Urban Growth Controls and Affordable Housing: The Case of Lexington, Kentucky

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Executive Summary

In recognition of the importance of zoning ordinances and urban land controls, the Lexington-Fayette Urban County Government Division of Community Development and the Lexington-Fayette County Human Rights Commission contracted with the University of Kentucky Center for Real Estate Studies (UKCRES) to conduct an analysis of the economic impact of various zoning ordinances on the housing market. This report presents the results of that effort.

Given the broad scope and the complexities inherent in analyzing the issues associated with modern urban land growth control, the research project is divided into three phases. Chapter one presents an extensive survey of the economic literature that examines the issues associated with various zoning ordinances and their impact on the housing market. Chapter two provides a more detailed survey of the theoretical economic models that offer insights into the expected impact of urban growth controls on land and housing values. Chapter three proceeds with an empirical analysis of the Lexington-Fayette market, paying particular attention to the impact the urban service boundary has had on property values. Finally, chapter four summarizes the major findings. The results of this survey provide the necessary background and perspective for the subsequent analysis of the impact of Lexington growth controls on the Lexington housing market.

Chapter one begins with a brief overview of the historical development of Lexington's growth control ordinances. Fayette County was one of the first counties in the nation to utilize a growth control ordinance that created an "urban service area" and "rural service area." These areas effectively limit the provision of county and city services to the designated urban area with the rural area being reserved for agricultural use. Since the implementation of these growth controls in the 1960s, Lexington has witnessed dramatic population growth. In the last few years, a growing concern is that the supply of developable land within the original urban service area has been effectively limited. As a result, local elected officials have come under increasing pressure to expand the urban service area.

In order to offer guidance to policy makers, chapter one provides a comprehensive survey of the literature on modern urban growth controls that addresses three questions surrounding modern growth controls. First, we examine which growth controls are effective in preserving farmland and open spaces. In answering this question, we examine the use of purchase of development rights programs (PDR), transferable development rights programs (TDR), agricultural zoning, and property tax relief programs. PDRs represent the separation of the property's rights from the actual property itself such that an easement is paid from a local government to a landowner in order to permanently restrict certain types of development and or land use. TDRs are similar to PDRs in their permanence and intended purpose of controlling development, but are without direct expense to taxpayers. Instead, landowners of preserved land are financially compensated for surrendering their development rights by funds collected from developers desiring to build in other areas that are usually designated for development. Separately, agricultural zoning represents minimum lot size zoning (nonexclusive) or the prevention of nonfarm activities (exclusive) on a parcel of land. Property tax relief programs entail local governments fully or partially dismissing payment of a parcel's property taxes in exchange for an agreement to forego development or adhere to less-than-minimum lot size segmentation. Lastly, right-to-farm laws are preventative measures designed to protect farmers from nuisance complaints filed by urban residents who live in proximity to farmland. Overall, our survey finds that the more successful policies are those that preserve large contiguous parcels of land, encourage participation, and are perceived to be permanent and binding. To this end, PDRs and TDRs are found to be effective, but may lack broad acceptance and participation.

Our second question focuses on how urban containment policies impact land value. We find that urban growth boundaries are positively related with higher home and land prices, but they also produce exclusionary effects on minority and low-income households.

The final part of chapter one addresses the issue of how smart growth initiatives impact land values. We conclude that the literature on the effectiveness of growth controls is mixed. Depending on land characteristics and the appraisal methods utilized, there is some evidence that growth controls are correlated with housing prices. Other studies found that factors not related to growth controls have a greater impact on housing prices – suggesting that growth control impacts are a second order effect.

Chapter two examines the extensive economic literature that formally models the impact of urban growth controls. The major strands of this literature show how various urban controls result in the creation of urban amenities that overcome lower consumer utility corresponding with population growth. Furthermore, these models attempt to determine how the growth restrictions impact equilibrium demand, both within and outside the restricted area. Amenity creation models attempt to capture an area's sensitivity to negative externalities associated with growth while supply restriction models concentrate on estimating the impact of supply and demand on land values.

Our survey covers three basic models. The first set describes the growth of urban areas, focusing on population growth and showing the impact of growth controls on the "optimum" population level. These models demonstrate that growth controls should have a positive impact on land values. The second set of models focuses explicitly on the relationship between urban growth boundaries and land values. These partial equilibrium models show that land within the urban boundary will have be valued at a premium due to the ability to convert the land to more intensive use. Finally, the third set of models, derived from the "real options" literature, show that constraining the development option via a growth control or growth boundary can negatively impact land values. The models demonstrate that the value of a landowner's option to convert is positively related to increased risk and the time to conversion. Therefore, growth controls can fuel higher option values, while also motivating premature development that is neither optimal (in terms of timing and profitability) nor economically favorable in the market.

Chapter three presents an empirical analysis that attempts to determine the impact of Lexington's growth control ordinances – specifically the creation of the "urban service area" and "rural service area." Our empirical analysis is guided by the theoretical predictions developed in chapter two. In that survey, we noted that urban economic theory suggests that local growth ordinances, which may limit the supply of new housing, may increase land values by controlling negative externalities associated with population growth.

The empirical analysis consisted of three parts. First, we examined Lexington's growth between 1970 and 2000 as compared to a set of "peer" cities. Overall, this comparison suggested that Lexington's population growth rate slowed during the 1990s relative to the benchmark cities. This reduction in Lexington's growth rate appears to correspond to the period when the urban service area boundary started to limit development within Lexington.

The second empirical approach examines the impact of changes in the urban service area on Lexington house prices. The results suggest that there was upward price pressure in housing prior to the expansion, and that house prices did decline in the quarter when the supply of developable land was expanded. This suggests that maintaining flexibility with respect to the growth boundary can reduce the negative consequences associated with limiting developable land.

The third empirical approach is a micro level analysis of vacant land sales in Lexington. This model allows us to specifically test for changes in sales prices during periods leading up to an expansion in the urban growth boundary. We focus on vacant land sales in order to minimize the impact of changes in quality or taste preferences in building improvements over time. Although the results from this analysis are relatively weak, they do tend to suggest that land prices were sensitive to expansion of the urban service area.

Considering the three empirical approaches together, our analysis suggests that the implementation of the urban growth boundary has produced the intended effect of limiting Lexington's growth – particularly in the second half of the 1990s as the supply of developable land declined. Given that the restriction on the supply of developable land has only recently begun to be felt, it is not surprising that our empirical analysis shows that the growth controls have had a weak impact on Lexington's housing market. However, the theoretical studies predict that as the supply of developable land within the urban service district continues to decline, we can expect significant impacts to be capitalized into Lexington land values.

Chapter 1: Literature Review

Introduction

The Lexington-Fayette Urban County Government Division of Community Development and Lexington-Fayette County Human Rights Commission have contracted with the University of Kentucky Center for Real Estate Studies to study the impact of government zoning and land use programs and policies on housing costs. In order to provide a foundation for the subsequent analysis of the particular rules and regulations utilized in Lexington, this chapter presents a literature review of previous studies that have examined the economic impact of various zoning ordinances on housing markets.

We first present a brief overview of the historical development of the Lexington growth control ordinances. This overview discusses the recently enacted 'purchase of development rights (PDR)' program and the expansion area master plan. Next follows a general literature review that consolidates the findings of previous research that document the impact of growth control ordinances on land values. In order to provide a presentation framework, the literature review is organized around three questions: First, which growth controls preserve farmland and open spaces? Second, how do urban containment policies impact land values? Third, how do smart growth initiatives impact land values? Within this last section, we present three case studies of smart growth initiatives in other cities. Finally, the Appendix contains a brief list of data and variables necessary for an empirical analysis of Lexington's growth control ordinances.

A Brief Review of Lexington's Use of Urban Growth Controls

Zoning ordinances and growth controls have been utilized in U.S. communities since the early twentieth century. New York City claims to have instituted the first zoning ordinance in 1916 with laws designed to control building height and densities. By the early 1920s, many communities had enacted various forms of zoning ordinances in recognition of the externalities associated with urban land use. In 1928, the U.S. Supreme Court upheld the right of communities to control private land use. Thus, it is not surprising that Fayette County followed the growing trend and installed its first planning and zoning commission in 1928 and initiated subdivision control regulations as early as 1929. The county implemented its first zoning ordinance in 1930 and drafted its first *Comprehensive Plan* in 1931. In 1958 the county revised its zoning and land use ordinances when it created the "Urban Service Area" (USA) and the "Rural Service Area" (RSA). By setting a boundary around the urban core of Lexington, the county defined where future development would be prohibited as well as encouraged.

Since 1958 Fayette County has employed a number of initiatives to coordinate and manage detailed neighborhood plans within the USA. For example, the county created a "Growth Planning System" to shape development growth, infrastructure maintenance, and redevelopment. In response to the demand for additional developable land - and as a separate component to the 1996 *Comprehensive Plan* - the urban county government enlarged the USA boundary with its "Expansion Area Master Plan."

The 1996 and 2001 Lexington-Fayette County *Comprehensive Plans* specify land use density and design criteria for residential housing, retail areas, public facilities, infrastructure, roads, greenways, and open spaces. In addition, the *Plans* map the county's urban core, employment centers, urban activities centers, commercial corridors, existing developed areas, urban growth areas, urban expansion areas, and horse and agricultural farms within the USA. Separately, it also maps the RSA's rural activities centers (Airport, Spindletop, Avon, and Blue Sky), general rural use areas, horse farms, prime agricultural land, and rural road corridors. Among each land use area, the *Plans* document and map environmentally sensitive areas, geologically hazardous areas, the Royal Springs Aquifer Recharge Area, and greenway systems. Furthermore, the *Plans* categorize land use areas in terms of zoning restrictions and intensity ranges while offering more than 20 goals and objectives for preservation and the management of future development and expansion.

One of the critical elements in the *Plans'* goals and objectives is outlining future development patterns in the USA's expansion area. Thus, the *Expansion Area Master Plan* (EAMP) designated three tracts comprising 5,330 acres of former RSA land for future development (9.8% of the USA and 2.92% of the entire county). Based on an assessment of future growth and land use needs, targeted uses within the expansion area are (1) low-residential development, (2) full range development of multiple housing densities, economic development, and community centers, and (3) economic development with minor low-to-medium density residential development.

In April 1999, the Fayette County Planning Commission adopted the "*Rural Service Area Land Management Plan*" to better protect and preserve farmland and open space in the RSA. Under this plan, the county seeks to purchase conservation easements in order to permanently restrict the development rights of 20+ acre parcels. Given the complicated nature of appraising properties in such a "purchase of development right" program (PDR), the county has yet to receive broad acceptance from the farming community, and has thus far been unable to place farms under permanent easement. Assuming greater response in the future, the county hopes to purchase the developments rights from large, contiguous blocks of open space and thus permanently preserve the aesthetic appeal of its rural farmland and open space.[1]

To summarize, since the 1920s the City of Lexington and Fayette County have implemented a wide range of zoning and growth control programs. These programs have directly and indirectly impacted the character and quality of life in Lexington. In order to gain a greater appreciation for the impact that these regulations will have on future growth and development as well as on the supply of "affordable" housing, we next survey the extant literature on growth control regulations.

[1] As of March 2002, approximately 2,200 acres (16 farm owners) had accepted easement offers and more than 6,340 acres (representing 33 farm owners) were in the appraisal process and/or are negotiating with the county's Rural Land Management Board.

Evaluating the Effectiveness and Problems Associated with Urban Growth Controls

A vast literature exists examining the effects of locally directed urban growth controls. To narrow the scope of the project, this review specifically surveys the research that (1) define the more commonly used local growth control measures designed to limit population growth, limit residential and commercial development, increase densities in targeted areas, and preserve farmland and open space; (2) theoretically model and empirically test the effectiveness of various controls; (3) specifically evaluate the effects of urban sprawl and the use of growth controls in the context of the "Smart Growth" initiative of the American Planning Association; and (4) focus on current regional studies on the applied economic, social, and environmental impacts of urban sprawl. In addition, we provide an overview of research methodologies that are commonly applied to the evaluation and measurement of urban growth controls.

Urban containment studies usually take one of two basic forms: (1) measuring the effectiveness of a policy's ability to provide and sustain contiguous and efficient urban land use with desired densities and accessibility to public services, and (2) measuring a policy's ability to preserve open space, farmland, and environmentally sensitive areas that are not suitable for development (Nelson 2000). Other areas of interest include issues associated with how growth controls and containment policies are capitalized into housing and vacant land values. Many studies empirically concentrate on a policy's influence, measuring how it constricts supply or fails to accommodate new demand. Such studies seem to be motivated by causal relationships between the development timing and rate of population growth, residential and commercial density patterns, the use and timing of public infrastructure improvement and development, the challenge to preserve open space or farmland, and failures to control the concentration or spread of public and private amenities that enhance or detract from land values.

Tables 1.1 and 1.2 summarize the motivating factors of local growth controls and control measures. Upon examination of the these factors and the research cited in this review, three questions seem to continuously surface: (1) What types of growth controls effectively preserve farmland and open space – especially on an urban area's fringe and beyond?; (2) How do urban growth controls influence urban and suburban housing and available land prices for both restricted and developable parcels?; and (3) Assuming growth controls and/or other factors lead to lower availability of affordable housing or vacant land, how are residents affected or even displaced?

Table 1.1: Factors Motivating Local Growth Controls

Population growth.

1. Ability to maintain desired residential and commercial densities.
2. Ability to curb sprawl and rural development (especially "scattered" or "leapfrog" development).
3. Desire to preserve contiguous open space and farmland.
4. Increased suburbanization pressuring continuous peripheral development
   a. Rural entrenchment of low density residential or commercial development.
   b. Increased stress on rural infrastructure (roads, sewer, water services…).
5. Increased demand for rental housing
   a. Higher density multi-family development within urban areas.
   b. Congestion accompanying higher density development.
6. Shift in employment to suburban areas accompanied by more traffic and infrastructure needs.
7. Maintaining infrastructure to meet urban growth, thus preserving a community's "quality of life" and creating amenities that are capitalized into higher land values.
8. Declining federal support of infrastructure development, thus creating local funding shortfalls.
9. Ballot initiatives allowing voters more involvement in urban growth management initiatives.
10. Desire of existing urban residents to exclude minority or lower-income population growth.

Table 1.2: Types of local urban growth controls

A: Farmland/Open Space Controls

1. Purchase of development rights/easements.
2. Transferable development rights programs.
3. Agricultural zoning (exclusive and non-exclusive).
4. Property tax relief to farm owners.
5. Right-to-farm laws.

B: Urban Containment Policies for Residential, Commercial, or Industrial Land Use

1. Adequate availability of public services to meet demand for development.
2. Reduction in permitted residential densities or "large-lot zoning".
3. Impact fees imposed on developers to transfer infrastructure costs and better control timing and permits for development.
4. Development Moratoria
    - Reduction in the allowable number of residential building permits.
    - Rezoning residential or commercial land to less intensive use.
    - Subdivision regulations.
    - Withholding sewage, water or other public services to newly developed areas.
    - Reduction in permitted height of commercial buildings.
    - Square footage restrictions for newly built or redeveloped commercial or industrial properties.
    - Structural floor area restrictions per parcel size of developed land.
    - Construction bans.
5. Growth phasing - allowing limited development over specific time intervals.
6. Rate-of-growth programs setting maximum permissible population growth rates (usually in conjunction with public service availability).
7. Urban growth boundaries or greenbelts beyond which development is reduced or not permitted.
8. Requirements for voter approval/referenda of zoning and min/maximum densities.

Which Growth Controls Preserve Farmland and Open Space?

The literature on the preservation of farmland and open space within and around urban areas is extensive and comprehensive in how it addresses a variety of growth controls and their effects. The more recent literature concentrates on the purchase of development rights (PDRs), transferable development rights (TDRs), agricultural zoning (exclusive and non-exclusive), property tax relief to farm owners, and right-to-farm laws. In the context of this review PDRs represent the separation of the property's rights from the actual property itself such that an easement is paid from a local government to a landowner in order to permanently restrict certain types of development and or land use (Fulton 1999). TDRs are similar to PDRs in their permanence and intended purpose of controlling development, but are without direct expense to taxpayers. Instead, landowners of preserved land, who surrender their development rights, are financially compensated by funds collected from developers desiring to build in other areas that are usually designated for development. Separately, agricultural zoning represents minimum lot size zoning (nonexclusive) or the prevention of nonfarm activities (exclusive) on a parcel of land. Property tax relief programs entail local governments fully or partially dismissing payment of a parcel's property taxes in exchange for agreement to forego development or adhere to less-than-minimum lot size segmentation. Lastly, right-to-farm laws are preventative measures designed to protect farmers from nuisance complaints filed by urban residents who live in proximity to farmland (Nelson 1992). The following sections provide an in-depth analysis of each of these growth control mechanisms.

Purchase of Development Rights (PDRs)

One of the more popularly researched farmland preservation tools is a PDR program. Under a PDR program, local governments purchase deeds of easement on the development rights to existing farmland parcels. There are consistent findings and mutual agreement among researchers that this particular growth control measure is most successful in terms of permanent farmland preservation and reduction of development speculation (Daniels 1991). The increase or decrease in the value of farmland or open space is typically a proxy for a PDRs perceived permanence. For example, if a preserved (either by restrictive zoning or the surrender of its development right) parcel of farmland on the fringe of an urban growth boundary sells in the open market at a price in excess of the present value of its agricultural output, then it is assumed that the market is signaling that the parcel also has perceived development value that may be captured at a future date (upon reversal of the zoning or development right ordinance).

PDR research usually concentrates on measuring the policy's relative effectiveness. For example, several studies attempt to measure the ability PDRs have to capture large, contiguous parcels of farmland in an economically efficient manner. Given that a PDR is financed with public funds, many studies question why seemingly costless forms of control, especially exclusive agricultural zoning, are not always better and preferred alternatives. Maynard et al (1998) address such concerns by studying a variety of PDR programs in the state of Pennsylvania. Among many long-run questions regarding effectiveness, they focus on (1) whether PDRs were able to preserve intended masses of farmland, (2) whether PDRs preserved farming or non-intended open space, and (3) how the proceeds from easement sales were used by a parcel's owner – especially whether farmers used the proceeds to improve agricultural productivity. They found that

Pennsylvania PDR programs had mixed success in preserving large, contiguous tracts of farmland. They did find that saving their farmland, not just the proceeds of easement sales, motivated early PDR participants. However, an overwhelming majority of original PDR participants were older farmers who did not use easement money to significantly boost additional agricultural activity. Instead, easement proceeds were typically used to help struggling farms stay in business (reduce existing debt).

