Land Value under Growth Control in King County

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Abstract

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As a hot topic in the field of urban planning, whether growth control is an effective planning tool overall and its potential impacts on land value have been discussed by a lot of literature, yet many of the studies reached quite different conclusions. The purpose of this thesis is to assess the price effect of the urban growth boundary by examining whether land values inside and outside the urban growth boundary in King County showed different trends after the presence of UGB. Using a time series pretest-posttest design, a multiple regression model is built, in which dummy variables are used to represent years before and after the adoption of UGB. The model uses all the valid vacant residential land transactions which took place over a twenty-year period in King County. Controlling for other variables representing the physical attributes and locational factors of the parcels, the findings indicate that land values inside the urban growth boundary in King

County increased at a higher rate than those outside the boundary after the UGB was drawn, suggesting a price effect from the UGB in King County. Policy makers are recommended to pay close attention to the trends of land prices inside and outside the boundary in order to take prompt measures when signs of major divergence appear.

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Introduction

In the 1960s, an increasing public concern over rising population growth and suburban sprawl accompanied by serious environmental issues spread over many states of US. First introduced by Hawaii in 1961 and Oregon in 1973, later followed with Delaware, Florida, Maryland, New Jersey and Washington State adopting similar programs in the 1980s and 1990s, a movement which is sometimes referred as the “Growth Management Revolution” (Lloyd, 2008) has changed the landscape of modern urban planning.

However, various questions have been raised regarding the effects of growth control policies in addition to their original goals. One of the controversies is that growth control may contribute to the inflation of land value in areas under control. Land value changes have important economic implications for several reasons:

- Land is necessary for all kinds of economic activities. Price fluctuations of land in different uses have fundamental impacts on human life.

- Market competition compels urban land to be used for its most productive purpose, therefore land value changes may alter the distribution of land uses to allow for the use with the highest bid at a given location.

- Land/housing costs comprise the largest expenditure for average households. The inflation or deflation of land value may cause severe changes in one's personal wealth and housing affordability. Continued increases in land value may contribute to economic inequity and intensify the widening gap between rich and poor.

- Land value taxation is considered as an important revenue source. Most government services are supplied by local governments, which relied heavily on property taxes.

As a hot topic in the field of urban planning, whether growth control is an effective planning tool overall and its potential impacts on land value have been discussed by a lot of literature, yet many of the studies reached quite different conclusions. Although a few researchers have sought to analyze growth control by building mathematical models and other assessing measures, so far little quantitative evidence succeeds in proving the validity of this planning tool.

This research provides knowledge in land value changes in King County over the 1980s and 1990s, and enhances our understanding of the role the urban growth boundary played in land value changes. It also contributes to related literature, where despite considerable interest in the effect of growth control on property values, few studies examined quantitatively the economic influence of it in a time series manner.

The research takes advantage of a time series pretest-posttest model, building on historical data available on land attributes and sales prices to examine the question. The data used covers the entire King County, including more than ten thousand parcels. GIS techniques have also been used to locate the parcels inside and outside the UGB and to calculate the distances of them to downtown. The findings of the thesis can provide a reference for other research to further investigate why UGBs have such an influence, and help urban planners and decision makers to be aware of the potential risks in adopting similar policies.

This thesis addresses the following research question: did land values inside and outside the urban growth boundary in King County show different trends after the presence of UGB?

Previous studies have already documented that physical characteristics and the external environment are important factors affecting land values. Gerrit J.Knaap (1985) pointed out that land use policies based on conventional economic theory influence the allocation of land must affect land values. In terms of physical restrictions on land use, urban growth boundary no doubt is a representative means among different regulations of the GMA. Hence this study focuses on the relationship between land value in King County and its urban growth boundary.

By examining the effects of growth boundary on land values in King County, the thesis is aimed to provide information to city planners and real estate professionals concerning the role growth control plays in land value changes in recent decades, and whether growth management acts as an efficient regulation in terms of urban land economics.

This thesis consists of five chapters. Chapter One reviews the relevant literature for the study; Chapter Two introduces the context of growth control in King County; Chapter Three and Four explains the methodology and data used in the analysis; the study is ended with the result analysis and conclusion in Chapter Five and Six.

Chapter 1 Literature Review

With the increasing concerns on the influence of land use regulations, researchers have been seeking to evaluate the price effect of growth controls. Numerous studies have been conducted regarding the price effects of UGB and other growth control instruments on housing price and housing affordability, yet less discussion has been focused on the subject of land value. This review is limited to the relationship between growth control and land value. Three parts will be included in this section: 1. urban growth boundary; 2. growth control and land value; 3. possible explanations.

Urban Growth Boundary

UGBs exist in many states and areas today as a major land use planning instrument for controlling urban growth and sprawl. Different from traditional land use regulations, it adds the dimension of timing, specifying that only land inside the UGB can be converted to urban use before a certain date while land outside the UGB is mostly open for nonurban use until the same specified date (Gleeson, 1979; Knaap, 1985). In Washington State, the Revised Code of Washington (RCW) provides the following definition and provisions of Urban Growth Areas under RCW 36.70a.110:

> Each county that is required or chooses to plan under RCW 36.70A.040 shall

> designate an urban growth area or areas within which urban growth shall be encouraged and outside of which growth can occur only if it is not urban in nature. Each city that is located in such a county shall be included within an urban growth area.

How urban growth boundaries should be rationally drawn has remained a major controversy. UGBs are typically established to contain urban developments for a period of 10 to 20 years (Nelson and Duncan, 1995). Yet, so far, there is no confirmatory conclusions reached on questions of how much developable land should be contained within a UGB and when the UGB should expand and by how much (Knaap and Hopkins, 2001). This may have important weight in the price effect that UGB brings on land value.

In Washington State, the RCW 36.70a.110 provides the legal principle in setting the UGB:

> Based upon the growth management population projection made for the county by the office of financial management, the county and each city within the county shall include areas and densities sufficient to permit the urban growth that is projected to occur in the county or city for the succeeding twenty-year period, except for those urban growth areas contained totally within a national historical reserve. As part of this planning process, each city within the county

> must include areas sufficient to accommodate the broad range of needs and uses that will accompany the projected urban growth including, as appropriate, medical, governmental, institutional, commercial, service, retail, and other nonresidential uses……

Growth Control and Land Value

It has long been found that land use controls such as zoning, which specify allowable uses, density, and lot size, influence land value (Gleeson, 1979; Grieson and White, 1981; Vaillancourt and Monty, 1985). In terms of growth control by means of UGBs, previous findings in general indicate that divergence of land value was found after growth control was implemented, yet mixed results were given regarding the land value changes inside and outside UGBs.

