



A geographic information system fiscal analysis of development patterns in Bozeman, Montana
by B Stewart Mitchell, Jr

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in
Earth Sciences

Montana State University

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Abstract:

Rapid population growth in and around Bozeman, Montana is creating sprawl. The community is struggling to manage the rising cost associated with sprawl and preserve the traditional quality of life. This thesis addresses the question of whether it is possible to accommodate the growth in a less costly manner and preserve the qualities that make the Gallatin Valley a desirable to place to live. Current planning practices' and zoning regulations permit only sprawl style development. However, new urbanism development patterns offer cost savings over sprawl. This thesis uses a geographic information system and a fiscal model to compare and contrast a sprawl development and a new urbanist development in Bozeman, Montana. The results demonstrate the new urbanist development generates more tax revenue and has a lower cost of services than the sprawl development.

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APPROVAL

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This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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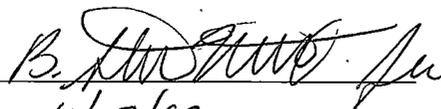
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ABSTRACT

Rapid population growth in and around Bozeman, Montana is creating sprawl. The community is struggling to manage the rising cost associated with sprawl and preserve the traditional quality of life. This thesis addresses the question of whether it is possible to accommodate the growth in a less costly manner and preserve the qualities that make the Gallatin Valley a desirable place to live. Current planning practices and zoning regulations permit only sprawl style development. However, new urbanism development patterns offer cost savings over sprawl. This thesis uses a geographic information system and a fiscal model to compare and contrast a sprawl development and a new urbanist development in Bozeman, Montana. The results demonstrate the new urbanist development generates more tax revenue and has a lower cost of services than the sprawl development.

Preamble

It was a warm spring day and I was riding in my father's car with my 10 year old eyes. I watched the endless rows of houses and stores scroll through the frame of my window. I asked my father, "How big is our town?" my father replied, "Its getting bigger every day. When I was a boy this whole area was nothing but farms and fields." I always enjoyed watching the "landscape movie" play through a car window. Every time I return to my childhood home and travel a familiar route, I am treated to a sequel, and just like a Hollywood sequel, it gets worse with every repetition. The forests and fields I loved as a child are now covered with subdivisions and mini malls. I have often wondered, if this never ending consumption is the best use of our land resources.

INTRODUCTION

The dominant pattern of land use that spreads out from most American population centers, converting farms and fields to homes and malls, is known as urban sprawl. Sprawl is low density, unplanned, inefficient, auto dependent growth (Burchell, 1997). Sprawl is the landscape signature of the American dream.

Until recently, such low density development was unquestionably accepted as progress in this country. Now, in the post modern era, some are beginning to question the merits of this type of expansion and realize this type of low density development has produced unanticipated consequences.

The drivers and consequences of sprawl represent a complex web of connections between socioeconomic factors and the landscape. The drivers of sprawl include population growth, land use conversion and zoning. Large scale land use conversion at low densities resulting from urban sprawl has been associated with low quality of life, rising tax burdens and increasing pollution (Gordon and Richardson, 1997). Moreover the sense of place is lost when the landscape becomes so homogenized, that one place becomes undistinguishable from another (Kunstler, 1993). These consequences are compounded in regions with little planning and rapid population growth. One of the most significant problems associated with urban sprawl is the cost of providing and maintaining municipal services to new low density development.

In the last ten years, there has been a growing wave of “Smart Growth” initiatives across the country (Morris, Feb. 1999). The main goal of these initiatives is to create a landscape that is less costly to the public and individuals from an economic and lifestyle perspective. Smart growth achieves these goals by encouraging or mandating land use development in a more efficient and compact pattern.

This study will quantify the costs of providing municipal services to a sprawl style development and contrast these results to the financial costs related to an alternative land use pattern known as new urbanism. New urbanism is associated with Smart Growth. The comparison of these development patterns will be conducted through the use of a Geographic Information System (GIS) model. The model results will test the hypothesis that higher density development with mixed zoning has economic benefits over low density sprawl development.

Urban sprawl, new urbanism, smart growth and land use are terms that have varying definitions in public and academic contexts. For clarity, the following definitions will be used in this thesis.