Other PDR literatures attempt to descriptively or quantitatively measure the advantages and disadvantages of utilizing such a program. Among the advantages are the program's fairness to landowners who are compensated for their lost rights to develop as well as the program's reversal of the perceived "impermanence syndrome" that gives rise to the expectation that growth control measures have little longevity (Coughlin and Keene, 1981). Another PDR advantage is the ability to help support farmers who are in financial need or simply desire to permanently preserve their land for future generations. Likewise, the ability to reduce imminent estate taxes paid by farmowner families is a benefit of PDR programs. Lastly, PDRs offer farmers a middle ground between selling to developers or having restrictions placed on their property through zoning ordinances. Zoning and most other regulatory mechanisms do not financially compensate landowners for their loss of the right to develop and are also vulnerable to legal challenges that they violate constitutional protection against the taking of private property (Daniels 1991).

PDRs also have several disadvantages. First, they open the door for potential speculators, not farmers, to gain from the purchase of development rights. The easement holder cannot require that a parcel be farmed; therefore, Daniels (1991) suggests that preserved parcels will evolve into open space, rather than productive farmland, in the post-acquisition period. In anticipation of an easement offer, speculators purchase prime agricultural farmland from established farmers with no intent to continue cultivatation. In the 1980s the PDR program in Suffolk County, NY found that more than 1/3 of easements were purchased from speculators. Second, many programs are forced to pay significantly higher prices for easements, when compared to the agricultural value of parcels (Landis 1992). Third, given that PDRs are voluntary programs, they can have difficulties in preserving large, contiguous blocks of land. Instead, they may preserve scattered parcels, thus actually encouraging sprawl in the form of "leapfrog" development in rural areas. Fourth, PDRs compensate landowners for a parcel's value that they didn't create; their land's increased value results from existing infrastructure (roads, sewer lines…) that was previously funded by taxpayers. Fifth, PDRs can be more successful in preserving non-priority open space as opposed to desirable farmland (Daniels 1991). Lastly, PDRs are permanent restrictions on future land use, but can be unsuccessful in countering the aforementioned "impermanence syndrome" as proxied by the expected decline in farmland values after the farmers have sold their rights.

Permanently preserved parcels may experience declining valuations when compared to agricultural land that is neither preserved nor under development pressure. However, Nickerson and Lynch (2001) find little evidence that permanent PDR or TDR restrictions had any effect on parcel values based analysis of farmland sales in three Maryland counties. They argue that values on PDR preserved land were unchanged because either their easements did not seem binding into the future or loopholes in Maryland law allowed for more speculation. Their referenced "loophole" is a particular regulation that allowed for grouping smaller parcels together to meet minimum PDR size requirements. Once such a package of parcels was established and preserved under a PDR, the individual owners could again separate themselves and sell their smaller pieces individually.

One of the more prominent criticisms of PDR programs is the inefficiency and difficulty in valuing the development rights of a parcel. Valuation methods are usually based on assessments or a series of assessments to determine a fair and equitable easement purchase price. However, appraisal methods that require the calculation of the present values of agricultural rents as well as potential rents from future development are difficult to implement because developed land rents and their timing are simply not observable. As a result, appraisal methods rely on comparable sales or income approaches in approximating potential development times and rents. Unfortunately, such estimates frequently understate returns from development in relation to returns from agricultural production. Estimates are simply based on subjective assumptions of appraisers who may not have current or complete data regarding recent sales or comparable property characteristics (Plantinga and Miller 2001).

To counter the problems associated with traditional appraisal methods, a number of studies have used hedonic methods to statistically derive valuations of land characteristics as well as different input variables that affect land values. Hedonic methods regress site-specific parcel characteristics, geographic data, and economic parameters on land values (Roka and Palmquist 1997). However, regression based methods are also suspect because of the difficulties in quantifying development pressure in relation to a parcel's proximity to metropolitan areas. In an attempt to derive a more precise and representative measure of PDR valuations, Plantinga and Miller (2001) use a model that incorporates previous hedonic approaches to valuing agricultural land. In addition to capturing observed agricultural rents, development rents, and land-specific characteristics to derive statistical estimates, they focus on distance measures to generate spatially explicit estimates of PDR values. As a result, their valuation technique relies not on the estimated future development timing and rents, but on readily available observations of land values and the determinants of those values.

In aggregate, the PDR literature not only concentrates on measuring a program's general effectiveness in conserving different types of farmland and open space, but it also provides research on the practicality, fairness, and usefulness of different valuation methods.

Transferable Development Rights (TDRs)

The first concept of a TDR was conceived in New York City in 1916. It permitted "sending" lot owners to sell their unused air rights to developers of adjacent lots, thus allowing the "receiving" adjacent lot to exceed height of setback requirements (Johnston and Madison 1997). TDRs have gained considerable popularity in recent years due to their level of permanence as well as the desire of local governments to reduce compensation costs associated with regulatory policies (Danner 1997). Such a program is seemingly costless in that the funds used to purchase property rights of farmland or open space ("designated sending areas") are raised by selling development rights to other parcels that are zoned for increased densities ("designated receiving areas"). There are two major types of TDRs that are usually used: mandatory, dual-transfer TDRs and voluntary, single-transfer TDRs.

The mandatory programs usually have distinctly chosen zones from which sending parcels will be downsized and receiving parcels will be further developed. The two most popularly studied mandatory programs (because of their historical effectiveness) are in the NJ Pinelands and in Montgomery County, MD. Each of these programs has a "development center bank" where developers can purchase "credits" for designated development. Often these credits are rights to simply develop, add density beyond current zoning regulations, or forego certain environmental or zoning guidelines and regulations. Most mandatory programs have a set formula for calculating the value of a development credit – many times such a value is based on the ratio of acreage in sending parcels to number of building units allowed in receiving parcels. Even though such a "blanket" ratio may not seem equitable to all parcels (given different characteristics of each), the Pinelands program has been successful in preserving in excess of 12,000 acres – or 1,424 building rights (out of 5,750 rights available). The Montgomery County program has preserved more than 34,000 acres (out of 90,000 designated down-zoned/agricultural acres) (Danner 1997).

The voluntary programs have been applauded as being more equitable because landowners and developers have more freedom in choosing to participate as well as in deciding where receiving areas will be located. However, they are also typically more complex and difficult to administer and maintain (Johnston and Madison 1997). Such programs do not force the sending parcel to downsize and thus are more popular in areas that don't want to completely forbid development. They are called "single-transfer" TDRs because they apply to an entire area, not specifically designated zones. In order to implement such a program, each parcel in an area is assessed and graded based on certain land characteristics, capabilities for development, and sensitivity to the environment. The parcel's "score" is then used to determine the allowable rights or permits it will receive for new/further development. Given that each parcel has a particular number of "permits," a "bank" is established whereby one parcel that wants to develop beyond what is allowable can purchase rights from another parcel that wishes to forego its right to develop. The two most popularly studied voluntary programs are in the Lake Tahoe Basin and in the Santa Monica Mountains of California. Both are widely successful in preserving parcels and transferring development rights, mostly due to the comprehensivess of their grading criteria in accurately reflecting the development potential of each parcel (Johnston and Madison 1997).

There are several important obstacles in implementing and maintaining a TDR program. First, they are usually difficult to administer, especially in a voluntary, single-transfer setting in which each parcel is individually "graded." Secondly, they must be coordinated with adequate levels of infrastructure, especially in dual-transfer mandatory programs that need to accommodate higher densities in specific receiving areas. Lastly, they must value the "rights" or "credits" in a way that is equitable and marketable in terms of attracting both sellers from sending areas and developers to receiving areas.

As a result, successful TDRs typically have a "TDR bank" to provide (1) stability and administer exchange, (2) enough financial motivation to induce farmland and open space owners to participate, (3) and suitable market demand (on behalf of developers) to spur desired development in receiving areas (Danner 1997, Pizor 1986).

Comparing PDRs and TDRs

One of the more comprehensive articles that study the effectiveness of development rights in preserving farmland or open space through controlled development is in the November 2001 issue of *Land Economics*. The authors, Lynch and Musser, design and employ an efficiency analysis of farmland preservation in four Maryland counties that have used a common form of PDR, one that requires minimum eligibility criteria, a bidding system, and TDR programs. Ultimately, they measure which program is most productive and cost efficient in meeting four primary goals: (1) achieving a maximum number of preserved acres, (2) preserving acres of productive farms, (3) preserving farmland most threatened by development, and (4) preserving large, contiguous blocks of farmland. Their efficiency analysis uses a Farrell nonparametric model to measure these goals in relation to parcel characteristics, output measures, and relative program costs. The Farrell methodology was originally used to study a group of firms with comparable technologies in order insert to measure their relative productivity and profitability for a given level of inputs. In the Lynch and Musser format, the Farrell methodology is translated to represent and measure parcel preservation objectives relevant to the variables associated with a program's cost and conditions.

Their primary findings are that both forms of PDR and TDRs are effective programs in meeting their criteria. However, the PDR programs appeared to achieve higher "technical" (TE) and "cost" (CE) efficiency rankings. Their TE measures graded the output characteristics of a program given a parcel's production possibilities frontier; their CE measure assessed the purchase price for a parcel's rights in relation to a combination of its output characteristics. One might expect TDRs to be more cost efficient given that they are not a direct financial burden to taxpayers. However, the authors not only find that PDRs (according to their established criteria of preservation and parcel characteristics) were more cost efficient, but were even used as supplements to existing TDR programs that weren't meeting their goals – specifically, their failing to preserve enough land bordering urban fringes.

In defense of TDR efficiency, the authors note that developers who purchase such rights don't necessarily care about parcels from which rights originated (sending parcels) and are simply most interested in the cost of a right. As a result, TDRs have a disadvantage in offering the same level of efficiency in preserving farmland with desired characteristics. In fact, this study showed that TDRs were more effective in simply preserving acreage, whereas PDRs were more effective in preserving more desirable parcels – specifically, farmland with existing crops and prime soils.

Agricultural Zoning (Exclusive and Non-Exclusive)

Restrictive agricultural zoning is a form of mandatory control, but often perceived to be impermanent. The two main types, exclusive and nonexclusive, differ in that exclusive simply prohibits nonfarm activities within a district, whereas non-exclusive enforces minimum lot size restrictions to contain urban sprawl and preserve land use (Nelson 1992). Non-exclusive zoning can take one of two forms: area-based or sliding-scale. The former simply fixes the number of dwellings per number of acres and the latter allows for fewer dwellings per acre. Non-exclusive zoning is often criticized since past usage of this form of zoning has set minimum lot sizes below 40 acres, thus enabling speculators, affluent landowners, and hobby farmers to purchase parcels. As a result, this preservation policy has typically encouraged, instead of contained, scattered and leapfrog development and urban sprawl (Fischel 1990, Coughlin 1991). Between the two types, exclusive zoning is typically the focus of farmland preservation research and is often criticized for its inefficiency in prohibiting hobby farmers and ill management of productive farmland.

In terms of measuring the effects of exclusive zoning, conventional wisdom and previous theoretical and empirical arguments show that strict agricultural zoning reduces the value of farmland due to the loss of potential amenities gained from development opportunities. Many of these studies that find restricted open land to decrease in value assume that exclusive zoning regulations have identical impacts on all different types of farmland/open space parcels (Fischel 1990).

In contrast, Henneberry and Barrows (1990) hypothesize that the price effect from exclusive zoning is dependent on parcel characteristics. They find that the price effect significantly depends on parcel size and distance from urban areas. More specifically, there is a significant and negative price effect for smaller parcels located closer to urban areas. Large parcels that are somewhat removed from urban areas and under less development pressure have positive effects. Given that exclusive zoning is non-voluntary and perceived to be nonpermanent, landowner expectations that local governments will eventually relax restrictive zones is typically argued as the cause for such effects (Nickerson and Lynch 2001). As a result, such agricultural zoning is perceived to be non-binding, ultimately to give way to the breaking-up of farmland/open space and the development of large residential lots with little or no capacity for agricultural production (Daniels 2001).

Property tax relief to farm owners and right-to-farm laws

Property tax relief is designed to encourage agricultural production and curb farmland speculation. These programs compensate farmers for lost development opportunities by relieving them of a portion (or all) of their property tax burden. However, studies show that such policies have the adverse effect (Nelson 1992). As with agricultural zoning laws, tax relief is perceived to be impermanent. For instance, two studies on income tax credit programs for farm families in New York and Michigan found that such a program had little effect on farmland values, suggesting that they weren't perceived to be binding (Vitaliano and Hill 1994). In addition, such relief is often an inadequate compensation to farm owners, especially when comparing the value of the relief to the speculative value of development. As a result, farmer owners are often torn between the decisions to either "sell-out" to developers or continue accepting inadequate compensation in the form of tax relief.

Right-to-farm laws are also designed to offer farmers relief from the pressures of urban development. They are typically intended to shield farmers from the influences of surrounding residential and commercial build-up, and especially helpful in shielding legal pressure to cease agricultural production. Even though they are a form of protection against costly legal battles over land use rights and policies, the literature does not find that their sole existence is significantly linked to success in farmland preservation.

Some of the agricultural conservation research does measure tax relief and right-to-farm laws when used in conjunction with PDRs, TDRs, and agricultural zoning, however, there is little evidence that tax-relief or right-to-farm laws add to the effectiveness of other measures.

Table 1.3: Summary of Growth Controls

Farmland Preservation

Type of Control	Objective	Empirical Evidence	Consequences
1) PDR	Permanent Land Use Preservation	More effective than PDR and Zoning	• More government control • The highest level of perceived permanence • Most costly to public
2) TDR	Permanent Land Use Preservation	Effective when properly implemented and maintained	• Less costly to the public than a PDR • More difficult to administer and maintain
3) Agricultural Zoning	Encourage agricultural production and conservation	Difficult to enforce	• Easier to implement and rarely permanent
4) Tax relief	Encourage agricultural production and conservation	Least effective	• Lost development opportunities not fully compensated

Urban Containment

Type of Control	Objective	Empirical Evidence	Consequences
1) Adequate public service availability	Delays development timing	Difficult to measure effects on infrastructure	• Successfully delays development and land use intensities • Can foster contiguous development • Difficult to monitor and implement
2) Density restrictions	Forestall development and/or promote specific intensity levels	Can be exclusionary to lower income residents, encourages urban sprawl, and has positive price effects	• Little flexibility in meeting future land use needs without continuous rezoning • Existing residents benefit, while new residents pay higher housing premiums
3) Impact Fees	Delays development, transfers cost to developers – and ultimately to new land owners	New residents bear costs; proper use requires accurate forecasting of development and population trends	• Can generate public revenue, but often translates into higher residential prices • Discourages low-income housing development
4) Various Development Moratoria (see list on page 9)	Stop/slow land use conversion by restricting certain forms of development	Best if used in conjunction with other regulations. Acting alone, they serve as temporary development freezes	• Low cost regulatory measures, but ineffective long-term growth controls seen as self-serving and exclusionary to existing residents
5) Growth Phasing	Regulates location and timing of new development	Very popular. Generally used in conjunction with	• Can foster contiguous development over the long

		infrastructure adequacy plans. Reduced housing availability may result from pre-set phasing of timing and development	term • Due to incompatible timing of allowable permit phasing, such plans often promote sprawl and/or undesirable development
6) Rate of growth programs	Allocate specific number of new residents to an area per year	Not very effective. Too many loopholes and ways for new residents to circumvent regulations	• Difficult to administrate and monitor residential inflow/outflow or location of new development • Often promote higher land values and sprawl
7) Urban Growth Boundaries	Define boundaries beyond which certain types of development is prohibited	Promotes higher land values within boundaries. Can encourage higher urban densities as well as infill and redevelopment rates	• If UGBs don't incorporate adequate plans to increase regional densities and allow for timely fringe expansion, they promote higher home prices and thus have exclusionary effects
8) Requiring voter approval/referenda	Allow voters to approve the timing and implementation of specific growth control measures	Existing residents have control, resulting in increased uncertainty - leading to reduced investment in land and economic development	• The cost of uncertainty translates into higher costs of development projects, thus delaying important land use decisions and/or desirable development

How Do Urban Containment Policies Impact Land Values?

The majority of the urban containment literature concentrates on empirical analysis of the effects of urban growth control ordinances on the stock, availability, cost, and displacement of owner-occupied and rental housing. As referenced in Table 2, most urban containment studies classify the more commonly used growth controls as either being (1) a form of zoning or regulatory ordinance (availability of public services, low density zoning, development moratoria, impact fees, growth phasing, rate of growth programs, public referenda approval, etc.) or (2) a form of growth containment such as an Urban Growth Boundary (UGB).

Zoning and regulatory ordinances

Development and growth ceilings and caps are often motivated to constrain population growth, control densities, and impose concurrency of public infrastructure. Most of the theoretical and empirical literature covering local regulations and zoning ordinances is dedicated to measuring housing valuation and affordability, population growth and density trends, and displacement and spillover to adjacent jurisdictions. Given the significant population growth in the Western states during the past 50 years, California is a primary source for much of the research on various growth control measures. In addition, other studies have concentrated on local governments in Maryland, Illinois, Wisconsin, Oregon, Washington, and Ohio due to their use and experimentation with a wide range of measures.

Most population and development restrictions and moratoria are positively correlated with higher prices for new and existing homes. Dowell (1984) attributes this effect increases in construction and development costs, downward pressure on the supply of new housing, and a motivation for builders to shift their efforts to higher-end residential homes. Fischel (1990, 1995) also finds that zoning affects housing price increases, especially in the suburbs. In addition, he references the evidence that zoning lowers the value of vacant land parcels due to their loss of potential amenities gained from development (Brueckner 1990, 1995).

Pollakowski and Wachter (1990) measured the effects of development ceilings and restrictive zoning in Montgomery County and the surrounding Washington, DC area. Using hedonic regressions to price median housing bundles across county zones, they find that such controls did raise the prices for housing and developed land between 1982 and 1987. They also found that spillover into adjoining counties did exist. Lastly, Beaton and Pollack (1992) measured price effects for 16 Maryland counties involved in the Chesapeake Bay Critical Area Protection Program. Using lagged results and hedonic estimations of land values of parcels in zoned conservation areas that were both “accessible” and “not-accessible” to urban centers, they found that residential and vacant parcels that were “accessible” did rise in value. Conversely, they found that “inaccessible” (remote) residential and vacant parcels actually fell in value.

