Sprawl in the Western United States: Do State Growth Management Programs Reduce Sprawl?

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Abstract

Sprawl is faulted for contributing to excessive commuting and transportation costs, raising the cost of providing infrastructure and other public services (Carruthers, 2002). With the advent of the environmental movement in the 1960s, concern for the impact urban growth was having on the environment caused a surge of growth management legislation that eventually led to several states implementing state growth management programs (SGMPs). While there have been several studies done on the effectiveness of SGMPs in containing sprawl, there have been no studies of state-growth management that focus solely on the Western States, states that have many characteristics in common such as the percentage of federal land and limited resources. Additionally, this study focuses on the period from 1990 to 2010, bringing the literature up-to-date for SGMPs in the West. This article examines the effectiveness of SGMPs on containing urban sprawl in the Western United States where five of eleven states had implemented SGMPs by 2000. Several measures were taken to assess the effectiveness of SGMPs in containing sprawl. While several methods were attempted, statistical significance was found using a dummy variable which supports the belief that SGMPs do help to contain urban sprawl.

Introduction

With the advent of the automobile, moving to the suburbs and the urban fringe became easier and more appealing for many Americans early in the twentieth century. As roads and highways transformed the landscape to make room for the burgeoning number of automobiles, families with growing incomes chose to pursue the American dream of owning their own homes and land far from the hustle and bustle of the city. Since the 1900s, the rate of population growth for the central cities in America's urban areas has become lower than that in the suburbs (Yin & Sun, 2007). This pattern habituated by Americans has resulted in what is commonly called urban sprawl. Most planners and policy makers see sprawl as causing the loss of prime agricultural and environmentally sensitive lands, deterioration of central cities, increased automobile dependency, and greater social inequality (Burchell, 1997; Downs, 1999; Ewing, 1994). It is also credited with costing tax payers money to expand infrastructures to rural areas on the fringes of central cities. However, some scholars disagree and see sprawl as something that creates more housing and job choices (Gordon & Richardson, 2000).

Due to attention from the media, sprawl came to the governmental agenda in the 1990s, and in 1999 the federal government announced a federally funded "Smart Growth Initiative" to combat urban sprawl (Anthony, 2004). However, growth management is not a new idea. Since the 1960s cities and other local governments have passed legislation that attempted to control and limit the growth and outward expansion. States began to get involved as problems of jurisdictions conflicted and fragmentation resulted in competitive agencies that did not work together, resulting in prolific development in the fringe where less regulation existed. Hawaii, Vermont, and Oregon were among the first states to adopt state growth management legislation followed by a slew of others. As of 2010, 10 additional states have adopted state growth management legislation, including Florida, New Jersey, Rhode Island, Georgia, Washington, Maryland, Arizona, Tennessee, Colorado and Wisconsin.

Several studies have been done to assess the effectiveness of state growth management programs on urban sprawl. In 2004, Jerry Anthony found that growth-managed states generally experience a lesser density decline than states without growth management. Since then, a number of other studies have been done on the impact that state growth management programs have on sprawl. Since state growth management is a relatively new approach and states are adopting growth management plans at a steady rate, it is appropriate to bring the literature to date. This study will focus on changes from 1990 to 2010 in 11 western states of which five will be considered state growth managed states. Western states are a unique bunch with ample amounts of federal lands, large mountain ranges, and

vast deserts. The choice to focus on these states seems appropriate as they have much in common. Additionally, lack of privately owned land may place a constraint on urban expansion and help check sprawl (Anthony, 2004). Prior to the economic downturn in 2008, no other region of the country was growing at a faster rate than the western states: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming. The United States as a whole grew 19.4% between 1990 and 2010 while the western states grew on average 31.3%, nearly 40% faster than the rest of the nation.

Sprawl

Definitions of sprawl vary, and the causes and consequences are often blurred. Sprawl is generally believed to be composed of low-density, single-use, scattered, strip, and leapfrog developments, and has been extensively criticized for being inefficient, inequitable, and environmentally insensitive (Ewing, 1997; Burchell, 1998; Downs, 1999, Carruthers, 2002). Galster, et al. (2001) contend that any land use pattern that has low values on one or more of eight definitions of land use patterns—density, continuity, concentration, compactness, nuclearity, diversity, proximity, and centrality—is sprawl. Many ways to measure sprawl have been used by a variety of different studies. There seems to be some agreement that large-scale conversion of agricultural land to urban uses and low-density urban development represent sprawl (Anthony, 2004). For the purpose of this study, sprawl will be defined as low-density along with the amount of increased urbanized land as these are seen as the best way to embody sprawl without creating an elaborate sprawl index.

