VOTING WITH THEIR FEET: DO PEOPLE CHOOSE RESIDENTIAL DESTINATIONS BASED ON NATURALLY OCCURRING ADVANTAGES OR MAN-MADE ADVANTAGES OF LOCATIONS?

by

Kristine Laura S. Canales

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Approved by:

_____
Dr. Artie Zillante

_____
Dr. Lisa Schulkind

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Dr. Isabelle Nilsson

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Dr. Suzanne Leland

ABSTRACT

KRISTINE LAURA S. CANALES. Voting with their feet: Do people choose residential destinations based on naturally occurring advantages or man-made advantages of locations? (Under the direction of DR. ARTIE ZILLANTE and DR. LISA SCHULKIND)

Local economies benefit from attracting in-migration either as workforce or as consumers. To compete for constituents, local economies need to provide attractive tax policy and expenditure bundles. An important consideration in this regard is the relative natural advantage of some locations in terms of its climate and geographical features, among other things. In this three-paper dissertation, I explore how natural amenities affect the variations in local government public goods and how people choose their residential locations as they trade-off between natural amenities and local government public goods as they go through phases in their life cycle. In Article 1, I propose that one of the reasons locations differ in their stock of local government public goods is because of differences in existing natural amenities by testing the hypothesis that some goods are substitutes while others are complements using spatial autoregressive random effects model estimation. In Article 2, I explore how local government expenditures and population vary in two contiguous areas that are similar in all but one natural amenity using border-matching methodology to determine how local government expenditures differ between counties sharing a border within a state that have the same level of natural amenities except for one natural feature. In Article 3, I use fixed effects panel data regression to test whether age and life milestones shape preferences and budget constraints of people when they choose residential locations as they trade-off between natural amenities and local government-provided public goods. My results indicate that some natural amenities are complements to local public goods while others are substitutes. Some expenditures are not affected by natural amenities because they have to be provided regardless of what are naturally available. Moreover, age and marital status are consistent predictors of moving. Natural amenities and certain per capita tax revenue and expenditure items also affect the likelihood of moving.

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Finally, a document that proves I went through everything I went through! This is the fruit of all the discussions, arguments, solving theoretical issues, estimations, re-estimations, robustness checks, conference presentations, and writing all nine versions of the FINAL draft. I never would have gotten to this point, with the level of knowledge and confidence that I have now, if not for everyone who believed and supported me. You know who you are but let me enumerate anyway.

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To all of you, please know that I am absolutely grateful. You believed in me and you kept me striving onward.

DEDICATION

For the best father and mother in the world, Waldomar Canales and Melaura Canales.

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LIST OF ABBREVIATIONS

BLS	Bureau of Labor Statistics
CONUS	Contiguous United States
CVI	Coastal vulnerability index
GFD	Government Finance Database
MRTS	Marginal rate of technical substitution
NCDC	National Climatic Data Center
NHGIS	National Historical Geographic Information System
NLSY	National Longitudinal Survey of Youth
OLS	Ordinary Least Squares
SAR-RE	Spatial Autoregressive – Random Effects
SPI	Standard precipitation index
USDA-ERS	United States Department of Agriculture – Economic Research Services
USGS	United States Geological Survey

INTRODUCTION

Several studies have explored how amenities affect population distribution and local economic development. Two major camps of research in this regard model migration and its effect on the local development using the disequilibrium approach (driven by job search) and the equilibrium approach (driven by preferences for certain amenities). My research can be classified under the equilibrium approach because of my interest in how amenities affect choices of residential location. However, my focus in this research is largely on how natural amenities affect provision of local government policies, both tax and expenditure policies. I look at how people choose residential locations at certain stages in their life cycle considering amenities that are naturally available and amenities that are provided by the government and which are inherently man-made.

Faggian, Olfert, and Partridge (2012) offer revealed preferences in people's residential location as a practical alternative to measuring well-being of people, because quality of life measures positively correlate with quality of public services. That being said, it becomes important to consider how the differences in effort necessary to attract people vary across localities because some locations have inherent naturally occurring advantages over others. These advantages include climate conditions, availability of natural resources, and natural geographical features such as landforms and ecosystems. In my research, I propose that the inherent natural advantages of locations are a factor that explains why local governments provide differing levels of public goods, which consequently affects their ability to attract in-migration. Locations that are not endowed with these advantages may have to spend more on man-made amenities, such as extensive roads, public safety, and strong public schools, to compensate. Because pricing natural advantages is difficult, it is difficult to estimate how much a location benefits from its inherent natural advantages and its man-made advantages. In my research, I explore the effect of naturally occurring advantages on the provision of man-made amenities. Moreover, I explore the relative importance of locally

provided man-made advantages[1] and naturally occurring advantages for attracting people into jurisdictions.

My hypothesis is that the persistent differences in local government attractiveness and population density across locations manifest not only because higher income populations can pay for and selectively migrate into locations with high value natural amenities, but also because the local government effort required to make some locations attractive for people choosing residential location is lower. The ease of providing man-made amenities in locations with more natural advantages enable their local governments to supply more man-made amenities compared to a location that has exactly the same characteristics but with fewer natural advantages. By understanding the extent to which natural amenities provide locations with an initial advantage, we can more fully understand the existence of inherent differences in the required effort among local governments to attract people into their jurisdictions, which affects economic opportunities for both people and locations.

In this research, I test a set of hypotheses relating to factors relevant in how people vote with their feet. The hypotheses are as follows:

(1) Some natural amenities are complements to local government-provided man-made amenities, while others are substitutes. (i.e., if there are more natural amenities in its location, local governments provide more of certain man-made amenities);

(2) The cost of attracting in-migration is lower for local governments with more natural amenities complementary to man-made amenities in its location (i.e., if a location has more natural amenities complementary to man-made amenities, then its local government incurs lower cost in attracting in-migration); and

[1] In this study, I interchangeably use 'public goods', 'expenditure bundles', 'human activities', and 'man-made amenities'. The same is true for 'advantages' and 'amenities'.

(3) Younger households' preferences for residential locations differ from older households. (e.g., young married couples with children prefer locations with good public schools while retirees prefer locations with warm weather).

Figure 1 presents the conceptual diagram of the research I plan to undertake for my dissertation.

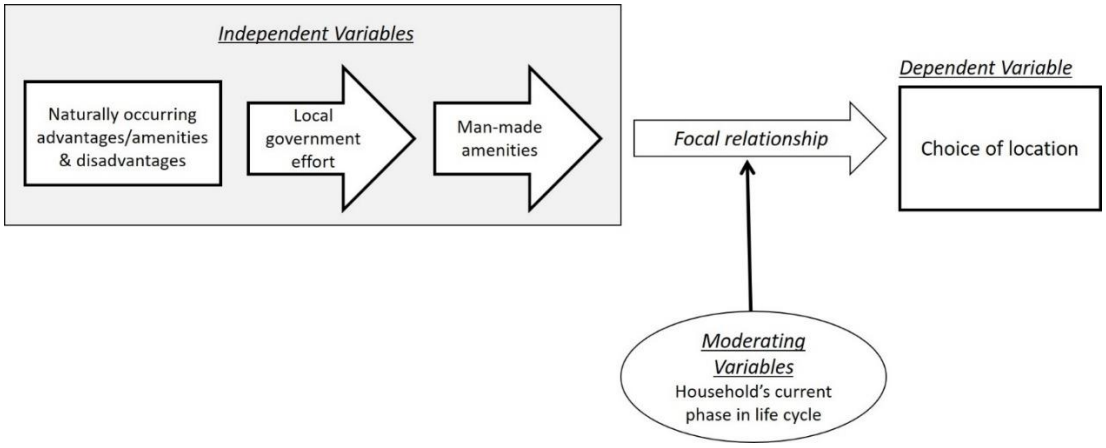


Figure 1: Conceptual Framework

ARTICLE 1: NATURAL AMENITIES AND LOCAL GOVERNMENT PUBLIC GOODS: SUBSTITUTES OR COMPLEMENTS?

1.1. Introduction

When choosing residential locations, people consider the differences in the levels of natural amenities and local government-provided public goods among competing alternatives. It is these differences in the stock of both that make some locations more attractive than others. I propose that one of the reasons locations differ in their stock of local government public goods is because of differences in their existing natural amenities.

Some local government public goods are either necessary or less costly to provide in locations that have certain natural amenities. For example, locations that are prone to natural hazards such as flooding may need to spend more on infrastructure that helps reduce the effects of flooding. Meanwhile, locations that have natural amenities suited for recreational purposes may have lower costs in providing for parks and recreation. I propose that some local government public goods are substitutes to natural amenities while others are complements. Substitutes[2] to natural amenities are local government public goods that are provided in the absence or low presence of certain natural amenities. Complements to natural amenities are local government public goods that are provided when certain natural amenities are abundant. In this study, I ask how natural amenities in a location affect the provision of local government public goods.

Existing studies do not separate the effect of natural amenities and local government public goods on residential location decisions nor do they consider the interaction between these two types of common resource. If natural amenities affect the provision of local government public goods, the effect of the latter on the attractiveness of a location may be overestimated (for

[2] Substitutes and complements in this study are not defined as they are in economics. In economics, a good is classified as either substitute or complement depending on how the quantity of its consumption changed because of a change in the price of a good related to it. In this study, a local government public good is classified as either substitute or complement depending on how the cost or benefit of providing it varies by the level of natural amenities existing in the same location.

substitutes) or underestimated (for complements). A gap in the literature is the lack of studies that explore how local government public goods vary with the existing natural amenities in locations.

In this study, I explore how local governments provide public goods in their respective jurisdiction considering the natural amenities in their location. Using a merged dataset of natural amenities and local government finance at the county-level for the period 1972-2002, I test whether some local government public goods in contiguous United States are substitutes to natural amenities, while others are complements. I take into account the presence of spillover effects among locations such that areas may either benefit or lose from an adjacent area's natural amenities and provision of local government public goods.

I find that per capita tax revenue varies with climatological variables including precipitation, temperature, short-term drought, and long-term drought. Per capita total expenditure varies with topography type and being on the coast of Gulf and Atlantic. Precipitation and long-term drought seem to be complemented by tax policies and local government expenditure. Being on tablelands is more complemented by tax policies and expenditures compared to plains, while plains with hills or mountains is more substituted by tax policies and expenditures. The effect of being a coastline county differs according to which coast: Atlantic, Gulf, or Pacific. Numerous types of expenditures complement canals while certain expenditures substitute intermittent stream/river.

The paper will proceed as follows: Section 1.2 reviews the existing related literature; Section 1.3 discusses the theoretical approach; Section 1.4 describes the data; Section 1.5 discusses the estimation strategy; Section 1.6 presents the estimation results; and Section 1.7 concludes.

1.2. Literature Review

There are different perspectives on describing how locations developed into their current state. Perspectives range from the geographic determinism in historical analysis of locations to the use of measurement and theory in finding general patterns of development. To the best of my knowledge, this is the first study to explore how the provision of local government public goods varies with respect to variations in natural amenities, with the goal of determining which ones are substitutes and which ones are complements.

Lynch (1981) describes normative[3] theories[4] that explain how cities have developed, but these theories do not explain general trends in how cities form. In addition, Lynch provides a set of performance dimensions to assess what makes a location suitable for settlement including vitality, sense, fit, access, and control. These dimensions, however, do not distinguish between natural amenities and man-made ones.

Diamond (1997) argues that environments shape people and the speed of development of civilizations in different parts of the world. He contends that certain geographical characteristics make it easier for people to provide for themselves and to modify their environment. Similarly, North (1966) describes the economic history of the US showing how certain locations received man-made amenities because of the natural resources in the area or its proximity to bodies of water. He notes that the economic pattern of US regions is a result of their respective physiographic characteristics, which shaped each region's production possibilities. For example, North describes how the location and geographic characteristics of New York enabled it to grow so much more and faster than the rest of the country. New York's land is fertile for agriculture

[3] Previous work focuses on functional theories of how cities get their form. Lynch argues that values are innate in functional theories. Hence, exploring what people value may provide a more complete picture of how cities come about.

[4] Lynch summarizes functional theory groupings as follows: (1) the city as a unique historical process; (2) the city as an ecosystem of human groups; (3) the city as a space for production and distribution of material goods; (4) the city as a field of force; (5) the city as a system of linked decisions; and (6) the city as an arena of conflict.

(e.g., grain and livestock). At the same time, its location makes it an important seaport.[5] Curti et al. (1953) present a narrative of the history of US civilization with particular attention on how natural amenities in locations enabled certain US states to act upon economic opportunities at specific periods. For example, the English prefer the Atlantic coastal plain because of its accessibility, weather, and how its topography allows for deep-water harbors. Meanwhile because of geographical challenges in the Rocky Mountains, it was hard to establish settlements. Although they all provide generalizations on which geographical characteristics among locations affect development, the method for establishing the causal relationship between natural amenities and man-made amenities is primarily narrative.

Other studies examine the relationship between topography type and cost of providing certain types of infrastructure. Collier, Kirchberger, and Soderbom (2015) find that the ruggedness of a country's terrain and its surface area are significantly and positively associated with the unit cost of building roads. Surface area includes the effect of being landlocked. Rahman and Rahman (2015) outline the numerous disaster vulnerabilities of coastal cities in Bangladesh which make it more challenging for infrastructure development such as "*construction and management of buildings, roads, power and telecommunication transmission lines, drainage and sewerage and waste management*" (p. 96).

There are a number of existing studies that explore the effect of natural amenities, economic productivity, or local fiscal policies on population growth and wage differentials. Glaeser (2005) and Glaeser and Tobio (2007) explore the effect of climate along with education and workers' skills on population growth. Existing studies that explore the effect of natural amenities and fiscal policies (e.g., tax rates and government-provided public goods) directly use these variables as explanatory variables to estimate either the probability of migrating (Biagi,

[5] A company in Amsterdam hired the English explorer, Henry Hudson, to find a northeast passage to Asia. Hudson found and established New Netherland (now, New York) in 1609 and made it a major seaport. Colonization of New Jersey followed in the same year for the same natural amenities – coast and bays. These are examples of complements, where the government (i.e., the European colonists at the time) made investments to enhance use of a location's natural resources.

Faggian, and McCann, 2011; Day, 1992; Ferguson, Ali, Olfert, and Partridge, 2007; Mueser and Graves, 1995; Clark, Lloyd, Wong, and Jain, 2002; Nakajima and Tabuchi, 2011; and Partridge, Rickman, Ali, and Olfert, 2008) or wage differentials (Beeson and Eberts, 1989; Gyourko and Tracy, 1989; and Clark, Herrin, Knapp, and White, 2003). Chen, Irwin, and Jayaprakash (2013) explore the effect of preference for natural amenities on population dispersion using a two-region model. However, they only considered endogeneity of ecosystem services[6] and man-made capital[7] towards high-valued natural amenities. In effect, they considered capital investments and man-made facilities that are complementary to natural amenities. As it stands, the existing literature has not explored which local government public goods are substitutes and complements to natural amenities.

1.3. Theoretical Approach

The unit of analysis in this study is the community's local government. The local government is similar to a competitive firm in a market in how it produces publicly provided goods to both attract and retain residents into its jurisdiction. Because residents compare local governments by the total supply of publicly available and publicly provided goods, **q**, I assume that local governments aim to provide a uniform acceptable level of **q**, $\bar{\boldsymbol{q}}$. This assumption adheres to my adoption of the behavioral assumption from Wildasin (1988) that local governments choose their policy instruments to maximize their utility considering how other jurisdictions choose their tax and expenditure policies. I also adopt the behavioral assumption from Janeba and Osterloh (2013) on how local governments perceive competition with

[6] The definition of ecosystem services considered in their paper is the following: "*Ecosystem services, which include any ecological feature that is either directly or indirectly valued by humans, are determined by the biophysical functioning of the ecosystem. These are assumed to be degradable and congestible and therefore negatively impacted by population. Examples include nutrient loadings that degrade the water quality of a lake and the loss of open space that results from increased population and congestion in a region*." (Chen et al., 2013, p. 263)

[7] Chen et al. (2013) defines 'man-made capital' as "*On the other hand, population growth may benefit the level of natural amenities in a region by generating additional man-made capital that enhance natural amenity benefits, e.g., through increasing tax revenues that are invested in public infrastructure or by increasing private capital investment in complementary man-made facilities.*" (p. 263)

neighboring jurisdictions; that is, geographic neighbors are important competitors when there are positive spillovers from infrastructure and agglomeration economies.

Like a firm, the local government's objective is to minimize costs while providing $\overline{\boldsymbol{q}}$. In providing the total supply of publicly available and publicly provided goods, $\overline{\boldsymbol{q}}$, the local government's objective is to minimize the total cost, **c(z)**, which is as follows:

$$\begin{gathered} minimize_z\ c(z) \\ subject\ to\ f(z) \geq \bar{q} \end{gathered} \tag{1.1}$$

I assume **c(z)** to be concave in prices, non-decreasing in **q**, and increasing in **z**. The vector of factors, **z**, consists of two types of factors: the location's natural characteristics (z_a) and the public goods (z_g) local governments provide (i.e., tax policies and government expenditures). The location's natural characteristics, z_a, is exogenous. The local government's production function is given by $f(z)$. The marginal rate of technical substitution (**MRTS**) between the two types of factors is:

$$MRTS_{z_g,z_a} = \frac{f_{z_g}(\bar{q})}{f_{z_a}(\bar{q})} \tag{1.2}$$

$MRTS_{z_g,z_a}$ gives the amount by which factor z_g should be increased or decreased to keep supply, **q**, constant at $\overline{\boldsymbol{q}}$ considering the available stock of factor z_a. Because supply is constant at $\overline{\boldsymbol{q}}$ and z_a is exogenous, the analysis using $MRTS_{z_g,z_a}$ is across communities; not within a community where the local government can choose the level of both types of factors to produce any chosen level of q. By definition, if $MRTS_{z_g,z_a} < 0$, then local government provided public goods are a substitute for the location's natural characteristics. If $MRTS_{z_g,z_a} > 0$, then local government provided public goods are a complement for the location's natural characteristics.

I intentionally left out of my model the labor and capital markets because they are inherently man-made but not government-provided. One of the arguments I make in setting up my model is that the development of labor and capital markets is a function of the population that

settles into a location. Population density is an important determinant of having labor and capital markets because efficiency of both markets depends on benefiting from increasing returns to scale. In effect, I argue that natural advantages determine government-provided man-made advantages as well as private market-provided man-made advantages. The latter argument is beyond the scope of this paper.

1.4. Data

To test the hypothesis that some local government public goods are substitutes to natural amenities while others are complements, I explore how local tax policies and local government expenditures vary with respect to natural amenities. I combine data on county-level government revenue and expenditures from Government Finance Database (GFD; Pierson, Hand, and Thompson, 2015), climatological data from the National Climatic Data Center (NCDC) of the U.S. Department of Commerce, topography from the United States Department of Agriculture Economic Research Services (USDA-ERS), detailed water provided from US Geological Survey (USGS) National Hydrography, and coastline vulnerability of counties from USGS. Table 1.1 below presents the summary statistics.

I have two sets of explanatory variables: time-invariant and time-varying. Time-invariant variables include being a coastline county, topography type, coastal vulnerability index (CVI), and different types of water bodies. Urbanity is included as a control variable. Time-varying variables include annual average inches of precipitation, annual average temperature, annual average drought index (both short- and long-term).

Out of the 2,981 counties, 177 are coastline counties, with coastline vulnerability index ranging from 1.73 (low CVI) to 28.87 (very high CVI). With respect to topography type, 1,450 counties are characterized with plains, 193 with tablelands, 210 with plains with hills or mountains, 703 with open hills and mountains, and 425 with hills and mountains. Most of the counties are rural, with 751 counties classified as urban.

Most counties (2,953) have perennial lakes/ponds. There are a large number of counties with swamp/marsh (1,402), intermittent lake/pond (1,277), reservoir (1,120), and perennial stream/river (803).

The dependent variables are expressed in nominal per capita terms. The mean of per capita total revenue is $494. The biggest component of total revenue comes from taxes ($177). Per capita total intergovernmental revenues from the state ($150) is larger than those from federal ($17) and local ($6). Average per capita total charges and miscellaneous revenue is $138.

The mean of per capita total expenditure is $485. The biggest per capita expenditure component is highway ($81) and followed by education ($71). Mean per capita expenditure for public welfare is $41, police is $28, health is $25, and financial administration is $19.

Table 1.1: Summary Statistics

Time-invariant variables

Variables	Count
Atlantic coastline counties	102
Gulf coastline counties	50
Pacific coastline counties	25
Topography type	
Plains	1,450
Tablelands	193
Plains with hills or mountains	210
Open hills and mountains	703
Hills and mountains	425
Urban counties	751

Variables	Count	Mean	SD	Minimum	Maximum
Coastal vulnerability index (CVI)	177	13.69	6.51	1.73	28.87
Total sqmi of canal	96	0.62	1.05	0.01	5.32
Total sqmi of ice mass	43	4.79	12.21	0.01	65.82
Total sqmi of lake/pond (intermittent)	1,277	1.61	5.05	0.01	103.38
Total sqmi of lake/pond (perennial)	2,953	6.69	18.64	0.01	331.85
Total sqmi of playa	104	16.03	45.68	0.01	319.73
Total sqmi of reservoir	1,120	0.42	2.02	0.01	41.42
Total sqmi of stream/river (intermittent)	13	0.31	0.44	0.01	1.47
Total sqmi of stream/river (perennial)	803	0.83	1.64	0.01	21.57
Total sqmi of swamp/marsh	1,402	20.19	81.65	0.01	2,122.85
Time-varying natural amenities					
Precipitation (inches)	20,867	3.25	1.25	0.11	11.76
Temperature (degrees Fahrenheit)	20,867	54.01	8.17	33.56	75.33
Short-term drought index (1 month)	20,867	0.09	0.29	-0.87	0.99
Long-term drought index (24 months)	20,867	0.05	0.91	-2.81	2.86

Variables	Mean	SD	Minimum	Maximum
Per capita revenue items (in nominal dollars)				
Total revenue	493.64	580.41	0	18,537.31
Total tax revenue	177.45	247.90	0	15,686.57
Total general sales tax	22.98	55.66	0	1,218.70
Total select sales tax	3.91	17.94	0	1,167.79
Individual income tax	3.00	24.09	0	718.20
Total IGR - federal	17.16	43.64	0	3,184.48
Total IGR - state	149.79	224.95	0	4,850.99
Total IGR - local	6.45	20.16	0	1,059.70
Total charges & misc revenue	137.61	280.81	0	9,372.43
Per capita expenditure items (in nominal dollars)				
Total expenditure	485.47	569.32	0	14,656.72
Highway expenditure	80.62	109.57	0	3,321.84
Total education expenditure	71.39	224.71	0	2,546.47
Public welfare expenditure	40.66	83.65	0	1,257.97
Police expenditure	28.09	41.75	0	1,208.61
Health	25.17	51.58	0	2,639.64
Financial administration	18.51	44.43	0	3,865.67
Solid waste management	7.70	19.93	0	964.21
Natural resources	6.49	21.49	0	2,000.00
Parks & recreation	5.36	17.91	0	890.86
Total utility	5.29	43.02	0	2,288.64
Fire protection	3.53	12.80	0	647.11
Sewerage	2.76	15.91	0	639.22
Housing & community development	2.29	12.28	0	535.83
Airport transport expenditure	1.85	14.33	0	654.69
Liquor store	0.64	5.81	0	199.54

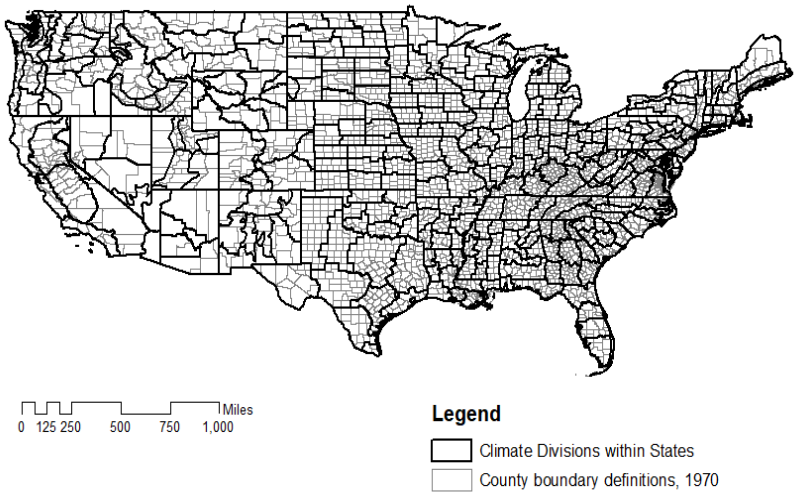
Climatological Divisions and US Counties

The smallest geographic unit I can collect climatological data for the US is at the level of state divisions. For the contiguous US (CONUS, hereafter), there are 344 climatological divisions. I collected monthly data for each climatological division within states for the period January 1972 to December 2002 from the National Climatic Data Center (NCDC) of the U.S. Department of Commerce. NCDC provides monthly data separately for each climatological division within each state. The following variables[8] are provided for each climatological division in the dataset: precipitation index, temperature index, minimum temperature, maximum temperature, Palmer Drought Severity Index, Palmer Hydrological Drought Index, Palmer Z-Index, Modified Palmer Drought Severity Index, cooling degree days, heating degree days, and Standard Precipitation Index for 1-, 2-, 3-, 6-, 9-, 12-, and 24-months. I then summarized the monthly data into yearly averages. Standard precipitation index (SPI) ranges from -4.00 to 4.00

[8] NCDC describes the computation of monthly data as follows, "*The divisional values are weighted by area to compute statewide values and the statewide values are weighted by area to compute regional values.* (Karl and Koss, 1984)}."

and it is a transformation of the probability of observing a given amount of precipitation within a given number of months. I considered 1-month SPI as a measure of short-term drought and 24-months SPI as a measure of long-term drought. An SPI of zero is the median of the distribution of precipitation. An SPI of -3.00 is an indication of extreme drought. An SPI of +3.00 is an indication of extreme wetness. Temperature is in degrees Fahrenheit.

The smallest unit for which local government revenues and expenditures are available is at the county level. For county-level tax policies and government expenditures, I used the Government Finance Database (GFD; Pierson et al. 2015). To merge the climatological divisions dataset with the county-level dataset, I assign[9] each county to their respective state climatological divisions using the maps from the National Weather Service's Climate Prediction Center website.[10] The county and state climatological division codes allow me to merge the climatological dataset with the GFD database. I assign a county into the climatological division where the largest portion of its area belongs. Figure 1.1 shows climatological divisions within states and the county boundary definition in 1970.



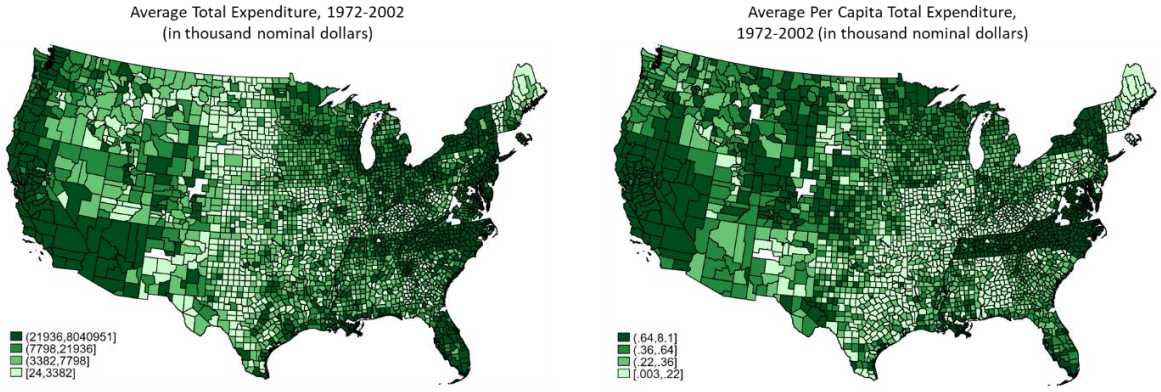
Source: NCDC and National Historical Geographic Information System (NHGIS)

Figure 1.1: Climatological Divisions and Contiguous US Counties

[9] I wrote a Stata code for this purpose and will make it available in my website.
[10] Accessed on June 2019

An important consideration in using panel data of US counties is the fact that county boundary definitions change within the period 1972-2002. Using documentation on substantial changes to counties and county equivalent entities for 1970-present from the US Census Bureau, I drop counties from my dataset to keep only counties that did not have significant county boundary definition change.[11] States that were dropped from the contiguous USA dataset due to missing values include Connecticut and Rhode Island. I have a balanced panel of 2,981 counties for the period 1972-2002.[12]

Figure 1.2 shows choropleth maps of the 2,981 US counties by their average total expenditure (left panel) and average per capita total expenditure (right panel) for the period 1972-2002. It is apparent in these maps that there are counties (total of 160) not included in the analysis, represented in the maps as white areas.



Source: GFD and NHGIS

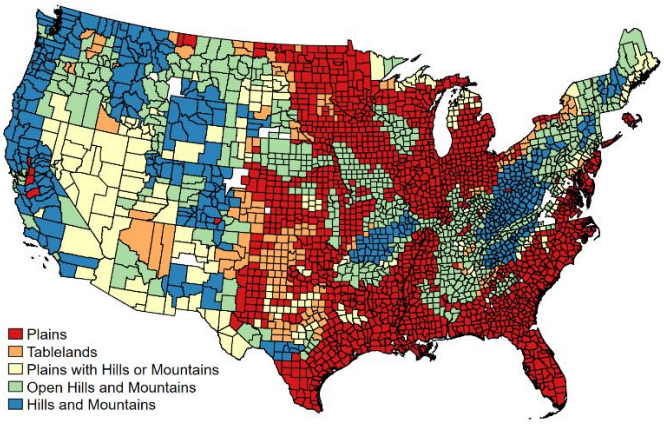
Figure 1.2: Average Total Expenditure of US Counties, 1972-2002

Topographic type

The USDA-ERS provided 21 categories for land surface type for 1970, which can be collapsed into five broader categories. These five broad categories include plains, tablelands,

[11] The list of counties dropped due to significant boundary changes is in Table A2 in the Appendix.
[12] Spatial regression using panel data runs only if there are no missing values for any variable included in the regression. The spatial weighting matrix imposes the assumption that the places are related to each other consistently across time. Missing values in any variable violate that assumption. (StataCorp 2017, 14)

plains with hills or mountains, open hills or mountains, and hills and mountains. Figure 1.3 shows the choropleth map of US counties included in my study by topography type.

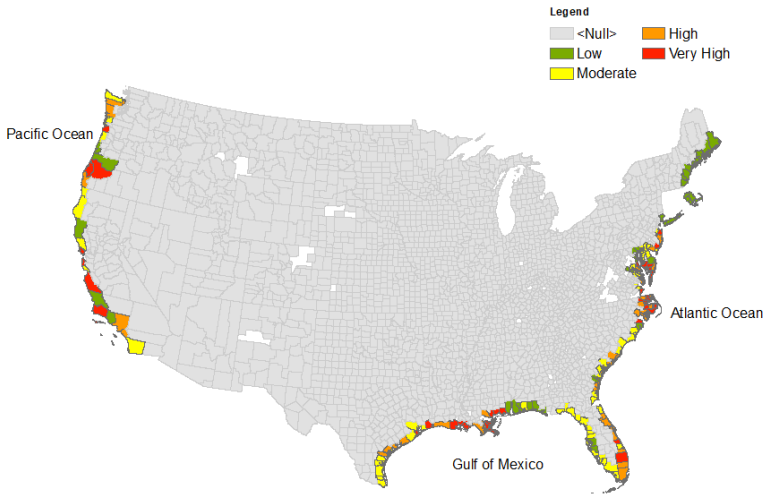


Source of data: USDA-ERS

Figure 1.3: CONUS Counties by Land Surface Type

Coastline and detailed water bodies

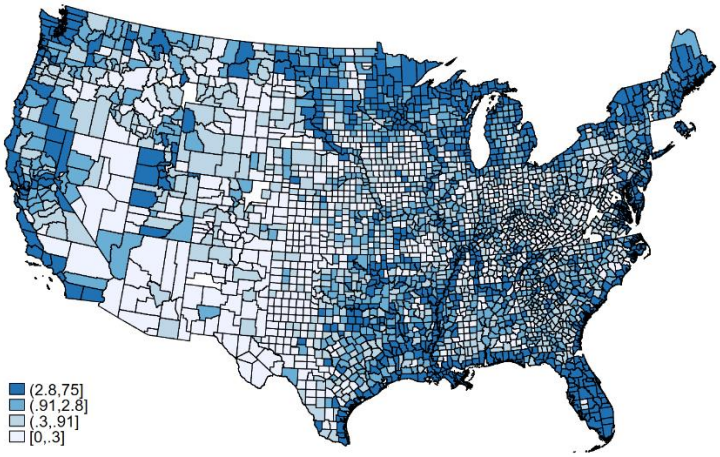
I got the dataset on coastline and detailed water bodies from US Geological Survey (USGS). USDA-ERS provides data on water area percentage for each county. The coastal vulnerability index (CVI) reflects the relative vulnerability of the coast to changes due to future rise in sea-level, based on the values of physical variables contributing to coastal change such as geomorphology, shoreline erosion and accretion rates, coastal slope, rate of relative sea-level rise, mean tidal range, and mean wave height. In the dataset, CVI ranges from 0 (i.e., not a coastal county) to 28.87 (i.e., very high coastal vulnerability). Figure 1.4 shows the coastline counties and their coastline vulnerability index.



Source of data: USGS

Figure 1.4: Coastline Counties and Coastline Vulnerability Index

The detailed water dataset maps out the following water body types: lake or pond, swamp or marsh, stream or river, playa, ice mass, canal or ditch. Lake/pond and stream/river are classified as either intermittent or perennial. Figure 1.5 shows the percentage of water area to a county's total area.

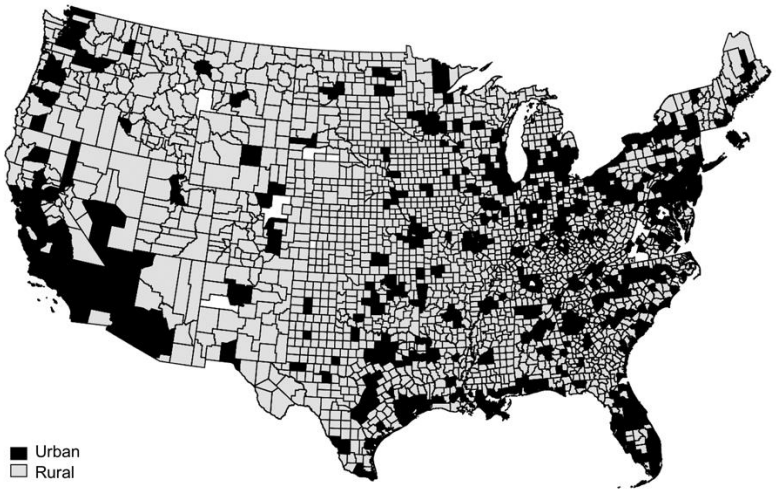


Source of data: USDA-ERS

Figure 1.5: CONUS Counties and Water Area Percentage (in percent)

Urbanity

I controlled for whether a county is urban or rural. I used the data on urbanity from USDA-ERS. Figure 1.6 shows the choropleth map of urbanity of counties.



Source of data: USDA-ERS

Figure 1.6: Urban and Rural Counties

1.5. Estimation Strategy

The goal of this research is to test whether a county's own and its neighbors' natural characteristics, taxes, and expenditure policies affect the level of government expenditures a local government provides so I need to use a method that uses information on spatial contiguity among locations. However, I first need to estimate the effects of natural amenities using a simple linear model and run diagnostic tests to check for spatial autocorrelation in the dependent variables and the error terms. Due to the computational limitations in the software that I use, I cannot run the simple linear model with all the diagnostic checks for my full panel sample of 2,981 counties.

I provide the results of the diagnostic checks for four subsets of states in the Appendix of this paper. The four subsets are the following: (1) Westside states -- California, Oregon, Nevada, and Arizona; (2) Northeast states -- New York, New Jersey, Massachusetts, and Pennsylvania; (3) Southeast states -- Florida, Georgia, Alabama, and South Carolina; and (4) Midwest states --

South Dakota, Nebraska, Minnesota, and Iowa. The goal of having four subsets in different parts of the US is to ensure that I am running the same models in areas of the US that have distinct differences in climatological variables, terrain, and water bodies. Tables A1.4 to A1.23 in the Appendix presents the results for the four subsets of states.

The results show that there is spatial autocorrelation in most of the dependent variables and error terms. The only items where there is no spatial autocorrelation for all four subsets of states include air transport, public building, parking, and sewerage expenditures. Hence, I use a simultaneous autoregressive (SAR) model to estimate the effect on the level of per capita revenue and per capita expenditure in counties of CONUS of the following: own and neighboring counties' natural amenities, per capita revenue items, per capita expenditure level (only for the per capita expenditure items), and residuals. SAR is ideal for the situation because it measures the effects on tax revenues and expenditure levels of a location's own variables (i.e., direct effects) and the effects of contiguous locations' variables (i.e., indirect effects).

I have two sets of natural amenities that may account for heterogeneity. One set of natural amenities change across periods. This includes climatological variables such as precipitation, temperature index, and drought indices. The other set of natural amenities does not change through time, hence, I run SAR random-effects model, and this includes topography type, type and size of water bodies, being a coastline county, and coastline vulnerability index. The second set of natural amenities motivates the need to use random effects model over fixed effects model because I need to assess the effect of these variables that have no within-group variation. Random effects estimation allows me to exploit both within-county and between-counties variation. Unfortunately, I do acknowledge that foregoing fixed effects estimation may possibly lead my estimates to suffer from omitted variable bias. By using random effects estimation, I am arguing that the data on county-level natural amenities can account for a substantial amount of heterogeneity.

The identification relies on the variation in the levels of natural amenities within and across counties in the determination of which natural characteristics of locations are important for setting tax policies and levels of certain local government expenditures. The SAR estimation model for county *k*'s tax revenue for tax item q is given as follows:

$$\tau_{k,q} = \rho_\tau W_{\tau 1}\tau_{k,q} + A_k\beta_\tau + e_{k,q} \quad (1.3)$$

$$e_{k,q} = \lambda_\tau W_{\tau 2} e_{k,q} + \epsilon_{k,q} \quad (1.4)$$

$$\text{where } \epsilon_{k,q} \sim (0, \sigma^2 I)$$

$\tau_{k,q}$ is the revenue level of tax item q (e.g., general sales, select sales, individual income, etc.) for county *k*. $W_{\tau 1}$ and $W_{\tau 2}$ are the spatial proximity matrices[13] or the spatial weight matrices associated with a spatial autoregressive process in the dependent variable $\tau_{k,q}$ and in the residuals $e_{k,q}$, respectively. $W_{\tau 1}$=1 for counties that are adjacent (queen contiguity criteria); 0 if otherwise. $W_{\tau 2}$ is defined similarly. ρ_τ is the spatial coefficient for $\tau_{k,q}$. I created a contiguity/adjacency matrix for the 2,967 counties in my dataset. This matrix contains 0's and 1's. A cell has 1 if the row county is adjacent to the column county, and 0 otherwise. The contiguity matrix enables me to compute spillover effects from adjacent counties with respect to the dependent variable, independent variables, and the error term. Missing counties in the dataset are not included in the contiguity matrix.[14]

λ is the spatial coefficient for the error term. A_k is the vector of natural amenities (i.e., topography type, climatological variables, bodies of water, etc.). β_τ is the coefficient of interest in this equation. $W_{\tau 1}\tau_{k,q}$ and $W_{\tau 2}e_{k,q}$ are spatially dependent lagged variables.[15] $\epsilon_{k,q}$ is the uncorrelated zero-mean error term. The SAR estimation model for county *k*'s government expenditure level for expenditure item *l* is given as follows:

$$g_{k,l} = \rho_g W_{g1} g_{k,l} + A_k\beta_g + \tau_k\delta + Z_k\theta_g + e_{k,q} \quad (1.5)$$

[13] Row standardized

[14] Missing counties may affect my results insofar as their values influence the direction and/or magnitude of the estimated relationships between contiguous areas.

[15] These are similar to the notation of temporally lagged variables as follows, for example: $\sum_{k=1}^{T} x_{t-k}$.

$$e_{k,l} = \lambda_g W_{g2} e_{k,l} + \epsilon_{k,l} \tag{1.6}$$

$$\text{where } \epsilon_{k,l} \sim (0, \sigma^2 I)$$

$g_{k,l}$ is the level of expenditure item *l* (e.g., education, highways, libraries, parks and recreation, etc.). Z_k is the vector of intergovernmental revenues county *k* receives from the federal,[16] state,[17] and local[18] governments, and fees for use of expenditure items. All other variables are as defined for equations (1.3) and (1.4) above. Expenditure items that *increase* with *more* natural amenities are interpreted as complements. Expenditure items that *decrease* with *more* natural amenities are interpreted as substitutes. $W_{g1} g_{k,l}$ and $W_{g2} e_{k,l}$ are spatially lagged variables. $\epsilon_{k,l}$ is the uncorrelated zero-mean error term.

In estimating equation (1.5), I also test for the significance of other variables on the level of government expenditure including tax policy τ_k, and transfers from the federal and state governments (Z_k).

In summary, the dependent variables are tax revenues and government expenditures. The independent variables are the climatological variables, topographic type, being a coastline county, coastline vulnerability, and types and size of water bodies.

1.6. Estimation Results

Average effects are divided into direct and indirect effects. Direct effects are due to the county's own independent variables. Indirect effects are due to the adjacent counties' independent

[16] The GFD classifies intergovernmental revenue counties receive from the federal government as follows: air transport, education, employment security administration, general revenue sharing, general support, health and hospitals, highways, transit subway, house community development, natural resources, public welfare, sewerage, and others (e.g., economic development, libraries, civil defense and militias, disaster assistance, public broadcasting, parks and recreation, water transportation).