Landis (1992) studied 7 California cities that had implemented some form of restrictive zoning in the 1980s and compared his results to 7 cities without any controls. He finds that median home prices of controlled cities did not vary significantly from median prices of uncontrolled cities, after adjusting for economic and city characteristics. He also argues that commonly used zoning regulations were either ineffective or encouraged spillover into adjacent areas.

A separate strand of research regarding housing prices focuses on the use of impact fees. Their use is found to significantly increase new and existing home values due to higher construction costs, development delays, and the resulting decline in the supply of available housing (Dingell and Lillydahl 1990, Skaburskis and Qadeer 1992). Dingell and Lillydahl's study concluded that, after controlling for other exogenous variables, more than 2/3 of housing price increases in localities using impact fees were due to the fees' effects.

Net housing change, as measured by net inflow of new housing units in a locality within a defined time period, is a widely cited measure in much of the zoning literature. Levine's 1999 study on the effects of local growth controls on 490 cities and counties in California between 1980 and 1990 focused on new housing development, specifically seeking to measure displacement of certain types of housing as well as the related displacement and relocation of lower-income or minority people. Levine used lagged data (up to 2 years) and found that development ceilings and restrictive zoning ordinances significantly slowed population growth, net new housing, and net new rental housing. In terms of the specific controls used, he found that rezoning from residential to agricultural use had the strongest impact on new housing development, followed by rezoning from commercial/industrial to less intensive uses. He also found that downsizing residential to lower densities as well as limitations on permitted building heights were significantly related to new housing development. While more than 73% of the localities in his survey offered affordable housing incentives, he found that such incentives had no significant impact on housing growth. Lastly, with regard to infrastructure concurrence to new housing development, infrastructure adequacy standards did not have any significant effects on reducing the growth of residential housing in California in the 1980s.

In terms of displacement, Levine found that jurisdictions with growth controls added fewer rental units, added fewer families, experienced higher median rent levels and home prices, and encountered lower population growth. Even the portion of Levine's sample that used some form of rent control added an insignificant level of new housing. Adding to these findings, growth controlled jurisdictions also experienced a smaller population increase in non-white residents. Levine notes that lower-income and minority residents tended to concentrate in multi-family housing and were therefore influenced by declines in new rental housing that especially resulted from density regulations and capped floor-area ratios. Ultimately, his findings demonstrate a population shift (especially among lower-income and minority residents) in controlled areas to less controlled jurisdictions.

Other population spillover and displacement studies reinforce the findings that zoning restrictions force spillover from controlled, high-growth areas to less controlled, low-growth areas. The resulting effect of such shifts is typically higher single-family housing prices in the low-growth areas (Fischel 1990, Wachter and Pollakowski 1990). To further complicate the effects of urban containment policies, Fischel (1980) and Downs (1992) argue that restrictive zoning encourages "leapfrog development." Bruekner (1990) finds that vacant land prices in adjoining, less controlled areas rise – further promoting population diffusion.

In aggregate, previous research suggests that the popularly used urban containment policies are somewhat successful in limiting short-term development. None of the policies studied adequately constrain upward housing and vacant land values. Specifically, maximum density moratoria, population growth rate plans, and restrictive zoning mechanisms have the strongest exclusionary and displacement effects due to the elimination of multi-family development and higher single-family home values. In terms of fostering contiguous development with desired densities and halting scattered "leapfrog" development, adequate public facility ordinances, minimum density requirements, and growth phasing plans were most successful. With regard to preserving agricultural land and open space, adequate public facility plans were somewhat successful, however, UGBs (see the following section) as well as PDR and TDR programs were found to offer the only permanent/long-term solutions.

Urban Growth Boundaries

Urban Growth Boundaries (UGBs) are spatial growth restrictions that were first implemented in Lexington, KY in 1958 and have since become one of the more popular methods of constraining urban development (Weitz and Moore 1998). As of 1999, more than 100 cities in the U.S. were using some form of UGB, and many states were following the lead of Oregon, Washington, and Tennessee in mandating their use on a state level (Staley and Mildner 1999).

In many of localities, UGBs are defined as buffer zones, outside of which residential and commercial development is either forbidden or confined to specific zoning restrictions and minimum lot sizes. Also, UGBs are usually part of a complex planning scheme that incorporates other growth controls and management plans for development inside a boundary. Many times a UGB will be coordinated with internal zoning mechanisms, such as minimum density requirements, in order to counter a boundary's impact on housing availability and affordability. Prior to implementation, most localities typically forecast their future need of developable land by estimating population growth rates and housing needs for the next 10-20 years. As a result, a UGB usually contains a total land area to accommodate 115-125% of projected urban growth over a 10-20 year time span (Knaap and Hopkins 2001).

One of the most studied UGBs is in Portland, OR because of its longevity and success in meeting certain development and density objectives (Phillips & Goodstein 2000). Portland implemented its UGB in 1979, complying with a statewide Oregon law that mandated such boundaries. Portland's popularity as a "cutting-edge" growth management city has grown over the past 20+ years because of its concurrent long-term planning initiatives, specifically its population density targets, the further development of its transportation infrastructure and mass transit, and the location and timing of developable new land. Even though Portland's population has almost tripled over the past 20+ years, the region's 24 cities spanning 3 counties were able to internalize their growth with higher residential densities and more infill and redevelopment. In contrast to such success, the city has also experienced significant appreciation in housing prices and land rents. Knaap (1985) empirically studied two of Portland's counties, Washington and Clackamas, and found that urban and non-urban land values inside the city's UGB significantly outpaced outer-UGB non-urban land values. His results were especially strong in Washington County where boundaries have been binding and strictly enforced. His results suggest that non-urban values within a UGB are more influenced by development expectations as well as the anticipation of future rents.

Staley and Mildner (1999) focus on Portland's 20-year use of an UGB and the associated rise in land values. They find that Portland ranked among the top 10 least affordable housing markets in the nation (as of 1999) and that more than 80,000 single-family homes were regarded as "unaffordable" by Portland residents (NAHB 2000). Even though housing densities from 1994 to 1997 improved from 5 units per acre to 8 units per acre, more than 25% of all new development inside the boundary was infill or redevelopment. More than one-half of 1999 new building permits were issued to multi-family development, Portland's housing prices increased 69% from 1991 to 1996 and were $25,000 higher than the national mean in 1996 (Phillips & Goodstein 2000). Given such upward pressure on housing prices, Portland did expand its boundary in 1997 (Arigoni 2001).

Theoretically, some researchers hypothesize that higher densities and infill/redevelopment rates can counter rising housing prices. Some theoretical models demonstrate how higher land prices that result from a binding growth control, such as an UGB, can be countered if population growth is efficiently spatially distributed (Cho 1997). Even though it makes intuitive sense that higher densities can help maintain supply levels and thus absorb increased housing demand, Cho (1997) finds that a "congestion effect" is an important, and often underestimated, variable. Due to lost amenities and potentially lower land values that result from congestion in higher density zones, his model attempts to derive a long-run equilibrium housing supply in an open city. Ultimately, Cho's equilibrium seeks to find optimal densities and housing supplies where the loss of value due to "congestion" that is absorbed by existing landowners is contained. Beyond Cho's model, the NAHB also contends that increasing affordability with higher densities is not always desirable among consumers. The NAHB's criticism of the Smart Growth Initiative, which advocates higher density zones, is that many Americans still prefer detached, single-family homes in the suburbs as opposed to higher density multi-family units closer to urban areas. Lastly, Danielson, Lang, and Fulton (1999) suggest that expensive upgrades of multi-family units is a motivating factor in bringing middle-to-upper class residents back into urban areas. They contend that such upgrades may achieve higher density goals while simultaneously exacerbating housing affordability problems.

Phillips and Goodstein (2000) specifically look at the upward pressure on Portland's housing prices to explain why its density requirements and credits for infill and redevelopment were unable to oppress such a housing supply shortfall and resulting spike in prices. They find weak, empirical evidence that Portland's UGB leads to increased median house prices, arguing that the large run-up in the mid-to-late 1990s was more reflective of a heightened demand in the midst of a speculative bull market. In fact, the most significant variables in their regressions to explain Portland's inflated housing prices were median income levels, a proxy for climate mildness, and a commonly used construction cost index. Instead of placing the blame on Portland's UGB, they focus on above average growth in employment as well as the occurrence of builders saturating the city's higher-end home market to satisfy demand from a barrage of new higher income residents. Rusk (1999) concurs with this finding. His research concludes that rapid economic growth and increased demand for housing by new residents lead to Portland's housing shortage and subsequent reduction in affordability.

Previous research also concentrates on the inability of UGBs to promote contiguous development as well as to restrict residents from purchasing large parcels of land within and outside a boundary. According to Portland's metro government, more than 90% of all farms outside of its UGB that were less than 160 acres reported no farm receipts in the 1980s This finding supports the opinion that protected rural land was falling into the hands of hobby farmers who engaged in sparse plantings of crops like Christmas trees or strawberry patches in order to justify their ownership and rural home building permits on large preserved parcels (Staley and Mildner 1999).

Weitz and Moore (1998) studied several Oregon cities that used UGBs finding that none of their long term planning initiatives incorporated any principles of contiguous urban development. As a result, they graded development inside an UGB as being contiguous and dense to the urban core, representing an "urban cluster" and thus being somewhat contiguous (example: a large subdivision that has a small farm within its boundaries), representing an "urban strip" and thus only being contiguous near major transportation corridors, or being urbanized non-contiguous development within one-quarter of a mile of contiguous development. Beyond their classifications, Ewing (1997) identifies non-contiguous development as "stripped," "leapfrogged," or "scattered" spatial patterns. According to the case studies of Weitz and Moore, more than 70% of the urban areas studied represented development that was contiguous to the urban core. This finding does not seem surprising given that UGBs are typically binding forms of urban containment and thus force more efficient land use of areas inside the boundary. Regardless, they also find that Oregon cities did not plan for contiguous urban forms that were "desirable" and well coordinated with infrastructure development and improvements. Some studies focus on such a lack of planning and infrastructure coordination as being a prime cause for declining housing affordability within a UGB (Arigoni, 2001).

Knaap and Hopkins (2001) offer a unique approach to dealing with the perceived connection between UGBs and rising home prices. Their “inventory approach” promotes a more efficient use of internal developable land by setting “trigger” marks for when a boundary is to be expanded. Given that most boundaries have set expansion dates and are “time driven,” they find that housing affordability is more manageable if land needs are continuously reassessed and acreage is added when existing inventory of developable land hits a “trigger” point. They find that current UGBs are only set for assessment and possible expansion at set time intervals and therefore do not accommodate growth rates beyond prior expectations. In addition, the authors also propose standards for setting land use growth rates, trigger levels for inventory of developable land, and safety inventory levels. Along with with Ding et al (1999), they also argue that UGB expansion should be coordinated with investment in infrastructure development and expansion.

In terms of coordinating infrastructure development and UGBs, Nelson and Moore (1996) specifically study four Oregon cities (Portland, Medford, Bend, and Brookings) of different sizes finding that UGBs were inefficient in managing land use inside or outside of a boundary. Besides Portland, which effectively preserved farmland and open space outside of its UGB, a large percentage of post-UGB development occurred outside of a city’s UGB. They attribute such a finding to a number of factors, including the exploitation of certain grandfather clauses and exemptions offered to suburban landowners.

In reference to interior land, they did find that most developed land was either at or close to allowable densities. However, non-developed, "urbanizable" parcels that were without appropriate public services were found to fall short of desired densities. They attribute this finding to a municipality's allowance of the subdividing of land prior to infrastructure development. As a result, larger parcels and low-density development eventually occurred – aggravating the diminishing supply of developable land within the UGB. Nelson and Moore recommend that cities control such a problem by forbidding pre-infrastructure parcel subdividing as well as setting minimum and maximum densities and lot sizes within newly developed urbanizable land.

In summary, UGBs are positively related to higher home and land prices, higher levels of spillover to adjacent counties, as well as exclusionary effects such as minority and low-income household displacement. Even though such boundaries promote higher urban densities and are often concurrently used with minimum density regulations in chosen locations, they are seemingly unable to constrain single-family home prices. Even though a city may simply intend to preserve its outer-boundary by installing an UGB, studies conclude that concurrent minimum density and infrastructure plans must also be in place in order to control how and where contiguous development will occur. Table 3 summarizes the main findings regarding the effectiveness and consequences of different types of urban growth controls.

How do Smart Growth Initiatives Impact Land Values?

The Smart Growth Initiative was introduced in the mid-to-late 1990s by a variety of organizations and government agencies (including the APA, HUD, Jackson Foundation, NRDC, and STPP) as a unified response to ongoing problems with urban growth. In general, the initiative was set forth to aid state and local governments in their planning agendas regarding housing diversity, traffic congestion, environmental degradation, and the commercial and residential use of urban and suburban land (Burchell, Listokin, and Galley 2000). More specifically, Smart Growth can be segmented into the following categories:

1. **Control of outward movement and growth.**
    a. Better accommodations for close-in areas for planned growth.
    b. Restrictions for outside, close-in areas from development to protect environment and natural habitat.
2. **Inner area revitalization.**
    a. Encouragement of public and private sector aid for the revitalization of communities and neighborhoods.
    b. Promotion of "tax yields" to spur public and private sector employment.
    c. Use of infill of vacant lands and the redevelopment of underused sites.
    d. Restoration of existing structures.
3. **Design innovation.**
    a. Creation and maintenance of attractive urban centers.
    b. Expansion of cultural exchanges to encourage more social and economic interaction.
    c. Integration of urban "living centers" to foster safe, attractive, and convenient neighborhoods.
    d. Improvement of infrastructure, public services, and community amenities.
4. **Land and natural resource preservation.**
    a. Promotion of more compact urban growth to protect external habitats
    b. Promotion of development that sustains natural resources.

5. **Transportation reorientation**
    a. Improvement of regional access to goods and services, recreation, and cultural centers.
    b. Emphasis on non-motorized and public transportation.
    c. Reconditioning of transportation systems to coincide with and meet future development.
    d. Linking transportation arteries to major retail and employment centers.

The cornerstones of the Smart Growth initiative are to offer governments tools and resources for achieving (1) more compact urban design, (2) greater choice in transportation and housing, and (3) efficient land use that enables development that is economically, environmentally, and socially desirable. Ultimately, such results should allow for the integration of housing and commercial/industrial land uses that allow for living centers to be in close proximity to employment centers. In addition, other results should be smaller lot sizes, more multi-family development-and attached homes, the development of "cluster subdivisions," and zoning that permits higher density land uses of all types. Needless to say, exclusionary zoning, especially large minimum lot size regulations, is a primary stumbling block for Smart Growth implementation (Arigoni, 2001).

Smart Growth Advantages

Advocates favor several features of Smart Growth, including its practicality and usefulness. First, it is very difficult for larger cities, which can contain a large number of independent cities and counties within their metro areas, to coordinate and implement growth management platforms without some form of bias or misrepresentation. As a result, Smart Growth is often used as an external breeding ground for land use policies that are mutually agreeable across a region. Second, given that two of Smart Growth's main objectives are to preserve open space and increase residential densities, its implementation is often an ideal supplement to existing growth controls that represent inclusive and efficient uses of developable land. As a result, Smart Growth advocates farmland and open space controls such as PDRs and TDRs as well as urban controls such as UGBs, infrastructure concurrence, impact fees, and minimum density requirements that are congenial with its land use objectives. Third, in response to critics who maintain that a combination of restrictive growth controls and high-density regulations are a major cause for inflated housing prices, some research finds that construction and infrastructure costs are less for higher-density developments. Assuming such cost savings are passed along from developers to consumers, higher density restrictions can actually increase housing affordability (Burchell et al 2000).

Housing affordability may also be enhanced by simply adding housing choices beyond usual detached, single-family homes; the inclusion and zoning for attached units, accessory units, smaller homes, and multi-family units in more urban areas are important strategies of Smart Growth. To this end, Smart Growth also endorses inclusionary land policies such as zoning regulations that mandate the development of a certain percentage of affordable housing units, or fair-share housing programs that offer density bonuses or fee waivers to developers in exchange for development of affordable units (Arigoni 2001). In reference to Smart Growth's support of higher density zoning, researchers at the University of North Carolina used a series of pictures to survey personal preference of development options. They found that consumers prefer higher density development if it combines smaller lots, smaller homes, mixed housing types, narrower streets, and nearby commercial development with sidewalks, parks, and adequate open space (Malizia 1999).

Smart Growth Disadvantages

Most of the criticism regarding Smart Growth focuses on housing affordability and the potential effects of gentrification and displacement of residents. Other criticisms are based on the following arguments: (1) Smart Growth policies represent a return to the 1970s – the height of government participation in urban structure and development (Burcell et al 2000), (2) Smart Growth lacks "horizontal" adoption and consistency among neighboring cities and counties in carrying its objectives as well as maintaining mutual opposition to market forces (i.e. commuters still favoring automobiles over public transportation), (3) Smart Growth may lack enough specific techniques that are necessary to carry out its initiatives, (4) Smart Growth policies do not have any built-in incentive mechanisms to reward cities for upholding their compliance, and (5) Smart Growth is often hampered by a city or municipality's inability to overcome certain legal and political problems that result from using boundaries and other land use regulations.

In terms of addressing housing affordability, the National Neighborhood Coalition, a principal advocate of the Smart Growth initiative, continuously stresses its concern over the effects of revitalizing and redeveloping urban neighborhoods. The Coalition is especially sensitive to urban areas that implement Smart Growth policies without a coordinated effort of adjoining jurisdictions. Their findings reveal that Smart Growth areas can become more desirable and thus attract more demand from a wider range of potential residents. As a result, a revitalized area with more public and private amenities can spur on higher home prices and ultimately drive-out existing residents. Many critics agree that such displacement of residents, commonly known as gentrification, is difficult to overcome with planning and design initiatives.

Three Examples of Smart Growth Initiatives

Los Angeles

The University of Southern California/Brooking Institute's 2001 report, *Sprawl Hits The Wall: Confronting the Realities of Metropolitan Los Angeles*, focuses on the realities of LA growing toward its natural boundaries – namely the ocean and the desert. Now that the city is forced to "grow differently," state and local governments are using Smart Growth to decide how to curtail growth in certain areas and encourage reformation in others.

Given the constraints on the outer boundaries of LA, most of its growth over the past 20+ has occurred in existing urban areas. The density of core, older communities has significantly increased, giving rise to a number of social and economic problems. The residents most affected by the city's extreme internal growth have primarily been Hispanic, Asian, and African American with lower relative socio-economic backgrounds. As a result, LA's middle class has been displaced from its core, only to seek residence in the outlying areas that are becoming less and less developable.