Sprawl is faulted for contributing to excessive commuting and transportation costs, raising the cost of providing infrastructure and other public services (Carruthers, 2002). Quality of life problems such as consumption of natural open space, socioeconomic segregation through inequitable land and housing markets are a prevalent result of sprawl. Sprawl also causes some negative externalities such as traffic congestion, environmental contamination, income and racial segregation, mismatch between jobs and housing, loss of farmland, excess energy use, and overdependence on cars (Yin & Sun, 2007). When market failures occur due to peoples' preference for single-family dwellings and automobiles, the marginal social costs of sprawl outweigh the marginal private costs (Carruthers & Ulfarsson, 2002a)

Rising incomes and consumer preference for single-family dwellings has perpetuated the pattern of growth that dominates America's cities and communities. The problem is bolstered and reinforced by preferences for small local governments that play an especially important role in fueling the process of political fragmentation and undermining the overall ability of land-use planning to guide the growth of metropolitan areas. Fragmentation occurs through the formation of local governments as residents attempt to gain a greater degree of autonomy from surrounding jurisdictions. Jurisdictions create regulations that promote specific preferences for their area, often resulting in exclusionary rules with limited land use. This can direct development to the urban fringe, where land is inexpensive and development is allowed to proceed with minimal regulation (Carruthers, 2002). Often times, these local jurisdictions compete with one another for economic growth opportunities. Sprawl is endemic to the urban fringe, fragmentation plays a large part in compounding the issue of maintaining the creation of low densities and scattered developments.

State Growth Management Programs

Land use issues and growth management lie in the hands of the states rather than the federal government. As Americans prefer smaller local governments, and in turn, the elected officials implement voters' interests, control over land use has historically been delegated to local governments and municipalities. With the advent of the environmental movement in the 1960's, concern for the impact urban growth was having on the environment caused a surge of growth management legislation that eventually led to several states implementing growth management at the state level.

According to Jerry Anthony, state growth management was first implemented by Hawaii in 1961 through the enactment of comprehensive state land-use planning. The goals of this first measure were to preserve environmentally sensitive areas and prevent haphazard development. For this reason, Hawaii's land use law is regarded as the first statewide growth management legislation (Kelly, 1993, Anthony, 2004). Ten years later, Vermont followed by adopting Act 250, a land use law that established a statewide development permitting system with substantial control at the regional level. Three years later in 1973, Oregon was the third state to adopt growth management legislation. Twelve years later, Florida combined a number of previously implemented regional and local growth management programs in what was to be a comprehensive state growth management program that

mandated all local governments to prepare growth management plans for guiding local development (DeGrove 1984,Anthony, 2004).

A second wave of states enacting growth management at the state level began with New Jersey in 1987 and was followed by Rhode Island in 1988, Georgia in 1989, Washington State in 1990, and Maryland in 1992. In this so-called second wave, the scope of concern was broadened from mostly environmental concerns to encompass a number of other objectives including specific requirements for local plans, containing urban sprawl and well-planned land use (DeGrove, 1992; Nelson & Peterman, 2000; Carruthers, 2002). Arizona and Tennessee joined the others in 1998, and were followed by the most recent additions of Colorado and Wisconsin, both added in 2000 (Anthony, 2004; Yin & Sun, 2007).

There is some debate as to whether California should be included on this list. They have implemented mandatory planning for highly urbanized areas, but some scholars (see, e.g., Dawkins & Nelson, 2003; Gale, 1992; Weitz, 1999) did not include California as a growth-managed state because the growth management regulations in California were concentrated in coastal areas and emphasized local planning. In addition, California has provided little oversight on local planning (Yin & Sun, 2007). In 1999, Weitz concluded that California should be included in this list on the basis of the numerous regional and local land use regulations (Weitz, 1999; Anthony, 2004). Other scholars (see Anthony, 2004; Bollens, 1992; Carruthers, 2002) argued that California qualifies as a growth-managed state because of its mandatory local-comprehensive plans, coastal programs, and some regional programs for compact development (Yin & Sun, 2007). For the purpose of this study, California will be considered a growth-managed state, along with Oregon, Washington, Arizona, and Colorado.