[17] The GFD classifies intergovernmental revenue counties receive from the state government as follows: education, general local government support, health and hospitals, highways, housing and community development, public welfare, sewerage, water supply systems, electric power systems, gas supply systems, public mass transit systems, and others (e.g., public works).

[18] The GFD classifies intergovernmental revenue counties receive from the local government as follows: interschool system revenue, education, general local government support, health and hospitals, highways, housing and community development, public welfare, sewerage, water supply systems, electric power systems, gas supply systems, public mass transit systems, and others (e.g., public works, share of costs for courts, and central computer services).

variables' effect on the county's dependent variable. Total effect is the sum of direct and indirect effects. The figures summarize the direct and indirect effects of independent variables (in per capita nominal dollars) that are significant at 10% level of significance, at least. Figure 1.7 below presents the SAR-RE estimation results for per capita total revenue, total tax[19] revenue, and total expenditure. See Tables A2 and A3 at the Appendix for more details.

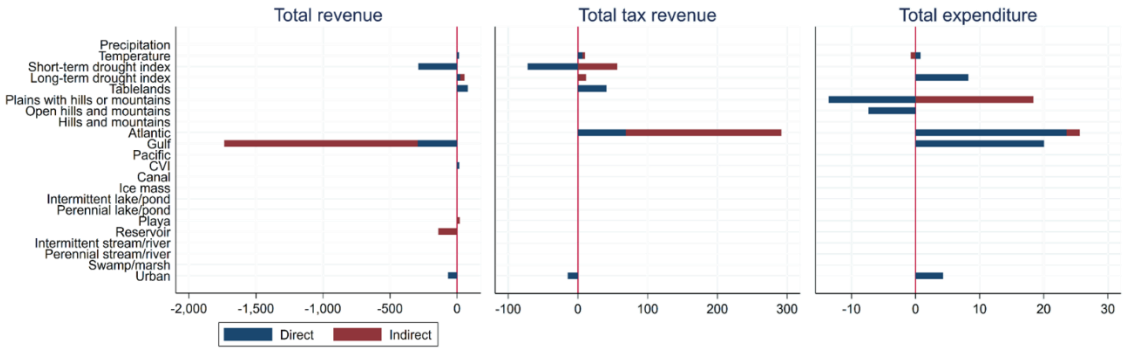


Figure 1.7: SAR-RE Estimation Results for per capita total revenue, tax revenue, and expenditure (in nominal dollars)

I will first discuss the direct effects. Having warmer temperature positively affects total revenue and total tax revenue while short-term wetness negatively affects them. Long-term wetness seems to lead to higher total expenditure. Counties with tablelands appear to have higher per capita total revenue and total tax revenue than counties characterized with plains. Counties characterized with plains with hills or mountains and those characterized with hills and mountains have lower per capita total expenditure than counties with plains.

It is interesting to note that the effects of being on the coast depends on whether a county is on the Atlantic, Gulf, or Pacific coast. Being on the Gulf coast has a negative effect on per capita total revenue and a positive effect on total expenditure. Being on the Atlantic coast is associated with both higher total tax revenue and total expenditure, which supports the observation in Curti et al. (1953) that the Atlantic coastal plain is historically attractive to English

[19] Total taxes include property tax, total sales tax, total license tax, total income tax, death and gift tax, documentary tax, severance tax, and taxes not elsewhere classified.

settlers due to accessibility to deep-water harbors. The Pacific coast does not seem to affect any of the per capita total items.

Water bodies do not seem to affect any of the per capita total items. Urban counties seem to have lower per capita total revenue and total tax revenue and higher per capita total expenditure than rural counties.

Indirect effects of natural amenities pertain to natural characteristics of a neighboring county that affect a county's per capita total items. A county that is adjacent to a Gulf coastline county has lower per capita total revenue. A county that is adjacent to an Atlantic coastline county has higher per capita total tax revenue. A neighbor's short-term and long-term wetness positively affects a county's per capita total tax revenue. A neighbor's plains with hills or mountains seem to make a county's per capita total expenditure higher.

To see which tax policies and expenditure items are driving the magnitude of effects with respect to natural amenities, see Figures 1.8, 1.9, 1.10, and 1.11. Figure 1.8 below presents the results by climatological variables. SAR-RE estimation results for per capita government expenditure items in thousands of nominal dollars control for revenue items.[20]

[20] Table A2 in the Appendix of this paper presents the SAR-RE estimation results for per capita expenditure items without per capita revenue regressors. The pseudo r-squared in those regressions range from 1.70% to 20.06%.

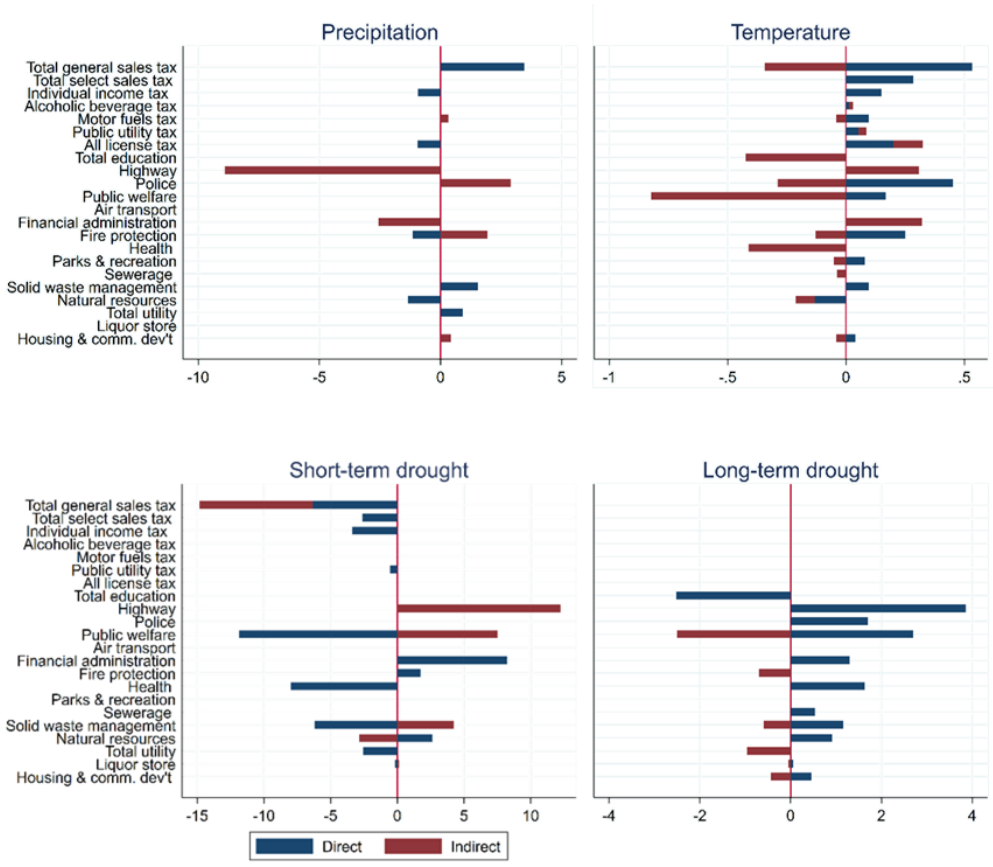


Figure 1.8: SAR-RE Estimation Results for per capita tax revenue and expenditure items, by climatological variables (in nominal dollars)

Among the climatological variables, warmer temperature is complemented the most by tax policies (i.e., select sales[21] and individual income tax) and local government expenditure (i.e., police, public welfare, fire protection, parks & recreation, solid waste management, and housing & community development).

Precipitation is complemented by general sales tax[22] and substituted by lower individual income tax and lower license tax. Per capita expenditures on solid waste management and total utility are complements to more rain while expenditures on fire protection and natural resources are substitutes.

[21] Total selective sales taxes include alcoholic beverage, amusement, insurance premium, motor fuel, pari-mutuels (sales taxes on wagers and betting), public utilities, tobacco, and other selective sales tax.
[22] General sales taxes include taxes on the sale of all types of goods and services.

Tax policies seem to substitute for short-term wetness. Per capita expenditures that substitute for short-term wetness include public welfare, health, solid waste management, and total utility. Expenditures that complement short-term wetness include financial administration, fire protection, and natural resources.

Long-term wetness is mostly complemented with expenditures, including highway, police, public welfare, financial administration, health, sewerage, solid waste management, natural resources, and housing & community development. Education expenditure substitutes for long-term wetness.

As for indirect effects, a neighbor having warmer temperature is mostly substituted with general sales tax, motor fuels tax, and expenditures.

Figure 1.9 below presents the results by topography type, where the base outcome is `Plains'.

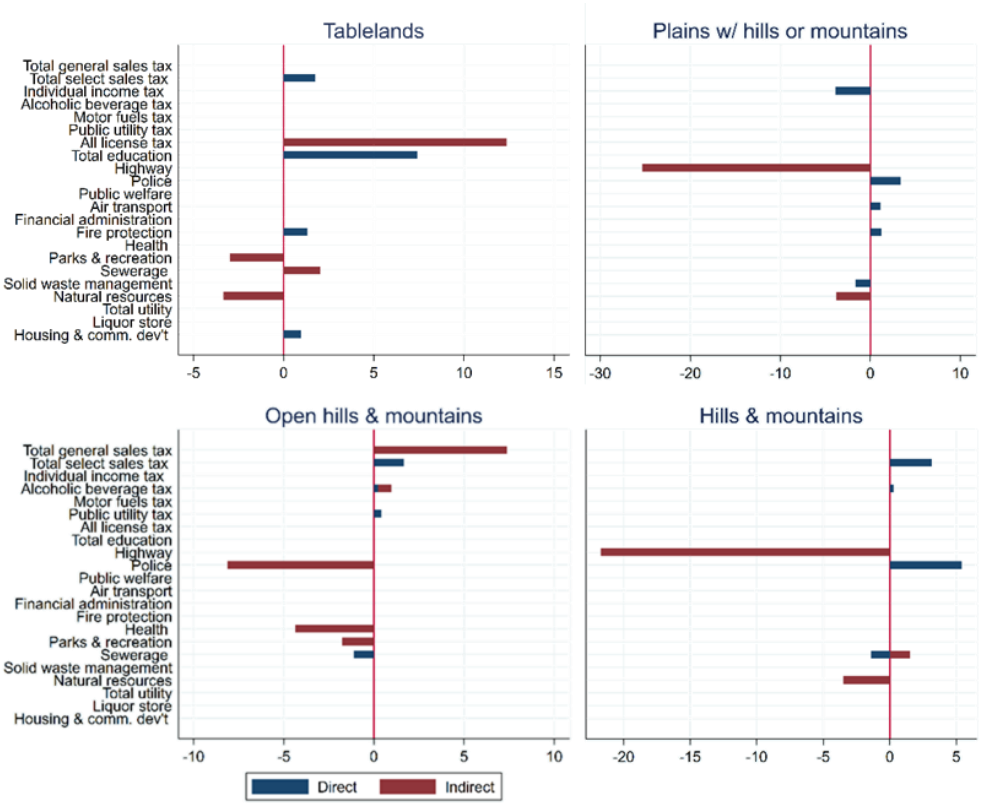


Figure 1.9: SAR-RE Estimation Results for per capita tax revenue and expenditure items, by topography type where base type is 'Plains' (in nominal dollars)

Among topography type, being on tablelands is complemented with select sales tax, per capita expenditure on education, fire protection and housing & community development compared to plains. Plains with hills or mountains are complemented with expenditures on police, air transport, and fire protection, while they are substituted by individual income tax and expenditures on sewerage and solid waste management. Open hills & mountains and hills & mountains are complemented with select sales tax and, very minimally with alcoholic beverage tax. Expenditure on police complements counties with hills & mountains while sewerage expenditure substitutes for it.

A neighbor that has tablelands seems to benefit a county in terms of all license tax revenue. A neighbor's open hills & mountains also benefits a county in terms of select sales tax and alcoholic beverage tax revenues. A county adjacent to a county that has either plains with hills or mountains or hills & mountains provides lower expenditures on highway and natural resources. It is surprising that the effect of topography on highway expenditures is primarily indirect. My result suggesting that a hilly or mountainous county has higher highway expenditures than its adjacent counties lends support to the finding of Collier et al. (2015) that terrain and surface area affect the unit cost of building roads.

Figure 1.10 below presents the results by coastline type and coastal vulnerability index.

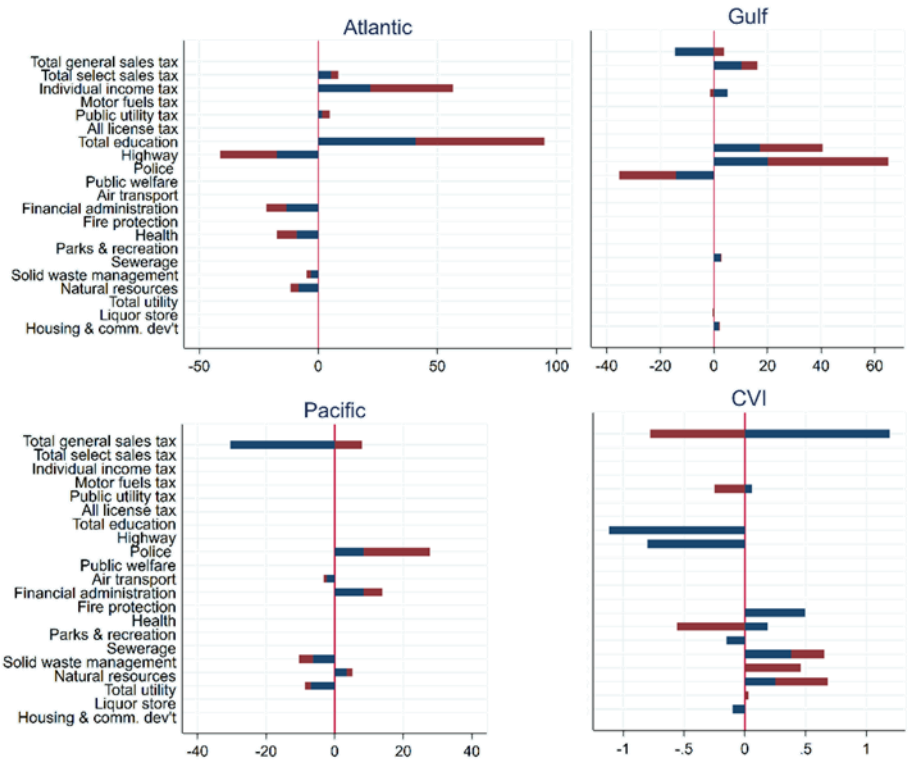


Figure 1.10: SAR-RE Estimation Results for per capita tax revenue and expenditure items, by coastline and coastal vulnerability index (in nominal dollars)

The effect of being a coastline county differs according to which coast -- Atlantic, Gulf, or Pacific. Select sales tax complements being on the Atlantic and Gulf coasts. General sales tax substitutes for (i.e., general sales tax revenues are lower) being on the Gulf and Pacific coasts. Expenditures that are substitutes for being in the Atlantic coast[23] include highway, financial administration, health, solid waste management, and natural resources. Meanwhile, education expenditure complements being on the Atlantic coast.

Gulf coast counties provide less public welfare expenditure (i.e., substitute) while providing more expenditure on highway, police, sewerage, and housing & community development (i.e., complements).

[23] Similarly, these are the expenditure items that counties not on the Atlantic coast provide more to compensate for it.

Pacific coast counties provide less expenditure on air transport, solid waste management, and total utility. They provide more expenditure on police, financial administration, and natural resources.

Counties with higher coastal vulnerability have higher revenues from general sales tax and public utility tax. Higher CVI is substituted by expenditure on highway, police, sewerage, and housing. Expenditures on health, parks & recreation, solid waste management, and total utility complement higher CVI.

Figure 1.11 below presents the results by type of water bodies.

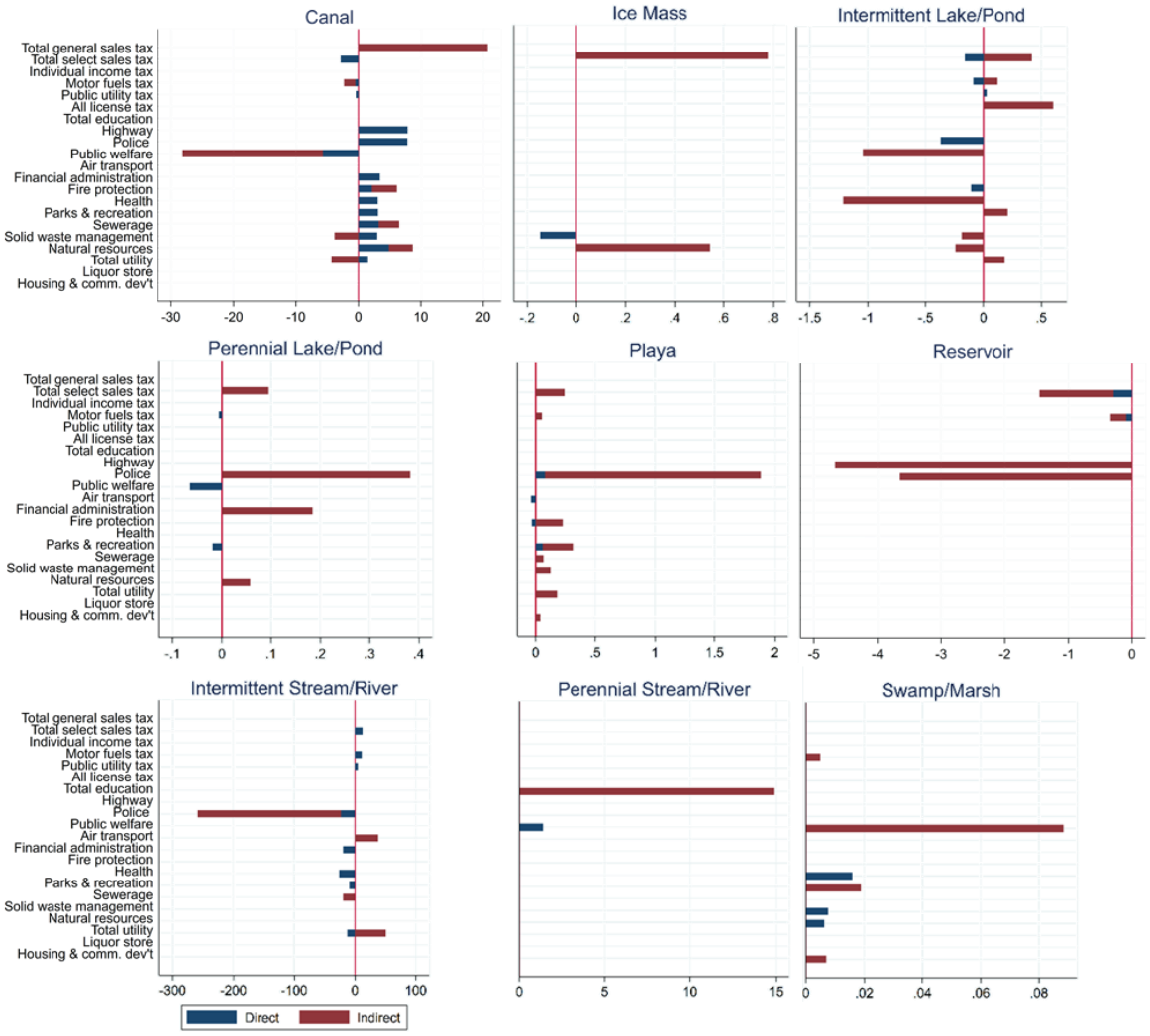


Figure 1.11: SAR-RE Estimation Results for per capita tax revenue and expenditure items, by type of water bodies (in nominal dollars)

Having canals in a county is complemented with a number of expenditures including highway, police, financial administration, fire protection, health, parks & recreation, sewerage, solid waste management, natural resources, and total utility. Substitutes for canal include select sales tax and public welfare expenditure. A plausible explanation for why canals complement several expenditures is the historical importance of canals as a mode of transportation before the construction of railroads all over US. Having canals is possibly providing a proxy for agglomeration economies that developed around important ports or access points, especially for New York, as outlined in North (1966).

Having intermittent stream/river is complemented with select sales, motor fuels and public utility tax. Substitutes for it include expenditures on police, financial administration, health, parks & recreation, and total utility.

Swamp/marsh is complemented with expenditures on health, solid waste management, and natural resources.

It can be observed from the graphs that indirect effects of water bodies are much larger than direct effects. A possible explanation for it is clustering of effect due to counties that contain the same water bodies.

Figure 1.12 shows the effect of urbanity.

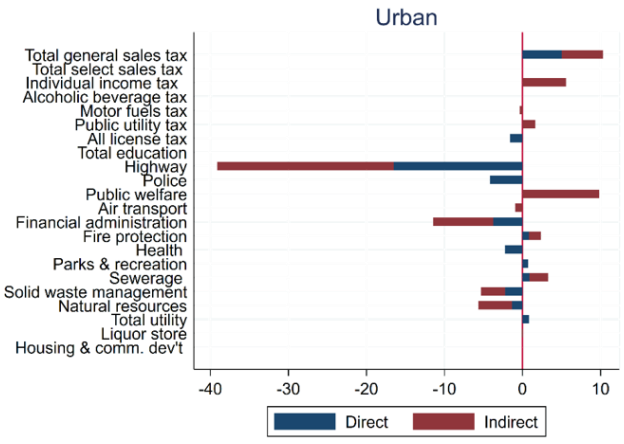


Figure 1.12: SAR-RE Estimation Results for per capita tax revenue and expenditure items, by urbanity (in nominal dollars)

Urban counties have higher general sales tax revenue but lower all license tax revenue. As for expenditures, urban counties have higher expenditures on fire protection, parks & recreation, sewerage, and total utility. They have lower per capita expenditures on highway, police, financial administration, health, solid waste management, and natural resources.

Figure 1.13 shows the effect of a county's revenue source.

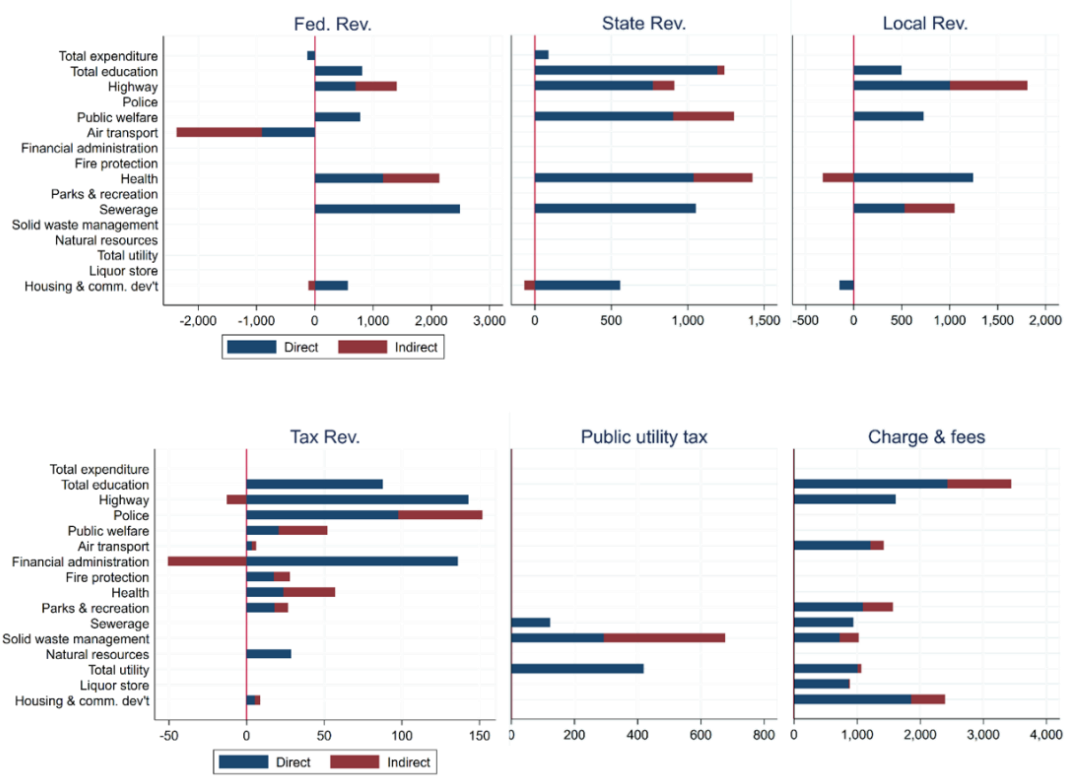


Figure 1.13: SAR-RE Estimation Results for per capita tax revenue and expenditure items, by revenue source (in nominal dollars)

Transfers from the federal government are used for counties' expenditure on education, highway, public welfare, health, sewerage, and housing & community development. Transfers from the state government are used for counties' expenditure on education, highway, public welfare, health, sewerage, and housing & community development. Local government transfers fund counties' expenditure on education, highway, public welfare, health, and sewerage.

Tax revenues are used for almost all expenditure items and very minimally for air transport (which seems to rely more on charges and fees). Public utility tax funds sewerage, solid waste management, and total utility expenditures. Charges and fees fund education, highway, air transport, parks & recreation, sewerage, solid waste management, total utility, liquor store, and housing & community development expenditures.

Within the estimation of spatial models, I computed for whether there are spillover effects from one county's tax revenue or expenditure item to other counties' same tax revenue or expenditure item. I also computed for whether error terms are correlated among counties. Table 1.2 below presents the correlation in dependent variable (ρ in equations 1.3 and 1.5) and error terms (λ in equations 1.4 and 1.6) among counties and their adjacent neighbors.

Table 1.2: Correlation in Dependent Variables and Error Terms

Dependent Variable	Correlation with Neighbors' DV	Correlation with Neighbors' Error Term
Revenue items		
Total revenue	0.95 ***	-0.57 ***
Total tax revenue	0.89 ***	-0.48 ***
Total general sales tax	-0.40 ***	0.98 ***
Total select sales tax	0.45 ***	0.07 **
Alcoholic beverage tax	0.82 ***	-0.84 ***
Motor fuels tax	-0.45 ***	0.96 ***
Public utility tax	0.80 ***	-0.13 ***
Tobacco tax	0.66 ***	-0.64 ***
Total license tax	0.91 ***	-0.86 ***
Individual income tax	0.73 ***	0.44 ***
Expenditure items		
Total expenditure	0.09 ***	-0.01
Air transport	0.30 ***	-0.26 ***
Total education	0.68 ***	-0.15 ***
Health	0.57 ***	-0.36 ***
Financial administration	0.47 ***	-0.24 ***
Fire protection	0.42 ***	-0.07 *
Judicial	-0.33 ***	0.73 ***
Public building	0.09 ***	-0.04
Central staff services	0.34 ***	-0.24 ***
Total highways	0.69 ***	-0.60 ***
Natural resources	0.36 ***	-0.17 ***
Parking	0.08 ***	-0.11 ***
Parks & recreation	0.44 ***	-0.40 ***
Police protection	0.81 ***	-0.64 ***
Protective inspection & regulation	0.81 ***	-0.68 ***
Public welfare	0.71 ***	-0.43 ***
Sewerage	0.15 ***	-0.08 **
Solid waste management	0.47 ***	-0.21 ***
Water transport	0.01	-0.02
Liquor store	0.12 ***	-0.09 ***
Total utility	0.22 ***	-0.11 ***
Transit subsidies	-0.41 ***	0.50 ***
Housing & community development	0.13 ***	-0.05
Libraries	0.62 ***	-0.50 ***

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

There is a strong positive correlation in revenues of adjacent counties in the following items: total revenue, total tax revenue, alcoholic beverage tax, public utility tax, total license tax, tobacco tax, and individual income tax. Adjacent counties have a moderate positive correlation in total select sales tax revenue. There is moderate negative correlation between adjacent counties in total general sales tax and motor fuels tax revenues.

For expenditure items, adjacent counties have strong positive correlation in total education, total highways, police protection, protective inspection & regulation, public welfare, and libraries. Counties have moderate positive correlation in air transport, health, financial administration, fire protection, central staff services, natural resources, parks & recreation, solid waste management, and total utility. There is weak positive correlation in adjacent counties' total expenditures, public building, parking, sewerage, liquor store, and housing & community development. Moderate negative correlation exists among adjacent counties' expenditures for judicial services and transit subsidies.

1.7. Conclusion

My estimation results show not only if tax policies and local government expenditures are complements or substitutes but also whether contiguous counties' natural amenities affect provision of local government public goods. Among the natural amenities, being a coastline county seems to have the largest average impact on per capita tax revenues and expenditures. Total select sales tax policy directly complements being on the Atlantic and Gulf coastlines. Total general sales tax policy directly substitutes for being on the Gulf and Pacific coastlines. Total education expenditure complements being on the Atlantic and Gulf coastlines. Highway expenditure substitutes for being on the Atlantic coastline, while it complements being on the Gulf and the Pacific coastlines.

Of all natural amenities considered in this study, climatological variables affect the most number of tax policies and expenditure types. Warmer temperature directly complements most

tax policies and expenditure types. Having a neighbor with warm temperature seems to be associated with lower tax revenues and expenditure levels. Having short-term wetness is mostly substituted by tax policies and expenditure levels while long-term wetness is mostly complemented by expenditures.

The effect of topography type is largely indirect (i.e., as a neighboring county's characteristic). The relatively large direct impact of tablelands compared to plains is on total education (complement). Meanwhile the relatively large direct impact of hills and mountains compared to plains is on police expenditure (complement).

Among water bodies, canals have the most direct and indirect effects on tax policy and expenditure levels. Meanwhile, intermittent streams/rivers have the biggest (mostly indirect) effect on expenditure levels -- negative for police expenditure and positive for air transport and total utility expenditure.

As expected, higher intergovernmental revenues, tax revenues, and charges & fees are mostly associated with larger direct impacts on expenditure levels. Indirect impacts of revenue items on expenditure levels are largely positive except for federal revenue on air transport, state revenue on housing & community development, and tax revenue on highway and financial administration expenditure. Moreover, when neighboring counties charge higher fees, a county tends to have higher levels of expenditure for the following expenditure items: education, air transport, parks & recreation, solid waste management, total utility, liquor store, and housing & community development.

Lastly, almost all tax revenue and expenditure items are positively correlated with the neighbor's similar tax revenue and expenditure items. There is negative correlation between a county and its neighbor in total general sales tax and motor fuels tax revenue, as well as in expenditures for judicial and transit subsidies.

Some of my results provide support for the observations in North (1966) and Curti et al. (1953) and for the findings in Collier et al. (2015). I also find some support for the argument in

Chen et al. (2013) that natural amenities complement provision of recreational facilities and expenditures on natural resources. My results that support Chen et al. (2013) indicate that warmer temperature, less precipitation, short-term and long-term wetness, topography type, being on the Pacific coast, having higher chances of coastal change, canals, intermittent stream/river, and swamp/marsh complement county-level expenditures on parks & recreation and natural resources.

From a policy standpoint, an urban planner may find utility in the results of this study by taking stock of what natural amenities its jurisdiction has and plan expenditure items that can be funded using taxes, intergovernmental transfers, or charges/fees. My results also provide guidance as to the types and magnitudes of spillovers from neighboring jurisdictions that urban planners may either need to be mindful of or take advantage of.

A major limitation in this study is that I am only looking at the variation in dollar amounts in expenditure. I am not controlling for how quantity and/or quality of expenditure items vary according to natural amenities. For example, variation in miles of highway built for variations in natural amenities provides a better measure of what counts as substitute and complement to it. Another limitation is the fact that my dataset begins only in 1972 so I cannot disentangle the effect of canals as a natural advantage and its effect as proxy for the agglomeration economies canals provide to early ports in the US such as New York.

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APPENDIX

Table A1.1: List of counties dropped from dataset due to significant county boundary changes

- Colorado:
  - Adams
  - Boulder
  - Jefferson
  - Weld
- Florida:
  - Franklin
  - Gulf
- Maryland:
  - Montgomery
  - Prince George's
- Montana:
  - Gallatin
  - Park
- New Mexico:
  - Valencia
- North Carolina:
  - Carteret
  - Craven
- Virginia:
  - Albemarle
  - Alleghany
  - Augusta
  - Bedford
  - Fairfax
  - Franklin
  - Greensville
  - Halifax
  - James City
  - Pittsylvania
  - Prince William
  - Rockbridge
  - Rockingham
  - Southampton
  - Spotsylvania
  - York

Table A1.2: SAR-RE Estimation Results for per capita total revenue and total tax revenue items, thousands of nominal dollars

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Total revenue			Total tax revenue			Total general sales tax revenue			Total select sales tax revenue			Individual income tax revenue		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
D(Atlantic=1)	-0.0720	-0.3536	-0.4255	0.0687 *	0.2229 *	0.2917 *	-0.0028	0.0007	-0.0021	0.0053 **	0.0032 **	0.0084 **	0.0217 ***	0.0348 ***	0.0565 ***
D(Gulf=1)	-0.2935 ***	-1.4421 ***	-1.7357 ***	-0.0296	-0.0959	-0.1254	-0.0146 **	0.0039 **	-0.0107 **	0.0102 ***	0.0061 ***	0.0163 ***	0.0020	0.0032	0.0052
D(Pacific=1)	-0.1552	-0.7625	-0.9177	-0.0298	-0.0967	-0.1265	-0.0304 ***	0.0080 ***	-0.0224 ***	0.0006	0.0004	0.0010	0.0021	0.0034	0.0055
CVI	0.0161 ***	0.0532	0.0693	0.0012	-0.0100	-0.0088	0.0012 ***	-0.0008 *	0.0004	-0.0001	-0.0002	-0.0003	-0.0003	-0.0008	-0.0010
Total sqmi of canal	0.0447	-0.6292	-0.5845	0.0043	-0.1239	-0.1196	-0.0032	0.0207 ***	0.0175 ***	-0.0028 ***	0.0038	0.0009	-0.0005	-0.0061	-0.0066
Total sqmi of ice mass	-0.0040	-0.0412	-0.0453	0.0008	0.0140	0.0148	-0.0004	0.0004	0.0000	0.0001	0.0008 *	0.0009 *	0.0000	-0.0001	-0.0001
Total sqmi of lake/pond (intermittent)	0.0008	-0.0047	-0.0040	-0.0011	0.0082	0.0071	-0.0002	-0.0004	-0.0006	-0.0002 **	0.0004 **	0.0003	0.0000	-0.0001	-0.0002
Total sqmi of lake/pond (perennial)	-0.0001	0.0087	0.0086	0.0001	0.0012	0.0013	0.0001	0.0001	0.0002 **	0.0000	0.0001 **	0.0001 **	0.0000	0.0000	0.0000
Total sqmi of playa	0.0004	0.0201 **	0.0205 *	0.0001	0.0036	0.0038	0.0000	0.0001	0.0001	0.0000	0.0002 ***	0.0003 ***	0.0000	0.0001	0.0001
Total sqmi of reservoir	-0.0058	-0.1395 **	-0.1453 *	-0.0033	-0.0377	-0.0410 *	-0.0004	-0.0012	-0.0016 *	-0.0003 *	-0.0012 **	-0.0015 ***	0.0000	0.0003	0.0003
Total sqmi of stream/river (intermittent)	0.2698	-1.3982	-1.1283	-0.0515	-0.6934	-0.7449	-0.0035	0.0100	0.0065	0.0122 **	0.0169	0.0291	-0.0006	-0.0068	-0.0074
Total sqmi of stream/river (perennial)	-0.0097	0.0840	0.0743	-0.0036	0.0395	0.0360	-0.0010	-0.0013	-0.0023	-0.0002	-0.0014	-0.0016 *	0.0000	0.0000	0.0000
Total sqmi of swamp/marsh	0.0001	0.0008	0.0009	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Topography type (Base: Plains)															
Tablelands	0.0795 **	0.0990	0.1784	0.0408 **	0.0496	0.0903	0.0038	0.0069	0.0107 **	0.0017 *	-0.0015	0.0003	0.0021	0.0078	0.0099 *
Plains with hills or mountains	-0.0212	-0.0895	-0.1108	-0.0129	-0.0516	-0.0644	-0.0008	-0.0057	-0.0066	0.0004	0.0028	0.0032	-0.0039 ***	-0.0020	-0.0059
Open hills and mountains	0.0136	0.1769	0.1905	0.0034	0.0580	0.0614	0.0015	0.0074 **	0.0089 ***	0.0016 **	0.0004	0.0020 *	-0.0011	0.0031	0.0020
Hills and mountains	0.0314	0.1198	0.1512	0.0072	0.0409	0.0481	0.0016	0.0065	0.0080 **	0.0032 ***	0.0007	0.0039 ***	-0.0016	-0.0011	-0.0028
Precipitation	0.0087	-0.0217	-0.0130	-0.0094	-0.0162	-0.0255 *	0.0035 **	0.0025	0.0059 ***	-0.0001	0.0005	0.0005	-0.0009 *	0.0012	0.0002
Temperature	0.0144 ***	0.0067	0.0210 ***	0.0066 ***	0.0035 **	0.0101 ***	0.0005 ***	-0.0003 ***	0.0002	0.0003 ***	0.0000	0.0003 ***	0.0001 ***	-0.0001	0.0000
Short-term drought index (1 month)	-0.2894 ***	0.0868	-0.2026 ***	-0.0721 ***	0.0564 **	-0.0157	-0.0063 **	-0.0085 *	-0.0149 ***	-0.0026 **	0.0021	-0.0006	-0.0034 ***	-0.0001	-0.0035
Long-term drought index (24 months)	0.0223 ***	0.0336 **	0.0559 ***	0.0026	0.0117 **	0.0143 ***	-0.0008	0.0012	0.0004	0.0004	-0.0006	-0.0001	0.0003	0.0005	0.0008
D(Urban=1)	-0.0679 ***	-0.1095	-0.1774	-0.0145 *	0.0204	0.0060	0.0050 ***	0.0053 *	0.0103 ***	0.0004	0.0008	0.0012	0.0008	0.0056 *	0.0064 *
Pseudo R-squared		0.0170			0.0225			0.0372			0.0590			0.0561	

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.2: SAR-RE Estimation Results for per capita total revenue and total tax revenue items, thousands of nominal dollars (cont'd.)