Gleeson (1979) proposed that by segmenting the land market into a developable and an undevelopable portion, which is expected not be developed for some time, the growth management system leads to a divergence in land prices between the two portions. Using a stratified random sample drawn from unimproved, subdivided parcels of land in Brooklyn Park, Minnesota in 1972 (the boundary was drawn in 1963), Gleeson examined the effect of segmenting on market land value per acre, meanwhile controlling for other determinants including travel time, parcel size, soil type, storm sewer, water system, etc. The findings indicate that more than two-thirds of the difference in value between the developable and undevelopable portions of land can be attributed to the segmenting of land. However, it was noted in the study that the finding only holds for larger parcels which are subject to growth control, while smaller parcels that are not subject to the control show no statistical difference. For the explanation of the land value divergence, the author stressed that since adequate developable land had been available, the land values increase in Brooklyn Park was not due to supply restriction, but related to the allowed use of land.

In a study examining the effects of UGBs on vacant land value in Portland, Oregon, Knaap (1985) proposed that according to conventional economic theory, land use policies that influence land use allocation must affect land value. To determine whether there is a price effect by the UGB, hedonic price estimation was established. The estimation used cross-sectional data of all the vacant residential land transactions recorded in 1980 (four years after the UGB was originally drawn) in Washington County and Clackamas County of Portland. In addition to the UGB dummy variable, a variable for the Intermediate Growth Boundary (IGB)[1] was also introduced. The findings demonstrated that the UGBs had a significant influence on land values in both counties. Nonurban land values were shown divergent at the UGB (nonurban land values are higher inside the UGB than outside the UGB), and urban land values could not be shown divergent at the IGB; meanwhile there proved to be a different effect of IGB on urban and

[1] The Intermediate Growth Boundary (IGB) identifies properties lying in areas designated as future urban or specially regulated. Properties outside the IGB cannot currently be developed at urban densities, but will presumably convert to urban use before properties outside the UGB.

nonurban land values. With respect to allocative impacts, the observed price divergence in nonurban land values suggests that UGBs are not redundant instruments. The research suggested that UBGs in Oregon do not restrict land supply but traditional zoning does; the high nonurban land values inside UGBs reflect expectations of future urban zoning, thus the UGBs affect land value via the timing of conversion of land uses.

Based on previous empirical literature on the effects of growth controls, Brueckner (1990) indicated that evidence to date conclusively establishes that growth control raises housing prices within areas where they are imposed. In his study on growth controls and land value in an open city, a dynamic open-city model with the presence of negative population externality[2] was built focusing on the land development decision of a landowner in a dynamic open-city environment. He indicated that by reducing negative population externalities, the growth control raises land value by improving the city’s quality of life.

Ihlanfeldt (2007) investigated the effects of land use regulation restrictiveness on house and vacant land prices. The index of restrictiveness, which is measured by summing up the number of individual land use management techniques used by the jurisdiction, is assigned as an endogenous variable instead of an exogenous variable as in other studies. Based on thousands

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[2] Brueckner noted in his work that a large population lowers the city's quality of life and reduces the rent that urban land command.

of vacant residential land transactions for the years 2000-2002[3] from 112 Florida cities located in 25 counties, a cross-sectional regression model was built. Natural log of price per acre is assigned as a dependent variable. Independent variables include lot size, distance to CBD, distance to coast, sale year, jurisdictional controls variables and some socio-demographic variables derived from 2000 census data. The results showed that the restrictiveness reduces land price per acre by 14%. However, given that the urban growth boundary is a component of the land use restriction measures for the restrictive index, this study can only provide some reference regarding the growth management overall.

Furthermore, some studies indicate that the imposition of growth controls delays or prohibits eventual development, which lowers the value of undeveloped land near the area under control (Gleeson, 1979; Vaillancourt and Monty, 1985; Nelson, 1988). However, building on the framework of Capozza and Helsley (1989), Brueckner (1990) obtained different results. His open city model showed evidence that the impact of the growth control on the value of undeveloped land may have a complex spatial pattern. The land value may rise near the boundary when the control is imposed, fall farther from the boundary and rise again at still more distant locations. The results showed that the control's impact on the value of undeveloped land depends on whether a city imposes a very mild or instead a stringent growth control. In the former situation, the value of all undeveloped land rises. Yet in the case of a stringent and continuous control, the

[3] Florida counties adopted growth control in 1985, indicating the author took a posttest design.

value of undeveloped land near the growth boundary rises, and more remote land may rise in value as well.

Similar evidence regarding the stringency of growth control also exists in the above mentioned work of Knaap's (1985). The results indicated that in Washington County, Portland where the growth control were strictly enforced, nonurban land values were shown divergent at growth boundaries, while in Clackamas County where the growth control inside the UGB were weakly enforced, nonurban land values could not be shown divergent at the boundary, and there is no effect shown from the IGB.

Possible Explanations

Various explanations have been proposed for study areas with different situations. Commonly proposed explanations for the price effect of UGB include that it may restrict the supply of developable land by allocating insufficient land for urban uses (Staley, Edgens, and Mildner, 1999; Knaap and D.Hopkins, 2001); the growth controls restrict the supply by requiring higher development standards and better neighborhood environment inside the UGB despite the population pressure, therefore leading to excess demand (Brueckner, 1990); growth controls allow for limited uses outside the boundary, thus lowering the value of undeveloped land under control (Gleeson, 1979).

The inconsistency in the results of the growth control's effect on land value can be attributed to numerous methodological problems (Ihlanfeldt, 2007). For example, Brueckner (1990) proposed that the mixed results for land value outside UGBs could be due to the difficulty in picking up the land value gains near the boundary empirically, especially if it's constrained by the form of estimating equation, or that actual controls are discontinuous, in which case all undeveloped land may fall in value. Whether the studies use aggregate data (citywide average or median values) to compare the controlled areas with non-controlled areas, or they use individual data may also influence the accuracy of the results (Schwartz and Zorn, 1988). As mentioned above, different stringency of growth controls can lead to different research results. Finally, different research designs can produce large differences in the magnitudes of estimated effects, thus leading to mixed results (Schwartz and Zorn, 1988).

Chapter 2 Growth Control in King County, WA

2.1 Regional Context

As Tim Trohimovich (2001) noted, the 1990s were a time of rapid change in Washington State, and for the first time Washington State grew by a million people in a ten-year period. In the 1990s Washington became the tenth fastest growing state in percentage terms and the seventh fastest growing state in absolute terms. The rapid population growth caused problems such as increasing urban density, traffic congestion, pollution, suburban sprawl, and loss of open space natural resources, threatening the overall quality of life in the State. At that time, however, cities and counties lacked tools and policies to cope with rapid growth. Prevailing planning tools, such as standard zoning requirements and project-level environmental review focused primarily on the compatibility of proposed land uses and improvements with those of neighboring sites, largely ignoring the broader regional impacts of development (Lloyd, 2008).

