient on the triple interaction term, ρ. These explanations apply to variation 1. The variables can be interpreted in a similar fashion for variation 2, except the treatment effects are allowed to vary by county.

The analysis of Riparian Corridors is similar to that for Agricultural lands. The DIDID model for riparian corridors is specified as follows:

$$Y_{it} = \beta_0 + \beta_1 T + \sigma_j R_{ji} + \alpha_k UGB_{ki} + \delta_{jk} UGB_{ki} R_{ji} + \gamma_j R_{ji} T + \theta_k UGB_{ki} T + \rho_{jk} UGB_{ki} R_{ki} T + \varepsilon_{it} \qquad (4)$$

Where j indicates county, k indicates city, i indicates pixel, $Y_{it} = 1$ if pixel i is developed (or disturbed) in time t, 0 otherwise, T =1 in the second period (2000), 0 in the initial period (1973), and R_{ji}=1 if the pixel is in the treated group, 0 otherwise. In the analysis of riparian corridors, the treated group consists of any pixel with a centroid located within 100 m of a stream or river. Finally, UGB_{ki}=1 if a pixel is located inside of a UGB, as defined in 1980, 0 otherwise. In the analysis of riparian buffer zones, we estimate two separate sets of models. In the first set, we evaluate the probability that land is developed. In the second set, we evaluate the probability that land is disturbed.

We estimate four variations of this model. In the first variation (variation 1), we define R_{ji}=1 if a pixel is in a riparian corridor, 0 otherwise, and UGB_{ki}= 1 if a pixel is located inside any UGB, 0 otherwise. In the second variation (variation 2), we allow effects of UGBs to vary by city. There are a total of 23 UGBs which overlap the LCT data in the Willamette Valley (K=23). In this variation, the indicator variable for riparian corridors, R_{ji}, is defined as in variation 1. In the third variation (variation 3), we allow effects of riparian corridors to vary by county. The UGB indicator, UGB_{ki} is defined as in variation 1. Finally, in the fourth variation (variation 4), we allow effects of riparian corridors to vary by county and effects of UGBs to vary by city.

The general time trend, indicated by β_1, can be interpreted in the same way as in the agricultural analysis. In the riparian analysis, γ now represents the change in the outcome variable that can be attributed to the location of a pixel within a riparian corridor. Because our focus is now on land inside of UGBs, θ represents the change in the outcome variable during the study period for land inside of UGBs. The coefficient on the interaction term, ρ, now represents the change in the outcome variable during the study period for land that is located both a riparian corridor and within a UGB. These explanations are for variation 1, however the variables may be expanded by city or county for variations 2, 3, and 4. Each variation is estimated twice; first to examine the probability of development, second to examine the probability of disturbance.

We estimate the DIDID model with least squares. A more common approach to estimate a probability model is to use binary probit or logit specifications, which have the advantage of constraining the probabilities of the binary outcomes to the unit interval. In contrast, there is no such constraint on the linear probability model in (1), so that predicted values of Y_{it} can fall outside the unit interval. The advantage of the linear probability model in a DIDID context is the ease of estimating the ATE, which likely explains its use in recent DID applications (Conley and Taber 2011, Abrevaya and Hamermesh 2012), and which we extend to the use of the DIDID model. In contrast, in a probit or logit model the ATE is a nonlinear function of all independent variables and estimated parameters, including any time-invariant terms that would drop out of the expression in (2). Furthermore, failure to control for spatially-correlated errors can result in biased coefficient estimates in probit and logit models. In our application, if development decisions are made for groups of contiguous pixels, rather than individual pixels, we might expect the error terms to be spatially correlated. Estimation of spatial probit and logit models is computationally difficult and requires strong assumptions about the structure of underlying spatial relationships. In a linear model, spatially-correlated errors have implications only for the precision of the estimates[21].

The binary property of Y_{it} implies that u_{it} is heteroskedastic, but because the exact form of the variance of u_{it} is known (see Wooldridge 2010), one can make an explicit correction for heteroskedasticity. However, if the prediction of Y_{it} is outside of the unit interval, then the variance of u_{it} is negative and common practice in this case is to drop the observation. An alternative is to keep all of the observations and use heteroskedasticity-robust standard errors. Based on the discussion in paper 1 of my dissertation (and because the study area is larger and therefore more heterogeneous than the study area in the first paper), I account for this heteroskedasticity using cluster robust standard errors. The clusters are defined by the jurisdiction in which the pixel is located. If the pixel is in a particular UGB, that defines the cluster. If the pixel is not located within a UGB, then the cluster is defined by the county in which it is located.

4.4. Results

<u>4.4.1. Agricultural Lands</u>

We began by investigating how well Oregon's land use planning regulations have been able to prevent development of agricultural lands located outside of UGBs.

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[21] Spatial correlation can be addressed with the use of a spatial weighting matrix, W. However, the true form of the spatial interdependence is not known with certainty, therefore we must assign a structure to the W matrix. If the matrix is mis-specified, we have introduced an additional form of uncertainty into our model. We partially account for spatial dependence with the inclusion of county and city indicator variables. In addition, the model is estimated using a cluster robust variance-covariance matrix.

Appendix 4.1a summarizes all of the results in the analysis of agricultural lands, while table 2 reports the key results. The R-squared value for variation 1 was 0.43, and R-squared for variation 2 was 0.46. Overall, we find that Oregon planning goal 3 has been successful in preventing development of agricultural land. Agricultural lands outside of UGBs were less likely to be developed than agricultural lands inside of UGBs, and they were also less likely to be developed than other land outside of UGBs. This is shown in table 2, in the results column for agricultural land outside of UGBs, which reports an ATE of -23.58 percentage points (p-value=0.000) for variation 1 of the model. This result implies that land that is located in EFU zones is much less likely to be developed than other lands. For variation 2, I also estimate negative and significant ATEs for all counties in the study area, with the exception of Columbia County. These ATEs range from -46.07 percentage points (Lane County) to -11.59 percentage points (Polk County). The ATE for Columbia County is insignificant.

Considering all agricultural lands (regardless of location inside or outside of a UGB), we find that agricultural lands were more likely to be developed than other lands in the study area. The second set of results in table 2 reports coefficients on the interaction of agriculture and time. For variation 1, the estimate is 24.71 (p-value=0.000). In other words, land that was used for agriculture in 1973 was 24.71 percentage points more likely to be developed during the study period than land that was not used for agriculture. This effect accounts for the overall trend in development that was experienced by all land in Oregon, as well as the initial difference between the probability of development of agricultural lands and all other lands. Similar to results for variation 1, the variation 2 results show positive and significant effects for all counties in the study area, with the exception of Columbia County. The estimates range from 12.12 percentage points (Polk County) to 54.23 percentage points (Washington County). The results for Columbia County are insignificant.

The discussion in the previous paragraph may seem to imply that agricultural land in general has a high probability of development, but this is not the case. The results for variation 1 that are presented in Appendix 4.1b indicate that that agricultural land located inside of UGBs had a development probability of 28.1 percentage points during the study period, while agricultural land located outside of UGBs only had a probability of development of 1.6 percent during the same period. In addition, the estimated effects of all agricultural lands and the estimated ATEs for agricultural lands located outside of UGBs tend to mirror each other. With the exception of Multnomah and Washington Counties, the ratio of these effects is close to -1 for all of the remaining cities. Therefore, we can conclude that a larger portion of agricultural plots inside of UGBs were developed, but there was almost no development of agricultural lands located outside of UGBs.

While it is not a focus of this paper, we are also able to compare the probability of development for land outside of UGBs to land located within UGBs. For variation 1, I estimate an effect of -2.91 (p-value=0.033). In other words, land that is located inside of a UGB was 2.91 percentage points less likely to be developed during the study period than land located inside of a UGB. For variation 2, I also estimate negative and significant effects for most counties in the study area. The estimate for Clackamas

County is insignificant. A positive effect of 10.78 (p-value=0.000) was estimated for Multnomah County. A marginally negative effect of -2.60 (p-value=0.051) was estimated for Columbia County. Estimates for the remaining counties are negative and significant, and range from -2.72 percentage points (Washington County) to -3.33 percentage points (Linn County). This is consistent with the results from the first paper in my dissertation.

4.4.2. Riparian Corridors – developed land

In this portion of the analysis, I investigate whether Oregon planning goal 5 reduced development in riparian corridors inside of UGBs. Appendix 4.2a summarizes all of the results in the analysis of riparian corridors, while table 3 reports the key results. Overall, goal 5 has been successful in curbing development in riparian corridors. The R-squared value for all variations were approximately 0.32. It should be noted that the definition of a Riparian Corridor that is used in this paper is not strictly enforced by Oregon's land use regulations. Therefore, unlike the analysis of land in EFU zones, we are also evaluating the stringency with which planning goal 5 is applied inside of individual UGBs. This applies to both development and disturbance within riparian corridors. For variation 1, I do not estimate a significant ATE, as shown in table 3a. However, significant ATEs are estimated for a number of cities and counties when they are examined separately. For variation 2, I estimate a separate ATE for land in riparian corridors within each UGB. Twelve cities in the study area have negative and significant ATEs, indicating that Oregon's land use law was able to slow development in riparian corridors in these urban areas. These results are also shown in table 3a. The cities with negative ATEs include Lafayette, McMinnville, Sheridan, Lowell, Newberg, Dayton, Dundee, Stayton, Philomath, Corvallis, St Helens, and Harrisburg, with values ranging from -16.63 percentage points (Lafayette) to -1.09 percentage points (Harrisburg). I estimate significant positive ATEs for three cities. These include: Metro, with an ATE of 1.17 percentage points (p-value=0.000); Carlton, with an ATE of 3.03 percentage points (p-value=0.000); and Lebanon, with an ATE of 4.18 percentage points (p-value=0.000). This indicates that land in riparian corridors located in these cities was more likely to be developed during the study period than other land inside the UGB. The remaining cities had insignificant ATEs. The predicted probability of development in riparian corridors inside of UGBs is presented in Appendix 4.2b for both time periods. During the study period, there was no change in the estimated probability of development of land in riparian corridors located in Brownsville, Dundee, Lowell, and Scappoose. However, a negative and significant ATE was estimated for land in riparian corridors located in the Dundee and Lowell UGBs. The underlying change in the probability of development within these two UGBs was positive, therefore the negative ATEs for Dundee and Lowell represent the difference between the trend for the UGBs and the probability of development in riparian corridors.

For variation 3, I estimate a separate ATE for riparian lands located within each county, while treating all UGBs in each county as one unit. A separate treatment effect is therefore estimated for riparian corridors inside of UGBs for each county. Overall, the results from variation 3 indicate that land located in a riparian corridor inside a UGB is less likely to be developed than other land. This is consistent with the results from variation 2. There are eight counties in the study area with negative and significant ATEs, with values ranging from -11.47 percentage points (Multnomah County) to -4.04 percentage points (Benton County). Washington County has a positive, significant ATE with a value of 6.68 percentage points (p-value=0.000). Linn County has an insignificant ATE. Similar to the discussion of Brownsville, Dundee, Lowell, and Scappoose, there is no change in the probability of development for land located in riparian corridors inside of UGBs in Lane County, as shown in Appendix 4.2.b.

In the estimation of variation 4, riparian lands are separated by county and UGBs by city. The results are similar to those found using variation 2, except that the Metro UGB has observations located within riparian corridors in Washington, Multnomah, and Clackamas Counties, and Stayton has observations located within riparian corridors in both Linn and Marion Counties. The portion of Stayton that is located in Linn County appears to be along the border of the UGB. There are not sufficient observations to interpret results from this area. Negative significant ATEs are estimated for Corvallis, Dayton, Dundee, Lafayette, Lowell, McMinnville, Metro (Clackamas and Multnomah County), Newberg, Philomath, Sheridan, Stayton and St. Helens. The negative ATEs range in value from -17.16 percent (Lafayette) to -2.49 percent (St. Helens). Positive significant ATEs are estimated for Carlton (2.5 percentage points, p-value=0.000), Lebanon (4.54 percentage points, p-value=0.000), and the portion of the Metro UGB that is in Washington County (5.55 percentage points, p-value=0.000). Estimated ATEs for all other cities are insignificant. Brownsville, Dundee, Lowell, Scappoose, and the portion of Stayton that is located in Linn County have no change in the probability of development of land located inside of riparian corridors. These results are presented in detail in table 3a and Appendix 4.2.b.

In the overall analysis of development probabilities in all riparian corridors the results are generally insignificant, which indicates that land within riparian corridors has roughly the same probability of development as land located outside of riparian corridors. These results are presented in table 3b. The estimates for variations 1 or 2 are insignificant. For variations 3 and 4, riparian zones are broken out by county. The results of variations 3 and 4 are the same in the analysis of all riparian corridors. Negative and significant effects were estimated for Benton County (-1.0 percentage points, p-value=0.026) and Lane County (-1.1 percent, p-value=0.014), indicating that land located inside of riparian corridors in each of these counties has a slightly lower probability of development during the study period than all other land in the respective counties. A positive and significant effect was calculated for Multnomah County (18.6 percentage points, p-value=0.000), which implies that land inside of riparian corridors was actually more likely to be developed than other lands in Multnomah County during the study period. Insignificant effects were estimated for riparian corridors in all other counties.

Although it is not a focus of this paper, we are also able to estimate a treatment effect for land inside of UGBs when compared to land outside of UGBs. We are then able to compare the results from this paper to the results from the first paper in my dissertation as a robustness check. These results are presented in table 3c. Overall, land that is located inside of UGBs has a higher probability of development than land located outside of UGBs. Results for variation 1 and variation 2 show that land located inside of any UGB within the Willamette valley is 98.7 percentage points more likely to be developed than land outside of UGBs. Results for variations 1 and 3 estimate negative or insignificant effects for land within the Brownsville, Carlton, Estacada, Halsey, Lyons, and Scappoose UGBs, however land within the remaining UGBs has a higher probability of development than land outside of these UGBs. These results are consistent with the results from the first paper in my dissertation.

4.4.3. Riparian Corridors – disturbed lands

In this portion of the analysis, I investigate whether Oregon planning goal 5 reduced the probability that land in riparian corridors inside of UGBs was disturbed during the study period. The R-squared value for all variations was approximately 0.03. Appendix 4.3a summarizes all of the results in the analysis of riparian corridors, while table 3 reports the key results. Unlike the analysis of development in riparian corridors, I find that land that is located in a riparian corridor inside a UGB has a higher probability of disturbance than other land inside of UGBs. However, these effects are all less than 10 percentage points, as shown in table 3a. For variation 1, I estimate a positive and significant ATE of 2.52 percentage points (p-value=0.035). I also estimate mostly positive ATEs for variation 2. A negative effect of -2.27 percentage points (p-value=0.007) was estimated for Philomath, and the estimated ATEs for Lafayette and Stayton are insignificant. For the remaining sixteen cities I estimate positive and significant ATEs, with values ranging from 1.61 percentage points (Dallas) to 8.33 percentage points (Harrisburg). These results are presented in table 3a. Interestingly, the results for Brownsville, Carlton, Dundee, Lebanon, Scappoose, and Sheridan are all the same, with an ATE of 2.62 percentage points (p-value=0.002). The general ATE for riparian zones in variation 2 has a value of -2.62 percentage points (p-value 0.020). This is shown in table 3a. Therefore, there is actually no change in the probability of disturbance over time for lands located inside of riparian zones in these UGBs. In Lowell, the estimated probability of disturbance for land within a riparian corridor in a UGB is equal to zero in all time periods. These probabilities are also presented in Appendix 4.3b. Similar to variation 2, I estimate positive and significant ATEs for variation 4. The results for variation 4 are very similar to those from variation 2, and are presented in table 3a. For variation 3, my results are not as conclusive as they are for the other variations. A negative ATE of -13.18 percentage points (p-value=0.000) is estimated for Multnomah County, while a positive ATE of 3.97 percentage points (p-value=0.003) is estimated for Clackamas County. All other ATEs estimated using variation 3 are insignificant. Similar to the results from variation 2, land that is located in riparian corridors inside of UGBs in Lane County has no probability of disturbance in any time periods, and there is no change in the probability of disturbance over time for land located inside of UGBs in Polk County that is also located in riparian corridors. These predicted probabilities are presented in Appendix 4.3b.

In the analysis of all riparian corridors, regardless of location inside or outside of a UGB, the overall results are negative and significant, indicating that land within riparian corridors has a lower probability of disturbance than land located outside of riparian corridors. These results are presented in table 3b. For variations 1 and 2, I estimate a negative and effect of -2.62 percentage points (p-value=0.020). For variations 3 and 4, the overall results are also negative. The estimated effect for Multnomah County is 21.5 percentage points (p-value=0.000) and the estimated effect for Polk County is insignificant. The estimated effects for the remaining eight counties are negative and significant, with values that range from -4.2 percentage points (Marion County) to -2.4 percentage points (Washington County).

Although it is not the focus of this paper, we are also able to evaluate the probability that land located inside a UGB was disturbed during the study period, when compared to land that is not contained within a UGB. Overall, we find that land inside of a UGB is less likely to be disturbed than other lands. The results for variations 1 and 2 do not indicate that location inside of a UGB influences the probability that a parcel is developed. However, the results for variations 3 and 4 indicate that land inside of a UGB has a lower probability of development than land outside of a UGB. Insignificant effects are estimated for Donald and Metro, however all other cities within the study area have negative and significant estimated effects. The results are presented in table 3c.

4.5. Conclusions

Predicted probabilities from each of the three analyses are demonstrated in Figure 2. Figure 2a presents the graph from the agricultural analysis. There are four lines on this graph, which represent the following: probability of development of agricultural land that is located outside of a UGB; probability of development of agricultural land that is located inside a UGB; probability of development of non-agricultural lands located outside a UGB, and probability of development of non-agricultural lands located inside a

UGB. There is an observation for each group in 1973, and an observation in 2000. Overall, this graph shows that hardly any development took place during the study period on agricultural lands located outside of a UGB. By definition, the initial probability of development for this group is zero. In the second time period, the probability of development had only risen to 1.6%. In contrast, agricultural land located inside of a UGB had an increase in the total probability of development of 28%. Therefore, we can conclude that agricultural land outside of UGBs was protected by Oregon's land use law, as we discussed in the results section. But, during the same time period, non-agricultural land outside of UGBs only had a 0.05% increase in the probability of development. Therefore, EFU land was protected when compared to agricultural land located inside of UGBs, but not necessarily when compared to other lands located outside of UGBs.

Figure 2b presents the graph from the analysis of development in riparian corridors. In this case, riparian corridors located inside of UGBs had a lower change in the probability of development than other lands located inside of UGBs, therefore we can conclude that the program was successful in protecting this land. Also, riparian corridors located outside of UGBs had a lower change in the probability of development than other lands located outside of UGBs. Figure 2c presents the graph from the analysis of disturbance in riparian corridors. Land located in riparian corridors outside of UGBs has a lower probability of disturbance in both periods than other land outside of UGBs, and land located in riparian corridors inside of UGBs has a lower probability of disturbance in both periods than other lands inside of UGBs. Riparian corridors inside and outside of UGBs have similar disturbance rates, especially when compared to the analysis of development in Riparian corridors. This may be caused by the inclusion of agricultural lands in the definition of disturbed lands.

Overall, it appears that Oregon's land use regulations have been successful in protecting agricultural and riparian lands. Development rates in agricultural lands outside of UGBs are extremely low. The only caveat is that over a quarter of the agricultural land inside of UGBs has been developed.

Riparian corridors also seem to have been successfully protected, although this story is not as clear. The patchwork system of riparian regulations throughout the state make it more difficult to obtain a clear picture of the effects of Oregon's land use laws on protection of riparian corridors. In addition, a different picture is painted with the analysis of development in riparian corridors compared to the analysis of disturbance in riparian corridors. Inside of UGBs, the initial probability of disturbance was much higher than the initial probability of development, which is likely caused by the fact that the disturbance category includes agricultural lands. Similarly, all lands outside of UGBs had a much higher probability of disturbance than development. Again, this is due to the fact that land outside of UGBs is more likely to be used for agriculture than developed, as discussed in the agricultural analysis in this paper. The DIDID estimator allows us to focus on the development and disturbance of riparian corridors inside UGBs, therefore we are able to conclude that planning goal 5 was successful in protecting these lands. A possible extension of this analysis would be to focus on agriculture in riparian corridors outside of UGBs. The definition of a Riparian Corridor that is used in this paper is not strictly enforced by Oregon's land use regulations. Therefore, unlike the analysis of land in EFU zones, we are also evaluating the stringency with which planning goal 5 is applied at the local level. This limits the applicability of this analysis to policy decisions.

It is important to note that this analysis was performed in the Willamette Valley, which has the highest concentration of UGBs within the state. The results would likely be different if the analysis was performed in a more rural region.

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4.7. Tables and Figures

Table 4-1: Cities and Counties in the Study Area

Cities in study area
Brownsville
Carlton
Corvallis
Dallas
Dayton
Donald
Dundee
Estacada
Halsey
Harrisburg
Lafayette
Lebanon
Lowell
Lyons
METRO
McMinnville
Newberg
Philomath
Scappoose
Sheridan
St. Helens
Stayton
Sublimity

Counties in study area
Benton County
Lane County
Linn County
Marion County
Multnomah County
Polk County
Clackamas County
Washington County
Yamhill County
Columbia

City and Corresponding County	
City	**County**
Brownsville	Linn County
Carlton	Yamhill County
Corvallis	Benton County
Dallas	Polk County
Dayton	Yamhill County
Donald	Marion County
Dundee	Yamhill County
Estacada	Clackamas County
Halsey	Linn County
Harrisburg	Linn County
Lafayette	Yamhill County
Lebanon	Linn County
Lowell	Lane County
Lyons	Linn County
Metro	Clackamas County
	Multnomah County
	Washington County
McMinnville	Yamhill County
Newberg	Yamhill County
Philomath	Benton County
Scappoose	Columbia County
Sheridan	Yamhill County
St. Helens	Columbia County
Stayton	Marion County
Sublimity	Marion County

Table 4-2: ATEs for the analysis of development in Agricultural Land

Agricultural land outside UGBs

	ATE		*p-value*
Variation 1	**-0.2358**	*	*0.000*
Variation 2: land use by county			
Benton County	**-0.1593**	*	*0.000*
Clackamas County	**-0.2770**	*	*0.022*
Columbia County	**0.0095**		*0.843*
Lane County	**-0.4607**	*	*0.000*
Linn County	**-0.1354**	*	*0.000*
Marion County	**-0.1661**	*	*0.000*
Multnomah County	**-0.1944**	*	*0.000*
Polk County	**-0.1159**	*	*0.000*
Washington County	**-0.3938**	*	*0.000*
Yamhill County	**-0.2482**	*	*0.000*

Agricultural land

	ATE		*p-value*
Variation 1	**0.2471**	*	*0.000*
Variation 2: land use by county			
Benton County	**0.1618**	*	*0.000*
Clackamas County	**0.2937**	*	*0.015*
Columbia County	**0.0698**		*0.154*
Lane County	**0.4618**	*	*0.000*
Linn County	**0.1383**	*	*0.000*
Marion County	**0.1702**	*	*0.000*
Multnomah County	**0.3812**	*	*0.000*
Polk County	**0.1212**	*	*0.000*
Washington County	**0.5423**	*	*0.000*
Yamhill County	**0.2615**	*	*0.000*

land outside UGBs

	ATE		*p-value*
Variation 1	**-0.0291**	*	*0.033*
Variation 2: land use by county			
Benton County	**-0.0305**	*	*0.024*
Clackamas County	**-0.0105**		*0.420*
Columbia County	**-0.0260**		*0.051*
Lane County	**-0.0331**	*	*0.015*
Linn County	**-0.0333**	*	*0.014*
Marion County	**-0.0309**	*	*0.022*
Multnomah County	**0.1078**	*	*0.000*
Polk County	**-0.0332**	*	*0.015*
Washington County	**-0.0272**	*	*0.043*
Yamhill County	**-0.0281**	*	*0.036*

* represents a p-value of 0.05 or below
Green cells represent significant positive ATEs
Pink cells highlight significant negative ATEs

Table 4-3: ATEs for the analysis of development and disturbance in Riparian Corridors

	riparian corridors inside UGBs					
	developed		*p-value*	**disturbed**		*p-value*
Variation 1						
all cities and counties	**-0.0271**		*0.115*	**0.0252**	*	*0.035*
Variation 2 (land use by city)						
Brownsville	**0.0047**		*0.107*	**0.0262**	*	*0.002*
Carlton	**0.0303**	*	*0.000*	**0.0262**	*	*0.002*
Corvallis	**-0.0448**	*	*0.000*	**0.0185**	*	*0.025*
Dallas	**-0.0045**		*0.118*	**0.0161**	*	*0.050*
Dayton	**-0.0793**	*	*0.000*	**0.0327**	*	*0.000*
Dundee	**-0.0668**	*	*0.000*	**0.0262**	*	*0.002*
Estacada	**0.0047**		*0.105*	**0.0283**	*	*0.001*
Harrisburg	**-0.0109**	*	*0.000*	**0.0833**	*	*0.000*
Lafayette	**-0.1663**	*	*0.000*	**0.0144**		*0.078*
Lebanon	**0.0418**	*	*0.000*	**0.0262**	*	*0.002*
Lowell	**-0.1329**	*	*0.000*	**0.0249**	*	*0.003*
McMinnville	**-0.1587**	*	*0.000*	**0.0348**	*	*0.000*
Metro	**0.0117**	*	*0.000*	**0.0500**	*	*0.000*
Newberg	**-0.0898**	*	*0.000*	**0.0212**	*	*0.011*
Philomath	**-0.0566**	*	*0.000*	**-0.0227**	*	*0.007*
Saint Helens	**-0.0154**	*	*0.000*	**0.0191**	*	*0.022*
Scappoose	**0.0047**		*0.107*	**0.0262**	*	*0.002*
Sheridan	**-0.1332**	*	*0.000*	**0.0262**	*	*0.002*
Stayton	**-0.0603**	*	*0.000*	**0.0124**		*0.126*
Variation 3 (land use by county)						
Benton County	**-0.0404**	*	*0.001*	**-0.0217**		*0.308*
Clackamas County	**-0.0425**	*	*0.010*	**0.0397**	*	*0.003*
Columbia County	**-0.0984**	*	*0.000*	**0.0187**		*0.208*
Lane County	**-0.0992**	*	*0.000*	**0.0089**		*0.542*
Linn County	**-0.0155**		*0.501*	**0.0063**		*0.670*
Marion County	**-0.0658**	*	*0.000*	**0.0060**		*0.680*
Multnomah County	**-0.1147**	*	*0.000*	**-0.1318**	*	*0.000*
Polk County	**-0.0427**	*	*0.000*	**-0.0251**		*0.092*
Washington County	**0.0668**	*	*0.000*	**0.0126**		*0.390*
Yamhill County	**-0.0778**	*	*0.000*	**0.0139**		*0.347*

Table 4-3a ATEs for riparian corridors inside UGBs

riparian corridors inside UGBs

Variation 4 (land use by both)	**developed**		*p-value*	**disturbed**		*p-value*
Brownsville (Linn County)	**0.0083**		*0.063*	**0.0278**	*	*0.010*
Carlton (Yamhill County)	**0.0250**	*	*0.000*	**0.0350**	*	*0.002*
Corvallis (Benton County)	**-0.0395**	*	*0.000*	**0.0238**	*	*0.026*
Dalls (Polk County)	**-0.0013**		*0.764*	**-0.0106**		*0.304*
Dayton (Yamhill County)	**-0.0846**	*	*0.000*	**0.0416**	*	*0.000*
Dundee (Yamhill County)	**-0.0721**	*	*0.000*	**0.0350**	*	*0.002*
Estacada (Clackamas County)	**-0.0013**		*0.758*	**0.0311**	*	*0.004*
Harrisburg (Linn County)	**-0.0073**		*0.098*	**0.0850**	*	*0.000*
Lafayette (Yamhill County)	**-0.1716**	*	*0.000*	**0.0233**	*	*0.029*
Lebanon (Linn County)	**0.0454**	*	*0.000*	**0.0278**	*	*0.010*
Lowell (Lane County)	**-0.1265**	*	*0.000*	**0.0322**	*	*0.003*
McMinnville (Yamhill County)	**-0.1640**	*	*0.000*	**0.0437**	*	*0.000*
Metro (Clackamas County)	**-0.0370**	*	*0.000*	**0.0267**	*	*0.013*
Metro (Multnomah County)	**-0.1260**	*	*0.000*	**-0.1506**	*	*0.000*
Metro (Washington County)	**0.0555**	*	*0.000*	**-0.0062**		*0.545*
Newberg (Yamhill County)	**-0.0950**	*	*0.000*	**0.0301**	*	*0.006*
Philomath (Benton County)	**-0.0512**	*	*0.000*	**-0.0174**		*0.097*
Saint Helens (Columbia County)	**-0.0249**	*	*0.000*	**0.0334**	*	*0.002*
Scappoose (Columbia County)	**-0.0048**		*0.273*	**0.0405**	*	*0.000*
Sheridan (Yamhill County)	**-0.1385**	*	*0.000*	**0.0350**	*	*0.002*
Stayton (Linn County)	**-0.0929**	*	*0.000*	**0.0257**	*	*0.017*
Stayton (Marion County)	**-0.0566**	*	*0.000*	**0.0284**	*	*0.009*