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Alcoholic beverage tax revenue			Motor fuels tax revenue			Public utility tax revenue			All license tax revenue		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
D(Atlantic=1)	0.0000	0.0000	0.0000	0.0006	-0.0002	0.0004	0.0015 ***	0.0032 ***	0.0047 ***	0.0000	0.0001	0.0001
D(Gulf=1)	-0.0003	-0.0007	-0.0010	0.0050 ***	-0.0015 ***	0.0036 ***	0.0004	0.0009	0.0013	0.0007	0.0027	0.0034
D(Pacific=1)	-0.0004	-0.0008	-0.0012	0.0002	-0.0001	0.0002	-0.0003	-0.0007	-0.0010	0.0001	0.0003	0.0004
CVI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001 *	-0.0002 **	-0.0002	-0.0001	-0.0006	-0.0007
Total sqmi of canal	-0.0001	-0.0005	-0.0006	-0.0005 ***	-0.0018 ***	-0.0023 ***	-0.0004 *	0.0014	0.0010	-0.0007	-0.0061	-0.0068
Total sqmi of ice mass	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0011	0.0012
Total sqmi of lake/pond (intermittent)	0.0000	0.0000	0.0000	-0.0001 ***	0.0001 ***	0.0000	0.0000 *	0.0000	0.0000	0.0000	0.0006 *	0.0006
Total sqmi of lake/pond (perennial)	0.0000	0.0000	0.0000	0.0000 **	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total sqmi of playa	0.0000	0.0000	0.0000	0.0000	0.0001 ***	0.0000 ***	0.0000	0.0000	0.0000	0.0000	-0.0001	-0.0001
Total sqmi of reservoir	0.0000	0.0000	-0.0001	-0.0001 ***	-0.0002 ***	-0.0003 ***	0.0000	-0.0003	-0.0003	-0.0001	-0.0008	-0.0008
Total sqmi of stream/river (intermittent)	0.0000	-0.0004	-0.0004	0.0110 ***	-0.0008	0.0102 ***	0.0044 ***	0.0087	0.0131	-0.0017	-0.0322	-0.0339
Total sqmi of stream/river (perennial)	0.0000	-0.0001	-0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0001	-0.0005	-0.0006
Total sqmi of swamp/marsh	0.0000	0.0000	0.0000	0.0000	0.0000 ***	0.0000 ***	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Topography type (Base: Plains)												
Tablelands	0.0001	-0.0001	0.0000	0.0000	0.0001	0.0001	0.0002	-0.0008	-0.0006	0.0005	0.0124 ***	0.0128
Plains with hills or mountains	-0.0001	0.0001	0.0000	0.0003	0.0003	0.0006 *	0.0002	0.0016	0.0018 *	0.0002	0.0062	0.0064
Open hills and mountains	0.0002 **	0.0007 **	0.0010 ***	0.0000	-0.0003	-0.0004 *	0.0004 **	0.0002	0.0006	-0.0001	0.0011	0.0010
Hills and mountains	0.0003 **	-0.0002	0.0001	-0.0001	-0.0004	-0.0005 **	0.0003	0.0008	0.0011 *	-0.0001	0.0010	0.0009
Precipitation	0.0000	0.0000	0.0000	0.0000	0.0003 **	0.0003 ***	-0.0001	0.0000	-0.0001	-0.0009 ***	0.0004	-0.0006
Temperature	0.0000 ***	0.0000 **	0.0000 ***	0.0001 ***	0.0000 ***	0.0001 ***	0.0001 ***	0.0000 *	0.0001 ***	0.0002 ***	0.0001 *	0.0003
Short-term drought index (1 month)	0.0000	0.0001	0.0000	-0.0004	0.0004	0.0000	-0.0006 **	0.0004	-0.0001	0.0006	0.0000	0.0006
Long-term drought index (24 months)	0.0000	0.0000	0.0000 *	0.0001	0.0000	0.0001	0.0000	-0.0001	0.0000	0.0002	0.0003	0.0005
D(Urban=1)	0.0000	0.0002	0.0003	0.0002	-0.0004 *	-0.0002	0.0003	0.0016 ***	0.0019 ***	-0.0016 ***	-0.0007	-0.0022
Pseudo R-squared		0.0671			0.0732			0.0423			0.2006	

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.3: SAR-RE Estimation Results for per capita expenditure items, thousands of nominal dollars

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Total expenditure			Total education expenditure			Highway expenditure			Police expenditure			Public welfare expenditure		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Per capita total revenue	0.9116 ***	0.0476 ***	0.9592 ***												
Per capita Federal revenue	-0.1306 ***	-0.0587	-0.1893 ***	0.8142 ***	0.4779	1.2920 ***	0.6969 ***	0.7075 ***	1.4044 ***				0.7775 ***	0.1591	0.9366 ***
Per capita State revenue	0.0880 ***	0.0046	0.0926 ***	1.1942 ***	0.0446 **	1.2388 ***	0.7740 ***	0.1392 ***	0.9133 ***				0.9043 ***	0.3989 ***	1.3032 ***
Per capita Local revenue				0.4979 ***	0.5913	1.0892 **	1.0009 ***	0.8098 ***	1.8107 ***				0.7298 ***	-0.388	0.3413
Per capita total taxes				0.0877 ***	0.0012	0.0889 ***	0.1428 ***	-0.013 **	0.1301 ***	0.0976 ***	0.0544 ***	0.152 ***	0.0205 ***	0.0316 ***	0.0521 ***
Per capita charge from exp item				2.4321 ***	1.0098 ***	3.4420 ***	1.6097 ***	0.44	2.0497 ***						
D(Atlantic=1)	0.0236 **	0.0020 *	0.0256 **	0.0409 ***	0.0540 ***	0.0949 ***	-0.0175 **	-0.0238 **	-0.0413 **	0.0003	0.0007	0.001	-0.0072	-0.0106	-0.0178
D(Gulf=1)	0.0200 *	0.0017	0.0218 *	-0.0012	-0.0016	-0.0029	0.0171 **	0.0233 **	0.0404 **	0.0200 ***	0.0451 ***	0.0651 ***	-0.0142 **	-0.0210 **	-0.0352 **
D(Pacific=1)	-0.0065	-0.0006	-0.0071	0.0018	0.0024	0.0042	0.0070	0.0095	0.0165	0.0085 *	0.0192 *	0.0278 *	-0.0078	-0.0116	-0.0194
CVI	-0.0010	0.0009	-0.0001	-0.0001	-0.0015	-0.0016	-0.0011 ***	-0.0012	-0.0024 *	-0.0008 ***	-0.0013	-0.0021 *	0.0003	0.0004	0.0007
Total sqmi of canal	-0.0014	-0.0170	-0.0184 *	-0.0010	-0.0028	-0.0038	0.0079 **	0.0099	0.0178	0.0078 ***	-0.0007	0.0072	-0.0057 **	-0.0225 *	-0.0282 **
Total sqmi of ice mass	-0.0003	-0.0016	-0.0019	0.0002	0.0014	0.0016	0.0005	0.0017	0.0022	-0.0001	-0.0018	-0.0019	-0.0002	-0.0022	-0.0024
Total sqmi of lake/pond (intermittent)	0.0004	-0.0007	-0.0003	0.0002	0.0006	0.0009	0.0003	-0.0003	0.0000	-0.0004 ***	-0.0001	-0.0005	0.0001	-0.0010 *	-0.0010
Total sqmi of lake/pond (perennial)	-0.0001	0.0000	0.0000	0.0000	-0.0003	-0.0003	0.0000	0.0002	0.0002	0.0000	0.0004 ***	0.0004 **	-0.0001 *	0.0001	0.0001
Total sqmi of playa	0.0000	0.0001	0.0001	0.0001	-0.0003	-0.0002	-0.0001	0.0004	0.0003	0.0001 *	0.0018 ***	0.0019 ***	0.0000	-0.0004	-0.0004
Total sqmi of reservoir	0.0003	-0.0014	-0.0011	0.0001	0.0037	0.0038	-0.0002	-0.0047 **	-0.0049 **	-0.0003	-0.0036 **	-0.0039 **	-0.0001	-0.0001	-0.0001
Total sqmi of stream/river (intermittent)	-0.0034	-0.0850	-0.0884	-0.0119	-0.0661	-0.0781	-0.0586	-0.1362	-0.1948	-0.0230 *	-0.2360 ***	-0.2589 ***	-0.0048	-0.0649	-0.0697
Total sqmi of stream/river (perennial)	-0.0010	-0.0012	-0.0022	-0.0002	0.0149 ***	0.0147 ***	-0.0003	0.0000	-0.0004	0.0001	-0.0002	-0.0001	0.0014 **	-0.0013	0.0001
Total sqmi of swamp/marsh	0.0000	0.0000	0.0000	0.0000	-0.0001	-0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001 *	0.0001 **
Topography type (Base: Plains)															
Tablelands	0.0033	-0.0075	-0.0043	0.0074 *	-0.0129	-0.0055	0.0025	0.0127	0.0152 *	0.0021	-0.0079	-0.0058	-0.0002	-0.0027	-0.0029
Plains with hills or mountains	-0.0136 ***	0.0184 **	0.0048	-0.0029	-0.0020	-0.0049	-0.0004	-0.0254 **	-0.0257 ***	0.0033 *	-0.0092	-0.0058	-0.0016	0.0068	0.0052
Open hills and mountains	-0.0074 **	0.0049	-0.0024	0.0029	0.0084	0.0113 *	0.0013	-0.0036	-0.0023	0.0005	-0.0081 **	-0.0076 **	0.0019	-0.0022	-0.0003
Hills and mountains	-0.0082	0.0028	-0.0053	0.0018	-0.0104	-0.0085	0.0037	-0.0217 ***	-0.0180 ***	0.0054 ***	0.0010	0.0064	-0.0035	-0.0073	-0.0109 **
Precipitation	0.0021	0.0006	0.0027 **	-0.0014	-0.0017	-0.0031	0.0011	-0.0089 ***	-0.0078 ***	-0.0003	0.0029 **	0.0026 **	-0.0009	0.0004	-0.0004
Temperature	0.0008 ***	-0.0007 ***	0.0000	-0.0001	-0.0004 **	-0.0005 *	0.0001	0.0003 *	0.0005 **	0.0005 ***	-0.0003 **	0.0002	0.0002 *	-0.0008 ***	-0.0007 ***
Short-term drought index (1 month)	0.0003	-0.0020	-0.0017	-0.0030	0.0066	0.0036	0.0006	0.0122 **	0.0129 ***	-0.0025	-0.0021	-0.0047 **	-0.0119 ***	0.0075 **	-0.0044 *
Long-term drought index (24 months)	0.0082 ***	-0.0043	0.0039 ***	-0.0025 **	0.0012	-0.0013	0.0039 ***	-0.0002	0.0037 ***	0.0017 ***	-0.0006	0.0011 **	0.0027 ***	-0.0025 ***	0.0002
D(Urban=1)	0.0043 *	0.0061	0.0104 ***	0.0031	0.0068	0.0098	-0.0165 ***	-0.0226 ***	-0.0391 ***	-0.0042 ***	-0.0065	-0.0107 **	-0.0010	0.0098 **	0.0088 *
Pseudo R-squared		0.9510			0.9166			0.7256			0.4958			0.7556	

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.3: SAR-RE Estimation Results for per capita expenditure items, thousands of nominal dollars (cont'd.)

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Air transport expenditure			Financial administration expenditure			Fire protection expenditure			Health expenditure			Parks & recreation expenditure		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Per capita total revenue															
Per capita Federal revenue	-0.9070 ***	-1.46487 **	-2.3718 ***							1.1687 ***	0.9683 ***	2.1370 ***			
Per capita State revenue										1.0392 ***	0.3862 ***	1.4254 ***			
Per capita Local revenue										1.2448 ***	-0.3221 *	0.9227 ***			
Per capita total taxes	0.0034 ***	0.002825 ***	0.0062 ***	0.1362 ***	-0.0507 ***	0.0855 ***	0.0175 ***	0.0103978 ***	0.0278674 ***	0.0236 ***	0.0336 ***	0.0572 ***	0.0180 ***	0.0087 ***	0.0266 ***
Per capita charge from exp item	1.2105 ***	0.211037 ***	1.4215 ***										1.0937 ***	0.4727 ***	1.5665 ***
D(Atlantic=1)	-0.0006	-0.0002	-0.0007	-0.0134 ***	-0.0086 ***	-0.0219 ***	0.0014	0.0008	0.0022	-0.0092 ***	-0.0082 ***	-0.0174 ***	0.0008	0.0004	0.0012
D(Gulf=1)	-0.0003	-0.0001	-0.0005	0.0034	0.0022	0.0056	-0.0005	-0.0003	-0.0008	-0.0042	-0.0038	-0.0080	0.0028	0.0016	0.0044
D(Pacific=1)	-0.0023 *	-0.0008 *	-0.0031 *	0.0085 *	0.0054 *	0.0139 *	0.0008	0.0005	0.0013	0.0029	0.0026	0.0055	-0.0006	-0.0004	-0.0009
CVI	0.0001	0.0000	0.0001	-0.0003	0.0002	-0.0001	0.0000	0.0000	0.0001	0.0005 **	0.0004	0.0009 *	0.0002 *	-0.0006 ***	-0.0004 *
Total sqmi of canal	-0.0004	-0.0001	-0.0005	0.0034 **	-0.0010	0.0025	0.0022 ***	0.0040 *	0.0062 **	0.0031 **	-0.0040	-0.0009	0.0031 ***	-0.0007	0.0024
Total sqmi of ice mass	0.0000	-0.0001	-0.0001	0.0002	0.0005	0.0007	0.0000	-0.0003	-0.0004	-0.0001	-0.0012	-0.0013	0.0000	0.0004	0.0005
Total sqmi of lake/pond (intermittent)	0.0000	-0.0001	-0.0001	-0.0001	0.0003	0.0002	-0.0001 **	0.0002	0.0001	0.0001	-0.0012 ***	-0.0011 ***	0.0000	0.0002 *	0.0002
Total sqmi of lake/pond (perennial)	0.0000	0.0000	0.0000	0.0000	0.0002 ***	0.0002 **	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000 *	0.0000	0.0000
Total sqmi of playa	0.0000 ***	0.0000	0.0000	0.0000	0.0002	0.0002	0.0000 *	0.0002 ***	0.0002 ***	0.0001	0.0002	0.0002 *	0.0001 ***	0.0003 ***	0.0003 ***
Total sqmi of reservoir	0.0000	-0.0002	-0.0002	-0.0001	0.0001	0.0000	-0.0001	-0.0003	-0.0004	-0.0002	-0.0012	-0.0014	0.0001	0.0000	0.0001
Total sqmi of stream/river (intermittent)	-0.0038	0.0385 ***	0.0347 ***	-0.0197 *	-0.0225	-0.0422	0.0056	0.0154	0.0210	-0.0258 ***	-0.0208	-0.0466	-0.0096 **	-0.0191	-0.0286
Total sqmi of stream/river (perennial)	-0.0001	0.0002	0.0002	-0.0004	-0.0020	-0.0024	0.0001	-0.0004	-0.0004	-0.0003	-0.0022	-0.0025 *	0.0001	0.0002	0.0003
Total sqmi of swamp/marsh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 **	0.0000	0.0000	0.0000	0.0000 **	0.0000 **
Topography type (Base: Plains)															
Tablelands	0.0002	-0.0009	-0.0007	-0.0027	0.0002	-0.0025	0.0013 *	0.0009	0.0022	-0.0013	-0.0013	-0.0026	0.0010	-0.0030 **	-0.0019
Plains with hills or mountains	0.0011 **	0.0003	0.0014 *	0.0019	-0.0027	-0.0009	0.0012 *	0.0013	0.0025 *	-0.0017	0.0045	0.0028	0.0006	0.0003	0.0009
Open hills and mountains	-0.0006	0.0003	-0.0003	-0.0012	0.0003	-0.0008	0.0007	-0.0013	-0.0006	-0.0003	-0.0044 **	-0.0047 **	0.0007	-0.0018 *	-0.0011
Hills and mountains	0.0001	0.0011	0.0012 ***	0.0022	0.0028	0.0050 **	0.0012	0.0003	0.0015 *	-0.0027	0.0010	-0.0016	0.0003	0.0003	0.0006
Precipitation	0.0000	-0.0002	-0.0001	-0.0006	-0.0026 **	-0.0031 ***	-0.0012 ***	0.0019 ***	0.0008 ***	0.0005	0.0008	0.0013 **	0.0000	0.0005	0.0004
Temperature	0.0000	0.0000	0.0000 *	0.0000	0.0003 ***	0.0003 ***	0.0002 ***	-0.0001 ***	0.0001 ***	0.0000	-0.0004 ***	-0.0004 ***	0.0001 ***	-0.0001 *	0.0000
Short-term drought index (1 month)	-0.0006	0.0005	-0.0001	0.0082 ***	-0.0035	0.0047 ***	0.0017 **	-0.0006	0.0011 **	-0.0080 ***	0.0002	-0.0078 ***	-0.0003	0.0005	0.0002
Long-term drought index (24 months)	-0.0001	0.0001	0.0000	0.0013 **	0.0001	0.0014 ***	0.0000	-0.0007 ***	-0.0007 ***	0.0016 **	-0.0003	0.0013 ***	0.0000	-0.0002	-0.0002 *
D(Urban=1)	-0.0004	-0.0009 *	-0.0013 ***	-0.0038 ***	-0.0077 ***	-0.0114 ***	0.0008 **	0.0015 *	0.0023 ***	-0.0022 ***	-0.0004	-0.0026	0.0007 *	0.0007	0.0014
Pseudo R-squared	0.4628			0.5267			0.2092			0.6196			0.3627		

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.3: SAR-RE Estimation Results for per capita expenditure items, thousands of nominal dollars (cont'd.)

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Sewerage expenditure			Solid waste management expenditure			Natural resources expenditure			Total utility expenditure			Liquor store expenditure			Housing & comm. dev't expenditure		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Per capita total revenue																		
Per capita Federal revenue	2.4946 ***	1.7660	4.2606 **													0.5690 ***	-0.1120 ***	0.457006 ***
Per capita State revenue	1.0547 **	-1.3913	-0.3366													0.5587 ***	-0.0683 ***	0.4903903 ***
Per capita Local revenue	0.5284 ***	0.5242 ***	1.0526 ***													-0.1507 *	0.1159	-0.034802
Per capita total taxes							0.0287 ***	-0.0003	0.0283418 ***							0.0052 ***	0.0034 ***	0.0086715 ***
Per capita charge from exp item	0.9383 ***	-0.0177	0.9206 ***	0.7225 ***	0.2989 ***	1.0213 ***	5.8658	47.0249	52.8907	1.0072 ***	0.0598 ***	1.067 ***	0.8705 ***	0.0099 ***	0.8804 ***	1.8569 ***	0.5372 ***	2.394112 ***
Per capita public utility tax	0.1233 ***	-0.0216	0.1017 **	0.2924 ***	0.3843 ***	0.6767 ***				0.4192 ***	0.0231	0.4422 ***						
Per capita property sale housing & comm dev																-0.7002	0.6782	-0.021981
D(Atlantic=1)	0.0013	0.0002	0.0015	-0.0031 **	-0.0020 **	-0.0050 **	-0.0082 ***	-0.0035 ***	-0.0117 ***	-0.0003	-0.0001	-0.0004	0.0000	0.0000	0.0000	0.0011	0.0001	0.0012
D(Gulf=1)	0.0024 *	0.0004 *	0.0028 *	-0.0003	-0.0002	-0.0006	0.0003	0.0001	0.0004	0.0008	0.0002	0.0010	-0.0002 *	0.0000 *	-0.0002 *	0.0019 **	0.0002 *	0.0022 **
D(Pacific=1)	0.0003	0.0001	0.0004	-0.0063 ***	-0.0041 ***	-0.0104 ***	0.0036 *	0.0015 *	0.0051 *	-0.0071 ***	-0.0016 ***	-0.0087 ***	-0.0001	0.0000	-0.0001	0.0014	0.0002	0.0015
CVI	-0.0002 **	0.0001	-0.0001	0.0004 ***	0.0003 *	0.0007 ***	0.0002	0.0005 ***	0.0006 ***	0.0002 **	0.0004 ***	0.0007 ***	0.0000	0.0000 ***	0.0000 ***	-0.0001 **	0.0001	0.0000
Total sqmi of canal	0.0033 ***	0.0033 **	0.0065 ***	0.0030 ***	-0.0038 *	-0.0008	0.0049 ***	0.0038 *	0.0087 ***	0.0015 *	-0.0043 **	-0.0028	0.0000	-0.0001	-0.0001	-0.0002	-0.0002	-0.0005
Total sqmi of ice mass	0.0001	0.0001	0.0001	-0.0001 *	-0.0004	-0.0005 *	0.0001	0.0005 *	0.0007 **	-0.0001	0.0004	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total sqmi of lake/pond (intermittent)	0.0000	0.0000	-0.0001	0.0000	-0.0002 *	-0.0002 *	-0.0001	-0.0002 **	-0.0003 ***	-0.0001	0.0002 *	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total sqmi of lake/pond (perennial)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001 **	0.0001 **	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total sqmi of playa	0.0000	0.0001 **	0.0001 **	0.0000	0.0001 ***	0.0001 ***	0.0000	0.0000	0.0000	0.0000	0.0002 ***	0.0001 ***	0.0000	0.0000	0.0000	0.0000	0.0000 **	0.0000 **
Total sqmi of reservoir	0.0000	-0.0001	-0.0001	-0.0001	-0.0004	-0.0005	0.0001	0.0003	0.0004	0.0000	-0.0004	-0.0004	0.0000	0.0000	0.0000	0.0001	0.0000	0.0001
Total sqmi of stream/river (intermittent)	-0.0022	-0.0198 **	-0.0219 **	-0.0032	-0.0183	-0.0215	0.0005	-0.0011	-0.0006	-0.0126 ***	0.0510 ***	0.0385 **	0.0000	0.0001	0.0000	0.0001	-0.0022	-0.0021
Total sqmi of stream/river (perennial)	-0.0001	-0.0001	-0.0001	-0.0002	0.0008	0.0006	-0.0002	-0.0006	-0.0008	-0.0001	-0.0002	-0.0003	0.0000	0.0000	0.0000	-0.0001	-0.0002	-0.0003
Total sqmi of swamp/marsh	0.0000	0.0000	0.0000	0.0000 **	0.0000	0.0000 *	0.0000 *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 *	0.0000 *
Topography type (Base: Plains)																		
Tablelands	0.0001	0.0020 **	0.0021 ***	0.0003	0.0004	0.0007	-0.0004	-0.0033 **	-0.0037 ***	-0.0001	0.0013	0.0012	0.0000	0.0000	0.0000	0.0010 **	-0.0008	0.0002
Plains with hills or mountains	-0.0010	0.0014	0.0004	-0.0017 **	-0.0001	-0.0018	-0.0003	-0.0038 **	-0.0042 ***	0.0007	0.0009	0.0016	0.0000	0.0000	0.0000	0.0001	0.0006	0.0007
Open hills and mountains	-0.0011 **	0.0009	-0.0003	-0.0006	0.0009	0.0004	-0.0002	-0.0012	-0.0015 **	-0.0007	0.0003	-0.0004	0.0000	0.0000	0.0000	0.0003	0.0001	0.0004
Hills and mountains	-0.0014 **	0.0015 *	0.0001	-0.0004	0.0007	0.0004	-0.0007	-0.0035 ***	-0.0042 ***	0.0003	-0.0004	-0.0001	0.0000	0.0000	0.0000	0.0001	0.0005	0.0006 **
Precipitation	0.0004	-0.0002	0.0002	0.0015 ***	-0.0006	0.0009 ***	-0.0014 ***	-0.0004	-0.0017 ***	0.0009 **	-0.0003	0.0006 ***	0.0000	0.0000	0.0000	0.0000	0.0004 **	0.0004 ***
Temperature	0.0000	0.0000 *	0.0000 **	0.0001 ***	0.0000	0.0001 *	-0.0001 ***	-0.0001 **	-0.0002 ***	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 **	0.0000 ***	0.0000
Short-term drought index (1 month)	0.0002	-0.0005	-0.0003	-0.0062 ***	0.0042 ***	-0.0020 ***	0.0026 *	-0.0029 *	-0.0002	-0.0025 *	0.0014	-0.0012 *	-0.0002 ***	0.0001 **	0.0000	-0.0001	-0.0004	-0.0005
Long-term drought index (24 months)	0.0005 *	-0.0005	0.0000	0.0012 ***	-0.0006 *	0.0006 ***	0.0009 *	-0.0002	0.0007 ***	0.0005	-0.0010 **	-0.0004 **	0.0001 ***	0.0000 ***	0.0000	0.0005 **	-0.0004 *	0.0000
D(Urban=1)	0.0009 ***	0.0024 ***	0.0033 ***	-0.0022 ***	-0.0031 ***	-0.0053 ***	-0.0014 ***	-0.0043 ***	-0.0057 ***	0.0008 *	-0.0002	0.0006	0.0000	-0.0001 **	-0.0001 ***	0.0003	0.0002	0.0004
Pseudo R-squared	0.409			0.5385			0.1565			0.8243			0.9845			0.4256		

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.4: Summary Statistics for California, Oregon, Nevada, and Arizona

Time-invariant variables

Variables	Count
Atlantic coastline counties	0
Gulf coastline counties	0
Pacific coastline counties	21
Topography type	
Plains	4
Tablelands	5
Plains with hills or mountains	27
Open hills and mountains	29
Hills and mountains	58
Urban counties	50

Variables	Count	Mean	SD	Minimum	Maximum
Coastal vulnerability index (CVI)	21	10.68	5.32	2.83	21.91
Total sqmi of canal	12	0.99	0.98	0.02	2.99
Total sqmi of ice mass	11	0.83	0.98	0.01	2.99
Total sqmi of lake/pond (intermittent)	100	4.05	12.73	0.01	103.38
Total sqmi of lake/pond (perennial)	121	16.44	33.08	0.05	186.09
Total sqmi of playa	44	29.46	59.03	0.03	319.73
Total sqmi of reservoir	81	1.94	3.65	0.01	21.23
Total sqmi of stream/river (intermittent)	8	0.46	0.51	0.02	1.47
Total sqmi of stream/river (perennial)	55	1.00	1.70	0.01	11.18
Total sqmi of swamp/marsh	77	5.64	18.96	0.01	128.89
Time-varying natural amenities					
Precipitation (inches)	861	2.21	1.60	0.11	8.19
Temperature (degrees Fahrenheit)	861	53.83	5.97	40.95	72.61
Short-term drought index (1 month)	861	0.02	0.35	-0.87	0.99
Long-term drought index (24 months)	861	-0.26	1.21	-2.81	2.86

Variables	Mean	SD	Minimum	Maximum
Per capita revenue items (in nominal dollars)				
Total revenue	893.70	874.22	50.95	9,802.98
Total tax revenue	214.52	265.36	1.45	3,267.38
Total general sales tax	12.86	21.88	0	211.14
Total select sales tax	14.20	39.94	0	519.04
Individual income tax	0	0	0	0
Alcoholic beverage tax	0.02	0.22	0	3.12
Motor fuels tax	2.92	11.24	0	86.79
Public utility tax	2.35	5.17	0	68.56
All license tax	0.43	3.85	0	59.71
Total IGR - federal	47.56	73.11	0	694.89
Total IGR - state	410.39	453.31	12.80	4,850.99
Total IGR - local	13.34	24.87	0	332.40
Total charges & misc revenue	190.36	242.84	3.80	2,336.15
Per capita expenditure items (in nominal dollars)				
Total expenditure	868.54	861.56	46.51	9,461.64
Highway expenditure	114.13	183.74	0	2,638.78
Total education expenditure	64.99	109.93	0	934.60
Public welfare expenditure	127.55	148.46	0	987.58
Police expenditure	66.49	98.54	0	1,208.61
Health	66.74	86.14	0	762.42
Financial administration	32.90	40.57	0.01	454.17
Solid waste management	12.08	40.72	0	939.95
Natural resources	9.51	18.56	0	306.29
Parks & recreation	13.53	33.82	0	554.21
Total utility	11.92	49.78	0	789.96
Fire protection	10.28	27.12	0	356.19
Sewerage	6.68	26.04	0	324.71
Housing & community development	4.96	26.17	0	535.83
Airport transport expenditure	5.78	25.96	0	506.14
Liquor store	0	0	0	0

Table A1.5: Diagnostics Results for Non-Spatial and Spatial Models for California, Oregon, Nevada, and Arizona

California, Oregon, Nevada, Arizona

Dependent Variable	Non-Spatial Model: Error Spatial Autocorrelation (Global Moran MI)	Non-Spatial Model: Has Lagged DV Spatial Autocorrelation?	Non-Spatial Model: AIC	Non-Spatial Model: R-squared	Non-Spatial Model: Heterosked?	Non-Spatial Model: Non-normal?	Spatial Model: AIC	Spatial Model: R-squared	Spatial Model: Heterosked?	Spatial Model: Non-normal?
Revenue items										
Total revenue	0.35 ***	Yes ***	0.7170	0.1117	Yes ***	Yes ***	0.7544	0.1077	Yes ***	Yes ***
Total tax revenue	0.20 ***	Yes ***	0.0679	0.0873	Yes ***	Yes ***	0.0661	0.1516	Yes ***	Yes ***
Total general sales tax	0.24 ***	Yes ***	0.0004	0.1603	Yes ***	Yes ***	0.0004	0.2531	Yes ***	Yes ***
Total select sales tax	0.13 ***	Yes ***	0.0016	0.0749	Yes ***	Yes ***	0.0015	0.1598	Yes ***	Yes ***
Alcoholic beverage tax	0.08 ***	Yes ***	0.0000	0.0276	Yes ***	Yes ***	0.0000	0.0524	Yes ***	Yes ***
Motor fuels tax	0.21 ***	Yes ***	0.0001	0.2985	Yes ***	Yes ***	0.0001	0.4018	Yes ***	Yes ***
Public utility tax	0.17 ***	Yes ***	0.0000	0.0830	Yes ***	Yes ***	0.0000	0.1495	Yes ***	Yes ***
Tobacco tax	0.13 ***	Yes ***	0.0000	0.0307	Yes ***	Yes ***	0.0000	0.0583	Yes ***	Yes ***
Total license tax	0.07 ***	Yes ***	0.0000	0.0301	Yes ***	Yes ***	0.0000	0.0898	Yes ***	Yes ***
Individual income tax										
Expenditure items										
Total expenditure	0.03	No	0.0233	0.9705	Yes ***	Yes ***	0.0237	0.9716	Yes ***	Yes ***
Air transport	0.02	No	0.0004	0.3901	Yes ***	Yes ***	0.0004	0.4141	Yes ***	Yes ***
Total education	0.20 ***	Yes ***	0.0020	0.8482	Yes ***	Yes ***	0.0018	0.866	Yes ***	Yes ***
Health	0.13 ***	Yes ***	0.0019	0.7550	Yes ***	Yes ***	0.0018	0.7833	Yes ***	Yes ***
Financial administration	0.00	No	0.0005	0.7188	Yes ***	Yes ***	0.0005	0.7448	Yes ***	Yes ***
Fire protection	0.11 ***	Yes **	0.0005	0.3832	Yes ***	Yes ***	0.0004	0.4512	Yes ***	Yes ***
Judicial	0.47 ***	Yes ***	0.0015	0.5726	Yes ***	Yes ***	0.0013	0.6514	Yes ***	Yes ***
Public building	0.02	No	0.0043	0.3501	Yes ***	Yes ***	0.0043	0.3877	Yes ***	Yes ***
Central staff services	0.10 ***	Yes ***	0.0015	0.6592	Yes ***	Yes ***	0.0014	0.697	Yes ***	Yes ***
Total highways	0.06 ***	No	0.0045	0.8748	Yes ***	Yes ***	0.0046	0.8793	Yes ***	Yes ***
Natural resources	0.03 *	No	0.0003	0.1212	Yes ***	Yes ***	0.0003	0.1802	Yes ***	Yes ***
Parking	-0.01	No	0.0000	0.1817	Yes ***	Yes ***	0.0000	0.2207	Yes ***	Yes ***
Parks & recreation	0.00	No	0.0005	0.5482	Yes ***	Yes ***	0.0005	0.5913	Yes ***	Yes ***
Police protection	0.11 ***	Yes ***	0.0029	0.7139	Yes ***	Yes ***	0.0026	0.7587	Yes ***	Yes ***
Protective inspection & regulation	0.14 ***	Yes ***	0.0001	0.3473	Yes ***	Yes ***	0.0001	0.4184	Yes ***	Yes ***
Public welfare	0.09 ***	Yes ***	0.0011	0.9520	Yes ***	Yes ***	0.0011	0.9562	Yes ***	Yes ***
Sewerage	-0.02	No	0.0004	0.4458	Yes ***	Yes ***	0.0004	0.4624	Yes ***	Yes ***
Solid waste management	-0.02	Yes **	0.0003	0.8079	Yes ***	Yes ***	0.0003	0.815	Yes ***	Yes ***
Water transport	-0.01	No	0.0000	0.4572	Yes ***	Yes ***	0.0000	0.4675	Yes ***	Yes ***
Liquor store										
Total utility	-0.05 ***	No	0.0013	0.4879	Yes ***	Yes ***	0.0013	0.5212	Yes ***	Yes ***
Transit subsidies	0.01	No	0.0000	0.0893	Yes ***	Yes ***	0.0000	0.1291	Yes ***	Yes ***
Housing & community development	-0.01	No	0.0005	0.2509	Yes ***	Yes ***	0.0006	0.2729	Yes ***	Yes ***
Libraries	-0.01	No	0.0001	0.4526	Yes ***	Yes ***	0.0001	0.5157	Yes ***	Yes ***

Legend : *sig at 10%, **sig at 5%, ***sig at 1%

Table A1.6: Spatial Correlation of Error and Dependent Variables with Neighbors for California, Oregon, Nevada, and Arizona

Dependent Variable	Correlation with Neighbors' DV	Correlation with Neighbors' Error Term
Revenue items		
Total revenue	0.90 ***	-0.97 ***
Total tax revenue	0.78 ***	-0.72 ***
Total general sales tax	0.88 ***	-0.97 ***
Total select sales tax	0.71 ***	-0.74 ***
Alcoholic beverage tax	0.31	-0.11
Motor fuels tax	-0.68 ***	0.86 ***
Public utility tax	0.52 ***	-0.26 *
Tobacco tax	0.45 ***	-0.17
Total license tax	0.34 ***	-0.20
Individual income tax		
Expenditure items		
Total expenditure	0.20	-0.15
Air transport	0.16	-0.18
Total education	-0.68 ***	0.81 ***
Health	0.56 ***	-0.45 ***
Financial administration	-0.40 **	0.41 ***
Fire protection	0.23 **	0.13
Judicial	0.81 ***	-0.43 ***
Public building	0.07	-0.05
Central staff services	0.35 **	-0.21
Total highways	0.42 ***	-0.39 **
Natural resources	0.13	-0.16
Parking	0.23 *	-0.36 **
Parks & recreation	-0.34 **	0.37 ***
Police protection	0.54 ***	-0.51 ***
Protective inspection & regulation	0.59 ***	-0.44 ***
Public welfare	-0.77 ***	0.78 ***
Sewerage	-0.12	0.06
Solid waste management	-0.19	0.14
Water transport	-0.12	0.08
Liquor store		
Total utility	-0.61 ***	0.46 ***
Transit subsidies	-0.01	0.03
Housing & community development	-0.12	0.07
Libraries	-0.35 *	0.37 **

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Table A1.7: SAR-RE Estimation Results for per capita total revenue and total tax revenue items for California, Oregon, Nevada, and Arizona, thousands of nominal dollars

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Total revenue			Total tax revenue			Total general sales tax revenue			Total select sales tax revenue		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
D(Pacific=1)	0.1041	1.0054	1.1094	0.0533	-0.0855	-0.0323	-0.0031	-0.0306	-0.0337	0.0024	-0.0716	-0.0692
CVI	-0.0057	-0.0449	-0.0505	-0.0036	-0.0112	-0.0148	0.0002	0.0014	0.0015	-0.0001	0.0017	0.0016
Total sqmi of canal	-0.2023	-1.8876	-2.0899	-0.0678	-0.3055	-0.3733	-0.0050	-0.0062	-0.0112	-0.0075	-0.0017	-0.0092
Total sqmi of ice mass	0.0339	0.7656	0.7995	0.0259	0.1151	0.1410	-0.0022	-0.0191	-0.0212	-0.0059	-0.0011	-0.0070
Total sqmi of lake/pond (intermittent)	-0.0030	-0.1028	-0.1057	-0.0006	0.0061	0.0054	-0.0002	-0.0033	-0.0035	-0.0002	0.0010	0.0008
Total sqmi of lake/pond (perennial)	-0.0009	0.0458	0.0449	-0.0010	0.0014	0.0004	0.0001	0.0012	0.0014	-0.0001	-0.0003	-0.0004
Total sqmi of playa	0.0003	0.0298	0.0301	-0.0004	0.0039	0.0035	0.0000	0.0006	0.0006	0.0000	0.0003	0.0003
Total sqmi of reservoir	-0.0181	-0.1777	-0.1958	0.0001	-0.0062	-0.0060	-0.0001	-0.0034	-0.0035	-0.0005	-0.0031	-0.0036
Total sqmi of stream/river (intermittent)	0.1394	-0.9488	-0.8094	-0.0719	-0.3256	-0.3975	0.0000	0.0753	0.0753	0.0098	-0.0132	-0.0033
Total sqmi of stream/river (perennial)	-0.1080	-1.2272	-1.3352	-0.0321	-0.1989	-0.2310	0.0002	-0.0055	-0.0053	-0.0023	-0.0189	-0.0212
Total sqmi of swamp/marsh	0.0022	-0.0139	-0.0118	-0.0003	-0.0039	-0.0042	-0.0001	-0.0014	-0.0016	-0.0001	0.0012	0.0011
Topography type (Base: Plains)												
Tablelands	-0.7713	-8.5366	-9.3079	-0.0682	-1.4892	-1.5574	-0.0117	-0.1633	-0.1750	-0.0043	-0.1840	-0.1884
Plains with hills or mountains	-0.8084	-9.5147 *	-10.3232 *	-0.1275	-1.2561	-1.3836	-0.0181	-0.1242	-0.1422	-0.0103	-0.0700	-0.0802
Open hills and mountains	-0.8301	-6.4643	-7.2944	-0.1320	-1.1927	-1.3247	-0.0117	-0.0650	-0.0768	0.0001	-0.0967	-0.0966
Hills and mountains	-0.8815 *	-8.0630	-8.9445	-0.1332	-1.0866	-1.2198	-0.0118	-0.1270	-0.1388	-0.0039	-0.0655	-0.0694
Precipitation	0.0542	0.3909	0.4452	0.0046	0.0322	0.0369	0.0009	0.0168 ***	0.0177 ***	-0.0012	0.0091	0.0079
Temperature	0.0339 ***	0.1884 ***	0.2222 ***	0.0041	0.0205 *	0.0246 **	0.0006 **	0.0028 **	0.0034 **	0.0007	0.0026 **	0.0033 **
Short-term drought index (1 month)	-0.4501 ***	-0.1863	-0.6364 *	-0.1038 **	-0.0176	-0.1214 *	-0.0096 ***	-0.0168 *	-0.0264 ***	-0.0050	-0.0082	-0.0132 *
Long-term drought index (24 months)	0.0788 **	0.0122	0.0910	0.0054	0.0061	0.0115	0.0012	0.0006	0.0018	-0.0014	0.0033	0.0019
D(Urban=1)	-0.4328 **	-3.9142 *	-4.3470 **	-0.1068 **	-0.4446	-0.5514	-0.0087 **	-0.0233	-0.0320	-0.0167 **	-0.0571	-0.0738
Pseudo R-squared		0.1983			0.1613			0.2560			0.1665	

Legend : *sig at 10%, **sig at 5%, ***sig at 1%

Notes : Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.7: SAR-RE Estimation Results for per capita total revenue and total tax revenue items for California, Oregon, Nevada, and Arizona, thousands of nominal dollars (cont'd.)

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Alcoholic beverage tax revenue			Motor fuels tax revenue			Public utility tax revenue			All license tax revenue		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
D(Pacific=1)	0.0000	-0.0002	-0.0002	0.0017	-0.0056	-0.0039	0.0013	-0.0003	0.0010	-0.0002	-0.0004	-0.0006
CVI	0.0000	0.0000	0.0000	-0.0001	0.0003	0.0002	-0.0001	0.0000	-0.0001	0.0000	0.0001	0.0000
Total sqmi of canal	0.0000	0.0000	0.0000	0.0005	-0.0003	0.0002	0.0002	0.0068 **	0.0070 **	-0.0003	0.0006	0.0003
Total sqmi of ice mass	0.0000	0.0000	0.0000	-0.0019	0.0014	-0.0006	-0.0006	-0.0004	-0.0010	0.0006	-0.0001	0.0005
Total sqmi of lake/pond (intermittent)	0.0000	0.0000	0.0000	-0.0002 ***	0.0002 *	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
Total sqmi of lake/pond (perennial)	0.0000	0.0000	0.0000	-0.0001 **	0.0000	-0.0001 *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total sqmi of playa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total sqmi of reservoir	0.0000	0.0000	0.0000	0.0000	-0.0002	-0.0002	-0.0002 *	-0.0007 *	-0.0009 **	-0.0001	0.0001	0.0000
Total sqmi of stream/river (intermittent)	0.0000	0.0000	0.0000	0.0121 ***	-0.0036	0.0085	0.0032 **	0.0015	0.0047	0.0001	-0.0007	-0.0006
Total sqmi of stream/river (perennial)	0.0000	0.0000	0.0000	0.0002	0.0002	0.0004	0.0000	0.0005	0.0006	0.0001	-0.0008	-0.0008
Total sqmi of swamp/marsh	0.0000	0.0000	0.0000 *	0.0000	0.0001 *	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Topography type (Base: Plains)												
Tablelands	-0.0001	0.0000	-0.0001	0.0035	0.0112	0.0147 **	-0.0017	-0.0080	-0.0097	-0.0047 ***	0.0167 ***	0.0121 ***
Plains with hills or mountains	0.0000	-0.0002	-0.0002	0.0046	0.0210 ***	0.0256 ***	0.0000	-0.0066	-0.0067	-0.0011	-0.0004	-0.0015
Open hills and mountains	0.0000	0.0000	-0.0001	0.0029	0.0064	0.0093 *	-0.0002	-0.0050	-0.0052	-0.0012	0.0012	0.0000
Hills and mountains	0.0000	-0.0001	-0.0002	0.0013	0.0095 *	0.0108 **	-0.0008	-0.0046	-0.0055	-0.0006	-0.0002	-0.0008
Precipitation	0.0000	0.0000	0.0000	-0.0005	0.0009	0.0004	-0.0003	0.0009	0.0006	0.0000	0.0000	0.0000
Temperature	0.0000	0.0000	0.0000	-0.0001	-0.0002	-0.0003 ***	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000
Short-term drought index (1 month)	0.0000	0.0000	-0.0001	-0.0064 ***	0.0061 **	-0.0003	-0.0015	-0.0012	-0.0027 ***	-0.0007	0.0000	-0.0007
Long-term drought index (24 months)	0.0000	0.0000	0.0000	0.0005	-0.0010	-0.0005	0.0006	-0.0001	0.0005 **	0.0001	0.0001	0.0003
D(Urban=1)	0.0000	-0.0001 *	-0.0002 *	0.0011	0.0005	0.0015	-0.0005	-0.0018	-0.0023	0.0002	-0.0011	-0.0009
Pseudo R-squared		0.0527			0.3473			0.1656			0.0909	

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.8: SAR-RE Estimation Results for per capita expenditure items for California, Oregon, Nevada, and Arizona, thousands of nominal dollars

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Total expenditure			Total education expenditure			Highway expenditure			Police expenditure			Public welfare expenditure		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Per capita total revenue	0.9001 ***	0.0801 **	0.9802 ***												
Per capita Federal revenue	-0.0708	-0.2835	-0.3543 *	0.7238 ***	-0.6641	0.0598	0.6007 ***	0.4441 **	1.0448 ***				0.9536 ***	-0.307 *	0.6466 ***
Per capita State revenue	0.1406 ***	-0.104	0.0366	1.0289 ***	0.0362	1.0651 ***	0.6835 ***	0.0276	0.7111 ***				0.8793 ***	0.0404 **	0.9197 ***
Per capita Local revenue				1.1410 ***	-0.106	1.0349 **	1.2582	-4.543	-3.285				-4.477 ***	0.5661	-3.911 ***
Per capita total taxes				-0.0037	0.0071	0.0034	0.2497 ***	-0.045	0.2043 ***	0.2605 ***	0.124 ***	0.3845 ***	0.0185 ***	-0.015 *	0.0038
Per capita charge from exp item				1.1452 **	1.1491	2.2943 **	1.8284 ***	0.1505	1.9789 ***						
D(Pacific=1)	-0.0064	-0.0694	-0.0757	-0.0040	-0.0055	-0.0094	-0.0199	0.0418	0.0218	-0.0094	-0.0111	-0.0205	0.0200 **	0.0016	0.0216
CVI	-0.0006	0.0105	0.0099	0.0006	0.0016	0.0022	0.0002	0.0022	0.0024	0.0001	0.0035	0.0036	-0.0005	-0.0036 ***	-0.0041 ***
Total sqmi of canal	-0.0153	0.0159	0.0006	0.0001	0.0242 **	0.0243 ***	0.0016	0.0014	0.0030	-0.0106	-0.0942 **	-0.1048 **	-0.0017	-0.0023	-0.0039
Total sqmi of ice mass	0.0273	0.0367	0.0640	-0.0006	-0.0154	-0.0160	0.0040	0.0049	0.0089	-0.0003	0.0357	0.0354	0.0007	0.0100	0.0107
Total sqmi of lake/pond (intermittent)	0.0002	-0.0032	-0.0030	0.0004 *	-0.0004	0.0001	0.0006	-0.0003	0.0003	-0.0011 ***	-0.0007	-0.0018	0.0003 *	0.0001	0.0005
Total sqmi of lake/pond (perennial)	0.0003	0.0005	0.0008	-0.0001	0.0001	0.0000	-0.0001	-0.0001	-0.0002	-0.0003	0.0009	0.0006	-0.0001	0.0000	-0.0002
Total sqmi of playa	0.0000	-0.0003	-0.0003	0.0000	0.0002 *	0.0002	-0.0001	0.0001	0.0001	0.0002 *	0.0005	0.0007 *	0.0000	-0.0001 **	-0.0002 **
Total sqmi of reservoir	0.0017	0.0074	0.0091	-0.0009	0.0015	0.0006	-0.0008	-0.0021	-0.0029	-0.0005	-0.0038	-0.0043	-0.0016 ***	-0.0002	-0.0018 *
Total sqmi of stream/river (intermittent)	0.0167	-0.0269	-0.0101	-0.0236 *	-0.0022	-0.0258	-0.0641 ***	-0.0871	-0.1512 *	-0.0229	-0.1371 *	-0.1600 *	0.0040	-0.0128	-0.0088
Total sqmi of stream/river (perennial)	-0.0036	-0.0244	-0.0280	-0.0012	-0.0058 *	-0.0070 *	-0.0030	-0.0157	-0.0187	0.0023	-0.0073	-0.0050	0.0045 ***	0.0037	0.0083 ***
Total sqmi of swamp/marsh	-0.0006	-0.0007	-0.0013	0.0004 **	-0.0002	0.0002	0.0001	0.0007	0.0008	0.0001	0.0000	0.0001	-0.0002	-0.0001	-0.0002
Topography type (Base: Plains)															
Tablelands	0.0018	0.0046	0.0064	0.0083	-0.0018	0.0065	-0.0115	0.0929	0.0814	-0.0522 **	0.0004	-0.0518	-0.0414 ***	-0.0133	-0.0547 ***
Plains with hills or mountains	-0.0025	0.0742	0.0716	0.0069	-0.0251	-0.0182	-0.0098	-0.0223	-0.0321	-0.0160	-0.1073	-0.1233	0.0012	-0.0203	-0.0191
Open hills and mountains	-0.0377	-0.0393	-0.0769	0.0038	0.0222	0.0260	-0.0375 *	-0.0376	-0.0750	-0.0468 **	-0.0828	-0.1296	-0.0050	-0.0259 *	-0.0309 **
Hills and mountains	-0.0278	-0.0245	-0.0523	0.0021	-0.0011	0.0010	-0.0173	-0.0358	-0.0531	-0.0348 *	-0.0717	-0.1065	-0.0135	-0.0020	-0.0156
Precipitation	-0.0030	0.0223 *	0.0193 *	0.0056 **	-0.0036	0.0020	0.0023	-0.0050	-0.0027	-0.0040	0.0055	0.0015	-0.0015	-0.0040	-0.0055 ***
Temperature	0.0019	-0.0016	0.0003	0.0010	0.0002	0.0012 **	-0.0017 **	-0.0003	-0.0021	0.0002	-0.0004	-0.0002	0.0007	0.0005	0.0012 ***
Short-term drought index (1 month)	0.0285	-0.0386	-0.0100	0.0034	-0.0091	-0.0057	0.0078	0.0033	0.0110	-0.0167	0.0192	0.0025	-0.0077	0.0153	0.0077
Long-term drought index (24 months)	0.0075	-0.0057	0.0017	-0.0044	0.0056	0.0012	0.0026	0.0041	0.0067 **	0.0052	-0.0037	0.0015	0.0031	-0.0040	-0.0009
D(Urban=1)	0.0056	-0.0121	-0.0065	-0.0080	-0.0226 **	-0.0306 ***	-0.0064	-0.0199	-0.0263	-0.0128 *	-0.0204	-0.0332	0.0040	-0.0129 *	-0.0089
Pseudo R-squared	0.9716			0.8630			0.8803			0.7596			0.9557		

Legend : *sig at 10%, **sig at 5%, ***sig at 1%

Notes : Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.8: SAR-RE Estimation Results for per capita expenditure items for California, Oregon, Nevada, and Arizona, thousands of nominal dollars (cont'd.)