To compound the city's constrained growth, housing production has significantly dropped in recent years – especially with multi-family units. Housing starts have not kept pace with population growth – putting stress on existing homes. Consequently, low to moderate-income families are facing over-crowding, especially in the cities' older communities in its inner core. LA's homeownership rate in 1998 was 49% - the second lowest among the largest cities in the U.S. In 2000 the average prices of single family homes were $270,000 in Orange & Ventura counties, $200,000 in LA county, and

$150,000 in the "Inland Empire." In addition, over 37% of pre-tax wages is spent on housing.

Atlanta

The Brookings Institution Center on Urban and Metropolitan Policy's 2000 report, *Moving Beyond Sprawl: The Challenge for Metropolitan Atlanta*, targets Atlanta's problems with unbalanced growth in its North and South regions. Atlanta's Northern counties represent the majority of its middle-to-upper class growth and economic development, while its Southern counties hold a disproportionate share of wealth and job opportunities.

Atlanta has historically experienced low-density development. There are no natural boundaries to prevent sprawl, which has caused much of the higher-end jobs and affluent suburbs to expand to the northern part of the city. In addition, Atlanta's transportation infrastructure enables and encourages outward growth. This is especially evident with its I-285 beltway and the ability to easily reach northern suburbs in Cobb, Gwinnett, Forsyth, and Cherokee counties by way of I-85 and I-75. Compounding its problems with traffic congestion, Atlanta's public transportation system (MARTA) does not reach many important job centers – making it difficult for lower-income residents of Southern counties to travel to the North where Atlanta's middle and upper class (who own cars and drive to work) live, and even work.

As a result of Atlanta's present condition, the report focuses on major obstacles facing its Smart Growth initiative:

- 70% of the region's growth is in the North; only growth in the South is suburban (Henry County.)

- Of the 350,000 new jobs that came into Atlanta in the 1990s, 75%+ are in the north.
- There is an extreme shortage of middle class housing – either the high-end or low-end dominates the region.
- Northern suburbs have an affordable housing shortage. An average 2 bedroom apartment in 1995 was $665+ in northern counties close to the perimeter.
- Atlanta's housing stock overwhelmingly low-density, single-family.
- The city's high-density development has historically only catered to the wealthy.
- Atlanta's northern counties use exclusionary zoning that prohibits affordable housing development.
- The city's middle class is squeezed-out and forced to seek housing 30+ minutes from downtown (assuming they seek residence in the north).
- Atlanta's public officials have historically been pro-growth. For example, the city's zoning and tax structure is the same throughout northern counties, thereby encouraging sprawl.
- Atlanta's governance is multi-layered, making decisions regarding regional growth issues and planning difficult.

Wake County, NC

Wake County consists of a land area of 858 square miles, a population of 574,828 (in 1998), and 12 municipalities and the County government. This combination makes Wake County the largest and most diverse county in the region. The 3,500-square-mile Triangle region is continually regarded as one of America's "Best Places" in national magazines and surveys. With a projected population of 954,324 in 2020, Wake County is now the fastest growing county in the state of North Carolina. Since 1980, Wake County has experienced an annual growth rate of 3.4 percent, with its population doubling from 301,429 to 610,284 (2000 estimate). The region's population surpassed one million persons in 1996, and is projected to grow to 1.5 million in the next 25 years.

To accommodate such growth, the county's main Smart Growth planning objectives are the following:

- Guide quality growth throughout the area in cooperation with local governments.
- Encourage growth that will take advantage of existing and planned infrastructure so that municipalities are able to provide basic public services in accordance with adopted plans.
- Focus compact development in mixed-use activity centers to include housing, commercial services, and employment opportunities designed with convenient pedestrian and vehicular access from surrounding development areas.
- Protect the unique character of the area by conserving significant natural features, historic resources, and the cultural heritage that collectively establishes a sense of place.
- Ensure that the area's land use plan takes advantage of, and reflects, the area's transportation plan.
- Support agriculture and forestry operations as viable land use options.
- Provide a variety of housing densities, ownership opportunities, prices and building types.

- Cluster a mutually supportive mix of land uses to create a focal point that integrates daily activities.
- Ensure that adjacent uses are compatible with each other in use and scale.
- Connect to municipal water and sewer where practicable and other new development be designed to facilitate future urban infill.
- Allow for a balanced transportation system that accommodates a variety of travel choices.
- Site and design buildings to create a pedestrian-friendly environment.

Based on its objectives to enhance affordable housing, the following challenges face the area's local governments:

- Provide for density in accordance with the area land use plan.
- Extend water and sewer services on a regular basis.
- Improve roads, provide schools and parks, and extend public transportation service in areas targeted for growth.
- Allow multi-family developments as permitted uses in appropriate zoning districts.
- Allow mother-in-law apartments as an accessory use to single family dwellings.
- Allow manufactured housing as a permitted use in districts, which allow single-family dwellings constructed on-site.
- Provide incentives for the development of affordable housing.

Smart Growth Obstacles

Many communities leave undeveloped, or lightly developed areas "holding" zones. These parcels are usually agricultural or low-density residential, even when their land use plans designate an urban use for the area. The reasons for this practice vary, but it often is because there are not services in the area to accommodate planned uses. The plan is generally about what uses on specific properties should be permitted (and the municipality does not feel it is appropriate to predetermine the use), or the municipality wishes to obtain improvements not specified in their ordinance through the rezoning process. This practice, however, often encourages development into rural areas, where the land is cheaper and densities are more determined by the ability of the land to provide water and accept wastewater rather than by zoning.

In addition, the Wake County Board of Commissioners adopted a PDR program in 1989. This program has never been funded beyond an initial $25,000 start-up allocation. Efforts to obtain additional general funds for the program were unsuccessful due to the tightening budget situation. An attempt to include funds for this program as part of the $10 million Parks Bond in 1993 did not succeed due to a legal barrier prohibiting the combination of funding for full public access projects (parks) and projects with no public access (farmland preservation).

Discussions with local farmers prior to adoption of the PDR program in 1989 indicated a significant level of interest in participation. Changes in the local farm economy may have altered this interest level. The unpredictable future of tobacco production, which has traditionally formed the backbone of the local farm industry, is a main factor in spurring re-examination of the benefits of a PDR program. To compound farmland preservation problems, high inheritance taxes often force farm families to sell land for development.

Conclusion

Recent growth control literature concentrates on measures designed to preserve farmland and open space as well as measures designed to contain low-density urban growth. Studies on farmland/open space controls find that the more successful policies are those that (1) preserve large, contiguous parcels of land, (2) encourage participation, and (3) are perceived to be permanent and binding, thus not allowing for the capitalization of development speculation into market values. To this end, PDRs and TDRs are found to be effective, but challenged to encourage and maintain broad acceptance and participation.

The urban control literature that studies internal containment finds that mandatory zoning and boundary mechanisms may be effective, but can also be exclusive. The majority of these studies offer mixed results and focus on a control's influence on housing affordability. Depending on parcel characteristics and appraisal methods used, some studies find a direct correlation between growth controls and housing prices. Others find non-related, exogenous variables to have more significant effects. The city of Portland and the use of UGBs have been popularly studied to determine whether its long-lasting and binding controls have had significant effects on its rapidly increasing land values.

In order to assist the planning and growth management of state and local governments, the Smart Growth initiative offers suggestions for using the many types of growth controls to achieve inclusionary, efficient, and attractive high-density development, redevelopment, and land use patterns. Even though Smart Growth may offer ideal urban design and farmland/open space preservation strategies for residential and commercial development, many obstacles – as evident in the LA, Atlanta, and Wake County reports, hamper it.

Finally, with respect to the impact of growth control policies on lower income households, the literature is relatively consistent that these policies have an exclusionary effect. In other words, the market response to the implementation of growth controls is usually an increase in land and house prices. In one of the more comprehensive studies, Pollakowski and Wachter (1990) found that growth controls implemented in Montgomery County Maryland resulted in an increase in housing prices. The increase in housing prices had the secondary effect of reducing the level of affordable housing in the area – effectively excluding lower income households. Furthermore, the empirical evidence presented by Levine (1999) indicates that growth controls result in a reduction in the supply of rental units with a corresponding increase in rent levels. Again, the natural outcome is to reduce the number of lower-income families living in the area. Combining these results with the analysis of Fischel (1980) and Downs (1992) indicates that cities that enact strict growth controls effectively exclude lower-income families causing a spillover to outlying areas. In other words, the effect of strict growth controls is to shift the distribution of lower-income households from the central urban area to surrounding areas that do not have growth controls and as a result have a greater supply of affordable housing.

Appendix

Summary of Variables Used to Measure an Urban Control's Effectiveness
In terms of measuring the effects of urban growth controls on population displacement and housing affordability, the following table summarizes the most frequently used variables used in empirical studies (adjusted for the Lexington-Fayette County area).

Table A1

1. Population/Demographic Data (Available from 1990/2000 Census)
- Population levels and growth trends per race, age, income level, and educational level
- Household demographic statistics and trends

2. Housing Data
- Total number of residential units
- Total number of single-family units
- Total number of multi-family units
- Average residential (single-family and multi-family) parcel size
- Total number of single-family home sales (existing and new homes)
- Mean and median single-family sale prices (per square foot)
- Total number of single-family and multi-family rental units
- Mean and median rental rates for 1, 2, and 3 bedroom apartments (per square foot) **RentSTATS**
- Number of multi-family units
- Number of detached single-family units
- Average square footage of new residential units (relative to area's maximum density standards)

3. Commercial and Industrial Data
- Total number of commercial properties within the USA
- Total workforce accommodated within the USA
- Employment density standards (employees per gross acre)
- Average size and number of units for commercial properties
- Mean and median commercial property sale prices (per square foot)
- Mean and median lease rates (per square foot)
- Average size and number of units for retail properties

4. Vacancy Measures
- Existing inventory of available single-family and multi-family units for sale
- Existing inventory of available single-family and multi-family units for rent

- Amount of land and infrastructure available to accommodate future USA development
- Amount of non-developable within the USA
- Amount of land potential for infill or redevelopment (possibly measured by permits issued to parcels not included in vacant land database)
- Average price per square foot for vacant land
- Average parcel size for vacant land
- Vacant land absorption rates

5. Zoning, infrastructure & growth control/incentive measures (within the USA)

- Types of zoning restrictions in place per area
- Density requirements per residential zone and expansion area
- Regulations governing infrastructure and public service concurrency in meeting development demand and capacity
- USA/RSA boundaries and acreage contained within each
- USA expansion area acreage and locations
- Subdivision and planned unit development regulations
- Low-to-moderate income housing incentives in place
- Time intervals and procedures for evaluating and adjusting depletion/inventory of developable land within the USA
- Predetermined replenishment rates or order sizes for developable and expansion areas

6. Farmland/horse farm data (RSA)

- Average price per square acre of prime farmland in the RSA
- Average price per square acre of parcels used for horse farming (RSA)
- Average price per square acre of parcels used for large lot residential (RSA)
- Average distance of sold parcels from urban area
- Accessibility of sold parcels to roads and public services
- Number of parcels preserved under PDR program
- Average parcel size under PDR program
- Easement values for parcels preserved under PDR program

Chapter 2: Theoretical Models

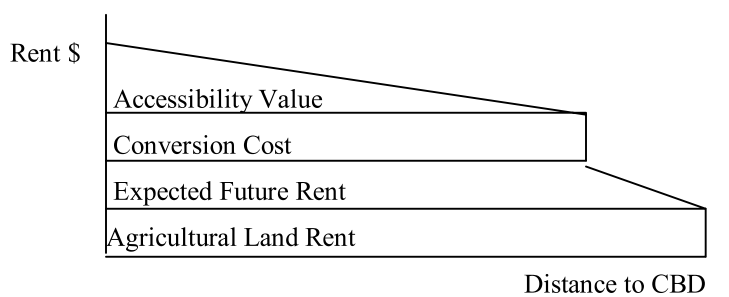
Introduction

Much of the theoretical urban growth control literature focuses on solving for optimal urban population levels, given the effects of land use regulations on land values and public and privately created amenities. The major strands of this literature model how various urban controls accomplish one of two results: (1) the creation of urban amenities that overcome lower consumer utility resulting from population growth, or (2) the restriction of developable land supply and the consequences of heightened demand within and outside of restricted areas (Brueckner 1990). Amenity creation models are typically better suited to smaller urban areas where population constraints are fully capitalized into increased land rents. In other words, such models attempt to capture an area's sensitivity to negative externalities associated with growth - such as congestion, pollution, and increased use or need for public facilities and infrastructure. Therefore, measuring reduced or enhanced amenity effects on land values is typically most effective in smaller urban areas that often do not have the capacity or will to embrace significant population growth. Conversely, supply restriction models better conform to large urban systems where growth controls have a stronger influence on demand and land values in controlled as well as adjoining (non-controlled) areas. As a result, such models shy away from negative externalities in favor of concentrating on constraints to the supply of available land.

Beyond creating amenities or restricting land supply, the theoretical growth control literature also concentrates on how the decision to convert non-developed land can impact land rents. This literature usually assumes that vacant land values have four major additive components (beyond the value-added of a parcel's unique characteristics):

- Value of agricultural rents
- Cost of development conversion
- Value of accessibility to an urban area
- Value of expected future rent increases – a growth premium

Capozza and Helsley (1989) find that growth premiums reflecting expected future rents easily account for more than 50% of a vacant parcel's value; therefore, the permanence and structure of land use regulations are an important determinant in valuing the decision or ability to convert undeveloped land.



To model the effects of growth controls on land values and conversion, a number of suppositions are assumed. First, urban areas are usually modeled as symmetrically monocentric with an urban core – the central business district (CBD). Second, most models assume that all urban residents commute to the CBD. Third, lot sizes and parcel characteristics are fixed parameters; few models actually have lot sizes increasing and population densities decreasing in their distance to the CBD. Fourth, land rents are linearly decreasing in their proximity to the CBD. Fifth, commuting costs are linearly increasing in their proximity to the CBD. Sixth, urban areas are usually represented as either “open” or “closed” cities – based on whether new residents can freely move into a city (open) or are banned from entering while existing residents are banned from exiting (closed). Also, a “closed” city usually denotes that existing residents are allowed to internally move across communities or cities within an urban system. Such an assumption sometimes incorporates another condition – the existence of a “passive” city or community within an urban system that is uncontrolled. This condition enables residents in a controlled area of a closed city to move to an adjoining area that has no density or boundary restrictions. Seventh, most models assume that a negative population externality exists such that higher population levels lower the utility of residents as well as add to increased levels of congestion. Eighth, land owners in an urban area are either assumed to be absentee landlords that simply collect rents or are resident-owners who pay rent to themselves and whose own utility can be adversely affected by population growth. Finally, the utility of existing residents is either exogenously assumed or endogenously a function of owned land units and the consumption of a congestible public good.

The remainder of this review will be organized as follows: The next section presents an overview of the models that are based on how growth controls either create amenities or restrict land supply; this follows with a discussion of research that specifically models optimal uses of urban growth boundaries. Section four then reviews some of the more recent literature involving the relationship between land conversion, the use of growth controls, and parcel values.

Using Urban Growth Controls to Derive Optimal Population Levels

Brueckner (1990) was one of the first scholars to write a theoretical article addressing the effects of urban growth controls in an amenity-based open city model. His model solves for an optimal growth control level that maximizes landowner value through enhanced residential amenities. He finds that an ***unanticipated*** land use regulation will have a positive effect on slowing population growth for all urban localities, thus improving a city's public amenities by reducing the effects of negative externalities (caused by higher population levels). His model also attempts to measure the direction of land value changes before and after the imposition of "marginal" and "continuous" controls ("continuous" modeled as a more permanent control).

To simplify the influences of many endogenous and exogenous variables, the model is based on the following assumptions:

- Population growth and consumer utility are exogenous factors that have no bearing on the type or timing of an urban growth control.
- The primary objective of growth controls is to maximize land value for existing landowners.
- The urban area/city is "open" to the relocation and spillover of potential or existing residents – allowing for a disamenity (lower quality of life) effect as population grows.
- The urban area/city is radially symmetric with an employment base (central business district) at its core.

- The utility of urban residents depends on their level of income, the rent per square acre, distance from the CBD, level of land consumption, and the level of the surrounding population.

The decision to convert undeveloped land into developed land is simply based on deriving an optimal conversion date. This choice is found by maximizing the difference between (1) the present value of agricultural rents from undeveloped land captured up until conversion, and (2) the present value of future urban rents after conversion (reduced by the present value of development costs incurred at conversion):

$$\int_0^T r_a e^{-it} dt + \int_T^\infty r(t, x, P(t)) e^{-it} dt - De^{-iT} \quad (2.1.)$$

where r = land rent per developed acre
r_a = land rent per acre in agricultural use
t = time
T = time at conversion
x = radial distance to the urban core
P = population growth path
D = cost of conversion
i = continuously compounded risk-free rate of interest

The first term in (2.1) represents the present value of the land used for agricultural purposes. The second term in (2.1) represents the present value of the land after development. The final term is simply the cost of conversion. Taking the first order, the optimal conversion date occurs when urban rents equal agricultural rents (plus development costs at conversion):

$$r(t, \tilde{x}, \pi\tilde{x}^2) = r_a + iD \quad (2.2.)$$

Therefore, this particular model implies that the choice to convert vacant land should be based on whether future cash flows (discounted to present value) from urban rents are strong enough to overcome the present value of forgone agricultural rents. As a result, landlords will arrive at equilibrium, at an optimal time, when a city's outward population growth path ultimately drives urban rents high enough. For example, a productive farmer in a rural tract that borders a newly designated urban expansion area – with concurrently expanded and developed public services, roads, and infrastructure – may reach an optimal development date (not withstanding growth controls and/or tax incentives and easements) as the present value of his rents from converted land may far exceed his agricultural cash flows and his cost to convert.

In terms of modeling the effects of growth controls on values of developed and undeveloped land, Brueckner differentiates between pre and post-control implementation dates as well as whether a "marginal" and "continuous" form of control is assumed. Ultimately, he seeks to solve for changes in the value of existing developed and non-developed parcels when a control either imposes a slight ("marginal") development delay or a stricter, long-term delay ("continuous"). As a result, his model derives and compares values for developed and undeveloped land in a pre and post-control time period - finding that the difference in a parcel's value between the pre and post-control time period is positive, and the value of future rents is also positive. Thus, his model solves to an indeterminate present value – suggesting the need for measuring the strictness of a control.