Table 4-3b ATEs for riparian corridors

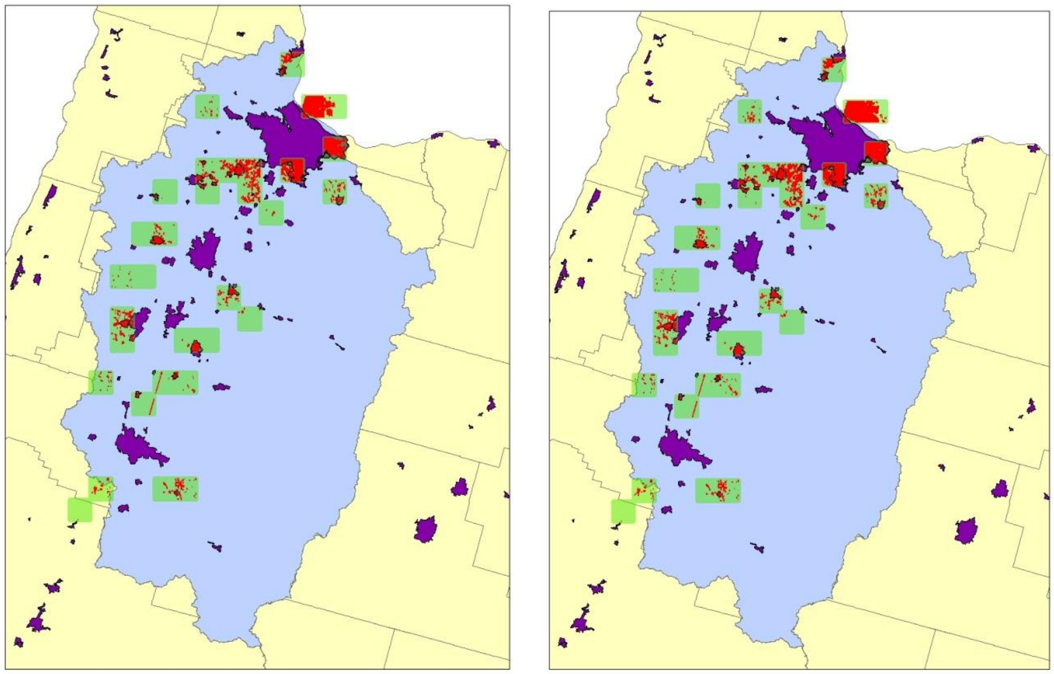
	riparian corridors					
	developed		*p-value*	**disturbed**		*p-value*
Variation 1 and Variation 2 (land use by city)						
all cities and counties	**-0.0047**		*0.1070*	**-0.0262**	*	*0.0020*
Variation 3 (land use by county) and Variation 4 (land use by both)						
Benton County	**-0.010**	*	*0.026*	**-0.031**	*	*0.004*
Clackamas County	**0.001**		*0.753*	**-0.029**	*	*0.008*
Columbia County	**0.005**		*0.273*	**-0.040**	*	*0.000*
Lane County	**-0.011**	*	*0.014*	**-0.033**	*	*0.002*
Linn County	**-0.008**		*0.063*	**-0.028**	*	*0.010*
Marion County	**-0.008**		*0.060*	**-0.042**	*	*0.000*
Multnomah County	**0.186**	*	*0.000*	**0.215**	*	*0.000*
Polk County	**-0.008**		*0.075*	**0.001**		*0.957*
Washington County	**0.004**		*0.355*	**-0.024**	*	*0.026*
Yamhill County	**0.001**		*0.890*	**-0.035**	*	*0.002*

Table 4-3c ATEs for land inside UGBs

	land inside UGBs					
	developed		*p-value*	**disturbed**		*p-value*
Variation 1 and variation 3 (land use by county)						
all cities and counties	**0.0987**	*	*0.000*	**-0.0194**		*0.188*
Variation 2 (land use by city) and Variation 4 (land use by both)						
Brownsville	**-0.0117**	*	*0.011*	**-0.0440**	*	*0.000*
Carlton	**-0.0003**		*0.950*	**-0.0440**	*	*0.000*
Corvallis	**0.0855**	*	*0.000*	**-0.0363**	*	*0.001*
Dallas	**0.0572**	*	*0.000*	**-0.0339**	*	*0.002*
Dayton	**0.0833**	*	*0.000*	**-0.0395**	*	*0.000*
Donald	**0.2543**	*	*0.000*	**-0.0193**		*0.066*
Dundee	**0.0598**	*	*0.000*	**-0.0440**	*	*0.000*
Estacada	**-0.0067**		*0.132*	**-0.0327**	*	*0.003*
Halsey	**-0.0117**	*	*0.011*	**-0.0440**	*	*0.000*
Harrisburg	**0.0897**	*	*0.000*	**-0.0440**	*	*0.000*
Lafayette	**0.1766**	*	*0.000*	**-0.0322**	*	*0.003*
Lebanon	**0.0551**	*	*0.000*	**-0.0440**	*	*0.000*
Lowell	**0.1260**	*	*0.000*	**-0.0427**	*	*0.000*
Lyons	**-0.0117**	*	*0.011*	**-0.0440**	*	*0.000*
McMinnville	**0.1755**	*	*0.000*	**-0.0424**	*	*0.000*
Metro	**0.1100**	*	*0.000*	**-0.0006**		*0.951*
Newberg	**0.1031**	*	*0.000*	**-0.0390**	*	*0.001*
Philomath	**0.1166**	*	*0.000*	**-0.0403**	*	*0.000*
Saint Helens	**0.0416**	*	*0.000*	**-0.0314**	*	*0.004*
Scappoose	**-0.0117**	*	*0.011*	**-0.0440**	*	*0.000*
Sheridan	**0.2684**	*	*0.000*	**-0.0440**	*	*0.000*
Stayton	**0.0895**	*	*0.000*	**-0.0418**	*	*0.000*
Sublimity	**0.4273**	*	*0.000*	**-0.0440**	*	*0.000*

* represents a p-value of 0.05 or below
Green cells represent significant positive ATEs
Pink cells highlight significant negative ATEs

Figure 4.1: LCT Blocks in the Wilamette Valley in 1973 (left) and 2000 (right).



The blue area in this figure represents the study area. UGBs are shown in red, and LCT blocks are shown in green. Developed parcels are depicted in red.

Figure 4.2: Treatment Effects.

Figure 4.2.a Predicted probability of development on Agricultural lands

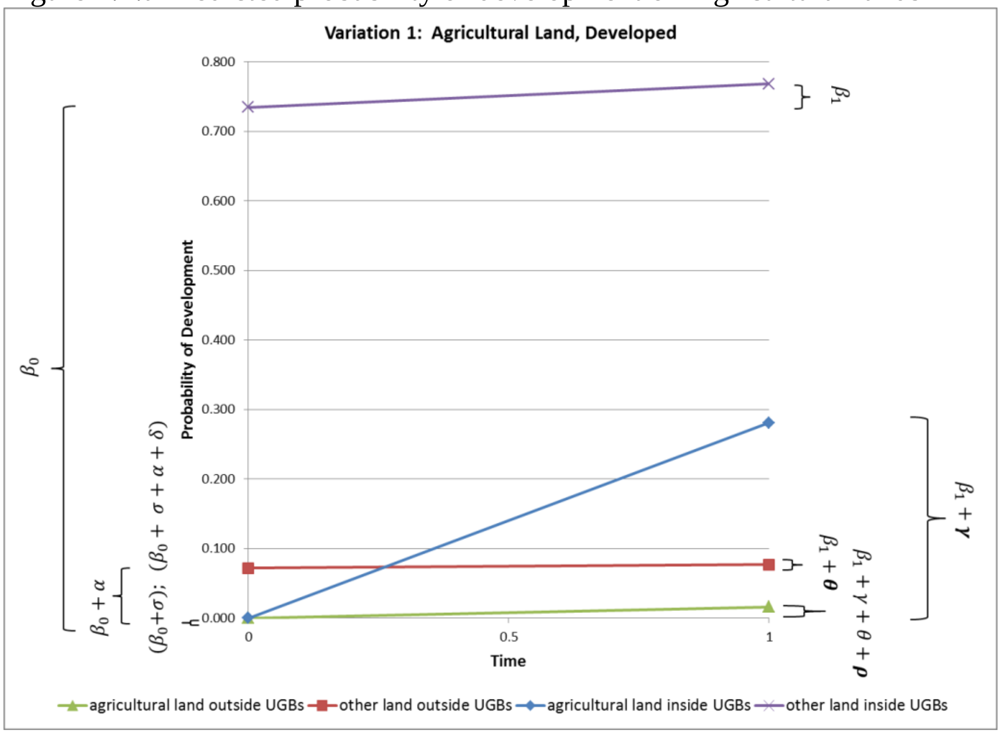


Figure 4.2.b Predicted probability of development in Riparian Corridors

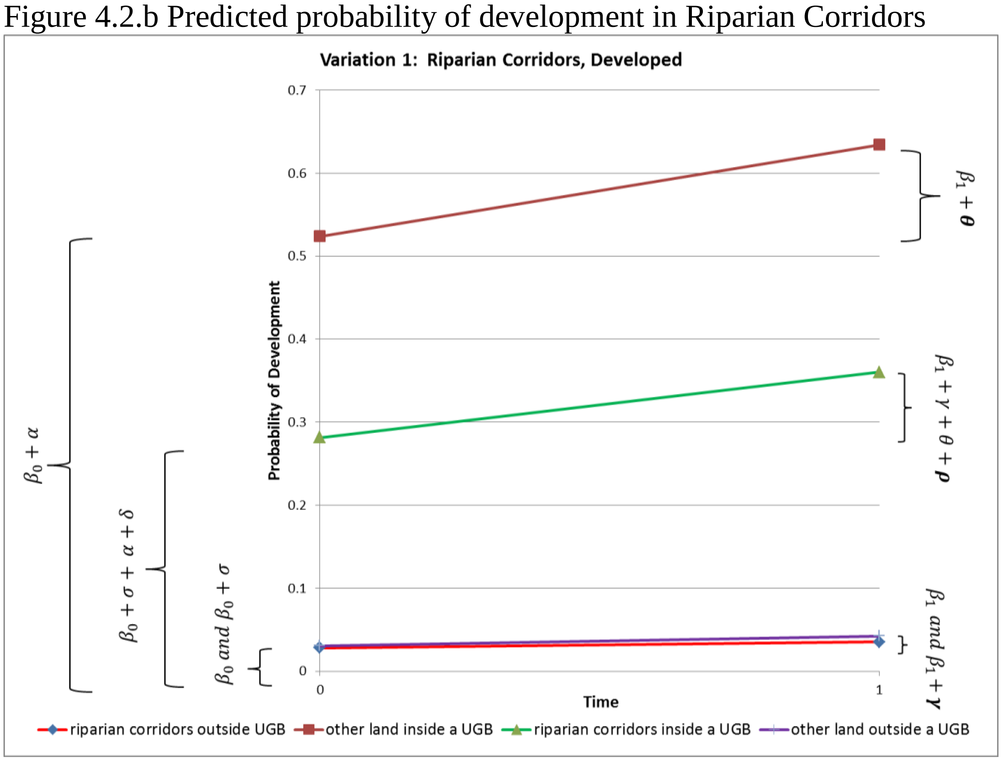
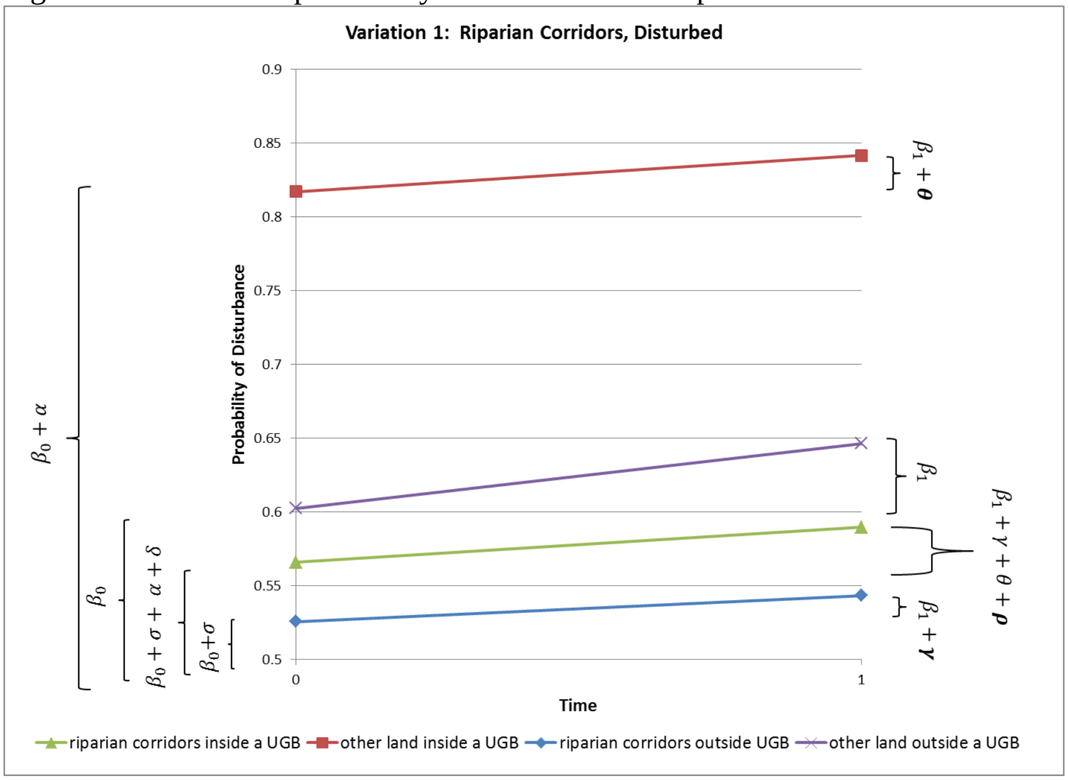


Figure 4.2.c Predicted probability of disturbance in Riparian Corridors



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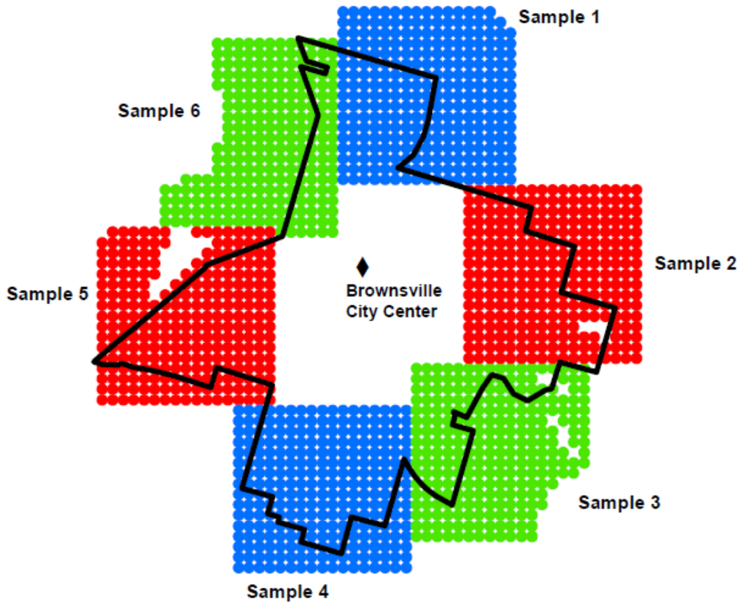
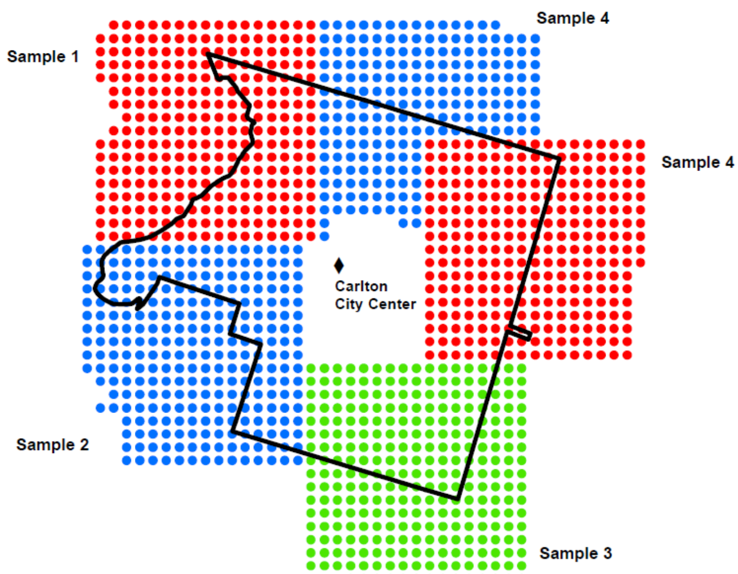
APPENDICES

Appendix 2.1: Maps of LCT blocks

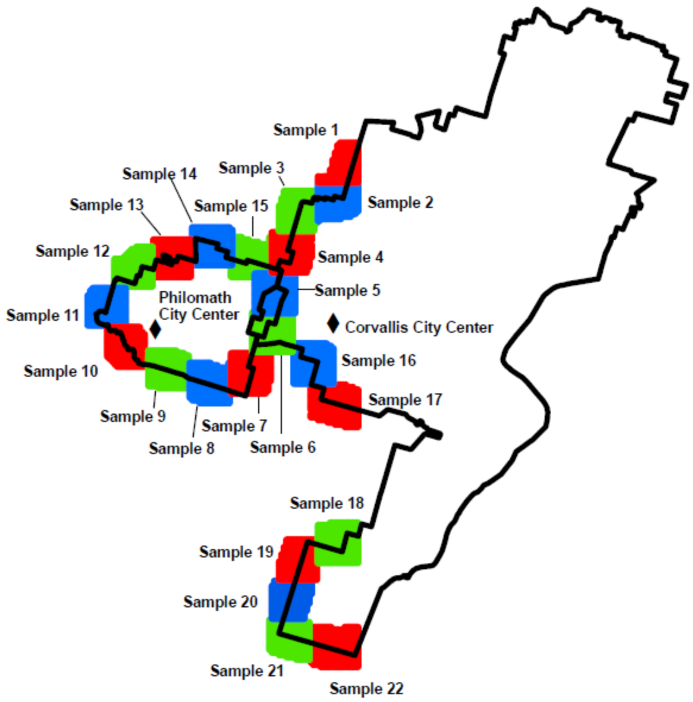
Appendix 2.1.a Brownsville Subsamples:



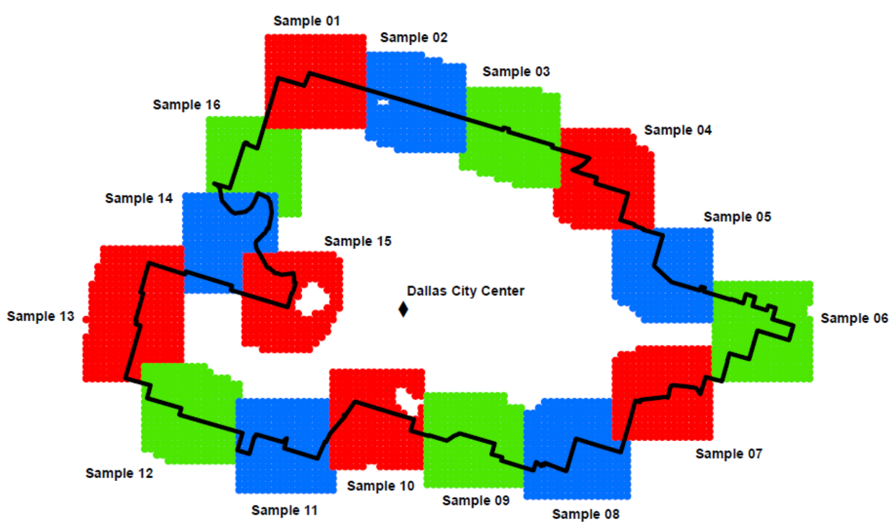
Appendix 2.1.b Carlton Subsamples:



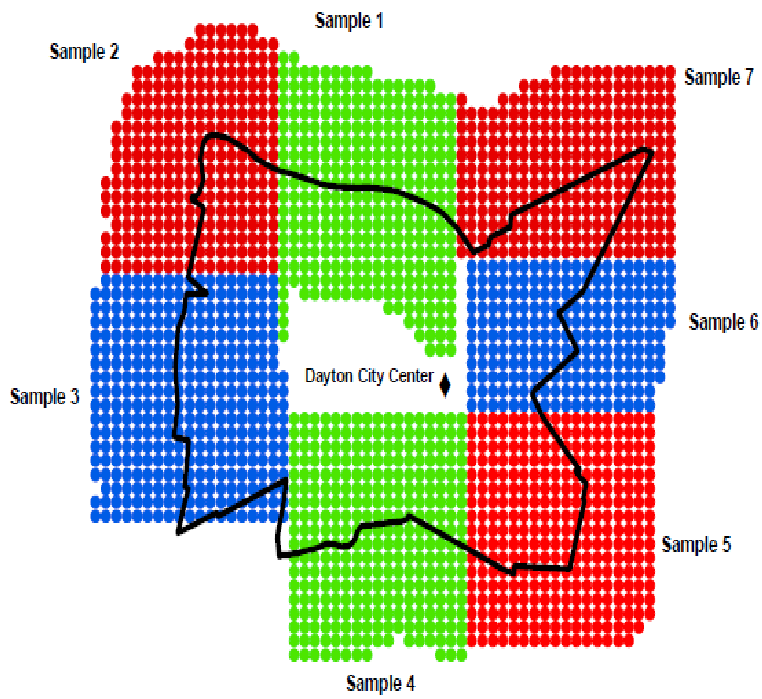
Appendix 2.1.c Corvallis/Philomath Subsamples:



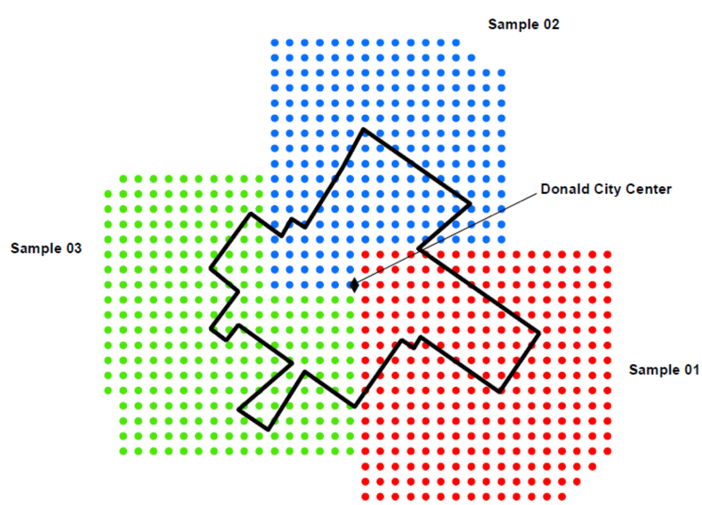
Appendix 2.1.d Dallas Subsamples:



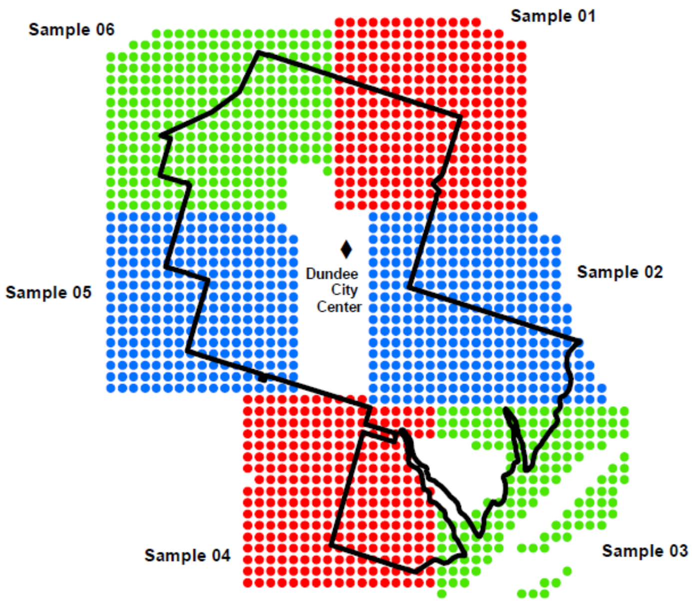
Appendix 2.1.e Dayton Subsamples:



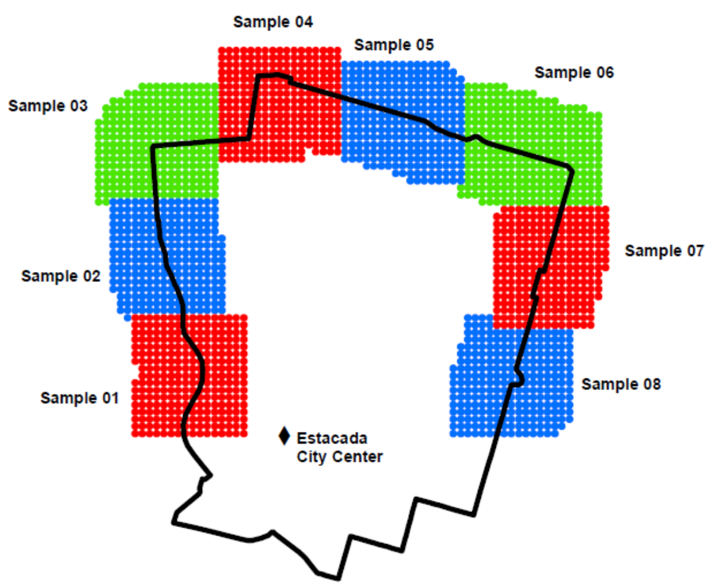
Appendix 2.1.f Donald Subsamples:



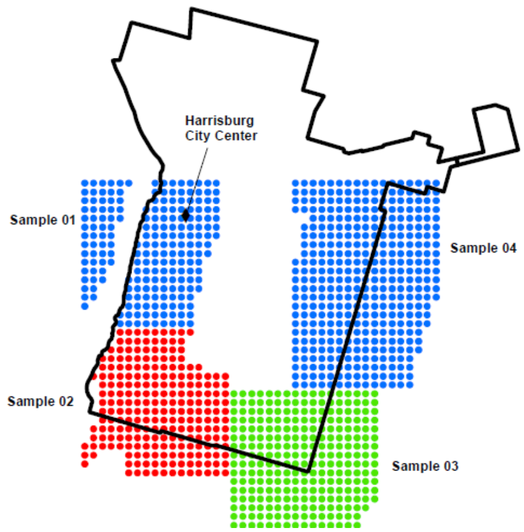
Appendix 2.1.g Dundee Subsamples:



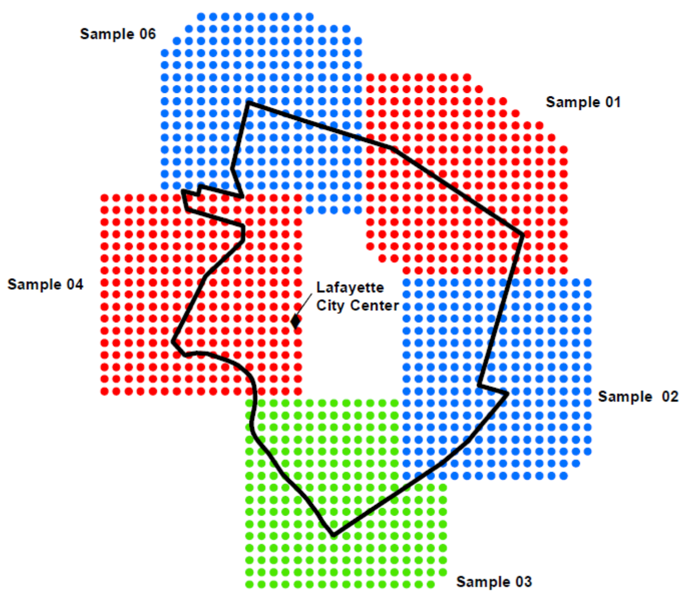
Appendix 2.1.h Estacada Subsamples:



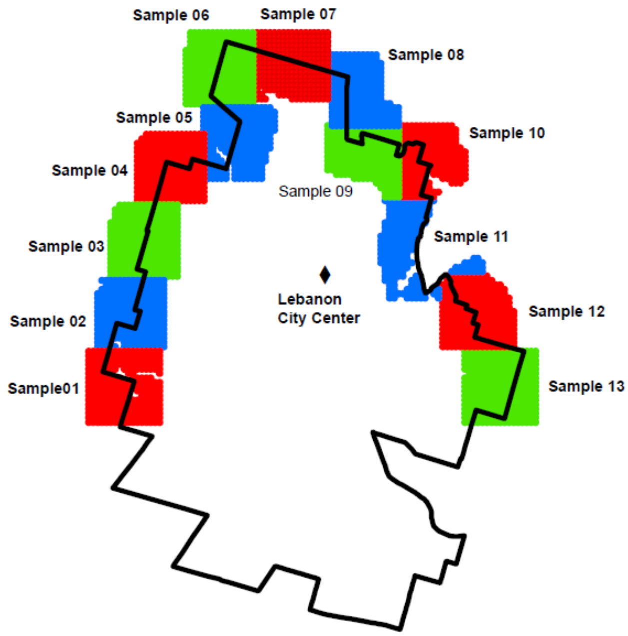
Appendix 2.1.i Harrisburg Subsamples:



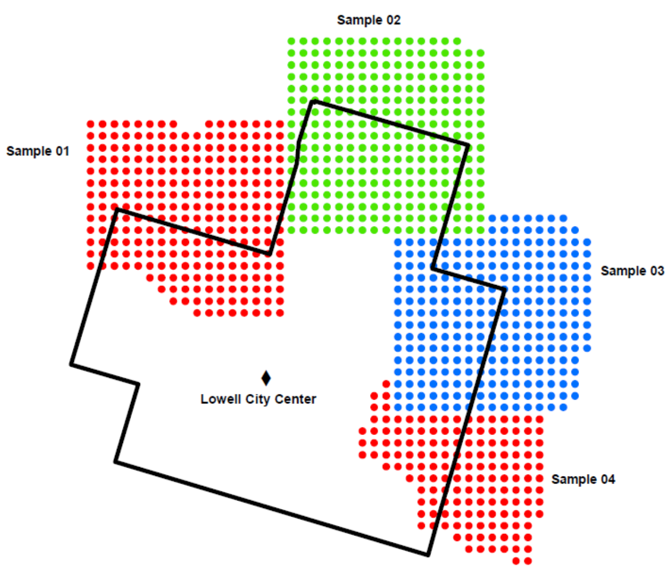
Appendix 2.1.j Lafayette Subsamples:



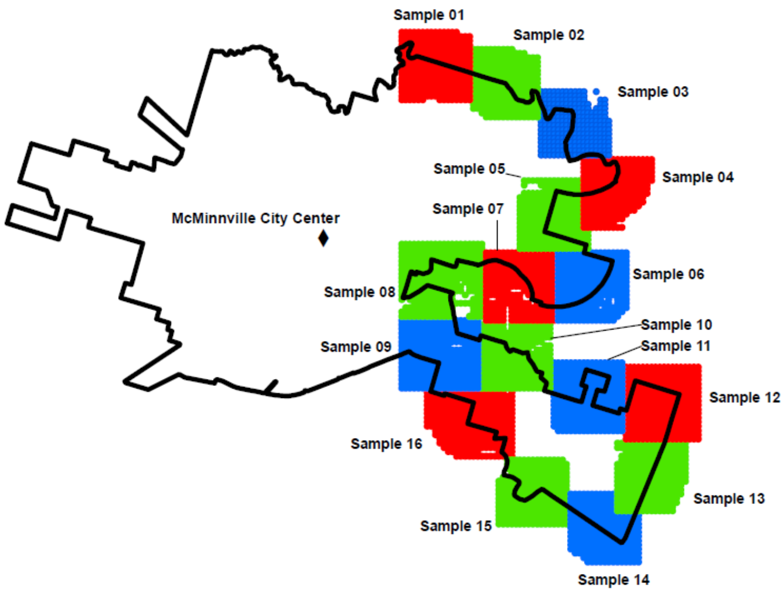
Appendix 2.1.k Lebanon Subsamples:



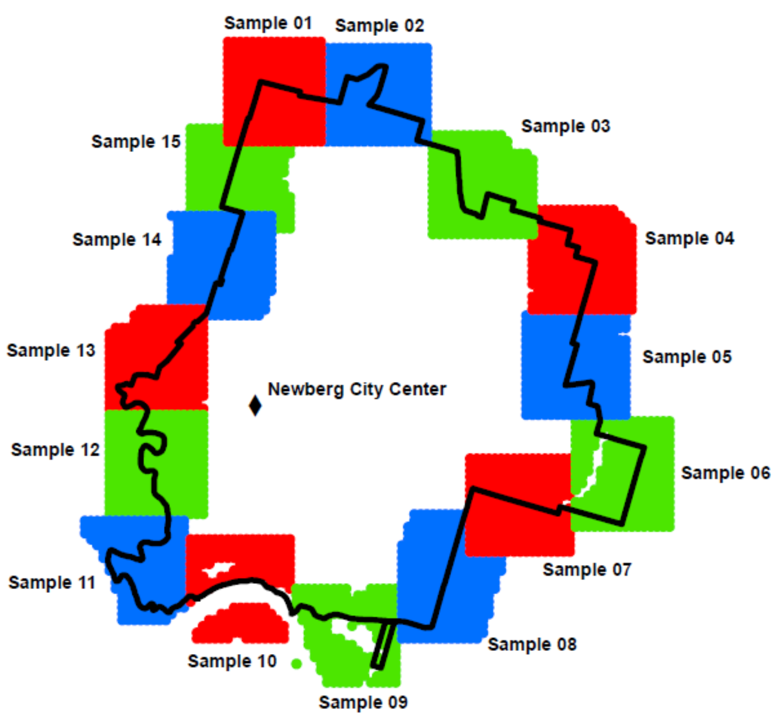
Appendix 2.1.l Lowell Subsamples:



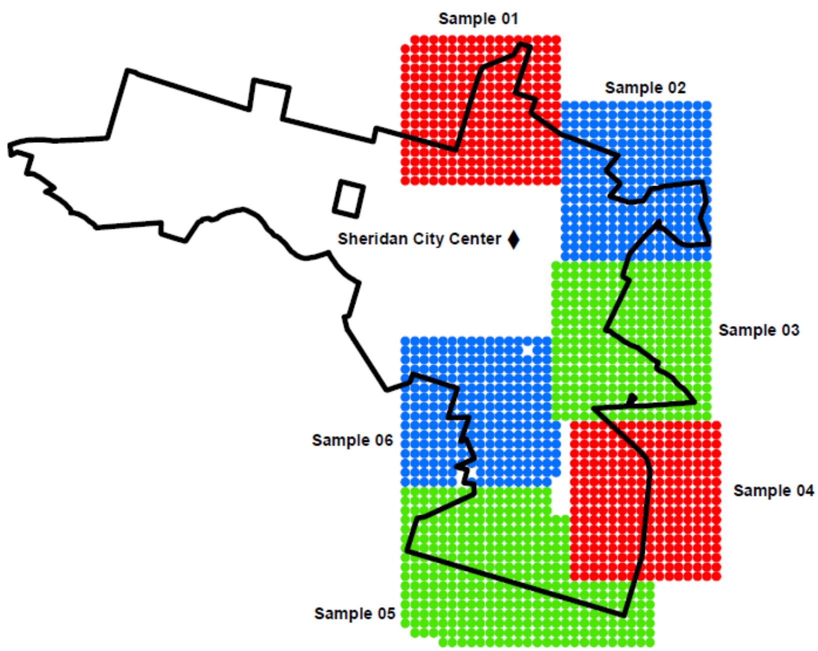
Appendix 2.1.m McMinnville Subsamples:



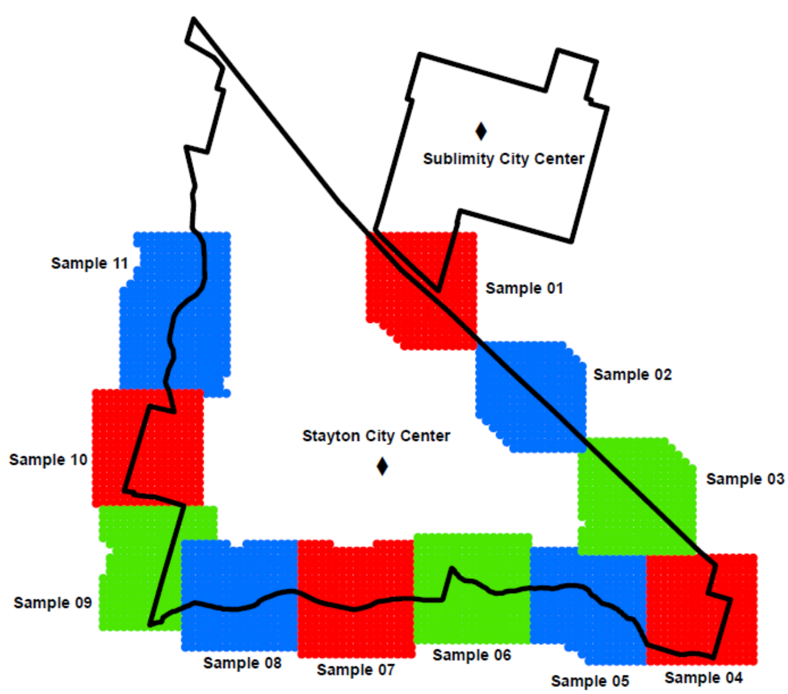
Appendix 2.1.n Newberg Subsamples:



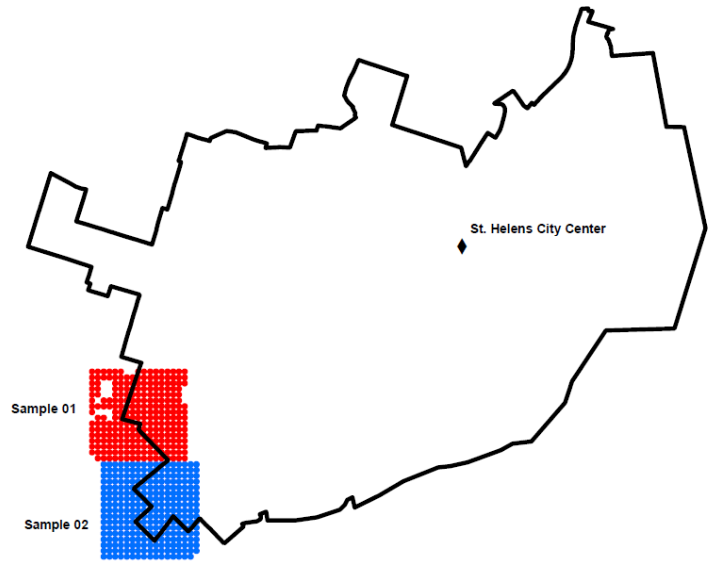
Appendix 2.1.o Sheridan Subsamples:



Appendix 2.1.p Stayton Subsamples:



Appendix 2.1.q St. Helens Subsamples:



Appendix 2.2: Complete Results

Appendix 2.2.a: Brownsville:

	Brownsville: Model I								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3168	number of negative weights: 0								
constant	0.1506	*	0.000	0.1506	*	0.000	0.1506		0.07
time	0.0000		1.000	0.0000		1.000	0.0000		0.38
group	0.2417	*	0.000	0.2417	*	0.000	0.2417	*	0.01
interaction	**0.0000**		**1.000**	**0.0000**		**1.000**	**0.0000**		**.**

	Brownsville: Model II								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3168	number of negative weights: 318								
constant	-0.2385		0.077	0.0308		0.842	0.0308		0.952
time	0.0000		1.000	0.0000		1.000	0.0000		1.000
group	0.1237	*	0.000	0.1095	*	0.000	0.1095		0.314
interaction	**0.0000**		**1.000**	**0.0000**		**1.000**	**0.0000**		**.**
1b.soil	0.0000		.	0.0000		.	0.0000		.
2.soil	0.1106	*	0.000	0.1236	*	0.000	0.1236	*	0.044
3.soil	-0.0797	*	0.000	-0.0488	*	0.017	-0.0488		0.435
4.soil	-0.0069		0.914	0.0172		0.758	0.0172		0.913
slope	-0.0134	*	0.000	-0.0100	*	0.007	-0.0100		0.257
elevation	0.0003		0.568	0.0005		0.353	0.0005		0.701
highway distance	0.0001	*	0.000	0.0001	*	0.002	0.0001		0.351
time*highway distance	0.0000		1.000	0.0000		1.000	0.0000		1.000
city center distance	0.0004	*	0.044	0.0000		0.932	0.0000		0.975
time*city center distance	0.0000		1.000	0.0000		1.000	0.0000		1.000
city center distance squared	0.0000	*	0.000	0.0000		0.141	0.0000		0.558
time * city center distance squared	0.0000		1.000	0.0000		1.000	0.0000		1.000
city limit distance	0.0001	*	0.000	0.0001	*	0.000	0.0001	*	0.044
time* city limit distance	0.0000		1.000	0.0000		1.000	0.0000		1.000

	Brownsville: Model III					
	aweight		robust		cluster robust	
	coefficient	p-value	coefficient	p-value	coefficient	p-value
observations: 3168	number of negative weights: 0					
constant	0.3144 *	0.000	0.3111 *	0.000	0.3111 *	0.000
time	0.0000	1.000	0.0000	1.000	0.0000	.
group	0.2333 *	0.000	0.2271 *	0.000	0.2271 *	0.002
interaction	**0.0000**	**1.000**	**0.0000**	**1.000**	**0.0000**	**.**
1b.soil						
2.soil						
3.soil						
4.soil						
slope						
elevation						
highway distance						
time*highway distance						
city center distance						
time*city center distance						
city center distance squared						
time * city center distance squared						
city limit distance						
time* city limit distance						
block 1 (base)	0.0000	.	0.0000	.	0.0000	.
block 2	-0.1067 *	0.003	-0.1017 *	0.011	-0.1017 *	0.000
block 3	-0.2157 *	0.000	-0.2078 *	0.000	-0.2078 *	0.000
block 4	-0.0690	0.066	-0.0546	0.178	-0.0546 *	0.003
block 5	-0.3141 *	0.000	-0.3048 *	0.000	-0.3048 *	0.000
block 6	-0.3079 *	0.000	-0.2975 *	0.000	-0.2975 *	0.000
time * block 1	0.0000	1.000	0.0000	1.000	0.0000	.
time * block 2	0.0000	1.000	0.0000	1.000	0.0000	.
time * block 3	0.0000	1.000	0.0000	1.000	0.0000	.
time * block 4	0.0000	1.000	0.0000	1.000	0.0000	.
time * block 5	0.0000	1.000	0.0000	1.000	0.0000	.
time * block 6 (base)	0.0000	.	0.0000	.	0.0000	.

	Brownsville: Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3168	number of negative weights: 358								
constant	0.3335	*	0.020	0.7395	*	0.000	0.7395		0.339
time	0.0000		1.000	0.0000		1.000	0.0000		1.000
group	0.1894	*	0.000	0.0922	*	0.001	0.0922		0.397
interaction	**0.0000**		**1.000**	**0.0000**		**1.000**	**0.0000**		**1.000**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	0.0539	*	0.015	0.0166		0.509	0.0166		0.745
3.soil	-0.1073	*	0.000	-0.1017	*	0.000	-0.1017	*	0.049
4.soil	-0.0277		0.542	0.0356		0.504	0.0356		0.690
slope	-0.0139	*	0.000	-0.0161	*	0.000	-0.0161		0.115
elevation	0.0020	*	0.000	0.0011		0.053	0.0011		0.269
highway distance	-0.0002	*	0.000	-0.0002	*	0.000	-0.0002		0.257
time*highway distance	0.0000		1.000	0.0000		1.000	0.0000	.	
city center distance	0.0000		0.867	-0.0002		0.471	-0.0002		0.826
time*city center distance	0.0000		1.000	0.0000		1.000	0.0000		1.000
city center distance squared	0.0000		0.260	0.0000		0.710	0.0000		0.899
time * city center distance squared	0.0000		1.000	0.0000		1.000	0.0000	.	
city limit distance	0.0001	*	0.000	0.0001	*	0.000	0.0001		0.122
time* city limit distance	0.0000		1.000	0.0000		1.000	0.0000		1.000
block 1 (base)	0.0000	.		0.0000	.		0.0000	.	
block 2	-0.2315	*	0.000	-0.2341	*	0.000	-0.2341	*	0.033
block 3	-0.3709	*	0.000	-0.5049	*	0.000	-0.5049		0.078
block 4	-0.4014	*	0.000	-0.5278	*	0.000	-0.5278		0.113
block 5	-0.5723	*	0.000	-0.6973	*	0.000	-0.6973	*	0.046
block 6	-0.2553	*	0.000	-0.3857	*	0.000	-0.3857	*	0.016
time * block 1	0.0000		1.000	0.0000		1.000	0.0000		1.000
time * block 2	0.0000		1.000	0.0000		1.000	0.0000		1.000
time * block 3	0.0000		1.000	0.0000		1.000	0.0000	.	
time * block 4	0.0000		1.000	0.0000		1.000	0.0000	.	
time * block 5	0.0000		1.000	0.0000		1.000	0.0000	.	
time * block 6 (base)	0.0000	.		0.0000	.		0.0000	.	

Appendix 2.2.b: Carlton:

	Carlton: Model I								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 2198	number of negative weights: 0								
constant	0.0361	*	0.000	0.0361	*	0.000	0.0361		0.109
time	0.0283	*	0.021	0.0283	*	0.021	0.0283		0.375
group	0.3427	*	0.000	0.3427	*	0.000	0.3427	*	0.031
interaction	**-0.0174**		**0.611**	**-0.0174**		**0.611**	**-0.0174**		**0.619**

	Carlton: Model II								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 2198	number of negative weights: 473								
							coefficient		p-value
constant	0.3872	*	0.004	0.4543	*	0.008	0.4543		0.588
time	-0.2536	*	0.044	-0.1309		0.311	-0.1309		0.460
group	-0.0231		0.210	0.0139		0.545	0.0139		0.908
interaction	**-0.0138**		**0.634**	**-0.0108**		**0.746**	**-0.0108**		**0.655**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	-0.0930	*	0.000	-0.0501	*	0.006	-0.0501		0.096
3.soil	0.0687	*	0.021	0.0323		0.539	0.0323		0.467
4.soil	-0.3980	*	0.000	-0.3435	*	0.000	-0.3435	*	0.024
slope	0.0018		0.701	0.0058		0.372	0.0058		0.734
elevation	0.0169	*	0.000	0.0143	*	0.000	0.0143		0.067
highway distance	0.0002	*	0.000	0.0002	*	0.001	0.0002		0.176
time*highway distance	0.0001	*	0.015	0.0001		0.170	0.0001		0.297
city center distance	-0.0027	*	0.000	-0.0026	*	0.000	-0.0026	*	0.005
time*city center distance	0.0001		0.777	0.0000		0.816	0.0000		0.676
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.005
time * city center distance squared	0.0000		0.645	0.0000		0.541	0.0000		0.496
city limit distance	0.0001	*	0.000	0.0001	*	0.000	0.0001		0.186
time* city limit distance	0.0001	*	0.000	0.0000		0.105	0.0000		0.442

	Carlton: Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 2198	number of negative weights: 145								
constant	0.0361	*	0.047	0.0491	*	0.009	0.0491		0.209
time	0.2492	*	0.000	0.0247		0.447	0.0247		0.179
group	0.4065	*	0.000	0.3454	*	0.000	0.3454	*	0.029
interaction	**-0.0906**	*	**0.038**	**-0.0142**		**0.677**	**-0.0142**		**0.657**
1b.soil									
2.soil									
3.soil									
4.soil									
slope									
elevation									
highway distance									
time*highway distance									
city center distance									
time*city center distance									
city center distance squared									
time * city center distance squared									
city limit distance									
time* city limit distance									
block 1 (base)	0.0000	.		0.0000	.		0.0000	.	
block 2	0.0000		0.999	0.0498		0.091	0.0498	*	0.007
block 3	-0.0153		0.446	-0.0388		0.162	-0.0388	*	0.004
block 4	-0.2091	*	0.000	-0.0609	*	0.044	-0.0609	*	0.013
time * block 1	-0.1532	*	0.018	0.0458		0.308	0.0458	*	0.001
time * block 2	-0.2268	*	0.001	-0.0184		0.677	-0.0184	*	0.001
time * block 3	-0.2466	*	0.000	-0.0189		0.652	-0.0189	*	0.004
time * block 4 (base)	0.0000	.		0.0000	.		0.0000	.	

	Carlton: Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 2198	number of negative weights: 520								
constant	-0.6017	*	0.001	-0.2299		0.294	-0.2299		0.816
time	-0.2615	*	0.031	-0.2433		0.066	-0.2433		0.243
group	0.0261		0.197	0.0168		0.469	0.0168		0.892
interaction	**-0.0273**		**0.298**	**-0.0093**		**0.780**	**-0.0093**		**0.560**
1b.soil	0.0000		.	0.0000		.	0.0000		.
2.soil	-0.0261		0.086	-0.0238		0.194	-0.0238		0.478
3.soil	-0.0331		0.354	-0.0114		0.819	-0.0114		0.764
4.soil	-0.5625	*	0.000	-0.4774	*	0.000	-0.4774	*	0.021
slope	0.0119	*	0.022	0.0089		0.202	0.0089		0.579
elevation	0.0236	*	0.000	0.0201	*	0.000	0.0201		0.063
highway distance	0.0004	*	0.000	0.0003	*	0.000	0.0003		0.147
time*highway distance	0.0001		0.238	0.0001		0.169	0.0001		0.118
city center distance	-0.0027	*	0.000	-0.0025	*	0.000	-0.0025	*	0.006
time*city center distance	0.0002		0.446	-0.0001		0.762	-0.0001		0.707
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.006
time * city center distance squared	0.0000		0.255	0.0000		0.825	0.0000		0.843
city limit distance	0.0003	*	0.000	0.0002	*	0.000	0.0002		0.084
time* city limit distance	0.0001	*	0.008	0.0001	*	0.025	0.0001	*	0.043
block 1 (base)	0.0000		.	0.0000		.	0.0000		.
block 2	-0.1657	*	0.000	-0.1170	*	0.001	-0.1170	*	0.028
block 3	-0.1427	*	0.000	-0.1171	*	0.000	-0.1171		0.206
block 4	0.0277		0.477	0.0063		0.913	0.0063		0.889
time * block 1	-0.0159		0.740	-0.0155		0.835	-0.0155		0.294
time * block 2	-0.1503	*	0.021	-0.1401		0.150	-0.1401	*	0.011
time * block 3	-0.1029	*	0.044	-0.0792		0.283	-0.0792	*	0.012
time * block 4 (base)	0.0000		.	0.0000		.	0.0000		.

Appendix 2.2.c: Corvallis/Philomath

	Corvallis/Philomath: Model I								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
11630 observations	number of negative weights: 0								
constant	0.1220	*	0.000	0.1220	*	0.000	0.1220	*	0.004
time	0.0335	*	0.000	0.0335	*	0.000	0.0335	*	0.018
group	0.1477	*	0.000	0.1477	*	0.000	0.1477	*	0.009
interaction	**0.0405**	*	**0.007**	**0.0405**	*	**0.007**	**0.0405**		**0.094**

	Corvallis/Philomath: Model II								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
11630 observations	number of negative weights: 686								
constant	-0.0614	*	0.025	0.0047		0.871	0.0047		0.974
time	-0.0007		0.983	0.0482		0.138	0.0482		0.201
group	0.1400	*	0.000	0.1327	*	0.000	0.1327	*	0.018
interaction	**0.0235**		**0.143**	**0.0328**	*	**0.025**	**0.0328**		**0.150**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	-0.0126		0.128	0.0001		0.987	0.0001		0.998
3.soil	0.1397	*	0.000	0.2342	*	0.000	0.2342		0.082
4.soil	0.5727	*	0.000	0.5619	*	0.000	0.5619	*	0.000
slope	-0.0008		0.551	-0.0156	*	0.000	-0.0156		0.262
elevation	0.0003		0.121	0.0008	*	0.000	0.0008		0.526
highway distance	-0.0001	*	0.000	-0.0001	*	0.000	-0.0001		0.136
time*highway distance	0.0000		0.335	0.0000	*	0.017	0.0000		0.125
city center distance	0.0001	*	0.000	0.0001	*	0.000	0.0001	*	0.040
time*city center distance	0.0000	*	0.001	0.0000		0.065	0.0000		0.249
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.014
time * city center distance squared	0.0000	*	0.000	0.0000	*	0.019	0.0000		0.152
city limit distance	0.0000	*	0.002	0.0000		0.322	0.0000		0.303
time* city limit distance	0.0000	*	0.020	0.0000		0.330	0.0000	*	0.015

	Corvallis/Philomath: Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
11630 observations	number of negative weights: 1740								
constant	0.0728	*	0.000	0.0469	*	0.016	0.0469	*	0.000
time	0.0365		0.342	0.0146		0.426	0.0146		0.274
group	0.1486	*	0.000	0.1314	*	0.000	0.1314	*	0.027
interaction	**0.0302**		**0.085**	**0.0400**	*	**0.005**	**0.0400**		**0.108**
1b.soil									
2.soil									
3.soil									
4.soil									
slope									
elevation									
highway distance									
time*highway distance									
city center distance									
time*city center distance									
city center distance squared									
time * city center distance squared									
city limit distance									
time* city limit distance									
block 1 (base)	0.0000		.	0.0000		.	0.0000		.
block 1 (base)	0.1861		0.000	0.2057	*	0.000	0.2057	*	0.000
block 1 (base)	0.0710		0.007	0.0518		0.096	0.0518	*	0.000
block 1 (base)	-0.0558		0.001	-0.0433		0.089	-0.0433		0.086
block 1 (base)	0.2387		0.000	0.2721	*	0.000	0.2721	*	0.000
block 1 (base)	0.2007		0.000	0.2400	*	0.000	0.2400	*	0.000
block 1 (base)	-0.1251		0.000	-0.0636	*	0.005	-0.0636	*	0.001
block 1 (base)	0.1358		0.000	0.1081	*	0.002	0.1081	*	0.000
block 1 (base)	0.1996		0.000	0.2492	*	0.000	0.2492	*	0.000
block 1 (base)	-0.1074		0.003	-0.0548	*	0.020	-0.0548	*	0.001
block 1 (base)	0.0413		0.140	0.0661	*	0.035	0.0661	*	0.003
block 1 (base)	-0.0573		0.009	-0.0012		0.964	-0.0012		0.868

	Corvallis/Philomath: Model III (continued)								
	aweight		robust			cluster robust			
	coefficient	p-value	coefficient		p-value	coefficient		p-value	
block 1 (base)	0.0103	0.710	0.0751	*	0.011	0.0751	*	0.000	
block 1 (base)	-0.1734	0.000	-0.0595	*	0.012	-0.0595	*	0.001	
block 1 (base)	0.5644	0.000	0.5914	*	0.000	0.5914	*	0.000	
block 1 (base)	0.1572	0.000	0.2123	*	0.000	0.2123	*	0.000	
block 1 (base)	0.0888	0.002	0.1503	*	0.000	0.1503	*	0.000	
block 1 (base)	0.1790	0.000	0.2264	*	0.000	0.2264	*	0.000	
block 1 (base)	-0.2214	0.000	-0.1017	*	0.000	-0.1017	*	0.000	
block 1 (base)	-0.2140	0.000	-0.1141	*	0.000	-0.1141	*	0.000	
block 1 (base)	-0.2214	0.000	-0.0932	*	0.000	-0.0932	*	0.000	
block 1 (base)	-0.1492	0.000	-0.0792	*	0.000	-0.0792	*	0.001	
time * block 1	-0.0303	0.501	0.0034		0.919	0.0034		0.690	
time * block 2	-0.0218	0.688	-0.0147		0.764	-0.0147	*	0.002	
time * block 3	-0.0229	0.625	-0.0211		0.587	-0.0211	*	0.000	
time * block 4	0.0665	0.114	0.0533		0.117	0.0533	*	0.000	
time * block 5	0.0052	0.922	0.0229		0.613	0.0229	*	0.000	
time * block 6	-0.0533	0.318	-0.0375		0.399	-0.0375	*	0.000	
time * block 7	0.1848	0.000	0.1995	*	0.000	0.1995	*	0.000	
time * block 8	-0.0230	0.643	-0.0175		0.693	-0.0175	*	0.000	
time * block 9	0.1299	0.017	0.1274	*	0.003	0.1274	*	0.000	
time * block 10	-0.0017	0.971	-0.0007		0.979	-0.0007		0.732	
time * block 11	0.0220	0.658	0.0479		0.243	0.0479	*	0.000	
time * block 12	-0.0438	0.303	-0.0272		0.363	-0.0272	*	0.000	
time * block 13	-0.0549	0.250	-0.0333		0.359	-0.0333	*	0.000	
time * block 14	-0.0667	0.215	-0.0330		0.209	-0.0330	*	0.000	
time * block 15	0.0225	0.662	0.0621		0.152	0.0621	*	0.000	
time * block 16	0.0320	0.541	0.0449		0.277	0.0449	*	0.000	
time * block 17	0.1187	0.018	0.1176	*	0.002	0.1176	*	0.000	
time * block 18	-0.0536	0.304	-0.0343		0.408	-0.0343	*	0.000	
time * block 19	-0.0667	0.192	-0.0313		0.097	-0.0313	*	0.000	
time * block 20	-0.0667	0.148	-0.0363		0.066	-0.0363	*	0.000	
time * block 21	-0.0129	0.818	-0.0098		0.629	-0.0098	*	0.048	
time * block 22 (base)	0.0000	.	0.0000		.	0.0000		.	

	Corvallis/Philomath: Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
11630 observations	number of negative weights: 1642								
constant	0.7274	*	0.000	0.7030	*	0.000	0.7030		0.247
time	0.5510	*	0.017	0.1822		0.444	0.1822		0.686
group	0.0938	*	0.000	0.1056	*	0.000	0.1056		0.072
interaction	**0.0464**	*	**0.001**	**0.0443**	*	**0.004**	**0.0443**		**0.113**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	-0.0307	*	0.000	-0.0155		0.113	-0.0155		0.766
3.soil	0.0964	*	0.000	0.1493	*	0.000	0.1493		0.161
4.soil	0.4447	*	0.000	0.4294	*	0.000	0.4294	*	0.007
slope	-0.0010		0.554	-0.0071	*	0.000	-0.0071		0.445
elevation	0.0002		0.466	0.0003		0.386	0.0003		0.808
highway distance	0.0000	*	0.005	0.0000		0.936	0.0000		0.988
time*highway distance	0.0000		0.079	0.0000		0.306	0.0000		0.532
city center distance	-0.0002	*	0.000	-0.0003	*	0.000	-0.0003		0.209
time*city center distance	0.0000		0.342	0.0000		0.537	0.0000		0.722
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000		0.177
time * city center distance squared	0.0000	*	0.008	0.0000		0.748	0.0000		0.844
city limit distance	0.0000		0.301	0.0000		0.752	0.0000		0.704
time* city limit distance	0.0000		0.111	0.0000		0.478	0.0000	*	0.011
block 1 (base)	0.0000	.		0.0000	.		0.0000	.	
block 1 (base)	0.2266	*	0.000	0.2575	*	0.000	0.2575		0.093
block 1 (base)	0.1380	*	0.000	0.0981		0.067	0.0981		0.605
block 1 (base)	-0.1195	*	0.011	-0.0011		0.985	-0.0011		0.997
block 1 (base)	0.1192		0.094	0.2265	*	0.011	0.2265		0.579
block 1 (base)	0.0247		0.763	0.1869		0.073	0.1869		0.710
block 1 (base)	-0.2919	*	0.000	-0.1303		0.165	-0.1303		0.773
block 1 (base)	-0.1137		0.163	-0.0731		0.454	-0.0731		0.865
block 1 (base)	-0.1785		0.061	-0.0999		0.352	-0.0999		0.827
block 1 (base)	-0.5166	*	0.000	-0.4312	*	0.000	-0.4312		0.377
block 1 (base)	-0.3280	*	0.000	-0.2327	*	0.039	-0.2327		0.634
block 1 (base)	-0.3608	*	0.000	-0.2934	*	0.002	-0.2934		0.495

	Corvallis/Philomath: Model IV (continued)								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
block 1 (base)	-0.2533	*	0.001	-0.1792	*	0.039	-0.1792		0.648
block 1 (base)	-0.2552	*	0.000	-0.1967	*	0.008	-0.1967		0.562
block 1 (base)	0.4607	*	0.000	0.5238	*	0.000	0.5238		0.121
block 1 (base)	0.0741		0.307	0.2429	*	0.014	0.2429		0.619
block 1 (base)	0.0550		0.334	0.1906	*	0.009	0.1906		0.609
block 1 (base)	0.0126		0.830	0.0826		0.194	0.0826		0.807
block 1 (base)	-0.2502	*	0.000	-0.2187	*	0.000	-0.2187		0.417
block 1 (base)	-0.3557	*	0.000	-0.3494	*	0.000	-0.3494		0.275
block 1 (base)	-0.5024	*	0.000	-0.5245	*	0.000	-0.5245		0.219
block 1 (base)	-0.6136	*	0.000	-0.6741	*	0.000	-0.6741		0.200
time * block 1	-0.5320	*	0.000	-0.1396		0.280	-0.1396		0.519
time * block 2	-0.6177	*	0.000	-0.1397		0.321	-0.1397		0.540
time * block 3	-0.6500	*	0.000	-0.1533		0.307	-0.1533		0.540
time * block 4	-0.5372	*	0.000	-0.0622		0.688	-0.0622		0.823
time * block 5	-0.5909	*	0.000	-0.0796		0.657	-0.0796		0.799
time * block 6	-0.6080	*	0.001	-0.1115		0.562	-0.1115		0.735
time * block 7	-0.3974	*	0.023	0.1030		0.578	0.1030		0.754
time * block 8	-0.6305	*	0.001	-0.1424		0.458	-0.1424		0.683
time * block 9	-0.4389	*	0.028	-0.0135		0.948	-0.0135		0.972
time * block 10	-0.5734	*	0.005	-0.1377		0.511	-0.1377		0.727
time * block 11	-0.5271	*	0.008	-0.0710		0.736	-0.0710		0.853
time * block 12	-0.6480	*	0.001	-0.1766		0.374	-0.1766		0.637
time * block 13	-0.6809	*	0.000	-0.1964		0.310	-0.1964		0.592
time * block 14	-0.7056	*	0.000	-0.1914		0.289	-0.1914		0.568
time * block 15	-0.6888	*	0.000	-0.0752		0.669	-0.0752		0.811
time * block 16	-0.5062	*	0.001	-0.0137		0.938	-0.0137		0.962
time * block 17	-0.4203	*	0.002	0.0404		0.784	0.0404		0.868
time * block 18	-0.3914	*	0.000	-0.0804		0.421	-0.0804		0.548
time * block 19	-0.5073	*	0.000	-0.1054		0.233	-0.1054		0.450
time * block 20	-0.3903	*	0.000	-0.0973		0.152	-0.0973		0.338
time * block 21	-0.1640	*	0.000	-0.0511		0.226	-0.0511		0.333
time * block 22 (base)	0.0000		.	0.0000		.	0.0000	.	