Reasons, goals and features of state growth management programs

At the heart of all growth management programs is "the belief that land development and population increases can be balanced with conservation of open space and natural, historical, and/or cultural resources" (Gale & Hart, 1992, Smutny, 1998). Common objectives of growth management regulations, according to Anthony, are controlling sprawl, preserving farmland, protecting environmentally sensitive areas, increasing density to make public transit viable, and reducing urban energy consumption. While local land-use control is the typical norm of land-use regulation, several states have chosen to take on the role of land-use regulator.

States intervene in local planning efforts for a number of reasons including but not limited to problems resulting from growth-related spillovers across jurisdictions and environmental issues. Many of the issues that are mitigated at the state level are transboundary problems that elude local control. Air pollution, traffic congestion, and lack of affordable housing are some of the transboundary problems that state growth management programs attempt to address (Smutny, 1998). Like individuals, communities act in their own self-interest, and the smaller they are, the more narrowly their goals may be defined (Fischel, 1999; Porodzinski & Sass, 1994). Without guidance from the state or higher authority, local jurisdictions are often unwilling to work together and often vie for the positive attributes of growth like higher tax incomes and ignore the negative aspects of growth such as pollution and traffic congestion. It is well known that the fragmented structure of the American government aggravates sprawl and unmanaged growth. Diamond and Noonan (1996) argue that state governments must help local governments by establishing reasonable ground rules and planning requirements and providing leadership on matters that can only be dealt with regionally.

According to Dawkins and Nelson, effective state growth management programs should ultimately affect land development outcomes by changing the location of available land development opportunities within the region. By removing or regulating power at the local level, state and regional growth management agencies can insure consistency among the jurisdictions within the state. Contemporary state growth management programs respond to the problem of fragmentation by mandating goals and standards for local land use plans, prescribing the use of specific policy instruments for regulating the outward pace of development, and using enforcement mechanisms aimed at ensuring uniform compliance among jurisdictions (Carruthers, 2002). State growth management programs have distinct advantages as they can require all communities within a state to adopt growth management practices and thereby ensure that benefits of growth management accrue to communities across the state (Anthony, 2004). The state can also assume review powers over local development policies (Anthony, 2004).

Since the beginning of the evolution of state growth management programs, state sponsorship of local and regional planning has taken several different forms. Therefore, there is some debate about what constitutes a state growth management program (Anthony, 2004). Specific consistency requirements vary from state to state. Vertical consistency requires plans to be consistent with state-defined policy objectives: horizontal consistency requires local plans to be consistent with one another; and internal consistency requires consistency between local plans and development regulations—especially the zoning ordinance. Vertical and horizontal consistency requirements work

to co-ordinate local planning practices, while internal consistency requirements are intended to ensure that plans are carried out once they have been prepared (Carruthers, 2002). The strongest state planning frameworks require all three types of consistency, but weaker frameworks require fewer, or only encourage consistency (Gale, 1992; Burby & May, 1997; Weitz, 1999).

State mandates and policies find leverage at the regional and local level through a variety of incentives and disincentives. Contemporary state planning mandates generally follow either a conjoint or co-operative approach (Bollens, 1992, 1993; DeGrove, 1992). In a penalty-based conjoint framework, local governments are required by law to prepare land-use plans and may be subject to strict sanctions, including temporary loss of funding and/or authority to approve development proposals, if they fail to meet state-defined standards. This compares with the more flexible co-operative framework, where planning is voluntary and incentives, such as additional state funding, are the primary means of enforcing prescribed standards. States may offer financial aid or assistance in both cases to assist in the outcomes of their plans (Carruthers, 2002).

Another tool states have used is concurrency, also referred to as adequate public facilities ordinances (APFOs) that seek to ensure that public infrastructure is available before development is permitted (Knaap & Nelson, 1992; Knaap & Hopkins, 2001; Anthony, 2004). In addition, urban growth boundaries (UGBs) have been employed and best exemplified by Portland, Oregon. APFOs and UGBs have become prominent features of sub-state direct urban containment policies (Boyle & Mohammed, 2007).