In response to voter anger, the state Legislature passed the Growth Management Act in 1990 (with major additions in 1991). The Act directed the state's large and fast-growing counties and the cities within those counties to agree on countywide planning policies and to prepare comprehensive plans that would guide growth and development and regulate land uses in their respective jurisdictions (Oldham, 2006).

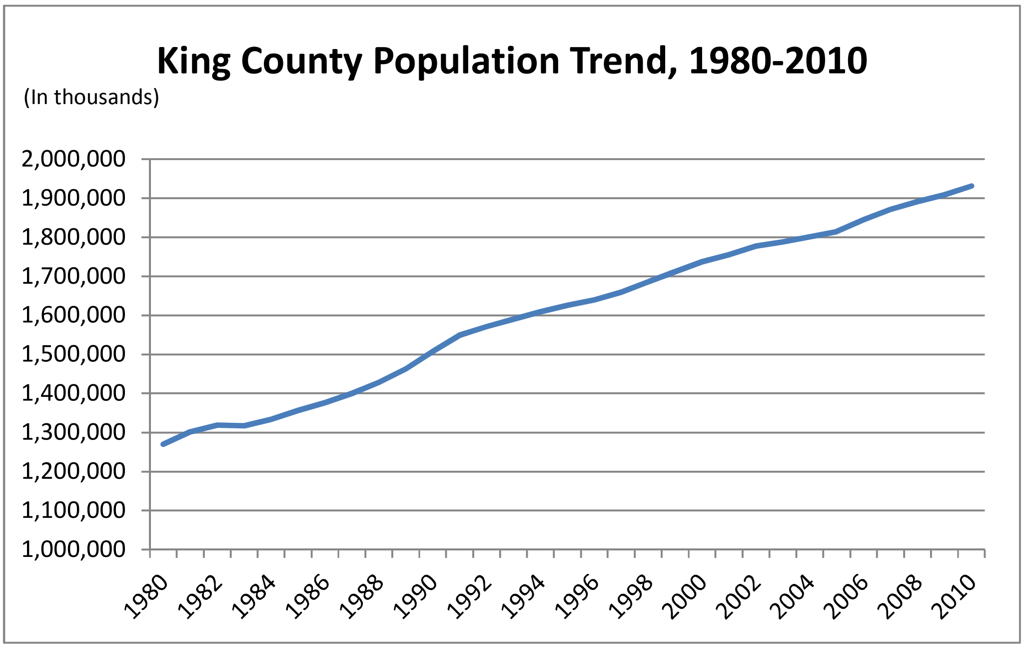
King County is bounded by Puget Sound to the west and the Cascade Range to the east, within the State of Washington. It borders Snohomish County to the north and Pierce County to the south. The western county is characterized by cities while the development pattern gradually gives way to suburban developments, rural residential lands, then farms and forestlands to the east ("Environment," 2013). The eastern half of King County is mountainous, with a majority of the area undevelopable; the western half is flat but split by a good number of water bodies. The physical geography of the county may constrain the supply of land developable.

As the most populous county with the county seat as Seattle, the largest city in the State, King County has been seeing great population growth in the past decades. It ranks 11th in the state in terms of land area and first in the state for population density (Vance-Sherman, 2013).

Table 2-1 King County Geographic Facts

King County	King County	Rank in state
Land area, 2013 (square miles)	2,115.57	11
Persons per square mile, 2013	936.82	1

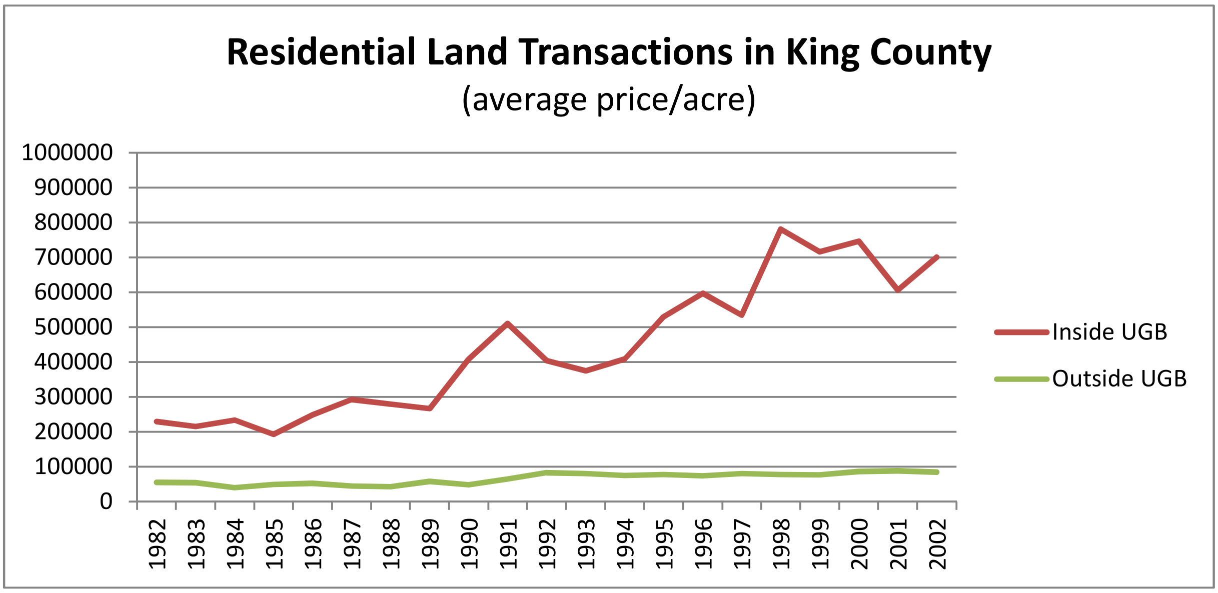
(Source: U.S. Census Bureau QuickFacts)



(*Source: Washington State Office of Financial Management*)

Demand for land increases with the growth of population. As discussed earlier, it was the unchecked growth around 1990s that induced the implementation of growth control in WA. The increasing demand for developable land, which derives from increasing housing demand, could help explain land price inflation over years. Figure 2-1 illustrates the population trends in King County from 1980 to 2010.

Historical data indicates that the average price per acre of residential land inside the UGB in King County kept an upward trend during the period of 1982-2002, while that outside the UGB only had minor increase over the same period. These differences may be attributable to differences in the locations and physical attributes of the land parcels sold, therefore these factors are held constant when estimating the regression model in the following chapters. Figure 2-2 illustrates the population trends in King County.



(Source: King County Department of Assessment)

2.2 The Urban Growth Boundary

In 1992, the King County Council approved an urban-growth boundary by requirement of the Growth Management Act. The boundary separated the western portion of the county and some other already-urbanized areas, where all new "urban growth" will be directed, from the rural eastern portions, where only limited future development will be allowed. Massive disputes went on since the boundary was proposed in 1991. Rural residents and property-rights activists claimed that the boundary limiting rural-development would reduce property values and deny them use of their land, while environmentalists were disappointed that the boundary incorporated some controversial areas they thought should be preserved as non-urban land (Lloyd, 2008). However, the urban boundary set in 1992 remains in place (with minor changes) in 2006 (Oldham, 2006).