Appendix 2.2.d: Dallas

	Dallas: Model I								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 8408	number of negative weights: 0								
constant	0.0911	*	0.000	0.0911	*	0.000	0.0911	*	0.014
time	0.0042		0.635	0.0042		0.635	0.0042		0.090
group	0.3019	*	0.000	0.3019	*	0.000	0.3019	*	0.000
interaction	**0.0430**	*	**0.015**	**0.0430**	*	**0.015**	**0.0430**	*	**0.034**

	Dallas: Model II								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 8408	number of negative weights: 804								
constant	1.0201	*	0.000	0.9409	*	0.000	0.9409	*	0.006
time	-0.1426		0.111	-0.1268		0.133	-0.1268		0.060
group	0.2058	*	0.000	0.2236	*	0.000	0.2236	*	0.015
interaction	**0.0644**	*	**0.001**	**0.0483**	*	**0.010**	**0.0483**	*	**0.032**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	-0.0343	*	0.000	-0.0501	*	0.000	-0.0501		0.170
3.soil	0.0455	*	0.003	0.0284		0.161	0.0284		0.710
4.soil	-0.2033	*	0.000	-0.2120	*	0.000	-0.2120	*	0.000
slope	0.0025		0.110	0.0061	*	0.001	0.0061		0.409
elevation	-0.0026	*	0.000	-0.0018	*	0.000	-0.0018	*	0.022
highway distance	0.0000	*	0.001	-0.0001	*	0.000	-0.0001		0.084
time*highway distance	0.0000		0.338	0.0000		0.376	0.0000		0.506
city center distance	-0.0004	*	0.000	-0.0004	*	0.000	-0.0004	*	0.041
time*city center distance	0.0000		0.681	0.0000		0.622	0.0000		0.478
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000		0.089
time * city center distance squared	0.0000		0.764	0.0000		0.646	0.0000		0.535
city limit distance	0.0000		0.243	0.0000		0.180	0.0000		0.829
time* city limit distance	0.0000	*	0.000	0.0000	*	0.011	0.0000	*	0.019

	Dallas: Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 8408	number of negative weights: 1406								
constant	-0.3359	*	0.000	-0.1337	*	0.000	-0.1337	*	0.001
time	-0.0229		0.701	-0.0274		0.483	-0.0274	*	0.029
group	0.3359	*	0.000	0.2776	*	0.000	0.2776	*	0.001
interaction	**0.0539**		**0.134**	**0.0449**	*	**0.008**	**0.0449**	*	**0.029**
1b.soil									
2.soil									
3.soil									
4.soil									
slope									
elevation									
highway distance									
time*highway distance									
city center distance									
time*city center distance									
city center distance squared									
time * city center distance squared									
city limit distance									
time* city limit distance									
block 1 (base)	0.0000		.	0.0000		.	0.0000		.
block 2	0.0611		0.394	0.0282		0.056	0.0282	*	0.000
block 3	0.4615	*	0.000	0.3203	*	0.000	0.3203	*	0.000
block 4	0.5274	*	0.000	0.2966	*	0.000	0.2966	*	0.000
block 5	0.5360	*	0.000	0.3773	*	0.000	0.3773	*	0.000
block 6	0.4215	*	0.000	0.2720	*	0.000	0.2720	*	0.000
block 7	0.2041	*	0.007	0.1306	*	0.000	0.1306	*	0.000
block 8	0.4142	*	0.000	0.1624	*	0.000	0.1624	*	0.000
block 9	0.6695	*	0.000	0.4985	*	0.000	0.4985	*	0.000
block 10	0.6292	*	0.000	0.4439	*	0.000	0.4439	*	0.000
block 11	0.3964	*	0.000	0.1344	*	0.000	0.1344	*	0.000
block 12	0.5723	*	0.000	0.4212	*	0.000	0.4212	*	0.000

	Dallas: Model III (continued)								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
block 13	0.0229		0.752	0.0375	*	0.002	0.0375	*	0.000
block 14	0.3357	*	0.000	0.1375	*	0.000	0.1375	*	0.000
block 15	0.5163	*	0.000	0.3714	*	0.000	0.3714	*	0.000
block 16	0.3924	*	0.000	0.2436	*	0.000	0.2436	*	0.000
time * block 1 (base)	-0.0310		0.744	0.0058		0.888	0.0058	*	0.029
time * block 2	0.1751		0.090	0.1060	*	0.019	0.1060	*	0.000
time * block 3	0.1060		0.219	0.1047	*	0.047	0.1047	*	0.000
time * block 4	0.0189		0.816	0.0166		0.771	0.0166	*	0.000
time * block 5	-0.0089		0.920	-0.0018		0.974	-0.0018	*	0.029
time * block 6	0.0390		0.617	0.0428		0.389	0.0428	*	0.000
time * block 7	0.2339	*	0.006	0.0366		0.475	0.0366	*	0.000
time * block 8	0.0485		0.503	0.1186	*	0.023	0.1186	*	0.000
time * block 9	0.0019		0.983	0.0107		0.846	0.0107	*	0.000
time * block 10	0.0030		0.973	0.0087		0.885	0.0087	*	0.029
time * block 11	-0.2103	*	0.018	0.0052		0.917	0.0052	*	0.029
time * block 12	-0.0051		0.954	0.0053		0.919	0.0053	*	0.029
time * block 13	-0.0310		0.757	0.0105		0.798	0.0105	*	0.029
time * block 14	-0.0725		0.548	0.0170		0.704	0.0170	*	0.029
time * block 15	-0.0195		0.831	-0.0079		0.892	-0.0079	*	0.029
time * block 16	0.0000		.	0.0000		.	0.0000		.

	Dallas: Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 8408	number of negative weights: 1421								
constant	0.0103		0.946	0.3254	*	0.026	0.3254		0.590
time	-0.0568		0.767	0.0727		0.704	0.0727		0.619
group	0.2734	*	0.000	0.2495	*	0.000	0.2495	*	0.004
interaction	**0.0414**		**0.086**	**0.0335**		**0.151**	**0.0335**	*	**0.036**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	-0.0907	*	0.000	-0.0738	*	0.000	-0.0738		0.064
3.soil	-0.0526	*	0.018	-0.0444	*	0.023	-0.0444		0.510
4.soil	-0.3713	*	0.000	-0.2793	*	0.000	-0.2793	*	0.000
slope	-0.0020		0.244	-0.0009		0.634	-0.0009		0.897
elevation	-0.0020	*	0.000	-0.0012	*	0.000	-0.0012		0.450
highway distance	-0.0001	*	0.020	0.0000		0.376	0.0000		0.819
time*highway distance	0.0000		0.459	0.0000		0.329	0.0000		0.281
city center distance	-0.0002		0.052	-0.0004	*	0.000	-0.0004		0.408
time*city center distance	0.0000		0.954	-0.0001		0.589	-0.0001		0.471
city center distance squared	0.0000	*	0.021	0.0000	*	0.000	0.0000		0.368
time * city center distance squared	0.0000		0.669	0.0000		0.936	0.0000		0.903
city limit distance	0.0000	*	0.000	0.0000	*	0.000	0.0000		0.163
time* city limit distance	0.0000		0.713	0.0000		0.599	0.0000		0.436
block 1 (base)	0.0000	.		0.0000	.		0.0000	.	
block 2	-0.1943	*	0.000	-0.1027	*	0.000	-0.1027		0.304
block 3	0.1420	*	0.020	0.1891	*	0.000	0.1891		0.256
block 4	0.1606	*	0.016	0.1598	*	0.007	0.1598		0.476
block 5	0.1749	*	0.009	0.2222	*	0.000	0.2222		0.353
block 6	0.0224		0.748	0.0229		0.771	0.0229		0.934
block 7	0.0986	*	0.017	0.0185		0.672	0.0185		0.908
block 8	0.2605	*	0.000	0.1321	*	0.000	0.1321		0.143
block 9	0.4878	*	0.000	0.3987	*	0.000	0.3987	*	0.001
block 10	0.4046	*	0.000	0.2837	*	0.000	0.2837	*	0.029
block 11	0.2643	*	0.000	0.1622	*	0.009	0.1622		0.253
block 12	0.5802	*	0.000	0.4933	*	0.000	0.4933	*	0.002

	Dallas: Model IV (continued)								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
block 13	0.2182	*	0.000	0.1591	*	0.000	0.1591		0.178
block 14	0.2886	*	0.000	0.1610	*	0.000	0.1610	*	0.016
block 15	0.3678	*	0.000	0.2551	*	0.000	0.2551		0.055
block 16	0.3061	*	0.000	0.2313	*	0.000	0.2313	*	0.002
time * block 1 (base)	-0.0586		0.294	0.0201		0.672	0.0201		0.411
time * block 2	0.1812	*	0.022	0.1397	*	0.020	0.1397	*	0.000
time * block 3	0.1172		0.191	0.1649	*	0.029	0.1649	*	0.001
time * block 4	0.0600		0.535	0.1032		0.246	0.1032		0.089
time * block 5	0.0471		0.627	0.0994		0.293	0.0994		0.122
time * block 6	0.1506		0.165	0.1883		0.107	0.1883	*	0.029
time * block 7	0.0503		0.372	0.1048		0.121	0.1048	*	0.012
time * block 8	0.0467		0.288	0.1238	*	0.018	0.1238	*	0.000
time * block 9	-0.0217		0.722	-0.0086		0.888	-0.0086		0.620
time * block 10	-0.0155		0.835	-0.0118		0.882	-0.0118		0.714
time * block 11	0.0831		0.266	0.0357		0.653	0.0357		0.474
time * block 12	0.0378		0.601	0.0574		0.442	0.0574		0.200
time * block 13	-0.0299		0.622	0.0466		0.327	0.0466	*	0.043
time * block 14	0.0067		0.875	0.0185		0.712	0.0185		0.293
time * block 15	-0.0059		0.937	-0.0117		0.883	-0.0117		0.814
time * block 16	0.0000		.	0.0000		.	0.0000		.

Appendix 2.2.e: Dayton

	Dayton: Model I								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3854	number of negative weights: 0								
constant	0.0079	*	0.003	0.0079	*	0.003	0.0079		0.113
time	0.0061		0.159	0.0061		0.159	0.0061		0.336
group	0.2671	*	0.000	0.2671	*	0.000	0.2671	*	0.004
interaction	**0.0591**	*	**0.013**	**0.0591**	*	**0.013**	**0.0591**	*	**0.030**

	Dayton: Model II								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3854	number of negative weights: 1012								
constant	0.1498	*	0.003	0.1545	*	0.020	0.1545		0.618
time	0.1061		0.101	0.0249		0.774	0.0249		0.743
group	0.2315	*	0.000	0.2185	*	0.000	0.2185		0.078
interaction	**0.0270**		**0.159**	**0.0426**		**0.096**	**0.0426**		**0.068**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	-0.0354	*	0.000	-0.0390	*	0.000	-0.0390		0.121
3.soil	-0.1496	*	0.000	-0.1184	*	0.000	-0.1184		0.100
slope	-0.0253	*	0.000	-0.0207	*	0.000	-0.0207		0.066
elevation	0.0103	*	0.000	0.0092	*	0.000	0.0092	*	0.047
highway distance	0.0001	*	0.000	0.0001	*	0.000	0.0001		0.435
time*highway distance	0.0000		0.291	0.0000		0.212	0.0000		0.132
city center distance	-0.0008	*	0.000	-0.0008	*	0.000	-0.0008	*	0.017
time*city center distance	-0.0001		0.286	0.0000		0.921	0.0000		0.903
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.032
time * city center distance squared	0.0000		0.521	0.0000		0.773	0.0000		0.719
city limit distance	0.0000		0.698	0.0000		0.845	0.0000		0.630
time* city limit distance	0.0000		0.959	0.0000		0.869	0.0000		0.684

	Dayton: Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3854	number of negative weights: 1023								
constant	-0.1740	*	0.000	-0.0354	*	0.020	-0.0354		0.305
time	0.3991	*	0.000	0.0538	*	0.005	0.0538	*	0.000
group	0.3533	*	0.000	0.2501	*	0.000	0.2501	*	0.007
interaction	**0.0570**		**0.130**	**0.0655**	*	**0.003**	**0.0655**	*	**0.026**
1b.soil									
2.soil									
3.soil									
slope									
elevation									
highway distance									
time*highway distance									
city center distance									
time*city center distance									
city center distance squared									
time * city center distance squared									
city limit distance									
time* city limit distance									
block 1 (base)	0.0000		.	0.0000		.	0.0000		.
block 2	-0.1793	*	0.007	-0.0259		0.125	-0.0259		0.159
block 3	0.2083	*	0.000	0.1415	*	0.000	0.1415	*	0.000
block 4	0.1686	*	0.000	0.0643	*	0.010	0.0643	*	0.000
block 5	0.1965	*	0.000	0.0843	*	0.001	0.0843	*	0.000
block 6	0.1737	*	0.000	0.0824	*	0.004	0.0824	*	0.000
block 7	-0.1793	*	0.007	-0.0130		0.469	-0.0130		0.464
time * block 1	-0.4492	*	0.000	-0.0831	*	0.005	-0.0831	*	0.000
time * block 2	-0.4561	*	0.000	-0.0699	*	0.002	-0.0699	*	0.000
time * block 3	-0.3863	*	0.000	-0.0386		0.251	-0.0386	*	0.001
time * block 4	-0.4889	*	0.000	-0.0829	*	0.010	-0.0829	*	0.000
time * block 5	-0.3922	*	0.000	-0.0357		0.275	-0.0357	*	0.000
time * block 6	-0.3923	*	0.000	-0.0397		0.293	-0.0397	*	0.000
time * block 7 (base)	0.0000		.	0.0000		.	0.0000		.

	Dayton: Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3854	number of negative weights: 1091								
constant	0.2766	*	0.000	0.2559	*	0.000	0.2559		0.252
time	0.5975	*	0.000	0.1632		0.080	0.1632		0.207
group	0.1722	*	0.000	0.1631	*	0.000	0.1631		0.071
interaction	**-0.0402**		**0.075**	**0.0369**		**0.172**	**0.0369**		**0.098**
1b.soil	0.0000		.	0.0000		.	0.0000		.
2.soil	-0.0650	*	0.000	-0.0579	*	0.000	-0.0579	*	0.049
3.soil	-0.1604	*	0.000	-0.1223	*	0.000	-0.1223		0.093
slope	-0.0134	*	0.000	-0.0174	*	0.000	-0.0174		0.060
elevation	0.0098	*	0.000	0.0104	*	0.000	0.0104	*	0.025
highway distance	0.0002	*	0.000	0.0002	*	0.000	0.0002		0.376
time*highway distance	0.0001		0.163	0.0001		0.188	0.0001		0.077
city center distance	-0.0009	*	0.000	-0.0009	*	0.000	-0.0009	*	0.000
time*city center distance	-0.0005	*	0.000	-0.0001		0.415	-0.0001		0.521
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.009
time * city center distance squared	0.0000	*	0.001	0.0000		0.916	0.0000		0.914
city limit distance	0.0000		0.520	0.0000		0.957	0.0000		0.899
time* city limit distance	0.0000		0.102	0.0000		0.814	0.0000		0.580
block 1 (base)	0.0000		.	0.0000		.	0.0000		.
block 2	0.0663	*	0.010	0.0309		0.144	0.0309		0.301
block 3	0.1896	*	0.000	0.1613	*	0.000	0.1613		0.085
block 4	-0.1191	*	0.000	-0.1251	*	0.000	-0.1251		0.088
block 5	-0.0030		0.886	-0.0268		0.258	-0.0268		0.187
block 6	-0.0299		0.223	-0.0416		0.130	-0.0416		0.512
block 7	-0.0155		0.452	-0.0377		0.055	-0.0377		0.499
time * block 1	-0.1910	*	0.000	-0.1126	*	0.001	-0.1126	*	0.001
time * block 2	-0.0936	*	0.019	-0.0567		0.138	-0.0567		0.065
time * block 3	-0.0402		0.224	-0.0018		0.964	-0.0018		0.932
time * block 4	-0.2508	*	0.000	-0.1346	*	0.002	-0.1346	*	0.005
time * block 5	-0.1352	*	0.000	-0.0659		0.053	-0.0659	*	0.011
time * block 6	-0.2178	*	0.000	-0.1014	*	0.031	-0.1014	*	0.029
time * block 7 (base)	0.0000		.	0.0000		.	0.0000		.

Appendix 2.2.f: Donald

	Donald: Model I								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 1580	number of negative weights: 0								
constant	0.0546	*	0.000	0.0546	*	0.000	0.0546	*	0.000
time	0.0171		0.230	0.0171		0.230	0.0171		0.230
group	0.4111	*	0.000	0.4111	*	0.000	0.4111	*	0.000
interaction	**0.2574**	*	**0.000**	**0.2574**	*	**0.000**	**0.2574**	*	**0.000**

	Donald: Model II								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 1580	number of negative weights: 367								
constant	2.5278	*	0.000	2.0906	*	0.000	2.0906	*	0.040
time	-0.4101	*	0.013	-0.3050	*	0.023	-0.3050		0.384
group	-0.0436		0.299	0.0006		0.988	0.0006		0.994
interaction	**0.3938**	*	**0.000**	**0.3437**	*	**0.000**	**0.3437**		**0.064**
1b.soil	0.0000		.	0.0000		.	0.0000		.
2.soil	0.0458	*	0.024	0.0490	*	0.044	0.0490		0.534
4.soil	-0.0500		0.215	-0.0201		0.688	-0.0201		0.813
slope	-0.0092		0.534	-0.0051		0.811	-0.0051		0.837
elevation	-0.0138	*	0.000	-0.0101	*	0.001	-0.0101		0.236
highway distance	-0.0001	*	0.000	0.0000	*	0.014	0.0000		0.124
time*highway distance	0.0001	*	0.001	0.0000		0.486	0.0000		0.231
city center distance	-0.0035	*	0.000	-0.0035	*	0.000	-0.0035	*	0.009
time*city center distance	0.0006		0.144	0.0011	*	0.001	0.0011		0.264
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.016
time * city center distance squared	0.0000		0.185	0.0000	*	0.000	0.0000		0.223
city limit distance	0.0000	*	0.000	0.0000		0.057	0.0000		0.164
time* city limit distance	0.0000		0.054	0.0000		0.978	0.0000		0.973

	Donald: Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 1580	number of negative weights: 330								
constant	0.0859	*	0.000	0.1013	*	0.000	0.1013	*	0.037
time	0.0279		0.252	0.0150		0.560	0.0150		0.234
group	0.4988	*	0.000	0.4191	*	0.000	0.4191	*	0.036
interaction	**0.2367**	*	**0.000**	**0.2572**	*	**0.000**	**0.2572**	*	**0.022**
1b.soil									
2.soil									
4.soil									
slope									
elevation									
highway distance									
time*highway distance									
city center distance									
time*city center distance									
city center distance squared									
time * city center distance squared									
city limit distance									
time* city limit distance									
block 1 (base)	0.0000	.		0.0000	.		0.0000	.	
block 2	-0.3069	*	0.000	-0.1316	*	0.000	-0.1316	*	0.001
block 3	-0.0353		0.150	-0.0272		0.333	-0.0272	*	0.003
time * block 1	-0.0112		0.752	0.0026		0.946	0.0026		0.062
time * block 2	0.0410		0.661	0.0039		0.917	0.0039		0.308
time * block 3 (base)	0.0000	.		0.0000	.		0.0000	.	

	Donald: Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 1580	number of negative weights: 403								
constant	3.2462	*	0.000	2.9804	*	0.000	2.9804	*	0.025
time	-0.3679	*	0.030	-0.2863		0.070	-0.2863		0.354
group	-0.0127		0.701	0.0244		0.489	0.0244		0.747
interaction	**0.3952**	*	**0.000**	**0.3431**	*	**0.000**	**0.3431**		**0.063**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	0.0525	*	0.022	0.0519	*	0.034	0.0519		0.480
4.soil	-0.0866	*	0.045	-0.0813		0.139	-0.0813		0.348
slope	0.0029		0.848	0.0075		0.729	0.0075		0.796
elevation	-0.0279	*	0.000	-0.0257	*	0.000	-0.0257	*	0.041
highway distance	0.0000		0.964	0.0000		0.341	0.0000		0.664
time*highway distance	0.0000		0.809	0.0000		0.524	0.0000		0.439
city center distance	-0.0036	*	0.000	-0.0036	*	0.000	-0.0036	*	0.017
time*city center distance	0.0011	*	0.005	0.0011	*	0.001	0.0011		0.262
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.022
time * city center distance squared	0.0000	*	0.001	0.0000	*	0.000	0.0000		0.224
city limit distance	0.0000	*	0.000	0.0000	*	0.043	0.0000		0.111
time* city limit distance	0.0000	*	0.024	0.0000		0.983	0.0000		0.980
block 1 (base)	0.0000	.		0.0000	.		0.0000	.	
block 2	-0.2303	*	0.000	-0.2032	*	0.000	-0.2032	*	0.042
block 3	-0.1117	*	0.005	-0.0375		0.390	-0.0375		0.583
time * block 1	-0.0524		0.329	-0.0109		0.849	-0.0109		0.721
time * block 2	-0.0667	*	0.038	0.0072		0.817	0.0072		0.241
time * block 3 (base)	0.0000	.		0.0000	.		0.0000	.	

Appendix 2.2.g: Dundee

	Dundee: Model I								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3188	number of negative weights: 0								
constant	0.1208	*	0.000	0.1208	*	0.000	0.1208		0.112
time	0.0168		0.290	0.0168		0.290	0.0168		0.168
group	0.4206	*	0.000	0.4206	*	0.000	0.4206	*	0.019
interaction	**0.0561**		**0.068**	**0.0561**		**0.068**	**0.0561**	*	**0.044**

	Dundee: Model II								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3188	number of negative weights: 640								
constant	1.2165	*	0.000	1.1111	*	0.000	1.1111	*	0.004
time	0.1149		0.218	0.0970		0.413	0.0970		0.595
group	0.4197	*	0.000	0.3637	*	0.000	0.3637	*	0.007
interaction	**0.0267**		**0.208**	**0.0406**		**0.109**	**0.0406**		**0.309**
1b.soil	0.0000		.	0.0000		.	0.0000		.
2.soil	0.0641	*	0.000	0.0532	*	0.009	0.0532		0.173
3.soil	-0.1244	*	0.000	-0.1494	*	0.000	-0.1494	*	0.048
slope	0.0268	*	0.000	0.0324	*	0.000	0.0324	*	0.010
elevation	0.0036	*	0.000	0.0023	*	0.000	0.0023		0.265
highway distance	-0.0007	*	0.000	-0.0006	*	0.000	-0.0006	*	0.006
time*highway distance	-0.0001		0.098	0.0000		0.445	0.0000		0.511
city center distance	-0.0017	*	0.000	-0.0016	*	0.000	-0.0016	*	0.002
time*city center distance	-0.0001		0.252	-0.0001		0.583	-0.0001		0.720
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.000
time * city center distance squared	0.0000		0.204	0.0000		0.662	0.0000		0.740
city limit distance	-0.0001	*	0.000	0.0000	*	0.043	0.0000		0.452
time* city limit distance	0.0000		0.905	0.0000		0.992	0.0000		0.993

	Dundee: Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3188	number of negative weights: 834								
constant	0.2545	*	0.000	0.3372	*	0.000	0.3372	*	0.001
time	-0.0270		0.420	-0.0252		0.388	-0.0252		0.080
group	0.6296	*	0.000	0.4117	*	0.000	0.4117	*	0.026
interaction	**0.0585**		**0.090**	**0.0535**	*	**0.030**	**0.0535**		**0.080**
1b.soil									
2.soil									
3.soil									
slope									
elevation									
highway distance									
time*highway distance									
city center distance									
time*city center distance									
city center distance squared									
time * city center distance squared									
city limit distance									
time* city limit distance									
block 1 (base)	0.0000		.	0.0000		.	0.0000		.
block 2	-0.5618	*	0.000	-0.3873	*	0.000	-0.3873	*	0.000
block 3	-0.8842	*	0.000	-0.4642	*	0.000	-0.4642	*	0.000
block 4	-0.8627	*	0.000	-0.4691	*	0.000	-0.4691	*	0.000
block 5	-0.0305		0.330	-0.0002		0.997	-0.0002		0.993
block 6	-0.0755	*	0.013	-0.0531		0.103	-0.0531	*	0.017
time * block 1	0.0921	*	0.028	0.0945	*	0.032	0.0945	*	0.000
time * block 2	0.0614		0.254	0.0488		0.223	0.0488	*	0.000
time * block 3	-0.0315		0.700	0.0087		0.807	0.0087		0.080
time * block 4	-0.0315		0.624	0.0071		0.830	0.0071		0.080
time * block 5	0.0698		0.097	0.0882		0.051	0.0882	*	0.000
time * block 6 (base)	0.0000		.	0.0000		.	0.0000		.

	Dundee: Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3188	number of negative weights: 812								
constant	0.4161	*	0.000	0.3893	*	0.009	0.3893		0.376
time	0.3449	*	0.009	0.1861		0.256	0.1861		0.424
group	0.3809	*	0.000	0.3638	*	0.000	0.3638	*	0.005
interaction	**0.0569**	*	**0.005**	**0.0360**		**0.149**	**0.0360**		**0.408**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	-0.0028		0.842	0.0043		0.813	0.0043		0.918
3.soil	-0.1362	*	0.000	-0.1389	*	0.000	-0.1389	*	0.018
slope	0.0149	*	0.000	0.0158	*	0.000	0.0158	*	0.025
elevation	0.0008	*	0.010	0.0001		0.808	0.0001		0.965
highway distance	-0.0009	*	0.000	-0.0009	*	0.000	-0.0009	*	0.004
time*highway distance	0.0001		0.054	0.0001		0.157	0.0001		0.280
city center distance	-0.0014	*	0.000	-0.0013	*	0.000	-0.0013	*	0.002
time*city center distance	-0.0003	*	0.009	-0.0001		0.313	-0.0001		0.581
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.000
time * city center distance squared	0.0000		0.097	0.0000		0.983	0.0000		0.987
city limit distance	0.0001	*	0.000	0.0001	*	0.000	0.0001	*	0.027
time* city limit distance	-0.0001	*	0.050	0.0000		0.233	0.0000		0.185
block 1 (base)	0.0000	.		0.0000	.		0.0000	.	
block 2	-0.0640	*	0.011	-0.0793	*	0.025	-0.0793		0.433
block 3	0.1903	*	0.000	0.1553	*	0.000	0.1553		0.434
block 4	0.0010		0.972	-0.0006		0.987	-0.0006		0.996
block 5	0.2602	*	0.000	0.2212	*	0.000	0.2212	*	0.037
block 6	0.5533	*	0.000	0.5483	*	0.000	0.5483	*	0.001
time * block 1	0.1749	*	0.000	0.1779	*	0.002	0.1779	*	0.011
time * block 2	0.0697		0.072	0.0995		0.053	0.0995	*	0.004
time * block 3	-0.0180		0.739	0.0545		0.263	0.0545		0.262
time * block 4	0.0350		0.272	0.0441		0.258	0.0441		0.289
time * block 5	0.0542		0.132	0.1147	*	0.030	0.1147	*	0.028
time * block 6 (base)	0.0000	.		0.0000	.		0.0000	.	