Findings of previous studies on state growth management programs

There have been several studies done on local and regional planning. In addition to these studies, there have been several studies done on the effectiveness of state-growth management in particular.

Yin and Sun (2007) cited Burby, et al. (1997) who compared local planning experiences in California, 20 coastal counties in North Carolina, and Florida with those in North Carolina's 20 mountain counties and Washington. They found that "local governments responding to a state comprehensive-planning mandate are more likely to have prepared comprehensive plans and to have higher-quality plans than local governments in states without a mandate, although the mandates only have limited effect in enhancing commitment of local officials to state goals." They conclude that "by influencing the quality and character of local plans, planning mandates in turn influence the extent and character of local development management" (p. 141).

Healy and Rosenberg (1979) found that Hawaii "had been relatively, but not completely, effective in stopping the urbanization of agricultural lands….Nevertheless, the law has had a striking effect on the pattern of Hawaii's growth, making urban expansion far more compact and orderly than it would have been without the law" (p. 186). An update to the status of Hawaii's growth management mandate was argued by Kelly (2004) saying that ninety-five percent of the land in the state remained in the rural conservation classifications in 1992 after more than three decades of operation of the SGMP (Yin & Sun, 2007).

Carruthers (2002) used three-stage least square models to examine the impacts of SGMPs on sprawl in terms of population density, the extent of urbanized land area, and property values. He selected 283 metropolitan counties in 14 states, with Oregon, California, Georgia, Florida, and Washington as the chosen SGMP states. He found that only Oregon's SGMP increased urban density within his five studied states with SGMPs. The other states had negative impacts on urban density including two among them having significant coefficients. The SGMP in Florida significantly increased the spatial extent of urbanized area, and SGMPs in the four states other than Florida have no significant impact on that (Yin & Sun, 2007).

Dawkins and Nelson (2003) examined the impact of SGMPs on central-city revitalization, in which a primary central city's share of new residential building permits was used to indicate central-city revitalization. Their panel data was composed of 19 periods for each of 293 metropolitan areas (MAs). The fixed effects model shows that SGMPs had significantly positive impacts on primary central city's share of new residential building permits, which might imply that SGMPs promoted the revitalization of central cities (Yin & Sun, 2007).

Anthony (2004) conducted a cross-sectional research by using data on 49 states at three time points, including 1982, 1992, 1997. Descriptive analysis revealed that growth-managed states generally experienced less density decline than states without growth management. However, his multivariate regression analysis, which examined the effect of SGMPs on urban density by comparing changes in urban densities of states with growth regulations to those without growth regulations, indicated that SGMPs in general had no statistically significant effect on the increase in urban density (Yin & Sun, 2007).

Research Purpose

The purpose of this research is to take a fresh look at the effects state-led growth management plans have on curbing the expansion of the population onto undeveloped land and on the perpetuation of sprawl. There have been several studies done on the effectiveness of state-growth management all of which measure state-growth management prior to 2000 with Yin & Sun assessing state-growth management in the 1990's. By assessing the years from 1990 to 2010, I will be able to bring the literature up-to-date and include states that have not been assessed. Additionally, there have been no studies of state-growth management that focus solely on the western states. The western states are similar in several ways including the inclusion of large percentages of federal land and limited resources such as water. Because of these unique characteristics, I found the west to be a particularly advantageous group to assess.

Research Method

The study was conducted through an examination of sprawl as the independent variable. Sprawl was operationalized as the percent change in people per square mile from 1990 to 2010, according to the US Census Bureau, divided by the percent change in urbanized land area during that same time period. Urbanized land area was obtained from the National Resource Inventory (NRI) of the US Department of Agriculture. According to Carruthers in 2002, both measures are necessary to get a clear picture of urban form because sprawl is characterized by the spread of development (land area) in addition to its bulk (density).

In this study, data was gathered from counties in the 11 states that were considered to be urban counties in each state by the US Census Bureau. According to the US Census Bureau, these counties had a minimum of at least one incorporated city of 25,000 people or greater. By choosing the most populous counties, I was able to leave out areas that were likely rural areas and undeveloped areas. The most populous counties in the western states were the unit of analysis. There were 118 urban counties in 11 western states examined including Washington, Oregon, California, Idaho, Nevada, Arizona, Montana, Utah, Wyoming, New Mexico, and Colorado. Five of these states were considered to have state growth management programs in place at the time of the study.