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Air transport expenditure			Financial administration expenditure			Fire protection expenditure			Health expenditure			Parks & recreation expenditure		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Per capita total revenue															
Per capita Federal revenue	-0.9035	-0.3560654	-1.2596							0.1684	0.5007	0.6690			
Per capita State revenue										0.7962 ***	0.4222 ***	1.2184 ***			
Per capita Local revenue										1.3374 **	2.7816	4.1190			
Per capita total taxes	0.0385 ***	-0.0021415	0.036311 ***	0.1064 ***	0.0117 **	0.1181 ***	0.059 ***	-0.0017	0.0573 ***	0.1179 ***	-0.0285	0.0894 ***	0.0821 ***	-0.0046	0.0775 ***
Per capita charge from exp item	1.0857 ***	-0.2173536	0.868334 ***										1.6878 ***	0.0684	1.7562 ***
D(Pacific=1)	-0.0061	-0.0064	-0.0125	-0.0004	-0.0078	-0.0082	-0.0026	0.0640 **	0.0614 *	-0.0004	0.0450	0.0447	-0.0078	0.0111	0.0033
CVI	0.0002	0.0007	0.0009	-0.0002	0.0010	0.0008	-0.0003	-0.0024	-0.0027	0.0006	-0.0042	-0.0035	0.0005	-0.0001	0.0004
Total sqmi of canal	0.0006	-0.0027	-0.0021	-0.0049	-0.0068	-0.0117 *	0.0006	0.0185	0.0192	-0.0036	-0.0013	-0.0049	0.0036	0.0016	0.0052
Total sqmi of ice mass	-0.0010	0.0075	0.0065	0.0057	-0.0008	0.0049	-0.0018	-0.0104	-0.0121	0.0224 ***	0.0190	0.0414	-0.0058	-0.0008	-0.0066
Total sqmi of lake/pond (intermittent)	0.0000	-0.0003	-0.0002	-0.0003 *	-0.0002	-0.0004	-0.0003	0.0006	0.0003	0.0004	-0.0017	-0.0013	0.0001	0.0008 *	0.0009 **
Total sqmi of lake/pond (perennial)	0.0000	-0.0001	-0.0001	-0.0001	0.0003 ***	0.0003 **	-0.0001	0.0002	0.0001	0.0001	0.0006	0.0006	-0.0001	-0.0003 **	-0.0004 **
Total sqmi of playa	0.0000	0.0000	-0.0001	0.0000	0.0001 *	0.0001 *	0.0000	0.0001	0.0001	0.0001 **	-0.0001	0.0000	0.0000	0.0000	0.0000
Total sqmi of reservoir	0.0000	-0.0002	-0.0002	-0.0003	-0.0002	-0.0005	-0.0003	0.0005	0.0002	-0.0009	0.0038	0.0029	0.0008 *	0.0008	0.0016 *
Total sqmi of stream/river (intermittent)	-0.0009	0.0408 ***	0.0400 ***	-0.0155 *	-0.0012	-0.0167	0.0009	0.0028	0.0037	-0.0126	0.0205	0.0079	-0.0092	-0.0063	-0.0155
Total sqmi of stream/river (perennial)	0.0005	0.0018	0.0022	-0.0010	-0.0038	-0.0048 *	0.0013	-0.0011	0.0003	0.0022	-0.0056	-0.0034	0.0013	0.0020	0.0033
Total sqmi of swamp/marsh	0.0000	0.0003	0.0003	0.0000	-0.0003	-0.0003	0.0000	-0.0003	-0.0003	0.0000	-0.0012	-0.0012	-0.0001	0.0002	0.0001
Topography type (Base: Plains)															
Tablelands	-0.0079	-0.0023	-0.0102	-0.0288 **	0.0093	-0.0195	-0.0175	0.0360	0.0185	-0.0466 ***	0.1310 *	0.0844	-0.0035	0.0155	0.0120
Plains with hills or mountains	-0.0016	0.0067	0.0051	-0.0080	-0.0259 *	-0.0339 **	0.0074	-0.0066	0.0008	-0.0235	0.0310	0.0075	-0.0012	0.0356 **	0.0344 **
Open hills and mountains	-0.0040	-0.0061	-0.0100	-0.0231 **	-0.0135	-0.0366 **	-0.0071	-0.0012	-0.0083	-0.0196	0.0056	-0.0140	0.0009	0.0020	0.0028
Hills and mountains	-0.0022	-0.0087	-0.0109	-0.0175 **	-0.0189	-0.0364 **	-0.0074	-0.0055	-0.0129	-0.0158	0.0263	0.0105	-0.0026	0.0108	0.0082
Precipitation	0.0000	0.0019	0.0019	-0.0010	0.0032	0.0022	-0.0022	0.0020	-0.0003	-0.0031	0.0000	-0.0031	-0.0021	0.0034	0.0013
Temperature	0.0000	0.0000	-0.0001	-0.0005	0.0004	-0.0001	0.0001	-0.0006	-0.0005	0.0005	-0.0013	-0.0007	-0.0004	-0.0004	-0.0007 **
Short-term drought index (1 month)	0.0075	-0.0025	0.0050 *	-0.0021	0.0028	0.0007	-0.0037	0.0043	0.0006	-0.0082	-0.0048	-0.0130	0.0107 *	-0.0057	0.0050 *
Long-term drought index (24 months)	-0.0041 **	0.0026	-0.0015 **	0.0010	-0.0008	0.0003	0.0029 **	-0.0023	0.0006	0.0036	0.0023	0.0059 ***	0.0015	-0.0027	-0.0012
D(Urban=1)	-0.0013	0.0005	-0.0009	-0.0084 **	-0.0141 **	-0.0225 ***	0.0092 **	-0.0010	0.0082	0.0126 **	0.0028	0.0154	0.0016	0.0056	0.0072
Pseudo R-squared		0.415			0.7495			0.4554			0.7833			0.5916	

Legend : *sig at 10%, **sig at 5%, ***sig at 1%

Notes : Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.8: SAR-RE Estimation Results for per capita expenditure items for California, Oregon, Nevada, and Arizona, thousands of nominal dollars (cont'd.)

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Sewerage expenditure			Solid waste management expenditure			Natural resources expenditure			Total utility expenditure		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Per capita total revenue												
Per capita Federal revenue	-47.22	8.9171	-38.3054									
Per capita State revenue	122.42 ***	15.7639	138.1807 *									
Per capita Local revenue	14.052	43321.8900 ***	43335.94 ***									
Per capita total taxes							0.0252 ***	-0.0019	0.0233 ***			
Per capita charge from exp item	1.1016 ***	-0.0484	1.0532 ***	0.8216 ***	0.0653 **	0.8869 ***	1.8106	-8.7475	-6.9369	0.8827 ***	-0.1759 **	0.7068 ***
Per capita public utility tax	-0.258 *	-0.0610	-0.3189	-0.0267	-0.0905	-0.1172				2.7707 ***	1.6646 ***	4.4352 ***
Per capita property sale housing & comm dev												
D(Pacific=1)	-0.0001	-0.0012	-0.0013	0.0040	-0.0161	-0.0121	-0.0023	0.0251	0.0228	0.0025	-0.0115	-0.0089
CVI	0.0000	0.0003	0.0003	-0.0001	0.0014 *	0.0014	0.0000	0.0000	0.0000	-0.0003	0.0013	0.0010
Total sqmi of canal	-0.0008	-0.0008	-0.0016	-0.0001	0.0076 *	0.0076	0.0021	0.0143 **	0.0164 **	0.0005	-0.0055	-0.0050
Total sqmi of ice mass	0.0014	0.0002	0.0016	0.0009	0.0009	0.0018	-0.0035	-0.0111 *	-0.0145 *	-0.0010	0.0004	-0.0006
Total sqmi of lake/pond (intermittent)	0.0001	0.0004	0.0005	0.0000	-0.0002	-0.0001	0.0000	0.0002	0.0002	-0.0001	0.0012 ***	0.0011 ***
Total sqmi of lake/pond (perennial)	-0.0001	-0.0001	-0.0002	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	-0.0002 **	-0.0001	-0.0003 ***
Total sqmi of playa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000	0.0001	0.0001
Total sqmi of reservoir	0.0003	0.0001	0.0004	-0.0001	0.0001	0.0000	0.0004	-0.0004	0.0000	0.0007	0.0014	0.0021 **
Total sqmi of stream/river (intermittent)	-0.0014	-0.0266 **	-0.0280 **	-0.0029	-0.0188 *	-0.0217 **	-0.0052	-0.0077	-0.0129	-0.0305 ***	-0.0042	-0.0347 **
Total sqmi of stream/river (perennial)	-0.0003	-0.0006	-0.0009	0.0001	-0.0001	0.0000	-0.0013	-0.0009	-0.0022	-0.0005	-0.0005	-0.0010
Total sqmi of swamp/marsh	0.0000	-0.0001	0.0000	-0.0001	-0.0001	-0.0001	0.0001	0.0000	0.0001	-0.0002 *	0.0000	-0.0002
Topography type (Base: Plains)												
Tablelands	-0.0033	-0.0154	-0.0187	0.0008	0.0096	0.0104	0.0140 *	0.0149	0.0289	-0.0129	0.0453 **	0.0324 *
Plains with hills or mountains	0.0009	-0.0043	-0.0033	-0.0008	0.0155 *	0.0147	-0.0038	0.0159	0.0121	-0.0132	0.0538 ***	0.0406 ***
Open hills and mountains	-0.0026	-0.0093	-0.0118	0.0005	0.0107	0.0111	0.0010	0.0256 *	0.0267 *	-0.0124	0.0226	0.0102
Hills and mountains	-0.0007	-0.0057	-0.0063	0.0068	0.0062	0.0130	-0.0006	0.0080	0.0073	-0.0042	0.0162	0.0120
Precipitation	-0.0009	-0.0001	-0.0010	0.0001	-0.0006	-0.0005	-0.0015	0.0036 **	0.0022	-0.0009	0.0012	0.0003
Temperature	-0.0004 *	0.0002	-0.0002	-0.0001	-0.0002	-0.0003	0.0005 **	-0.0005 **	0.0000	-0.0008 *	-0.0004	-0.0012 ***
Short-term drought index (1 month)	0.0017	0.0026	0.0043 *	0.0009	-0.0017	-0.0008	-0.0049	0.0038	-0.0012	-0.0143	0.0150	0.0007
Long-term drought index (24 months)	0.0018	-0.0024	-0.0006	0.0021	-0.0018	0.0003	0.0024 *	-0.0025 *	0.0000	0.0062 *	-0.0077 **	-0.0016
D(Urban=1)	0.0000	-0.0010	-0.0010	-0.0049 **	0.0035	-0.0014	0.0015	0.0005	0.0020	-0.0007	0.0122 *	0.0115 **
Pseudo R-squared		0.4627			0.8153			0.181			0.5267	

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.9: Summary Statistics for New York, New Jersey, Massachusetts, and Pennsylvania

Time-invariant variables

Variables	Count
Atlantic coastline counties	16
Gulf coastline counties	0
Pacific coastline counties	0
Topography type	
Plains	23
Tablelands	18
Plains with hills or mountains	10
Open hills and mountains	75
Hills and mountains	23
Urban counties	90

Variables	Count	Mean	SD	Minimum	Maximum
Coastal vulnerability index (CVI)	16	10.57	6.30	1.73	22.36
Total sqmi of canal	7	0.21	0.22	0.06	0.68
Total sqmi of ice mass	0	0.00	0.00	0	0.00
Total sqmi of lake/pond (intermittent)	12	0.03	0.03	0.01	0.12
Total sqmi of lake/pond (perennial)	149	6.04	9.87	0.04	79.06
Total sqmi of playa	0	0.00	0.00	0	0.00
Total sqmi of reservoir	22	0.10	0.21	0.01	1.03
Total sqmi of stream/river (intermittent)	0	0.00	0.00	0	0.00
Total sqmi of stream/river (perennial)	66	0.70	1.47	0.01	11.16
Total sqmi of swamp/marsh	99	8.77	15.72	0.06	87.84
Time-varying natural amenities					
Precipitation (inches)	1,043	3.64	0.50	2.68	5.27
Temperature (degrees Fahrenheit)	1,043	47.74	3.10	38.44	55.71
Short-term drought index (1 month)	1,043	0.08	0.28	-0.38	0.75
Long-term drought index (24 months)	1,043	0.12	0.91	-1.95	2.40

Variables	Mean	SD	Minimum	Maximum
Per capita revenue items (in nominal dollars)				
Total revenue	471.48	433.31	14.22	2,483.36
Total tax revenue	186.97	190.25	0.00	1,157.55
Total general sales tax	60.31	107.85	0.00	659.98
Total select sales tax	0.92	2.61	0.00	30.89
Individual income tax	0.00	0.00	0.00	0.15
Alcoholic beverage tax				
Motor fuels tax				
Public utility tax	0.00	0.05	0.00	1.10
All license tax	0.81	3.76	0.00	94.26
Total IGR - federal	13.09	18.49	0.00	239.64
Total IGR - state	150.49	126.47	0.00	660.80
Total IGR - local	7.67	16.07	0.00	270.87
Total charges & misc revenue	105.59	143.03	0.20	1,388.55
Per capita expenditure items (in nominal dollars)				
Total expenditure	482.78	457.81	14.42	2,634.20
Highway expenditure	35.01	52.35	0.00	606.99
Total education expenditure	39.91	67.61	0.00	414.59
Public welfare expenditure	141.14	147.60	0.00	808.48
Police expenditure	12.46	28.16	0.00	409.22
Health	34.58	44.91	0.00	272.17
Financial administration	8.25	6.88	0.00	85.73
Solid waste management	6.64	17.51	0.00	155.94
Natural resources	3.53	5.79	0.00	59.89
Parks & recreation	4.95	8.88	0.00	76.11
Total utility	2.49	10.26	0.00	118.05
Fire protection	0.82	2.55	0.00	53.20
Sewerage	4.46	17.51	0.00	215.28
Housing & community development	4.14	10.60	0.00	116.05
Airport transport expenditure	2.70	17.63	0.00	409.76
Liquor store				

Table A1.10: Diagnostics Results for Non-Spatial and Spatial Models for New York, New Jersey, Massachusetts, and Pennsylvania

	Non-Spatial Model						Spatial Model			
Dependent Variable	Error Spatial Autocorrelation (Global Moran MI)	Has Lagged DV Spatial Autocorrelation?	AIC	R-squared	Heterosked?	Non-normal?	AIC	R-squared	Heterosked?	Non-normal?
Revenue items										
Total revenue	0.70 ***	Yes ***	0.1907	0.0234	Yes ***	Yes ***	0.1463	0.2751	Yes ***	Yes ***
Total tax revenue	0.71 ***	Yes ***	0.0361	0.0406	Yes ***	Yes ***	0.0291	0.2527	Yes ***	Yes ***
Total general sales tax	0.65 ***	Yes ***	0.0103	0.1446	Yes ***	Yes ***	0.0088	0.2996	Yes ***	Yes ***
Total select sales tax	0.11 ***	Yes ***	0.0000	0.0795	Yes ***	Yes ***	0.0000	0.2116	Yes ***	Yes ***
Alcoholic beverage tax										
Motor fuels tax										
Public utility tax	0.00	No	0.0000	0.0175	Yes ***	Yes ***	0.0000	0.0289	Yes ***	Yes ***
Tobacco tax										
Total license tax	0.05 ***	Yes **	0.0000	0.0609	Yes ***	Yes ***	0.0000	0.0898	Yes ***	Yes ***
Individual income tax	-0.01 **	No	0.0000	0.0119	Yes ***	Yes ***	0.0000	0.0213	Yes ***	Yes ***
Expenditure items										
Total expenditure	0.06 ***	No	0.0031	0.9857	Yes ***	Yes ***	0.0031	0.9862	Yes ***	Yes ***
Air transport	0.01	No	0.0001	0.7481	Yes ***	Yes ***	0.0001	0.7520	Yes ***	Yes ***
Total education	0.18 ***	Yes ***	0.0004	0.9209	Yes ***	Yes ***	0.0004	0.9278	Yes ***	Yes ***
Health	0.19 ***	Yes ***	0.0005	0.7618	Yes ***	Yes ***	0.0005	0.7926	Yes ***	Yes ***
Financial administration	0.37 ***	Yes ***	0.0000	0.3435	Yes ***	Yes ***	0.0000	0.3988	Yes ***	Yes ***
Fire protection	0.12 ***	Yes ***	0.0000	0.0958	Yes ***	Yes ***	0.0000	0.1091	Yes ***	Yes ***
Judicial	0.65 ***	Yes ***	0.0002	0.3885	Yes ***	Yes ***	0.0002	0.4205	Yes ***	Yes ***
Public building	-0.02	No	0.0006	0.1355	Yes ***	Yes ***	0.0006	0.1434	Yes ***	Yes ***
Central staff services	0.14 ***	Yes ***	0.0001	0.3446	Yes ***	Yes ***	0.0001	0.3863	Yes ***	Yes ***
Total highways	0.16 ***	Yes ***	0.0005	0.8305	Yes ***	Yes ***	0.0005	0.8422	Yes ***	Yes ***
Natural resources	0.02	Yes ***	0.0000	0.2101	Yes ***	Yes ***	0.0000	0.2620	Yes ***	Yes ***
Parking	0.00	No	0.0000	0.3694	Yes ***	Yes ***	0.0000	0.3817	Yes ***	Yes ***
Parks & recreation	0.02	No	0.0000	0.5835	Yes ***	Yes ***	0.0000	0.6099	Yes ***	Yes ***
Police protection	0.13 ***	Yes ***	0.0003	0.6623	Yes ***	Yes ***	0.0002	0.7125	Yes ***	Yes ***
Protective inspection & regulation	0.00	No	0.0000	0.0190	Yes ***	Yes ***	0.0000	0.0374	Yes ***	Yes ***
Public welfare	0.16 ***	Yes ***	0.0032	0.8599	Yes ***	Yes ***	0.0027	0.8871	Yes ***	Yes ***
Sewerage	0.00	No	0.0002	0.4735	Yes ***	Yes ***	0.0002	0.4935	Yes ***	Yes ***
Solid waste management	0.08 ***	Yes ***	0.0001	0.5505	Yes ***	Yes ***	0.0001	0.5965	Yes ***	Yes ***
Water transport										
Liquor store										
Total utility	0.07 ***	Yes ***	0.0000	0.7075	Yes ***	Yes ***	0.0000	0.7298	Yes ***	Yes ***
Transit subsidies	0.15 ***	Yes ***	0.0000	0.3993	Yes ***	Yes ***	0.0000	0.4900	Yes ***	Yes ***
Housing & community development	0.03 *	Yes ***	0.0001	0.3876	Yes ***	Yes ***	0.0001	0.4494	Yes ***	Yes ***
Libraries	0.12 ***	Yes ***	0.0000	0.2364	Yes ***	Yes ***	0.0000	0.2826	Yes ***	Yes ***

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Table A1.11: Spatial Correlation of Error and Dependent Variables with Neighbors for New York, New Jersey, Massachusetts, and Pennsylvania

Dependent Variable	Correlation with Neighbors' DV	Correlation with Neighbors' Error Term
Revenue items		
Total revenue	-0.03	0.94 ***
Total tax revenue	0.86 ***	0.11
Total general sales tax	0.79 ***	0.33 ***
Total select sales tax	0.06	0.24 *
Alcoholic beverage tax		
Motor fuels tax		
Public utility tax	-0.07	0.06
Tobacco tax		
Total license tax	0.35 ***	-0.34 **
Individual income tax	-0.01	-0.04
Expenditure items		
Total expenditure	-0.16	0.32
Air transport	-0.19	0.31 ***
Total education	-0.42 ***	0.71 ***
Health	0.46 ***	-0.04
Financial administration	0.84 ***	-0.72 ***
Fire protection	-0.09	0.38 *
Judicial	0.89 ***	-0.13
Public building	-0.02	-0.05
Central staff services	0.70 ***	-0.66 ***
Total highways	0.47 ***	-0.08
Natural resources	0.51 ***	-0.45 **
Parking	0.00	-0.06
Parks & recreation	-0.16	0.22 *
Police protection	0.39 ***	0.30 ***
Protective inspection & regulation	0.19	-0.22
Public welfare	0.33	0.00
Sewerage	-0.02	-0.02
Solid waste management	0.19	-0.07
Water transport		
Liquor store		
Total utility	0.10	0.19 *
Transit subsidies	0.30 ***	-0.04
Housing & community development	0.16	-0.13
Libraries	0.13	0.35 ***

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Table A1.12: SAR-RE Estimation Results for per capita total revenue and total tax revenue items for New York, New Jersey, Massachusetts, and Pennsylvania, thousands of nominal dollars

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Total revenue			**Total tax revenue**			**Total general sales tax revenue**			**Total select sales tax revenue**			**Individual income tax revenue**		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
D(Atlantic=1)	0.4232 ***	-0.9389 **	-0.5157	0.0374	-1.2582	-1.2208	0.0368	-0.2437	-0.2070	0.0029 **	-0.0032	-0.0002	0.0000	0.0000	0.0000
CVI	-0.0248 **	0.0131	-0.0117	-0.0026	0.0533	0.0507	-0.0049 *	-0.0102	-0.0151	-0.0002 **	-0.0002	-0.0003 *	0.0000	0.0000	0.0000
Total sqmi of canal	-0.2397	2.0198 ***	1.7801 **	0.0068	2.8999	2.9067	-0.0220	0.7426	0.7206	-0.0011	0.0021	0.0010	0.0000	0.0000	0.0000
Total sqmi of lake/pond (intermittent)	2.6508 *	-9.7262	-7.0755	1.7495 *	-11.9506	-10.2011	1.3661 ***	3.0623	4.4285	0.0389 ***	-0.0265	0.0124	0.0000	0.0001 *	0.0001
Total sqmi of lake/pond (perennial)	-0.0020	0.0217 ***	0.0197 ***	0.0027 **	0.0240 **	0.0267 **	0.0007	0.0121 ***	0.0128 ***	0.0000	0.0002 ***	0.0002 ***	0.0000	0.0000	0.0000
Total sqmi of reservoir	0.4600 **	-0.1064	0.3536	0.2079	0.2791	0.4871	0.1112	-0.1869	-0.0757	0.0018	-0.0077	-0.0059	0.0000	0.0000	0.0000
Total sqmi of stream/river (perennial)	0.0362	0.2825 ***	0.3187 ***	0.0166	0.1940	0.2106	0.0125	0.0951	0.1076	-0.0002	-0.0004	-0.0007	0.0000	0.0000	0.0000
Total sqmi of swamp/marsh	-0.0059 ***	-0.0152 **	-0.0211 ***	-0.0032 **	-0.0160	-0.0192	-0.0016 **	-0.0087	-0.0103	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Topography type (Base: Plains)															
Tablelands	0.1067	-0.6274 ***	-0.5207 **	-0.0079	-0.4568	-0.4648	-0.0121	-0.3526 *	-0.3647 *	0.0002	0.0001	0.0002	0.0000	0.0000	0.0000
Plains with hills or mountains	-0.0729	-1.0583 ***	-1.1312 ***	-0.0692	-1.0127 **	-1.0820 **	-0.0514	-0.5960 ***	-0.6475 ***	-0.0001	-0.0063 ***	-0.0064 ***	0.0000	0.0000	0.0000
Open hills and mountains	0.0427	-0.5473 **	-0.5046 ***	-0.0028	-0.3406	-0.3434	-0.0111	-0.2896 *	-0.3007 *	0.0008	-0.0035 **	-0.0027 *	0.0000	0.0000	0.0000
Hills and mountains	0.1041	-0.7359 ***	-0.6317 ***	0.0226	-0.5865	-0.5639	-0.0033	-0.4811 **	-0.4844 **	0.0014	-0.0041 **	-0.0027 *	0.0000	0.0000	0.0000
Precipitation	-0.2826 ***	-0.1304	-0.4130 ***	-0.1351 ***	-0.2218 *	-0.3568 ***	-0.0687 ***	-0.0626	-0.1313 **	-0.0011	0.0000	-0.0011 *	0.0000	0.0000	0.0000
Temperature	0.0671 ***	0.0217 **	0.0888 ***	0.0226 ***	0.0558 ***	0.0784 ***	0.0080 ***	0.0153 **	0.0233 ***	0.0002 ***	0.0001	0.0003 ***	0.0000	0.0000	0.0000
Short-term drought index (1 month)	0.1960	0.1140	0.3101	0.1211 **	0.3546 *	0.4757 **	0.0697 **	0.1092	0.1789 *	0.0022 *	-0.0009	0.0013	0.0000	0.0000	0.0000
Long-term drought index (24 months)	-0.0131	0.0603 *	0.0471	0.0013	0.0271	0.0284	0.0026	0.0047	0.0073	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
D(Urban=1)	0.0502	-0.0130	0.0372	0.0281	0.0125	0.0406	0.0127	-0.0256	-0.0129	0.0003	-0.0002	0.0001	0.0000	0.0000	0.0000
Pseudo R-squared		0.2384			0.3139			0.3402			0.2149			0.0213	

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.12: SAR-RE Estimation Results for per capita total revenue and total tax revenue items for New York, New Jersey, Massachusetts, and Pennsylvania, thousands of nominal dollars (cont'd.)

Average impacts (dy/dx)

Per capita values of dependent variable

in thousands of nominal dollars

	Public utility tax revenue			All license tax revenue		
	Direct	Indirect	Total	Direct	Indirect	Total
D(Atlantic=1)	0.0000	0.0000	0.0000	0.0007	0.0042	0.0049
CVI	0.0000	0.0000	0.0000	-0.0001	-0.0002	-0.0002
Total sqmi of canal	0.0000	0.0000	0.0000	-0.0011	-0.0045	-0.0056
Total sqmi of lake/pond (intermittent)	0.0000	0.0002	0.0001	-0.0073	-0.0889 *	-0.0961 *
Total sqmi of lake/pond (perennial)	0.0000	0.0000	0.0000	0.0000	0.0001 **	0.0001 ***
Total sqmi of reservoir	0.0000	0.0000	0.0000	-0.0014	-0.0046	-0.0059
Total sqmi of stream/river (perennial)	0.0000	0.0000	0.0000	0.0006 ***	0.0000	0.0005
Total sqmi of swamp/marsh	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0001
Topography type (Base: Plains)						
Tablelands	0.0000	0.0000	0.0000	-0.0002	0.0055 **	0.0053 **
Plains with hills or mountains	0.0000	0.0000	0.0000	-0.0006	-0.0009	-0.0015
Open hills and mountains	0.0000	0.0000	0.0000	0.0006	0.0000	0.0006
Hills and mountains	0.0000	0.0000	0.0000	0.0006	0.0007	0.0012
Precipitation	0.0000	0.0000	0.0000	-0.0003	-0.0031 ***	-0.0034 ***
Temperature	0.0000	0.0000	0.0000	0.0001	0.0002 ***	0.0003 ***
Short-term drought index (1 month)	0.0000	0.0000	0.0000	0.0008	0.0048 **	0.0056 ***
Long-term drought index (24 months)	0.0000	0.0000	0.0000 **	0.0001	0.0002	0.0002
D(Urban=1)	0.0000	0.0000 *	0.0000 **	0.0000	0.0003	0.0003
Pseudo R-squared	0.0287			0.0951		

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect"

Table A1.13: SAR-RE Estimation Results for per capita expenditure items for New York, New Jersey, Massachusetts, and Pennsylvania, thousands of nominal dollars

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Total expenditure			Total education expenditure			Highway expenditure			Police expenditure			Public welfare expenditure		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Per capita total revenue	1.0821	-0.014	1.0677												
Per capita Federal revenue	0.0343	-0.2275	-0.1932	0.6977 ***	-0.6413	0.0564	1.4852 ***	0.9617 ***	2.4469 ***				0.0947	-1.106	-1.011
Per capita State revenue	-0.0963	0.0873	-0.0090	0.7743 ***	0.3203 ***	1.0946 ***	0.7995 ***	1.1555 ***	1.955 ***				1.1126 ***	-0.005	1.1073 ***
Per capita Local revenue	-0.5953	0.0982	-0.4971	1.0933 ***	-0.288	0.8053 ***	2.0113 ***	0.9502 **	2.9615 ***				-0.42	1.2313	0.8115
Per capita total taxes				0.0528 ***	-0.027 **	0.026 **	0.0804 ***	0.005	0.0854 ***	0.1053 ***	-0.007	0.0986 ***	0.1897 ***	0.1841 ***	0.3738 ***
Per capita charge from exp item				1.6739 ***	0.271 **	1.9449 ***	1.0249 ***	0.2088	1.2337						
D(Atlantic=1)	0.0106	-0.0163	-0.0056	0.0078	-0.0310 **	-0.0232 *	-0.0348 ***	0.0503	0.0155	-0.0060	0.0475	0.0416	-0.0120	0.0405	0.0284
CVI	-0.0016	0.0022	0.0006	-0.0007	0.0032 ***	0.0025 ***	0.0020 ***	0.0015	0.0035	-0.0001	-0.0032 *	-0.0033 *	-0.0004	-0.0100 *	-0.0105 **
Total sqmi of canal	0.0697	-0.0106	0.0591	0.0305 *	-0.0336	-0.0031	-0.0435 *	-0.0966	-0.1401	-0.0003	0.0591	0.0589	-0.0285	0.2666 *	0.2381
Total sqmi of lake/pond (intermittent)	0.4925	-0.5165	-0.0240	0.0480	-0.1133	-0.0653	-0.1141	-0.3475	-0.4617	0.9801 ***	2.4402 ***	3.4203 ***	-0.7540 ***	-0.2767	-1.0306
Total sqmi of lake/pond (perennial)	-0.0001	-0.0014	-0.0015	0.0000	0.0003	0.0003	0.0009 ***	-0.0016 **	-0.0007	-0.0002	-0.0002	-0.0004	-0.0009 **	0.0022 *	0.0012
Total sqmi of reservoir	-0.0073	0.0409	0.0336	-0.0119	0.0297	0.0178	-0.0112	0.0245	0.0133	-0.0009	0.0495	0.0485	0.0159	-0.0570	-0.0411
Total sqmi of stream/river (perennial)	0.0022	0.0082	0.0104	0.0002	0.0029	0.0032	-0.0017	0.0111	0.0094	-0.0007	0.0022	0.0015	0.0031	0.0376 **	0.0407 **
Total sqmi of swamp/marsh	0.0000	-0.0001	0.0000	-0.0001	-0.0004 *	-0.0005 **	0.0000	-0.0003	-0.0003	0.0000	-0.0005	-0.0005	-0.0002	-0.0035 **	-0.0037 **
Topography type (Base: Plains)															
Tablelands	-0.0086	-0.0037	-0.0123	-0.0034	-0.0083	-0.0117	-0.0121	0.0631 **	0.0511 *	-0.0163 ***	-0.0044	-0.0207	-0.0023	-0.0968 *	-0.0991 *
Plains with hills or mountains	-0.0076	0.0056	-0.0020	-0.0072	-0.0176	-0.0249 **	-0.0160 *	0.0555 *	0.0394	-0.0145 **	0.0145	0.0000	-0.0377 **	-0.1394 ***	-0.1771 ***
Open hills and mountains	-0.0039	0.0082	0.0044	-0.0038	-0.0124	-0.0163 **	-0.0098	0.0400 *	0.0303	-0.0175 ***	0.0081	-0.0094	-0.0171	-0.0879 **	-0.1050 **
Hills and mountains	-0.0065	0.0187	0.0123	-0.0085	-0.0068	-0.0153 *	-0.0075	0.0488 *	0.0413	-0.0188 ***	-0.0279 *	-0.0467 ***	-0.0218	-0.0655	-0.0873 *
Precipitation	-0.0212	0.0144	-0.0068	-0.0016	-0.0016	-0.0031	0.0100 *	-0.0015	0.0085	-0.0162 ***	0.0297 ***	0.0135 **	-0.0308 **	0.0382 *	0.0074
Temperature	0.0006	-0.0014	-0.0008	0.0007	0.0002	0.0009	-0.0010	-0.0014 *	-0.0024 ***	0.0014 ***	-0.0021 ***	-0.0007	0.0041 ***	-0.0006	0.0035 *
Short-term drought index (1 month)	0.0623	-0.0101	0.0522	0.0009	0.0070	0.0079	-0.0153	0.0003	-0.0150	0.0231 ***	-0.0396 ***	-0.0165	0.0825 ***	-0.0652 *	0.0173
Long-term drought index (24 months)	-0.0085	0.0005	-0.0080	0.0022	-0.0022	0.0000	0.0008	-0.0019	-0.0011	0.0004	-0.0014	-0.0009	-0.0102 **	0.0038	-0.0064 ***
D(Urban=1)	0.0030	0.0144	0.0174	-0.0005	0.0042	0.0037	-0.0053	0.0098	0.0045	-0.0040 *	-0.0174 ***	-0.0213 ***	0.0070	-0.0170	-0.0100
Pseudo R-squared		0.9861			0.9255			0.8431			0.7003			0.8879	

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.13: SAR-RE Estimation Results for per capita expenditure items for New York, New Jersey, Massachusetts, and Pennsylvania, thousands of nominal dollars (cont'd.)

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Air transport expenditure			Financial administration expenditure			Fire protection expenditure			Health expenditure			Parks & recreation expenditure		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Per capita total revenue															
Per capita Federal revenue	-2.1960 ***	-1.24801	-3.4440 ***							0.0842	0.0147	0.0989			
Per capita State revenue										0.6485 ***	0.3820 ***	1.0305 ***			
Per capita Local revenue										0.5511	2.6828	3.2339			
Per capita total taxes	-0.004	0.0005	-0.003	0.0184 ***	-0.0016	0.0168 ***	0.0044 ***	-0.001476	0.0029427 ***	0.0728 ***	0.0030	0.0758 ***	0.0219 ***	-0.0091 ***	0.0128 ***
Per capita charge from exp item	1.5806 ***	0.340403 **	1.921 ***										1.2147 ***	0.4378 ***	1.6525 ***
D(Atlantic=1)	-0.0052 *	0.0038	-0.0014	-0.0054 **	0.0013	-0.0041	0.0002	0.0006	0.0009	-0.0108	0.0047	-0.0061	-0.0035	0.0009	-0.0026
CVI	0.0004 **	0.0001	0.0005	0.0002	-0.0015	-0.0013	0.0000	-0.0001	-0.0001	0.0002	-0.0003	-0.0002	0.0003 **	-0.0001	0.0002
Total sqmi of canal	0.0022	0.0027	0.0049	0.0056	0.0794	0.0849	0.0010	-0.0026	-0.0016	-0.0258	-0.0775	-0.1033	-0.0004	-0.0171 *	-0.0175 *
Total sqmi of lake/pond (intermittent)	0.0170	0.0427	0.0597	-0.0021	-0.1734	-0.1755	0.0078	-0.0039	0.0039	-0.0483	0.1340	0.0857	0.1144 ***	-0.0831	0.0312
Total sqmi of lake/pond (perennial)	0.0000	0.0002	0.0002 *	0.0002 ***	0.0000	0.0002	0.0000	0.0000	0.0000	0.0003	-0.0002	0.0000	0.0000	0.0000	0.0000
Total sqmi of reservoir	-0.0012	0.0034	0.0022	-0.0016	-0.0212	-0.0228	-0.0009	0.0046	0.0038	0.0015	-0.0142	-0.0126	0.0143 ***	0.0105	0.0247 ***
Total sqmi of stream/river (perennial)	-0.0006	-0.0017	-0.0024 *	-0.0008	-0.0025	-0.0033	0.0000	0.0001	0.0001	0.0008	0.0059	0.0067	-0.0001	-0.0019 **	-0.0020 *
Total sqmi of swamp/marsh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0001	-0.0001 ***	0.0002 **	0.0001
Topography type (Base: Plains)															
Tablelands	-0.0025	0.0070 *	0.0044	0.0003	-0.0061	-0.0057	-0.0003	0.0002	-0.0001	-0.0062	0.0443 **	0.0381 *	-0.0021	0.0014	-0.0007
Plains with hills or mountains	-0.0025	0.0097 **	0.0072 *	0.0004	0.0055	0.0058	-0.0002	-0.0002	-0.0004	-0.0111 *	0.0106	-0.0005	0.0012	0.0059 *	0.0071 **
Open hills and mountains	-0.0038 **	0.0063 *	0.0025	0.0017	-0.0014	0.0003	-0.0001	0.0009	0.0008	-0.0030	0.0169	0.0139	-0.0008	-0.0011	-0.0019
Hills and mountains	-0.0051 **	0.0064	0.0013	0.0034 *	0.0010	0.0044	-0.0001	0.0002	0.0001	-0.0057	0.0191	0.0134	-0.0008	0.0010	0.0001
Precipitation	-0.0012	-0.0024	-0.0037 *	0.0014	-0.0080 **	-0.0066 **	-0.0003	0.0002	-0.0001	0.0055	-0.0163 *	-0.0108	-0.0002	-0.0004	-0.0006
Temperature	0.0001	0.0000	0.0001	0.0002	0.0013 ***	0.0014 ***	0.0001 *	0.0000	0.0001	-0.0006	0.0004	-0.0002	-0.0001	0.0001	-0.0001
Short-term drought index (1 month)	0.0055	0.0014	0.0070 **	-0.0037	0.0119 **	0.0082	0.0008	-0.0014	-0.0006	-0.0086	0.0261	0.0176	0.0006	0.0001	0.0007
Long-term drought index (24 months)	-0.0001	-0.0002	-0.0002	-0.0002	0.0002	0.0000	0.0001	0.0003	0.0004 ***	-0.0016	0.0026	0.0010	0.0004	-0.0007	-0.0003
D(Urban=1)	-0.0022 ***	-0.0013	-0.0035 **	-0.0019 **	-0.0061	-0.0080	-0.0007 ***	0.0001	-0.0005	-0.0020	0.0018	-0.0003	0.0000	-0.0007	-0.0007
Pseudo R-squared	0.7521			0.4483			0.1071			0.7906			0.6099		

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.13: SAR-RE Estimation Results for per capita expenditure items for New York, New Jersey, Massachusetts, and Pennsylvania, thousands of nominal dollars (cont'd.)