Appendix 2.2.h: Estacada

	Estacada: Model I								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3770	number of negative weights: 0								
constant	0.0305	*	0.000	0.0305	*	0.000	0.0305		0.085
time	0.0000		1.000	0.0000		1.000	0.0000		1.000
group	0.1748	*	0.000	0.1748	*	0.000	0.1748		0.133
interaction	**0.0011**		**0.958**	**0.0011**		**0.958**	**0.0011**		**0.356**

	Estacada: Model II								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3770	number of negative weights: 933								
constant	0.9760	*	0.000	1.0359	*	0.000	1.0359	*	0.001
time	-0.0124		0.871	0.0007		0.993	0.0007		0.776
group	0.1780	*	0.000	0.1417	*	0.000	0.1417	*	0.034
interaction	**-0.0032**		**0.854**	**0.0020**		**0.921**	**0.0020**		**0.243**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	-0.1199	*	0.000	-0.1084	*	0.000	-0.1084	*	0.008
3.soil	-0.1811	*	0.000	-0.1629	*	0.000	-0.1629	*	0.000
4.soil	0.1468	*	0.000	0.0971	*	0.000	0.0971		0.095
slope	-0.0004		0.138	0.0002		0.511	0.0002		0.894
elevation	0.0004		0.149	-0.0002		0.487	-0.0002		0.889
highway distance	0.0000		0.193	0.0000		0.439	0.0000		0.768
time*highway distance	0.0000		0.486	0.0000		0.949	0.0000		0.106
city center distance	-0.0012	*	0.000	-0.0011	*	0.000	-0.0011	*	0.000
time*city center distance	0.0000		0.957	0.0000		0.999	0.0000		0.974
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.001
time * city center distance squared	0.0000		0.949	0.0000		0.992	0.0000		0.700
city limit distance	0.0001	*	0.000	0.0001	*	0.000	0.0001		0.193
time* city limit distance	0.0000		0.644	0.0000		0.957	0.0000		0.108

	Estacada: Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3770	number of negative weights: 848								
constant	0.5815	*	0.000	0.5581	*	0.000	0.5581	*	0.000
time	-0.0013		0.984	-0.0008		0.956	-0.0008		0.337
group	0.1384	*	0.000	0.1376	*	0.000	0.1376		0.113
interaction	**0.0013**		**0.974**	**0.0014**		**0.939**	**0.0014**		**0.337**
1b.soil									
2.soil									
3.soil									
4.soil									
slope									
elevation									
highway distance									
time*highway distance									
city center distance									
time*city center distance									
city center distance squared									
time * city center distance squared									
city limit distance									
time* city limit distance									
block 1 (base)	0.0000	.		0.0000	.		0.0000	.	
block 2	-0.5385	*	0.000	-0.4975	*	0.000	-0.4975	*	0.000
block 3	-0.7200	*	0.000	-0.5971	*	0.000	-0.5971	*	0.000
block 4	-0.4918	*	0.000	-0.5532	*	0.000	-0.5532	*	0.000
block 5	-0.7200	*	0.000	-0.6308	*	0.000	-0.6308	*	0.000
block 6	-0.4984	*	0.000	-0.4660	*	0.000	-0.4660	*	0.000
block 7	-0.5392	*	0.000	-0.5006	*	0.000	-0.5006	*	0.000
block 8	-0.6972	*	0.000	-0.6181	*	0.000	-0.6181	*	0.000
time * block 1	0.0005		0.996	-0.0003		0.996	-0.0003		0.337
time * block 2	0.0002		0.998	-0.0004		0.993	-0.0004		0.337
time * block 3	0.0000		1.000	0.0003		0.978	0.0003		0.337
time * block 4	0.0025		0.970	0.0000		0.999	0.0000		0.337
time * block 5	0.0000		1.000	0.0000		0.999	0.0000		0.337
time * block 6	0.0032		0.964	0.0036		0.906	0.0036	*	0.000
time * block 7	0.0009		0.990	0.0001		0.997	0.0001		0.337
time * block 8 (base)	0.0000	.		0.0000	.		0.0000	.	

	Estacada: Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3770	number of negative weights: 924								
constant	0.5025	*	0.003	0.3271	*	0.005	0.3271		0.681
time	0.4389		0.206	-0.0093		0.972	-0.0093		0.533
group	0.1466	*	0.000	0.0843	*	0.000	0.0843		0.314
interaction	**0.0175**		**0.595**	**0.0006**		**0.981**	**0.0006**		**0.437**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	-0.0602	*	0.000	-0.0542	*	0.000	-0.0542		0.161
3.soil	-0.1714	*	0.000	-0.1535	*	0.000	-0.1535	*	0.005
4.soil	0.2382	*	0.000	0.1751	*	0.000	0.1751		0.170
slope	0.0015	*	0.001	0.0029	*	0.000	0.0029		0.170
elevation	-0.0015	*	0.001	-0.0028	*	0.000	-0.0028		0.169
highway distance	-0.0001	*	0.004	0.0000		0.155	0.0000		0.764
time*highway distance	0.0000		0.603	0.0000		0.989	0.0000		0.733
city center distance	-0.0009	*	0.000	-0.0008	*	0.000	-0.0008	*	0.014
time*city center distance	0.0000		0.810	0.0000		0.963	0.0000		0.359
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.025
time * city center distance squared	0.0000		0.502	0.0000		0.947	0.0000		0.269
city limit distance	0.0002	*	0.000	0.0002	*	0.000	0.0002		0.087
time* city limit distance	-0.0001		0.120	0.0000		0.992	0.0000		0.811
block 1 (base)	0.0000	.		0.0000	.		0.0000	.	
block 2	-0.1859	*	0.036	-0.1371		0.096	-0.1371		0.419
block 3	-0.2411	*	0.019	-0.1649		0.064	-0.1649		0.522
block 4	-0.3924	*	0.000	-0.3266	*	0.000	-0.3266		0.342
block 5	-0.4621	*	0.000	-0.4511	*	0.000	-0.4511		0.189
block 6	-0.2008		0.077	-0.1953	*	0.029	-0.1953		0.543
block 7	-0.1465		0.223	-0.2974	*	0.003	-0.2974		0.486
block 8	-0.3886	*	0.000	-0.5099	*	0.000	-0.5099		0.257
time * block 1	-0.1462		0.335	0.0032		0.979	0.0032		0.481
time * block 2	-0.1789		0.139	0.0015		0.990	0.0015		0.566
time * block 3	-0.2089		0.079	0.0027		0.982	0.0027		0.402
time * block 4	-0.1876		0.108	0.0029		0.980	0.0029		0.345
time * block 5	-0.1230		0.130	0.0025		0.976	0.0025		0.291
time * block 6	-0.1227		0.084	0.0067		0.938	0.0067	*	0.032
time * block 7	0.0166		0.722	0.0009		0.981	0.0009		0.235
time * block 8 (base)	0.0000	.		0.0000	.		0.0000	.	

Appendix 2.2.i: Harrisburg

	Harrisburg: Model I								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 2152	number of negative weights: 0								
constant	0.0098	*	0.025	0.0098	*	0.025	0.0098		0.331
time	0.0411	*	0.000	0.0411	*	0.000	0.0411		0.331
group	0.5814	*	0.000	0.5814	*	0.000	0.5814	*	0.041
interaction	**0.0846**	*	**0.005**	**0.0846**	*	**0.005**	**0.0846**		**0.332**

	Harrisburg: Model II								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 2152	number of negative weights: 537								
constant	-5.3984	*	0.000	-2.3938	*	0.001	-2.3938		0.073
time	0.0199		0.913	-0.3466	*	0.006	-0.3466		0.099
group	0.4794	*	0.000	0.4215	*	0.000	0.4215		0.124
interaction	**0.1672**	*	**0.000**	**0.1060**	*	**0.003**	**0.1060**		**0.054**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	-0.1508	*	0.000	0.1272	*	0.000	0.1272		0.178
3.soil	0.2910	*	0.027	0.2790	*	0.003	0.2790		0.394
4.soil	-0.1377	*	0.009	-0.1076	*	0.000	-0.1076		0.419
slope	-0.0899	*	0.000	-0.0845	*	0.000	-0.0845		0.209
elevation	0.0670	*	0.000	0.0293	*	0.000	0.0293		0.068
highway distance	0.0000		0.915	-0.0001		0.112	-0.0001		0.772
time*highway distance	0.0000		0.926	0.0000		0.934	0.0000		0.972
city center distance	-0.0009	*	0.000	-0.0008	*	0.000	-0.0008		0.055
time*city center distance	-0.0005	*	0.000	0.0002	*	0.004	0.0002		0.205
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000		0.103
time * city center distance squared	0.0000	*	0.000	0.0000		0.057	0.0000		0.247
city limit distance	0.0000		0.560	0.0001	*	0.000	0.0001		0.173
time* city limit distance	0.0000		0.715	0.0001	*	0.018	0.0001		0.174

	Harrisburg: Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 2152	number of negative weights: 447								
constant	0.0860	*	0.012	0.3081	*	0.000	0.3081		0.070
time	0.2307	*	0.000	0.0040		0.850	0.0040		0.902
group	0.9029	*	0.000	0.5729	*	0.000	0.5729	*	0.037
interaction	**-0.1281**	*	**0.002**	**0.0948**	*	**0.001**	**0.0948**		**0.201**
1b.soil									
2.soil									
3.soil									
4.soil									
slope									
elevation									
highway distance									
time*highway distance									
city center distance									
time*city center distance									
city center distance squared									
time * city center distance squared									
city limit distance									
time* city limit distance									
block 1 (base)	0.0000	.		0.0000	.		0.0000	.	
block 2	-0.5996	*	0.000	-0.4169	*	0.000	-0.4169	*	0.000
block 3	-0.0921	*	0.007	-0.2201	*	0.000	-0.2201	*	0.038
block 4	-0.6453	*	0.000	-0.4255	*	0.000	-0.4255	*	0.001
time * block 1	-0.1226	*	0.012	-0.0701		0.055	-0.0701	*	0.007
time * block 2	0.3018	*	0.000	0.1249	*	0.009	0.1249	*	0.001
time * block 3	-0.0940		0.098	0.0719	*	0.031	0.0719	*	0.009
time * block 4 (base)	0.0000	.		0.0000	.		0.0000	.	

	Harrisburg: Model IV					
	aweight		robust		cluster robust	
	coefficient	p-value	coefficient	p-value	coefficient	p-value
observations: 2152	number of negative weights: 604					
constant	-0.6803	0.320	0.0650	0.933	0.0650	0.923
time	0.5542 *	0.003	0.2798	0.131	0.2798	0.452
group	0.5519 *	0.000	0.4574 *	0.000	0.4574	0.141
interaction	**-0.0921** *	**0.018**	**-0.0128**	**0.776**	**-0.0128**	**0.736**
1b.soil	0.0000	.	0.0000	.	0.0000	.
2.soil	0.0837 *	0.000	0.1004 *	0.000	0.1004	0.384
3.soil	0.3225 *	0.000	0.2859 *	0.000	0.2859	0.319
4.soil	-0.1099 *	0.013	-0.1959 *	0.000	-0.1959	0.203
slope	-0.0700 *	0.000	-0.0631 *	0.000	-0.0631	0.303
elevation	0.0171 *	0.015	0.0102	0.213	0.0102	0.429
highway distance	-0.0002 *	0.004	0.0000	0.706	0.0000	0.948
time*highway distance	0.0001	0.275	0.0000	0.664	0.0000	0.890
city center distance	-0.0001	0.473	-0.0002 *	0.033	-0.0002	0.674
time*city center distance	-0.0006 *	0.000	-0.0004 *	0.005	-0.0004	0.346
city center distance squared	0.0000	0.926	0.0000	0.496	0.0000	0.884
time * city center distance squared	0.0000	0.052	0.0000	0.181	0.0000	0.616
city limit distance	-0.0001 *	0.000	-0.0001 *	0.000	-0.0001	0.464
time* city limit distance	0.0000	0.348	0.0001	0.117	0.0001	0.450
block 1 (base)	0.0000	.	0.0000	.	0.0000	.
block 2	-0.3360 *	0.000	-0.1980 *	0.003	-0.1980	0.539
block 3	0.0053	0.947	-0.0980	0.302	-0.0980	0.868
block 4	-0.4904 *	0.000	-0.5000 *	0.000	-0.5000	0.461
time * block 1	-0.4403 *	0.000	-0.4290 *	0.001	-0.4290	0.289
time * block 2	0.2182 *	0.024	0.0060	0.957	0.0060	0.981
time * block 3	0.0930	0.220	0.0949	0.210	0.0949 *	0.040
time * block 4 (base)	0.0000	.	0.0000	.	0.0000	.

Appendix 2.2.j: Lafayette

	Lafayette: Model I								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 2526	number of negative weights: 0								
constant	0.0423	*	0.000	0.0423	*	0.000	0.0423		0.096
time	0.0013		0.899	0.0013		0.899	0.0013		0.381
group	0.2028	*	0.000	0.2028	*	0.000	0.2028		0.071
interaction	**0.1588**	*	**0.000**	**0.1588**	*	**0.000**	**0.1588**		**0.128**

	Lafayette: Model II								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 2526	number of negative weights: 456								
constant	0.7586	*	0.000	0.9011	*	0.000	0.9011	*	0.033
time	-0.0146		0.905	-0.2050		0.197	-0.2050		0.526
group	0.0260		0.054	-0.0046		0.824	-0.0046		0.909
interaction	**0.1562**	*	**0.000**	**0.1902**	*	**0.000**	**0.1902**		**0.080**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	-0.0045		0.674	-0.0120		0.502	-0.0120		0.685
3.soil	-0.0194		0.138	-0.0495	*	0.004	-0.0495		0.410
slope	-0.0173	*	0.000	-0.0168	*	0.000	-0.0168	*	0.031
elevation	0.0053	*	0.000	0.0044	*	0.000	0.0044		0.172
highway distance	-0.0002	*	0.000	-0.0001	*	0.000	-0.0001		0.125
time*highway distance	0.0001	*	0.038	0.0000		0.913	0.0000		0.934
city center distance	-0.0016	*	0.000	-0.0017	*	0.000	-0.0017	*	0.000
time*city center distance	0.0002		0.070	0.0005	*	0.002	0.0005		0.107
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.001
time * city center distance squared	0.0000	*	0.029	0.0000	*	0.002	0.0000		0.129
city limit distance	0.0000		0.087	0.0000		0.636	0.0000		0.858
time* city limit distance	0.0000		0.135	0.0000		0.771	0.0000		0.876

	Lafayette: Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 2526	number of negative weights: 468								
constant	-0.1478	*	0.001	-0.0554	*	0.000	-0.0554		0.122
time	-0.3199	*	0.000	-0.0407		0.067	-0.0407		0.157
group	0.1886	*	0.000	0.1867	*	0.000	0.1867		0.067
interaction	**0.2532**	*	**0.000**	**0.1576**	*	**0.000**	**0.1576**		**0.129**
1b.soil									
2.soil									
3.soil									
slope									
elevation									
highway distance									
time*highway distance									
city center distance									
time*city center distance									
city center distance squared									
time * city center distance squared									
city limit distance									
time* city limit distance									
block 1 (base)	0.0000		.	0.0000		.	0.0000		.
block 2	0.1848	*	0.000	0.0705	*	0.000	0.0705	*	0.000
block 3	0.1714	*	0.000	0.0792	*	0.000	0.0792	*	0.000
block 4	0.3651	*	0.000	0.2920	*	0.000	0.2920	*	0.000
block 5	0.1787	*	0.000	0.0655	*	0.000	0.0655	*	0.001
time * block 1	0.4660	*	0.000	0.1049	*	0.001	0.1049	*	0.000
time * block 2	0.3373	*	0.000	0.1341	*	0.000	0.1341	*	0.000
time * block 3	0.0651		0.398	-0.0270		0.453	-0.0270		0.089
time * block 4	0.2405	*	0.001	-0.0079		0.855	-0.0079		0.641
time * block 5 (base)	0.0000		.	0.0000		.	0.0000		.

	Lafayette: Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 2526	number of negative weights: 538								
constant	1.2802	*	0.000	1.2403	*	0.000	1.2403		0.127
time	-1.1052	*	0.000	-0.8472		0.059	-0.8472		0.370
group	-0.0278		0.106	-0.0079		0.767	-0.0079		0.899
interaction	**0.1388**	*	**0.000**	**0.1238**	*	**0.002**	**0.1238**		**0.112**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	-0.0152		0.202	-0.0089		0.612	-0.0089		0.809
3.soil	-0.0082		0.622	-0.0557	*	0.002	-0.0557		0.248
slope	-0.0211	*	0.000	-0.0152	*	0.000	-0.0152	*	0.029
elevation	0.0053	*	0.000	0.0050	*	0.000	0.0050		0.366
highway distance	-0.0002	*	0.000	-0.0001		0.066	-0.0001		0.449
time*highway distance	0.0002	*	0.000	0.0000		0.667	0.0000		0.604
city center distance	-0.0018	*	0.000	-0.0017	*	0.000	-0.0017	*	0.000
time*city center distance	0.0002		0.187	0.0003		0.139	0.0003		0.310
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.000
time * city center distance squared	0.0000	*	0.002	0.0000	*	0.014	0.0000		0.178
city limit distance	0.0000		0.248	0.0000		0.178	0.0000		0.393
time* city limit distance	0.0001	*	0.001	0.0001		0.088	0.0001		0.466
block 1 (base)	0.0000	.		0.0000	.		0.0000	.	
block 2	-0.0297		0.214	0.0324		0.376	0.0324		0.741
block 3	-0.0003		0.990	0.0558		0.224	0.0558		0.745
block 4	-0.0403		0.330	0.0680		0.254	0.0680		0.653
block 5	0.1070	*	0.004	0.1592	*	0.000	0.1592		0.111
time * block 1	0.1656	*	0.000	0.1751	*	0.002	0.1751		0.117
time * block 2	0.3223	*	0.000	0.2623	*	0.002	0.2623		0.138
time * block 3	0.1750	*	0.005	0.0945		0.346	0.0945		0.593
time * block 4	0.0647		0.150	0.0073		0.917	0.0073		0.896
time * block 5 (base)	0.0000	.		0.0000	.		0.0000	.	

Appendix 2.2.k: Lebanon

	Lebanon: Model I								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 6472	number of negative weights: 0								
constant	0.0077	*	0.001	0.0077	*	0.001	0.0077		0.341
time	0.0064		0.085	0.0064		0.085	0.0064		0.341
group	0.0974	*	0.000	0.0974	*	0.000	0.0974		0.193
interaction	**0.0262**	*	**0.027**	**0.0262**	*	**0.027**	**0.0262**		**0.150**

	Lebanon: Model II								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 6472	number of negative weights: 2488								
constant	1.9392	*	0.000	2.0201	*	0.000	2.0201	*	0.001
time	0.1299		0.360	0.0386		0.664	0.0386		0.429
group	-0.0184	*	0.010	-0.0090		0.117	-0.0090		0.691
interaction	**0.0905**	*	**0.000**	**0.0179**	*	**0.043**	**0.0179**		**0.197**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	-0.0460	*	0.000	-0.0475	*	0.000	-0.0475		0.091
3.soil	-0.1382	*	0.000	-0.1478	*	0.000	-0.1478	*	0.009
4.soil	-0.2704		0.080	-0.2928	*	0.000	-0.2928	*	0.001
slope	-0.0008	*	0.000	-0.0009	*	0.000	-0.0009	*	0.008
elevation	0.0008	*	0.000	0.0009	*	0.000	0.0009	*	0.008
highway distance	0.0000	*	0.000	0.0000		0.387	0.0000		0.880
time*highway distance	0.0000	*	0.000	0.0000	*	0.004	0.0000		0.052
city center distance	-0.0014	*	0.000	-0.0015	*	0.000	-0.0015	*	0.001
time*city center distance	0.0001		0.167	0.0001		0.147	0.0001		0.084
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.001
time * city center distance squared	0.0000		0.091	0.0000		0.084	0.0000		0.117
city limit distance	0.0000	*	0.000	0.0000	*	0.000	0.0000		0.316
time* city limit distance	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.044

	Lebanon: Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 6472	number of negative weights: 2347								
constant	-0.0918	*	0.000	-0.0195	*	0.000	-0.0195		0.177
time	-0.0853	*	0.000	-0.0201	*	0.002	-0.0201		0.159
group	0.0918	*	0.000	0.0364	*	0.000	0.0364		0.177
interaction	**0.0853**	*	**0.000**	**0.0329**	*	**0.001**	**0.0329**		**0.159**
1b.soil									
2.soil									
3.soil									
4.soil									
slope									
elevation									
highway distance									
time*highway distance									
city center distance									
time*city center distance									
city center distance squared									
time * city center distance squared									
city limit distance									
time* city limit distance									
block 1 (base)	0.0000		.	0.0000		.	0.0000		.
block 2	0.0900	*	0.000	0.0449	*	0.001	0.0449	*	0.000
block 3	0.0000		1.000	0.0016		0.312	0.0016		0.177
block 4	0.0000		1.000	0.0062	*	0.001	0.0062		0.177
block 5	0.0061		0.553	-0.0008		0.850	-0.0008		0.815
block 6	0.0000		1.000	0.0037	*	0.027	0.0037		0.177
block 7	0.1539	*	0.000	0.1057	*	0.000	0.1057	*	0.000
block 8	0.0000		1.000	0.0115	*	0.000	0.0115		0.177
block 9	0.1143	*	0.000	0.0905	*	0.000	0.0905	*	0.000
block 10	0.0000		1.000	0.0085	*	0.000	0.0085		0.177
block 11	0.6154	*	0.000	0.5896	*	0.000	0.5896	*	0.000
block 12	0.0000		1.000	0.0051	*	0.004	0.0051		0.177

	Lebanon: Model III (continued)								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
block 13	0.0000		1.000	-0.0028		0.080	-0.0028		0.177
time * block 1	0.0068		0.688	0.0062		0.210	0.0062	*	0.003
time * block 2	0.1093	*	0.000	0.0795	*	0.001	0.0795	*	0.000
time * block 3	0.0000		1.000	0.0040		0.259	0.0040		0.159
time * block 4	0.1883	*	0.000	0.0912	*	0.000	0.0912	*	0.000
time * block 5	0.0244		0.152	0.0144		0.158	0.0144	*	0.000
time * block 6	0.0000		1.000	0.0059		0.117	0.0059		0.159
time * block 7	0.1218	*	0.000	0.0779	*	0.011	0.0779	*	0.000
time * block 8	0.0000		1.000	0.0129	*	0.011	0.0129		0.159
time * block 9	0.0232		0.319	-0.0078		0.787	-0.0078		0.159
time * block 10	0.0000		1.000	0.0102	*	0.026	0.0102		0.159
time * block 11	0.0116		0.744	-0.0086		0.856	-0.0086		0.159
time * block 12	0.0000		1.000	0.0071		0.071	0.0071		0.159
time * block 13 (base)	0.0000		.	0.0000		.	0.0000		.

	Lebanon: Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 6472	number of negative weights: 2547								
constant	1.8732	*	0.000	1.7993	*	0.000	1.7993	*	0.024
time	0.2348		0.054	0.2339		0.073	0.2339		0.214
group	-0.0345	*	0.000	-0.0311	*	0.000	-0.0311		0.142
interaction	**0.0160**	*	**0.048**	**0.0133**		**0.200**	**0.0133**		**0.255**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	-0.0300	*	0.000	-0.0373	*	0.000	-0.0373		0.197
3.soil	-0.0816	*	0.000	-0.0983	*	0.000	-0.0983		0.110
4.soil	-0.4221	*	0.000	-0.3851	*	0.000	-0.3851	*	0.000
slope	-0.0013	*	0.000	-0.0013	*	0.000	-0.0013		0.084
elevation	0.0012	*	0.000	0.0012	*	0.000	0.0012		0.086
highway distance	0.0000		0.764	0.0000		0.264	0.0000		0.822
time*highway distance	0.0000		0.890	0.0000		0.586	0.0000		0.653
city center distance	-0.0015	*	0.000	-0.0015	*	0.000	-0.0015	*	0.020
time*city center distance	0.0000		0.951	0.0000		0.757	0.0000		0.794
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.020
time * city center distance squared	0.0000		0.541	0.0000		0.355	0.0000		0.424
city limit distance	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.029
time* city limit distance	0.0000	*	0.001	0.0000	*	0.003	0.0000		0.189
block 1 (base)	0.0000	.		0.0000	.		0.0000	.	
block 2	0.0070		0.563	0.0040		0.758	0.0040		0.859
block 3	-0.0727	*	0.000	-0.0653	*	0.000	-0.0653		0.392
block 4	-0.0673	*	0.004	-0.0388		0.138	-0.0388		0.778
block 5	-0.1563	*	0.000	-0.1118	*	0.000	-0.1118		0.297
block 6	-0.0404	*	0.011	-0.0406	*	0.006	-0.0406		0.555
block 7	0.1114	*	0.000	0.1030	*	0.000	0.1030		0.327
block 8	-0.2384	*	0.000	-0.2278	*	0.000	-0.2278		0.204
block 9	-0.3553	*	0.000	-0.3475	*	0.000	-0.3475	*	0.050
block 10	-0.2897	*	0.000	-0.2790	*	0.000	-0.2790	*	0.024
block 11	-0.1318	*	0.002	-0.1470	*	0.001	-0.1470		0.539
block 12	-0.2536	*	0.000	-0.2442	*	0.000	-0.2442	*	0.005

	Lebanon: Model IV (continued)								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
block 13	-0.1890	*	0.000	-0.1932	*	0.000	-0.1932		0.080
time * block 1	-0.0072		0.675	-0.0336		0.061	-0.0336		0.308
time * block 2	0.0401	*	0.039	0.0319		0.170	0.0319		0.268
time * block 3	-0.0446	*	0.045	-0.0523	*	0.050	-0.0523		0.143
time * block 4	0.0393		0.247	0.0327		0.493	0.0327		0.526
time * block 5	-0.0209		0.493	-0.0559		0.093	-0.0559		0.210
time * block 6	0.0057		0.822	-0.0136		0.608	-0.0136		0.703
time * block 7	0.0507		0.138	0.0341		0.392	0.0341		0.491
time * block 8	0.0724	*	0.036	0.0598		0.244	0.0598		0.458
time * block 9	-0.0082		0.811	0.0006		0.990	0.0006		0.988
time * block 10	0.0323		0.219	0.0271		0.372	0.0271		0.517
time * block 11	-0.0383		0.455	-0.0243		0.667	-0.0243		0.588
time * block 12	-0.0376		0.056	-0.0131		0.415	-0.0131		0.466
time * block 13 (base)	0.0000		.	0.0000		.	0.0000		.

Appendix 2.2.l: Lowell

	Lowell: Model I								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 1926	number of negative weights: 0								
constant	0.0736	*	0.000	0.0736	*	0.000	0.0736		0.108
time	0.0683	*	0.000	0.0683	*	0.000	0.0683		0.244
group	0.1535	*	0.000	0.1535	*	0.000	0.1535		0.420
interaction	**0.1562**	*	**0.000**	**0.1562**	*	**0.000**	**0.1562**		**0.118**

	Lowell: Model II								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 1926	number of negative weights: 404								
constant	1.8415	*	0.000	1.7341	*	0.000	1.7341	*	0.000
time	-0.6197	*	0.000	-0.4711	*	0.009	-0.4711		0.504
group	0.0787	*	0.000	0.0803	*	0.001	0.0803		0.661
interaction	**0.0007**		**0.984**	**0.0307**		**0.474**	**0.0307**		**0.410**
2b.soil	0.0000		.	0.0000		.	0.0000		.
3.soil	0.1656	*	0.000	0.1536	*	0.000	0.1536	*	0.025
4.soil	-0.0294		0.274	-0.0410		0.203	-0.0410		0.331
slope	-0.0300	*	0.000	-0.0243	*	0.000	-0.0243		0.070
elevation	-0.0005	*	0.000	-0.0002		0.124	-0.0002		0.709
highway distance	-0.0001	*	0.000	-0.0001	*	0.014	-0.0001		0.435
time*highway distance	0.0002	*	0.000	0.0001	*	0.000	0.0001	*	0.029
city center distance	-0.0015	*	0.000	-0.0015	*	0.000	-0.0015	*	0.007
time*city center distance	0.0002		0.288	0.0000		0.855	0.0000		0.955
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.025
time * city center distance squared	0.0000	*	0.005	0.0000		0.153	0.0000		0.703
city limit distance	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.004
time* city limit distance	0.0000	*	0.000	0.0000	*	0.000	0.0000		0.092

	Lowell: Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 1926	number of negative weights: 469								
constant	0.1250	*	0.000	0.2204	*	0.000	0.2204	*	0.037
time	0.0357		0.335	-0.0465		0.321	-0.0465		0.146
group	0.3832	*	0.000	0.1669	*	0.000	0.1669		0.399
interaction	**-0.0294**		**0.577**	**0.1391**	*	**0.000**	**0.1391**		**0.112**
2b.soil									
3.soil									
4.soil									
slope									
elevation									
highway distance									
time*highway distance									
city center distance									
time*city center distance									
city center distance squared									
time * city center distance squared									
city limit distance									
time* city limit distance									
block 1 (base)	0.0000		.	0.0000		.	0.0000		.
block 2	-0.4858	*	0.000	-0.2252	*	0.000	-0.2252	*	0.001
block 3	-0.4233	*	0.000	-0.2533	*	0.000	-0.2533	*	0.000
block 4	-0.0426		0.247	-0.0999	*	0.013	-0.0999	*	0.000
time * block 1	0.0862		0.092	0.1077		0.061	0.1077	*	0.000
time * block 2	0.5683	*	0.000	0.3056	*	0.000	0.3056	*	0.000
time * block 3	0.0314		0.668	0.0058		0.906	0.0058	*	0.019
time * block 4 (base)	0.0000		.	0.0000		.	0.0000		.

	Lowell: Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 1926	number of negative weights: 446								
constant	2.6064	*	0.000	2.1477	*	0.000	2.1477	*	0.000
time	-1.6010	*	0.000	-0.8408	*	0.001	-0.8408		0.069
group	-0.0316		0.169	0.0221		0.474	0.0221		0.886
interaction	**0.1025**	*	**0.003**	**0.0337**		**0.494**	**0.0337**		**0.354**
2b.soil	0.0000	.		0.0000	.		0.0000	.	
3.soil	0.1471	*	0.000	0.1262	*	0.000	0.1262	*	0.039
4.soil	-0.0556		0.075	-0.0857	*	0.007	-0.0857		0.094
slope	-0.0256	*	0.000	-0.0232	*	0.000	-0.0232	*	0.018
elevation	0.0000		0.887	0.0002		0.357	0.0002		0.803
highway distance	-0.0001	*	0.029	-0.0002	*	0.002	-0.0002		0.415
time*highway distance	-0.0004	*	0.000	-0.0003	*	0.000	-0.0003		0.125
city center distance	-0.0021	*	0.000	-0.0018	*	0.000	-0.0018	*	0.003
time*city center distance	0.0006	*	0.020	0.0002		0.454	0.0002		0.614
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.005
time * city center distance squared	0.0000	*	0.024	0.0000		0.241	0.0000		0.516
city limit distance	-0.0001	*	0.000	0.0000	*	0.000	0.0000	*	0.021
time* city limit distance	0.0001	*	0.000	0.0001	*	0.000	0.0001	*	0.026
block 1 (base)	0.0000	.		0.0000	.		0.0000	.	
block 2	0.4571	*	0.000	0.2364	*	0.000	0.2364	*	0.009
block 3	0.3558	*	0.000	0.1604	*	0.000	0.1604		0.182
block 4	0.2145	*	0.000	0.0172		0.775	0.0172		0.925
time * block 1	0.7505	*	0.000	0.5142	*	0.000	0.5142	*	0.038
time * block 2	0.5706	*	0.000	0.6331	*	0.000	0.6331	*	0.049
time * block 3	0.2003	*	0.000	0.1961	*	0.002	0.1961		0.161
time * block 4 (base)	0.0000	.		0.0000	.		0.0000	.	