I used multiple regression analysis to test which independent variables were statistically significant. The independent variables are listed and described below.

Measuring state growth management programs

As we can see from Table 1, SGMPs differ from one another on several factors. Several methods for measuring state-growth management were used. First, accounting for the year of implementation through a simple scale variable was thought to be useful in that those states that have had programs in place for a longer period of time would likely have a greater effect than those who have been around for a shorter amount of time.

The second method involved creating an index that scored the state-growth managed states on several characteristics found in Table 2. (Yin & Sun, 2007) An overall index is calculated based on the evaluations of the contexts and criteria in Table 1. The contexts of each criterion are scaled as 1, 2, and 3 to indicate low, medium, and high levels of state involvement. For "Year Adopted," the earlier a SGMP was set up, the higher the score. The ages of SGMPs that are at least 30% higher than the average are scored as 3, those with middle aged SGMPs are scored as 2, and those in the 30% youngest SGMPs are scored as a 1. For "Community Planning Requirement," 3 is assigned to the states where community planning is mandatory for all areas in the state, 2 is assigned to the states where community planning is mandatory in only fast-growing areas, and 1 is assigned to the states where community planning is only voluntary. For "Principal Plan Review Authority," 3 is assigned to the "State," 2 is assigned to "Region," and 1 is assigned to "Local Government." Based on the elements of the last two criteria, "Amendments of Original Plan" and "Approval of Amendments," 3 is given to the states where the amendments of an original plan are approved by a state government, 2 is assigned to the states where the amendments of the original plan are approved according to regional consensus, and 1 is assigned to the states where the amendments are approved by a local planning authority. The final indices are then added together for the 5 states that had adopted SGMPs in the study. Then the indices were assigned to the corresponding counties in the 5 SGMP states (Yin & Sun, 2007). Logs were also taken of the index as the best model often uses logarithms.

Table 1. Features of State Growth Management Programs

State	Year adopted	Community planning requirement	Principal plan review authority	Amendment of original plan	Approval of amendments
Arizona	1998	Mandatory	Local government	Amendment required every 10 years for larger and fast growing cities	An affirmation vote of the local legislative body
California	1965	Mandatory	Local government	Amendments by local agencies	No state role, some regional role
Colorado	2000	Mandatory	Local government	Amendment as recommended by local planning authority	Local planning authority
Oregon	1973	Mandatory	State	Amendments at will by local agencies	State can challenge amendments
Washington	1990	Mandatory for fast growing areas	Local government	Only one major amendment recommended every 5 years	No state role

Sources: Yin & Sun, 2007; Anthony, 2004

And lastly, SGMPs were measured with only a dummy variable where all the states that were considered to have a growth management plan in place (Oregon, Washington, California, Arizona and Colorado) were represented by a 1, and states with no state growth management plan in place were represented with a 0.

Table 2. Scores of SGMPs by Criteria

State	Year adopted	Community planning requirement	Principal plan review authority	Amendment of original plan & approval of amendments	Total score
Arizona	1	3	3	3	10
California	3	3	1	2	9
Colorado	1	3	1	1	6
Oregon	3	3	3	3	12
Washington	2	2	1	1	6

Source: Yin & Sun, 2007

Other Data Sets

There are other factors associated with sprawl that include economic factors, fragmentation factors, additional land policies, farm revenues, and median house values. Therefore, the researcher has selected a number of other variables to include in the regression model.

Percentage change in median household income, 1990 to 2010

The researcher believes that percent change in income is a good economic indicator to include in the model. Therefore, the percentage change of income between 1990 and 2010 was obtained from the US Census Bureau. The amounts were normalized to 2010 levels to account for inflation factors. The effect of economic growth in an area can have several effects. A rise in income can cause people to want to live in the core of the city where housing costs are higher than the suburbs. Alternatively, a rise in income can cause people to prefer the suburbs where they can live in areas with less density. The researcher hypothesizes that an increase in wages will cause sprawl to increase, thus indicating a positive relationship between income and sprawl.