Brueckner's model also finds that when a control is "marginal" and thus only poses a slight delay in development conversion, the value of undeveloped land increases since land conversion dates are relatively unaffected by the loss of value from delayed development. Conversely, under a "continuous" control the optimal development conversion and the city's population growth path are ultimately bound. As a result, only locations adjacent to an urban limit have positive increases in value; otherwise the sign in values is mixed and indeterminate.

The last part of Brueckner's model addresses whether an efficient growth control can be implemented. Again, assuming that the city planner's primary objective is to enhance the welfare of existing landowners, the model focuses on the urban and agricultural land rents that parcels can capture – subtracting out the cost to convert agricultural parcels. His model finds an optimal control level where the difference between the present value of urban and agricultural rents and the present value of conversion costs is greatest (difference between equations (2.3) and (2.4)).

$$\int_{t=0}^{\infty}\{\int_{x=0}^{\tilde{x}_e(t)} 2\pi x r(t,x,\pi\tilde{x}_e(t)^2)dx + \int_{\tilde{x}_e(t)}^{B} 2\pi x r_a dx\}e^{-it}dt \qquad (2.3.)$$

$$\int_{x=0}^{\infty} \pi\tilde{x}_e(t)^2 iDe^{-it}dt \qquad (2.4.)$$

where $x_e(t)$ = city boundary under an efficient control
$\pi x_e(t)^2$ = total population under an efficient control
B = outer boundary of a planner's jurisdiction

As a result, the efficient growth control is chosen relative to a population growth path that maximizes this difference. Its first order condition yields the equilibrium urban rent under an efficient growth control - assuming specific boundary conditions as well as urban and agricultural rents.

$$r(t,\tilde{x}_e(t),\pi\tilde{x}_e(t)^2) = r_a + iD - \int_0^{\tilde{x}_e(t)} 2\pi x r_p(t,x,\pi\tilde{x}_e(t)^2)dx \qquad (2.5.)$$

The first inside integral in equation (2.3) represents total urban land rents at time t, given the existence of an efficient city boundary (donated by $x_e(t)$) and a population level. The second inside integral simply represents total agricultural rents at time t – bound by a city planner's jurisdiction (B). As a result, the outside integral in equation (2.3) is simply the discounted present value of the combination of urban and agricultural rents from time t = 0 to infinity. Conversely, equation (2.4) represents the present value of conversion at the optimal conversion date, given a developable land boundary condition and a population growth path. As a result, maximizing equation (5) produces an efficient growth control. In other words, equation (2.5) produces the highest land value for a given level of land use control. This result implies that planners continuously incur the challenge of balancing how they can maximize urban and agricultural rents (minus conversion costs) with self-imposed boundaries. Also, as land near urban boundaries rise in value, an efficient and value maximizing control is continuous, and equilibrium growth paths are continuously revised – making the decision to assume a population growth path and efficient boundary difficult.

Beyond the planner's challenge, Brueckner notes that presence of political implications can weigh heavily on the decision to implement growth controls. Even though controls can be welfare improving through the enhancement of amenities and the reduction of negative population externalities, vacant landowners who are delayed or restricted from conversion and capturing urban rents can severely disagree with developed landowners over the timing and strength of a control. Therefore, Brueckner's model is also valuable in structuring debates on the relationship between land use/control and land valuation.

Brueckner's model also finds that growth controls raise rents of developed land at all locations. Since residents experience higher utility from a controlled population level, they are found to pay a higher premium to live in a smaller, controlled city. In terms of undeveloped land, his findings are somewhat conflicting and thus ambiguous. His model shows vacant land to both increase and decrease in value due to the potential of capturing urban rents countered by the delay from such conversion.

Extending from Brueckner (1990), Engle et al (1992) also offer a model that measures the amenity effects of urban growth control. Again, through the use of comparative static analysis, the authors make several key assumptions and solve for the effects on land rents as well as the welfare of renters and owners of both developed land and non-developed land. Their assumptions are standard and similar to Brueckner's with two major adjustments:

- The existence of two open cities with free migration
- The existence of two agents: (1) renter residents who are indifferent in utility and welfare gained/lost, and (2) absentee landowners who enjoy all utility gained from increased land rents.

Regardless of these adjustments, their model finds that land use regulations again counter the negative externalities associated with population growth. As a result, the increased amenities created by lower populations are captured in higher land rents – simply boosting the utility of absent landlords.

The most useful insights from the Engle et al model are the effects of growth controls on specific amenities or negative externalities. In particular, the authors focus on the effects of congestion, pollution, transportation costs, the use of public facilities, as well as the demand for labor. The congestion-related negative externalities (pollution, crime, and increased commuting time) are all found to reduce the social welfare of resident owners of developed land. As a result, developed landowners favor growth controls – not only because they counter reduced amenities, but also because of the higher rent levels in a supply-restricted area.

In terms of public facilities and labor demand, landowners are also found to favor growth controls because they counter the increased use of public facilities as well as the increased supply of labor. If population growth spurs the demand for public facilities and their marginal costs outweigh their average costs, the authors stipulate that owner-residents are forced to subsidize growth. In terms of employment, even the most elastic labor demand still motivates developed landowners to control growth. The authors contend that there is no clear empirical relationship between population growth and unemployment or economic prosperity.

Ultimately, the Engle et al paper finds that growth controls reduce negative externalities, which benefits owners of developed land, but disadvantages owners of non-developed land. Since their model assumes that growth controls completely restrict any new construction, non-developed landowners only capture some of the amenity enhancements and capture little, if any, increase in land rents. Their model does not incorporate the effects on renters; they are simply assumed to be indifferent to growth controls and their effects.

Extending the Engle et al model, Sakashita (1995) offers much of the same amenity-based analysis on the effects of growth controls. However, his model slightly differs in that it assumes a closed two-city area and endogenizes resident utility. In other words, instead of assuming that landowners are absent and strictly derive their utility from higher land rents, this research allows for landowners to be residents who also derive welfare from consumption of housing service and a composite good. Regardless, Sakashita offers similar findings to Engle et al, that is growth controls that limit negative externalities associated with population growth are welfare enhancing and utility maximizing to owner-residents, especially those that minimize transportation costs related to increased commuting time.

Pasha (1996) offers another growth control model with a closed city assumption. He makes many of the same assumptions as his predecessors with regard to spatial patterns and the existence of negative population externalities. As with the Sakashita model, Pasha also considers resident utility to be endogenous. However, unlike other research, he makes one major alteration to his assumptions – the inclusion of two income groups within a city. In other words, wealthier residents own land and live in the suburban periphery of a city's region and thus commute to their employment in the CBD: Conversely, poorer residents live and work in the central part of the city. In addition, he assumes that both types of residents have the same level of utility and that the city's growth control is in the form of a minimum lot size ordinance.

The Pasha model interestingly solves for several unexpected outcomes. First, he finds that the implementation of a minimum lot size decreases the value of land in the CBD. Second, suburban land values do not change in the same direction within different proximities to the CBD – land values actually fall in the outer suburbs and rise closer to the city's periphery. These findings can be attributed to the form of control the model assumes – one in which residential growth and suburban sprawl are permitted.

Ultimately, the Pasha model concludes that minimum lot size zoning in a closed city has a negative valuation effect on most parcels (except those on the periphery) and encourages outward metropolitan growth. In addition, his study finds such outward growth reduces the utility of wealthier suburban residents (even though they gain utility from lower density land use) while actually increasing the utility of poorer urban residents. In other words, Pasha argues that minimum suburban lot sizes artificially increases external land consumption and thus "flattens the rent gradient" in the central part of the city.

Since a major difference among much of the theoretical growth control literature is how different studies assume and accommodate population movement and relocation within a city or group of cities, Helsley and Strange (1995) also follow Engle et al in offering strategic policies for controlling urban growth within a "closed" system of communities, thereby presenting a model that disallows population growth, but enables migration between a city's internal communities. By making a "closed" city assumption, they find that they can best capture utility levels of a fixed population, rather than an outlying and excluded population that would be potential residents in an "open" city model.

The Helsely and Strange (1995) model is based on game theory and makes two major assumptions: (1) growth controls are endogenous and thus are only implemented to serve a communities' self-interest, and (2) there exists equilibrium effects of growth controls on both housing prices and residential utility. In addition, their model is the first to find growth controls to be supply restricting, thus having no connection to amenity effects. Such an assumption does not rely on enhanced welfare stemming from a small city effect. Instead, this type of model is best suited for larger urban areas where growth controls create diversions in population and increased demand throughout a city. As a result, each city-wide community in their model has a particular equilibrium utility level that depends on the balance between rising home prices, the preservation of a community's quality of life, and welfare-decreasing growth controls that even profit-maximizing developers may endorse and help enact.

The main contribution of the Helsely and Strange (1995) supply-restriction model is that they find growth controls to be inefficient in achieving equilibrium between price and population. Their model derives this result because more exclusion (via growth controls) is desirable to existing residents when it lowers the utility level in rival/adjoining communities. In other words, profit-maximizing residents will want to restrict the size of their communities in order to exert a negative externality (population growth) on uncontrolled communities. As a result, community residents tend to favor non-optimal controls to push potential residents to other communities – thereby lowering those utility levels and enhancing their own property values.

Another important contribution of Helsley and Strange is that they find the "open city" assumption to be limiting because of the difficulty in measuring utility and welfare of existing residents. With the free migration assumption in an open city, it is seemingly impossible to differentiate welfare reduction (among current residents) from rising housing values that may actually offset amenity enhancements. In addition to focusing on how growth control effects are capitalized into land rents for absentee landowners, the authors examine the exclusionary effect of growth controls, which forces residents to neighboring areas and thereby damages utility levels in adjoining communities.

To remedy some of the limitations in the prior literature, Brueckner and Lai (1996) offer a second supply-restriction model that assumes the following:

- Landowners are residents and thus pay rent to themselves (a more realistic assumption).
- The urban area is closed, but allows for free migration within the urban area.
- Resident landowners are immobile, but renter residents are allowed to move within the urban system.
- Resident landowners dominate the political process and thus decide on the implementation and timing of land use regulations.
- There exists a "passive city" within the urban system – allowing for residents to move to an uncontrolled area.
- All residents work in the urban core and commuting costs linearly decline with distance to the CBD.

These assumptions allow Brueckner and Lai to develop a model that focuses on the effects of restricting land supply - solving for an optimal growth control that balances the increased level of rent from a control-induced supply restriction and the resulting reduction in size of rentable land. In addition, they account for how growth controls make a city more compact, thus lowering the commuting costs of owner-residents. Ultimately, their model solves for an optimal control level where the landowners' rental income is equivalent to their cost to commute to the CBD.

The Brueckner and Lai model adds to the prior literature in an important way: as already mentioned, it allows landowners to be residents (compared to being absentee).

This assumption is not only more realistic, but it also forces landowners to be more tolerant of population growth – and its accompanying negative externalities. In other words, since landowners are paying rent to themselves, they incur no benefits and thus need to augment their welfare by other means (i.e. more rent from renter-residents). Therefore, the model finds that resident-owners gain higher levels of utility from increased population growth and are less apt to strictly enforce land use regulations.

However, the Brueckner and Lai model primarily focuses on optimal urban spatial structure in light of restricted land supply, which results from growth controls. It does not accommodate amenity effects nor does it measure production activity, congestion externalities, or public good provisions. As a result, Sasaki (1998) expanded the Brueckner and Lai model to incorporate these effects and derive "more realistic" results.

Like Brueckner and Lai, Sasaki (1998) assumes a closed, two-city system where one city actively controls growth and the other passively reacts. Also, renter-residents reside in the CBD while owner residents live in the outer suburbs. Unlike Brueckner and Lai, the Sasaki model measures the effects of growth controls on labor and productivity by assuming that owner-residents run businesses in the CBD in which renter-residents work and produce output. In addition, the model allows for owner-resident businesses to sell their output nationally – allowing them to pay wages and distribute excess earnings among themselves. As a result, instead of assuming an exogenously given income level among residents (as in the Brueckner and Lai model), this model shows that urban production also has significant consequences on the effects of growth controls. Likewise, the inclusion of congestion externalities (used in much of the previous literature) as well as public good provisions (not treated in the Brueckner and Lai model) has effects on Sasaki's optimal city size (assuming growth control implementation).

Given his adjustments and added assumptions, Sasaki's model concludes that (1) the productivity inclusion generates a larger optimal city size since owner-resident business managers are more accommodating to higher populations of a renter-resident labor force, (2) the inclusion of a negative congestion externality drives the optimal city size lower due to higher transportation costs, and (3) the inclusion of a public good provision also pushes the optimal city size lower since owner-residents are assumed to finance the additional demand for public services. Unfortunately, the model does not solve for the combined effects and thus only finds that the inclusion of labor's marginal product offsets congestion and public good externalities and expenses in terms of the influences of a landowner-mandated growth control.

In conclusion, the theoretical literature on driving optimal controls of population growth has developed from relatively simple models with basic demographic and spatial assumptions to models that attempt to more realistically depict urban patterns. Even though all of the aforementioned articles agree that growth controls have a positive effect on land values and can influence resident utility, each has one or two assumptions that differ and motivate unique results. This is particularly evident in amenity based models that try to capture the effects of population externalities in open and closed cities. In some cases optimal growth controls are more restricting and thus favor smaller urban areas with fewer congestion related externalities. In other cases controls are less welfare enhancing due to reduced productivity or rent appreciation accruing to landowner-residents.

Modeling the Relationship of UGBs and Land Values

Knaap (1985) was the first to specifically model the effects of an urban boundary on land rents. Before concentrating on UGBs, he first introduces a basic partial equilibrium model that offers a simple understanding of how a zoning regulation affects nondeveloped ("urban" and "nonurban") land values. His model assumes the following:

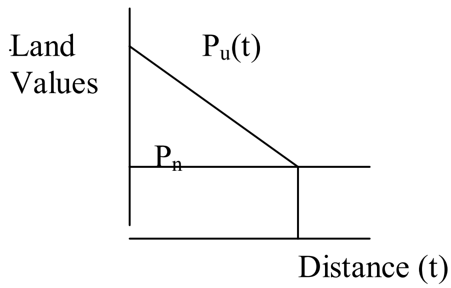
- All parcels have a radial distance to the urban core (CBD).
- "Urban" vacant parcels are currently zoned for development and generate rents that linearly decline with distance ("t") from the urban core.
- "Nonurban" vacant parcels outside of an urban boundary are not currently zoned for development. They are "spatially invariant and thus generate rents that are equivalent with respect to their distance from the urban core."
- "Nonurban" vacant parcels are categorized as "urban" within the urban boundary.

If zoning designations are perceived to be permanent, the values of either urban or nonurban are simply the present values of their future cash flows (rents):

Nonurban: $$P_n = R_n + R_n/(1+r)^1 + R_n/(1+r)^2 + ...R_n/(1+r)^\infty \quad (2.6.)$$

Urban: $$P_u(t) = R_u(t) + R_u(t)/(1+r)^1 + R_u(t)/(1+r)^2 + ...R_u(t)/(1+r)^\infty \quad (2.7.)$$

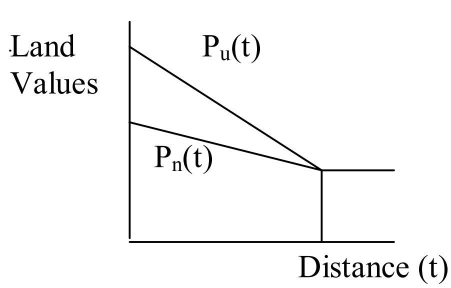
where R_n = Nonurban rents
R_u = Urban rents
r = Market discount rate
t = Linear distance to CBD
x = Expected date of up-zoning.



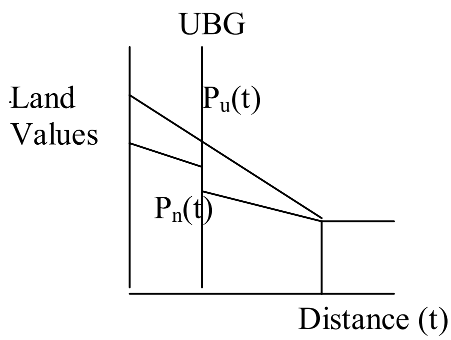
Graphically, the value of urban parcels linearly decline with distance to the urban core – eventually meeting the value of nonurban parcels in equilibrium. However, when zoning designations are not permanent and certain nonurban parcels will be converted (date of upzoning = x) into urban parcels, the nonurban parcel value becomes:

$$P_n(t) = R_n + R_n/(1+r)^1 + ...R_n/(1+r)^{x-1} + R_u(t)/(1+r)^x + ...R_u(t)/(1+r)^\infty \qquad (2.8.)$$

As a result, nonurban land that is designated for upzoning conversion in the future takes on a higher present value due to anticipated future urban rents – reflected in higher nonurban parcel values closer to the urban core. Ultimately, a partial equilibrium is again reached where $P_n(t) = P_u(t)$.



The model also extends to incorporate an UGB as the method of zoning and thus separates nonurban land values based on their location within or outside of the boundary as well as the timing of their up-zoning conversion. Again, nonurban prices that are perceived to be up-zoned are more highly valued than nonurban land that is not expected to be up-zoned. The main difference with such a finding is that nonurban land within an UGB is more highly valued than nonurban land outside of an UGB because of expectations of sooner zoning conversions.



Graphically, within the UGB both nonurban and urban parcels have higher values – as determined by their proximity to the CBD. Urban parcels are always higher in value given their ability to extract higher rents. Also, nonurban parcels drop in value at the UGBs fringe due to the expectation that their conversion will be delayed by a more permanent boundary condition (UGB). Conversely, urban parcel values remain linearly tied to their radial distance to the CBD and simply decline until reaching an equilibrium level with nonurban parcel values.

Therefore, the primary findings of this model are that (1) the value of urban land linearly decreases with distance to the urban core – both inside and outside of an UGB, and (2) the value of nonurban land also decreases in value with its distance to the urban core, however severely decreases outside of an UGB.

Extending from Knaap's earlier work, Ding, Knaap, and Hopkins (1998) offer a more extensive theoretical analysis of the effects of managing urban growth with an Urban Growth Boundary. Their model focuses on an optimal size and expansion area for maximizing social welfare. As with the aforementioned model, they ignore specific landscape features and assume a city to be linearly monocentric with decreasing urban rents respective to the distance to the urban core. Also, they assume that a city's infrastructure is a fixed investment that is augmented with lump-sum capital infusions.