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Sewerage expenditure			Solid waste management expenditure			Natural resources expenditure			Total utility expenditure			Housing & comm. dev't expenditure		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Per capita total revenue															
Per capita Federal revenue	1.5181 **	1.6900	3.2081										0.5334 ***	0.3532 ***	0.8865882 ***
Per capita State revenue	1.777	-2.5325	-0.7555										0.4180 ***	0.1511	0.5690166 ***
Per capita Local revenue	-2.093	-4.2128	-6.306										0.0398	-0.5585	-0.5187319
Per capita total taxes							0.0069 ***	0.0077 ***	0.0146549 ***				0.0000	0.0108 ***	0.0108158 ***
Per capita charge from exp item	1.1607 ***	-0.2819 *	0.8788 ***	0.8207 ***	0.3954 ***	1.2162 ***				1.2323 ***	0.611 ***	1.8433 ***	1.5876 ***	1.3486 **	2.93615 ***
Per capita public utility tax	3.2831	2.2672	5.5502	-0.201	-1.532	-1.732				-0.302	-2.12	-2.422			
Per capita property sale housing & comm dev													58.9487	136.9658	195.9145
D(Atlantic=1)	0.0242 ***	-0.0574 ***	-0.0331 **	0.0095 *	-0.0195	-0.0100	-0.0054 ***	0.0222 **	0.0168 *	0.0038 *	-0.0031	0.0008	-0.0013	0.0021	0.0008
CVI	-0.0013 ***	0.0017 *	0.0004	-0.0004	0.0017 *	0.0013	0.0002 *	-0.0011 *	-0.0009	-0.0002	0.0005	0.0003	0.0002	-0.0001	0.0001
Total sqmi of canal	-0.0035	0.0088	0.0053	-0.0278 ***	-0.0212	-0.0490	0.0007	0.0183	0.0190	-0.0014	0.0175 *	0.0161	0.0012	-0.0055	-0.0043
Total sqmi of lake/pond (intermittent)	0.3649 ***	-0.2751	0.0898	-0.0223	-0.1768	-0.1991	-0.0272	0.0447	0.0175	0.1016 ***	0.1165	0.2180 **	-0.0088	0.1338	0.1250
Total sqmi of lake/pond (perennial)	0.0000	0.0001	0.0001	0.0000	0.0004 *	0.0003 *	0.0001 **	-0.0001	0.0000	0.0000	0.0000	0.0000	-0.0001	0.0002 *	0.0001
Total sqmi of reservoir	0.0310 ***	-0.0185	0.0125	0.0011	0.0569 **	0.0580 **	-0.0016	0.0097	0.0081	-0.0075 ***	-0.0259 ***	-0.0334 ***	-0.0008	0.0302 *	0.0294
Total sqmi of stream/river (perennial)	0.0011	0.0005	0.0016	0.0009	0.0039	0.0049	-0.0004	-0.0008	-0.0012	-0.0002	-0.0006	-0.0008	-0.0007 *	0.0010	0.0003
Total sqmi of swamp/marsh	-0.0002 **	0.0000	-0.0002	0.0000	-0.0003	-0.0002	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001 **	-0.0002	-0.0001
Topography type (Base: Plains)															
Tablelands	0.0019	-0.0169 **	-0.0150 **	0.0025	0.0052	0.0077	-0.0018	0.0029	0.0011	0.0012	0.0052	0.0063 *	0.0017	-0.0076	-0.0058
Plains with hills or mountains	0.0023	-0.0344 ***	-0.0321 ***	0.0033	-0.0062	-0.0030	-0.0016	0.0091 *	0.0075	0.0023	0.0040	0.0063	-0.0001	0.0115 **	0.0115 **
Open hills and mountains	0.0029	-0.0189 ***	-0.0161 ***	0.0040	0.0035	0.0074	-0.0018	0.0073 *	0.0055	0.0031 **	0.0065 **	0.0096 ***	-0.0014	0.0023	0.0008
Hills and mountains	0.0039	-0.0255 ***	-0.0215 ***	0.0039	0.0002	0.0041	-0.0012	0.0051	0.0038	0.0034 **	0.0022	0.0056 *	-0.0015	0.0046	0.0032
Precipitation	0.0024	-0.0003	0.0021	0.0025	-0.0039	-0.0014	0.0009	-0.0036 *	-0.0027 *	-0.0016	0.0023	0.0007	-0.0037 **	0.0003	-0.0034 *
Temperature	-0.0003	0.0004	0.0000	0.0000	0.0002	0.0003	0.0000	0.0002	0.0002	0.0004 ***	-0.0003 *	0.0001	0.0002	-0.0001	0.0001
Short-term drought index (1 month)	-0.0115	0.0066	-0.0049	-0.0072	0.0090	0.0018	-0.0009	0.0049	0.0041	0.0018	-0.0021	-0.0003	0.0044	0.0002	0.0046
Long-term drought index (24 months)	-0.0008	0.0011	0.0003	0.0008	-0.0010	-0.0003	0.0002	-0.0001	0.0001	-0.0001	-0.0003	-0.0004	0.0000	0.0003	0.0003
D(Urban=1)	0.0019	0.0029	0.0048	0.0016	0.0017	0.0033	-0.0015 ***	-0.0032	-0.0047 **	0.0011 **	-0.0024 *	-0.0013	-0.0002	-0.0028	-0.0030
Pseudo R-squared	0.4956			0.5992			0.2533			0.7293			0.4496		

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.14: Summary Statistics for Florida, Georgia, Alabama, and South Carolina

Time-invariant variables

Variables	Count
Atlantic coastline counties	24
Gulf coastline counties	23
Pacific coastline counties	0
Topography type	
Plains	233
Tablelands	15
Plains with hills or mountains	4
Open hills and mountains	65
Hills and mountains	13
Urban counties	108

Variables	Count	Mean	SD	Minimum	Maximum
Coastal vulnerability index (CVI)	47	12.84	4.04	5.48	22.36
Total sqmi of canal	24	0.29	0.48	0.01	2.04
Total sqmi of ice mass	0	0.00	0.00	0	0.00
Total sqmi of lake/pond (intermittent)	68	1.18	4.10	0.01	30.66
Total sqmi of lake/pond (perennial)	330	6.09	17.37	0.04	158.14
Total sqmi of playa	0	0.00	0.00	0	0.00
Total sqmi of reservoir	88	0.20	0.53	0.01	4.69
Total sqmi of stream/river (intermittent)	0	0.00	0.00	0	0.00
Total sqmi of stream/river (perennial)	94	0.52	0.70	0.01	3.72
Total sqmi of swamp/marsh	255	28.15	57.49	0.02	711.90
Time-varying natural amenities					
Precipitation (inches)	2,310	4.46	0.55	3.32	6.12
Temperature (degrees Fahrenheit)	2,310	64.26	3.88	58.05	75.33
Short-term drought index (1 month)	2,310	0.11	0.23	-0.51	0.54
Long-term drought index (24 months)	2,310	-0.08	0.87	-2.30	2.12

Variables	Mean	SD	Minimum	Maximum
Per capita revenue items (in nominal dollars)				
Total revenue	340.41	346.68	17.21	4,961.05
Total tax revenue	166.00	158.58	2.52	1,030.29
Total general sales tax	42.77	68.72	0.00	471.31
Total select sales tax	14.17	23.11	0.00	340.39
Individual income tax	0.00	0.09	0.00	3.22
Alcoholic beverage tax	2.14	3.53	0.00	30.96
Motor fuels tax	3.48	11.66	0.00	230.62
Public utility tax	1.30	5.71	0.00	71.32
All license tax	0.97	2.20	0.00	21.68
Total IGR - federal	12.46	24.36	0.00	642.70
Total IGR - state	59.80	51.31	0.00	453.01
Total IGR - local	2.73	9.26	0.00	284.73
Total charges & misc revenue	91.50	211.69	0.00	4,165.35
Per capita expenditure items (in nominal dollars)				
Total expenditure	339.61	370.28	18.47	6,373.78
Highway expenditure	55.62	47.07	0.00	642.69
Total education expenditure	1.98	7.39	0.00	171.04
Public welfare expenditure	5.95	8.84	0.00	100.90
Police expenditure	33.01	38.49	0.00	816.91
Health	19.34	26.42	0.00	402.92
Financial administration	16.10	16.13	0.00	145.93
Solid waste management	15.23	23.64	0.00	241.91
Natural resources	2.77	6.89	0.00	146.75
Parks & recreation	7.33	14.87	0.00	250.20
Total utility	12.43	52.15	0.00	1,023.41
Fire protection	7.90	16.68	0.00	168.82
Sewerage	4.43	22.55	0.00	639.22
Housing & community development	3.41	10.16	0.00	112.21
Airport transport expenditure	1.97	12.64	0.00	290.72
Liquor store				

Table A1.15: Diagnostics Results for Non-Spatial and Spatial Models for Florida, Georgia, Alabama, and South Carolina

	Non-Spatial Model						Spatial Model			
Dependent Variable	Error Spatial Autocorrelation (Global Moran MI)	Has Lagged DV Spatial Autocorrelation?	AIC	R-squared	Heterosked?	Non-normal?	AIC	R-squared	Heterosked?	Non-normal?
Revenue items										
Total revenue	0.33 ***	Yes ***	0.1035	0.1549	Yes ***	Yes ***	0.1032	0.1699	Yes ***	Yes ***
Total tax revenue	0.73 ***	Yes ***	0.0207	0.1931	Yes ***	Yes ***	0.0201	0.2286	Yes ***	Yes ***
Total general sales tax	0.61 ***	Yes ***	0.0041	0.1405	Yes ***	Yes ***	0.0039	0.1932	Yes ***	Yes ***
Total select sales tax	0.46 ***	Yes ***	0.0005	0.1545	Yes ***	Yes ***	0.0005	0.1739	Yes ***	Yes ***
Alcoholic beverage tax										
Motor fuels tax										
Public utility tax	0.16 ***	Yes ***	0.0000	0.2212	Yes ***	Yes ***	0.0000	0.2661	Yes ***	Yes ***
Tobacco tax										
Total license tax	0.24 ***	Yes ***	0.0000	0.0731	Yes ***	Yes ***	0.0000	0.1312	Yes ***	Yes ***
Individual income tax	-0.01	Yes ***	0.0000	0.0058	Yes ***	Yes ***	0.0000	0.0107	Yes ***	Yes ***
Expenditure items										
Total expenditure	0.00	No	0.0184	0.8688	Yes ***	Yes ***	0.0185	0.8706	Yes ***	Yes ***
Air transport	0.00	Yes ***	0.0000	0.8635	Yes ***	Yes ***	0.0000	0.8657	Yes ***	Yes ***
Total education	0.15 ***	Yes ***	0.0001	0.0622	Yes ***	Yes ***	0.0001	0.0995	Yes ***	Yes ***
Health	0.13 ***	Yes ***	0.0002	0.7486	Yes ***	Yes ***	0.0002	0.7618	Yes ***	Yes ***
Financial administration	0.17 ***	Yes ***	0.0001	0.4953	Yes ***	Yes ***	0.0001	0.5413	Yes ***	Yes ***
Fire protection	0.17 ***	Yes ***	0.0001	0.4724	Yes ***	Yes ***	0.0001	0.5012	Yes ***	Yes ***
Judicial	0.11 ***	Yes ***	0.0001	0.7200	Yes ***	Yes ***	0.0001	0.749	Yes ***	Yes ***
Public building	0.00	No	0.0047	0.0130	Yes ***	Yes ***	0.0047	0.0249	Yes ***	Yes ***
Central staff services	0.06 ***	Yes ***	0.0003	0.3178	Yes ***	Yes ***	0.0003	0.3324	Yes ***	Yes ***
Total highways	0.08 ***	Yes ***	0.0010	0.5796	Yes ***	Yes ***	0.0009	0.6095	Yes ***	Yes ***
Natural resources	0.00	No	0.0000	0.1926	Yes ***	Yes ***	0.0000	0.2036	Yes ***	Yes ***
Parking	0.00	Yes ***	0.0000	0.0485	Yes ***	Yes ***	0.0000	0.053	Yes ***	Yes ***
Parks & recreation	0.11 ***	Yes ***	0.0001	0.5458	Yes ***	Yes ***	0.0001	0.5529	Yes ***	Yes ***
Police protection	0.20 ***	Yes ***	0.0005	0.6471	Yes ***	Yes ***	0.0005	0.6691	Yes ***	Yes ***
Protective inspection & regulation	0.20 ***	Yes ***	0.0000	0.5054	Yes ***	Yes ***	0.0000	0.5329	Yes ***	Yes ***
Public welfare	0.02 *	No	0.0000	0.4263	Yes ***	Yes ***	0.0000	0.4419	Yes ***	Yes ***
Sewerage	-0.01	Yes ***	0.0003	0.4936	Yes ***	Yes ***	0.0003	0.5002	Yes ***	Yes ***
Solid waste management	0.17 ***	Yes ***	0.0003	0.5247	Yes ***	Yes ***	0.0003	0.5677	Yes ***	Yes ***
Water transport	0.04 ***	Yes ***	0.0000	0.2208	Yes ***	Yes ***	0.0000	0.8341	Yes ***	Yes ***
Liquor store										
Total utility	0.02 *	Yes ***	0.0007	0.7580	Yes ***	Yes ***	0.0007	0.7638	Yes ***	Yes ***
Transit subsidies	0.00	Yes ***	0.0001	0.0814	Yes ***	Yes ***	0.0001	0.1863	Yes ***	Yes ***
Housing & community development	0.03 ***	Yes ***	0.0001	0.4022	Yes ***	Yes ***	0.0001	0.4112	Yes ***	Yes ***
Libraries	0.17 ***	Yes ***	0.0000	0.3132	Yes ***	Yes ***	0.0000	0.3412	Yes ***	Yes ***

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Table A1.16: Spatial Correlation of Error and Dependent Variables with Neighbors for Florida, Georgia, Alabama, and South Carolina

Dependent Variable	Correlation with Neighbors' DV	Correlation with Neighbors' Error Term
Revenue items		
Total revenue	0.91 ***	-0.70 ***
Total tax revenue	0.94 ***	-0.37 ***
Total general sales tax	0.94 ***	-0.68 ***
Total select sales tax	0.83 ***	-0.32 ***
Alcoholic beverage tax		
Motor fuels tax		
Public utility tax	0.04	0.47 ***
Tobacco tax		
Total license tax	0.71 ***	-0.57 ***
Individual income tax	-0.03	0.02
Expenditure items		
Total expenditure	0.03	-0.05
Air transport	0.14 **	-0.17 **
Total education	0.75 ***	-0.89 ***
Health	-0.36 ***	0.60 ***
Financial administration	-0.43 ***	0.66 ***
Fire protection	0.56 ***	-0.24 *
Judicial	0.46 ***	-0.32 ***
Public building	0.04	-0.07
Central staff services	0.15	0.01
Total highways	0.15	0.03
Natural resources	-0.16	0.19 *
Parking	0.03	-0.05
Parks & recreation	0.34 ***	-0.07
Police protection	0.27 ***	0.28 ***
Protective inspection & regulation	-0.29 *	0.63 ***
Public welfare	-0.09	0.17
Sewerage	-0.07	0.02
Solid waste management	0.48 ***	-0.22 **
Water transport	-0.05	0.21 ***
Liquor store		
Total utility	0.17	-0.15
Transit subsidies	-0.95 ***	0.82 ***
Housing & community development	0.26 ***	-0.22 *
Libraries	0.62 ***	-0.47 ***

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Table A1.17: SAR-RE Estimation Results for per capita total revenue and total tax revenue items for Florida, Georgia, Alabama, and South Carolina, thousands of nominal dollars

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Total revenue			**Total tax revenue**			**Total general sales tax revenue**			**Total select sales tax revenue**			**Individual income tax revenue**		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
D(Atlantic=1)	-0.1316	-1.2616	-1.3932	0.0207	0.5137	0.5345	0.0469	1.1543 *	1.2012 *	0.0025	-0.0159	-0.0134	0.0000	0.0000	0.0000
D(Gulf=1)	-0.0250	-1.1478	-1.1728	0.0248	-0.1829	-0.1581	0.0189	0.5642	0.5831	0.0111	-0.0352	-0.0241	0.0000	0.0000	0.0000
CVI	0.0153	0.0923	0.1076	0.0021	-0.0219	-0.0198	-0.0023	-0.0765	-0.0788	-0.0001	0.0002	0.0002	0.0000	0.0000	0.0000
Total sqmi of canal	0.1528	0.2354	0.3882	0.0493	0.1855	0.2348	-0.0114	0.1288	0.1174	-0.0036	-0.0401	-0.0436	0.0000	0.0000	0.0000
Total sqmi of lake/pond (intermittent)	-0.0203	-0.2741	-0.2944	-0.0061	-0.0625	-0.0686	-0.0002	0.0232	0.0230	-0.0001	-0.0027	-0.0028	0.0000	0.0000	0.0000
Total sqmi of lake/pond (perennial)	-0.0004	0.0017	0.0014	0.0001	-0.0007	-0.0006	0.0002	0.0005	0.0007	0.0000	0.0002	0.0002	0.0000	0.0000	0.0000
Total sqmi of reservoir	0.0139	-0.8977	-0.8838	-0.0135	-0.4383	-0.4519	-0.0066	-0.1457	-0.1523	-0.0039	-0.0658 ***	-0.0697 ***	0.0000	0.0000	0.0000
Total sqmi of stream/river (perennial)	0.0042	0.0996	0.1039	0.0045	0.0361	0.0406	0.0001	-0.0248	-0.0246	0.0016	-0.0009	0.0008	0.0000	0.0000	0.0000
Total sqmi of swamp/marsh	-0.0003	-0.0021	-0.0024	-0.0001	-0.0015	-0.0017	0.0000	-0.0008	-0.0009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Topography type (Base: Plains)															
Tablelands	0.0978	0.2691	0.3669	0.0543 **	0.3350	0.3893	0.0219 *	0.0801	0.1019	0.0048	0.0144	0.0191	0.0000	0.0000	0.0000
Plains with hills or mountains	0.1074	-0.0075	0.0998	-0.0070	-0.1483	-0.1553	-0.0165	-0.1784	-0.1949	0.0002	0.0391	0.0393	0.0000	0.0000	0.0000
Open hills and mountains	0.0493	-0.0173	0.0319	0.0151	0.0302	0.0453	0.0081	-0.0013	0.0068	0.0003	0.0144	0.0147	0.0000	0.0000	0.0000
Hills and mountains	0.1293	0.1791	0.3084	0.0686 ***	0.1444	0.2129	0.0070	0.0394	0.0464	0.0066 *	0.0336	0.0402 *	0.0000	0.0000	0.0000
Precipitation	-0.0873 *	0.3542 *	0.2669	-0.0312 *	0.0873	0.0561	-0.0087	0.0421	0.0334	-0.0016	0.0052	0.0036	0.0000	0.0000	0.0000
Temperature	0.0281 ***	0.0698 **	0.0979 ***	0.0100 ***	0.0356 **	0.0456 ***	0.0017 *	0.0029	0.0046	0.0016 ***	0.0035 ***	0.0051 ***	0.0000	0.0000	0.0000
Short-term drought index (1 month)	0.4070 ***	-0.5440	-0.1370	0.1734 ***	-0.0894	0.0840	0.0534 ***	-0.0543	-0.0009	0.0138 *	-0.0041	0.0096	0.0000	0.0000	0.0000
Long-term drought index (24 months)	0.0041	-0.0494	-0.0453	-0.0138 ***	-0.0160	-0.0298	-0.0102 ***	-0.0073	-0.0175 **	0.0004	-0.0003	0.0002	0.0000	0.0000	0.0000
D(Urban=1)	-0.0083	0.3182	0.3098	-0.0009	0.1475	0.1466	-0.0027	0.0011	-0.0016	0.0011	0.0072	0.0083	0.0000	0.0000	0.0000
Pseudo R-squared		0.1116			0.2185			0.2202			0.1743			0.0107	

Legend : *sig at 10%, **sig at 5%, ***sig at 1%

Notes : Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.17: SAR-RE Estimation Results for per capita total revenue and total tax revenue items for Florida, Georgia, Alabama, and South Carolina, thousands of nominal dollars (cont'd.)

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Public utility tax revenue			All license tax revenue		
	Direct	Indirect	Total	Direct	Indirect	Total
D(Atlantic=1)	-0.0098 ***	-0.0107 *	-0.0205 ***	0.0002	-0.0064	-0.0062
D(Gulf=1)	-0.0067 ***	-0.0070	-0.0136 ***	-0.0003	-0.0045	-0.0049
CVI	0.0008 ***	0.0008 *	0.0016 ***	0.0000	0.0003	0.0003
Total sqmi of canal	-0.0015	-0.0069 *	-0.0084 **	-0.0005	-0.0007	-0.0012
Total sqmi of lake/pond (intermittent)	0.0003 ***	-0.0010 **	-0.0007	0.0000	-0.0002	-0.0002
Total sqmi of lake/pond (perennial)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total sqmi of reservoir	0.0000	-0.0080 ***	-0.0080 ***	0.0004	0.0014	0.0018
Total sqmi of stream/river (perennial)	-0.0004	0.0018 *	0.0014	0.0001	0.0005	0.0006
Total sqmi of swamp/marsh	0.0000 ***	0.0000	0.0000 **	0.0000	0.0000 *	0.0000
Topography type (Base: Plains)						
Tablelands	0.0005	-0.0002	0.0003	0.0002	-0.0025 *	-0.0023
Plains with hills or mountains	0.0000	0.0053	0.0053	0.0008	-0.0039	-0.0032
Open hills and mountains	0.0003	0.0008	0.0011	0.0002	0.0015 **	0.0017 ***
Hills and mountains	0.0001	0.0056 **	0.0057 ***	0.0011 **	-0.0030 *	-0.0020
Precipitation	0.0012	-0.0015	-0.0003	0.0007 **	0.0007	0.0014 ***
Temperature	0.0008 ***	0.0001	0.0009 ***	0.0000	0.0000	0.0000
Short-term drought index (1 month)	-0.0002	0.0028	0.0025	-0.0017 **	-0.0007	-0.0025 **
Long-term drought index (24 months)	0.0008 **	-0.0003	0.0005 **	0.0002	-0.0006 ***	-0.0004 ***
D(Urban=1)	0.0010 **	0.0033 ***	0.0043 ***	-0.0001	0.0009	0.0008
Pseudo R-squared	0.2653			0.1378		

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect"

Table A1.18: SAR-RE Estimation Results for per capita expenditure items for Florida, Georgia, Alabama, and South Carolina, thousands of nominal dollars

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Total expenditure			Total education expenditure			Highway expenditure			Police expenditure			Public welfare expenditure		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Per capita total revenue	0.9933 ***	0.0396 **	1.0328 ***												
Per capita Federal revenue	-0.4493 ***	0.1380	-0.3113	1.2854	7.7501	9.0355	1.0596 ***	2.3427 ***	3.4022 ***				0.5217 ***	-0.119	0.4032 *
Per capita State revenue	-0.1492 *	-0.099	-0.2483 **	0.2355	4.5231 *	4.758634 *	0.7184 ***	0.1663 ***	0.8847 ***				0.6858 ***	0.1757 ***	0.8615 ***
Per capita Local revenue	-0.9914 ***	1.0779	0.0865	-1.4577	24.778	23.32053	1.4026 **	-2.28	-0.878				0.0121	2.7855 ***	2.7976 ***
Per capita total taxes				0.0010	-0.001	-0.0004488	0.1306 ***	0.0397 ***	0.1703 ***	0.1578 ***	0.026 ***	0.1838 ***	0.0234 ***	-0.005 ***	0.0181 ***
Per capita charge from exp item				0.2799	-4.651	-4.3711	1.5949 ***	3.6144 ***	5.2093 ***						
D(Atlantic=1)	0.0045	0.0893	0.0938	0.0007	0.0020	0.0028	0.0130	0.0851 **	0.0981 ***	-0.0158 *	-0.0635 **	-0.079 **	-0.0022	-0.0091	-0.0113 *
D(Gulf=1)	0.0307	0.0894	0.1202	-0.0001	-0.0024	-0.0026	0.0153	0.0715 ***	0.0868 ***	0.0022	-0.0298	-0.0276	0.0000	-0.0065	-0.0065
CVI	-0.0006	-0.0041	-0.0047	0.0000	-0.0003	-0.0003	-0.0014 *	-0.0061 **	-0.0075 ***	0.0005	0.0053 **	0.0058 **	0.0000	0.0007	0.0007
Total sqmi of canal	-0.0373	-0.1083 *	-0.1456 **	-0.0001	0.0046	0.0045	0.0056	0.0107	0.0164	0.0103 *	0.0181	0.0284	0.0022	-0.0026	-0.0004
Total sqmi of lake/pond (intermittent)	0.0029	0.0208 ***	0.0238 ***	0.0000	0.0001	0.0001	-0.0003	-0.0006	-0.0009	-0.0009 *	-0.0014	-0.0024	0.0003 ***	-0.0001	0.0002
Total sqmi of lake/pond (perennial)	0.0000	-0.0002	-0.0002	0.0000	0.0000	0.0000	0.0000	0.0004 ***	0.0003 ***	0.0001	-0.0002	-0.0001	0.0000 ***	0.0000	0.0000
Total sqmi of reservoir	0.0170	-0.0373	-0.0203	0.0008	0.0025	0.0032	-0.0066 **	-0.0153 *	-0.0219 **	-0.0058 **	-0.0003	-0.0061	-0.0005	0.0021	0.0017
Total sqmi of stream/river (perennial)	-0.0030	0.0076	0.0046	0.0001	0.0036	0.0038	-0.0026	-0.0034	-0.0060	0.0068 ***	-0.0038	0.0030	-0.0001	0.0010	0.0009
Total sqmi of swamp/marsh	0.0000	-0.0003	-0.0003	0.0000	0.0000	0.0000	0.0001 **	-0.0001 **	-0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
Topography type (Base: Plains)															
Tablelands	-0.0054	0.0224	0.0169	0.0015	-0.0113 **	-0.0097 **	0.0021	0.0036	0.0057	-0.0034	-0.0131	-0.0166 *	-0.0011	0.0022	0.0011
Plains with hills or mountains	-0.0229	0.0078	-0.0150	-0.0015	-0.0112	-0.0128	-0.0013	-0.0062	-0.0076	0.0028	0.0164	0.0192	0.0006	-0.0028	-0.0022
Open hills and mountains	-0.0178	0.0212	0.0034	0.0000	0.0027	0.0027	-0.0001	0.0128 **	0.0127 ***	0.0005	0.0054	0.0059	0.0003	-0.0005	-0.0002
Hills and mountains	0.0026	0.0174	0.0200	0.0003	-0.0079	-0.0076	0.0084	0.0293 **	0.0377 ***	-0.0015	0.0043	0.0028	0.0019	-0.0009	0.0010
Precipitation	0.0211	-0.0111	0.0100	0.0007	0.0033 *	0.0040 **	0.0109 **	-0.0114 *	-0.0005	-0.0035	0.0055	0.0020	0.0000	-0.0005	-0.0005
Temperature	0.0012	0.0003	0.0016	-0.0001	-0.0004	-0.0005 *	0.0007	0.0007	0.0014 **	0.0018 ***	-0.0002	0.0017 ***	0.0002	0.0000	0.0001
Short-term drought index (1 month)	-0.0993	0.0657	-0.0336	-0.0031	-0.0063	-0.0094 ***	-0.0104	0.0136	0.0032	0.0244 **	-0.0276 **	-0.0032	-0.0009	0.0023	0.0014
Long-term drought index (24 months)	0.0058	-0.0015	0.0043	-0.0008 *	-0.0003	-0.0011 ***	0.0001	0.0015	0.0015	0.0003	0.0017	0.0021 **	0.0008	-0.0005	0.0004 *
D(Urban=1)	0.0131 *	-0.0199	-0.0068	0.0000	0.0031	0.0031	-0.0049 **	-0.0162 ***	-0.0211 ***	-0.0006	0.0102 **	0.0096 *	-0.0007	0.0021 **	0.0013
Pseudo R-squared		0.8706			0.1041			0.6101			0.6688			0.4419	

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.18: SAR-RE Estimation Results for per capita expenditure items for Florida, Georgia, Alabama, and South Carolina, thousands of nominal dollars (cont'd.)

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Air transport expenditure			Financial administration expenditure			Fire protection expenditure			Health expenditure			Parks & recreation expenditure		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Per capita total revenue															
Per capita Federal revenue	0.8216 ***	0.8524115	1.6740							0.2140 **	0.1577	0.3717			
Per capita State revenue										0.9357 ***	-0.1684 ***	0.7673 ***			
Per capita Local revenue										0.1497	0.2908	0.4405			
Per capita total taxes	0.0034 ***	-0.0022365 *	0.0011	0.0443 ***	0.0242 ***	0.0685 ***	0.0678 ***	-0.003338	0.0644815 ***	0.0440 ***	0.0245 ***	0.0686 ***	0.0429 ***	-0.0063 *	0.0367 ***
Per capita charge from exp item	1.1314 ***	0.0647365 *	1.1961 ***										1.8667 ***	0.6410 **	2.5077 ***
D(Atlantic=1)	-0.0004	-0.0095 **	-0.0099 **	0.0036	-0.0109	-0.0073	-0.0014	-0.0474 *	-0.0489 *	0.0073	0.0001	0.0074	-0.0092 **	0.0030	-0.0062
D(Gulf=1)	-0.0004	-0.0059 **	-0.0063 **	0.0005	0.0093	0.0098	-0.0079 *	-0.0247	-0.0327	0.0071 *	0.0073	0.0144 *	-0.0062 **	0.0019	-0.0042
CVI	0.0002 *	0.0008 ***	0.0010 ***	-0.0004	0.0003	0.0000	0.0003	0.0038 *	0.0041 *	-0.0003	-0.0002	-0.0004	0.0009 ***	-0.0005	0.0004
Total sqmi of canal	-0.0014	0.0038 *	0.0024	0.0017	0.0163 ***	0.0180 ***	0.0020	0.0004	0.0025	0.0086 **	0.0040	0.0126 *	0.0056 **	0.0027	0.0083
Total sqmi of lake/pond (intermittent)	0.0000	-0.0004	-0.0004	-0.0003	-0.0014 **	-0.0018 ***	0.0003	-0.0017	-0.0014	-0.0003	-0.0009	-0.0012	0.0000	-0.0009	-0.0009
Total sqmi of lake/pond (perennial)	0.0000	0.0000	0.0000 **	0.0000	0.0000	0.0000	0.0000	0.0002 *	0.0002	0.0000	0.0000	0.0000	0.0000 *	0.0000	-0.0001 *
Total sqmi of reservoir	0.0004	-0.0009	-0.0005	-0.0013	-0.0043 *	-0.0056 **	-0.0011	-0.0131 *	-0.0142 *	-0.0027 **	0.0029	0.0002	0.0011	-0.0036	-0.0025
Total sqmi of stream/river (perennial)	0.0003	-0.0006	-0.0004	0.0002	-0.0025	-0.0022	-0.0007	-0.0042	-0.0049	0.0001	-0.0012	-0.0011	0.0001	-0.0007	-0.0006
Total sqmi of swamp/marsh	0.0000 ***	0.0000 *	0.0000 **	0.0000 *	0.0000 **	0.0001 ***	0.0000 ***	-0.0001 **	-0.0002 ***	0.0000	0.0000 *	0.0000 **	0.0000	0.0000	0.0000
Topography type (Base: Plains)															
Tablelands	-0.0005	-0.0002	-0.0007	-0.0034	-0.0030	-0.0065 **	0.0061 ***	0.0049	0.0110	-0.0028	-0.0053	-0.0081 **	0.0012	0.0044	0.0057 *
Plains with hills or mountains	-0.0003	-0.0002	-0.0005	-0.0002	-0.0004	-0.0006	-0.0002	0.0162	0.0159	-0.0052	-0.0025	-0.0077	0.0047 *	-0.0024	0.0023
Open hills and mountains	-0.0001	-0.0012 **	-0.0013 ***	-0.0017	0.0037 *	0.0020	-0.0009	-0.0009	-0.0019	-0.0006	0.0002	-0.0004	0.0003	-0.0001	0.0002
Hills and mountains	-0.0003	-0.0013	-0.0016	0.0007	0.0033	0.0040	-0.0043	0.0104	0.0061	0.0002	-0.0011	-0.0009	-0.0023	0.0065	0.0042
Precipitation	-0.0013 *	0.0018 **	0.0005	0.0041 *	0.0006	0.0047 ***	-0.0028	0.0009	-0.0019	0.0036	-0.0059 **	-0.0023	0.0000	0.0001	0.0001
Temperature	0.0000	-0.0001 **	-0.0002 **	0.0013 ***	-0.0006 ***	0.0007 ***	0.0007 ***	0.0004	0.0010 **	-0.0004 *	0.0004 **	0.0000	0.0002	0.0001	0.0003
Short-term drought index (1 month)	0.0017	-0.0026	-0.0009	0.0048	-0.0114 *	-0.0066 **	0.0090 *	-0.0080	0.0011	-0.0030	0.0086	0.0057	-0.0011	-0.0018	-0.0029
Long-term drought index (24 months)	0.0009 **	-0.0010 ***	-0.0001	-0.0001	0.0012	0.0011 **	-0.0002	0.0007	0.0006	-0.0007	0.0001	-0.0006	0.0005	-0.0005	0.0000
D(Urban=1)	0.0001	-0.0010	-0.0009	-0.0019 **	0.0026	0.0007	0.0019 **	0.0102 **	0.0121 ***	-0.0019 *	-0.0002	-0.0021	0.0023 ***	-0.0002	0.0022
Pseudo R-squared		0.8656			0.5399			0.4978			0.7615			0.5531	

Legend : *sig at 10%, **sig at 5%, ***sig at 1%

Notes : Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.18: SAR-RE Estimation Results for per capita expenditure items for Florida, Georgia, Alabama, and South Carolina, thousands of nominal dollars (cont'd.)

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Sewerage expenditure			Solid waste management expenditure			Natural resources expenditure			Total utility expenditure			Housing & comm. dev't expenditure		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Per capita total revenue															
Per capita Federal revenue	0.0895	-6.3659	-6.276										0.6774 ***	-0.1051	0.5723126 ***
Per capita State revenue	5.0335	3.9590	8.9925										0.4494 ***	0.0455	0.4948792 ***
Per capita Local revenue	-4018 ***	-1477.7810	-5495										-0.5021	0.0338	-0.4683018
Per capita total taxes							0.0109 ***	0.0026	0.0135834 ***				0.0154 ***	0.0018	0.0171993 ***
Per capita charge from exp item	1.4318 ***	0.1415 **	1.5732 ***	0.7161 ***	0.5759 ***	1.292 ***				1.0419 ***	0.186 ***	1.2279 ***	2.4768 ***	0.1172	2.593993
Per capita public utility tax	-0.121	-0.5730 ***	-0.694 ***	0.106	-0.194	-0.088				1.089 ***	-0.364	0.725 ***			
Per capita property sale housing & comm dev													-17.4886	-177.2222	-194.7108
D(Atlantic=1)	0.0026	-0.0022	0.0004	0.0053	-0.0007	0.0046	-0.0059 ***	-0.0050	-0.0109 **	0.0004	-0.0600 **	-0.0596 **	0.0000	0.0013	0.0013
D(Gulf=1)	-0.0024	-0.0008	-0.0032	0.0138 ***	0.0015	0.0152	-0.0015	-0.0017	-0.0032	0.0014	-0.0348 *	-0.0333 *	-0.0007	0.0048	0.0042
CVI	-0.0003	0.0003	0.0001	-0.0002	-0.0001	-0.0003	0.0003 **	0.0004	0.0006 *	0.0002	0.0035 *	0.0037 *	0.0000	-0.0005	-0.0005
Total sqmi of canal	-0.0013	-0.0083	-0.0096	0.0049	-0.0033	0.0016	-0.0017	0.0040	0.0023	0.0089	0.0104	0.0194	-0.0020	-0.0067	-0.0087 *
Total sqmi of lake/pond (intermittent)	-0.0001	0.0005	0.0004	-0.0002	-0.0035 **	-0.0037 *	0.0002 **	-0.0001	0.0001	-0.0007	-0.0034 *	-0.0041 **	0.0001	-0.0003	-0.0001
Total sqmi of lake/pond (perennial)	0.0000	0.0000	0.0000	0.0000	0.0002 *	0.0001	0.0000	0.0000	0.0000	-0.0001 ***	0.0001	-0.0001	0.0000 ***	0.0000	0.0000
Total sqmi of reservoir	-0.0004	-0.0067 **	-0.0072 **	-0.0014	-0.0076	-0.0090	0.0015 ***	-0.0017	-0.0003	0.0007	0.0152 **	0.0159 **	-0.0004	-0.0021	-0.0026
Total sqmi of stream/river (perennial)	0.0009	0.0009	0.0018	0.0018 *	0.0003	0.0022	-0.0007 *	-0.0009	-0.0015 *	-0.0006	-0.0037	-0.0043	-0.0002	0.0015	0.0013
Total sqmi of swamp/marsh	0.0000 **	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000 *	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
Topography type (Base: Plains)															
Tablelands	-0.0009	-0.0023	-0.0032	0.0048 **	-0.0017	0.0031	-0.0002	-0.0011	-0.0013	0.0032	0.0119 *	0.0151 **	0.0005	-0.0018	-0.0013
Plains with hills or mountains	-0.0030	-0.0070	-0.0100	0.0021	-0.0006	0.0015	0.0007	-0.0019	-0.0013	-0.0006	0.0015	0.0009	0.0016	-0.0001	0.0015
Open hills and mountains	-0.0022	0.0034 *	0.0012	0.0024	-0.0006	0.0018	0.0013 **	-0.0006	0.0007	-0.0023	0.0007	-0.0016	0.0002	0.0011	0.0014
Hills and mountains	-0.0018	0.0023	0.0006	0.0030	-0.0017	0.0014	0.0012	0.0014	0.0027 **	0.0008	-0.0033	-0.0025	-0.0004	0.0037	0.0033
Precipitation	0.0028	-0.0017	0.0011	-0.0043 *	0.0014	-0.0029	-0.0015	0.0020	0.0004	0.0015	0.0017	0.0032	0.0034 ***	-0.0037 **	-0.0003
Temperature	0.0000	0.0001	0.0001	0.0002	-0.0004	-0.0002	0.0006 ***	-0.0002 **	0.0004 ***	0.0002	-0.0001	0.0001	0.0001	0.0003 ***	0.0004 ***
Short-term drought index (1 month)	-0.0036	0.0021	-0.0015	0.0149 **	-0.0029	0.0120 **	0.0074 ***	-0.0083 ***	-0.0008	-0.0051	-0.0033	-0.0084	-0.0059 *	0.0072 **	0.0013
Long-term drought index (24 months)	-0.0013	0.0009	-0.0004	0.0012	-0.0024 **	-0.0012 **	0.0003	0.0004	0.0007 ***	0.0018	-0.0015	0.0003	0.0004	-0.0002	0.0003
D(Urban=1)	0.0007	0.0020	0.0027	-0.0038 ***	-0.0107 ***	-0.0145 ***	-0.0002	0.0003	0.0001	0.0054 ***	0.0017	0.0070 *	0.0005	-0.0005	0.0000
Pseudo R-squared		0.5001			0.5707			0.2037			0.7638			0.4114	

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.19: Summary Statistics for South Dakota, Nebraska, Minnesota, and Iowa

Time-invariant variables

Variables	Count
Atlantic coastline counties	0
Gulf coastline counties	0
Pacific coastline counties	0
Topography type	
Plains	224
Tablelands	14
Plains with hills or mountains	7
Open hills and mountains	94
Hills and mountains	4
Urban counties	37

Variables	Count	Mean	SD	Minimum	Maximum
Coastal vulnerability index (CVI)	0	0.00	0.00	0.00	0.00
Total sqmi of canal	4	0.12	0.09	0.07	0.25
Total sqmi of ice mass	0	0.00	0.00	0.00	0.00
Total sqmi of lake/pond (intermittent)	237	1.42	4.00	0.01	32.60
Total sqmi of lake/pond (perennial)	343	10.70	34.05	0.04	331.85
Total sqmi of playa	2	3.89	5.01	0.35	7.43
Total sqmi of reservoir	210	0.20	1.32	0.01	15.95
Total sqmi of stream/river (intermittent)	0	0.00	0.00	0.00	0.00
Total sqmi of stream/river (perennial)	79	0.75	1.48	0.01	10.51
Total sqmi of swamp/marsh	173	44.35	202.55	0.05	2,122.85
Time-varying natural amenities					
Precipitation (inches)	2,401	2.35	0.62	0.76	4.08
Temperature (degrees Fahrenheit)	2,401	46.31	3.80	33.68	53.71
Short-term drought index (1 month)	2,401	0.11	0.35	-0.86	0.98
Long-term drought index (24 months)	2,401	0.16	0.77	-1.78	1.97