Number of jurisdictions per thousand persons in 2007

Fragmentation is believed to be one of the many factors shaping urban development patterns, and it plays a role since it is the embodiment of many policy factors and lifestyle choices (Yin & Sun, 2007). Even though individual jurisdictions can limit their own growth, they cannot effect what happens to the region as a whole. The cumulative effect is uncoordinated growth shifted from one community to another, generating the spatial expansion of the metropolitan area. Urban growth evolves into a sprawl pattern under fragmented governance (Carruthers, 2002; Carruther & Ulfarsson, 2002; Downs, 1999).

The number of jurisdictions including county, city, or township for each county in 2007 was collected from the US Census Bureau which is used to indicate the fragmentation of the county. The number of special districts is not included as most special districts have very limited powers and do not contribute substantially to fragmentation.

Percentage change in the unemployment rate, 1990 to 2010

The unemployment rate can have a large impact on where people choose to live. As people earn less money, they are likely to choose places where it is cheaper to live, often times driving them to the fringe. An additional data collection point was added to account for the great recession which began in late 2007. Data was collected on unemployment rates in each individual county for 1990, 2006, and 2010. The percentage change for 1990 to 2006 and the percentage change from 2006 to 2010 was then calculated and added to the model.

Percentage change of median house values, 1990 to 2007

House values may be an important variable to explain sprawl. House values are, in theory, at equilibrium between housing supply and demand. Higher house values suggest higher housing demand or relatively lower housing supply. A high percentage increase in house prices may have two possible effects on land uses. On one hand, the supply side of the housing market may produce more houses to meet the high demand by increasing residential densities. On the other hand, it may provide more low-density houses with lower land costs by developing suburb or rural areas. Therefore, the impacts of the growth in house prices on land uses could be mixed (Yin & Sun, 2007). In this article, the percentage change of median house values between 1990 and 2007 were used. The information regarding median house values was obtained from the US Census Bureau and was calculated for each county.

Percentage change of annual farm revenues, 1987 to 2002

The average annual farm revenue in a county can have some impact on sprawl. When county A has more farm revenue than county B, the transformation from rural area to urban area would be more costly in county A, and thus county A may be less prone to sprawling, holding other factors constant. When a county has a higher percentage increase in average farm revenues, it is more likely for the MA to curtail the urbanization of agricultural lands (Yin & Sun, 2007).

Annual farm revenues for each county in 1987 and 2002 were calculated from the Census of Agriculture. The percentage change of annual farm revenues between 1987 and 2002 was then calculated.

Agriculture conservation districts and agriculture protection zoning

Other land policies can have an influence on the supply of land. Agricultural Conservation Districts and Agriculture Protection Zoning can both have an effect on preventing sprawl (Anthony, 2004; Yin & Sun, 2007). The 1980 National Agricultural Land Study found 22 states had some type of agricultural protection zoning (Coughlin, 1991). More states now have such measures and the Sierra Club's *1999 Sprawl Report* found that all states have some form of agricultural protection zoning and districting. The report also provides information on the effectiveness of each policy in each state. Because these programs could reduce the conversion of undeveloped land for urban uses and increase urban densities, two dummy variables set at 1, 2, or 3 and corresponding to low, moderate, or high effectiveness were included in the model (Anthony, 2004).

Rationale

Hypothesis: All other things being equal, the presence of a state growth management plan in place will cause sprawl to increase at a slower rate. No state growth management plan in place will cause sprawl to increase.

Hypothesis: All other things being equal, the longer a state growth management plan is in place, sprawl will increase at a slower rate than those without a state growth management plan.

Hypothesis: All other things being equal, an increase in median household income in the county will increase sprawl.

Hypothesis: All other things being equal, the greater the number of municipalities in the county per thousand persons, the greater increase in sprawl.

Hypothesis: All other things being equal, an increase in unemployment in the county will cause a decrease in the rate of sprawl.

Hypothesis: All other things being equal, an increase in median house values in a county will cause a greater increase in sprawl.

Hypothesis: All other things being equal, a percentage increase in annual farm revenue in the county will cause a decrease of sprawl.

Hypothesis: All other things being equal, effective agricultural zoning in the county will cause a decrease in sprawl.