The authors' main findings are that (1) social welfare can be increased by setting an UGB, (2) an optimal UGB increases with infrastructure capacity, (3) an optimal UGB decreases with development costs and agricultural rents, and (4) UGB expansion is best coordinated with urban infrastructure investment. To derive their results, the model derives the following valuation of urban vacant land and its maximization:

$$V = \int_0^T [\int_0^n r(t,x)dx + (B - n(t)) * r^a - C(n(t), \bar{K}) - n_t D] e^{-it} dt \quad (2.9.)$$

$$r(t,n) - C_n(\overline{K}, n) = r^a + iD \quad (2.10.)$$

where
r = urban bid rents from owning land
r^a = nonurban, agricultural land rents
t = time component
B = distance from CBD
n = urban population
T = terminal value of planning horizon
x = number of miles from CBD
i = market discount rate
C = cost of public good
K = infrastructure level
D = cost to convert nonurban land.

Therefore, as seen in equation (2.9), the present value of aggregate land rents is represented by (1) positive urban rents as a function of time and proximity to the business district (CBD), (2) positive agricultural rents that decline with proximity to the CBD, but rise with increasing population (n) growth, (3) negative costs associated with public goods (as a function of population levels and infrastructure needs), and (4) negative costs associated with the conversion of nonurban land. Ultimately, this entire function is first integrated with respect to population level and then with respect to the time of a planning horizon – allowing one to derive an area's aggregate vacant land value for a given population at a particular time.

As a result, since the value of vacant parcels are represented by the present value of their urban rents and agricultural rents (adjusted for proximity to the CBD and deducting for provisions to pay for public goods and a future cost of conversion), maximized aggregate vacant land values are derived in equation (2.10). Assuming a fixed level of the "public good," the above first order condition simply states that urban growth should continue until equilibrium is reached between the urban rents (minus the marginal cost of the public good) and agricultural rents (minus the interest cost of development).

When incorporating the use of an UGB to control urban expansion, their model finds that an optimal population level is achieved when the present value of urban rents – net of agricultural rents and the marginal cost of a publicly consumed infrastructure (summed over the period extending form the UGB implementation and some terminal date) is equal to the present value of development costs. As a result, the optimal size of a UGB decreases with development costs and agricultural rents, and expands with the marginal cost of infrastructure as well as the lengthening of the control's terminal date or planning horizon. In conclusion, this model is an important extension to this literature because it shows UGBs to be welfare enhancing - as long as their use is coordinated with infrastructure capacity/investment and planning horizons. UGBs are found to be most suitable in areas where development costs and agricultural rents are highest.

Extending from many of the prior amenity-based and supply-restriction studies on the effects of urban growth controls, Cho (1997) offers a model that specifically addresses binding controls such as UGBs. His model concedes that such controls do increase the scarcity of developable land and thus have a positive effect on land values within a boundary. Cho finds that binding controls raise land rents in non-restricted areas, create positive amenity effects by restraining population growth, produce a welfare loss to residents in restricted areas because of delayed conversion opportunities, decrease the cost of infrastructure development (due to less population growth), and promote higher density development in certain areas. Given his finding that a boundary constraint can motivate cities to allow for higher density development in specific regions, he allows for housing supply to keep pace with demand. This assumption enables stability in housing prices – at least from supply-side forces.

Contrary to price stability from increased density development, the important contribution of Cho's model is the effect of reduced amenities that stem from congestion externalities caused by higher densities. He finds that the increased costs of congestible urban amenities and public goods will inflate land values as urban residents are forced to pay more for what they consume (roads, water, sewage…). Therefore, even though supply constraints caused by UGBs can be countered with higher density zoning, his model concludes that land values will still inflate because of a lack of public planning and response to various congestion externalities.

Part of the UGB theory development has focused on modeling expansion techniques that soften an UGBs effect on land values. Knaap and Hopkins (2001) created an inventory approach to structuring and expanding urban boundaries that seeks to improve upon past practices of urban planners. They argue that planners have historically used "time-driven" systems of inventory control to expand UGBs and accommodate population growth. In other words, much UGB planning has centered on forecasting the need for developable land over a 10 to 20 year time horizon. In addition, they contend that planners seek to contain land areas and minimum densities sufficient to accommodate between 115 and 125% of projected urban growth for a 10-20 year period. As a result, UGB expansion is often pre-determined, regardless of the rate of population growth, and assumes constant consumption patterns – allowing for fixed intervals of additions to the supply of developable urban acres.

The authors argue that variable and uncertain consumption rates often work against time-driven inventory replenishment and therefore model an "event-driven" system. They find that creating reorder trigger levels allows for smoother consumption patterns and less volatility in land values. Such a system is especially functional if it allows for (1) "lead-time" inventory that enables partial expansion prior to full implementation of an UGB expansion area, (2) "safety-stock" inventory to meet land use demand that quickly outpaces trigger levels, and (3) "market-factor" inventory to allow for additional land supply in the event landowners have an unfair competitive advantage and can monopolize price. Ultimately, the event-driven system allows for a much smoother land consumption path that allows for a boundary to grow in tandem with the timing of volatile urban expansion periods.

To conclude, Knaap and Hopkins discuss several possible problems and disadvantages to any system of growth boundary extension. First, they note that such systems are based on preconceived urban growth rates that can widely vary and have little predictive ability. Second, there are costs with ordering the expansion of inventory as well as holding it. Even though holding excess inventory may smooth consumption and valuations, it may not be the most efficient or cost effective use of such land. Third, meeting infrastructure expansion needs is also costly and time consuming, thus, prompting the need for coordinated investment and expansion. As a result, the use of UGBs offers urban planners a challenge in determining an appropriate expansion area and inventory size that will meet their growth needs as well as cost effective.

The Conversion Decision and Urban Growth Controls

A third major strand of the theoretical growth control literature focuses on the decision to convert undeveloped land in the face of urban growth restrictions. Since a potential government zoning ordinance or taking can severely reduce the supply and availability of vacant land, large opportunity costs and real option premia can exist and even motivate irrational development. Conversion and development is often a direct result of the increased risk in not being able to capture future land rents.

Capozza and Helsley (1989) were one of the first to address the land conversion decision by modeling the value of vacant urban land. Their model solves for the sum of the present values of future agricultural rents, future capital improvements, future value of parcel accessibility, and future urban rent increases resulting from conversion. When incorporating urban growth boundaries, they find that (1) vacant land far outside of a boundary is priced at its agricultural value, (2) agricultural land closer to a boundary sells for a premium due to the potential of a relaxed boundary constraint and the future value of conversion, (3) vacant (nonagricultural) land at the boundary's periphery includes both the value of future urban rents minus the cost of conversion, and (4) vacant urban land within the boundary capitalizes future rents, conversion costs, as well as accessibility to the CBD. Ultimately, the primary contribution of their research is that the value of convertible land rises with agricultural rents, a decreased cost of conversion, a lower cost of commuting, and an increased city size (making the probability of future conversion and capturing urban rent more likely).

Capozza and Sick (1994) extend prior land conversion research to include the price of uncertainty. They develop a real options approach to valuing land prices and the decision to convert vacant land by accommodating risky growth opportunities and the existence of risk adverse investors. Ultimately, they derive a closed form solution for a parcel's price using both arbitrage pricing theory and the capital asset pricing model – allowing for the pricing of systematic and unsystematic risk. In addition, they derive a "hurdle value" for parcels at which urban land value (less conversion) meets or exceeds agricultural land value.

The authors find that the price of vacant land is (1) an increasing function of the growth rate of future urban rents, (2) an increasing function of unsystematic risk (higher volatility of returns), (3) a decreasing function of an investor's risk aversion, and (4) an ambiguous function of systematic/non-diversifiable market risk. In addition, the authors argue that systematic risk raises the value of the option to convert, but decreases the value of undeveloped land. As a result, they ultimately derive a "hurdle value" above which it is optimal to convert. In other words, the hurdle price is set where the present value of future urban rents (minus the cost to convert) exceed the present value of agricultural rents. Since the risk of uncertainty in returns is accommodated in their model, the authors find that higher levels of risk associated with capturing urban rents is significantly related to higher option values and thus higher hurdle rates. The final consequence of increased risk is longer time periods to convert and develop – meaning that optimal conversions are extended in time due to increased uncertainty.

Extending from the Capozza and Sick model, Riddiough (1997) also developed a real options approach to valuing undeveloped land. His model differs in that it focuses on the loss of landowner flexibility that results from regulatory takings. Since land use constraints can impair flexibility of choice and reduce a vacant property's value, the author measures the effect on the option to convert as well as the economic consequences.

Riddiough's model assumes that a property value's returns are normally distributed across continuous time. The drift (μ-δ) is simply the annualized expected return minus the built property's payout rate. The stochastic term is the annual standard deviation of the property's return, assuming a standardized Weiner process.

$$dP / P = (\mu - \delta) dt + \sigma dz \qquad (2.11.)$$

The model imposes several possible limitations to the potential of achieving cash flows from P – namely the aforementioned imposition of a regulatory taking period that can stall optimal conversion. As a result, he solves for a "hurdle value" at which it is optimal to incur development costs and thus create an "in the money" option to convert.

However, due to the increased uncertainty associated with government regulations on land use, the model finds that market participants "endogenize" the possibility of strict growth controls and thus increase their required expected returns. Therefore, to compensate for such risk, the authors argue that landowners are prematurely motivated to convert and develop vacant land – before an optimal date (had there been no risk of regulatory loss of property rights). The hurdle rate at which development should occur decreases as land values become more sensitive to regulatory pressure – leading to a higher probability of conversion. As a result, the model's main finding is that, as premature development activity grows in anticipation of loss of development rights, overbuilding occurs and once profitable projects actually become unprofitable.

Conclusion

In this chapter, we have found that the decision to convert vacant land is influenced by uncertainties related to future urban rents as well as the probability of being able to capture such rents. Our survey covered three basic models. The first set of models describes the growth of urban areas. These models focus on population growth and show the impact of growth controls on the "optimum" population level. Furthermore, these models demonstrate at the theoretical level that growth controls should have a positive impact on land values. The second set of models focuses explicitly on the relationship between urban growth boundaries and land values. These partial equilibrium models show that land within the urban boundary will have be valued at a premium due to the ability to convert the land to more intensive use. Finally, the third set of models are derived from the "real options" literature and theoretically document that constraining the development option via a growth control or growth boundary will impact land values. The models demonstrate that the value of a landowner's option to convert is positively related to increased risk and the time to conversion. Therefore, growth controls can fuel higher option values, while also motivating premature development that is neither optimal (in terms of timing and profitability) nor economically favorable in the market.

Chapter 3: Empirical Analysis

Introduction

In this chapter, we empirically test the extent that Lexington's growth controls have affected housing prices and vacant property values. Our empirical tests are based on the theoretical predictions derived from the models surveyed in chapter two. In that survey, we noted that urban economic theory suggests that local growth ordinances may increase land values by controlling negative externalities associated with population growth. Urban economic theory also suggests that local growth ordinances may limit the supply and availability of new housing. The overall assessment from a theoretical view is that growth controls require a cost/benefit tradeoff for policy makers. In this chapter, we provide evidence on the costs as well as benefits associated with Lexington's growth controls.

One of the overall principles identified in chapter two was that vacant land values move in proportion to the potential or likelihood of future development. As a result, strong growth controls and the corresponding perception of development delay can significantly reduce vacant parcel valuations (Brueckner, 1990). Thus, if a vacant land control is perceived to be "marginal" and only produce minor delays in development, then urban growth controls will have a small impact on the value of undeveloped land. Conversely, under a "continuous" control, the binding of a vacant parcel's development conversion to a city's population growth path is found to have indeterminate or even negative effects on valuations. Given the permanence of Lexington's urban growth boundary (UGB), we examine the impact of changes in the UGB over time on vacant property values.

Assuming vacant developable land parcels exist within an urban boundary, Brueckner, Engle et al, Sakashita, Helsely and Stange, and Knaap argue that existing residents benefit from increases in parcel values. Their models reflect how land use restrictions limit population growth and reduce negative externalities associated with congestion – thereby enhancing welfare. Such results, coupled with reductions in the supply of developable vacant land, tend to support both theoretical and empirical claims that growth controls raise rents of developable vacant land at all locations within an urban boundary.

However, if a control or boundary exhibits inflexibility over time, the Helsely and Strange (1995) model also suggests that growth in and around an urban center can stabilize as negative externalities associated with congestion encourage spillover of potential residents to uncontrolled communities. Thereafter, vacant land values may no longer increase as the urban service area reaches a saturation point.

Fayette County's use of an urban boundary over the past 40 years is unique and thus produces a significant measurement problem for empirical researchers attempting to assess the effect of the urban boundary on property values. The measurement problem results from the inability to identify a valid baseline to benchmark against. That is, it is difficult to obtain appropriate data on property values prior to enactment of the UGB, which creates problems in measuring the impact of the UGB. Unlike previous research that attempts to measure the immediate effects of implementing an urban boundary or other form of restrictive zoning mechanism, we examine property values over the past 30 years – during the existence of a "permanent" boundary that has been expanded seven times (from 1970 to 2001). Our analysis incorporates specific expansion dates as well as other quantifiable data in an attempt to explain what has most significantly influenced growth in parcel values within Fayette County.

Given the difficulty in estimating the impact of urban growth controls on land values, we develop a three prong approach that moves from macro-level data to micro-level data. As a first step in determining the impact of Lexington's urban growth controls, we address the question of how has Lexington changed relative to a group of "peer" cities over a long time-horizon. By using a four decade window, this approach has the advantage of allowing us to observe long-term trends in Lexington's growth. Furthermore, this approach also allows us to compare the "relative performance" of Lexington to an objective benchmark that is easily identifiable.

Our second approach moves toward identifying the impact of Lexington's UGB on property values by utilizing an index of housing value changes. Rather than simply rely on examining changes in demographics from census data, this approach allows us to formally model quarterly changes in housing values. As a regression based approach, this method has the advantage of allowing for a precise estimate of changes in house prices during periods when the UGB changed. Unfortunately, the house price index is an aggregate measure of Lexington property values and thus does not allow us to control for the impact of location or changes in investor taste preferences.

Our third approach is a micro-level analysis of Lexington property values. This approach allows us to specifically test for changes in sales prices during periods leading up to an expansion of the UGB. Using a regression based method, this approach controls for various factors that impact property values and allows us to isolate the impact of the UGB.

Finally, as noted in the literature review, growth controls typically produce spillover effects to neighboring counties. Thus, as a brief measure of spillover from Fayette to the surrounding area, we examine the population and growth rates from the 1990 and 2000 census for Fayette and the surrounding counties.

Comparative Study of 20 Metropolitan Service Areas (MSAs) and the Lexington/Fayette County MSA

As a first cut at estimating the impact of Lexington's UGB, we begin with a comparison of Lexington's growth over the past 40 years. In 1970, Lexington's population was 174,339 and ranked 138. Over the next 30 years, Lexington experienced significant population growth such that by 2000, Lexington's population was 260,512, ranking 86. Over the 30 year period, this population increase corresponds to a 1.35% per year growth rate. Given that the urban growth boundary effectively caused the amount of developable land to remain relatively constant between 1970 and 2000, this pattern of growth is remarkable. In comparison, the U.S. population growth rate was 1.09% per year. Thus, it appears that Lexington has achieved a faster growth rate than the U.S. population.

However, a more accurate picture of Lexington's growth requires that we compare Lexington to a more accurate benchmark than the national growth rate. Thus, we compare Lexington's growth rate to other "comparable" or "peer" cities in order to determine if its growth is unusual. Using the census population county from 1970 as the base for comparison, we selected 20 cities to serve as benchmark cities: 10 ranked just below Lexington in size and 10 ranked just above Lexington in size. These twenty cities constitute our "peer" city comparisons (see Table 3.1). If Lexington is able to achieve faster growth than its "peer" cities, then this would provide evidence that Lexington's growth controls have not had a detrimental impact on growth. On the other hand, if

Lexington's growth is slower than that of its peers, then perhaps the growth controls may have a negative impact. It is important to caution that this comparison of Lexington against its peers does not constitute a "scientific" or statistical test, and thus we are not able to prove that Lexington's growth controls had a positive or negative effect. Rather, the peer comparison provides a rough measure of relative performance.

Table 3.1: 1970 "Peer" Cities

Durham NC
Brockton MA.
Savannah GA
Salem, OR
Wheeling, WV-OH
McAllen-Pharr-Edinburgh, TX
Roanoke VA
Lubbock, TX
Terre Haute, IN
Atlantic City, NJ
Lexington KY
Lima, OH
Racine, WI
Galveston-Texas City, TX
Lincoln NE
Steunbenville-Wierton, OH-WV
Champaign-Urbana, IL
Cedar Rapids, IA
Springfield, IL
Fort Smith, Ark.-OK
Green Bay, WI

In order to determine whether any of these "peer" cities had urban land use controls that remotely compared to the perceived permanence of Lexington's UGB, we surveyed each city's planning commission as to the type of growth control utilized as well as when it was enacted. In most cases the responding cities either did not have urban growth controls, or used relatively impermanent controls to slow development growth in specific areas of their MSAs.

Table 3.2: Growth Controls

MSA	1970	1980	1990	2002
Durham NC	n/a	n/a	n/a	n/a
Brockton MA.	n/a	n/a	n/a	n/a
Savannah GA	n/a	n/a	n/a	n/a
Salem, OR	3	3	3	3
Wheeling, WV-OH	2	2	2	2
McAllen-Pharr-Edinburgh, TX	n/a	n/a	n/a	3
Roanoke VA	n/a	n/a	n/a	1
Lubbock, TX	2	2	2	2
Terre Haute, IN	n/a	n/a	n/a	n/a
Atlantic City, NJ	n/a	2	2	2
Lexington KY	8	8	8	8
Lima, OH	2	2	2	2
Racine, WI	3,4	3,4	3,4	3,4
Galveston-Texas City, TX	n/a	n/a	n/a	n/a
Lincoln NE	6	6	6	6
Steunbenville-Wierton, OH-WV	2	2	2	2
Champaign-Urbana, IL	n/a	n/a	n/a	4
Cedar Rapids, IA	n/a	n/a	n/a	3,4
Springfield, IL	n/a	n/a	n/a	1
Fort Smith, Ark.-OK	n/a	n/a	n/a	4
Green Bay, WI	n/a	n/a	7	7

1. In-fill & redevelopment
2. No urban growth control practiced
3. Sewer/public services unavailable
4. Annexation
5. Boarded by surrounding cities
6. No competing suburban jurisdiction
7. Zoning/residential development policy
8. Urban growth boundary

Figure 3.1 shows Lexington's population, along with the average population of the two peer city groups, for each census from 1970 to 2000. Figure 3.2 shows the decade-by-decade population growth rate. It is interesting to note that Lexington's growth rate exceeded both peer city average growth rates during the 1970s and 1980s. Relative to the cities that ranked just below Lexington in 1970, Lexington's growth during the 1970s and 1980s is remarkable. For example, during the 1980s, Lexington's population growth rate was 0.99% while the average growth rate for the peer cities ranked just below Lexington in 1970 was 0.24%. The national growth rate was 0.94%. Thus, based on population growth during the 1970s and 1980s, it does not appear that Lexington's urban growth boundary negatively impacted growth between 1970 and 1990.