The UGA includes all cities within the county, the cities' annexation areas, and land within the unincorporated part of the county characterized by urban-type growth. The King County Comprehensive Plan gives the following description for the Urban Growth Area:

> The Growth Management Act requires the county to designate an Urban Growth Area where most growth and development forecasted for King County will be accommodated. By designating an Urban Growth Area, King County and other

counties in the state will:

Limit sprawling development;

Reduce costs by encouraging concentrated development;

Improve the efficiency of transportation, human services and utilities;

Protect the Rural Area and Resource Lands;

Enhance open space; and

Mitigate the impacts of climate change and adapt its effects.

By requirement of the GMA, the County Comprehensive Plan regulates that the Urban Growth Area designations can accommodate 20 years of population growth. Only minor changes happened before 2006 when the updated Comprehensive Plan was approved.

Chapter 3 Methodology

3.1 Research Methods Introduction

To reduce bias in research and increase accuracy, various research methods are adopted by researchers in their studies evaluating the price effects of regulatory programs for urban growth control. This section describes and compares characteristics of several major research methods for measuring effects of growth management programs, and discusses the reasons why this study uses the pretest-posttest design with quasi-experimental control as the research method.

3.1.1 Research problem

The research problem in measuring the effect of growth control on land or housing prices is the same as in other evaluation studies: how to control for factors other than the growth management program in order to measure the program effect as unbiasedly as possible (Schwartz and Zorn, 1988). A true experiment is impossible, for land or houses can't be selected randomly as a control group and an experimental group because growth controls usually impose on an entire jurisdiction. Given the absence of a true experiment, alternatives for this type of study are a quasiexprimental design with an assigned control group, statistical control (ex. regression model), or a combination of the two (Schwartz and Zorn, 1988).

3.1.2 Research Methods

Quasiexperimental Controls

Seymour I. Schwartz and Peter M. Zorn (1988) made a good summary of the characteristics and weaknesses of the quasiexperimental controls method:

> Quasiexperimental controls rely entirely on the nonrandomly selected com-parison city to control for factors other than the GC program. A pretest-posttest design with a control group is essential for reducing possible sources of bias that would exist with either a posttest-only design or a pretest-posttest comparison using only data from the GC city. The posttest-only design cannot control for differences between the two communities prior to GC, and the effect of these differences would be attributed incorrectly to the GC program. The pretest-posttest design without control group is not able to control for changes over time that are due not to the GC program, but to such factors as regional demand, interest rates, and other economic factors that affect all cities in a region. (p. 494)

Statistical Controls

The approach of statistical control with posttest only is the most widely used method in evaluating the price effects of growth management or other types of land use policies (Wallen, 1993). It inputs in a regression model independent variables of land (housing) attributes with a dummy variable (0 and 1) as the experimental variable for the growth control. The posttest design examines the observations only after growth controls are adopted in a city or communities in comparison with a control group, therefore ingoring the differences between the quasiexperimental and the control groups before the the treatment of the growth control. Compared to the pretest-posttest design, however, it usually has more data sourses available for various land (housing) attributes.

The approach of statitical control with pretest-posttest design advances on the basis of the posttest design. Land or housing prices are regressed on their attributes, including physical characteristics and locational attributes, and a dummy variable representing city and time period, which means separate variables are assigned to observations before and after the implementation of the growth control, and observations in growth control cities (areas) and non-growth control ones, thus controlling statistically for differences between the quasiexperimental and the control groups before the growth control (Cho, 1997).

Based on the discussion above, this thesis uses the pretest-posttest design with control group (land outside the growth boundary) as the research method.

3.2 Methodology

The primary purpose of this thesis is to examine whether presence of UGB affects land value inside the growth boundary. The effects of different types of variables, including the UGB, are measured on land values inside and outside the growth boundary.

3.2.1 Research Design

The association between the adoption of urban growth boundary and land values is analyzed by a linear regression model:

- Land price per acre is modelled as a function of parcel and locational attributes. The data of price per acre is tested not to be perfectly normally distributed and therefore natural log transformation is employed for variables in order to attain the normality of data distribution (Sohn, 2006).

- The time period chosen is from 1982 to 2002, which includes ten years before the implementation of UGB in 1992 and ten years after that.

- Time-series variables are used to represent different years of transactions before and after the adoption of the UGB. Each year of the period in study is assigned 1 and 0 for land inside and outside the UGB respectively. To have a valid number of transactions for each time-series variable in the regression model, three-year periods are combined together assigned as one variable. The variable for land transactions inside the UGB between 1991 and 1993 is treated as the base level. See 4.3 Summary of Variables.

- Property attributes and locational factors are used as independent variables (Figure 1). Detailed variable descriptions will be presented in the Data section.

- To exclude the influences of property improvement on the sales prices, only vacant parcel transactions are used in this study to focus on the effects on land value only.

Conceptual Framework

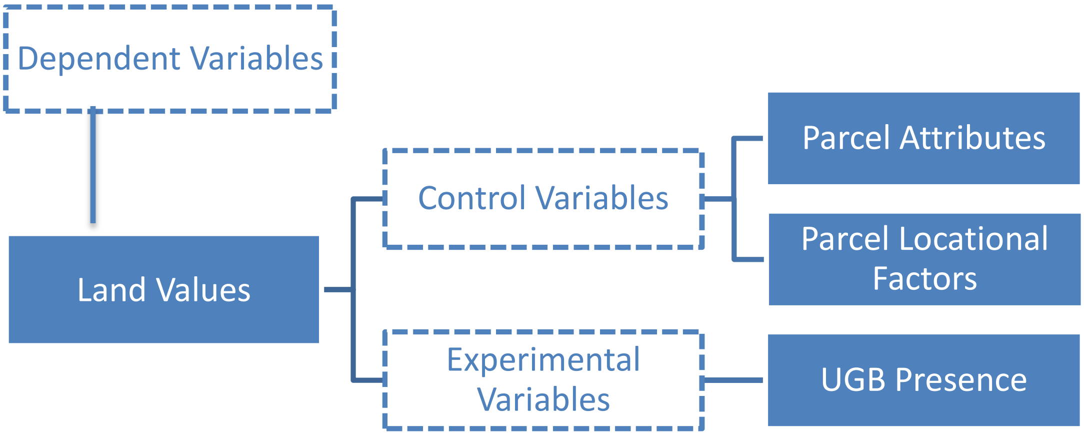


Figure 1 Conceptual Framework of the hedonic regression model

Chapter 4 Data

4.1 Data Source

a) Land transaction data

The land transaction data comes from the property Real Property Sales data set from the King County Department of Assessments. It records all the property sales information dating from 1982 to 2012, including document date, sales price, property type, etc. For the purpose of this study, Major strings and Minor strings in the table are combined to generate the Parcel identifier number (PIN), which is the key attribute used to connect with parcel record data and GIS parcel shape file.