Equation

$y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + b_{10}x_{10} + e$

y = Percentage change of people per square mile in the county from 1990 to 2010 divided by the percentage change in urbanized land from 1987 to 2007.

a = Constant

b_1 = SGMP dummy

b_2 = SGMP year of implementation

b_3 = Percentage change of median household income in the county from 1990 to 2010

b_4 = The number of municipalities in the county per 1000 persons

b_5 = Percentage change of the unemployment rate in the county from 1990 to 2006

b_6 = Percentage change of the unemployment rate in the county from 2006 to 2010

b_7 = Percentage change of median house values in the county from 1990 to 2007

b_8 = Percentage change of annual farm revenues in the county from 1987 to 2002

b_8 = e = Error

b_9 = Agricultural protection district effectiveness rating in the county of 1 is very effective, 2 is moderately effective and 3 is not effective

b_{10} = Agricultural protection zoning effectiveness rating in the county of 1 is very effective, 2 is moderately effective and 3 is not effective

Results (I)

The data used for the dependent variable, sprawl, is summarized in Table 3 for each state. While the percentage change in urbanized land and the percentage change in urban population were used as a ratio to operationalize sprawl, the numbers for each state can be useful as well. The results vary for each state whether or not it had state growth management regulations.

Table 3. Results from Simple Analysis of National Resource Inventory (NRI) Data

	Change in Urban Land, 1987-2007	Change in Urban population, 1987-2007
States with growth management regulations		
Arizona	69.33%	85.11%
California	42.10%	30.42%
Colorado	45.50%	48.51%
Oregon	31.37%	38.21%
Washington	47.11%	42.66%
States without growth management regulations		
Idaho	45.19%	52.21%
Montana	26.34%	18.90%
Nevada	109.53%	150.91%
New Mexico	63.44%	33.16%
Utah	56.89%	58.74%
Wyoming	17.67%	9.74%
Eleven western state average	50.41%	51.69%
Average of states with state growth management regulations	47.08%	48.98%
Average of states without state growth management regulations	53.18%	53.94%

Source: NRI & US Census Bureau

Of the SGMP states, according to these calculations, some had less sprawl than others. Oregon, whose urbanized land increased 31% while its urban population increased at 38%, showed that it sprawled at a slower rate. Colorado and Arizona also increased urban population at a greater rate than they increased urbanized land. Washington, another SGMP state, shows that their increase in urban land was greater at 47% than their change in urban population at 43%. California also had greater increases of urbanization of land than urban population.

For the states without state growth management regulations, there was a great deal of variation. New Mexico had a greater percentage increase in urbanization of land at 63% in comparison to its urban population increase of 33%. Montana and Wyoming also increased urbanization of land at a greater rate than urban population. Nevada had increases in urbanization of land at a rate of 110%, while they increased population at a significantly greater rate of 151%.

The average for the 11 western states shows a slightly greater increase in population than in urbanized land with 50% and 52% respectively. The average of states with state growth management regulations shows that urban population increased at 49%, while the urbanization of land increased at a slower rate of 47%. The average of states without growth management regulations shows that the urbanization of land increased at a slightly slower rate of 53% than did urban population change at 54%. When comparing the SGMP states to the non-SGMP states, there is only a slight difference in urbanization of land and urban population changes. However slight, growth-managed states as a group experienced lesser density than the states without growth regulation.

Results (II)

The results of the regression analysis, shown in Table 4, show that the overall model is relatively weak with an adjusted r-square of .290, indicating that 71% of the predictors of sprawl as defined in this study are missing from the model. There were, however, some statistically significant findings. Four of the variables, the SGMP dummy variable, the percentage change of median household income from 1990 to 2010, the percentage change of the unemployment rate from 1990 to 2006, and Agricultural Conservation Zoning experienced statistical significance.