Appendix 2.2.m: McMinnville

	McMinnville: Model I					
	aweight		robust		cluster robust	
	coefficient	p-value	coefficient	p-value	coefficient	p-value
observations: 8772	number of negative weights: 0					
constant	0.0707 *	0.000	0.0707 *	0.000	0.0707 *	0.030
time	0.0131	0.103	0.0131	0.103	0.0131	0.275
group	0.2195 *	0.000	0.2195 *	0.000	0.2195 *	0.001
interaction	**0.1267** *	**0.000**	**0.1267** *	**0.000**	**0.1267** *	**0.000**

	McMinnville: Model II					
	aweight		robust		cluster robust	
	coefficient	p-value	coefficient	p-value	coefficient	p-value
observations: 8772	number of negative weights: 1476					
constant	0.5425 *	0.000	0.5535 *	0.000	0.5535 *	0.026
time	0.2963 *	0.000	0.1059	0.207	0.1059	0.452
group	0.1898 *	0.000	0.1996 *	0.000	0.1996 *	0.009
interaction	**0.1095** *	**0.000**	**0.1115** *	**0.000**	**0.1115** *	**0.001**
1.soil	0.0000	.	0.0000	.	0.0000	.
2.soil	0.0131	0.095	0.0146	0.166	0.0146	0.695
3.soil	-0.0006	0.945	0.0017	0.911	0.0017	0.961
slope	0.0040 *	0.000	0.0014	0.508	0.0014	0.840
elevation	0.0083 *	0.000	0.0070 *	0.000	0.0070 *	0.019
highway distance	-0.0001 *	0.000	-0.0001 *	0.000	-0.0001 *	0.045
time*highway distance	0.0000 *	0.014	0.0000 *	0.033	0.0000	0.205
city center distance	-0.0004 *	0.000	-0.0004 *	0.000	-0.0004 *	0.002
time*city center distance	-0.0001 *	0.007	0.0000	0.889	0.0000	0.936
city center distance squared	0.0000 *	0.000	0.0000 *	0.000	0.0000 *	0.001
time * city center distance squared	0.0000	0.094	0.0000	0.663	0.0000	0.786
city limit distance	0.0000 *	0.000	0.0000 *	0.000	0.0000	0.195
time* city limit distance	0.0000	0.870	0.0000	0.771	0.0000	0.915

	McMinnville: Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 8772	number of negative weights: 1504								
constant	-0.2793	*	0.000	-0.1245	*	0.000	-0.1245	*	0.002
time	-0.0235		0.616	-0.0022		0.884	-0.0022		0.842
group	0.2855	*	0.000	0.2236	*	0.000	0.2236	*	0.001
interaction	**0.1275**	*	**0.000**	**0.1094**	*	**0.000**	**0.1094**	*	**0.001**
1.soil									
2.soil									
3.soil									
slope									
elevation									
highway distance									
time*highway distance									
city center distance									
time*city center distance									
city center distance squared									
time * city center distance squared									
city limit distance									
time* city limit distance									
block 1	0.0000		.	0.0000		.	0.0000		.
block 2	-0.0062		0.856	0.0230	*	0.025	0.0230	*	0.004
block 3	0.3877	*	0.000	0.2112	*	0.000	0.2112	*	0.000
block 4	0.3942	*	0.000	0.2852	*	0.000	0.2852	*	0.000
block 5	0.2826	*	0.000	0.1486	*	0.000	0.1486	*	0.000
block 6	0.2779	*	0.000	0.1470	*	0.000	0.1470	*	0.000
block 7	0.2780	*	0.000	0.1451	*	0.000	0.1451	*	0.000
block 8	0.3814	*	0.000	0.2811	*	0.000	0.2811	*	0.000
block 9	0.3904	*	0.000	0.2580	*	0.000	0.2580	*	0.000
block 10	0.2066	*	0.000	0.1185	*	0.000	0.1185	*	0.000
block 11	0.2769	*	0.000	0.1346	*	0.000	0.1346	*	0.000
block 12	0.5297	*	0.000	0.3852	*	0.000	0.3852	*	0.000
block 13	0.7653	*	0.000	0.6156	*	0.000	0.6156	*	0.000

	McMinnville: Model III (continued)								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
block 14	0.3335	*	0.000	0.2169	*	0.000	0.2169	*	0.000
block 15	0.0263		0.433	0.0281	*	0.025	0.0281	*	0.000
block 16	-0.0062		0.854	0.0310	*	0.002	0.0310	*	0.003
time * block 1	0.0441		0.428	0.0244		0.304	0.0244	*	0.000
time * block 2	-0.1040		0.082	-0.0474	*	0.015	-0.0474	*	0.000
time * block 3	0.0244		0.637	-0.0221		0.556	-0.0221	*	0.000
time * block 4	0.0491		0.381	0.0349		0.323	0.0349	*	0.000
time * block 5	0.2034	*	0.000	0.1957	*	0.000	0.1957	*	0.000
time * block 6	-0.1168	*	0.043	-0.0494		0.099	-0.0494	*	0.000
time * block 7	-0.1012		0.087	-0.0391		0.198	-0.0391	*	0.000
time * block 8	0.1265	*	0.018	0.1116	*	0.002	0.1116	*	0.000
time * block 9	0.0636		0.234	0.0691		0.083	0.0691	*	0.000
time * block 10	0.0959		0.087	0.0514		0.120	0.0514	*	0.000
time * block 11	0.0248		0.609	0.0294		0.345	0.0294	*	0.000
time * block 12	0.0177		0.747	0.0071		0.864	0.0071	*	0.000
time * block 13	-0.0352		0.529	-0.0524		0.151	-0.0524	*	0.000
time * block 14	0.0024		0.963	-0.0422		0.221	-0.0422	*	0.000
time * block 15	0.1887	*	0.003	0.0947	*	0.001	0.0947	*	0.000
time * block 16 (base)	0.0000		.	0.0000		.	0.0000		.

	McMinnville: Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 8772	number of negative weights: 1732								
constant	-0.1903		0.089	-0.0741		0.548	-0.0741		0.911
time	0.0288		0.857	-0.2817		0.106	-0.2817		0.623
group	0.2107	*	0.000	0.1701	*	0.000	0.1701	*	0.001
interaction	**0.0755**	*	**0.000**	**0.0921**	*	**0.000**	**0.0921**	*	**0.014**
1.soil	0.0000		.	0.0000		.	0.0000		.
2.soil	0.0013		0.881	0.0034		0.738	0.0034		0.896
3.soil	0.0222		0.070	0.0224		0.147	0.0224		0.585
slope	0.0031		0.076	-0.0004		0.845	-0.0004		0.951
elevation	0.0100	*	0.000	0.0078	*	0.000	0.0078	*	0.005
highway distance	-0.0002	*	0.000	-0.0001	*	0.000	-0.0001		0.189
time*highway distance	-0.0001	*	0.000	-0.0001	*	0.000	-0.0001		0.058
city center distance	-0.0001	*	0.009	-0.0001		0.065	-0.0001		0.785
time*city center distance	0.0001		0.233	0.0002	*	0.050	0.0002		0.517
city center distance squared	0.0000	*	0.004	0.0000	*	0.034	0.0000		0.776
time * city center distance squared	0.0000		0.076	0.0000	*	0.043	0.0000		0.426
city limit distance	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.000
time* city limit distance	0.0000		0.417	0.0000		0.169	0.0000		0.554
block 1	0.0000		.	0.0000		.	0.0000		.
block 2	0.0792	*	0.020	0.0674	*	0.000	0.0674		0.317
block 3	0.2919	*	0.000	0.1494	*	0.000	0.1494		0.237
block 4	0.3262	*	0.000	0.2314	*	0.000	0.2314		0.059
block 5	0.2297	*	0.000	0.1053	*	0.000	0.1053	*	0.008
block 6	0.5111	*	0.000	0.3504	*	0.000	0.3504	*	0.001
block 7	0.4438	*	0.000	0.3295	*	0.000	0.3295	*	0.000
block 8	0.4083	*	0.000	0.3319	*	0.000	0.3319		0.052
block 9	0.3604	*	0.000	0.2920	*	0.000	0.2920	*	0.006
block 10	0.3903	*	0.000	0.2907	*	0.000	0.2907	*	0.003
block 11	0.3553	*	0.000	0.2361	*	0.000	0.2361		0.095
block 12	0.5105	*	0.000	0.4104	*	0.000	0.4104		0.165
block 13	0.7916	*	0.000	0.6458	*	0.000	0.6458		0.106

	McMinnville: Model IV (continued)								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
block 14	0.3498	*	0.000	0.1949	*	0.001	0.1949		0.613
block 15	0.2674	*	0.000	0.1666	*	0.000	0.1666		0.302
block 16	0.0714	*	0.041	0.0907	*	0.000	0.0907		0.111
time * block 1	0.0694		0.172	0.1242	*	0.000	0.1242	*	0.002
time * block 2	-0.1362	*	0.006	-0.0064		0.806	-0.0064		0.850
time * block 3	-0.1284	*	0.005	-0.0640		0.166	-0.0640		0.467
time * block 4	0.0132		0.786	0.0529		0.248	0.0529		0.503
time * block 5	0.1912	*	0.000	0.2514	*	0.000	0.2514	*	0.000
time * block 6	0.0446		0.372	0.0445		0.311	0.0445		0.452
time * block 7	-0.0112		0.812	0.0473		0.220	0.0473		0.460
time * block 8	0.1294	*	0.045	0.2252	*	0.000	0.2252		0.259
time * block 9	-0.0593		0.230	0.0668		0.173	0.0668		0.527
time * block 10	-0.0948	*	0.020	0.0043		0.907	0.0043		0.891
time * block 11	-0.0766		0.063	-0.0287		0.478	-0.0287		0.745
time * block 12	0.0164		0.801	0.0114		0.864	0.0114		0.924
time * block 13	0.0653		0.397	0.0354		0.672	0.0354		0.797
time * block 14	0.1669	*	0.020	0.1193		0.160	0.1193		0.358
time * block 15	0.2471	*	0.000	0.1955	*	0.000	0.1955	*	0.032
time * block 16 (base)	0.0000		.	0.0000		.	0.0000		.

Appendix 2.2.n: Newberg

	Newberg: Model I								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 7596	number of negative weights: 0								
constant	0.2998	*	0.000	0.2998	*	0.000	0.2998	*	0.000
time	0.1192	*	0.000	0.1192	*	0.000	0.1192	*	0.011
group	0.1025	*	0.000	0.1025	*	0.000	0.1025		0.161
interaction	**0.0340**		**0.127**	**0.0340**		**0.127**	**0.0340**		**0.644**

	Newberg: Model II								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 7596	number of negative weights: 456								
constant	0.8375	*	0.000	0.7047	*	0.000	0.7047	*	0.031
time	-0.0672		0.440	-0.0207		0.825	-0.0207		0.913
group	0.0165		0.146	0.0061		0.672	0.0061		0.916
interaction	**0.0630**	*	**0.000**	**0.0387**		**0.053**	**0.0387**		**0.546**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	-0.0422	*	0.002	-0.0377	*	0.010	-0.0377		0.318
3.soil	-0.0540	*	0.000	-0.0540	*	0.005	-0.0540		0.421
4.soil	-0.1241	*	0.005	-0.1597	*	0.006	-0.1597		0.302
slope	-0.0080	*	0.000	-0.0055	*	0.021	-0.0055		0.620
elevation	0.0073	*	0.000	0.0081	*	0.000	0.0081	*	0.000
highway distance	-0.0002	*	0.000	-0.0002	*	0.000	-0.0002	*	0.002
time*highway distance	-0.0001	*	0.000	-0.0001	*	0.000	-0.0001	*	0.003
city center distance	-0.0004	*	0.000	-0.0004	*	0.000	-0.0004		0.061
time*city center distance	0.0002	*	0.000	0.0002	*	0.002	0.0002		0.348
city center distance squared	0.0000	*	0.000	0.0000	*	0.005	0.0000		0.529
time * city center distance squared	0.0000	*	0.004	0.0000	*	0.014	0.0000		0.520
city limit distance	0.0000		0.338	0.0000		0.068	0.0000		0.616
time* city limit distance	0.0000		0.190	0.0000		0.506	0.0000		0.688

	Newberg: Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 7596	number of negative weights: 556								
constant	0.2271	*	0.000	0.2170	*	0.000	0.2170	*	0.000
time	0.2038	*	0.000	0.2162	*	0.000	0.2162	*	0.000
group	0.0713	*	0.000	0.0941	*	0.000	0.0941		0.197
interaction	**0.0605**	*	**0.006**	**0.0376**	*	**0.049**	**0.0376**		**0.615**
1b.soil									
2.soil									
3.soil									
4.soil									
slope									
elevation									
highway distance									
time*highway distance									
city center distance									
time*city center distance									
city center distance squared									
time * city center distance squared									
city limit distance									
time* city limit distance									
block 1	0.0000		.	0.0000		.	0.0000		.
block 2	0.2479	*	0.000	0.2488	*	0.000	0.2488	*	0.000
block 3	0.0968	*	0.017	0.0807	*	0.044	0.0807	*	0.000
block 4	-0.0757	*	0.036	-0.0859	*	0.014	-0.0859	*	0.000
block 5	0.1719	*	0.000	0.1722	*	0.000	0.1722	*	0.000
block 6	-0.2984	*	0.000	-0.2512	*	0.000	-0.2512	*	0.000
block 7	-0.1545	*	0.000	-0.2083	*	0.000	-0.2083	*	0.000
block 8	0.0488		0.223	0.0570		0.130	0.0570	*	0.000
block 9	0.2796	*	0.000	0.2799	*	0.000	0.2799	*	0.000
block 10	0.1117	*	0.018	0.1202	*	0.005	0.1202	*	0.000
block 11	-0.2804	*	0.000	-0.2550	*	0.000	-0.2550	*	0.000
block 12	0.1947	*	0.000	0.1957	*	0.000	0.1957	*	0.000

	Newberg: Model III (continued)					
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
block 13	0.4663	*	0.000	0.4529	*	0.000	0.4529	*	0.000
block 14	0.5511	*	0.000	0.5476	*	0.000	0.5476	*	0.000
block 15	-0.0607		0.133	-0.0558		0.148	-0.0558	*	0.000
time * block 1	0.0029		0.963	0.0008		0.989	0.0008		0.947
time * block 2	0.0464		0.453	0.0503		0.388	0.0503	*	0.000
time * block 3	-0.2136	*	0.001	-0.2229	*	0.000	-0.2229	*	0.000
time * block 4	0.0397		0.514	0.0399		0.492	0.0399	*	0.001
time * block 5	0.0523		0.401	0.0395		0.492	0.0395	*	0.000
time * block 6	-0.2644	*	0.000	-0.2328	*	0.000	-0.2328	*	0.000
time * block 7	-0.3921	*	0.000	-0.2335	*	0.000	-0.2335	*	0.000
time * block 8	0.0023		0.971	-0.0129		0.823	-0.0129	*	0.005
time * block 9	-0.1437	*	0.042	-0.1486	*	0.024	-0.1486	*	0.000
time * block 10	-0.2455	*	0.001	-0.2395	*	0.000	-0.2395	*	0.000
time * block 11	-0.0063		0.912	-0.1134	*	0.022	-0.1134	*	0.000
time * block 12	-0.0923		0.152	-0.0967		0.103	-0.0967	*	0.000
time * block 13	-0.1621	*	0.008	-0.1591	*	0.005	-0.1591	*	0.000
time * block 14	-0.2129	*	0.000	-0.2126	*	0.000	-0.2126	*	0.000
time * block 15 (base)	0.0000		.	0.0000		.	0.0000		.

	Newberg: Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 7596	number of negative weights: 795								
constant	1.4644	*	0.000	1.6464	*	0.000	1.6464	*	0.014
time	-1.1710	*	0.000	-0.1980		0.237	-0.1980		0.691
group	-0.0732	*	0.000	-0.0206		0.203	-0.0206		0.646
interaction	**-0.0944**	*	**0.000**	**0.0447**		**0.056**	**0.0447**		**0.481**
1b.soil	0.0000		.	0.0000		.	0.0000		.
2.soil	0.0079		0.643	-0.0280	*	0.044	-0.0280		0.524
3.soil	0.0481	*	0.004	-0.0504	*	0.006	-0.0504		0.416
4.soil	-0.1118		0.071	-0.1456	*	0.015	-0.1456		0.339
slope	-0.0312	*	0.000	-0.0026		0.272	-0.0026		0.790
elevation	0.0114	*	0.000	0.0072	*	0.000	0.0072	*	0.035
highway distance	-0.0002	*	0.000	-0.0001	*	0.000	-0.0001		0.414
time*highway distance	-0.0002	*	0.000	-0.0002	*	0.000	-0.0002		0.063
city center distance	-0.0009	*	0.000	-0.0009	*	0.000	-0.0009	*	0.011
time*city center distance	0.0014	*	0.000	0.0003	*	0.001	0.0003		0.366
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000		0.071
time * city center distance squared	0.0000	*	0.000	0.0000	*	0.009	0.0000		0.529
city limit distance	0.0000		0.483	0.0000		0.125	0.0000		0.627
time* city limit distance	0.0000	*	0.000	0.0000		0.215	0.0000		0.289
block 1	0.0000		.	0.0000		.	0.0000		.
block 2	-0.0181		0.730	0.0786		0.090	0.0786		0.476
block 3	-0.0429		0.426	-0.0333		0.426	-0.0333		0.818
block 4	0.0197		0.758	-0.0193		0.703	-0.0193		0.881
block 5	0.2015	*	0.002	0.2455	*	0.000	0.2455		0.060
block 6	-0.0201		0.745	-0.0392		0.429	-0.0392		0.789
block 7	-0.0602		0.255	-0.0760		0.070	-0.0760		0.525
block 8	0.0485		0.377	0.0378		0.408	0.0378		0.691
block 9	0.4078	*	0.000	0.3065	*	0.000	0.3065	*	0.020
block 10	0.1833	*	0.036	0.0265		0.698	0.0265		0.914
block 11	0.0050		0.952	-0.2857	*	0.000	-0.2857		0.222
block 12	-0.4095	*	0.000	-0.4471	*	0.000	-0.4471		0.096

	Newberg: Model IV (continued)								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
block 13	-0.2436	*	0.009	-0.2588	*	0.001	-0.2588		0.323
block 14	-0.0206		0.799	0.0213		0.735	0.0213		0.910
block 15	-0.2517	*	0.000	-0.2294	*	0.000	-0.2294	*	0.019
time * block 1	-0.0330		0.659	-0.0622		0.296	-0.0622		0.529
time * block 2	-0.0034		0.970	-0.0947		0.202	-0.0947		0.490
time * block 3	-0.0303		0.703	-0.1942	*	0.003	-0.1942		0.097
time * block 4	0.4286	*	0.000	0.0039		0.966	0.0039		0.982
time * block 5	0.2237	*	0.035	-0.1556		0.076	-0.1556		0.183
time * block 6	0.2470	*	0.025	-0.3153	*	0.001	-0.3153		0.123
time * block 7	0.0074		0.927	-0.3022	*	0.000	-0.3022	*	0.000
time * block 8	0.0572		0.497	-0.1656	*	0.015	-0.1656	*	0.011
time * block 9	0.0162		0.860	-0.2277	*	0.003	-0.2277	*	0.000
time * block 10	0.3038	*	0.004	-0.0942		0.270	-0.0942		0.365
time * block 11	0.3787	*	0.000	-0.0279		0.731	-0.0279		0.770
time * block 12	0.8960	*	0.000	-0.0154		0.875	-0.0154		0.908
time * block 13	0.7966	*	0.000	-0.1432		0.157	-0.1432		0.335
time * block 14	-0.2257	*	0.025	-0.2163	*	0.005	-0.2163	*	0.029
time * block 15 (base)	0.0000		.	0.0000		.	0.0000		.

Appendix 2.2.o: Sheridan

	Sheridan: Model I								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3418	number of negative weights: 0								
constant	0.0310	*	0.000	0.0000		.	0.0000		1.000
time	0.0000	.		0.0310	*	0.000	0.0310		0.213
group	0.0252	*	0.010	0.0563	*	0.000	0.0563		0.158
interaction	**0.3433**	*	**0.000**	**0.3123**	*	**0.000**	**0.3123**	*	**0.009**

	Sheridan: Model II								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3418	number of negative weights: 1097								
constant	0.4481	*	0.000	0.4877	*	0.000	0.4877		0.109
time	0.7297	*	0.000	0.6273	*	0.000	0.6273		0.117
group	0.0049		0.498	0.0143	*	0.003	0.0143		0.384
interaction	**0.2428**	*	**0.000**	**0.2128**	*	**0.000**	**0.2128**		**0.063**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	0.0076		0.278	-0.0008		0.954	-0.0008		0.987
3.soil	-0.0388	*	0.000	-0.0412	*	0.025	-0.0412		0.510
4.soil	-0.0704	*	0.000	-0.0740	*	0.001	-0.0740		0.292
slope	-0.0119	*	0.000	-0.0118	*	0.000	-0.0118		0.121
elevation	0.0019	*	0.000	0.0018	*	0.000	0.0018	*	0.027
highway distance	-0.0001	*	0.000	-0.0001	*	0.000	-0.0001		0.173
time*highway distance	-0.0002	*	0.000	-0.0002	*	0.000	-0.0002	*	0.031
city center distance	-0.0007	*	0.000	-0.0008	*	0.000	-0.0008		0.110
time*city center distance	-0.0007	*	0.000	-0.0006	*	0.000	-0.0006		0.265
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000		0.135
time * city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000		0.262
city limit distance	0.0001	*	0.000	0.0001	*	0.000	0.0001		0.178
time* city limit distance	0.0000	*	0.003	0.0000		0.350	0.0000		0.751

	Sheridan: Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3418	number of negative weights: 964								
constant	-0.1088	*	0.000	-0.0266	*	0.000	-0.0266		0.202
time	0.1328	*	0.000	0.1920	*	0.000	0.1920	*	0.023
group	0.1088	*	0.000	0.0523	*	0.000	0.0523		0.202
interaction	**0.3702**	*	**0.000**	**0.2874**	*	**0.000**	**0.2874**	*	**0.017**
1b.soil									
2.soil									
3.soil									
4.soil									
slope									
elevation									
highway distance									
time*highway distance									
city center distance									
time*city center distance									
city center distance squared									
time * city center distance squared									
city limit distance									
time* city limit distance									
block 1 (base)	0.0000	.		0.0000	.		0.0000	.	
block 2	0.0417	*	0.021	0.0219	*	0.009	0.0219	*	0.000
block 3	0.1528	*	0.000	0.1109	*	0.000	0.1109	*	0.000
block 4	0.0000		1.000	0.0021		0.350	0.0021		0.202
block 5	0.0000		1.000	0.0037		0.089	0.0037		0.202
block 6	0.0952	*	0.000	0.0393	*	0.003	0.0393	*	0.003
time * block 1	-0.4524	*	0.000	-0.3126	*	0.000	-0.3126	*	0.000
time * block 2	-0.0567		0.087	-0.1497	*	0.000	-0.1497	*	0.001
time * block 3	-0.0153		0.659	-0.0275		0.539	-0.0275		0.170
time * block 4	-0.0190		0.562	-0.0906	*	0.023	-0.0906	*	0.007
time * block 5	-0.3884	*	0.000	-0.2678	*	0.000	-0.2678	*	0.000
time * block 6 (base)	0.0000	.		0.0000	.		0.0000	.	

	Sheridan: Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 3418	number of negative weights: 1157								
constant	0.2881	*	0.000	0.3360	*	0.000	0.3360		0.146
time	0.8699	*	0.000	0.7253	*	0.000	0.7253		0.077
group	-0.0322	*	0.000	-0.0279	*	0.000	-0.0279		0.128
interaction	**0.1968**	*	**0.000**	**0.1701**	*	**0.000**	**0.1701**	*	**0.021**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	-0.0280	*	0.001	-0.0271		0.053	-0.0271		0.486
3.soil	-0.0302	*	0.002	-0.0289		0.098	-0.0289		0.438
4.soil	-0.0670	*	0.000	-0.0750	*	0.001	-0.0750		0.100
slope	-0.0154	*	0.000	-0.0139	*	0.000	-0.0139	*	0.046
elevation	-0.0001		0.462	-0.0002		0.360	-0.0002		0.850
highway distance	0.0002	*	0.000	0.0002	*	0.000	0.0002		0.085
time*highway distance	0.0002	*	0.000	0.0002	*	0.000	0.0002		0.308
city center distance	-0.0005	*	0.000	-0.0006	*	0.000	-0.0006		0.163
time*city center distance	-0.0008	*	0.000	-0.0006	*	0.000	-0.0006		0.268
city center distance squared	0.0000	*	0.000	0.0000	*	0.001	0.0000		0.499
time * city center distance squared	0.0000	*	0.000	0.0000	*	0.014	0.0000		0.634
city limit distance	0.0001	*	0.000	0.0001	*	0.000	0.0001		0.447
time* city limit distance	-0.0002	*	0.000	-0.0002	*	0.000	-0.0002		0.371
block 1 (base)	0.0000	.		0.0000	.		0.0000	.	
block 2	0.0797	*	0.000	0.0781	*	0.000	0.0781		0.065
block 3	0.2642	*	0.000	0.2733	*	0.000	0.2733	*	0.011
block 4	0.3030	*	0.000	0.3003	*	0.000	0.3003	*	0.040
block 5	0.3375	*	0.000	0.3291	*	0.000	0.3291		0.138
block 6	0.2332	*	0.000	0.2389	*	0.000	0.2389		0.091
time * block 1	-0.3965	*	0.000	-0.3167	*	0.000	-0.3167		0.183
time * block 2	-0.0745		0.117	-0.0803		0.259	-0.0803		0.750
time * block 3	0.0809	*	0.009	0.1067	*	0.040	0.1067		0.527
time * block 4	0.1442	*	0.000	0.1759	*	0.000	0.1759		0.056
time * block 5	-0.1382	*	0.000	-0.1395	*	0.003	-0.1395		0.404
time * block 6 (base)	0.0000	.		0.0000	.		0.0000	.	

Appendix 2.2.p: Stayton/Sublimity

	Stayton/Sublimity: Model I					
	aweight		robust		cluster robust	
	coefficient	p-value	coefficient	p-value	coefficient	p-value
observations: 5022	number of negative weights: 0					
constant	0.0420 *	0.000	0.0420 *	0.000	0.0420 *	0.040
time	0.0069	0.427	0.0069	0.427	0.0069	0.178
group	0.1038 *	0.000	0.1038 *	0.000	0.1038	0.077
interaction	**0.1211** *	**0.000**	**0.1211** *	**0.000**	**0.1211** *	**0.016**

	Stayton/Sublimity: Model II					
	aweight		robust		cluster robust	
	coefficient	p-value	coefficient	p-value	coefficient	p-value
observations: 5022	number of negative weights: 827					
constant	0.8442 *	0.000	0.4247 *	0.000	0.4247	0.281
time	-0.4275 *	0.000	-0.0813	0.382	-0.0813	0.663
group	0.0039	0.691	0.0730 *	0.000	0.0730	0.234
interaction	**0.1391** *	**0.000**	**0.1138** *	**0.000**	**0.1138**	**0.059**
1b.soil	0.0000	.	0.0000	.	0.0000	.
2.soil	-0.0036	0.592	-0.0499 *	0.000	-0.0499	0.132
3.soil	-0.1366 *	0.000	-0.0499 *	0.003	-0.0499	0.612
4.soil	-0.1949 *	0.000	-0.1001 *	0.000	-0.1001	0.076
slope	-0.0002	0.927	0.0024	0.281	0.0024	0.712
elevation	0.0008	0.068	0.0015 *	0.014	0.0015	0.571
highway distance	0.0000 *	0.002	0.0001 *	0.000	0.0001	0.253
time*highway distance	0.0000 *	0.022	0.0000	0.114	0.0000	0.691
city center distance	-0.0007 *	0.000	-0.0006 *	0.000	-0.0006 *	0.001
time*city center distance	0.0004 *	0.000	0.0002	0.073	0.0002	0.366
city center distance squared	0.0000 *	0.000	0.0000 *	0.000	0.0000 *	0.006
time * city center distance squared	0.0000 *	0.000	0.0000 *	0.034	0.0000	0.275
city limit distance	0.0000	0.101	0.0000	0.116	0.0000	0.705
time* city limit distance	0.0000	0.786	0.0000 *	0.019	0.0000	0.491

	Stayton/Sublimity: Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 5022	number of negative weights: 1046								
constant	0.0923	*	0.000	0.0467		0.062	0.0467		0.291
time	-0.2011	*	0.000	-0.0399	*	0.004	-0.0399		0.071
group	0.1754	*	0.000	0.1194	*	0.000	0.1194		0.078
interaction	**0.2398**	*	**0.000**	**0.1277**	*	**0.000**	**0.1277**	*	**0.016**
1b.soil									
2.soil									
3.soil									
4.soil									
slope									
elevation									
highway distance									
time*highway distance									
city center distance									
time*city center distance									
city center distance squared									
time * city center distance squared									
city limit distance									
time* city limit distance									
block 1 (base)	0.0000	.		0.0000	.		0.0000	.	
block 2	-0.0776	*	0.000	0.0099		0.749	0.0099		0.298
block 3	-0.2677	*	0.000	-0.1120	*	0.000	-0.1120	*	0.000
block 4	-0.2677	*	0.000	-0.0936	*	0.000	-0.0936	*	0.000
block 5	-0.2677	*	0.000	-0.0829	*	0.001	-0.0829	*	0.000
block 6	-0.0914	*	0.000	-0.0170		0.614	-0.0170		0.196
block 7	0.1075	*	0.000	0.1920	*	0.000	0.1920	*	0.000
block 8	-0.1951	*	0.000	-0.0885	*	0.003	-0.0885	*	0.000
block 9	-0.0157		0.519	0.0644		0.054	0.0644	*	0.037
block 10	-0.0035		0.887	0.0942	*	0.004	0.0942	*	0.000
block 11	-0.2290	*	0.000	-0.0829	*	0.001	-0.0829	*	0.000
time * block 1	0.1873	*	0.000	0.1212	*	0.003	0.1212	*	0.000
time * block 2	0.1761	*	0.000	0.0530		0.116	0.0530	*	0.000
time * block 3	-0.0056		0.892	-0.0119		0.489	-0.0119	*	0.022
time * block 4	-0.0387		0.358	-0.0366		0.110	-0.0366	*	0.000
time * block 5	0.0409		0.395	0.0136		0.618	0.0136	*	0.010
time * block 6	0.2551	*	0.000	0.1695	*	0.000	0.1695	*	0.000
time * block 7	0.1001	*	0.044	-0.0231		0.603	-0.0231	*	0.000
time * block 8	-0.0306		0.474	-0.0669		0.053	-0.0669	*	0.007
time * block 9	0.1915	*	0.000	0.0579		0.097	0.0579	*	0.000
time * block 10	0.3182	*	0.000	0.2060	*	0.000	0.2060	*	0.000
time * block 11 (base)	0.0000	.		0.0000	.		0.0000	.	