However, the 1990s presents a different picture. Figure 3.2 shows that during the 1990s, Lexington's population growth rate was 1.46% per year while the average growth rate for the peer cities above Lexington was 1.64%. Although Lexington grew at a faster rate during the 1990s than the United States average, Lexington's growth is not as remarkable compared its benchmark cities. This is consistent with ad hoc empirical observations that Lexington's growth boundary started to impact development during the 1990s. Prior to the 1990s, the amount of undeveloped land within the urban growth boundary was sufficient to support Lexington's growth during the 1970s and 1980s. However, by the 1990s the amount of developable land available to meet growing demand, which resulted in Lexington expanding the urban growth area.

Whether the additional land added to the urban service district was sufficient to meet demand is the subject of considerable debate. To gain some perspective on the growth in Lexington housing values relative to its peer cities, Figure 3.3 shows the levels of the Office of Federal Housing Enterprise Oversight (OFHEO) Repeat Sales Index. The index values are set to 100 for 1985 and the indexes for the peer groups are calculated by averaging the yearly change in the OFHEO index for each city. It appears that single-family home values in Lexington did not keep pace with its peers or the national average over the past two decades. Between 1985 and 2001, the average growth rate for Lexington's housing was 3.6% per year. In comparison, over the same period the national average housing growth rate was 4.6%. However, consistent with the perception that the urban growth boundary was starting to impact the supply of developable land during the later part of the 1990s, we see that Lexington's average housing price growth rate between 1996 and 2001 was 5.2% compared to the peer cities housing growth rate of 4.8% for the group larger than Lexington and 4.1% for the group smaller than Lexington. In the next section, we utilize micro level data in an effort to gain greater precision in determining whether expansion of the urban service district had an impact on prices.

Figure 3.1: Lexington and "Peer" Average Populations (1970-2000)

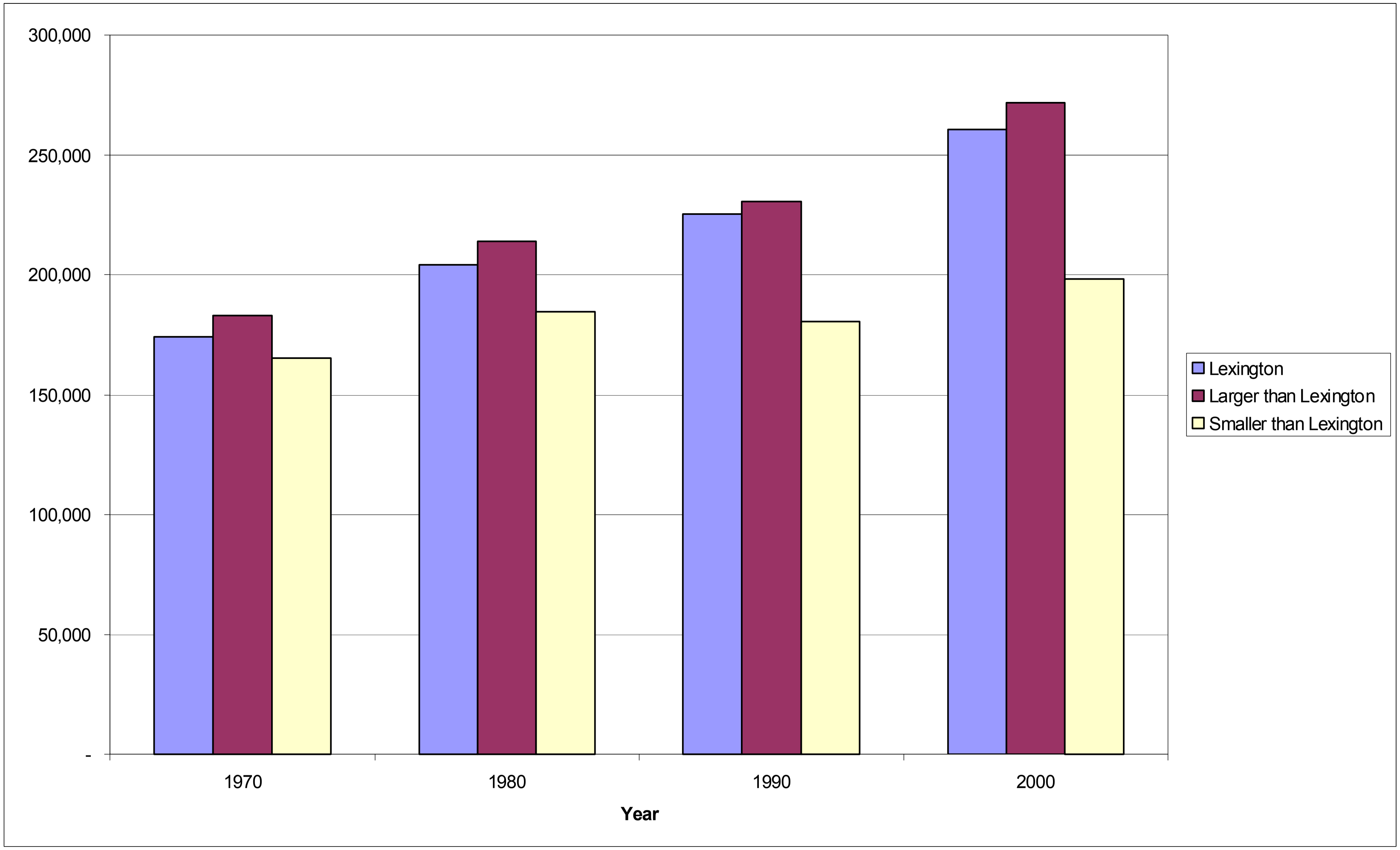


Figure 3.2: Lexington and "Peer" City Average Population Growth Rates

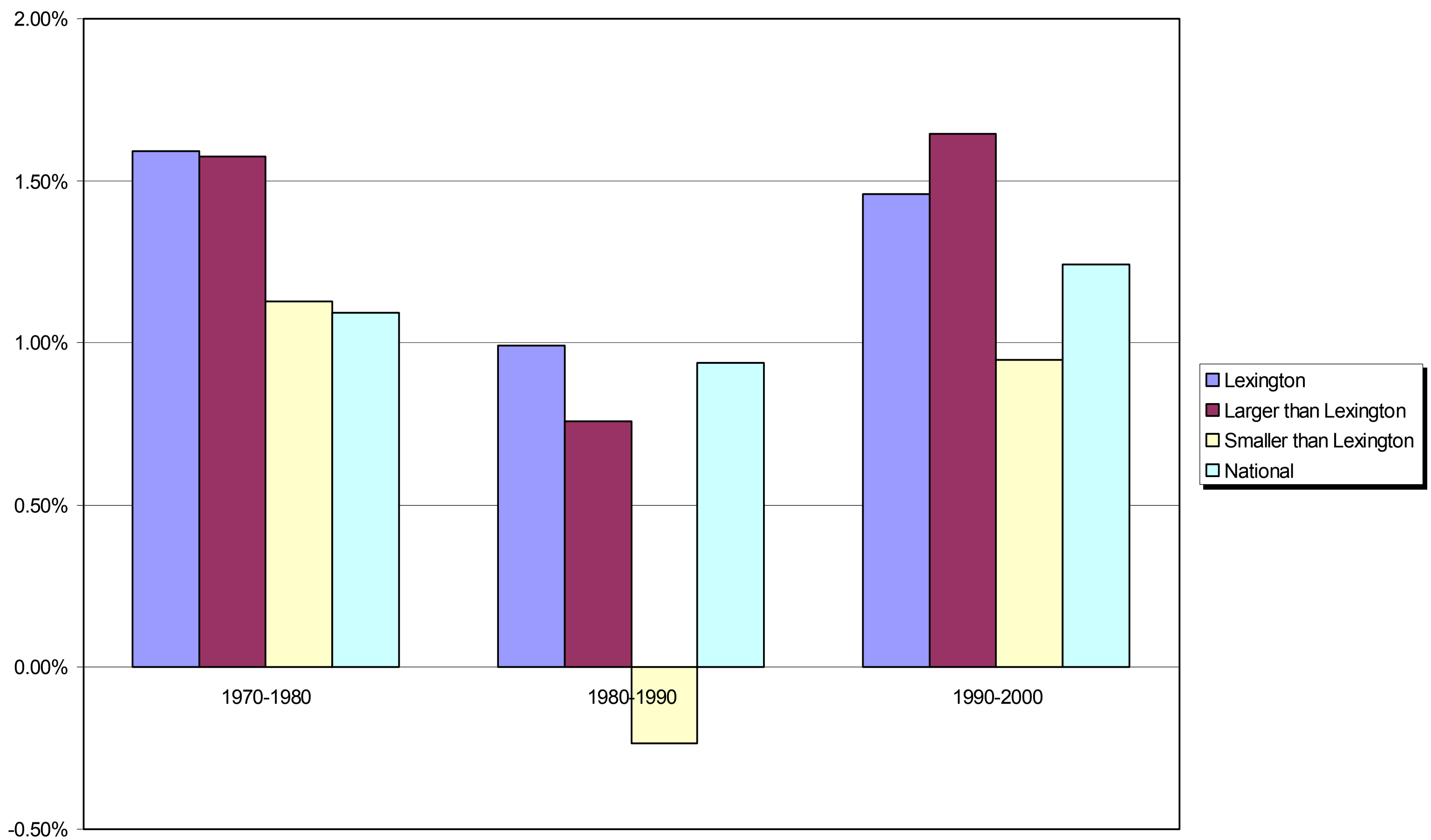
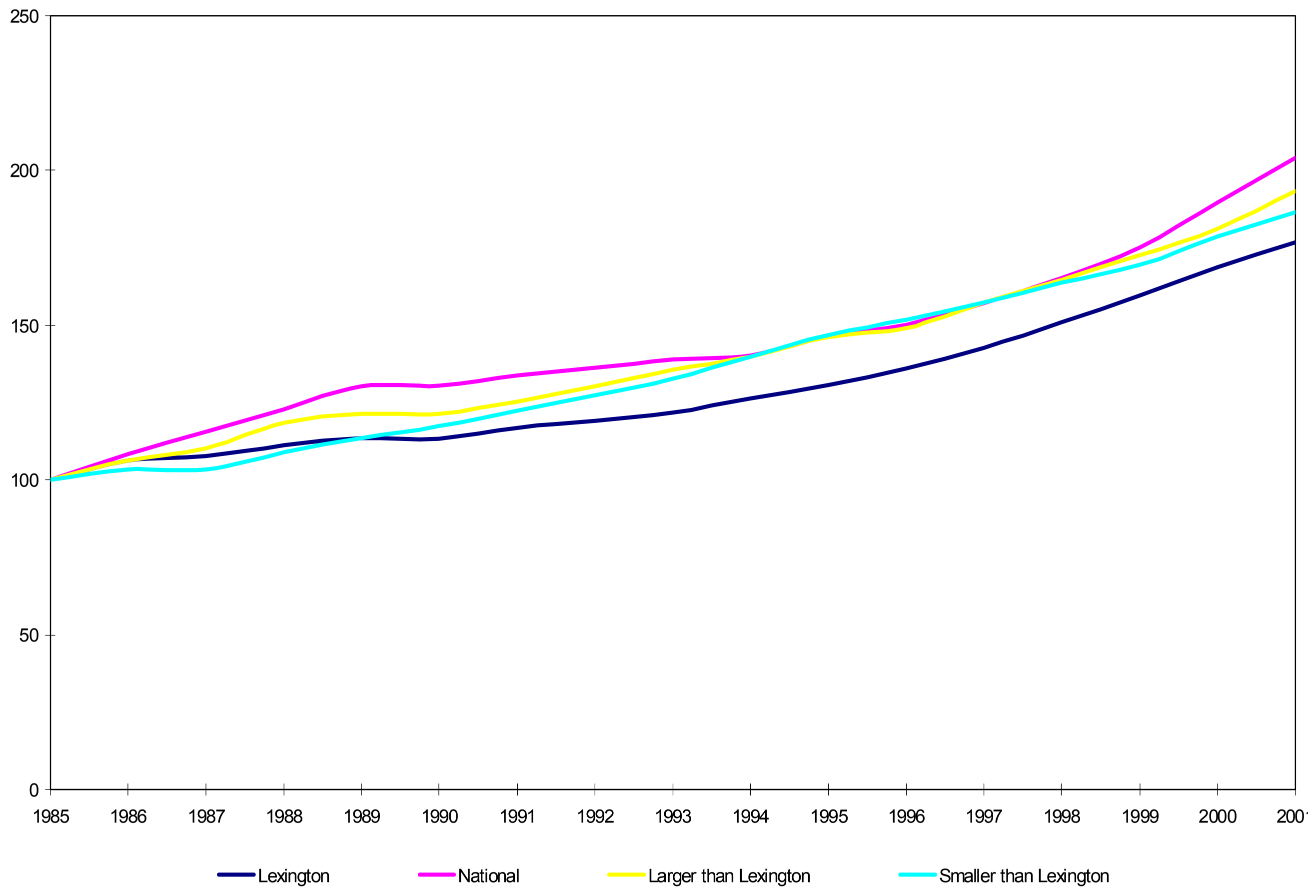


Figure 3.3: House Price Indices



The Effects of Lexington's Growth Controls on House Prices

In this section, we analyze the impact of changes in Lexington's urban service boundary on home prices in Lexington. In the previous section, we determined that Lexington's growth control ordinances appear to have impacted Lexington's growth rate in the 1990s. This is consistent with ad hoc empirical observation that the supply of developable land was constrained in the late 1990s. Thus, in this section we develop a statistical model that allows us to test for an impact of expansions in the growth boundary using the Office of Federal Housing Enterprise Oversight (OFHEO) Repeat Sales Index.

OFHEO estimates and publishes quarterly house price indexes for single-family detached properties using data on conventional conforming mortgage transactions obtained from the Federal Home Loan Mortgage Corporation (Freddie Mac) and the Federal National Mortgage Association (Fannie Mae). The house price index (HPI) is based on a modified version of the weighted-repeat sales methodology proposed by Case and Shiller (1989)[2] and is constructed for a variety of geographic areas including MSAs, states, and national regions of the U.S.

OFHEO estimates the HPI for each geographic area using repeated observations of housing values for individual single-family residential properties on which at least two mortgages were originated and subsequently purchased by either Freddie Mac or Fannie Mae since January 1975. The use of repeat transactions on the same physical property units helps to control for differences in the quality of the houses comprising the sample used for statistical estimation. As a result, the HPI is often categorized as a "constant quality" house price index.

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[2] "The Efficiency of the Market for Single-Family Homes", The American Economic Review, March 1989

Since the HPI is produced using data on single-family detached properties, which are financed by conforming conventional mortgages purchased by the either Fannie Mae or Freddie Mac, it excludes transactions on attached and multi-unit properties, properties financed by government insured loans, and properties financed by mortgages exceeding the conforming loan limits that determine eligibility for purchase by Freddie Mac or Fannie Mae.

As noted earlier, Lexington's urban service district has undergone several transformations. Table 3.3 details the expansion dates for the growth boundary. We note that since 1980, the urban service area has been expanded five times.

Table 3.3: Lexington USA Expansion Dates

- Comprehensive Plan 1973: 74.44 sq miles in Urban Service Area (USA) adopted 5/73 by Planning Commission (PC).
- Comprehensive Plan 1980: 75.9 sq miles in USA adopted by PC 9/80.
- Comprehensive Plan 1988: 48,600 acres in USA adopted 5/88 by Urban County Council.
- Comprehensive Plan 1996: adopted 1/96 by PC. EAMP added 5,400 acres adopted by PC 7/96.
- Bracktown and Marshall Property added 200 acres to USA adopted by PC 3/98.
- Rural Land Use Plan 1999: adopted by PC 4/99 for a total adopted 200 sq miles rural area and 85 sq miles USA.
- Comprehensive Plan 2001: land use portion adopted 4/2001 by PC added another 210 acres for a total of 54,664 acres in the USA.

If the Urban Service Area is restricting development, then the natural price reaction is for the price of existing housing to increase rapidly during periods of high growth and when the supply of developable land is constrained. A natural assumption is that the supply of developable land in Lexington was constrained in the period just prior to an expansion date. During periods of constrained supply, developers can effectively lobby the planning commission that the supply of developable land within the USA is not sufficient to meet the city's housing needs. As a result, the simple economics of supply and demand dictate that we should observe a negative price reaction following the USA expansion.