Table 4. Ordinary Least-Squares Regression Estimates of the Predictors of Sprawl

Independent Variables	Standardized Coefficient	T-Value	Sig.
SGMP index score	-.082	-0.732	.233
SGMP dummy variable	-.246	-1.811	.037
Percentage change of median household income 1990-2010	.203	2.221	.015
Number of jurisdictions per 1,000 persons in 2007	-.033	-0.373	.355
Percentage change in unemployment rate 1990-2006	.403	4.196	.000
Percentage change in unemployment rate 2006-2010	.149	1.497	.069
Percentage change of median house valued 1990-2007	.079	0.808	.211
Percentage Change of Annual Farm Revenues 1987-2002	.008	0.090	.464
Agricultural Conservation Districts	.072	0.731	.233
Agricultural Conservation Zoning	.305	2.636	.005
r-square	.351		
adjusted r-square	.290		
N	118		
r	.593		

While the scoring index of SGMPs was found to be statistically insignificant, as was running it as a logarithm, running the model with only the SGMP dummy variable was found to be advantageous with a t-value of -1.811. As the direction of the relationship between the presence of a SGMP and sprawl is easily predicted to be negative, it is only necessary to use a 1-tail test where significance is found at -1.645.

The t-value of 2.221 of the percentage change of median household income from 1990 to 2010 performed as expected, showing a positive relationship between household income and sprawl. With a one unit increase in sprawl, the median household income would expect to rise by .203. The t-value of 4.196 for the percentage change in the unemployment rate from 1990 to 2006 shows a positive relationship as well, indicating that as sprawl increased by one unit, the unemployment rate increases by .403. Also experiencing statistical significance is agricultural conservation zoning with a t-value of 2.636.

Discussion

A common objective of state growth management programs is to reduce urban sprawl by coordinating the planning activities of local governments in a way that creates greater regulatory consistency across metropolitan areas (Carruther, 2002). Controlling urban sprawl is a prerequisite for realizing some of the other potential benefits of growth regulations, such as cost efficiencies in the provision of public goods and services, making transit options viable, reducing commuting trip lengths, and decreasing urban energy consumption and air pollution levels (Anthony, 2004).

This research has found that the mere presence of a state growth management plan reduces urban sprawl as defined by the parameters of the study. While SGMPs vary in consistencies and styles, and Yin & Sun found statistical significance using a scoring system of these consistencies and styles, I found that scoring them as Yin & Sun had done was not advantageous and did not produce statistical significance. It is further noted that the SGMP

group of states and the non-SGMP group of states both have varying degrees of growth and urbanization as was discussed earlier. It is clear that there is no uniform result since there are so many variations to how these programs are implemented. There are many factors that can have an effect on growth such as the presence of physical characteristics to the political landscape found in the region.

The other factors that obtained statistical significance on having an effect on sprawl, such as unemployment and median household incomes, show that factors other than growth management regulations can have a significant effect on sprawl as would be expected. While the presence of a SGMP in a state has an effect on sprawl, the other factors can potentially have a greater impact than the regulation, as economic factors are powerful variables.

Although the number of jurisdictions present in a county did not return any statistically significant results, it has been found by other researchers to have a significant effect on the proliferation of sprawl. Carruthers found, through the use of a series of econometrics models, that fragmentation and a host of other factors play a role in shaping the spatial distribution of population growth in American cities (2002). Additionally, he found that municipal fragmentation exerts a significant outward push that grows more powerful with distance from the urban core. He further asserts that infrastructure planning can be used to regulate the location and timing of new development. Yin & Sun obtained statistical significance for this variable and argued that highly fragmented governance causes more intensive competitions among jurisdictions (2007).

Conclusion

This research presents one of the first empirical evaluations of the effects of state growth management regulations on urban sprawl that focuses only on the western states. It also brings the literature up-to-date by assessing the period of 1990 through 2010. Several recent additions to the state growth management family have been assessed as well, making this an integral part of the literature regarding state growth management regulations. The findings show that states with SGMPs have, in general, experienced a lesser density decline between 1987 and 2007 than states without SGMPs in the study. While SGMPs were not found to be statistically significant using a scoring system, the mere presence of an SGMP was found to be statistically significant, resulting in a reduction of the proliferation of sprawl in states that have them.

Western states in this study could use this information as a basis for implementing planning requirements that are regulated by the state in a variety of ways, as is evident in the different SGMPs in the study and in previous literature. The conclusions of this study have confirmed results of past studies that show that state growth management programs slow urban sprawl. There is abundant literature that shows what works best in the states that currently have SGMPs in place. While each state has the power to decide what types of consistencies to include that might fit their political climate and circumstances best, it is recommended that these states considering the adoption of a SGMP look to the literature to assess the best options for their state.

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