	Stayton/Sublimity: Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 5022	number of negative weights: 1196								
constant	0.9395	*	0.000	0.9345	*	0.000	0.9345		0.085
time	-0.3573	*	0.008	0.0608		0.725	0.0608		0.803
group	-0.0522	*	0.000	0.0285		0.108	0.0285		0.626
interaction	**0.0995**	*	**0.000**	**0.0984**	*	**0.000**	**0.0984**		**0.052**
1b.soil	0.0000		.	0.0000		.	0.0000		.
2.soil	0.0186	*	0.012	-0.0385	*	0.001	-0.0385		0.242
3.soil	-0.0644	*	0.000	-0.0141		0.468	-0.0141		0.899
4.soil	-0.1482	*	0.000	-0.0113		0.719	-0.0113		0.800
slope	-0.0001		0.981	0.0074	*	0.003	0.0074		0.393
elevation	0.0015	*	0.005	0.0008		0.361	0.0008		0.792
highway distance	-0.0002	*	0.000	-0.0002	*	0.000	-0.0002		0.270
time*highway distance	-0.0004	*	0.000	-0.0002	*	0.000	-0.0002		0.110
city center distance	-0.0010	*	0.000	-0.0009	*	0.000	-0.0009	*	0.003
time*city center distance	0.0006	*	0.000	0.0002		0.108	0.0002		0.369
city center distance squared	0.0000	*	0.000	0.0000	*	0.000	0.0000	*	0.016
time * city center distance squared	0.0000	*	0.000	0.0000		0.062	0.0000		0.245
city limit distance	0.0003	*	0.000	0.0002	*	0.000	0.0002		0.179
time* city limit distance	0.0003	*	0.000	0.0000		0.354	0.0000		0.641
block 1 (base)	0.0000		.	0.0000		.	0.0000		.
block 2	0.0391		0.106	0.0966	*	0.003	0.0966	*	0.007
block 3	-0.1458	*	0.000	-0.0789		0.055	-0.0789		0.428
block 4	-0.2140	*	0.000	-0.2044	*	0.000	-0.2044		0.323
block 5	-0.0820	*	0.047	-0.0584		0.167	-0.0584		0.694
block 6	-0.1709	*	0.000	-0.1681	*	0.000	-0.1681		0.197
block 7	0.0541		0.232	-0.0188		0.759	-0.0188		0.915
block 8	-0.0063		0.892	-0.0384		0.520	-0.0384		0.837
block 9	0.3140	*	0.000	0.3155	*	0.000	0.3155		0.125
block 10	0.3893	*	0.000	0.4070	*	0.000	0.4070	*	0.045
block 11	0.3720	*	0.000	0.3548	*	0.000	0.3548		0.067
time * block 1	-0.0909		0.190	-0.1223		0.119	-0.1223		0.404
time * block 2	-0.1694	*	0.010	-0.2102	*	0.009	-0.2102		0.171
time * block 3	-0.5507	*	0.000	-0.3093	*	0.001	-0.3093		0.104
time * block 4	-0.5542	*	0.000	-0.2860	*	0.006	-0.2860		0.231
time * block 5	-0.4698	*	0.000	-0.1770	*	0.047	-0.1770		0.219
time * block 6	-0.0824		0.282	0.1298		0.141	0.1298		0.306
time * block 7	0.2364	*	0.001	0.0978		0.290	0.0978		0.618
time * block 8	-0.0223		0.710	0.1089		0.161	0.1089		0.545
time * block 9	0.1688	*	0.003	0.2711	*	0.000	0.2711		0.209
time * block 10	0.3373	*	0.000	0.3372	*	0.000	0.3372	*	0.017
time * block 11 (base)	0.0000		.	0.0000		.	0.0000		.

Appendix 2.2.q: St. Helens

	Saint Helens: Model I								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 1084	number of negative weights: 0								
constant	0.1333	*	0.000	0.1333	*	0.000	0.1333		0.186
time	0.0633	*	0.037	0.0633	*	0.037	0.0633		0.339
group	0.3501	*	0.000	0.3501	*	0.000	0.3501		0.175
interaction	**-0.0137**		**0.801**	**-0.0137**		**0.801**	**-0.0137**		**0.538**

	Saint Helens: Model II								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 1084	number of negative weights: 93								
constant	9.0996	*	0.007	8.0352	*	0.006	8.0352		0.410
time	0.3646		0.931	-2.6955		0.485	-2.6955		0.731
group	0.3075	*	0.000	0.2818	*	0.000	0.2818		0.360
interaction	**0.1061**		**0.234**	**-0.0288**		**0.733**	**-0.0288**		**0.764**
1b.soil	0.0000	.		0.0000	.		0.0000	.	
2.soil	-0.1530	*	0.000	-0.0565		0.094	-0.0565		0.691
3.soil	-0.4098	*	0.000	-0.2981	*	0.000	-0.2981	*	0.040
slope	0.0198		0.145	-0.0142		0.295	-0.0142		0.849
elevation	0.0300	*	0.000	0.0206	*	0.000	0.0206	*	0.004
highway distance	-0.0001		0.783	0.0001		0.407	0.0001		0.813
time*highway distance	0.0006	*	0.021	-0.0001		0.565	-0.0001		0.765
city center distance	-0.0047	*	0.005	-0.0040	*	0.006	-0.0040		0.407
time*city center distance	-0.0005		0.821	0.0014		0.459	0.0014		0.726
city center distance squared	0.0000		0.372	0.0000		0.685	0.0000		0.779
time * city center distance squared	0.0000		0.466	0.0000		0.451	0.0000		0.659
city limit distance	0.0036	*	0.000	0.0034	*	0.000	0.0034		0.289
time* city limit distance	0.0017		0.110	-0.0003		0.703	-0.0003		0.847

	Saint Helens: Model III								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 1084	number of negative weights: 0								
constant	0.0742	*	0.000	0.0296		0.264	0.0296		0.671
time	0.0946	*	0.035	0.0884	*	0.025	0.0884	*	0.045
group	0.3524	*	0.000	0.3767	*	0.000	0.3767		0.163
interaction	**0.0034**		**0.952**	**-0.0041**		**0.937**	**-0.0041**		**0.846**
1b.soil									
2.soil									
3.soil									
slope									
elevation									
highway distance									
time*highway distance									
city center distance									
time*city center distance									
city center distance squared									
time * city center distance squared									
city limit distance									
time* city limit distance									
block 1 (base)	0.0000		.	0.0000		.	0.0000		.
block 2	0.1265	*	0.000	0.1729	*	0.000	0.1729		0.055
time * block 1	-0.0819		0.099	-0.0626		0.217	-0.0626	*	0.026
time * block 2 (base)	0.0000		.	0.0000		.	0.0000		.

	Saint Helens: Model IV								
	aweight			robust			cluster robust		
	coefficient		p-value	coefficient		p-value	coefficient		p-value
observations: 1084	number of negative weights: 95								
constant	9.0217	*	0.004	7.5908	*	0.010	7.5908		0.484
time	-0.6174		0.872	-2.6386		0.486	-2.6386		0.552
group	0.3428	*	0.000	0.2823	*	0.000	0.2823		0.367
interaction	**-0.0475**		**0.568**	**-0.0424**		**0.619**	**-0.0424**		**0.603**
1b.soil	0.0000		.	0.0000		.	0.0000		.
2.soil	-0.1478	*	0.000	-0.0752	*	0.032	-0.0752		0.680
3.soil	-0.3571	*	0.000	-0.2972	*	0.000	-0.2972	*	0.000
slope	-0.0197		0.123	-0.0184		0.178	-0.0184		0.807
elevation	0.0288	*	0.000	0.0199	*	0.000	0.0199		0.153
highway distance	0.0000		0.883	0.0001		0.357	0.0001		0.795
time*highway distance	0.0001		0.595	-0.0001		0.738	-0.0001		0.770
city center distance	-0.0047	*	0.003	-0.0038	*	0.010	-0.0038		0.488
time*city center distance	0.0005		0.789	0.0015		0.427	0.0015		0.524
city center distance squared	0.0000		0.321	0.0000		0.695	0.0000		0.719
time * city center distance squared	0.0000		0.560	0.0000		0.509	0.0000		0.487
city limit distance	0.0036	*	0.000	0.0031	*	0.000	0.0031		0.447
time* city limit distance	0.0001		0.898	-0.0006		0.437	-0.0006		0.534
block 1 (base)	0.0000		.	0.0000		.	0.0000		.
block 2	-0.0054		0.937	0.0679		0.379	0.0679		0.766
time * block 1	-0.1708		0.085	-0.1648		0.131	-0.1648	*	0.012
time * block 2 (base)	0.0000		.	0.0000		.	0.0000		.

Appendix 4.1: development in agricultural lands

Appendix 4.1.a Analysis of development on agricultural lands

Results: Agricultural Lands								
						ATE		
	constant	**agriculture**	**county**	**county * agriculture**	**time**	**time * agriculture**	**time * county**	**time * county * agriculture**
Variation 1								
All Counties	0.7343 *	-0.7343 *	-0.6623 *	0.6623 *	0.0338 *	0.2471 *	-0.0291 *	-0.2358 *
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.013)*	*(0.000)*	*(0.033)*	*(0.000)*
Variation 2: land use by county								
Benton	0.7343 *	-0.7343 *	-0.6709 *	0.6709 *	0.0338 *	0.1618 *	-0.0305 *	-0.1593 *
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.013)*	*(0.000)*	*(0.024)*	*(0.000)*
Clackamas	0.7343 *	-0.7343 *	-0.5869 *	0.5869 *	0.0338 *	0.2937 *	-0.0105	-0.2770 *
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.013)*	*(0.015)*	*(0.420)*	*(0.022)*
Columbia	0.7343 *	-0.7343 *	-0.3163 *	0.3163 *	0.0338 *	0.0698	-0.0260	0.0095
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.013)*	*(0.154)*	*(0.051)*	*(0.843)*
Lane	0.7343 *	-0.7343 *	-0.7055 *	0.7055 *	0.0338 *	0.4618 *	-0.0331 *	-0.4607 *
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.013)*	*(0.000)*	*(0.015)*	*(0.000)*
Linn	0.7343 *	-0.7343 *	-0.7006 *	0.7006 *	0.0338 *	0.1383 *	-0.0333 *	-0.1354 *
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.013)*	*(0.000)*	*(0.014)*	*(0.000)*
Marion	0.7343 *	-0.7343 *	-0.3947 *	0.3947 *	0.0338 *	0.1702 *	-0.0309 *	-0.1661 *
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.013)*	*(0.000)*	*(0.022)*	*(0.000)*
Multnomah	0.7343 *	-0.7343 *	-0.6759 *	0.6759 *	0.0338 *	0.3812 *	0.1078 *	-0.1944 *
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.013)*	*(0.000)*	*(0.000)*	*(0.000)*
Polk	0.7343 *	-0.7343 *	-0.7155 *	0.7155 *	0.0338 *	0.1212 *	-0.0332 *	-0.1159 *
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.013)*	*(0.000)*	*(0.015)*	*(0.000)*
Washington	0.7343 *	-0.7343 *	-0.6783 *	0.6783 *	0.0338 *	0.5423 *	-0.0272 *	-0.3938 *
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.013)*	*(0.000)*	*(0.043)*	*(0.000)*
Yamhill	0.7343 *	-0.7343 *	-0.5977 *	0.5977 *	0.0338 *	0.2615 *	-0.0281 *	-0.2482 *
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.013)*	*(0.000)*	*(0.036)*	*(0.000)*

* represents a p-value of 0.05 or below
The italicized numbers in brackets are p-values

Appendix 4.1.b Predicted probability of development on agricultural lands

Results: Agricultural Lands												
	time=0				time=1				Δ time			
	agricultural land outside UGB	agricultural land inside UGB	other land outside UGB	other land inside UGB	agricultural land outside UGB	agricultural land inside UGB	other land outside UGB	other land inside UGB	agricultural land outside UGB	agricultural land inside UGB	other land outside UGB	other land inside UGB
Variation 1												
All Counties	0.0000	0.0000	0.0719	0.7343	0.0160	0.2809	0.0766	0.7681	0.0160	0.2809	0.0047	0.0338
Variation 2: land use by county												
Benton	0.0000	0.0000	0.0634	0.7343	0.0059	0.1956	0.0667	0.7681	0.0059	0.1956	0.0033	0.0338
Clackamas	0.0000	0.0000	0.1474	0.7343	0.0399	0.3275	0.1707	0.7681	0.0399	0.3275	0.0233	0.0338
Columbia	0.0000	0.0000	0.4180	0.7343	0.0871	0.1036	0.4257	0.7681	0.0871	0.1036	0.0077	0.0338
Lane	0.0000	0.0000	0.0288	0.7343	0.0019	0.4956	0.0295	0.7681	0.0019	0.4956	0.0007	0.0338
Linn	0.0000	0.0000	0.0337	0.7343	0.0034	0.1721	0.0342	0.7681	0.0034	0.1721	0.0005	0.0338
Marion	0.0000	0.0000	0.3396	0.7343	0.0070	0.2040	0.3425	0.7681	0.0070	0.2040	0.0029	0.0338
Multnomah	0.0000	0.0000	0.0584	0.7343	0.3284	0.4149	0.2000	0.7681	0.3284	0.4149	0.1416	0.0338
Polk	0.0000	0.0000	0.0188	0.7343	0.0059	0.1550	0.0194	0.7681	0.0059	0.1550	0.0006	0.0338
Washington	0.0000	0.0000	0.0560	0.7343	0.1552	0.5761	0.0627	0.7681	0.1552	0.5761	0.0066	0.0338
Yamhill	0.0000	0.0000	0.1366	0.7343	0.0190	0.2953	0.1422	0.7681	0.0190	0.2953	0.0057	0.0338

* represents a p-value of 0.05 or below
The italicized numbers in brackets are p-values

Appendix 4.2: development in riparian corridors

Appendix 4.2a Analysis of development in riparian corridors

Results: Riparian Lands. Dependant Variable: Developed								
						ATE		
DEVELOPED	constant	riparian	UGB	UGB * riparian	time	time * riparian	time * UGB	time * riparian * UGB
Variation 1								
all riparian corridors	0.0308 *	-0.0025	0.4930 *	-0.2396 *	0.0117 *	**-0.0047**	**0.0987** *	**-0.0271**
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.000)***	***(0.115)***
Variation 2: land use by city								
Brownsville	0.0308 *	-0.0025	0.4154 *	-0.1055 *	0.0117 *	**-0.0047**	**-0.0117** *	**0.0047**
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.011)***	***(0.107)***
Carlton	0.0308 *	-0.0025	0.5073 *	-0.3226 *	0.0117 *	**-0.0047**	**-0.0003**	**0.0303** *
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.950)***	***(0.000)***
Corvallis	0.0308 *	-0.0025	0.2859 *	-0.1412 *	0.0117 *	**-0.0047**	**0.0855** *	**-0.0448** *
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.000)***	***(0.000)***
Dallas	0.0308 *	-0.0025	0.4877 *	-0.1831 *	0.0117 *	**-0.0047**	**0.0572** *	**-0.0045**
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.000)***	***(0.118)***
Dayton	0.0308 *	-0.0025	0.3980 *	-0.3530 *	0.0117 *	**-0.0047**	**0.0833** *	**-0.0793** *
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.000)***	***(0.000)***
Dundee	0.0308 *	-0.0025	0.5438 *	-0.5721 *	0.0117 *	**-0.0047**	**0.0598** *	**-0.0668** *
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.000)***	***(0.000)***
Estacada	0.0308 *	-0.0025	0.2625 *	-0.0891 *	0.0117 *	**-0.0047**	**-0.0067**	**0.0047**
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.132)***	***(0.105)***
Harrisburg	0.0308 *	-0.0025	0.7111 *	-0.5680 *	0.0117 *	**-0.0047**	**0.0897** *	**-0.0109** *
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.000)***	***(0.000)***
Lafayette	0.0308 *	-0.0025	0.3516 *	-0.3023 *	0.0117 *	**-0.0047**	**0.1766** *	**-0.1663** *
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.000)***	***(0.000)***
Lebanon	0.0308 *	-0.0025	0.4337 *	-0.0543 *	0.0117 *	**-0.0047**	**0.0551** *	**0.0418** *
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.000)***	***(0.000)***
Lowell	0.0308 *	-0.0025	0.3030 *	-0.3312 *	0.0117 *	**-0.0047**	**0.1260** *	**-0.1329** *
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.000)***	***(0.000)***
McMinnville	0.0308 *	-0.0025	0.3469 *	-0.3105 *	0.0117 *	**-0.0047**	**0.1755** *	**-0.1587** *
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.000)***	***(0.000)***
Metro	0.0308 *	-0.0025	0.5583 *	-0.2829 *	0.0117 *	**-0.0047**	**0.1100** *	**0.0117** *
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.000)***	***(0.000)***
Newberg	0.0308 *	-0.0025	0.5730 *	-0.2327 *	0.0117 *	**-0.0047**	**0.1031** *	**-0.0898** *
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.000)***	***(0.000)***
Philomath	0.0308 *	-0.0025	0.3980 *	-0.1584 *	0.0117 *	**-0.0047**	**0.1166** *	**-0.0566** *
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.000)***	***(0.000)***
Scappoose	0.0308 *	-0.0025	0.6578 *	-0.3322 *	0.0117 *	**-0.0047**	**-0.0117** *	**0.0047**
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.011)***	***(0.107)***
Sheridan	0.0308 *	-0.0025	0.1872 *	0.1477 *	0.0117 *	**-0.0047**	**0.2684** *	**-0.1332** *
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.000)***	***(0.000)***
Saint Helens	0.0308 *	-0.0025	0.4071 *	-0.3857 *	0.0117 *	**-0.0047**	**0.0416** *	**-0.0154** *
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.000)***	***(0.000)***
Stayton	0.0308 *	-0.0025	0.3790 *	-0.1840 *	0.0117 *	**-0.0047**	**0.0895** *	**-0.0603** *
	(0.000)	*(0.466)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.107)***	***(0.000)***	***(0.000)***

* represents a p-value of 0.05 or below
The italicized numbers in brackets are p-values

Appendix 4.2a Analysis of development in riparian corridors

Results: Riparian Lands. Dependant Variable: Developed								
						ATE		
DEVELOPED	**constant**	**riparian**	**UGB**	**UGB * riparian**	**time**	**time * riparian**	**time * UGB**	**time * riparian * UGB**
Variation 3: land use by county								
Benton	0.0308 *	0.0110	0.4930 *	-0.3018 *	0.0117 *	**-0.0100** *	**0.0987** *	**-0.0404** *
	(0.000)	*(0.156)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.026)***	***(0.000)***	***(0.001)***
Clackamas	0.0308 *	0.0119	0.4930 *	-0.2660 *	0.0117 *	**0.0014**	**0.0987** *	**-0.0425** *
	(0.000)	*(0.125)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.753)***	***(0.000)***	***(0.010)***
Columbia	0.0308 *	0.0397 *	0.4930 *	-0.3629 *	0.0117 *	**0.0048**	**0.0987** *	**-0.0984** *
	(0.000)	*(0.000)*	*(0.000)*	*(0.003)*	*(0.011)*	***(0.273)***	***(0.000)***	***(0.000)***
Lane	0.0308 *	0.0005	0.4930 *	-0.5242 *	0.0117 *	**-0.0111** *	**0.0987** *	**-0.0992** *
	(0.000)	*(0.951)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.014)***	***(0.000)***	***(0.000)***
Linn	0.0308 *	-0.0232 *	0.4930 *	-0.1167 *	0.0117 *	**-0.0083**	**0.0987** *	**-0.0155**
	(0.000)	*(0.005)*	*(0.000)*	*(0.019)*	*(0.011)*	***(0.063)***	***(0.000)***	***(0.501)***
Marion	0.0308 *	0.0005	0.4930 *	-0.3007 *	0.0117 *	**-0.0084**	**0.0987** *	**-0.0658** *
	(0.000)	*(0.948)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.060)***	***(0.000)***	***(0.000)***
Multnomah	0.0308 *	-0.0308 *	0.4930 *	-0.1469 *	0.0117 *	**0.1864** *	**0.0987** *	**-0.1147** *
	(0.000)	*(0.000)*	*(0.000)*	*(0.001)*	*(0.011)*	***(0.000)***	***(0.000)***	***(0.000)***
Polk	0.0308 *	-0.0213 *	0.4930 *	-0.1696 *	0.0117 *	**-0.0079**	**0.0987** *	**-0.0427** *
	(0.000)	*(0.008)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.075)***	***(0.000)***	***(0.000)***
Washington	0.0308 *	0.0387 *	0.4930 *	-0.4887 *	0.0117 *	**0.0040**	**0.0987** *	**0.0668** *
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.355)***	***(0.000)***	***(0.000)***
Yamhill	0.0308 *	0.0088	0.4930 *	-0.2969 *	0.0117 *	**0.0006**	**0.0987** *	**-0.0778** *
	(0.000)	*(0.252)*	*(0.000)*	*(0.000)*	*(0.011)*	***(0.890)***	***(0.000)***	***(0.000)***

* represents a p-value of 0.05 or below
The italicized numbers in brackets are p-values

Appendix 4.2a Analysis of development in riparian corridors

Results: Riparian Lands. Dependant Variable: Developed								
						ATE		
DEVELOPED	constant	riparian	UGB	UGB * riparian	time	time * riparian	time * UGB	time * riparian * UGB
Variation 4: land use by city and by county								
Brownsville (Linn county)	0.0308 *	-0.0232 *	0.4154 *	-0.0848 *	0.0117 *	-0.0083	-0.0117 *	0.0083
	(0.000)	(0.005)	(0.000)	(0.000)	(0.011)	(0.063)	(0.011)	(0.063)
Carlton (Yamhill county)	0.0308 *	0.0088	0.5073 *	-0.3339 *	0.0117 *	0.0006	-0.0003	0.0250 *
	(0.000)	(0.252)	(0.000)	(0.000)	(0.011)	(0.890)	(0.950)	(0.000)
Corvallis (Benton county)	0.0308 *	0.0110	0.2859 *	-0.1547 *	0.0117 *	-0.0100 *	0.0855 *	-0.0395 *
	(0.000)	(0.156)	(0.000)	(0.000)	(0.011)	(0.026)	(0.000)	(0.000)
Dallas (Polk county)	0.0308 *	-0.0213 *	0.4877 *	-0.1643 *	0.0117 *	-0.0079	0.0572 *	-0.0013
	(0.000)	(0.008)	(0.000)	(0.000)	(0.011)	(0.075)	(0.000)	(0.764)
Dayton (Yamhill county)	0.0308 *	0.0088	0.3980 *	-0.3644 *	0.0117 *	0.0006	0.0833 *	-0.0846 *
	(0.000)	(0.252)	(0.000)	(0.000)	(0.011)	(0.890)	(0.000)	(0.000)
Dundee (Yamhill county)	0.0308 *	0.0088	0.5438 *	-0.5834 *	0.0117 *	0.0006	0.0598 *	-0.0721 *
	(0.000)	(0.252)	(0.000)	(0.000)	(0.011)	(0.890)	(0.000)	(0.000)
Estacada (Clackamas county)	0.0308 *	0.0119	0.2625 *	-0.1035 *	0.0117 *	0.0014	-0.0067	-0.0013
	(0.000)	(0.125)	(0.000)	(0.000)	(0.011)	(0.753)	(0.132)	(0.758)
Harrisburg (Linn county)	0.0308 *	-0.0232 *	0.7111 *	-0.5473 *	0.0117 *	-0.0083	0.0897 *	-0.0073
	(0.000)	(0.005)	(0.000)	(0.000)	(0.011)	(0.063)	(0.000)	(0.098)
Lafayette (Yamhill county)	0.0308 *	0.0088	0.3516 *	-0.3136 *	0.0117 *	0.0006	0.1766 *	-0.1716 *
	(0.000)	(0.252)	(0.000)	(0.000)	(0.011)	(0.890)	(0.000)	(0.000)
Lebanon (Linn county)	0.0308 *	-0.0232 *	0.4337 *	-0.0336 *	0.0117 *	-0.0083	0.0551 *	0.0454 *
	(0.000)	(0.005)	(0.000)	(0.000)	(0.011)	(0.063)	(0.000)	(0.000)
Lowell (Lane county)	0.0308 *	0.0005	0.3030 *	-0.3342 *	0.0117 *	-0.0111 *	0.1260 *	-0.1265 *
	(0.000)	(0.951)	(0.000)	(0.000)	(0.011)	(0.014)	(0.000)	(0.000)
McMinnville (Yamhill county)	0.0308 *	0.0088	0.3469 *	-0.3218 *	0.0117 *	0.0006	0.1755 *	-0.1640 *
	(0.000)	(0.252)	(0.000)	(0.000)	(0.011)	(0.890)	(0.000)	(0.000)
Metro (Clackamas county)	0.0308 *	0.0119	0.5583 *	-0.3134 *	0.0117 *	0.0014	0.1100 *	-0.0370 *
	(0.000)	(0.125)	(0.000)	(0.000)	(0.011)	(0.753)	(0.000)	(0.000)
Metro (Multnomah county)	0.0308 *	-0.0308 *	0.5583 *	-0.2122 *	0.0117 *	0.1864 *	0.1100 *	-0.1260 *
	(0.000)	(0.000)	(0.000)	(0.000)	(0.011)	(0.000)	(0.000)	(0.000)
Metro (Washington county)	0.0308 *	0.0387 *	0.5583 *	-0.5540 *	0.0117 *	0.0040	0.1100 *	0.0555 *
	(0.000)	(0.000)	(0.000)	(0.000)	(0.011)	(0.355)	(0.000)	(0.000)
Newberg (Yamhill county)	0.0308 *	0.0088	0.5730 *	-0.2440 *	0.0117 *	0.0006	0.1031 *	-0.0950 *
	(0.000)	(0.252)	(0.000)	(0.000)	(0.011)	(0.890)	(0.000)	(0.000)
Philomath (Benton county)	0.0308 *	0.0110	0.3980 *	-0.1719 *	0.0117 *	-0.0100 *	0.1166 *	-0.0512 *
	(0.000)	(0.156)	(0.000)	(0.000)	(0.011)	(0.026)	(0.000)	(0.000)
Saint Helens (Columbia county	0.0308 *	-0.0232 *	0.4071 *	-0.4279 *	0.0117 *	0.0048	0.0416 *	-0.0249 *
	(0.000)	(0.005)	(0.000)	(0.000)	(0.011)	(0.273)	(0.000)	(0.000)
Scappoose (Columbia county)	0.0308 *	0.0397 *	0.6578 *	-0.3744 *	0.0117 *	0.0048	-0.0117 *	-0.0048
	(0.000)	(0.000)	(0.000)	(0.000)	(0.011)	(0.273)	(0.011)	(0.273)
Sheridan (Yamhill county)	0.0308 *	0.0088	0.1872 *	0.1364 *	0.0117 *	0.0006	0.2684 *	-0.1385 *
	(0.000)	(0.252)	(0.000)	(0.000)	(0.011)	(0.890)	(0.000)	(0.000)
Stayton (Linn county)	0.0308 *	-0.0232 *	0.3790 *	-0.3866 *	0.0117 *	-0.0083	0.0895 *	-0.0929 *
	(0.000)	(0.005)	(0.000)	(0.000)	(0.011)	(0.063)	(0.000)	(0.000)
Stayton (Marion county)	0.0308 *	0.0005	0.3790 *	-0.1867 *	0.0117 *	-0.0084	0.0895 *	-0.0566 *
	(0.000)	(0.948)	(0.000)	(0.000)	(0.011)	(0.060)	(0.000)	(0.000)

* represents a p-value of 0.05 or below
The italicized numbers in brackets are p-values

Appendix 4.2b Predicted probability of development in riparian corridors

Results: Riparian Lands. Dependant Variable: Developed												
	time=0				time=1				Δ time			
DEVELOPED	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB
Variation 1												
all riparian corridors	0.2817	0.0283	0.5238	0.0308	0.3602	0.0353	0.6341	0.0424	0.0786	0.0070	0.1103	0.0117
Variation 2: land use by city												
Brownsville	0.3382	0.0283	0.4462	0.0308	0.3382	0.0353	0.4462	0.0424	0.0000	0.0070	0.0000	0.0117
Carlton	0.2130	0.0283	0.5380	0.0308	0.2500	0.0353	0.5494	0.0424	0.0370	0.0070	0.0114	0.0117
Corvallis	0.1729	0.0283	0.3166	0.0308	0.2206	0.0353	0.4138	0.0424	0.0476	0.0070	0.0971	0.0117
Dallas	0.3329	0.0283	0.5185	0.0308	0.3926	0.0353	0.5874	0.0424	0.0597	0.0070	0.0689	0.0117
Dayton	0.0733	0.0283	0.4288	0.0308	0.0842	0.0353	0.5237	0.0424	0.0110	0.0070	0.0950	0.0117
Dundee	0.0000	0.0283	0.5745	0.0308	0.0000	0.0353	0.6461	0.0424	0.0000	0.0070	0.0715	0.0117
Estacada	0.2017	0.0283	0.2932	0.0308	0.2067	0.0353	0.2982	0.0424	0.0050	0.0070	0.0050	0.0117
Harrisburg	0.1714	0.0283	0.7419	0.0308	0.2571	0.0353	0.8432	0.0424	0.0857	0.0070	0.1014	0.0117
Lafayette	0.0776	0.0283	0.3824	0.0308	0.0948	0.0353	0.5706	0.0424	0.0172	0.0070	0.1882	0.0117
Lebanon	0.4077	0.0283	0.4645	0.0308	0.5115	0.0353	0.5313	0.0424	0.1038	0.0070	0.0668	0.0117
Lowell	0.0000	0.0283	0.3337	0.0308	0.0000	0.0353	0.4714	0.0424	0.0000	0.0070	0.1376	0.0117
McMinnville	0.0646	0.0283	0.3776	0.0308	0.0884	0.0353	0.5648	0.0424	0.0238	0.0070	0.1872	0.0117
Metro	0.3037	0.0283	0.5891	0.0308	0.4324	0.0353	0.7107	0.0424	0.1287	0.0070	0.1217	0.0117
Newberg	0.3686	0.0283	0.6037	0.0308	0.3889	0.0353	0.7185	0.0424	0.0203	0.0070	0.1148	0.0117
Philomath	0.2678	0.0283	0.4287	0.0308	0.3348	0.0353	0.5569	0.0424	0.0670	0.0070	0.1282	0.0117
Scappoose	0.3539	0.0283	0.6886	0.0308	0.3539	0.0353	0.6886	0.0424	0.0000	0.0070	0.0000	0.0117
Sheridan	0.3632	0.0283	0.2179	0.0308	0.5053	0.0353	0.4980	0.0424	0.1421	0.0070	0.2800	0.0117
Saint Helens	0.0497	0.0283	0.4379	0.0308	0.0829	0.0353	0.4911	0.0424	0.0331	0.0070	0.0533	0.0117
Stayton	0.2232	0.0283	0.4097	0.0308	0.2594	0.0353	0.5109	0.0424	0.0361	0.0070	0.1012	0.0117