Table 4-1 shows the attributes of the sales database used in this research.

Table 4-1 Attributes of the parcel sales data

Field Name	Format	Description
Major	character	
Minor	character	
Document Date	character	Date of the transaction
Sale Price	number	
Plat Number	character	6-digit string
Property Type	number	The type of property as reported on the Excise Tax affidavit.
Principal Use	number	The primary use of the property as reported on the Excise Tax affidavit.

Sale Instrument	number	The type of document as reported on the Excise Tax affidavit.
Forest Land	character	Indicates whether or not the property was reported on the Excise Tax affidavit as classified or designated forest land.
Current Use Land	character	Indicates whether or not the property was reported on the Excise Tax affidavit as classified current use land.
Non Profit Use	character	Indicates whether or not the property was reported on the Excise Tax affidavit as exempt from property tax as a nonprofit organization.
Historic Property	character	Indicates whether or not the property was reported on the Excise Tax affidavit as receiving special valuation as historic property.
Property Class	number	General classification of properties.
Sale Warning	number	A list of two-character warning codes separated by blanks e.g. 32 15 46

To obtain valid residential parcel transaction data from all the sales records of different property types, the following filters are conducted in the original Excel file:

- Property type filter

  Property Type=1(land only), 91(undeveloped land (land only));

  Principle use=6 (residential);

  Property class=7(Res-Land only)

- Special use filter

  The following filters are conducted to exclude the records of properties in some special uses:

Forest Land=N;

Current Use Land[4]=N;

Non Profit Use=N.

- Sale instrument and sale warning

  Only records with the "sale warning" value in blank are selected. Sale Instrument is filtered to contain Warranty Deed and Statutory Warranty Deed only. Records with Sale Price as "0" are also excluded from the data set.

- Plat

  Whether the parcel was recorded as platted land and subdivided into separate lots may influence the property value, for platted land usually has streets, water and sewer system and other utilities available for use on site, while "unplatted" land tends to be raw land which still needs much preparation before it can be developed. Therefore unplatted parcel before undertaking subdivision may have lower value perceived by market and may treated differently from platted land. In this study only platted parcels are used in the regression model.

4 The Current Use Land on the Excise Tax affidavit refers to current use as open space, farm and agricultural, or timber land.

b) Parcel record data

The parcel record data is also obtained from King County Department of Assessments. It contains a comprehensive set of parcel related attributes, such as lot square footage, property type, physical attributes of the parcel (e.g. access, topography, street surface, etc.) and other miscellaneous information. Since the parcel attributes data used in this study are limited to current situations yet the attributes of the properties may have changed since the time of sale, there could be inaccuracies with the data.

Table 4-2 shows the attributes of the parcel database used in this research.

Field Name	Format	Description
Major	character	
Minor	character	
Property Type	character	C Commercial K Condominium M Coal and Mineral Rights N Mining R Residential T Timber U Undivided Interest X Exempt
Lot Square Footage	number	
Access[5]	number	1 RESTRICTED

[5] Restricted Access: If the subject property has no known legal access or subject access is restricted by topographical features resulting in extremely high costs to correct. Legal Access Undeveloped: if subject property has legal access that is not currently developed. Public Access: if access to subject is via publicly dedicated street.

		2 LEGAL/UNDEVELOPED 3 PRIVATE 4 PUBLIC
Topography[6]	number	1 YES 0 NO
Street Surface	number	1 PAVED 2 GRAVEL 3 DIRT 4 UNDEVELOPED
Restrictive Size / Shape[7]	number	1 YES 0 NO
Easements[8]	number	Y/N
Adjacent Greenbelt	number	Y/N
Water Problems[9]	character	Y/N

- Property Type filter

  Property Type = R (Residential)

- Lot Square Footage

  Lot Square Footage is converted to Acre, which is added in the table as an independent variable.

- Price per Acre

Private Access (base level): if access to subject is via developed private or easement access. Source: King County Department of Assessment.

[6] Code yes if topography severely limits building on or use of the property. Ibid.

[7] Code yes if size/shape severely limits the building on or use of the property. Ibid.

[8] An interest in real property that conveys use, but no ownership, of a portion of an owner's property. This field should be coded Yes when an easement exists in favor of another property and has a negative impact on the subject property. Ibid.

[9] Areas that are frequently saturated by surface water; or other related water problems. Ibid.

A variable representing the sales price per acre is added in the regression model.

- Logged variables

  The data of price per acre is tested not to be perfectly normally distributed. Natural log transformation is employed for variables in order to attain the normality of data distribution (Sohn, 2006). Price per acre, Distance to downtown and Acre are transformed as logged values.

c) GIS Data

1. Urban Growth Areas for King County: As this thesis reviews the following two hypotheses—the adoption of Urban Growth Boundary increases the land value inside the boundary and decreases the land value outside the boundary in King County, the geographical location of the growth boundary is necessary to separate the vacant land transactions that occurred inside and outside the boundary. The shapefile of Urban Growth Areas for King County obtained from the King County GIS Center is used to illustrate the data distribution on the King County map.

2. Parcels: the parcel shapefile obtained from the King County GIS Center represents the tax parcels in King County.

3. Downtown: distances from each parcel (converted into points) to downtown is calculated by the *Points Distance* tool.

4. Area grouping: parcels are regrouped into three categories-- North, South and Center by their locations to account for the general price effects associated with different regions in King County. The North, South and Center groups are determined generally by geography of Seattle, which contains most of the observations inside the UGB in this study.

4.2 Data Selection

Basic data filtering is conducted as described above and the parcel file is joined to property sales data, resulting in a total of 10,538 records. To reduce the different locational influence on land inside and outside the boundary, a buffer of four miles is drawn on each side of the boundary. Parcels located in the buffer are selected and assigned “0” and “1” indicating whether they are located inside or outside the boundary. Excluding several apparent outlier observations, 3,476 observations remain.

Figure 3-1, 3-2 and 3-3 show the distribution of the observations in King County.