Definitions

Land use refers to how humans interact with, change and use the natural landscape of a region for various economic functions (Platt, 1996). **Land use** types are used by the United States Geological Survey (USGS) to distinguish specific types and subsets of specific land uses such as, agricultural, commercial, urban or

residential. **Subdivision** refers to the division of a tract or parcel of land into two or more lots or parcels (Kelly and Becker, 2000). **Urban sprawl** or simply **sprawl** is the unlimited outward expansion from population centers of low density, segregated, auto dependent, commercial and residential land uses (Jackson, 1987). This type of land use usually follows a path of least resistance along existing roads (Lewis, 1999).

Leap Frog development is a term used to describe sprawl development that occurs beyond the edge of existing developed land uses (Vermont Forum on Sprawl, 1999).

Smart growth is an all encompassing term that is frequently used to describe a type of land use development that seeks to decrease the negative impacts of commercial and residential land use development through higher densities, less dependence on the automobile and mixed zoning types (O'Neil, 1998). **New urbanism** is depicted as an area where homes are closer together and closer to the street, walking is made easy by attractive pathways connecting homes to shopping and community services, street systems are interconnected to reduce traffic congestion, forms and scales are comfortable and comparable and open spaces of many kinds are readily accessible (Porter, 1997).

Table 1: General characteristics of residential sprawl and new urbanist developments.

Sprawl	New Urbanist
Based on a Grid	Based on a Grid
Single type of residential land use	Mixed types of residential and commercial
Low dwelling units per acre	High dwelling units per acre

The first chapter will set the general context for the local and national landscape from the perspective of land use issues and will introduce the development patterns that will be compared by the model. The second chapter provides a detailed explanation of the software used to model the differences between the development patterns. Chapter 3 outlines the data compilation methods for the project. Chapter 4 explains the methodology used in the study. Chapter 5 will present the results of model. Chapter 6 discusses all findings and suggests areas for further research. The conclusion will be stated in the final chapter.

CHAPTER 1

GENERAL CONTEXT OF THE THESIS

The objective of this thesis is to compare the cost of providing specific municipal services and to determine the amount of tax revenue generated by two distinct land use development patterns using a GIS model. The model will compare a sprawl and new urbanist development with an equal spatial footprint. The specific aspects of these developments to be compared by the model include: the cost of municipal services, tax revenue generated, spatial properties and amount of projected future land use conversion with each development pattern.

The comparison of land use development patterns on the landscape presents a very complex task. Various large scale elements of land use must be introduced for the small scale analysis of different development patterns to be understood. The large scale elements affecting land use include population growth, specific types of land use conversion, planning and socio-economic conditions.

Population Growth

In the United States there are 3148 counties of which 838 experienced a population growth rate between 14% - 156% percent between 1990 through 1999 (ArcView® /Census, 1999). Two hundred and eleven of these counties are located in

the Rocky Mountain states: Arizona, Colorado, Idaho, Montana, New Mexico, Utah and Wyoming (ArcView® /Census, 1999). The average population growth rate of these 211 counties was 26 percent. In Montana, 17 counties grew by 14 % or more during the same period.

The population of Gallatin County expanded by 26% between 1990 and 1999 (Montana Department of Commerce, 2000). The latest wave of growth is the result of a uniquely motivated surge of immigration from other national regions (Jobes, et. al., 1992). Significantly, this migration was not motivated by economic opportunity, the historical norm in previous waves of western settlement (Jobes, et. al., 1992). Rather, the primary motivation of these new migrants was the perceived quality of life, sense of community and access to resource amenities that provide a wide array of recreational opportunities (Jobes, et. al., 1992).

From the late 1940s through the 1980s, Bozeman, the largest town in Gallatin County, grew at a relatively constant rate and retained a compact development pattern. The town's main socio-economic structure was based largely on agriculture, the retail sectors and government entities (Rasker, et.al., 1991).

Population growth in Gallatin county provides a driving factor creating shifts in land use conversion and increasing demand for public services.