* represents a p-value of 0.05 or below
The italicized numbers in brackets are p-values

Appendix 4.2b Predicted probability of development in riparian corridors

Results: Riparian Lands. Dependant Variable: Developed												
	time=0				time=1				Δ time			
DEVELOPED	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB
Variation 3: land use by county												
Benton	0.2330	0.0418	0.5238	0.0308	0.2928	0.0434	0.6341	0.0424	0.0599	0.0016	0.1103	0.0117
Clackamas	0.2697	0.0427	0.5238	0.0308	0.3389	0.0557	0.6341	0.0424	0.0692	0.0130	0.1103	0.0117
Columbia	0.2006	0.0705	0.5238	0.0308	0.2173	0.0870	0.6341	0.0424	0.0167	0.0165	0.1103	0.0117
Lane	0.0000	0.0312	0.5238	0.0308	0.0000	0.0318	0.6341	0.0424	0.0000	0.0005	0.1103	0.0117
Linn	0.3839	0.0076	0.5238	0.0308	0.4704	0.0110	0.6341	0.0424	0.0865	0.0034	0.1103	0.0117
Marion	0.2235	0.0313	0.5238	0.0308	0.2597	0.0345	0.6341	0.0424	0.0362	0.0033	0.1103	0.0117
Multnomah	0.3462	0.0000	0.5238	0.0308	0.5282	0.1981	0.6341	0.0424	0.1821	0.1981	0.1103	0.0117
Polk	0.3329	0.0095	0.5238	0.0308	0.3926	0.0133	0.6341	0.0424	0.0597	0.0038	0.1103	0.0117
Washington	0.0738	0.0695	0.5238	0.0308	0.2550	0.0852	0.6341	0.0424	0.1812	0.0157	0.1103	0.0117
Yamhill	0.2357	0.0396	0.5238	0.0308	0.2689	0.0519	0.6341	0.0424	0.0332	0.0123	0.1103	0.0117

* represents a p-value of 0.05 or below
The italicized numbers in brackets are p-values

Appendix 4.2b Predicted probability of development in riparian corridors

Results: Riparian Lands. Dependant Variable: Developed												
	time=0				time=1				Δ time			
DEVELOPED	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB
Variation 4: land use by city and by county												
Brownsville (Linn county)	0.3382	0.0076	0.4462	0.0308	0.3382	0.0110	0.4462	0.0424	0.0000	0.0034	0.0000	0.0117
Carlton (Yamhill county)	0.2130	0.0396	0.5380	0.0308	0.2500	0.0519	0.5494	0.0424	0.0370	0.0123	0.0114	0.0117
Corvallis (Benton county)	0.1729	0.0418	0.3166	0.0308	0.2206	0.0434	0.4138	0.0424	0.0476	0.0016	0.0971	0.0117
Dallas (Polk county)	0.3329	0.0095	0.5185	0.0308	0.3926	0.0133	0.5874	0.0424	0.0597	0.0038	0.0689	0.0117
Dayton (Yamhill county)	0.0733	0.0396	0.4288	0.0308	0.0842	0.0519	0.5237	0.0424	0.0110	0.0123	0.0950	0.0117
Dundee (Yamhill county)	0.0000	0.0396	0.5745	0.0308	0.0000	0.0519	0.6461	0.0424	0.0000	0.0123	0.0715	0.0117
Estacada (Clackamas county)	0.2017	0.0427	0.2932	0.0308	0.2067	0.0557	0.2982	0.0424	0.0050	0.0130	0.0050	0.0117
Harrisburg (Linn county)	0.1714	0.0076	0.7419	0.0308	0.2571	0.0110	0.8432	0.0424	0.0857	0.0034	0.1014	0.0117
Lafayette (Yamhill county)	0.0776	0.0396	0.3824	0.0308	0.0948	0.0519	0.5706	0.0424	0.0172	0.0123	0.1882	0.0117
Lebanon (Linn county)	0.4077	0.0076	0.4645	0.0308	0.5115	0.0110	0.5313	0.0424	0.1038	0.0034	0.0668	0.0117
Lowell (Lane county)	0.0000	0.0312	0.3337	0.0308	0.0000	0.0318	0.4714	0.0424	0.0000	0.0005	0.1376	0.0117
McMinnville (Yamhill county)	0.0646	0.0396	0.3776	0.0308	0.0884	0.0519	0.5648	0.0424	0.0238	0.0123	0.1872	0.0117
Metro (Clackamas county)	0.2876	0.0427	0.5891	0.0308	0.3736	0.0557	0.7107	0.0424	0.0860	0.0130	0.1217	0.0117
Metro (Multnomah county)	0.3462	0.0000	0.5891	0.0308	0.5282	0.1981	0.7107	0.0424	0.1821	0.1981	0.1217	0.0117
Metro (Washington county)	0.0738	0.0695	0.5891	0.0308	0.2550	0.0852	0.7107	0.0424	0.1812	0.0157	0.1217	0.0117
Newberg (Yamhill county)	0.3686	0.0396	0.6037	0.0308	0.3889	0.0519	0.7185	0.0424	0.0203	0.0123	0.1148	0.0117
Philomath (Benton county)	0.2678	0.0418	0.4287	0.0308	0.3348	0.0434	0.5569	0.0424	0.0670	0.0016	0.1282	0.0117
Saint Helens (Columbia county	-0.0132	0.0076	0.4379	0.0308	0.0200	0.0241	0.4911	0.0424	0.0331	0.0165	0.0533	0.0117
Scappoose (Columbia county)	0.3539	0.0705	0.6886	0.0308	0.3539	0.0870	0.6886	0.0424	0.0000	0.0165	0.0000	0.0117
Sheridan (Yamhill county)	0.3632	0.0396	0.2179	0.0308	0.5053	0.0519	0.4980	0.0424	0.1421	0.0123	0.2800	0.0117
Stayton (Linn county)	0.0000	0.0076	0.4097	0.0308	0.0000	0.0110	0.5109	0.0424	0.0000	0.0034	0.1012	0.0117
Stayton (Marion county)	0.2235	0.0313	0.4097	0.0308	0.2597	0.0345	0.5109	0.0424	0.0362	0.0033	0.1012	0.0117

* represents a p-value of 0.05 or below
The italicized numbers in brackets are p-values

Appendix 4.3: disturbance in riparian corridors

Appendix 4.3a Analysis of disturbance in riparian corridors

Results: Riparian Lands. Dependant Variable: Disturbed								
						ATE		
DISTURBED	**constant**	**riparian**	**UGB**	**UGB * riparian**	**time**	**time * riparian**	**time * UGB**	**time * riparian * UGB**
Variation 1								
all riparian corridors	0.6025 *	-0.0768	0.2146 *	-0.1743 *	0.0440 *	**-0.0262 ***	**-0.0194**	**0.0252 ***
	(0.000)	*(0.179)*	*(0.003)*	*(0.016)*	*(0.000)*	***(0.002)***	***(0.188)***	***(0.035)***
Variation 2: land use by city								
Brownsville	0.6025 *	-0.0768	0.2276 *	-0.2654 *	0.0440 *	**-0.0262 ***	**-0.0440 ***	**0.0262 ***
	(0.000)	*(0.179)*	*(0.001)*	*(0.000)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.002)***
Carlton	0.6025 *	-0.0768	0.3271 *	-0.1584 *	0.0440 *	**-0.0262 ***	**-0.0440 ***	**0.0262 ***
	(0.000)	*(0.179)*	*(0.000)*	*(0.008)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.002)***
Corvallis	0.6025 *	-0.0768	0.2592 *	-0.1208 *	0.0440 *	**-0.0262 ***	**-0.0363 ***	**0.0185 ***
	(0.000)	*(0.179)*	*(0.000)*	*(0.038)*	*(0.000)*	***(0.002)***	***(0.001)***	***(0.025)***
Dallas	0.6025 *	-0.0768	0.3202 *	-0.0740	0.0440 *	**-0.0262 ***	**-0.0339 ***	**0.0161 ***
	(0.000)	*(0.179)*	*(0.000)*	*(0.194)*	*(0.000)*	***(0.002)***	***(0.002)***	***(0.050)***
Dayton	0.6025 *	-0.0768	0.2862 *	-0.5116 *	0.0440 *	**-0.0262 ***	**-0.0395 ***	**0.0327 ***
	(0.000)	*(0.179)*	*(0.000)*	*(0.000)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.000)***
Dundee	0.6025 *	-0.0768	0.3514 *	-0.2565 *	0.0440 *	**-0.0262 ***	**-0.0440 ***	**0.0262 ***
	(0.000)	*(0.179)*	*(0.000)*	*(0.000)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.002)***
Estacada	0.6025 *	-0.0768	0.1068	-0.1350 *	0.0440 *	**-0.0262 ***	**-0.0327 ***	**0.0283 ***
	(0.000)	*(0.179)*	*(0.090)*	*(0.021)*	*(0.000)*	***(0.002)***	***(0.003)***	***(0.001)***
Harrisburg	0.6025 *	-0.0768	0.3975 *	-0.4089 *	0.0440 *	**-0.0262 ***	**-0.0440 ***	**0.0833 ***
	(0.000)	*(0.179)*	*(0.000)*	*(0.000)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.000)***
Lafayette	0.6025 *	-0.0768	0.2191 *	-0.5638 *	0.0440 *	**-0.0262 ***	**-0.0322 ***	**0.0144**
	(0.000)	*(0.179)*	*(0.001)*	*(0.000)*	*(0.000)*	***(0.002)***	***(0.003)***	***(0.078)***
Lebanon	0.6025 *	-0.0768	0.2612 *	0.0852	0.0440 *	**-0.0262 ***	**-0.0440 ***	**0.0262 ***
	(0.000)	*(0.179)*	*(0.000)*	*(0.137)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.002)***
Lowell	0.6025 *	-0.0768	0.0089	-0.5347 *	0.0440 *	**-0.0262 ***	**-0.0427 ***	**0.0249 ***
	(0.000)	*(0.179)*	*(0.885)*	*(0.000)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.003)***
McMinnville	0.6025 *	-0.0768	0.3326 *	-0.5285 *	0.0440 *	**-0.0262 ***	**-0.0424 ***	**0.0348 ***
	(0.000)	*(0.179)*	*(0.000)*	*(0.000)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.000)***
Metro	0.6025 *	-0.0768	0.1642 *	-0.2324 *	0.0440 *	**-0.0262 ***	**-0.0006**	**0.0500 ***
	(0.000)	*(0.179)*	*(0.011)*	*(0.000)*	*(0.000)*	***(0.002)***	***(0.951)***	***(0.000)***
Newberg	0.6025 *	-0.0768	0.3263 *	-0.2816 *	0.0440 *	**-0.0262 ***	**-0.0390 ***	**0.0212 ***
	(0.000)	*(0.179)*	*(0.000)*	*(0.000)*	*(0.000)*	***(0.002)***	***(0.001)***	***(0.011)***
Philomath	0.6025 *	-0.0768	0.2290 *	0.0080	0.0440 *	**-0.0262 ***	**-0.0403 ***	**-0.0227 ***
	(0.000)	*(0.179)*	*(0.001)*	*(0.887)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.007)***
Saint Helens	0.6025 *	-0.0768	0.1090	-0.4911 *	0.0440 *	**-0.0262 ***	**-0.0314 ***	**0.0191 ***
	(0.000)	*(0.179)*	*(0.083)*	*(0.000)*	*(0.000)*	***(0.002)***	***(0.004)***	***(0.022)***
Scappoose	0.6025 *	-0.0768	0.1862 *	-0.0940	0.0440 *	**-0.0262 ***	**-0.0440 ***	**0.0262 ***
	(0.000)	*(0.179)*	*(0.005)*	*(0.102)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.002)***
Sheridan	0.6025 *	-0.0768	0.3883 *	0.0701	0.0440 *	**-0.0262 ***	**-0.0440 ***	**0.0262 ***
	(0.000)	*(0.179)*	*(0.000)*	*(0.218)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.002)***
Stayton	0.6025 *	-0.0768	0.2831 *	-0.2076 *	0.0440 *	**-0.0262 ***	**-0.0418 ***	**0.0124**
	(0.000)	*(0.179)*	*(0.000)*	*(0.001)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.126)***

* represents a p-value of 0.05 or below
The italicized numbers in brackets are p-values

Appendix 4.3a Analysis of disturbance in riparian corridors

Results: Riparian Lands. Dependant Variable: Disturbed								
						ATE		
DISTURBED	**constant**	**riparian**	**UGB**	**UGB * riparian**	**time**	**time * riparian**	**time * UGB**	**time * riparian * UGB**
Variation 3: land use by county								
Benton	0.6025 *	-0.0846	0.2146 *	-0.0059	0.0440 *	**-0.0314** *	**-0.0194**	**-0.0217**
	(0.000)	*(0.175)*	*(0.003)*	*(0.938)*	*(0.000)*	***(0.004)***	***(0.188)***	***(0.308)***
Clackamas	0.6025 *	-0.1483 *	0.2146 *	-0.2582 *	0.0440 *	**-0.0290** *	**-0.0194**	**0.0397** *
	(0.000)	*(0.021)*	*(0.003)*	*(0.000)*	*(0.000)*	***(0.008)***	***(0.188)***	***(0.003)***
Columbia	0.6025 *	-0.1681 *	0.2146 *	-0.2702	0.0440 *	**-0.0405** *	**-0.0194**	**0.0187**
	(0.000)	*(0.010)*	*(0.003)*	*(0.148)*	*(0.000)*	***(0.000)***	***(0.188)***	***(0.208)***
Lane	0.6025 *	-0.2299 *	0.2146 *	-0.5872 *	0.0440 *	**-0.0334** *	**-0.0194**	**0.0089**
	(0.000)	*(0.001)*	*(0.003)*	*(0.000)*	*(0.000)*	***(0.002)***	***(0.188)***	***(0.542)***
Linn	0.6025 *	0.1005	0.2146 *	-0.1255	0.0440 *	**-0.0278** *	**-0.0194**	**0.0063**
	(0.000)	*(0.109)*	*(0.003)*	*(0.240)*	*(0.000)*	***(0.010)***	***(0.188)***	***(0.670)***
Marion	0.6025 *	-0.0833	0.2146 *	-0.1317	0.0440 *	**-0.0422** *	**-0.0194**	**0.0060**
	(0.000)	*(0.182)*	*(0.003)*	*(0.060)*	*(0.000)*	***(0.000)***	***(0.188)***	***(0.680)***
Multnomah	0.6025 *	-0.2958 *	0.2146 *	0.0310	0.0440 *	**0.2148** *	**-0.0194**	**-0.1318** *
	(0.000)	*(0.000)*	*(0.003)*	*(0.650)*	*(0.000)*	***(0.000)***	***(0.188)***	***(0.000)***
Polk	0.6025 *	-0.1186	0.2146 *	0.0733	0.0440 *	**0.0005**	**-0.0194**	**-0.0251**
	(0.000)	*(0.061)*	*(0.003)*	*(0.286)*	*(0.000)*	***(0.957)***	***(0.188)***	***(0.092)***
Washington	0.6025 *	-0.3421 *	0.2146 *	-0.0119	0.0440 *	**-0.0237** *	**-0.0194**	**0.0126**
	(0.000)	*(0.000)*	*(0.003)*	*(0.861)*	*(0.000)*	***(0.026)***	***(0.188)***	***(0.390)***
Yamhill	0.6025 *	-0.1103	0.2146 *	-0.1914	0.0440 *	**-0.0350** *	**-0.0194**	**0.0139**
	(0.000)	*(0.080)*	*(0.003)*	*(0.070)*	*(0.000)*	***(0.002)***	***(0.188)***	***(0.347)***

* represents a p-value of 0.05 or below
The italicized numbers in brackets are p-values

Appendix 4.3a Analysis of disturbance in riparian corridors

Results: Riparian Lands. Dependant Variable: Disturbed								
						ATE		
DISTURBED	**constant**	**riparian**	**UGB**	**UGB * riparian**	**time**	**time * riparian**	**time * UGB**	**time * riparian * UGB**
Variation 4: land use by city and by county								
Brownsville (Linn county)	0.6025 *	0.1005	0.2276 *	-0.4427 *	0.0440 *	**-0.0278 ***	**-0.0440 ***	**0.0278 ***
	(0.000)	*(0.109)*	*(0.001)*	*(0.000)*	*(0.000)*	***(0.010)***	***(0.000)***	***(0.010)***
Carlton (Yamhill county)	0.6025 *	-0.1103	0.3271 *	-0.1249 *	0.0440 *	**-0.0350 ***	**-0.0440 ***	**0.0350 ***
	(0.000)	*(0.080)*	*(0.000)*	*(0.049)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.002)***
Corvallis (Benton county)	0.6025 *	-0.0846	0.2592 *	-0.1129	0.0440 *	**-0.0314 ***	**-0.0363 ***	**0.0238 ***
	(0.000)	*(0.175)*	*(0.000)*	*(0.073)*	*(0.000)*	***(0.004)***	***(0.001)***	***(0.026)***
Dallas (Polk county)	0.6025 *	-0.1186	0.3202 *	-0.0322	0.0440 *	**0.0005**	**-0.0339 ***	**-0.0106**
	(0.000)	*(0.061)*	*(0.000)*	*(0.601)*	*(0.000)*	***(0.957)***	***(0.002)***	***(0.304)***
Dayton (Yamhill county)	0.6025 *	-0.1103	0.2862 *	-0.4781 *	0.0440 *	**-0.0350 ***	**-0.0395 ***	**0.0416 ***
	(0.000)	*(0.080)*	*(0.000)*	*(0.000)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.000)***
Dundee (Yamhill county)	0.6025 *	-0.1103	0.3514 *	-0.2230 *	0.0440 *	**-0.0350 ***	**-0.0440 ***	**0.0350 ***
	(0.000)	*(0.080)*	*(0.000)*	*(0.001)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.002)***
Estacada (Clackamas county)	0.6025 *	-0.1483 *	0.1068	-0.0635	0.0440 *	**-0.0290 ***	**-0.0327 ***	**0.0311 ***
	(0.000)	*(0.021)*	*(0.090)*	*(0.306)*	*(0.000)*	***(0.008)***	***(0.003)***	***(0.004)***
Harrisburg (Linn county)	0.6025 *	0.1005	0.3975 *	-0.5862 *	0.0440 *	**-0.0278 ***	**-0.0440 ***	**0.0850 ***
	(0.000)	*(0.109)*	*(0.000)*	*(0.000)*	*(0.000)*	***(0.010)***	***(0.000)***	***(0.000)***
Lafayette (Yamhill county)	0.6025 *	-0.1103	0.2191 *	-0.5303 *	0.0440 *	**-0.0350 ***	**-0.0322 ***	**0.0233 ***
	(0.000)	*(0.080)*	*(0.001)*	*(0.000)*	*(0.000)*	***(0.002)***	***(0.003)***	***(0.029)***
Lebanon (Linn county)	0.6025 *	0.1005	0.2612 *	-0.0921	0.0440 *	**-0.0278 ***	**-0.0440 ***	**0.0278 ***
	(0.000)	*(0.109)*	*(0.000)*	*(0.141)*	*(0.000)*	***(0.010)***	***(0.000)***	***(0.010)***
Lowell (Lane county)	0.6025 *	-0.2299 *	0.0089	-0.3816 *	0.0440 *	**-0.0334 ***	**-0.0427 ***	**0.0322 ***
	(0.000)	*(0.001)*	*(0.885)*	*(0.000)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.003)***
McMinnville (Yamhill county)	0.6025 *	-0.1103	0.3326 *	-0.4950 *	0.0440 *	**-0.0350 ***	**-0.0424 ***	**0.0437 ***
	(0.000)	*(0.080)*	*(0.000)*	*(0.000)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.000)***
Metro (Clackamas county)	0.6025 *	-0.1483 *	0.1642 *	-0.2307 *	0.0440 *	**-0.0290 ***	**-0.0006**	**0.0267 ***
	(0.000)	*(0.021)*	*(0.011)*	*(0.001)*	*(0.000)*	***(0.008)***	***(0.951)***	***(0.013)***
Metro (Multnomah county)	0.6025 *	-0.2958 *	0.1642 *	0.0813	0.0440 *	**0.2148 ***	**-0.0006**	**-0.1506 ***
	(0.000)	*(0.000)*	*(0.011)*	*(0.192)*	*(0.000)*	***(0.000)***	***(0.951)***	***(0.000)***
Metro (Washington county)	0.6025 *	-0.3421 *	0.1642 *	0.0385	0.0440 *	**-0.0237 ***	**-0.0006**	**-0.0062**
	(0.000)	*(0.000)*	*(0.011)*	*(0.533)*	*(0.000)*	***(0.026)***	***(0.951)***	***(0.545)***
Newberg (Yamhill county)	0.6025 *	-0.1103	0.3263 *	-0.2481 *	0.0440 *	**-0.0350 ***	**-0.0390 ***	**0.0301 ***
	(0.000)	*(0.080)*	*(0.000)*	*(0.000)*	*(0.000)*	***(0.002)***	***(0.001)***	***(0.006)***
Philomath (Benton county)	0.6025 *	-0.0846	0.2290 *	0.0159	0.0440 *	**-0.0314 ***	**-0.0403 ***	**-0.0174**
	(0.000)	*(0.175)*	*(0.001)*	*(0.796)*	*(0.000)*	***(0.004)***	***(0.000)***	***(0.097)***
Saint Helens (Columbia county)	0.6025 *	-0.1681 *	0.1090	-0.3998 *	0.0440 *	**-0.0405 ***	**-0.0314 ***	**0.0334 ***
	(0.000)	*(0.010)*	*(0.083)*	*(0.000)*	*(0.000)*	***(0.000)***	***(0.004)***	***(0.002)***
Scappoose (Columbia county)	0.6025 *	-0.1681 *	0.1862 *	-0.0027	0.0440 *	**-0.0405 ***	**-0.0440 ***	**0.0405 ***
	(0.000)	*(0.010)*	*(0.005)*	*(0.965)*	*(0.000)*	***(0.000)***	***(0.000)***	***(0.000)***
Sheridan (Yamhill county)	0.6025 *	-0.1103	0.3883 *	0.1036	0.0440 *	**-0.0350 ***	**-0.0440 ***	**0.0350 ***
	(0.000)	*(0.080)*	*(0.000)*	*(0.099)*	*(0.000)*	***(0.002)***	***(0.000)***	***(0.002)***
Stayton (Linn county)	0.6025 *	0.1005	0.2831 *	-0.9861 *	0.0440 *	**-0.0278 ***	**-0.0418 ***	**0.0257 ***
	(0.000)	*(0.109)*	*(0.000)*	*(0.000)*	*(0.000)*	***(0.010)***	***(0.000)***	***(0.017)***
Stayton (Marion county)	0.6025 *	-0.0833	0.2831 *	-0.2002 *	0.0440 *	**-0.0422 ***	**-0.0418 ***	**0.0284 ***
	(0.000)	*(0.182)*	*(0.000)*	*(0.002)*	*(0.000)*	***(0.000)***	***(0.000)***	***(0.009)***

* represents a p-value of 0.05 or below
The italicized numbers in brackets are p-values

Appendix 4.3b Predicted probability of disturbance in riparian corridors

Results: Riparian Lands. Dependant Variable: Disturbed												
	time=0				time=1				Δ time			
DISTURBED	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB
Variation 1												
all riparian corridors	0.5660	0.5257	0.8171	0.6025	0.5896	0.5436	0.8416	0.6465	0.0236	0.0178	0.0245	0.0440
Variation 2: land use by city												
Brownsville	0.4879	0.5257	0.8301	0.6025	0.4879	0.5436	0.8301	0.6465	0.0000	0.0178	0.0000	0.0440
Carlton	0.6944	0.5257	0.9297	0.6025	0.6944	0.5436	0.9297	0.6465	0.0000	0.0178	0.0000	0.0440
Corvallis	0.6642	0.5257	0.8617	0.6025	0.6642	0.5436	0.8694	0.6465	0.0000	0.0178	0.0076	0.0440
Dallas	0.7719	0.5257	0.9227	0.6025	0.7719	0.5436	0.9328	0.6465	0.0000	0.0178	0.0101	0.0440
Dayton	0.3004	0.5257	0.8887	0.6025	0.3114	0.5436	0.8932	0.6465	0.0110	0.0178	0.0045	0.0440
Dundee	0.6207	0.5257	0.9539	0.6025	0.6207	0.5436	0.9539	0.6465	0.0000	0.0178	0.0000	0.0440
Estacada	0.4975	0.5257	0.7093	0.6025	0.5109	0.5436	0.7206	0.6465	0.0134	0.0178	0.0113	0.0440
Harrisburg	0.5143	0.5257	1.0000	0.6025	0.5714	0.5436	1.0000	0.6465	0.0571	0.0178	0.0000	0.0440
Lafayette	0.1810	0.5257	0.8216	0.6025	0.1810	0.5436	0.8333	0.6465	0.0000	0.0178	0.0118	0.0440
Lebanon	0.8721	0.5257	0.8637	0.6025	0.8721	0.5436	0.8637	0.6465	0.0000	0.0178	0.0000	0.0440
Lowell	0.0000	0.5257	0.6114	0.6025	0.0000	0.5436	0.6127	0.6465	0.0000	0.0178	0.0012	0.0440
McMinnville	0.3299	0.5257	0.9352	0.6025	0.3401	0.5436	0.9367	0.6465	0.0102	0.0178	0.0016	0.0440
Metro	0.4576	0.5257	0.7668	0.6025	0.5248	0.5436	0.8101	0.6465	0.0672	0.0178	0.0433	0.0440
Newberg	0.5705	0.5257	0.9288	0.6025	0.5705	0.5436	0.9338	0.6465	0.0000	0.0178	0.0049	0.0440
Philomath	0.7627	0.5257	0.8315	0.6025	0.7176	0.5436	0.8352	0.6465	-0.0451	0.0178	0.0037	0.0440
Saint Helens	0.1436	0.5257	0.7115	0.6025	0.1492	0.5436	0.7241	0.6465	0.0055	0.0178	0.0126	0.0440
Scappoose	0.6180	0.5257	0.7887	0.6025	0.6180	0.5436	0.7887	0.6465	0.0000	0.0178	0.0000	0.0440
Sheridan	0.9842	0.5257	0.9908	0.6025	0.9842	0.5436	0.9908	0.6465	0.0000	0.0178	0.0000	0.0440
Stayton	0.6013	0.5257	0.8856	0.6025	0.5897	0.5436	0.8878	0.6465	-0.0116	0.0178	0.0021	0.0440

* represents a p-value of 0.05 or below
The italicized numbers in brackets are p-values

Appendix 4.3.b Predicted probability of disturbance in riparian corridors

Results: Riparian Lands. Dependant Variable: Disturbed												
	time=0				time=1				Δ time			
DISTURBED	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB
Variation 3: land use by county												
Benton	0.7265	0.5179	0.8171	0.6025	0.6980	0.5304	0.8416	0.6465	-0.0285	0.0125	0.0245	0.0440
Clackamas	0.4106	0.4542	0.8171	0.6025	0.4458	0.4692	0.8416	0.6465	0.0353	0.0150	0.0245	0.0440
Columbia	0.3788	0.4344	0.8171	0.6025	0.3816	0.4379	0.8416	0.6465	0.0028	0.0035	0.0245	0.0440
Lane	0.0000	0.3726	0.8171	0.6025	0.0000	0.3832	0.8416	0.6465	0.0000	0.0105	0.0245	0.0440
Linn	0.7921	0.7030	0.8171	0.6025	0.7951	0.7191	0.8416	0.6465	0.0030	0.0161	0.0245	0.0440
Marion	0.6021	0.5192	0.8171	0.6025	0.5904	0.5210	0.8416	0.6465	-0.0116	0.0018	0.0245	0.0440
Multnomah	0.5523	0.3067	0.8171	0.6025	0.6599	0.5655	0.8416	0.6465	0.1076	0.2588	0.0245	0.0440
Polk	0.7719	0.4839	0.8171	0.6025	0.7719	0.5285	0.8416	0.6465	0.0000	0.0445	0.0245	0.0440
Washington	0.4631	0.2604	0.8171	0.6025	0.4765	0.2807	0.8416	0.6465	0.0134	0.0203	0.0245	0.0440
Yamhill	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440

* represents a p-value of 0.05 or below
The italicized numbers in brackets are p-values

Appendix 4.3.b Predicted probability of disturbance in riparian corridors

Results: Riparian Lands. Dependant Variable: Disturbed												
	time=0				time=1				Δ time			
DISTURBED	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB	riparian corridors inside UGB	riparian corridors outside UGB	other land inside UGB	other land outside UGB
Variation 4: land use by city and by county												
Brownsville (Linn county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Carlton (Yamhill county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Corvallis (Benton county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Dallas (Polk county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Dayton (Yamhill county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Dundee (Yamhill county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Estacada (Clackamas county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Harrisburg (Linn county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Lafayette (Yamhill county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Lebanon (Linn county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Lowell (Lane county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
McMinnville (Yamhill county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Metro (Clackamas county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Metro (Multnomah county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Metro (Washington county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Newberg (Yamhill county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Philomath (Benton county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Saint Helens (Columbia county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Scappoose (Columbia county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Sheridan (Yamhill county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Stayton (Linn county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440
Stayton (Marion county)	0.5154	0.4922	0.8171	0.6025	0.5189	0.5012	0.8416	0.6465	0.0034	0.0089	0.0245	0.0440

* represents a p-value of 0.05 or below
The italicized numbers in brackets are p-values