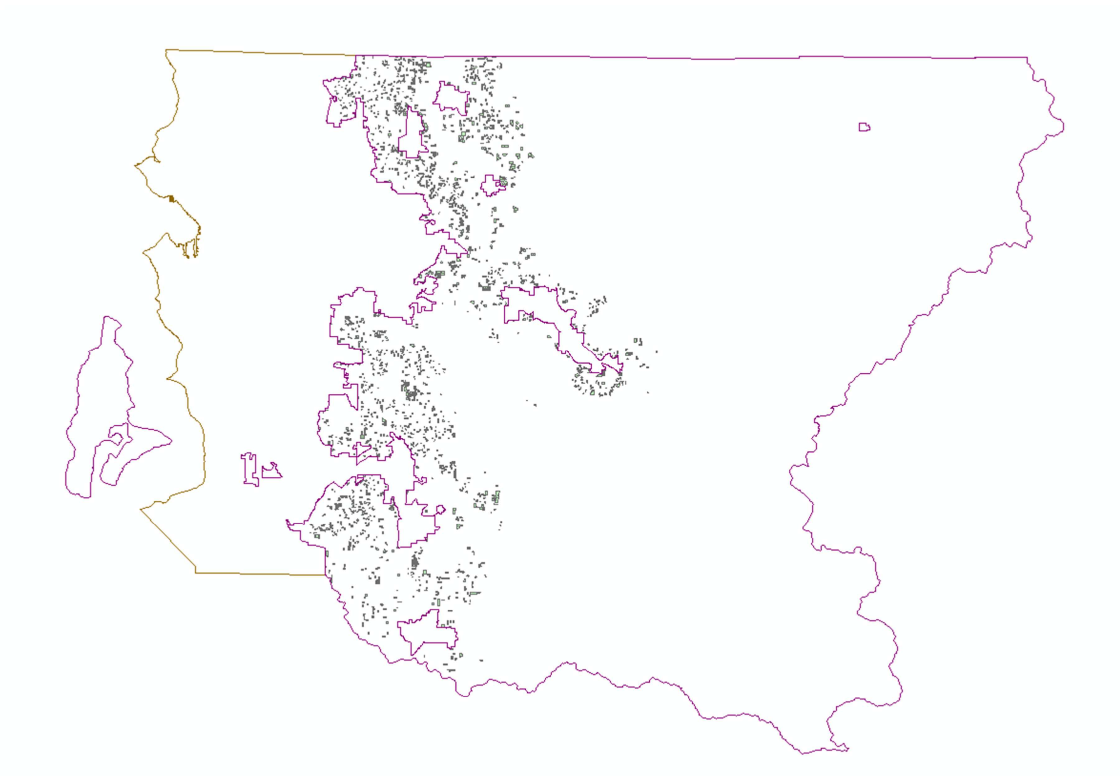


Figure 3-1 Parcels outside the UGB

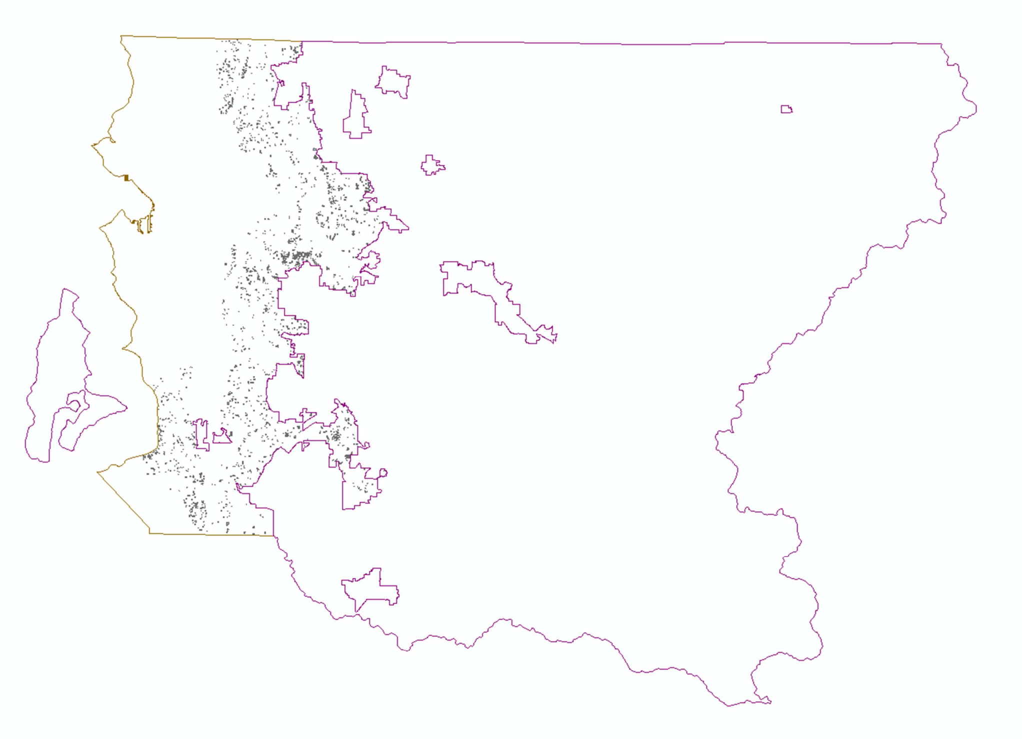


Figure 3-2 Parcels inside the UGB

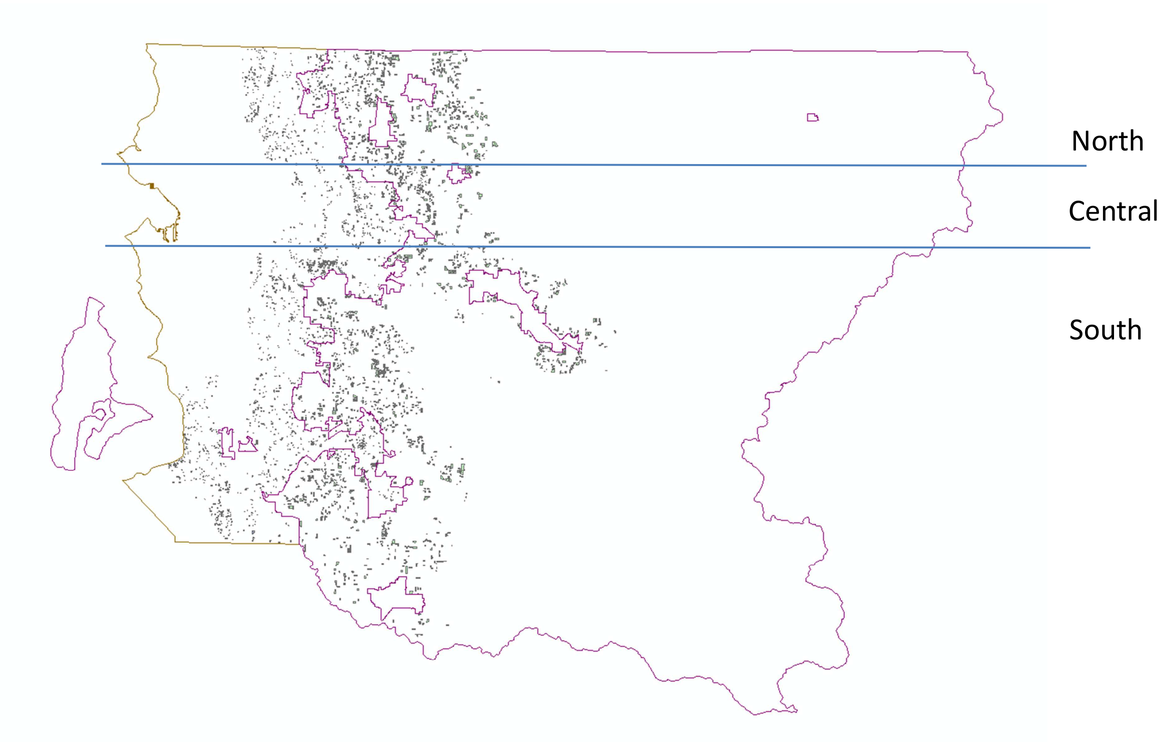


Figure 3-3 Location grouping

4.3 Summary of Variables

Characteristics of the parcel itself are important determinants of land values. The size of the parcel has been found to be negatively related to its value, which means larger parcels would probably be sold at a lower price per acre (Tabors, Shapiro, and Rogers, 1975; Gleeson, 1979). Accessibility of the parcel has long been proved to be a significant factors affecting land value. The distance to downtown of each parcel is included in the model. Other related factors, such as the distance to neighborhood retail stores or the nearest bus stop, are not considered in this model because of unavailable historical data. Physical restrictions in developing a site, such as restrictive site shape, water problem, or topography that severely limits use of the property, also affect the land value. Finally, the amenities and services associated with a parcel can influence how the markets perceive its utility, such as whether it is adjacent to greenbelts, and surface types of the streets around it, therefore impacting its land value.

Table 4-3 Summary of Variables

Variable	**Description**	**Data Source**
Dependent Variable		
Log_Price.acre	Logged price per acre	Real property sales data
Independent Variable		
Acre	Logged parcel size in acre	Real property sales data
Access_restricted	Access categorized as restricted or undeveloped	Parcel record data
Access_public	Access categorized as public	Parcel record data
Topography	Topography defect	Parcel record data

Variable	Description	Data Source
StreetSurface_gravel	Street Surface categorized as gravel	Parcel record data
StreetSurface_undev	Street surface categorized as dirt or undeveloped	Parcel record data
RestrictiveSzShape	Restrictive shape defect	Parcel record data
Adjacent_Greenbelt	Existence of adjacent greenbelt	Parcel record data
Easement	Existence of easement	Parcel record data
WaterProblem	Water problem defect	Parcel record data
Location North	Parcel located in north	GIS data
Location South	Parcel located in south	GIS data
DISTANCE	Distance to downtown, log (feet)	GIS data
time_series1982-84_0	Land transactions 1982-1984; outside the UGB	Real property sales data; GIS data
time_series1982-84_1	Land transactions 1982-1984; inside the UGB	Real property sales data; GIS data
time_series1985-87_0	Land transactions 1985-1987; outside the UGB	Real property sales data; GIS data
time_series1985-87_1	Land transactions 1985-1987; inside the UGB	Real property sales data; GIS data
time_series1988-90_0	Land transactions 1988-1990; outside the UGB	Real property sales data; GIS data
time_series1988-90_1	Land transactions 1988-1990; inside the UGB	Real property sales data; GIS data
time_series1991-93_0	Land transactions 1991-1993; outside the UGB	Real property sales data; GIS data
time_series1994-96_0	Land transactions 1994-1996; outside the UGB	Real property sales data; GIS data
time_series1994-96_1	Land transactions 1994-1996; inside the UGB	Real property sales data; GIS data
time_series1997-99_0	Land transactions 1997-1999; outside the UGB	Real property sales data; GIS data