Variables	Mean	SD	Minimum	Maximum
Per capita revenue items (in nominal dollars)				
Total revenue	490.15	413.14	36.49	4,556.89
Total tax revenue	176.94	112.27	0.00	1,073.42
Total general sales tax	1.12	7.33	0.00	162.93
Total select sales tax	0.64	3.55	0.00	84.11
Individual income tax	0.01	0.46	0.00	20.62
Alcoholic beverage tax				
Motor fuels tax				
Public utility tax	0.25	1.36	0.00	31.83
All license tax	5.19	11.96	0.00	155.95
Total IGR - federal	15.11	30.53	0.00	678.65
Total IGR - state	146.37	146.29	0.00	1,400.93
Total IGR - local	5.82	21.55	0.00	784.56
Total charges & misc revenue	145.88	245.02	0.00	2,219.37
Per capita expenditure items (in nominal dollars)				
Total expenditure	474.92	398.39	0.00	4,096.36
Highway expenditure	144.80	113.89	0.00	1,045.48
Total education expenditure	2.26	6.79	0.00	107.96
Public welfare expenditure	59.76	100.90	0.00	1,257.97
Police expenditure	24.97	24.70	0.00	251.98
Health	17.69	29.22	0.00	290.87
Financial administration	24.50	22.51	0.00	494.17
Solid waste management	4.82	13.98	0.00	248.55
Natural resources	11.44	16.33	0.00	297.87
Parks & recreation	4.10	10.23	0.00	299.72
Total utility	0.20	4.34	0.00	178.93
Fire protection	0.54	2.16	0.00	39.17
Sewerage	0.20	4.40	0.00	206.71
Housing & community development	0.69	4.94	0.00	124.28
Airport transport expenditure	0.23	4.42	0.00	207.60
Liquor store				

Table A1.20: Diagnostics Results for Non-Spatial and Spatial Models for South Dakota, Nebraska, Minnesota, and Iowa

	Non-Spatial Model						Spatial Model			
Dependent Variable	Error Spatial Autocorrelation (Global Moran MI)	Has Lagged DV Spatial Autocorrelation?	AIC	R-squared	Heterosked?	Non-normal?	AIC	R-squared	Heterosked?	Non-normal?
Revenue items										
Total revenue	0.27 ***	No	0.1358	0.2174	Yes ***	Yes ***	0.1284	0.2698	Yes ***	Yes ***
Total tax revenue	0.49 ***	Yes *	0.0095	0.2597	Yes ***	Yes ***	0.0093	0.2799	Yes ***	Yes ***
Total general sales tax	0.10 ***	Yes ***	0.0001	0.0436	Yes ***	Yes ***	0.0001	0.0776	Yes ***	Yes ***
Total select sales tax	0.03 ***	Yes ***	0.0000	0.0260	Yes ***	Yes ***	0.0000	0.048	Yes ***	Yes ***
Alcoholic beverage tax										
Motor fuels tax										
Public utility tax	0.06 ***	Yes ***	0.0000	0.0248	Yes ***	Yes ***	0.0000	0.0312	Yes ***	Yes ***
Tobacco tax	-0.01 ***	Yes ***	0.0000	0.0119	Yes ***	Yes ***				
Total license tax	0.20 ***	Yes ***	0.0001	0.1662	Yes ***	Yes ***	0.0001	0.2333	Yes ***	Yes ***
Individual income tax	-0.01	Yes ***	0.0000	0.0109	Yes ***	Yes ***	0.0000	0.0255	Yes ***	Yes ***
Expenditure items										
Total expenditure	0.01	Yes ***	0.0066	0.9591	Yes ***	Yes ***	0.0065	0.9606	Yes ***	Yes ***
Air transport	0.00	Yes ***	0.0000	0.1168	Yes ***	Yes ***	0.0000	0.1567	Yes ***	Yes ***
Total education	0.31 ***	Yes ***	0.0000	0.0968	Yes ***	Yes ***	0.0000	0.139	Yes ***	Yes ***
Health	0.20 ***	Yes ***	0.0005	0.3966	Yes ***	Yes ***	0.0004	0.5143	Yes ***	Yes ***
Financial administration	0.07 ***	Yes *	0.0003	0.4664	Yes ***	Yes ***	0.0003	0.4797	Yes ***	Yes ***
Fire protection	0.12 ***	Yes ***	0.0000	0.0733	Yes ***	Yes ***	0.0000	0.0964	Yes ***	Yes ***
Judicial	0.29 ***	Yes ***	0.0001	0.4668	Yes ***	Yes ***	0.0001	0.5249	Yes ***	Yes ***
Public building	0.00	Yes ***	0.0001	0.2216	Yes ***	Yes ***	0.0001	0.2357	Yes ***	Yes ***
Central staff services	0.04 ***	Yes ***	0.0003	0.2020	Yes ***	Yes ***	0.0003	0.2272	Yes ***	Yes ***
Total highways	0.10 ***	Yes ***	0.0026	0.8072	Yes ***	Yes ***	0.0025	0.8134	Yes ***	Yes ***
Natural resources	0.14 ***	Yes ***	0.0002	0.2873	Yes ***	Yes ***	0.0002	0.3159	Yes ***	Yes ***
Parking	0.00	Yes ***	0.0000	0.9458	Yes ***	Yes ***	0.0000	0.9488	Yes ***	Yes ***
Parks & recreation	0.05 ***	Yes ***	0.0001	0.3111	Yes ***	Yes ***	0.0001	0.3566	Yes ***	Yes ***
Police protection	0.16 ***	Yes ***	0.0003	0.5696	Yes ***	Yes ***	0.0002	0.6269	Yes ***	Yes ***
Protective inspection & regulation	0.00	Yes ***	0.0000	0.0200	Yes ***	Yes ***	0.0000	0.0313	Yes ***	Yes ***
Public welfare	0.11 ***	Yes ***	0.0021	0.7973	Yes ***	Yes ***	0.0019	0.8213	Yes ***	Yes ***
Sewerage	0.00	Yes ***	0.0000	0.5196	Yes ***	Yes ***	0.0000	0.5216	Yes ***	Yes ***
Solid waste management	0.17 ***	Yes ***	0.0001	0.3893	Yes ***	Yes ***	0.0001	0.4655	Yes ***	Yes ***
Water transport	-0.01	Yes ***	0.0000	0.0503	Yes ***	Yes ***	0.0000	0.0592	Yes ***	Yes ***
Liquor store										
Total utility	0.01	Yes ***	0.0000	0.0769	Yes ***	Yes ***	0.0000	0.0635	Yes ***	Yes ***
Transit subsidies	0.00	Yes ***	0.0000	0.0039	Yes ***	Yes ***	0.0000	0.0324	Yes ***	Yes ***
Housing & community development	0.01	Yes ***	0.0000	0.1889	Yes ***	Yes ***	0.0000	0.1947	Yes ***	Yes ***
Libraries	0.17 ***	Yes ***	0.0000	0.1456	Yes ***	Yes ***	0.0000	0.2017	Yes ***	Yes ***

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Table A1.21: Spatial Correlation of Error and Dependent Variables with Neighbors for South Dakota, Nebraska, Minnesota, and Iowa

Dependent Variable	Correlation with Neighbors' DV	Correlation with Neighbors' Error Term
Revenue items		
Total revenue	0.90 ***	-0.41 ***
Total tax revenue	0.94 ***	-0.43 ***
Total general sales tax	-0.29 **	0.50 ***
Total select sales tax	0.31	-0.25
Alcoholic beverage tax		
Motor fuels tax		
Public utility tax	0.63 ***	-0.68 ***
Tobacco tax		
Total license tax	-0.74 ***	0.86 ***
Individual income tax	-1.21 ***	0.88 ***
Expenditure items		
Total expenditure	0.02	0.03
Air transport	0.01	-0.07
Total education	0.86 ***	-0.60 ***
Health	0.64 ***	-0.61 ***
Financial administration	0.19 **	0.03
Fire protection	0.47 ***	-0.38 ***
Judicial	-0.46 ***	0.85 ***
Public building	0.02	-0.03
Central staff services	0.06	0.05
Total highways	0.35 ***	-0.12
Natural resources	-0.34 ***	0.61 ***
Parking	-0.03	-0.02
Parks & recreation	-0.69 ***	0.67 ***
Police protection	0.30 ***	0.09
Protective inspection & regulation	0.04	-0.11
Public welfare	0.22 *	0.07
Sewerage	-0.06	0.05
Solid waste management	0.40 ***	-0.11
Water transport	-0.12	0.11
Liquor store		
Total utility	0.03	-0.03
Transit subsidies	0.04	-0.08
Housing & community development	0.01	0.03
Libraries	0.57 ***	-0.40 ***

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Table A1.22: SAR-RE Estimation Results for per capita total revenue and total tax revenue items for South Dakota, Nebraska, Minnesota, and Iowa, thousands of nominal dollars

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Total revenue			Total tax revenue			Total general sales tax revenue			Total select sales tax revenue			Individual income tax revenue		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Total sqmi of canal	-1.7598 *	4.7251	2.9653	-0.3163	-2.1858	-2.5021	-0.0029	-0.0161	-0.0190	-0.0008	-0.0020	-0.0029	0.0013 **	-0.0003	0.0011
Total sqmi of lake/pond (intermittent)	0.0014	-0.0482	-0.0468	0.0014	0.0055	0.0069	0.0000	-0.0001	-0.0001	-0.0001	0.0000	-0.0001	0.0000	0.0000	0.0000 *
Total sqmi of lake/pond (perennial)	0.0008	0.0022	0.0030	0.0001	-0.0001	0.0001	0.0000 **	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total sqmi of playa	-0.0025	0.0006	-0.0020	-0.0069	-0.0671	-0.0740	0.0001	0.0007	0.0009	0.0001	-0.0001	0.0000	0.0000	0.0000	0.0001 *
Total sqmi of reservoir	-0.0229	-0.2936	-0.3165	0.0043	0.1262	0.1306	-0.0008 ***	-0.0016 **	-0.0023 ***	-0.0002	-0.0004	-0.0006	0.0000	0.0000	0.0000
Total sqmi of stream/river (perennial)	0.0274	0.8031 **	0.8305 **	0.0037	0.2560 *	0.2597 *	0.0001	0.0048 ***	0.0050 ***	-0.0001	0.0019 ***	0.0018 ***	0.0000	0.0000	0.0000
Total sqmi of swamp/marsh	-0.0001	0.0003	0.0002	-0.0001	-0.0006	-0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Topography type (Base: Plains)															
Tablelands	-0.0277	-0.6118	-0.6394	0.0077	-0.3168	-0.3091	-0.0016	0.0028	0.0012	0.0008	0.0002	0.0010	0.0002 ***	0.0000	0.0002 ***
Plains with hills or mountains	-0.0756	0.0093	-0.0663	0.0390	-0.0486	-0.0097	-0.0010	0.0001	-0.0009	0.0002	-0.0011	-0.0009	0.0001	0.0001	0.0002 *
Open hills and mountains	-0.0208	-0.0650	-0.0858	-0.0010	0.0128	0.0118	0.0002	-0.0008	-0.0005	0.0000	-0.0001	-0.0001	-0.0001 *	0.0000	0.0000
Hills and mountains	-0.1442	-2.6342	-2.7784	-0.0101	-0.9103	-0.9204	-0.0019	0.0051	0.0033	0.0010	-0.0043	-0.0032	0.0004 ***	-0.0009 ***	-0.0004 ***
Precipitation	0.1709 ***	-0.2397 *	-0.0688	0.0290 **	-0.0439	-0.0149	0.0036 ***	-0.0017	0.0019 ***	0.0016 ***	-0.0019 ***	-0.0003	0.0003 ***	-0.0003 ***	0.0000
Temperature	0.0049	0.0039	0.0087	0.0032 ***	0.0013	0.0045	-0.0002 *	0.0001	-0.0001	0.0000	0.0001 ***	0.0000	0.0000 *	0.0000 ***	0.0000
Short-term drought index (1 month)	-0.5971 ***	0.2990 *	-0.2981 **	-0.1528 ***	0.0414	-0.1114 **	-0.0057 ***	0.0003	-0.0054 ***	-0.0041 ***	0.0033 ***	-0.0008 **	-0.0003 ***	0.0003 **	0.0000
Long-term drought index (24 months)	0.0426 **	0.0081	0.0507 *	0.0173 ***	-0.0007	0.0166	0.0006	-0.0010	-0.0004	0.0001	-0.0001	0.0000	0.0000	0.0001	0.0000 *
D(Urban=1)	-0.1853 ***	-0.0797	-0.2649	-0.0320 ***	-0.0163	-0.0483	-0.0005	-0.0007	-0.0012	0.0001	0.0001	0.0002	0.0000	0.0000	0.0000
Pseudo R-squared		0.1719			0.2168			0.0757			0.0467			0.0202	

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.22: SAR-RE Estimation Results for per capita total revenue and total tax revenue items for South Dakota, Nebraska, Minnesota, and Iowa, thousands of nominal dollars (cont'd.)

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Public utility tax revenue			All license tax revenue		
	Direct	Indirect	Total	Direct	Indirect	Total
Total sqmi of canal	0.0012	-0.0015	-0.0003	-0.0016	0.0042	0.0025
Total sqmi of lake/pond (intermittent)	0.0000	0.0000	0.0000	-0.0002	0.0013 ***	0.0011 ***
Total sqmi of lake/pond (perennial)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total sqmi of playa	-0.0001	-0.0005	-0.0005	-0.0021 **	-0.0047 ***	-0.0068 ***
Total sqmi of reservoir	0.0000	0.0001	0.0001	-0.0006	0.0009	0.0003
Total sqmi of stream/river (perennial)	0.0000	0.0002	0.0002	-0.0004	-0.0005	-0.0009
Total sqmi of swamp/marsh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Topography type (Base: Plains)						
Tablelands	0.0001	-0.0003	-0.0003	-0.0021	0.0034	0.0013
Plains with hills or mountains	0.0002	-0.0009	-0.0007	0.0135 ***	-0.0017	0.0119 ***
Open hills and mountains	0.0001	-0.0002	-0.0001	0.0006	0.0012	0.0018 *
Hills and mountains	0.0006	-0.0019	-0.0013	-0.0006	0.0071	0.0065
Precipitation	-0.0001	-0.0001	-0.0002	-0.0039 *	0.0001	-0.0038 ***
Temperature	0.0000	0.0000	0.0000 **	0.0003	-0.0001	0.0002 **
Short-term drought index (1 month)	0.0002	-0.0004	-0.0002	-0.0049 *	0.0029	-0.0020
Long-term drought index (24 months)	0.0000	0.0000	0.0000	0.0007	-0.0007	0.0000
D(Urban=1)	0.0000	0.0003	0.0003	-0.0002	0.0011	0.0009
Pseudo R-squared	0.0319			0.2221		

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect"

Table A1.23: SAR-RE Estimation Results for per capita expenditure items for South Dakota, Nebraska, Minnesota, and Iowa, thousands of nominal dollars

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Total expenditure			Total education expenditure			Highway expenditure			Police expenditure			Public welfare expenditure		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Per capita total revenue	0.9314 ***	0.0465 ***	0.9779 ***												
Per capita Federal revenue	0.0021	-0.0433	-0.0412	0.3488	0.0302	0.3790	1.1858 ***	0.5004	1.6862				0.7722 ***	0.0362	0.8084 ***
Per capita State revenue	-0.0750 ***	0.0589	-0.0161	1.5833 ***	5.1933 **	6.776635 ***	0.7459 ***	-0.032	0.7135				0.8465 ***	0.6012 ***	1.4477 ***
Per capita Local revenue	-0.4722 ***	0.0917	-0.3805	0.5195 **	-0.378	0.1416302	0.3313 **	1.2038 **	1.5351				0.7986 ***	-0.325 *	0.4738 **
Per capita total taxes				0.0042 ***	-0.011 **	-0.007174	0.4116 ***	-0.05 *	0.3618	0.1066 ***	0.0933 ***	0.1999 ***	0.0651 ***	0.0008	0.0659 ***
Per capita charge from exp item				0.9087	-76.01	-75.1024	0.3979	4.6706 ***	5.0684						
Total sqmi of canal	-0.0846	-0.2884	-0.3730	-0.0080	0.1315 *	0.1235	-0.0639	0.0135	-0.0504	0.0154	-0.0216	-0.0062	0.0285	-0.3173	-0.2888
Total sqmi of lake/pond (intermittent)	0.0001	-0.0010	-0.0009	0.0000	-0.0001	-0.0002	0.0018 ***	0.0003	0.0021	-0.0003	-0.0006 *	-0.0009 ***	0.0000	-0.0010	-0.0010
Total sqmi of lake/pond (perennial)	0.0000	0.0000	-0.0001	0.0000	0.0000	0.0000	-0.0001	-0.0002	-0.0003	0.0000 **	0.0000	0.0000	-0.0002 **	0.0003 **	0.0002
Total sqmi of playa	-0.0015	0.0038	0.0023	0.0003	0.0002	0.0005	-0.0043	-0.0041	-0.0085	0.0009	0.0017	0.0026	0.0009	-0.0009	0.0000
Total sqmi of reservoir	0.0022	0.0153 *	0.0176 *	-0.0001	-0.0015	-0.0015	-0.0008	0.0057	0.0049	-0.0020 **	-0.0046	-0.0066 *	0.0046 *	-0.0114	-0.0068
Total sqmi of stream/river (perennial)	0.0039	-0.0034	0.0004	0.0000	0.0031	0.0031	0.0070 ***	-0.0137	-0.0067	0.0005	0.0010	0.0015	0.0117 ***	0.0104	0.0221 **
Total sqmi of swamp/marsh	0.0000	-0.0001	-0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 *	0.0000	0.0000	0.0000	-0.0001	0.0000
Topography type (Base: Plains)															
Tablelands	0.0054	0.0001	0.0055	0.0005	0.0014	0.0019	0.0000	0.0000	0.0000	0.0015	0.0005	0.0020	-0.0072	-0.0017	-0.0089
Plains with hills or mountains	-0.0109	-0.0002	-0.0112	0.0006	0.0019	0.0025	0.0340 ***	0.0141 *	0.0480	-0.0048	-0.0016	-0.0063	-0.0272 **	-0.0063	-0.0335 **
Open hills and mountains	0.0002	0.0000	0.0002	0.0003	0.0010	0.0013	-0.0002	-0.0001	-0.0002	-0.0005	-0.0002	-0.0006	-0.0089 **	-0.0021	-0.0110 **
Hills and mountains	-0.0395 **	-0.0008	-0.0403 **	-0.0018	-0.0055	-0.0073	-0.0293 **	-0.0121	-0.0414	0.0089 **	0.0029	0.0118 **	-0.0260 *	-0.0060	-0.0320 *
Precipitation	0.0157	-0.0224 *	-0.0067	0.0009	-0.0012	-0.0004	-0.0053	-0.0088	-0.0141	0.0085 ***	-0.0047	0.0038 **	0.0057	0.0042	0.0100 **
Temperature	-0.0011	0.0003	-0.0008	0.0001	0.0003 **	0.0004 **	-0.0003	0.0001	-0.0003	-0.0005 **	-0.0005 ***	-0.0010 ***	0.0006	-0.0009 **	-0.0004
Short-term drought index (1 month)	-0.0122	0.0057	-0.0066	0.0005	0.0021	0.0026	0.0005	0.0087	0.0092	-0.0227 ***	0.0183 ***	-0.0045 **	-0.0212 *	0.0180	-0.0032
Long-term drought index (24 months)	0.0201 ***	-0.0223 ***	-0.0022	-0.0007 *	0.0004	-0.0003	0.0066 *	-0.0083 **	-0.0017	0.0048 ***	-0.0052 ***	-0.0004	0.0115 ***	-0.0082 **	0.0033 **
D(Urban=1)	-0.0016	0.0110	0.0094	-0.0006	-0.0006	-0.0012	-0.0263 ***	-0.0181	-0.0444	-0.0019	0.0102 ***	0.0083 **	0.0039	-0.0100	-0.0061
Pseudo R-squared		0.9605			0.1392			0.8126			0.6218			0.8216	

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.23: SAR-RE Estimation Results for per capita expenditure items for South Dakota, Nebraska, Minnesota, and Iowa, thousands of nominal dollars (cont'd.)

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Air transport expenditure			Financial administration expenditure			Fire protection expenditure			Health expenditure			Parks & recreation expenditure		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Per capita total revenue															
Per capita Federal revenue										0.4235 ***	1.0471 **	1.4707 ***			
Per capita State revenue										0.3491 ***	1.0261 ***	1.3752 ***			
Per capita Local revenue										0.0232	-0.0820	-0.0588			
Per capita total taxes	0.0083 ***	-0.0073 ***	0.001	0.1108 ***	0.0310 ***	0.1419 ***	0.0031 ***	-0.000835	0.0022484 ***	0.0352 ***	0.0431 ***	0.0783 ***	0.0107 ***	0.0177 ***	0.0284 ***
Per capita charge from exp item	2.5321 ***	-0.43395	2.0982 ***										0.6708 ***	0.5438 ***	1.2146 ***
Total sqmi of canal	0.0006	0.0000	0.0006	-0.0044	-0.0856	-0.0900	-0.0011	-0.0086	-0.0097	-0.0200	-0.0937	-0.1137	-0.0024	-0.0274	-0.0299
Total sqmi of lake/pond (intermittent)	-0.0001	0.0000	0.0000	0.0000	-0.0003	-0.0003	0.0000	0.0002 ***	0.0002 ***	0.0001	-0.0005	-0.0003	-0.0001	0.0001	0.0000
Total sqmi of lake/pond (perennial)	0.0000 ***	0.0000	0.0000	0.0000	-0.0001	-0.0001	0.0000	0.0000	0.0000	0.0000	0.0002	0.0002	0.0000	0.0000	0.0000
Total sqmi of playa	0.0002	0.0001	0.0002	0.0000	0.0029	0.0029	-0.0002	-0.0015 **	-0.0017 **	-0.0002	0.0041	0.0039	-0.0001	-0.0015	-0.0016
Total sqmi of reservoir	-0.0004 ***	-0.0007	-0.0011 **	-0.0012 *	-0.0002	-0.0014	0.0000	0.0003	0.0003	0.0015	0.0017	0.0032	-0.0006 *	0.0037 ***	0.0032 ***
Total sqmi of stream/river (perennial)	-0.0002	0.0028 ***	0.0026 ***	-0.0009	0.0011	0.0003	-0.0001	-0.0007	-0.0008	-0.0009	-0.0018	-0.0026	-0.0002	-0.0009	-0.0011
Total sqmi of swamp/marsh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 ***	0.0000	0.0000
Topography type (Base: Plains)															
Tablelands	0.0000	0.0000	0.0000	0.0009	0.0002	0.0010	0.0002	0.0001	0.0003	-0.0004	-0.0004	-0.0008	-0.0003	0.0001	-0.0002
Plains with hills or mountains	-0.0010	0.0000	-0.0010	0.0007	0.0001	0.0008	0.0015 ***	0.0010 ***	0.0025 ***	-0.0025	-0.0029	-0.0053	0.0002	-0.0001	0.0001
Open hills and mountains	0.0000	0.0000	0.0000	0.0012	0.0002	0.0014	0.0002	0.0001	0.0003	0.0004	0.0005	0.0009	0.0004	-0.0002	0.0003
Hills and mountains	0.0006	0.0000	0.0006	-0.0029	-0.0005	-0.0034	0.0014 **	0.0009 **	0.0024 **	0.0018	0.0021	0.0038	-0.0005	0.0002	-0.0003
Precipitation	0.0014 **	-0.0009	0.0005 **	-0.0007	-0.0027	-0.0034 ***	-0.0008 **	0.0007 *	-0.0002	0.0044	0.0003	0.0047 *	0.0026 *	0.0003	0.0029 ***
Temperature	-0.0001 ***	0.0000	-0.0001 ***	-0.0003 *	-0.0003	-0.0006 ***	0.0000	0.0000	0.0000	0.0001	-0.0001	0.0000	-0.0001	-0.0001	-0.0002 ***
Short-term drought index (1 month)	-0.0021 **	0.0014	-0.0007 *	-0.0072 *	0.0118 ***	0.0046 **	0.0008 *	-0.0007	0.0001	-0.0101 **	0.0086	-0.0015	-0.0052 **	0.0033	-0.0019 **
Long-term drought index (24 months)	-0.0004	0.0003	-0.0001	0.0038 ***	-0.0029 **	0.0009 *	-0.0001	0.0002	0.0001 *	-0.0007	0.0013	0.0006	0.0010	-0.0009	0.0002
D(Urban=1)	0.0001	-0.0003	-0.0002	-0.0030 *	-0.0034	-0.0064 **	-0.0002	0.0001	-0.0001	0.0009	-0.0010	-0.0001	0.0005	-0.0006	-0.0001
Pseudo R-squared		0.1538			0.4784			0.0958			0.529			0.353	

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

Table A1.23: SAR-RE Estimation Results for per capita expenditure items for South Dakota, Nebraska, Minnesota, and Iowa, thousands of nominal dollars (cont'd.)

Average impacts (dy/dx)
Per capita values of dependent variable
in thousands of nominal dollars

	Sewerage expenditure			Solid waste management expenditure			Natural resources expenditure			Total utility expenditure			Housing & comm. dev't expenditure		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Per capita total revenue															
Per capita Federal revenue													0.2164 ***	0.0039	0.2202522 ***
Per capita State revenue													1.0348 ***	-0.0434	0.9913921 ***
Per capita Local revenue													-0.6871 ***	-0.1617	-0.8487788 **
Per capita total taxes							0.0624 ***	0.0130 **	0.0754552 ***				0.0019	0.0053 ***	0.0071854 ***
Per capita charge from exp item	4.5916 ***	0.0655	4.6571 ***	0.7489 ***	0.878 ***	1.6269 ***				0.4242 ***	-0.076	0.3479	0.6919 ***	-0.2798	0.4120245
Per capita public utility tax	-0.003	-0.1484	-0.152	-0.029	0.0586	0.0293				-5E-04	-2E-04	-7E-04			
Per capita property sale housing & comm dev															
Total sqmi of canal	-0.0007	-0.0019	-0.0026	-0.0029	-0.0271	-0.0300	0.0197	-0.0136	0.0061	0.0010	-0.0008	0.0002	0.0011	-0.0017	-0.0006
Total sqmi of lake/pond (intermittent)	0.0000	0.0000	0.0000	-0.0002 *	0.0000	-0.0002	-0.0002	-0.0007 ***	-0.0008 ***	0.0000	-0.0001	-0.0001	0.0000	0.0000	0.0000
Total sqmi of lake/pond (perennial)	0.0000	0.0000	0.0000	0.0000	-0.0001 ***	-0.0001 ***	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total sqmi of playa	0.0000	-0.0001	-0.0001	0.0005	-0.0006	-0.0001	0.0003	0.0011	0.0014	0.0000	0.0001	0.0001	0.0001	0.0001	0.0002
Total sqmi of reservoir	0.0001	-0.0001	0.0000	-0.0034 ***	-0.0108 ***	-0.0142 ***	0.0004	0.0072 ***	0.0076 ***	0.0000	-0.0004	-0.0004	0.0002 *	0.0003	0.0005
Total sqmi of stream/river (perennial)	-0.0002 *	0.0001	-0.0001	0.0003	0.0051 ***	0.0054 ***	-0.0012 **	-0.0047 ***	-0.0059 ***	0.0000	-0.0005	-0.0004	-0.0002	0.0000	-0.0001
Total sqmi of swamp/marsh	0.0000	0.0000	0.0000	0.0000 ***	0.0001 ***	0.0001 ***	0.0000 *	0.0000 **	0.0000 ***	0.0000	0.0000	0.0000	0.0000	0.0000 *	0.0000 *
Topography type (Base: Plains)															
Tablelands	0.0000	0.0000	0.0000	0.0008	0.0004	0.0011	-0.0011	0.0003	-0.0009	-0.0002	0.0000	-0.0002	-0.0001	0.0000	-0.0001
Plains with hills or mountains	0.0002	0.0000	0.0002	-0.0030	-0.0015	-0.0045	0.0040	-0.0009	0.0031	-0.0008	0.0000	-0.0009	-0.0001	0.0000	-0.0001
Open hills and mountains	0.0000	0.0000	0.0000	-0.0005	-0.0002	-0.0007	-0.0025 **	0.0006 *	-0.0019 **	-0.0001	0.0000	-0.0001	0.0000	0.0000	0.0000
Hills and mountains	0.0004	0.0000	0.0004	-0.0021	-0.0010	-0.0031	-0.0069 **	0.0016 *	-0.0052 **	-0.0011	0.0000	-0.0011	0.0005	0.0000	0.0005
Precipitation	0.0002	-0.0001	0.0001	0.0043 ***	-0.0020	0.0023 ***	-0.0005	-0.0013	-0.0018 *	-0.0006	0.0005	-0.0001	0.0004	0.0000	0.0004 *
Temperature	0.0000	0.0000	0.0000	-0.0003 **	-0.0001	-0.0003 ***	-0.0010 ***	0.0002	-0.0007 ***	0.0000	-0.0001	0.0000	-0.0001 *	0.0000	-0.0001 ***
Short-term drought index (1 month)	0.0011	-0.0010	0.0001	-0.0094 ***	0.0046 *	-0.0048 ***	0.0022	0.0006	0.0028	0.0030 ***	-0.0028 **	0.0002	-0.0003	0.0002	-0.0001
Long-term drought index (24 months)	0.0002	-0.0001	0.0001	0.0028 ***	-0.0022 ***	0.0006	0.0006	0.0003	0.0010 *	-0.0011 ***	0.0010 ***	-0.0001	-0.0002	0.0003	0.0000
D(Urban=1)	-0.0007 ***	-0.0001	-0.0008 **	-0.0007	-0.0057 ***	-0.0064 ***	-0.0028 **	-0.0095 ***	-0.0122 ***	0.0001	-0.0002	-0.0001	0.0005	0.0004	0.0009
Pseudo R-squared	0.5213			0.4693			0.3113			0.0719			0.1944		

Legend: *sig at 10%, **sig at 5%, ***sig at 1%

Notes: Each set of columns give the results from a separate regression, where the dependent variable is given at the top of the column. There is a spillover effect from neighboring counties' variables when variables under the "Indirect" column are statistically significant.

ARTICLE 2: MEASURING THE RELATIONSHIP BETWEEN NATURAL ADVANTAGES OF LOCATIONS AND LOCAL GOVERNMENT EXPENDITURES USING BORDER MATCHING ANALYSIS

2.1. Introduction

People are arguably the most important resource in an economy either as workers (Schultz (1961), Becker (1994), Carneiro and Heckman (2003)) or as consumers (Glaeser (2001)). Hence, local economies benefit from attracting people into their jurisdictions. If communities are to compete for constituents, local governments must provide bundles of public goods.[24] An important consideration in this regard is the relative advantage of some locations over others. The effort necessary to attract people varies across localities because some locations have inherent naturally occurring advantages over others. These advantages include climate conditions, availability of natural resources, and natural geographical features such as landforms and ecosystems. In my research, I propose that the inherent natural advantages of locations are a factor that explains why local governments provide differing levels of public goods, which consequently affects their ability to attract in-migration. Locations that are not endowed with these advantages may have to spend more on local government public goods, such as extensive roads, public safety, and strong public schools, to compensate.

Naturally occurring amenities are defined here as "*valued natural attributes of a place, including terrestrial and aquatic landscapes, distinguishing topographical features, climate, air, water and biodiversity quality and quantity*" (Moss 2006, as cited in Cherry and Rickman (2010), p.8), which provide non-monetary benefits to residents. Locally provided public goods include non-monetary provisions that improve livability, convenience, safety, and opportunities for

[24] In this research, "public goods" are goods that are provided by the government for public consumption that may or may not be excludable (i.e., people can be excluded from consuming it) and rivalrous (i.e., one person's consumption leaves less of the good for other people). For example, regular highways and public parks are non-excludable but rivalrous. Public schools are excludable and rivalrous. Streetlights and city culture are non-excludable and non-rivalrous.

human capital enhancement. This study aims to explore the effect of naturally occurring advantages on the provision of local government public goods; and to explore the relative importance of locally provided man-made amenities and naturally occurring advantages for attracting people into jurisdictions.

My hypothesis is that the persistent differences in local government attractiveness and population density across locations manifest not only because higher income populations can pay for and selectively migrate into locations with high value natural amenities, but also because the local government effort required to make some locations attractive for people choosing residential location is lower. The ease of providing man-made amenities in locations with more natural advantages enable their local governments to supply more man-made amenities compared to a location that has exactly the same characteristics but with fewer natural advantages. By understanding the extent to which natural amenities provide locations with an initial advantage, we can more fully understand the existence of inherent differences in the required effort among local governments to attract people into their jurisdictions, which affects economic opportunities for both people and locations.

The paper will proceed as follows: Section 2.2 reviews the existing related literature; Section 2.3 discusses the theoretical approach; Section 2.4 discusses the data and the estimation strategy; Section 2.5 presents the estimation results; and Section 2.6 concludes.

2.2. Literature Review

My research focuses on how local governments respond to the natural amenities in their jurisdiction in providing public goods and how people respond to the variations in the availability of natural amenities and local public goods. Numerous literature exist on how people choose their residential locations based on the job prospects, wage differentials, natural amenities, and local government policies in locations. However, much less literature exist on how local governments

provide public goods in their jurisdiction considering the natural amenities in their locations that they can work with.

I argue that differences in natural amenities is important in understanding why some locations inherently have an initial advantage in attracting population. This is because in a spatial economy, the Tiebout (1956) model presents a mechanism where people can express preference for a bundle of government-provided public goods and for the government to tax them accordingly resulting in the optimal amount of public goods similar to the private market result. Assuming a large number of locational options, availability of information on locations, residential mobility, and that communities have the ability to set their tax system and public expenditure pattern, people can express their preference for locations through moving. Tiebout predicts that even when local governments do not adapt their revenue and expenditure patterns to fit the preference of their current constituents, communities in an economy provide the optimal level of taxation and public goods because people are sufficiently mobile to satisfy their demand for a specific bundle of goods and services they can afford.

A number of studies tested the claims of the Tiebout model including Orbell and Uno (1972), Lowery and Lyons (1989), Dehoog (1990), Teske (1993), and Bickers (2006). Orbell and Uno (1972) argue the merits of the view by Hirschman (1970) that consumers can either exit or use political action when they are dissatisfied with a product. Lowery and Lyons (1989) find that use of voice and private contracting may be other responses to jurisdictional dissatisfaction. Dehoog (1990) find that efficacy of the local government and ties to the community are important for the satisfaction of households. Teske (1993) argue that not all citizen-consumers have to be informed when shopping for communities, a subset of the citizen-consumers -- who are better-informed, have high income, and have stronger political voice than most people -- is enough to make local governments responsive and efficient in providing local services and taxes. Bickers (2006) find that citizens' evaluation of core local government services is a strong factor that influences the probability of moving.

Wildasin (1988) presents a game-theoretic approach to how local governments compete with each other through optimizing either tax policy or expenditure policy. He argues that local governments in fiscal competition take into account not only the tax rates set by other local governments but also other salient policy instruments such as the expenditure bundles offered. He finds that the difference between the two policy instruments, i.e., tax rate and expenditure bundle, goes to zero with higher number of jurisdictions. In terms of which jurisdictions are considered competition for a local government, Janeba and Osterloh (2013) assume two levels of competition. The first level is with geographic neighbors. The second level is with economic competitors (i.e., other jurisdictions with similar per capita income and/or racial composition). They argue that competition among local governments matter among geographic neighbors when there are agglomeration advantages that can be shared. Their analysis covers metropolitan regions consisting of an urban center, which is surrounded by peripheral areas (i.e., hinterlands).

There are a number of studies exploring the effect of amenities on economic outcomes. Pollard (1982) estimates the effect of topographic amenities on housing prices. Diamond and Tolley (1982) provide a theoretical and empirical analysis on the effect of amenities on household well-being and urban form. Gottlieb (1994) explores the impact of amenities in regional development and argues that amenities do not necessarily improve regional development because some amenities grow with urbanization while others decline. Schlapfer (2015) find that landscape views, cultural sites, and recreational infrastructure positively affect rental prices while road and railway noise, industries, and power lines negatively affect rents. Lee and Lin (2017) provide theoretical and empirical support that the distribution of natural amenities explains the stability of the income distribution through space across U.S. metropolitan areas. Most of these papers, however, consider only metropolitan areas.

With respect to migration studies, there are two main traditions in the literature on what determines migration: the disequilibrium model and the equilibrium model of migration. The disequilibrium model of migration argues that migration is a response to economic opportunities

in the form of employment and higher wages, starting with Hicks (1932, as cited in Biagi et al., 2011). The results of Bowles (1970) suggest that present value of expected income gain positively relates to the likelihood of moving and this lends support for the economic incentive model of migration. Fielding (1993) finds that housing and labor market forces are significant causes of moving to Southeast England but that differences exist between the circumstances of manual laborers and professional, technical, and managerial occupations. Juarez (2000) explores interregional labor migration in Spain and finds that changes in relative wages explain out-migration.

On the other hand, the equilibrium model of migration argues that people migrate to enjoy non-tradable and location-specific features, such as natural amenities, and differences in wages across locations reflect the spatial variations in both natural and man-made amenities, starting with Graves (1976, 1979, 1980, 1983). Gyourko and Tracy (1989) find that compensating wage differentials across cities are due to differences in tax rates and local services provision. Day (1992) explores the role of local public goods in the probability of moving between provinces in Canada and finds that provincial income tax rates, transfer payments, and unemployment insurance benefits significantly affect migration. Waltert and Schlapfer (2007) survey literature on the effect of landscape amenities on local economic development and find that location-specific amenities affect decisions to migrate as much as low tax burden. Rappaport (2008) find that consumption amenities are more strongly capitalized into housing prices than into wages, which then explains population density variation in U.S. metro areas. Clark et al. (2002) emphasizes the role of amenities and culture in driving urban growth. Clark et al. (2003) uses a two-stage empirical method to estimate earnings as a function of human capital characteristics and location's site attributes. They find that migration is a response to over- and under-compensation for site attributes, which provides support for spatial equilibrium. Considering social and cultural amenities, Florida (2002a, 2002b) and Florida, Mellander, and Stolarick (2008) highlight the importance of the creative class of human capital and tolerance in

attracting high-technology firms that significantly factors into regional incomes and regional development in general.

Some more recent lines of research integrate the disequilibrium and the equilibrium models (Mueser and Graves, 1995; Blomquist et al., 1988; Beeson and Eberts, 1989; Ferguson et al., 2007; Glaeser, 2005; Glaeser and Tobio, 2007; Partridge et al., 2008; Biagi et al., 2011; Nakajima and Tabuchi, 2011). Mueser and Graves (1995) model migration in metropolitan areas as a function of economic opportunity (i.e., labor demand) and residential amenities (i.e., labor supply). Their results indicate no conclusive answer, because profit-shifting variables in one period may cancel utility-shifting variables in another period. They note that household preferences for amenities work with economic productivity changes in shaping systematic migration trends observed over decades. Blomquist et al. (1988) estimates quality of life rankings for 253 U.S. counties using a national hedonic model including variation in wages, housing expenditures, and various location-specific amenities. Beeson and Eberts (1989) find that nominal wage differentials have two components -- a supply-shift portion due to amenities and a demand-shift portion due to productivity. Ferguson et al. (2007) examines the population change in 2,400 Canadian communities for the period 1991-2001 as a function of economic, natural amenity, and social capital variables. The results suggest differences in intensity of effect of these variables between rural and urban populations and by age. Glaeser (2005) highlights the importance of education as a determinant of urban growth in cold-weather metropolitan areas in both the United States and Great Britain. Glaeser and Tobio (2007) find a positive association between economic productivity and warmer climates explaining the population growth in the Sunbelt before 1970. Partridge et al. (2008) examines the effect of urban agglomeration to natural amenity-rich hinterlands in the United States using the United States Department of Agriculture Economic Research Services (USDA-ERS) natural amenities index dataset. They find that proximity to urban areas is significant in population growth patterns in the hinterlands in the period 1950-2000. Biagi et al. (2011) explores the role of economic, social, and environmental characteristics

in explaining long and short distance migration in Italy. Results suggest that long distance migration tends to be due to economic reasons and agglomeration economies (i.e., presence of local university, better-educated population, airports) while short distance migration is more apparent in smaller provinces with better amenities. Nakajima and Tabuchi (2011) estimate regional utility differentials in Japan using interregional migration data and find that non-economic factors (e.g., life cycle milestones and regional amenities) are important when looking at utility.

Meanwhile, Storper and Scott (2009) and Storper and Manville (2006) are calling for a more holistic way of modeling the process of urbanization, taking into account the delicate common ingredient of fast-growing and self-sustaining locations, which is agglomeration economies[25].

To summarize, although there have been numerous studies on what natural amenities and government policies affect migration decisions, there has been limited existing literature that explores the relationship between natural and local government public goods as well as their effect on variations in population for contiguous areas. This research aims to contribute to existing literature by looking at how local government expenditures and population vary in two contiguous areas that are similar in all but one natural amenity.

2.3. Theoretical Approach

In this research, the geographic unit that competes for constituents is the decision-making agent towards supply of local government public goods shaping migration decisions. Thus, the unit of analysis in this study is the community's local government.

[25] Defined as external economies of scale due to "labor market pooling, input sharing, and knowledge spillovers" (Marshall, 1920; as cited in Rosenthal and Strange, 2002) that extends over industrial, geographic, and temporal scope of economic activity. (Rosenthal and Strange, 2002)

The foundation of my theoretical approach is the Tiebout (1956) model. For the community's local government, I adopt the behavioral assumption from Wildasin (1988) that local governments choose their policy instruments to maximize their utility considering how other jurisdictions choose their tax and expenditure policies. I also adopt the behavioral assumption on how local governments perceive competition with neighboring jurisdictions from Janeba and Osterloh (2013). With the addition of the assumptions from the models of Wildasin (1988) and Janeba and Osterloh (2013), I am relaxing the assumption of no spillovers between communities in the Tiebout model (1956).