Land Use Conversion

According to a recent study only 2.7% of the total area of the continental United States is urban (Imhoff, et. al. 1999). This figure suggests that a benign amount of land has been converted to urban land use. However, this study and others have found that residential, commercial, and industrial land use development has occurred on the most productive agricultural lands (Imhoff, et. al. 1999). This phenomenon is largely a result of America's agrarian heritage. Population centers historically developed in rich agricultural areas. Consequently, increasingly large tracks of land are being converted from agriculture to commercial and residential uses as urban areas continue to grow at low densities. This process is known as sprawl. The Rocky Mountain region is experiencing a new wave of land development driven by the expansion in the service, recreational, and information sectors. (Riebsame, et.a.l., 1996). As the population of Gallatin Country grows the amount of land converted from agricultural to commercial and residential land use steadily increases.

Sprawl is becoming an increasingly prevalent topic across the country. The loss of open spaces and climbing costs associated with such development have brought this issue to the forefront of public policy debate (Morris, Feb. 1999). The geographic area affected by urban sprawl can be identified as most areas surrounding established population clusters that have been, or are currently experiencing increases in land use development (American Farmland Trust, 1995).

Between 1970 and 1990, there was a 6% - 12% increase in land consumption for every 1% gain in population in metropolitan areas (American Farmland Trust, 1999). In Chicago, in the same period, the population grew by 4% while the land area devoted to urban uses increased by 46% (American Farmland Trust, 1999). These numbers support the observation that land use conversion is occurring at relatively low residential and commercial densities. In Gallatin County and western Montana more people are moving to rural areas than to incorporated areas such as cities (Johnson 1998).

Basic economic forces also encourage this type of land use conversion. Land sold for commercial and residential development has a higher value than equivalent parcels designated for agricultural use (Platt, 1996). Limiting the amount of land for this development conversion eliminates the potential for capital gain by individuals (Platt, 1996). Low density development assists in the perpetuation of land use conversion by ensuring the demand for commercial land development is higher than if land use development is done at higher densities (Platt, 1996).

Another factor driving the shift in land use patterns since WWII is the automobile (Platt, 1996). The post WWII development patterns are characterized by the improvement and extension of roads, setting stores further back from roads to allow for store front parking and homogeneous development occurring along connecting road corridors (Platt, 1996). The Highway Act of 1956 increased the spread of low density development by making previously distant land accessible to large population centers (Audriac et al, 1990).

For the last 50 years, the automobile has been an undisputed feature of American life, however many are beginning to question its real benefits (1000 Friends of Oregon, 1996). There are more automobiles on American roads than ever before and people are spending more time in their automobiles (Davis and Seskin, 1997). Although the automobile can be a great convenience and has made significant contributions to the development of our culture, it is now apparent that this contribution has come with hidden costs. These costs include pollution, cost of constructing and maintaining roadways, and individual operating costs (Bartholomew, 1993). The automobile has also been accused of decreasing the quality of life experienced by many Americans (Davis and Seskin, 1997). The time spent in an automobile reaching frequently needed services is lost to more productive uses. From 1970-1990, the U.S. Population grew by 22.5% and the number of vehicle miles traveled grew 98% (American Farmland Trust, 1999). The proliferation of the automobile has increased the amount of land use development and significantly reduced its overall density (Handy, 1992). Prior to large scale use of the automobile, population centers were designed around the distance one could walk, rather than drive.

It is important to note that an array of other factors have also contributed to the contemporary landscape. Low cost mortgage programs created under the Federal Housing Act made home ownership possible to many who could not otherwise afford to buy a home (Gerckens, 1994).

Montana and other rural areas in the Rocky Mountain region have not experienced the same high levels of low density land use conversion that occurred in the rest of the country since the 1950s due to the region's long distances to major metropolitan centers. Much of the low density land use development in this region has occurred in the last 15 years. An isoline map of well density by date in the Gallatin Valley shows developments have sprung up far from existing population clusters in the greater Bozeman area in the last 13 years (Figure 1). Low transportation costs afforded by the automobile make this type of development possible. The map depicts densities of well permits for residential use in ten year increments from 1977 through 1997. On the map there are several residential developments that appeared in the last decade in areas with little or no previous residential development.

Planning

A major influence on land use patterns that has functioned in concert with the automobile is single land use zoning (Canter, 1985). It is also known as Euclidean zoning from the precedent setting case of *Euclid vs. Amber Realty* in 1926 that upheld the validity of New York's Zoning Ordinance of 1916 (Woodruff, 1980). Euclidean zoning was introduced in the first half of this century in most large