time_series1997-99_1	Land transactions 1997-1999; inside the UGB	Real property sales data; GIS data
time_series2000-02_0	Land transactions 2000-2002; outside the UGB	Real property sales data; GIS data
time_series2000-02_1	Land transactions 2000-2002; inside the UGB	Real property sales data; GIS data

Chapter 5 Results and Analysis

5.1 Regression Model

The relationship between residential land value in King County and the effects of its urban growth boundary is estimated in the regression model. Logged value of land price is used as the dependent variable. A total of 3,476 observations are used in the model. See Appendix for the summary of descriptive statistics of data.

Time-series Observations		
	Inside UGB	Outside UGB
1982-1990 (before UGB)	138	95
1991-1993	169	42
1994-2002 (after UGB)	2292	740

The regression model results are shown in Table 5-1.

Table 5-1 Model Results

```
Residuals:
     Min       1Q   Median       3Q      Max 
-1.64380 -0.14765 -0.01926  0.13319  1.58518 

Coefficients:
                             Estimate Std. Error t value Pr(>|t|)    
(Intercept)                  8.611134   0.214222  40.197  < 2e-16 ***
log(table8$Acre)            -0.313940   0.007903 -39.723  < 2e-16 ***
table8$Access_restricted    -0.198880   0.061965  -3.210 0.001342 ** 
table8$Access_public         0.053464   0.019662   2.719 0.006578 ** 
table8$Topography           -0.118805   0.016374  -7.256 4.91e-13 ***
```

Table 5-1 Model Results (continued)

```
table8$StreetSurface_gravel -0.173958   0.026765  -6.499 9.22e-11 ***
table8$StreetSurface_undev  -0.206227   0.047724  -4.321 1.60e-05 ***
table8$RestrictiveSzShape   -0.203889   0.041959  -4.859 1.23e-06 ***
table8$Adjacent_Greenbelt    0.221803   0.021004  10.560  < 2e-16 ***
table8$Easement             -0.035835   0.029789  -1.203 0.229077
table8$WaterProblem         -0.301261   0.031212  -9.652  < 2e-16 ***
log(table8$DISTANCE)        -0.320567   0.018894 -16.967  < 2e-16 ***
table8$LocationNorth        -0.033396   0.020908  -1.597 0.110299
table8$LocationSouth        -0.088315   0.018346  -4.814 1.54e-06 ***
table8$year82_84_0          -0.439650   0.053562  -8.208 3.13e-16 ***
table8$year82_84_1          -0.406751   0.045660  -8.908  < 2e-16 ***
table8$year85_87_0          -0.332944   0.067319  -4.946 7.95e-07 ***
table8$year85_87_1          -0.379716   0.055309  -6.865 7.83e-12 ***
table8$year88_90_0          -0.254070   0.083798  -3.032 0.002448 **
table8$year88_90_1          -0.302191   0.077201  -3.914 9.24e-05 ***
table8$year91_93_0          -0.077651   0.058033  -1.338 0.180966
table8$year94_96_0          -0.021936   0.034349  -0.639 0.523123
table8$year94_96_1           0.011277   0.027318   0.413 0.679760
table8$year97_99_0           0.068868   0.033867   2.034 0.042077 *
table8$year97_99_1           0.096569   0.027671   3.490 0.000489 ***
table8$year00_02_0           0.214566   0.037672   5.696 1.33e-08 ***
table8$year00_02_1           0.387084   0.029193  13.260  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Residual standard error: 0.3258 on 3461 degrees of freedom
Multiple R-squared:  0.6552,   Adjusted R-squared:  0.6526
F-statistic: 252.9 on 26 and 3461 DF,  p-value: < 2.2e-16
```

The coefficients of the time series variables for 1991-1993 and 2000-2002 are rearranged in the table below.