To maximize its utility, the community's local government sets its tax policy and expenditure bundle to attract and retain households into its jurisdiction. I assume that the number of households in a community is a function of its tax policy, expenditure bundle, and natural advantages in the location. I assume that local governments set their tax policies considering the natural amenities in their locations, transfers from the federal government, and the competing local governments' tax policies. Moreover, because I assume that local governments consider their budget constraint, a community's tax policy affects its expenditure bundle policy but the reverse is not true.

2.4. Data and Estimation Strategy

In the estimation, I use border-matching methodology (Holmes, 1998) to determine how local government expenditures differ with the location's naturally occurring advantages. I compare counties sharing a border within a state that have the same level of naturally occurring amenities except for one natural feature. Determination of which locations have approximately equivalent advantages from naturally occurring amenities necessitates using the United States Department of Agriculture Economic Research Services (USDA-ERS) natural amenities scale. The USDA-ERS natural amenities scale scores counties according to measures including warm

winter, winter sun, temperate summer, low summer humidity, topographic variation, and water area. Figure 2.1 shows the USDA-ERS natural amenities scale.

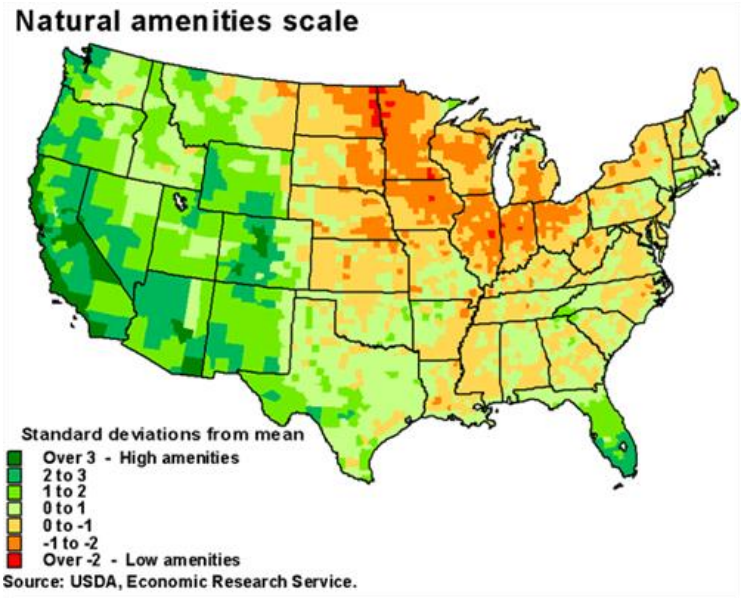

Figure 2.1: USDA-ERS Natural Amenities Scale

Using the dataset used to compute for the USDA-ERS natural amenities scale, I computed the counties' climate amenity scores using the climate variables (i.e., warm winter, winter sun, temperate summer, low summer humidity) and map the counties according to these climate amenity scores. I then map the counties according to their topography type.

The USDA-ERS natural amenities scale provides the following broad classifications for topography type: plains, tablelands, plains with hills or mountains, open hills and mountains, and hills and mountains. The USDA-ERS natural amenities scale increases linearly from plains to hills and mountains.

In this regard, I chose two states for each of the three levels of natural amenities. I compare contiguous counties in the following states that have similar scores for weather variables but different topography type: California and New Mexico (High); Georgia and Oklahoma (Moderate); and Iowa and Wisconsin (Low).[26] For California, Georgia, Iowa, and Wisconsin,

[26] I provide the list of counties in Table A1 of the Appendix.

hills or mountains characterize the advantaged counties, while plains characterize the disadvantaged counties. For New Mexico, advantaged counties have hills or mountains while disadvantaged counties are characterized by plains with hills or mountains. For Oklahoma, advantaged counties have tablelands while disadvantaged counties have plains. Figure 2.2 below presents the map highlighting the counties for the border matching analysis where the left panel classifies the counties by z-scores based on weather variables and the right panel classifies the counties by topography type.

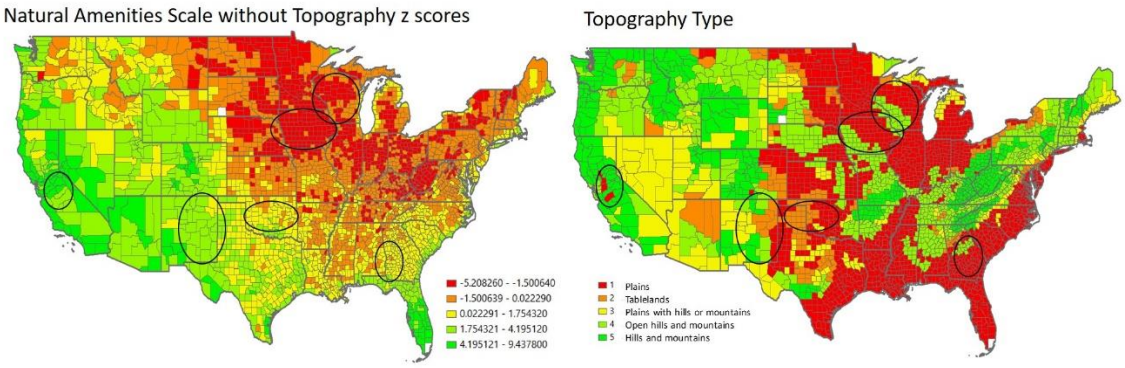

Figure 2.2: Natural Amenities Scale and Topography Type of Counties

I chose to hold constant the z-scores of weather variables and differ the topography type. I use the monthly data on climatological variables such as precipitation (in inches), temperature (in degrees Fahrenheit), short-term (1-month) and long-term (24-month) drought indices from the National Climatic Data Center (NCDC) of the U.S. Department of Commerce. I summarized these monthly data into annual averages for the years 1972-2012.

I use the Government Finance Database (GFD; Pierson et al. (2015)) in the analysis of government expenditures. By using border-matching methodology, I propose that the political border explains the observed differences in government expenditures and population in these mostly similar counties. I am interested in seeing which expenditure items are provided differently in these two groups of counties considering they are similar except for one feature. In particular, I hypothesize that the counties with the natural advantage will have a lower need to provide man-made amenities to attract population compared to its neighbor. Table 2.1 below

shows the distribution of counties in the sample I used. I included 128 counties for 9 census years for the period 1972-2012. This is a balanced panel. Natural Amenities Level denotes the level of natural amenities scale using only climate variables. N[Advantaged] denotes the sample size of counties within states that have a topographical advantage[27] (i.e., hills or mountains, or tablelands) while N[Disadvantaged] denotes the sample size of counties within states that lack a topographical advantage (i.e., plains, or plains with hills or mountains).

Table 2.1: Sample of Counties

Natural Amenities Level	State	N[Advantaged]	N[Disadvantaged]	N
Low	Iowa	17	15	32
Low	Wisconsin	9	8	17
Moderate	Georgia	17	19	36
Moderate	Oklahoma	5	8	13
High	California	12	4	16
High	New Mexico	6	8	14

Figure 2.3 below shows the counties for border matching analysis. The green counties are the ones with topographical advantage.

[27] According to USDA, natural amenities scale increases in the following order: (1) Plains, (2) Tablelands, (3) Plains with hills or mountains, (4) Open hills and mountains, and (5) Hills and mountains.

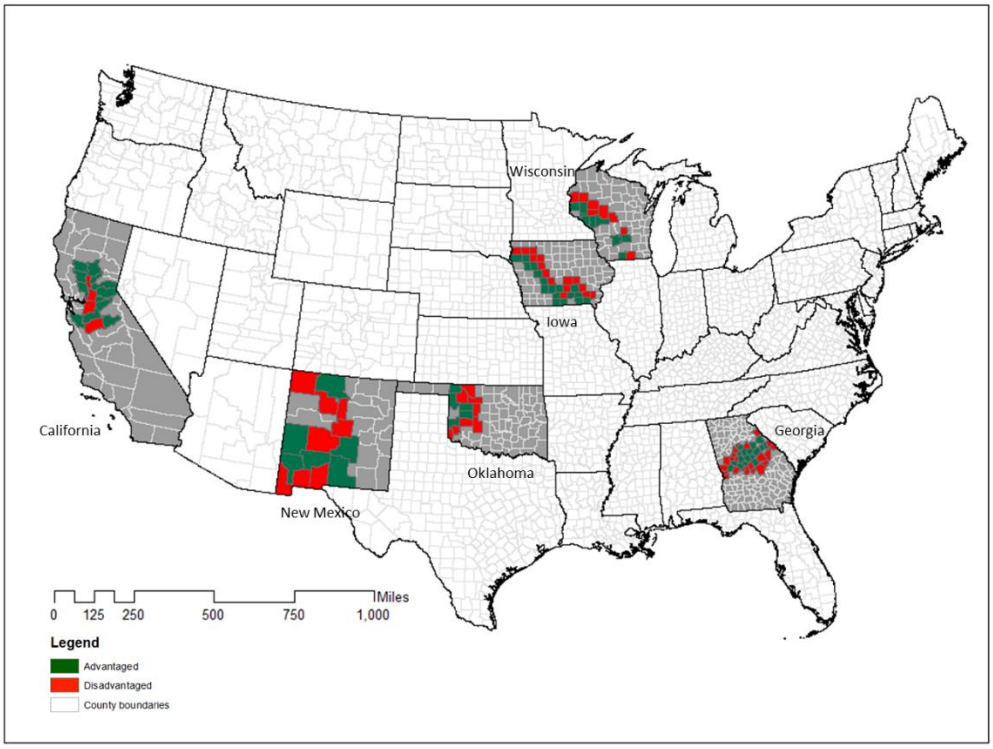

Figure 2.3: Counties for Border Matching Analysis

The summary statistics are presented in Table 2.2 below. It can be observed that the climatological variables (i.e., precipitation, temperature, short-term and long-term drought indices) are roughly similar for advantaged counties and disadvantaged counties. Average population is higher in disadvantaged counties. Per capita total revenue, total taxes, and total expenditure are higher in advantaged counties.

Table 2.2: Summary Statistics

Variable	Natural Amenities Level	Advantaged				Disadvantaged			
		Mean	Std Dev	Min	Max	Mean	Std Dev	Min	Max
Precipitation (in inches)	Low	2.9	0.5	2.0	4.1	2.8	0.5	2.0	4.1
	Moderate	3.5	1.0	1.2	5.2	3.6	0.9	1.6	5.2
	High	1.9	0.9	0.5	3.9	1.4	0.7	0.5	3.9
Temperature (in Fahrenheit)	Low	48.1	3.2	40.7	54.2	46.8	3.8	37.2	54.2
	Moderate	62.1	2.6	55.2	66.1	62.1	2.2	57.0	66.1
	High	55.2	3.5	45.4	61.7	54.4	4.8	45.4	61.7
Short-term drought index	Low	0.1	0.3	-0.6	0.8	0.1	0.3	-0.6	0.8
	Moderate	0.0	0.3	-0.6	0.7	0.0	0.3	-0.6	0.7
	High	0.0	0.3	-0.6	1.0	0.1	0.4	-0.6	1.0
Long-term drought index	Low	0.2	0.7	-1.6	1.4	0.2	0.7	-1.6	1.5
	Moderate	-0.4	1.1	-2.6	1.9	-0.4	1.1	-2.6	2.1
	High	-0.2	1.1	-2.8	2.3	-0.1	1.2	-2.8	2.3
Population	Low	21,085.57	15,058.25	6,403.00	84,345.00	33,842.35	31,051.54	7,310.00	160,331.00
	Moderate	22,462.16	31,123.11	3,348.00	156,450.00	25,887.14	28,843.97	2,922.00	203,922.00
	High	154,066.20	339,487.30	2,198.00	1,781,642.00	183,290.60	297,372.90	4,734.00	1,418,788.00
Per capita total revenue	Low	806.65	653.47	84.65	4,433.55	676.61	544.72	89.25	3,354.43
	Moderate	547.88	472.15	34.30	3,380.04	408.68	304.65	41.48	1,493.94
	High	1,044.10	803.58	20.17	3,665.89	701.48	641.10	26.47	2,775.58
Per capita total taxes	Low	229.72	160.84	1.04	1,024.30	209.09	145.69	17.42	718.51
	Moderate	323.95	336.15	15.38	3,079.42	228.38	210.16	19.45	921.66
	High	262.68	198.08	8.91	1,172.81	186.60	141.75	9.40	720.34
Per capita total expenditure	Low	866.27	741.84	83.94	4,825.39	728.79	625.18	89.26	3,869.64
	Moderate	561.41	559.61	39.60	3,939.92	436.17	360.97	36.50	1,799.48
	High	1,052.22	837.07	17.62	3,946.23	675.30	605.31	17.55	2,229.85

Figures 2.4, 2.5, and 2.6 graphically show the pattern of population, per capita total revenue, and per capita total expenditure by natural amenities level and having a natural advantage. The left panel shows the absolute value of the variable and the right panel shows the natural logarithm of the variable. The upper panels show the disadvantaged counties while the lower panels show the advantaged counties.

It can be observed from Figure 2.4 that counties with high level of natural amenities tend to more population than those with low and moderate levels. Counties with high level natural amenities and topographical advantage have more population than its disadvantaged counterpart.

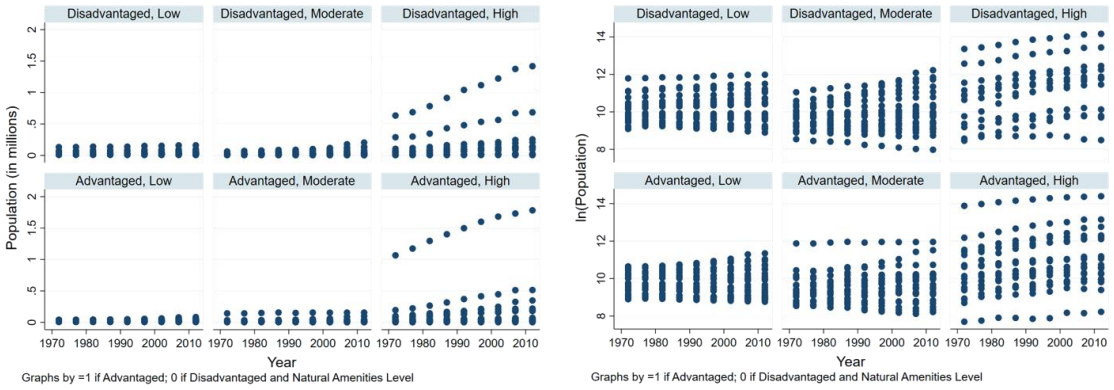

Figure 2.4: Population across the years, by natural amenities level and having natural advantage

Figure 2.5 shows per capita total revenue over the years. Counties with low and high level amenities have higher per capita total revenue than counties with moderate natural amenities.

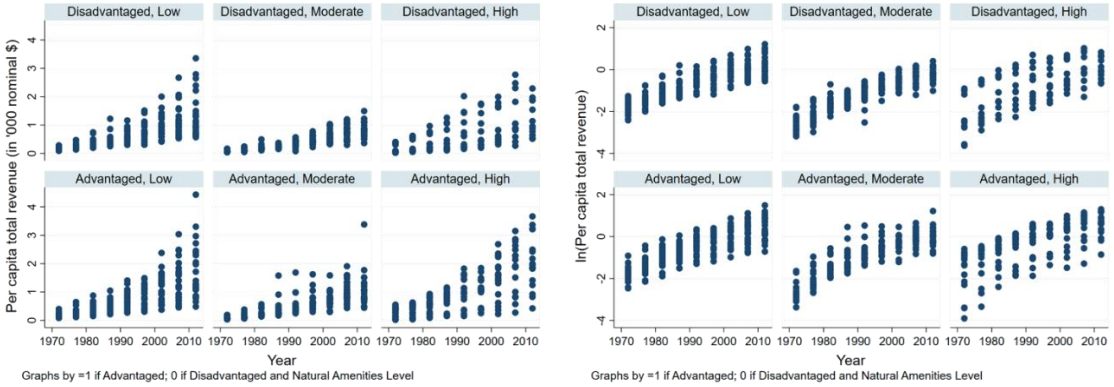

Figure 2.5: Per capita total revenue across the years, by natural amenities level and having natural advantage

Figure 2.6 shows per capita total expenditure over the years. Counties with low level of natural amenities have the highest per capita total expenditure. For counties with moderate and high levels of natural amenities, per capita total expenditure is higher for counties with topographic advantage.

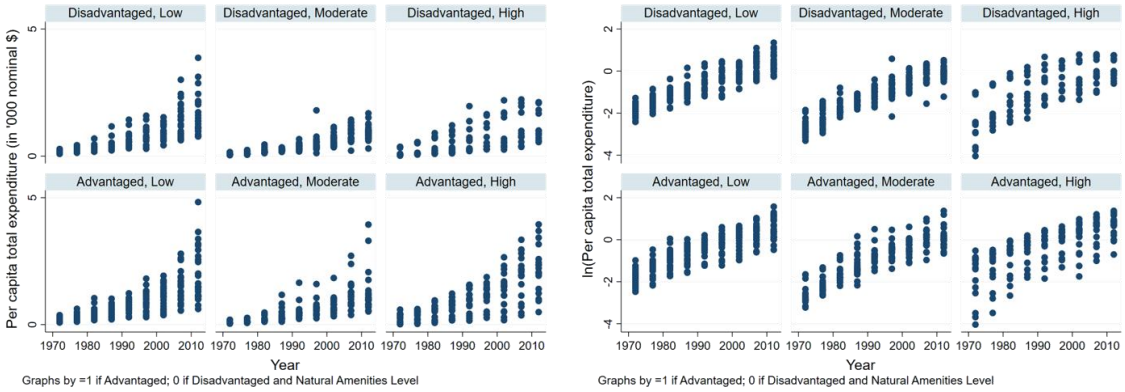

Figure 2.6: Per capita total expenditure across the years, by natural amenities level and having natural advantage

To understand which expenditure types drive the differences in per capita total expenditure, I run regressions on different types of county-level expenditures. The estimation model for the expenditure level is as follows:

$$g_{k,l,t} = D_k\beta_1 + X_k\beta_2 + \gamma_t + e_{k,l,t} \quad (2.1)$$

$g_{k,l,t}$ is county k's expenditure level for item l at year t. D_k is an indicator variable for the county that has a natural advantage. X_k is the vector of county characteristics including the state where it belongs, its level of natural amenities, whether it is urban, topography type, and climatological variables (i.e., precipitation, temperature, short-term and long-term drought indices). I also control for population density, per capita total revenue or per capita total taxes. γ_t is a time fixed effect. $e_{k,l,t}$ is the error term.

The estimation model for population is as follows:

$$N_{k,t} = D_k\beta_1 + X_k\beta_2 + \gamma_t + e_{k,t} \quad (2.2)$$

$N_{k,t}$ is the population count in county k at year t. The other variables are defined as in the estimation model for expenditure level. $e_{k,t}$ is the error term.

2.5. Estimation Results

I run pooled ordinary least squares (OLS) with clustered standard errors at the county-level. Tables 2.3, 2.4, 2.5, 2.6, and 2.7 summarize the estimation results. All expenditure and revenue items are in per capita and thousand nominal dollars.

Table 2.3 presents the estimation results for population, per capita total expenditure, correctional, and air transport expenditures. The variable of interest is D(Advantaged), which is the dummy variable equal to one if a county has the natural advantage. Having the natural advantage does not seem to affect variation in population. Advantaged counties do not have a statistically significant difference with disadvantaged ones on per capita total expenditure, correctional, and air transport expenditures.

Urban counties tend to have more population than rural counties, as expected. Counties with moderate natural amenities seem to have less people than those with low level of natural amenities.

Per capita total expenditure is lower for counties with moderate natural amenities compared to those with low natural amenities. As expected, higher per capita total revenue is associated with higher total expenditures. Per capita expenditure on correctional facilities is lower for counties with moderate natural amenities compared to those with low natural amenities.

Table 2.3: Regression results for population, per capita total expenditure, per capita correctional expenditure, per capita air transport expenditure (in '000 nominal dollars)

Variable	Population	Total Expenditure	Correctional	Air Transport
D(Advantaged)	-0.807	0.006	0.316	-1.589
Precipitation (in inches)	-0.113	-0.013	0.132	-0.146
Temperature (in Fahrenheit)	0.014	-0.001	0.039 *	0.045
Short-term drought index	0.168	0.096 ***	-0.199	0.907
Long-term drought index	-0.023	-0.004	0.031	-0.041
D(Urban)	1.270 ***	0.039 *	-0.048	-0.756
Natural Amenities Level (Base: Low)				
Moderate	-1.239 **	-0.130 **	-1.681 ***	-2.383
High	0.809	-0.031	0.438	0.987
Topography type (Base: Plains)				
Tablelands	0.580	-0.051	0.716	
Plains with Hills or Mountains	-0.517	-0.009	0.753 *	-2.076 *
Open Hills and Mountains	0.630	-0.011	-0.546 *	0.849
Hills and Mountains	*(omitted)*	*(omitted)*	*(omitted)*	*(omitted)*
State (Base: California)				
Georgia	0.369	0.033	0.998 ***	0.919
Iowa	-0.685 **	-0.078 ***	-0.877 ***	-0.625
New Mexico	-0.989 *	-0.142 ***	-1.083 ***	-0.241
Oklahoma	*(omitted)*	*(omitted)*	*(omitted)*	*(omitted)*
Wisconsin	*(omitted)*	*(omitted)*	*(omitted)*	*(omitted)*
Year (Base: 1972)				
1977	0.020	0.029	1.026 ***	0.283
1982	0.132 ***	0.020	1.540 ***	0.236
1987	0.179 **	0.129 ***	1.552 ***	0.975
1992	0.198 ***	0.142 ***	2.096 ***	0.981
1997	0.249 ***	0.154 ***	2.376 ***	1.229
2002	0.283 ***	0.186 ***	2.665 ***	1.424
2007	0.302 ***	0.302 ***	2.775 ***	1.709
2012	0.285 *	0.359 ***	2.941 ***	1.483
ln(Per capita total revenue)		0.935 ***		
ln(Population)		-0.028 **	0.195 ***	-0.144
ln(Per capita total taxes)			0.460 ***	0.376
Constant	9.769 ***	0.235	-9.577 ***	-6.162 *
N	1,152	1,152	1,012	258
R-squared	0.619	0.979	0.763	0.367
Adjusted R-squared	0.612	0.979	0.757	0.305

legend: * p<.05; ** p<.01; *** p<.001

Note: Each column is a separate regression for the variable on the top of the column.

Table 2.4 presents the estimation results for per capita education, fire protection, judicial, and health expenditure. Topographic advantage does not have an effect on these types of expenditures. Moderate and high natural amenities have positive effects on education and fire

protection expenditures compared to low natural amenities. Having high natural amenities is associated with higher judicial expenditures than low natural amenities. Per capita expenditure on health is lower for counties with moderate natural amenities than those with low natural amenities.

Table 2.4: Regression results for per capita education, fire protection, judicial, and health expenditure (in '000 nominal dollars)

Variable	Total Education	Fire Protection	Judicial	Total Health
D(Advantaged)	-0.136	0.835	0.018	-0.215
Precipitation (in inches)	0.137	-0.449	0.005	0.099
Temperature (in Fahrenheit)	-0.086 **	-0.050	-0.015	0.025
Short-term drought index	-0.339	0.668	0.077	-0.516 **
Long-term drought index	0.064	-0.050	-0.031	0.014
D(Urban)	-0.085	0.552	-0.039	-0.035
Natural Amenities Level (Base: Low)				
Moderate	2.766 ***	3.919 ***	-0.411	-2.905 ***
High	4.954 ***	3.402 ***	1.235 ***	0.073
Topography type (Base: Plains)				
Tablelands	0.577	-1.193	-0.206	0.363
Plains with Hills or Mountains	1.684 **	0.199	-0.095	-0.070
Open Hills and Mountains	0.315	-0.824	0.051	0.010
Hills and Mountains	*(omitted)*	*(omitted)*	*(omitted)*	*(omitted)*
State (Base: California)				
Georgia	-2.966 ***	1.335 *	0.656 ***	1.080 **
Iowa	1.005 ***	3.247 ***	-0.608 ***	-1.070 ***
New Mexico	-8.196 ***	0.800	-3.731 ***	-2.527 ***
Oklahoma	*(omitted)*	*(omitted)*	*(omitted)*	*(omitted)*
Wisconsin	*(omitted)*	*(omitted)*	*(omitted)*	*(omitted)*
Year (Base: 1972)				
1977	-0.044	0.350	*(base)*	0.612 ***
1982	-0.125	1.074 ***	1.452 ***	1.935 ***
1987	-0.167	1.126 **	1.793 ***	1.876 ***
1992	0.415	1.275 **	1.813 ***	2.426 ***
1997	0.754 *	1.481 **	1.892 ***	2.564 ***
2002	1.010 *	1.781 ***	2.042 ***	2.643 ***
2007	1.242 **	1.887 ***	2.163 ***	2.878 ***
2012	1.191 *	2.027 ***	2.336 ***	2.868 ***
ln(Population)	-0.204 *	-0.027	0.031	-0.123
ln(Per capita total taxes)	0.227	0.628 **	0.362 ***	0.085
Constant	-0.292	-5.900 **	-4.757 ***	-4.597 ***
N	443	602	884	1,083
R-squared	0.795	0.642	0.827	0.732
Adjusted R-squared	0.783	0.628	0.822	0.726

legend: * p<.05; ** p<.01; *** p<.001

Note: Each column is a separate regression for the variable on the top of the column.

Table 2.5 presents the results for per capita highways, transit subsidies, police protection, and public welfare expenditures. Advantaged counties seem to have lower public welfare expenditure than disadvantaged counties. Counties with moderate natural amenities seem to have lower per capita expenditures on police protection and public welfare than those with low natural amenities.

Table 2.5: Regression results for per capita highways, transit subsidies, police protection, and public welfare expenditure (in '000 nominal dollars)

Variable	Total Highways	Transit Subsidies	Police Protection	Public Welfare
D(Advantaged)	0.055	-1.336	0.145	-0.408 *
Precipitation (in inches)	-0.080	-1.025	-0.070	0.179
Temperature (in Fahrenheit)	-0.026 **	-0.009	0.004	0.012
Short-term drought index	0.135	2.415	0.052	-0.085
Long-term drought index	0.023	0.568	0.012	-0.024
D(Urban)	-0.046	-2.436	0.209 ***	-0.129
Natural Amenities Level (Base: Low)				
Moderate	0.369	2.614	-0.870 ***	-4.595 ***
High	-0.187	-1.980	0.102	0.613 *
Topography type (Base: Plains)				
Tablelands	-0.087		-0.233	-0.087
Plains with Hills or Mountains	-0.007		-0.030	-0.083
Open Hills and Mountains	0.054	1.855	-0.139	0.430 *
Hills and Mountains	*(omitted)*	*(omitted)*	*(omitted)*	*(omitted)*
State (Base: California)				
Georgia	-1.000 ***	*(omitted)*	0.414 **	0.722 **
Iowa	-0.160	*(omitted)*	-0.822 ***	-2.224 ***
New Mexico	-0.911 ***		-0.546 ***	-2.777 ***
Oklahoma	*(omitted)*		*(omitted)*	*(omitted)*
Wisconsin	*(omitted)*		*(omitted)*	*(omitted)*
Year (Base: 1972)				
1977	0.339 ***	*(base)*	0.708 ***	-0.590 ***
1982	0.416 ***	-3.603	1.143 ***	-0.688 ***
1987	0.647 ***	-4.462	1.288 ***	-0.214
1992	0.739 ***	-5.304 *	1.480 ***	-0.010
1997	0.864 ***	-4.327 *	1.679 ***	0.079
2002	1.016 ***	-2.991	1.926 ***	0.030
2007	1.073 ***		2.029 ***	-0.057
2012	1.153 ***		2.153 ***	-0.201
ln(Population)	-0.348 ***	1.116	-0.198 ***	0.108
ln(Per capita total taxes)	0.289 ***	-0.284	0.441 ***	0.374 **
Constant	2.855 ***	-11.288	-1.801 **	-3.198 **
N	1,148	27	1,142	1,067
R-squared	0.824	0.593	0.880	0.750
Adjusted R-squared	0.820	-0.057	0.878	0.745

legend: * p<.05; ** p<.01; *** p<.001

Note: Each column is a separate regression for the variable on the top of the column.

Table 2.6 presents the results for per capita housing, libraries, natural resources, and parks and recreation expenditures. Counties with natural advantage tend to have higher per capita expenditures on libraries. Moderate natural amenities seem to positively affect per capita expenditure on housing while it negatively affects per capita expenditure on natural resources.

Table 2.6: Regression results for per capita housing, libraries, natural resources, and parks & recreation expenditure (in '000 nominal dollars)

Variable	Housing	Libraries	Natural Resources	Parks & Recreation
D(Advantaged)	-0.550	0.626 **	-0.363	-0.571
Precipitation (in inches)	0.199	-0.212	0.081	-0.517 **
Temperature (in Fahrenheit)	0.038	0.028	-0.013	-0.057 *
Short-term drought index	-0.869	0.395	-0.110	0.640 *
Long-term drought index	-0.229	-0.084 *	0.124 ***	-0.005
D(Urban)	-0.055	0.074	-0.165	-0.025
Natural Amenities Level (Base: Low)				
Moderate	2.232 *	0.200	-1.089 **	0.874
High	1.535	-0.372	-0.110	0.312
Topography type (Base: Plains)				
Tablelands	-3.927 ***	-1.162	0.133	-0.789
Plains with Hills or Mountains	0.174	0.600	-0.289	-0.515
Open Hills and Mountains	0.684	-0.811 ***	0.242	0.681 *
Hills and Mountains	*(omitted)*	*(omitted)*	*(omitted)*	*(omitted)*
State (Base: California)				
Georgia	-2.661 **	-1.060	-0.919 **	0.921 *
Iowa	0.138	-0.731 ***	-0.930 ***	0.894 ***
New Mexico	0.311	-2.749 ***	-0.993 **	-0.831
Oklahoma	*(omitted)*	*(omitted)*	*(omitted)*	*(omitted)*
Wisconsin	*(omitted)*	*(omitted)*	*(omitted)*	*(omitted)*
Year (Base: 1972)				
1977	*(base)*	0.163	0.253 **	0.764 ***
1982	2.329 **	0.418 **	0.293 *	0.716 ***
1987	1.984 **	0.606 **	0.063	0.788 *
1992	2.795 ***	0.709 **	0.378	0.773 *
1997	2.623 ***	0.725 **	0.509 *	0.798 *
2002	2.566 ***	0.925 ***	0.701 **	1.004 *
2007	1.674 *	0.698 *	1.054 ***	0.868
2012	1.769 *	0.755 *	1.232 ***	1.008 *
ln(Population)	-0.042	0.088	-0.376 ***	0.213
ln(Per capita total taxes)	0.669 **	0.640 ***	0.363 ***	0.834 ***
Constant	-9.738 **	-6.760 ***	0.159	-3.189
N	338	889	1,025	910
R-squared	0.310	0.663	0.571	0.490
Adjusted R-squared	0.259	0.654	0.561	0.476

legend: * p<.05; ** p<.01; *** p<.001

Note: Each column is a separate regression for the variable on the top of the column.

Table 2.7 presents the results for per capita sewerage, solid waste management, and total utilities expenditures. Counties with natural advantage seem to have higher per capita expenditure on total utilities. The level of natural amenities does not affect expenditures on sewerage, solid waste management, and total utilities.

Table 2.7: Regression results for per capita sewerage, solid waste management, and total utilities expenditure (in '000 nominal dollars)

Variable	Sewerage	Solid Waste Mgmt	Total Utilities
D(Advantaged)	-0.949	-0.608	1.623 *
Precipitation (in inches)	0.720	-0.131	0.464
Temperature (in Fahrenheit)	0.116	-0.019	0.089
Short-term drought index	-2.190 *	0.055	-1.790
Long-term drought index	0.098	-0.070	0.335
D(Urban)	-0.272	-0.297	0.482
Natural Amenities Level (Base: Low)			
Moderate	-0.430	0.840	-0.466
High	-0.887	1.365	-1.221
Topography type (Base: Plains)			
Tablelands		-1.338	
Plains with Hills or Mountains	-1.600	-0.402	-1.021
Open Hills and Mountains	0.934	0.765	-1.006
Hills and Mountains	*(omitted)*	*(omitted)*	*(omitted)*
State (Base: California)			
Georgia	0.397	0.108	*(omitted)*
Iowa	2.267 **	-0.515	-1.420
New Mexico	4.012 **	-0.982 *	1.310
Oklahoma	*(omitted)*	*(omitted)*	
Wisconsin	*(omitted)*	*(omitted)*	*(omitted)*
Year (Base: 1972)			
1977	0.391	1.189 ***	2.275 *
1982	0.968	1.787 ***	3.173 **
1987	-1.288	1.937 ***	2.406 *
1992	-1.743	2.597 ***	3.384 *
1997	-1.928 *	2.798 ***	2.939 *
2002	-3.288 **	2.866 ***	3.097 *
2007	-3.609 **	2.718 ***	3.073
2012	-3.584 **	2.729 ***	3.328 *
ln(Population)	0.802 ***	-0.187	0.242
ln(Per capita total taxes)	2.262 ***	0.419 *	0.434
Constant	-17.847 ***	-3.634	-16.294 ***
N	199	815	207
R-squared	0.527	0.493	0.377
Adjusted R-squared	0.465	0.478	0.303

legend: * p<.05; ** p<.01; *** p<.001

Note: Each column is a separate regression for the variable on the top of the column.

2.6. Conclusion

This research aims to explore the variations in local government expenditures for contiguous counties that have similar natural amenities from climatological variables but differing in topographic type. Counties characterized by plains or by plains with hills or mountains are considered as having a topographic disadvantage. Meanwhile, counties with tablelands or hills and mountains are considered as having topographic advantage. I run the regressions using pooled OLS with clustered standard errors at the county-level.

Estimation results suggest that the level of natural amenities affect the level of per capita expenditures such as correctional facilities, education, fire protection, judicial, health, police protection, public welfare, housing, and natural resources. Some expenditures are not affected by natural amenities because they have to be provided regardless of what are naturally available including sewerage, solid waste management, and total utilities expenditures.

Counties with natural advantage in the form of a topographic advantage seem to have lower per capita expenditure on public welfare and higher per capita expenditure on libraries and total utilities.

Variations in population among the counties included in the analysis seem to be explained by whether a county is urban and by state fixed effects more than climatological and topographic variables.

The results of my analysis have limitations including the simplistic OLS regression I performed on population for which I did not sufficiently control for endogeneity bias. Another limitation is that county-level analysis is too large of a geographic unit to be able to disentangle the effect of one topographical advantage. With metropolitan areas spanning more than one county, it is highly possible that county-level expenditures observed from the dataset I utilize are the result of more than one local government unit maximizing its utility. Having metropolitan areas spanning more than one county could also account for mild effects of advantaged counties. It is possible that policymakers in metropolitan areas are utilizing benefits from advantaged

counties to spillover to its adjacent disadvantaged counties. Nevertheless, a policymaker can take stock of what natural amenities are present in his jurisdiction and prioritize local government expenditures accordingly. For example, among the expenditure items affected by the level of natural amenities, it seems appropriate to prioritize spending on those that improve safety such as fire protection and police protection and those that improve welfare like health, education, and public welfare.

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APPENDIX

Table A2.1: List of counties for border matching analysis

- High natural amenities

California

Disadvantaged (Plains): Merced, San Joaquin, Sacramento, Sutter

Advantaged (Hills or mountains): Stanislaus, Calaveras, Amador, Yuba, Butte, Colusa, Yolo, Glenn, Placer, El Dorado, Santa Clara, Mariposa

New Mexico

Disadvantaged (Plains with hills or mountains): San Juan, Socorro, Torrance, Santa Fe, Sandoval, Hidalgo, Luna, Dona Ana

Advantaged (Hills or mountains): Catron, Grant, Sierra, Otero, Lincoln, Rio Arriba

- Moderate natural amenities

Georgia

Disadvantaged (Plains): Elbert, Morgan, Rockdale, Henry, Spalding, Lamar, Pike, Meriwether, Harris, Taylor, Peach, Houston, Twiggs, Laurens, Bleckley, Johnson, Washington, Jefferson, Columbia

Advantaged (Hills or mountains): Newton, Butts, Jasper, Putnam, Greene, Wilkes, McDuffie, Warren, Hancock, Baldwin, Bibb, Jones, Monroe, Crawford, Upson, Talbot, Wilkinson

Oklahoma

Disadvantaged (Plains): Woods, Woodward, Major, Blaine, Washita, Caddo, Greer, Harmon

Advantaged (Tablelands): Harper, Ellis, Beckham, Custer, Dewey

- Low natural amenities

Iowa

Disadvantaged (Plains): Sioux, O'Brien, Buena Vista, Clay, Pocahontas, Calhoun, Greene, Dallas, Jasper, Marion, Poweshiek, Keokuk, Jefferson, Henry, Lucas

Advantaged (Hills or mountains): Plymouth, Cherokee, Sac, Ida, Carroll, Guthrie, Madison, Adair, Warren, Clarke, Decatur, Wayne, Monroe, Mahaska, Wapello, Davis, Van Buren

Wisconsin

Disadvantaged (Plains): Polk, Barron, Chippewa, Eau Claire, Clark, Wood, Marquette, Rock

Advantaged (Hills or mountains): St. Croix, Dunn, Buffalo, Pepin, Trempealeau, Jackson, Sauk, Columbia, Green

ARTICLE 3: LIFE CYCLE EFFECTS IN RESIDENTIAL MOBILITY DECISIONS[28]

3.1. Introduction

How do people choose their residential locations? Going by the utility maximization theory, people choose their residential locations based on their preferences and their budget constraint. What is seemingly apparent from considering how people choose their residences is how preferences and budget constraints evolve throughout the life cycle. At certain stages of the life cycle, people prefer to pursue goals and milestones such as getting a degree, getting married, having children, retiring, and so on. In this paper, I explore how the life cycle shapes people's choices in residential locations as they trade-off between natural characteristics/amenities with the local government tax policies and expenditures. In particular, I aim to know whether age or life milestones affect people's choice of moving[29] and whether they choose new locations with either higher natural amenities or local government public goods.

To pursue this research question, I provide a theoretical framework on how people choose residential locations considering their monetary resources and a proxy for psychic costs of moving. In the empirical analysis, I use the public use and confidential geocoded datasets from the National Longitudinal Survey of Youth 1979 (NLSY79) and merge them with datasets on natural amenities and county-level tax revenues and expenditures. Constrained with the overlap in years of the datasets, I analyze the time period 1979, 1982, 1987, 1992, and 2002. I estimate the likelihood of moving using fixed effects panel regression where the NLSY79 respondents were tracked from when they were aged 14-22 up to when they were 37-45 in 2002.

The estimation results indicate that age is the biggest predictor of the likelihood to move. The results suggest that persons aged 25 and above are 45% more likely to move than those aged

[28] This research was conducted with restricted access to Bureau of Labor Statistics (BLS) data. The views expressed here do not necessarily reflect the views of the BLS.
[29] Moving is defined as any change in residential address.

below 25. Persons who are never married are 25% more likely to move than married people. An additional point in the destination county's natural amenities scale index makes a person 50% more likely to move to it. County tax revenues are not significant and among per capita county expenditures, only natural resources expenditure is significant.

On the probability of moving to a county with better natural amenities, persons who are never married are 35% more like to move than married persons. Age does not appear to be relevant. People are 47% more likely to move to counties with warmer weather and 60% more likely to move to counties with more rain. Counties with higher per capita total expenditures make people 6.2% to 7.6% more likely to move. Distance of at most 20 miles between origin and destination counties is statistically significant.

The paper will proceed as follows: Section 3.2 reviews the existing related literature; Section 3.3 discusses the theoretical approach; Section 3.4 describes the data and the estimation strategy; Section 3.5 presents the estimation results; and Section 3.6 concludes.

3.2. Literature Review

Contrary to the assumption in the Tiebout model of zero moving costs, moving entails financial and psychic costs (Sjaastad (1962)). Graves (1980) describes moving as "*investment in human capital over space*." Lowry (1966) finds that locations characterized by economic prosperity tend to have more favorable labor market conditions that attract in-migration but uncertainty and financial and psychic costs of migration deter people from moving.

Tolley (1974, as cited in Graves and Linneman (1979)) presents two broad classifications of goods: traded and non-traded. Traded goods are those that may be moved or exported to different locations. Non-traded goods are those that are specific to a location. Graves and Linneman (1979) argue that migration decisions result from changes in demand for non-traded goods, which depend on the phase a household is in its life cycle, unexpected changes within the

household, or exogenous shocks in the market for non-traded goods. The study, however, is not able to test whether supply shifts in non-traded goods affect migration decisions.

Some studies look at the influence of local tax policies and expenditures provision on the migration behavior. Day (1992) tests whether government tax and expenditure policies affect migration across provinces in Canada and finds that provincial income tax rates, transfer payments to individuals, average unemployment insurance benefits, and provincial government expenditures influence migration. However, the study did not control for natural amenities and life cycle effects. Assadian (1995) use 1980-89 data on metropolitan areas in Florida to test if fiscal policies influence migration decisions of the aged differently from the general population. Results indicate that while the general population seem to prefer low taxes and greater assistance to public schools, the elderly prefer low taxes and low school spending. Blank (1988) finds that female-headed households are more likely to move to locations with higher welfare benefits and wage rates. Gelbach (2004) looks at how variation in state welfare benefits affect migration among single mothers and finds that younger single mothers are more likely to move to states with higher welfare benefits. Although these studies account for age, they did not control for natural amenities, which is important to control for according to the next set of studies.