Time Series Variables	Inside UGB	Outside UGB	Difference
Year91_93	0	-0.077651	0.078
Year00_02	0.387084	0.214566	0.173

5.2 Results

The regression model has an adjusted R-square value of 0.653, indicating 65.3% of the response variable variation is explained by the model. Nineteen out of the twenty six independent variables are statistically significant at the 0.01 level. The residual standard error of 0.3258 indicates the magnitude of difference between predicted value and the observed value. The p-value is smaller than 2.2e-16, indicating little probability that the variables have no effect (a slope coefficient equals to zero).

All of the variables are tested by variation inflation factor (VIF) and proved to be exempt from multicollinearity.

Among the independent variables for physical attributes in the model, the number of acres and water problem show the strongest association with land value. The logged acre is negatively related to the price per acre, indicating the larger the size of the land parcel, the lower the price per acre it achieves; the presence of water problem is negatively related to land value, indicating an adverse effect on the sales price. The locational variable, distance to downtown, is also found to have a strong association with land value. The sign of the association suggests that the price of land decreases as it is located farther from downtown. Variables of adjacent to greenbelt, restricted access, topography, restrictive size shape and location in the south are also related to the sales price but show weaker relationships.

Focusing on the variables of interest in this analysis, the dummy variables representing the years before 1991-1993 show statistical significance and all of them are negatively related to price per acre, which indicates that before the adoption of UGB, the land values were much deflated. In the several years following the adoption of UGB, land values didn’t see a significant increase. The variable of land transactions outside the UGB in 1991-1993 doesn’t show statistical significance, which suggests that there is little variance between prices of land sales that happened inside and outside the UGB, holding other variables constant.

Both coefficients for land transactions inside and outside the UGB show an upward trend in later years. However, the magnitude of change of the two coefficients since 1991-1993 is different. The difference (7.8%) between land transaction prices inside and outside the UGB in 1991-1993, is smaller than that (17.3%) in 2000-2002, which reveals the growth boundary has different correlation with change of land prices inside and outside the boundary, implying a higher magnitude of price change inside the boundary than outside after the presence of UGB.

The statistical significance of the differences between the coefficients is tested. The standard error of the two coefficients[10] for 2000-2002 is computed to be 0.0318, and that for 1991-1993 is shown in the regression result as 0.180966. The standard error of the two new coefficients for land value differences is calculated in the same way, giving an approximate value of 0.184. The p-value for it is 0.347, indicating that the result is not statistically significant, and that there is relatively high possibility that the different magnitudes of price change was due to random variability rather than to the imposition of the UGB.

In terms of price per acre, when holding all other variables constant, the difference of price per acre between land inside and outside the UGB is $40,822 in 1991-1993, while the difference of price per acre ten years later went up to $101,538 at a mean value of $207,491 per acre. The magnitude of the differences in land values increased by $60,716, suggesting the result of the change in land prices is economically meaningful.

[10] The equation to compute the standard error of C1-C2:
$SE(C1 - C2) = \sqrt[2]{V(C1)^2 + V(C2)^2 - 2 \times cov(C1, C2)}$. (Fox, 2008)

Chapter 6 Conclusion

This analysis of land value changes in King County, WA seeks to identify the price effects of the urban growth boundary. A regression model testing the effects of the UGB on land values inside and outside the boundary is presented. Using vacant land transactions data over a twenty-year period, the model takes a time series pretest-posttest design and controls for parcel related variables. By comparing the different statistics associated with land value changes inside and outside the UGB, the test results suggest that there could be a UGB effect on land values; the different change magnitude for land prices reveals that land values inside and outside the urban growth boundary in King County show different trends after the presence of UGB.

Although the price effect of UGB indicated by the model is not large compared with the overall transaction price of a parcel, the divergence of land value on either side of the UGB may expand as years go by. Policy makers therefore are recommended to pay close attention to the trends of land prices inside and outside the boundary in order to take prompt measures when signs of major divergence appear.

While this paper has sought to ensure validity of research results reliability by using a pretest-posttest design, there are some limitations due to unavailable data, including the lack in historical locational data such as accessibility to other land uses, public transit, as well as the historical parcel data. The parcel attributes used in this study are limited to current situations and may cause some bias. As discussed in the Research Method section, compared to the post design which is most commonly used in related studies, a time series pretest-posttest design leads to the lack of socio-demographic data, since most census surveys on census tracts or block groups are conducted on decennial level. Finally, the study doesn't measure the possible spillover of population to other counties or areas adjacent to King County, which may impair the validity of the results. Further research is needed to fully examine the effects of a combination of various factors on land value in King County.

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Appendix

Summary of land transaction records

Year	Inside UGB	Outside UGB
1982	21	17
1983	29	22
1984	24	11
1985	18	9
1986	13	14
1987	13	5
1988	10	4
1989	7	9
1990	3	4
1991	15	4
1992	111	28
1993	43	10
1994	228	55
1995	365	113
1996	362	106
1997	377	121
1998	285	103
1999	198	76
2000	209	66
2001	156	53
2002	124	47

<u>Descriptive Statistics of Variables</u>

Variable	**Minimum**	**Median**	**Mean**	**Maximum**
SqFtLot	1056	13600	29920	765300
Acre	0.0242	0.3121	0.6868	17.5700
Log_Price.acre	3.437	3.437	3.437	7.520
Access_restricted	0.0000	0.0000	0.0120	1.0000
Access_public	0.0000	1.0000	0.8922	1.0000
Topography	0.0000	0.0000	0.1588	1.0000
WaterProblem	0.0000	0.0000	0.0350	1.0000
Easement	0.0000	0.0000	0.03698	1.0000
RestrictiveSzShape	0.0000	0.0000	0.01835	1.0000
Adjacent_Greenbelt	0.0000	0.0000	0.08228	1.0000
StreetSurface_gravel	0.0000	0.0000	0.05132	1.0000
StreetSurface_undev	0.0000	0.0000	0.01978	1.0000
DISTANCE	32200	80570	82760	242800
North	0.0000	0.0000	0.1243	1.0000
Central	0.0000	0.0000	0.1420	1.0000
South	0.0000	0.0000	0.6971	1.0000