A number of studies note the importance of a household's life cycle in mobility decisions. Graves (1979) hypothesizes that age shapes preferences, income opportunities, and psychic costs. Chen and Rosenthal (2008) find that young households prefer higher quality business environments while older households prefer locations with high value consumer amenities. Rappaport (2007) finds that largely the elderly drive movement to places with nice weather. Rodriguez-Pose and Ketterer (2012) note that areas with largely young population tend to have net population outflow, which indicates age as a measure of migration barrier. Schwartz (1976) finds that the manner in which age and education factor into migration decision is consistent with job search behavior. Morgan and Robb (1981) examine the effect of age on probability of migrating and find that economic opportunity differentials due to migration sharply

go down as people age. Results also shows that having friends and relatives in the area significantly affect the decision to migrate in all age groups and past migration behavior predicts migration of people aged above 65. Sandefur and Scott (1981) find that likelihood of moving declines with age due to life cycle and career variables. Plane (1993) emphasize that age or a person's stage in the life cycle is one of the most powerful determinant of migration behavior. Ferguson et al. (2007) find that decision to move with respect to local amenities vary by age in Canadian communities for the period 1991-2001. Molloy, Smith, and Wozniak (2011) investigate why U.S. migration rates continuously decline since 1980 by looking at cross-state migration rates for different demographic and socioeconomic groups. They find that the likelihood to migrate increases with education and declines with age. Results also indicate that propensity to move is higher for unemployed workers and renters. These studies, however, do not account for the interaction of natural and man-made amenities, which appear to be important as my findings in the first two articles of my manuscript.

Clark and Hunter (1992) test the effect of economic opportunities, amenities, and state and local factors on migration behavior of white males in the U.S. for the period 1970-1980. Results suggest that economic opportunities are the strongest determinant of migration in working-age years of males. Amenities and inheritance and estate taxes are influential in the migration decision for older males while counties with high state income and death taxes are not attractive for working-age males. This study, however, bundles natural amenities, state recreational facilities, and cultural amenities together in its definition of amenities. It also ran estimations on a cross-sectional data instead of tracking individuals through their life cycle.

A gap in the literature is in estimating the effect of life cycle in choosing residential locations while controlling for natural amenities and local government-provided public goods such as tax policies and expenditures. In this research, I aim to provide a possible explanation as to how people choose where to live in different stages of the life cycle.

3.3. Theoretical Framework

The decision-making unit in this research is the household head. I am adopting the structure of the household utility model from Graves and Linneman (1979). As in the Tiebout (1956), I assume that households are mobile and are capable to search for information on communities. Household head maximizes utility for household i as follows:

$$\begin{gathered} maximize_{x_i,\tau_{ik},g_{ik}}\ u_i(x_{ik}, g_{ik}, \tau_{ik}, a_k, B_i) \\ subject\ to \\ y_i = p_x x_{ik} + \tau_k \\ \pi_{iM} = f(p_{iM}, w_i, B_i) \end{gathered} \tag{3.1}$$

The household's utility function for public goods is continuous, twice differentiable, and strictly quasi-concave. The total cost function, p_{iM}, is non-decreasing in p_{iM}, w_i, and B_i. It is homogeneous of degree one, concave, and continuous for positive values of each of its cost components. x_{ik} is the vector of private goods available in community *k* for consumption of household *i* while p_x is the vector of prices of private goods. g_{ik} is the expenditure bundle household *i* can enjoy in community *k* while τ_{ik} is the tax that it has to pay if it chooses to reside in community *k*. a_k is the vector of natural advantages in community *k*. B_i is a vector of taste and/or consumption efficiency shifters. (Graves and Linneman (1979))

y_i is household *i*'s income and it is the limit to what the household can pay for private commodities and taxes. For household *i* to enjoy the natural advantages, expenditure bundle, and private goods available in community *k*, the household has to reside in community *k* and pay tax τ_{ik}. p_{iM} is the total cost of moving. p_{iM} is the monetary cost of moving for household *i*. w_i is the value of time lost due to moving. B_i includes the psychic cost of moving and it varies across the life cycle. (Graves and Linneman (1979))

3.4. Data and Estimation Strategy

To find out which characteristics relating to a household's life cycle are relevant to the choice of location, I use the National Longitudinal Survey of Youth 1979 (NLSY79) from the U.S. Bureau of Labor Statistics (BLS) and the dataset I compiled on natural amenities from the United States Department of Agriculture Economic Research Services (USDA-ERS), National Climatic Data Center (NCDC) of the U.S. Department of Commerce, detailed water provided from US Geological Survey (USGS) National Hydrography, and whether counties are in the coastline from USGS. I use the Government Finance Database (GFD; Pierson, Hand, and Thompson (2015)) for county-level government tax revenues and expenditures.

The NLSY79[30] is divided into two datasets: (1) a public use file, which can be downloaded from the NLS Investigator from the BLS website; and (2) a geocoded file, which is confidential and requires special permissions and signed agreement with the BLS. I use both the public use and geocoded NLSY79 datasets.

The public use NLSY dataset has the respondent's educational attainment, marital status, total income[31], number of children, family size, and whether the household is under the poverty line. The following variables are provided in the geocoded NLSY file datasets that are not provided in the public use files: (1) state, county, and metropolitan statistical area of residence for each respondent in each round of survey; (2) respondent's country or U.S. state and county of birth; (3) parents' and grandparents' country or U.S. state of birth; (4) specific dates of births, marriages, divorces, school attendance; (5) name and location of colleges and universities attended; (6) distance between respondent's residences at each survey round; and (7) return migration.

[30] A nationally representative sample of 12,686 young men and women who were 14-22 years old when they were first surveyed in 1979. These individuals were interviewed annually through 1994 and are currently interviewed on a biennial basis.(bls.gov/nls/nlsy79.htm)

[31] Unfortunately, very few respondents were willing to answer questions pertaining to income and family size. Hence, I am limited to using number of children and whether family is under the poverty line.

I analyze the period where the NLSY79 panel dataset overlaps with the years available in the GFD dataset. Hence, the panel dataset I use are for the years 1979[32], 1982, 1987, 1992, and 2002. Because I analyze what determines the likelihood moving from one county to another, the analysis use data on moving to the current destination at the time of interview for the years 1982, 1987, 1992, and 2002. I use data in 1979 only for comparing the differences in natural amenities and per capita county tax revenues and expenditures between residence in 1979 and residence in 1982.

I am using the USDA-ERS dataset on natural amenities scale by county and it covers only the contiguous US. See Figure 3.1 below. Because I use the overlap among NLSY79, GFD, and USDA-ERS natural amenities dataset, the sample size in my analysis is down to almost half of the respondents in 1979 -- from 12,686 in 1979 to 6,857 in 1982. See Table 1 below.

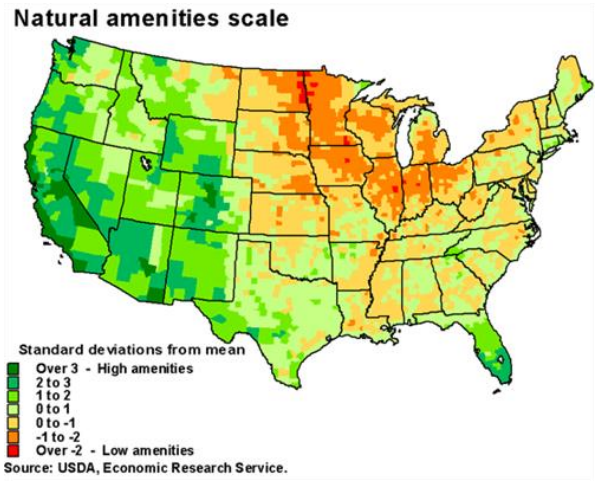

Figure 3.1: USDA-ERS Natural Amenities Scale by counties

Table 3.1 presents the number of respondents who moved and did not move between years. The range of age of respondents at the end year[33] is also provided in the table. The fluctuation in the number of respondents per year is due to missing values due to reasons stated in

[32] GFD is available for 1977 while NLSY79 starts are 1979. I merged the 1977 GFD corresponding with the available county tax revenues and expenditures at the county of residence of the respondents in 1979.
[33] e.g., the end year for period 1979-1982 is 1982

the NLSY79 documentation.[34] It can be observed from the table that the number of movers is higher for those aged 22 to 45. At age range 17-25, respondents could still be in school, getting out of school, finding a job, or starting a career with limited resources.

Table 3.1: Distribution of NLSY respondents who moved residences between years

Year	Age range	Did not move	Moved	Total
1979-1982	17-25	4,593	2,264	6,857
1982-1987	22-30	2,220	2,824	5,044
1987-1992	27-35	1,769	2,511	4,280
1992-2002	37-45	2,413	3,538	5,951
Total		10,995	11,137	22,132

Table 3.2 presents the number of respondents who moved to a county with higher natural amenities scale between years. From the table, it can be observed that the share of those who moved to a county with higher natural amenities scale is higher for age ranges 17-25 (25%) and 22-30 (27%).

Table 3.2: Distribution of NLSY respondents who moved to county with higher natural amenities scale between years

Year	Not higher natural amenities scale	Higher natural amenities scale	Total
1979-1982	1,704 (75%)	560 (25%)	2,264
1982-1987	2,064 (73%)	760 (27%)	2,824
1987-1992	2,040 (81%)	471 (19%)	2,511
1992-2002	2,798 (79%)	740 (21%)	3,538
Total	8,606 (77%)	2,531 (23%)	11,137

Putting together all datasets for the relevant years, Table 3.3 below presents the summary statistics for the variables I use in analysis.

[34] Missing data values indicate either a) a non-interview for a given year; or b) respondents who have missing value in the data for the following reasons: (1) Respondents who were in the military or who had an APO address; (2) Respondents who were residing outside of the United States; (3) Respondents whose state or county codes could not be determined; (4) Respondents who reside in a county or SMSA/MSA for which there is missing data for that geographic location for that specific item; (5) Respondents who do not reside in an SMSA for any survey year 1994-2004 who will be missing SMSA level environmental variables for that year; and (6) Respondents whose state, county, and ZIP codes for any survey year 1994-2004 do not lead to an unambiguous SMSA designation. This generally applies only to a small number of respondents living in New England.

Table 3.3: Summary Statistics

Variable	Count	Mean	Std. Dev.	Min	Max
Natural amenities scale	23,812	1.19	3.28	-6.40	11.17
Canal: total sq mi	2,654	1.06	0.96	0.01	5.32
Ice mass: total sq mi	844	13.76	25.46	0.01	65.82
Intermittent lake: total sq mi	11,917	1.14	3.01	0.01	103.38
Perennial lake: total sq mi	23,776	9.06	14.76	0.01	331.85
Playa: total sq mi	2,303	30.16	87.37	0.01	319.73
Reservoir: total sq mi	11,936	0.69	2.13	0.01	41.42
Intermittent stream: total sq mi	1,136	0.53	0.23	0.01	1.47
Perennial stream: total sq mi	10,015	0.68	1.09	0.01	21.57
Swamp: total sq mi	12,705	15.99	42.79	0.01	2122.85
Precipitation (in inches)	22,132	3.21	1.23	0.11	7.99
Temperature (in Fahrenheit)	22,132	55.97	8.49	35.28	75.29
Short-term drought index	22,132	0.08	0.31	-0.87	0.99
Long-term drought index	22,132	-0.04	0.89	-2.63	2.47
Urban counties	17,777				
Atlantic coastline counties	1,855				
Gulf coastline counties	1,314				
Pacific coastline counties	1,566				
Age at interview	22,132	29.15	8.34	17.00	45.00
Number of children	11,901	0.50	0.91	0.00	7.00
Marital status					
Never married	9,892				
Married	9,411				
Separated	832				
Divorced	1,900				
Widowed	93				
Poverty status					
Not in poverty	15,031				
In poverty	3,148				

Per capita terms (in nominal dollars)

Variable	Count	Mean	Std. Dev.	Min	Max
County tax revenue items					
Total tax revenue	22,132	202.60	181.65	0.00	2487.04
Total general sales tax revenue	22,132	36.09	75.48	0.00	1120.37
Total select sales tax revenue	22,132	7.34	19.34	0.00	259.24
Alcoholic beverage tax revenue	22,132	0.55	1.89	0.00	30.69
Motor fuels tax revenue	22,132	1.40	5.88	0.00	124.48
Public utility tax revenue	22,132	1.74	6.83	0.00	87.34
Tobacco tax revenue	22,132	0.29	1.34	0.00	8.88
Total license tax revenue	22,132	1.81	4.26	0.00	67.23
Individual income tax revenue	22,132	2.43	29.56	0.00	718.20
County expenditure items					
Total expenditure	22,132	621.39	522.08	2.55	6373.78
Air transport expenditure	22,132	5.79	27.06	0.00	344.68
Total education expenditure	22,132	65.95	208.64	0.00	2546.47
Financial admin expenditure	22,132	15.66	12.00	0.00	121.05
Fire protection expenditure	22,132	5.99	15.10	0.00	163.90
Judicial expenditure	22,132	30.56	28.73	0.00	220.62
Central staff expenditure	22,132	13.74	18.15	0.00	306.65
Gen. public building expenditure	22,132	9.26	26.46	0.00	3214.77
Health expenditure	22,132	47.60	60.80	0.00	708.04
Total highway expenditure	22,132	42.79	49.48	0.00	720.64
Transit subsidies expenditure	22,132	2.08	12.40	0.00	162.50
Housing & community dev't expenditure	22,132	5.40	11.70	0.00	262.87
Libraries expenditure	22,132	5.07	7.98	0.00	161.57
Natural resources expenditure	22,132	6.24	12.27	0.00	306.29
Parks & recreation expenditure	22,132	10.73	17.87	0.00	250.20
Police protection expenditure	22,132	34.38	39.81	0.00	409.22
Protective inspection expenditure	22,132	2.05	4.42	0.00	65.50
Public welfare expenditure	22,132	98.00	131.73	0.00	1081.43
Sewerage expenditure	22,132	12.80	46.69	0.00	639.22
Solid waste mgmt expenditure	22,132	8.51	16.94	0.00	241.91
Liquor store expenditure	22,132	0.48	4.84	0.00	199.54
Total utilities expenditure	22,132	10.33	34.12	0.00	456.99

The natural amenities scale of counties included in this sample range from -6.40 to 11.17 and has a mean of 1.19. Most of the respondents reside in urban counties. Data for water bodies are in total square miles. Types of water bodies included in the dataset are canal, ice mass, intermittent lake, perennial lake, playa, reservoir, intermittent stream, perennial stream, and swamp. Climatological variables include precipitation in inches, temperature in degrees Fahrenheit, short-term drought index, and long-term drought index.

Age of respondents at time of interview for years included range from 17 to 45. Number of children range from 0 to 7. Most of the respondents are never married. Some respondents got married within the time period of the dataset. Most of the respondents throughout the time period considered are not in poverty.

County tax revenues and expenditures are in per capita terms and are expressed in nominal dollars.

I also put together the summary statistics for differences in natural amenities scale and per capita county tax revenues and expenditures in Table 3.4 that follows.

Table 3.4: Summary Statistics: Differences in origin and destination counties

Difference between destination and origin variables

Variable	Count	Mean	Std. Dev.	Min	Max
Natural amenities scale	21,454	0.03	1.46	-14.58	14.58
Canal: total sq mi	13,025	-0.01	0.26	-5.32	5.32
Ice mass: total sq mi	13,025	0.01	2.62	-65.82	65.82
Intermittent lake: total sq mi	13,025	0.01	2.49	-103.38	103.38
Perennial lake: total sq mi	13,025	0.16	14.18	-325.25	331.60
Playa: total sq mi	13,025	0.55	23.74	-319.73	319.73
Reservoir: total sq mi	13,025	0.02	1.33	-23.99	41.16
Intermittent stream: total sq mi	13,025	0.00	0.07	-1.47	1.47
Perennial stream: total sq mi	13,025	0.00	0.72	-20.60	20.60
Swamp: total sq mi	13,025	0.23	41.19	-2122.85	2122.85
Precipitation	11,345	-0.08	0.83	-6.33	7.08
Temperature	11,345	0.68	4.37	-29.09	35.22
Short-term drought index	11,345	-0.10	0.43	-1.65	1.33
Long-term drought index	11,345	-0.08	1.02	-5.01	4.17

Distance between destination and origin residence

0 miles (Non-mover)	6,313
0-999 feet	1,272
1000 feet - 1 mile	1,655
1-5 miles	4,462
5-20 miles	3,701
20-50 miles	1,022
50-100 miles	651
100-500 miles	1,584
500+ miles	1,472

Difference between destination and origin variables

Per capita terms (in nominal dollars)

Variable	Count	Mean	Std. Dev.	Min	Max
Total tax revenue	21,454	57.91	104.46	-1458.61	2062.62
Total general sales tax revenue	21,454	13.40	44.91	-456.49	791.43
Total select sales tax revenue	21,454	2.95	13.27	-168.12	252.88
Alcoholic beverage tax revenue	21,454	0.07	1.34	-15.34	30.69
Motor fuels tax revenue	21,454	0.50	4.48	-98.79	107.21
Public utility tax revenue	21,454	0.76	4.91	-59.69	71.32
Tobacco tax revenue	21,454	0.05	0.95	-7.73	8.88
Total license tax revenue	21,454	0.43	3.15	-42.22	53.86
Individual income tax revenue	21,454	0.78	16.89	-344.56	718.20
Total expenditure	21,454	195.78	282.20	-3207.55	6017.01
Air transport expenditure	21,454	1.98	19.52	-242.40	298.69
Total education expenditure	21,454	20.91	112.89	-1222.01	2341.95
Financial admin expenditure	21,454	4.44	8.54	-107.81	101.47
Fire protection expenditure	21,454	2.21	10.86	-124.57	162.06
Judicial expenditure	21,454	12.42	16.45	-96.53	176.39
Central staff expenditure	21,454	3.08	16.37	-155.17	277.19
Gen. public building expenditure	21,454	2.15	28.59	-247.11	3211.36
Health expenditure	21,454	19.84	43.87	-350.75	567.26
Total highway expenditure	21,454	11.86	36.31	-283.44	679.86
Transit subsidies expenditure	21,454	0.11	11.98	-162.50	162.50
Housing & community dev't expenditure	21,454	2.66	9.87	-144.40	253.29
Libraries expenditure	21,454	1.33	6.81	-119.47	159.24
Natural resources expenditure	21,454	1.64	10.32	-102.27	304.99
Parks & recreation expenditure	21,454	3.61	15.23	-114.45	180.14
Police protection expenditure	21,454	12.98	23.83	-272.36	382.40
Protective inspection expenditure	21,454	0.83	3.26	-33.55	64.29
Public welfare expenditure	21,454	22.80	69.28	-488.95	729.20
Sewerage expenditure	21,454	4.64	43.59	-277.48	639.09
Solid waste mgmt expenditure	21,454	3.08	13.60	-241.91	241.14
Liquor store expenditure	21,454	0.08	3.41	-134.75	186.17
Total utilities expenditure	21,454	4.04	27.10	-220.74	354.75

Take note that Table 3.4 presents the summary statistics for differences between origin and destination counties. The distance between moves are included -- from 0 miles (non-mover) to more than 500 miles.

In the empirical exercise, I interpret the act of moving or not moving as the utility-maximizing decision for the household. Referring to the utility-maximizing behavior in the theory section, I assume that the household is rational. Hence, observing a household move to a different location means that the benefits of moving outweigh its monetary and psychic costs. I perform panel data analysis of households in the U.S. that were tracked since 1979 while controlling for the natural amenities in the locations they chose. I test the hypothesis that preferences for certain amenities are formed according to specific life events of the household and bounded by its budget constraint. I estimate two equations in this regard. In the first equation, I intend to see how the probability of moving changes with respect to household characteristics and the characteristics of its current county of residence, which is the destination residence after moving. I estimate

equations (3.2) and (3.3) using fixed effects[35] regression. The outcome variable, moving versus not moving, is a binary variable. Hence, the empirical models take on a logistic functional form.

$$\ln\left[\frac{\Pr(Move)_{it}}{1-\Pr(Move)_{it}}\right] = a_{it}^{d}\gamma + \tau_{it}^{d}\delta + g_{it}^{d}\psi + X_{it}\beta + h_i + u_{it} \quad (3.2)$$

In equation (3.2), the subscripts *i* and *t* denote household and year, respectively. The superscript *o* denotes origin county of residence. $\Pr(Move)_{it}$ is the binary variable equal to 1 if the household moves at year *t*, and 0 otherwise. a_{it}^{d} is a vector of natural amenities in the county of residence that the household enjoys at time *t*. τ_{it}^{d} is the vector of tax policy at the household's county of residence at time *t*. g_{it}^{d} is the vector of government expenditures at the household's county of residence at time *t*. X_{it} is the vector of household characteristics at time *t*, including the dummy for being under the poverty line, age of household head, marital status[36] of household head, dummy for having children, and highest educational attainment of household head. h_i is the household fixed effect. u_{it} is the residual.

In the second equation below, I estimate the probability of moving to a county with better or more natural amenities.

$$\ln\left[\frac{\Pr(Higher\ a^{d}|Move=1)_{it}}{1-\Pr(Higher\ a^{d}|Move=1)_{it}}\right] = a_{it}^{do}\gamma + \tau_{it}^{do}\delta + g_{it}^{do}\psi + dist_{it}^{do} + X_{it}\beta + h_i + u_{it} \quad (3.3)$$

The superscript *d* denotes the destination county of residence after moving. The superscript *do* denotes the difference in the value of a variable between the destination and the origin county of residence. $\Pr(Higher\ a^{d}|Move=1)_{it}$ is the probability of moving to a county with a higher natural amenities index . a_{it}^{do} is the difference in natural amenities index between the destination and origin county. τ_{it}^{do} is the vector of differences in tax policies between

[35] In fixed effects regression, the effect of time-invariant characteristics of the household are controlled for in estimation.

[36] Marital status of the household head at time *t* can indicate important events in the household such as shifting from being Single to Married, Married to Divorced, etc.

destination and origin. g_{it}^{do} is the vector of differences in government expenditures between destination and origin.

$dist_{it}^{do}$ is the distance between destination and origin. Distance between destination and origin can serve as a proxy for the monetary and psychic costs of moving.[37] The rest of the variables are defined similarly as in equation (3.2).

3.5. Estimation Results

Table 3.5 shows the results of including only the statistically significant variables for the three specifications implementing Equation (3.2). Table A3.1 in the Appendix presents regression results for the full models.

I try two specifications of age: as a continuous variable (Model 1) and as a dummy variable equal to one is a person is aged 25 years and above (Models 2 and 3). Model 1 specifies the log of odds of moving as a function of a vector of respondents' characteristics, vector of natural amenities, vector of control variables of the destination county, and the destination county's total tax revenues and total expenditures. The control variables of destination county characteristics include a dummy variable for whether it is urban or not, median age, median family income, and crime rate known to police for every 100,000 population. Model 2 is similar to Model 1's specification except for age; Model 2 has a dummy variable for when a person is aged 25 years and above. Model 3 has the same specification as Model 2 with the specific items of county tax revenues and expenditures. The models explain around 16% of the variation in probability of moving.

[37] This is an imperfect proxy for costs of moving because the monetary cost of moving is not linearly related to distance. It is also not necessarily true that the household has family and/or friends in its origin county of residence.

Table 3.5: Log of odds ratios from fixed effects panel regression of Equation (3.2)

Variable	Model 1	Model 2	Model 3
Respondent's characteristics			
Age	-0.0022		
D(Aged 25 and over)		-0.2054 **	-0.1832 *
Marital status (Base: Married)			
Never married	-1.0749 ***	-1.0859 ***	-1.0823 ***
Separated	-0.2529	-0.2540	-0.2394
Divorced	-0.2064	-0.1925	-0.1745
Widowed	14.1675	14.2085	14.2587
D(Has at least 1 child)	0.0473	0.1025	0.1487
D(Poverty)	0.1471	0.1395	0.1443
Natural amenities variables			
Natural amenities scale	0.0786 **	0.0792 **	
Canal	-0.2136	-0.2090	
County tax revenues and expenditures			
Per capita judicial expenditure			-0.5763
Per capita health expenditure			-2.2888
Per capita natural resources expenditure			12.2344 **
Per capita protective inspection expenditure			-16.2108
Per capita solid waste management expenditure			1.7375
Median age in destination county	0.0002	0.0005	0.0007
Median family income in dest. county	0.0001 ***	0.0001 ***	0.0001 ***
Crime rate per 100,000 population in dest. county	0.0001 ***	0.0001 ***	0.0001 ***
D(Urban)			-0.0777
N	5,099	5,099	5,099
Pseudo R-squared	0.158	0.159	0.159
AIC	3,113.95	3,109.78	3,118.89

legend: * p<.1; **p<.05; *** p<.01

Age as a continuous variable is not statistically significant, but the dummy for whether a person is aged 25 and above is statistically significant. The results indicate that a person who is aged 25 and above is approximately 45% more likely[38] to move than a person aged below 25. With respect to marital status[39], persons who are never married are around 25% more likely to move than married people. Being poor or having children are not statistically significant.

Every additional point in the natural amenities scale in the destination county makes a person 50% more likely to move. Total county tax revenues and expenditures are not statistically

[38] To compute for the probability of moving, I use the following formula: $e^{log\ odds}/(1 + e^{log\ odds})$.

[39] I used 'Married' as the base outcome for marital status because married people seem to have more in common with people who are separated, divorced, and widowed when compared to those are never married.

significant. Among the specific county expenditures, only the per capita natural resources expenditure appears to be statistically significant in the determination of probability of moving (i.e., very close to 100%).

Among the control variables for the destination county's characteristics, median family income and crime rate are statistically significant.

Table 3.6 shows the results of including only the statistically significant variables for three specifications implementing Equation (3.3). Table A3.2 in the Appendix presents regression results for the full models. Take note that the explanatory variables for natural amenities and per capita county revenues and expenditures are in terms of the difference in the destination and origin counties. The model specifications explain around 90% of the variation in the probability of moving to a county with higher natural amenities index.

Table 3.6: Log of odds ratios from fixed effects panel regression of Equation (3.3)

Variable	Model 1	Model 2	Model 3
Respondent's characteristics			
Age	-0.0398		
D(Aged 25 and over)		-0.1161	-0.3424
Marital status (Base: Married)			
Never married	-0.6388 *	-0.5721	-0.6345 *
Separated	-0.0063	-0.0045	0.0490
Divorced	-0.5043	-0.5675	-0.4267
Widowed	16.3216	16.3026	15.6952
D(Has at least 1 child)	0.2021	0.0548	-0.0334
D(Poverty)	-0.1621	-0.1127	0.0224
Difference in natural amenities between origin and destination counties			
Natural amenities scale	-0.1344	-0.1132	-0.1929
Precipitation			0.3974 **
Temperature	-0.1193 **	-0.1137 **	-0.1199 **
Difference in county tax revenues & expenditures between origin & destination counties			
Per capita total expenditure	-2.5009 **	-2.6932 ***	
Per capita air transport expenditure			-15.3651
Per capita transit subsidies expenditure			48.2229 **
Per capita police expenditure			12.4496
Per capita solid waste management expenditure			-17.2206 ***
Diff. in median age	-0.0156	-0.0150	-0.0137
Diff. in median family income	0.0001 **	0.0001 **	0.0001 ***
Diff. in crime rate	0.0000	0.0000	0.0000
Distance between residences (Base: Non-mover)			
0-999 feet	2.2944 **	2.3626 **	2.8845 **
1000 feet - 1 mile	4.8191 ***	4.7900 ***	5.1789 ***
1-5 miles	7.3173 ***	7.2828 ***	7.7491 ***
5-20 miles	10.1914 ***	10.1554 ***	10.6740 ***
20-50 miles	27.5078	27.3945	28.6366
50-100 miles	27.8275	27.8227	29.0744
100-500 miles	28.6283	28.4853	29.1165
500+ miles	31.7473	31.8782	31.2893
N	5,012	5,012	5,012
Pseudo R-squared	0.901	0.901	0.903
AIC	398.61	399.97	398.41

legend: * p<.1; **p<.05; *** p<.01

In this regression, the log of odds is for when people move to counties with higher amenities versus those who move to counties with less than or equal natural amenities scale. The respondent's characteristics are as defined in the earlier regression. Per capita county tax revenues and expenditures are expressed as difference in origin and destination counties. I include distance between origin and destination counties in the regression.

The results suggest that age is not an important factor on whether people move to a place with higher natural amenities index. People who are never married are 35% more likely than married people to move to a place with better natural amenities. Differences in precipitation and temperature are statistically significant. People are 47% more likely to move to counties with warmer weather and 60% more likely to move to counties with more precipitation.

Per capita total expenditures are statistically significant; people are 6.2% to 7.6% more likely to move to counties with higher per capita total expenditures. Among specific per capita county expenditures, transit subsidies and solid waste management are statistically significant. With respect to distance from the origin county, distance is statistically significant in moving to a place with higher natural amenities index if the destination county is at most 20 miles from the origin.

Among the destination county's control variables, only the difference in median family income appears to be significant.

3.6. Conclusion

In this paper, I pose the following question: How do people choose their residential location? Starting with the theoretical framework based on rational behavior, people choose to their residences based on their preferences and budget constraint. My hypothesis in this research is that life cycle shapes both preferences and budget constraint. Hence, we can expect people to move as they get older or as they hit certain life milestones.

The results of my study are consistent with the findings of earlier literature. Using a panel dataset on people tracked from when they were 14-22 years old to when they were 37-45 years old, I perform fixed effects panel data regression and I find that natural amenities and county expenditures affect likelihood to move. Age and marital status are important factors for the decision to move. The results suggest that persons aged 25 and above are 45% more likely to move than those aged below 25. Persons who are never married are 25% more likely to move

than married people. Being poor or having children are not statistically significant. An additional point in the destination county's natural amenities scale index makes a person 50% more likely to move to it. County tax revenues are not significant and among per capita county expenditures, only natural resources expenditure is significant. Among control variables for destination counties' characteristics, only median income and crime rate known to police per 100,000 population are significant.

On the probability of moving to a county with better natural amenities, persons who are never married are 35% more like to move than married persons. Age does not appear to be relevant. Differences in precipitation and temperature are significant. People are 47% more likely to move to counties with warmer weather and 60% more likely to move to counties with more rain. Counties with higher per capita total expenditures make people 6.2% to 7.6% more likely to move. Per capita transit subsidies and solid waste management expenditures are significant in the decision to move to counties with higher natural amenities index. Distance of at most 20 miles between origin and destination counties is statistically significant.

The significant number of missing responses on important life milestones and household characteristics, such as highest grade completed and household income, limits the results of my analysis. My sample size significantly drops when I include these variables in the regression. Information on whether the respondents in my sample were renting or owning a house in each period would also have provided an important control variable in my analysis.

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APPENDIX

Table A3.1: Log of odds ratios from full models - Fixed effects panel regression of Equation (3.2)

Variable	Model 1	Model 2	Model 3
Respondent's characteristics			
Age	-0.0108		
D(Aged 25 and over)		-0.2431 **	-0.2209 **
Marital status (Base: Married)			
Never married	-1.0719 ***	-1.0833 ***	-1.1080 ***
Separated	-0.2495	-0.2536	-0.2472
Divorced	-0.1723	-0.1642	-0.1412
Widowed	13.8770	13.8922	12.3929
D(Has at least 1 child)	0.0506	0.0783	0.1335
D(Poverty)	0.1324	0.1249	0.1369
Natural amenities variables			
Natural amenities scale	0.1137 **	0.1129 **	0.1401 ***
Precipitation	-0.0160	-0.0160	-0.0070
Temperature	0.0103	0.0119	0.0154
Short-term drought index	0.0530	0.0594	0.0944
Long-term drought index	0.0369	0.0418	0.0544
D(Gulf)	-0.4611	-0.4736	-0.5496
D(Atlantic)	0.0818	0.0527	0.1814
D(Pacific)	-0.5424	-0.5329	-0.6920
Canal	-0.3212 *	-0.3181 *	-0.3006
Ice mass	-0.0189	-0.0192	-0.0173
Intermittent lake	-0.0016	-0.0006	-0.0106
Perennial lake	0.0077	0.0075	0.0073
Playa	0.0025	0.0025	0.0031
Reservoir	0.0184	0.0193	-0.0011
Intermittent stream	-0.2851	-0.2906	-0.3674
Perennial stream	0.1004	0.0993	0.1254
Swamp	-0.0014	-0.0013	-0.0001
County tax revenues and expenditures			
Per capita total tax revenue	0.4950	0.4735	
Per capita total expenditure	-0.0865	-0.0683	
Per capita total general sales tax			-1.1548
Per capita total select sales tax			6.3320
Per capita alcoholic beverage tax			66.1743
Per capita motor fuels tax			-4.8141
Per capita public utility tax			-20.9668
Per capita tobacco tax			-9.3647
Per capita total license tax			-23.0993
Per capita individual income tax			-5.3563
Per capita air transport expenditure			-1.9544
Per capita total education expenditure			2.3759 ***
Per capita financial administration expenditure			21.1758 ***
Per capita fire protection expenditure			-2.5777
Per capita judicial expenditure			-2.2402
Per capita central staff expenditure			-10.0655 *
Per capita general public building expenditure			-0.1151
Per capita health expenditure			-1.6529
Per capita total highway expenditure			0.9815
Per capita transit subsidies expenditure			11.5579 **
Per capita housing & comm. dev't expenditure			-7.3838
Per capita library expenditure			-7.7145
Per capita natural resources expenditure			11.3476 *
Per capita parks & recreation expenditure			8.5617 *
Per capita police expenditure			-3.2147
Per capita protective inspection expenditure			-41.0293 *
Per capita public welfare expenditure			-0.3950
Per capita sewerage expenditure			-0.8780
Per capita solid waste management expenditure			-3.0138
Per capita liquor store expenditure			-8.3058
Per capita total utilities expenditure			0.3915
Median age in destination county	0.0001	0.0003	-0.0003
Median family income in dest. county	0.0001 ***	0.0001 ***	0.0001 ***
Crime rate per 100,000 population in dest. county	0.0001 **	0.0001 **	0.0000
D(Urban)	-0.0449	-0.0662	0.0081
N	5,099	5,099	5,099
Pseudo R-squared	0.162	0.164	0.176
AIC	3,133.09	3,127.96	3,136.94

legend: * p<.1; **p<.05; *** p<.01

Table A3.2: Log of odds ratios from full models - Fixed effects panel regression of Equation (3.3)

Variable	Model 1	Model 2	Model 3
Respondent's characteristics			
Age	-0.0405		
D(Aged 25 and over)		-0.1231	-0.1103
Marital status (Base: Married)			
Never married	-0.6339 *	-0.5697	-0.5193
Separated	-0.0853	-0.0819	-0.0157
Divorced	-0.5226	-0.5865	-0.6215
Widowed	19.4583	20.4887	16.7909
D(Has at least 1 child)	0.2138	0.0938	0.0959
D(Poverty)	-0.1701	-0.1279	-0.0293
Difference in natural amenities between origin and destination counties			
Natural amenities scale	-0.0521	-0.0532	0.3758
Precipitation	0.4184	0.3864	0.8338 **
Temperature	-0.1207 **	-0.1154 *	-0.1566 **
Short-term drought index	-0.2813	-0.2786	-0.5618
Long-term drought index	0.0418	0.0624	0.0100
Canal	0.8077	0.7891	1.2665
Ice mass	-0.0064	-0.0078	-0.0125
Intermittent lake	0.7970	0.7867	0.3265
Perennial lake	0.0645	0.0653	-0.0067
Playa	-0.0043	-0.0042	0.0034
Reservoir	-0.1488	-0.1431	-0.1011
Intermittent stream	-3.6515	-3.4784	-6.1179
Perennial stream	0.8080	0.8217	0.7019
Swamp	-0.0974	-0.0987	-0.0315
D(Gulf)	-0.0939	-0.1351	-0.5672
D(Atlantic)	0.8028	0.8783	1.4794
D(Pacific)	-1.9889	-2.0533	-1.8526
Difference in county tax revenues & expenditures between origin & destination counties			
Per capita total tax revenue	-0.2506	-0.8327	
Per capita total expenditure	-2.6533 ***	-2.8094 ***	
Per capita total general sales tax			-2.9047
Per capita total select sales tax			-29.2717
Per capita alcoholic beverage tax			-35.2167
Per capita motor fuels tax			122.9295
Per capita public utility tax			-84.6554
Per capita tobacco tax			-21.8412
Per capita total license tax			-50.5790
Per capita individual income tax			-116.2848
Per capita air transport expenditure			-21.0261 **
Per capita total education expenditure			2.4292
Per capita financial administration expenditure			-25.9590
Per capita fire protection expenditure			-2.3156
Per capita judicial expenditure			-20.1409
Per capita central staff expenditure			-3.3822
Per capita general public building expenditure			5.2381
Per capita health expenditure			-8.7267
Per capita total highway expenditure			-0.3654
Per capita transit subsidies expenditure			49.4592 *
Per capita housing & comm. dev't expenditure			-6.1333
Per capita library expenditure			43.8111
Per capita natural resources expenditure			21.8672
Per capita parks & recreation expenditure			-20.2330
Per capita police expenditure			33.8008 *
Per capita protective inspection expenditure			-158.5494
Per capita public welfare expenditure			0.0702
Per capita sewerage expenditure			-7.4096
Per capita solid waste management expenditure			-24.0882 ***
Per capita liquor store expenditure			59.9456
Per capita total utilities expenditure			-10.7405
Diff. in median age	-0.0170	-0.0165	-0.0152
Diff. in median family income	0.0001 **	0.0001 **	0.0001 **
Diff. in crime rate	0.0000	0.0000	0.0000
D(Urban)			
Distance between residences (Base: Non-mover)			
0-999 feet	2.2677 *	2.3274 **	2.8240 **
1000 feet - 1 mile	4.9418 ***	4.9270 ***	5.2190 ***
1-5 miles	7.4673 ***	7.4407 ***	7.9386 ***
5-20 miles	10.3833 ***	10.3621 ***	10.9942 ***
20-50 miles	32.6186	33.5833	33.5953
50-100 miles	30.8607	31.9759	31.8054
100-500 miles	43.7584	44.6554	44.5374
500+ miles	35.1074	36.0988	43.5445
N	5,012	5,012	5,012
Pseudo R-squared	0.903	0.903	0.910
AIC	423.87	425.06	453.12

legend: * p<.1; **p<.05; *** p<.01

OVERALL CONCLUSION

In this research, I ask whether natural amenities affect the provision of local government-provided public goods and whether the interaction between the two factor into how people choose their residential locations through their life cycle. In the first article, using spatial autoregressive random effects model estimation, I find that natural amenities of locations and that of their neighbors are important for the determination of tax policies and levels of county expenditures using a panel dataset at the county level. Per capita tax revenue varies with climatological variables including precipitation, temperature, short-term drought, and long-term drought. Per capita total expenditure varies with topography type and being on the coast of Gulf and Atlantic. The effect of topography type is largely indirect (i.e., as a neighboring county's characteristic). Canals have the most direct and indirect effects on tax policy and expenditure levels among water bodies. Moreover, almost all tax revenue and expenditure items are positively correlated with the neighbor's similar tax revenue and expenditure items. There is negative correlation between a county and its neighbor in total general sales tax and motor fuels tax revenue, as well as in expenditures for judicial and transit subsidies.

The results of my second article suggest that the level of natural amenities affect the level of per capita expenditures such as correctional facilities, education, fire protection, judicial, health, police protection, public welfare, housing, and natural resources. Meanwhile, some expenditures are not affected by natural amenities because they have to be provided regardless of what are naturally available including sewerage, solid waste management, and total utilities expenditures. Counties with natural advantage in the form of a topographic advantage seem to have lower per capita expenditure on public welfare and higher per capita expenditure on libraries and total utilities.

My third article explores whether age and life milestones shape the preferences and budget constraints of people when they choose among alternative residential locations as they trade-off between natural amenities and local government-provided public goods. The results indicate that age and marital status predict the probability of moving. Age and marital status are important factors for the decision to move. The results suggest that persons aged 25 and above are 45% more likely to move than those aged below 25. Persons who are never married are 25% more likely to move than married people. Being poor or having children are not statistically significant. An additional point in the destination county's natural amenities scale index makes a person 50% more likely to move to it. County tax revenues are not significant and among per capita county expenditures, only natural resources expenditure is significant. Among control variables for destination counties' characteristics, only median income and crime rate known to police per 100,000 population are significant.

Going back to the question posed as to how people vote with their feet, people do choose residential destinations based on naturally occurring advantages and local government-provided advantages of locations moderated by their current stage they are in their life cycle.

Regardless of whether people vote with their feet through job search or through amenities, what is consistent in findings in regional science is the importance of aggregate economies (Rosenthal and Strange, 2002) in initiating and sustaining a dynamic local economic environment. A policymaker may find utility in the results of this study by prioritizing expenditures that work best with the natural amenities already existing in their location. In doing so, local governments can broadly classify expenditures into health and safety (police and fire protection, protective inspection, health, sewerage, solid waste management, and local roads expenditures), welfare (education, libraries, parks & recreation, transportation, public housing expenditures), and housekeeping expenditures (judicial, central staff, public building expenditures). Climatological variables seem to be complemented by local government expenditures towards health and safety (i.e., police and fire protection) and welfare (i.e., public

welfare, parks & recreation, and housing & community development). Topography type appears to be complemented by welfare expenditures such as education, air transport, and housing & community development, and by health and safety expenditures including police and fire protection. The effect of coastline differs among Gulf, Atlantic, and Pacific. However, a limitation of this study is that my dataset does not allow me to distinguish whether the effect is from the natural amenity or the economic consequences of being prone to natural events such as hurricanes.

Most of the health and safety expenditures seem to be provided regardless of the natural amenities in locations. Depending on the demographic profile that policymakers want to attract into their jurisdiction, the results of my study can provide guidance as to what expenditures need to be prioritized and which ones can be provided to maximize natural amenities.

My results also echo the results of earlier literature suggesting that life cycle effects matter in residential mobility decisions as I distinguish between natural and man-made amenities. A glaring limitation in my research, however, is that the panel dataset I use does not cover the entire life span because my sample includes only people aged 17 through 45. Moreover, due to my focus in this research on how local governments respond with policies to the natural amenities in their locations, I did not control for variations in cost of living, wages and industrial composition, jobs availability, and quality of schools.

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