To test this hypothesis, we estimate the following regression equation:

$$R_t = \beta_1 P_t + \beta_2 E_t + \beta_3 A_t + \varepsilon_t \tag{3.12.}$$

where R_t is the simple quarterly return on the Lexington OFHEO repeat sales index, P_t is a dummy variable denoting the six months prior to an expansion in the USA, E_t is a dummy variable denoting the quarter in which the USA was expanded, and A_t is a dummy variable denoting the six months after expansion. If our hypothesis is correct, then we should observe that $\beta_1>0$ and $\beta_2<0$. If the price effect of the expansion is significant, then $\beta_3<0$. Estimating (3.1) via ordinary least squares (OLS) yields

$$R_t = \underset{(2.14)}{0.013} P_t - \underset{(-0.30)}{0.004} E_t + \underset{(1.34)}{0.012} A_t;\ R^2 = 0.05 \tag{3.13.}$$

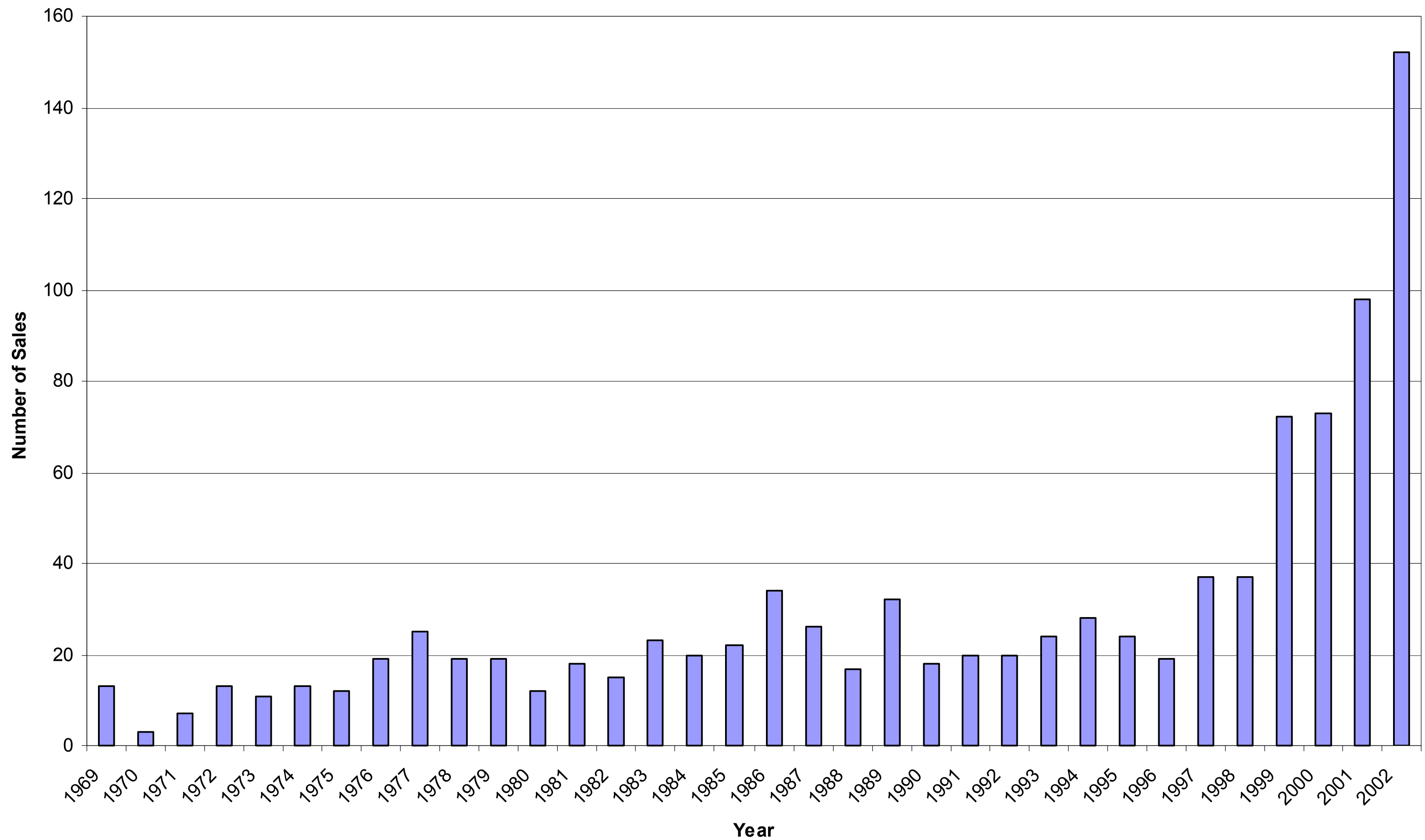
As expected, the OLS results indicate that housing returns were significantly positive in the six months prior to USA expansion, while the returns spanning the expansion date were negative (although not significant).

Impact of Lexington Growth Controls on Vacant Land

In this section, we continue the analysis from the previous section by examining the impact of Lexington's growth control ordinances on micro level data. In this model, we control for location, size, time, and zoning in an effort to fully capture the pricing dynamics for vacant land in Lexington. Our study uses vacant land sales in an effort to minimize the impact of changes in quality or taste preferences in building improvements over time. For example, an analysis of existing or new home sales would have to control for changes in housing quality as well as physical deprecation over time. By using the Lexington OFHEO house price index in the previous section, we utilized a "constant quality" index that avoided these issues. Thus, in this section we utilize vacant lot, or "unimproved" lots since these sales prices do not need to be adjusted for changes in building quality or depreciation.

Our dataset consists of all vacant lot transfers from 1970 to 2001 collected from the Lexington Property Valuation and Assessment ("PVA") office. This is a comprehensive database of all title changes recorded in Fayette County. The Lexington PVA office collects information on each sales transaction, including the date of the transaction, the transaction price, the tract zoning in effect at the time of transfer, and the tract location. In order to ensure that our analysis utilizes true market sales prices, we restricted the transactions to verified 'arms length' sales (i.e. no sales between family members or transactions involving multiple tracts). These restrictions result in a dataset covering 1,005 vacant land sales transactions that occurred between 1970 and 2001. Figure 3.4 shows the frequency count of Lexington vacant land sales by year. The increase in sales frequency over time reflects both the growth in Lexington as well as the movement to computerized sales transaction recording in the 1990s.

Figure 3.4: Frequency of Lexington Vacant Land Sales



As in the previous section, we create a series of dummy variables to control for the transaction sale relative to when the urban service area was expanded. Since we are utilizing micro level data and we know the exact transfer date, we created a series of four dummy variables representing a sale that occurred two years prior to an expansion (EA-2), one year prior to an expansion (EA-1), one following expansion (EA+1), and two years following expansion (EA+2). This specification will allow us to test the hypothesis that significant price movements occurred surrounding an expansion date. Thus, we estimate the following model of vacant land prices:

$$P_i = \beta_0 + \Phi' E_i + \Gamma L_i + \Theta X_i + \Pi T_i + \varepsilon_i \qquad (3.14.)$$

where P_i is the parcel sales price per square foot; E_i represents a series of dummy variables denoting whether the transaction occurred when the USA was expanded; L_i is a matrix of variables controlling for the parcel location and zoning; X_i is a matrix of variables controlling of the macro economic characteristics; and T_i is a series of dummy variables controlling for the year of sale. In order to test for real price changes in vacant land, we adjust each parcel sales price to reflect the impact of inflation as measured by the annual change in the consumer price index (CPI). Thus, we express all sales prices in constant 2002 dollars.

Since zoning restrictions have a significant impact on property utilization (and hence value), we create a series of dummy variables to control for the broad zoning restrictions on the parcel at the time of transfer. Table 3.4 summarizes the Lexington zoning uses and control variables. We also control for the parcel's location with a series of five dummy variables that denote the areas defined by the Lexington-Bluegrass

Realtors.[3] In addition, we include a variable (PROXCBD) that denotes the distance (in square feet) the parcel is to the Central Business District. We also include a dummy variable to control for whether the parcel was located in the urban service area at the time of transfer. Finally, to control for demographic variation in location, we include the median family income of the census tract in which the parcel is located.

[3] Areas 1 through 4 designate Northwest, Southwest, Northeast, and Southeast. Area 5 is assigned to the Central Business District.

Table 3.4: List of Zoning Categories in Fayette County

ZONEA	**A-R**	Agricultural Rural
	A-U	Agricultural Urban
	A-B	Agricultural Buffer
	A-N	Agricultural Natural Areas
ZONER	**R-1A**	Single Family Res. (Min. lot size 1ac; or 25,000 sq ft if after 7/14/94)
	R-1B	Single Family Residential (Min. lot size 15,000 sq. ft)
	R-1C	Single Family Residential (Min. lot size 8,000 sq.ft)
	R-1D	Single Family Residential (Min. lot size 6,000 sq.ft)
	R-1E	Single Family Residential (4,000 [min] - 7,500 [max] sq ft lot sizes)
	R-1T	Townhouse Residential
	R-2	Two Family Residential (Duplex)
	R-3	Planned Neighborhood Residential (Max. floor area ratio of .5)
	R-4	High Density Apartment (Max. floor area ratio of .7)
	R-4	High Rise Apartment (Max. floor area ratio of 1.3)
ZONEB	**P-1**	Professional Office
	P-2	Office, Industry, and Research Park
	B-1	Neighborhood Business
	B-2	Downtown Business
	B-2	Downtown Frame Business
	B-2B	Downtown Center Business
	B-3	Highway Service Business
	B-4	Wholesale and Warehouse Business
	B-5P	Interchange Business
	B-6P	Planned Shopping Center
	I-1	Light Industrial
	I-2	Heavy Industrial
ZONEE	**EAR-1**	Expansion Area Residential (0-3 Units/Ac)
	EAR-2	Expansion Area Residential (3-6 Units/Ac)
	EAR-3	Expansion Area Residential (6-18 Units/Ac)
	TA	Transition Area (Overlay Zone)

Table 3.5 presents the estimated coefficients for the regression model of vacant land. In order to better isolate the impact of an expansion of the urban service area, we estimated two versions of (3.3). The first is the restricted model where only the expansion year dummy variables and year dummies are included. The second model is the full model including expansion year dummy variables as well as location and demographic characteristics and time dummies. In order to conserve space, we do not report the estimated coefficients for the yearly dummy variables.

It is evident from examining the expansion area coefficients in models 1 and 2 that the impact of increasing the size of the urban service area has had a limited effect on vacant land values. In the both models, the estimated coefficients for the variables denoting a sale occurring in the year prior to and after an expansion (EA-1 and EA+1) are positive (but not statistically significant). Although the coefficients are not statistically significant, the positive signs are consistent with demand pressure occurring during the period when the expansion of the urban service area was debated. In both models, the variables controlling for a sale in the second year following expansion are negative (but again not statistically significant). Again, this is consistent with our expectation that an increase in the supply of developable land produces a negative impact on prices. That is, prices respond as predicted by the laws of supply and demand.

In model 2, we include variables to control for size, location, and demographic characteristics. The size coefficient is negative, as expected, indicating that larger parcels sell at a discount on a size adjusted basis. The coefficients also confirm our prior predictions in that land located within the urban service area sells at a significant premium to land located outside the urban service area. Furthermore, we see that parcels located in areas outside the central business district (AREA5) sell at a discount. This is consistent with the theoretical models surveyed in chapter two that predicted a price decline as one moved away from the CBD. The negative coefficient on the variable measuring the distance from the CBD (PROXCBD) also confirms this hypothesis.

Overall, we caution that the results from the micro level analysis of Lexington land sales are very weak. For example, the overall model fit is relatively poor with adjusted R^2 under 5 percent. As a result, we are hesitant to state that our analysis has proven a link between Lexington's growth controls and the value of vacant land.

Table 3.5: OLS Estimates of Impact of USA Expansion on Vacant Land Values

	Model 1				Model 2			
	Parameter Estimate	Standard Error	t Value	Pr > |t|	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	6.216	2.115	2.940	0.003	1151.399	1484.779	0.780	0.438
EA-2	-1.432	1.535	-0.930	0.351	-1.180	1.535	-0.770	0.442
EA-1	1.017	1.252	0.810	0.417	1.797	1.254	1.430	0.152
EA+1	0.087	0.987	0.090	0.930	0.631	1.076	0.590	0.558
EA+2	-0.487	1.989	-0.240	0.807	-0.316	1.990	-0.160	0.874
USA					0.000	0.000	-0.980	0.328
AREA1					4.044	1.480	2.730	0.006
AREA2					-4.509	1.341	-3.360	0.001
AREA3					-3.567	1.292	-2.760	0.006
AREA4					-0.719	1.505	-0.480	0.633
PROXCBD					-3.373	1.285	-2.630	0.009
ZONEA					-1.5E-05	3.3E-05	-0.460	0.644
ZONER					2.704	2.726	0.990	0.322
ZONEB					-0.092	2.109	-0.040	0.965
MEDINC					0.847	2.161	0.390	0.695
RATE					0.000	0.000	-0.060	0.951
Adj. R^2	0.0235				0.0494			

Note: Yearly dummy variables not reported to conserve space.

Spillover Effects

Previous empirical studies of growth controls have noted a pronounced spillover effect on neighboring areas. Theoretically, one would expect that as growth controls begin to impact the supply of developable land, growth moves to areas outside the sphere of influence. This effect should be most noticeable in an area such as Lexington, where there is an ample supply of available land in political jurisdictions not covered by the growth controls in close proximity to the controlled area. Since we noted in the previous section that the impact of Lexington's growth controls appears to be concentrated in the 1990s, any spillover of growth to neighboring counties should be most pronounced during the 1990s.

To test for a spillover effect, we examine the relative growth in population and income between 1990 and 2000 for the six counties bordering Fayette. These counties are Scott, Woodford, Jessamine, Madison, Clark, and Bourbon. Table 3.6 reports the growth rates in population and income.

Table 3.6: Comparison of Population and Income Growth for Fayette and Surrounding Counties

County	1990-2000 Population Growth	1990-2000 Income Growth
Scott	38.5%	70.8%
Woodford	16.3%	50.6%
Jessamine	28.0%	48.2%
Madison	23.2%	53.6%
Clark	12.4%	57.7%
Bourbon	0.6%	56.1%
Fayette	15.5%	41.9%

Consistent with the theory that Lexington's growth controls began to take effect during the 1990s, Table 3.6 shows that with the exception of Clark and Bourbon counties, Fayette county's population growth rate was substantially lower than the surrounding area. Again this suggests that a spillover effect is taking place where households seeking lower priced housing or lower density housing are migrating to areas without strict growth controls. Furthermore, the growth in median household income between 1990 and 2000 for the surrounding counties was also substantially higher than the median household income growth in Fayette.

Conclusions

In this section, we have empirically examined the question of whether growth controls have had an impact on the value of housing in Lexington. Our empirical analysis consisted of three parts. First, we examined Lexington's growth between 1970 and 2000 as compared to a set of "peer" cities. These peer cities were identified as being the cities that ranked just above and just below Lexington in terms of population as reported in the 1970 census. Given that these cities do not have growth controls that are as strict as Lexington's, this approach allowed us to address the relative performance of Lexington to a set of benchmark cities to determine whether Lexington's growth between 1970 and 2000 was hindered by the use of the urban service area growth control. Overall, this comparison suggests Lexington's population growth rate slowed, relative to benchmark cities, during the 1990s. This also corresponds to the period when the urban service area boundary started to limit development within Lexington. Furthermore, our analysis of Fayette county's population and income growth rates relative to the surrounding counties confirm a spillover effect as neighboring areas experienced faster growth than Lexington during the 1990s.

Our second approach examined the impact of changes in the urban service area in the 1980s and 1990s on Lexington house prices. In this approach, we utilized a constant quality house price index produced by the Office of Federal Housing Enterprise Oversight. The results from this approach suggest that there was upward price pressure in housing prior to the expansion and that house prices did decline in the quarter when the supply of developable land was expanded.

Our final approach consisted of a micro level analysis of vacant land sales in Lexington. Focusing on vacant land allowed us to effectively remove the confounding impact of changes in consumer housing taste preferences and physical depreciation from the analysis. Furthermore, by using micro level vacant lot sales, we are able to control for physical characteristics (lot size), location, and permitted uses (zoning). Although the results from this analysis are relatively weak, they do suggest that land prices were sensitive to expansion of the urban service area.

Chapter 4: What have we learned?

The purpose of this study is to examine the impact of government zoning and land use programs and policies on housing costs. Fayette County was one of the first counties in the nation to utilize a growth control ordinance that created an "urban service area" and "rural service area." These areas effectively limited the provision of county and city services to the urban designated area with the rural area being reserved for agricultural use. Since the implementation of these growth controls in the 1960s, Lexington has witnessed dramatic population growth. As a result, the supply of developable land within the original urban service area is effectively limited. This has created extensive pressure on elected officials to expand the urban service area. In order to provide guidance to policy makers, this study provides a comprehensive survey of the extensive literature on modern urban growth controls, a survey of theoretical models that provide economic predictions of the impact of growth controls, and finally, an empirical analysis of Lexington's growth ordinances.

Our literature survey addressed three questions surrounding modern growth controls. First, we examined which growth controls are effective in preserving farmland and open spaces. In answering this question, we examined the use of purchase of development rights programs, transferable development rights programs, agricultural zoning, and property tax relief programs. Second, we examined how urban containment policies impact land value, and third, we examined the question of how smart growth initiatives impact land values. Our survey of existing literature on growth controls found that the more successful policies are those that preserve large, contiguous parcels, encourage participation by land owners, and are perceived to be permanent and thus preventing the capitalization of development option values into market values. Our survey concluded that purchase development rights and transfer development rights programs are effective. Overall, our survey found mixed results on the question of whether mandatory zoning and boundary controls have an impact on housing affordability. We conclude that the literature on the effectiveness of growth controls is mixed. Depending on land characteristics and appraisal methods utilized, there is some evidence that growth controls are correlated with housing prices. However, other studies found that factors not related to growth controls have a greater impact on housing prices – suggesting that growth control impacts are a second order effect.

In the second section, we examine the extensive economics literature that attempts to formally model the impact of urban growth controls. The major strands of this literature show how various urban controls result in the creation of urban amenities that overcome lower consumer utility corresponding with population growth and how the restriction of development impacts demand within and outside the restricted area. The amenity creation models attempt to capture an area's sensitivity to negative externalities associated with growth while supply restriction models concentrate on estimating the impact of supply and demand on land values.

Our survey covered three basic models. The first set of models describes the growth of urban areas. These models focus on population growth and show the impact of growth controls on the "optimum" population level. Furthermore, these models demonstrate at the theoretical level that growth controls should have a positive impact on land values. The second set of models focuses explicitly on the relationship between urban growth boundaries and land values. These partial equilibrium models show that land within the urban boundary will have to be valued at a premium given the ability to convert the land to more intensive use. Finally, the third set of models are derived from the "real options" literature and theoretically document that constraining the development option via a growth control or growth boundary will impact land values. The models demonstrate that the value of a landowner's option to convert is positively related to increased risk and the time to conversion. Therefore, growth controls can fuel higher option values while also motivating premature development that is neither optimal (in terms of timing and profitability) nor economically favorable in the market.

Our final section presents an empirical analysis that attempts to determine the impact of Lexington's growth control ordinances – specifically the creation of the "urban service area" and "rural service area." Our empirical analysis was guided by the theoretical predictions developed in chapter two. In that survey, we noted that urban economic theory suggests that local growth ordinances, which may limit the supply of new housing, may increase land values by controlling negative externalities associated with population growth.

Our empirical analysis consisted of three parts. First, we examined Lexington's growth between 1970 and 2000 as compared to a set of "peer" cities. Overall, this comparison suggested that Lexington's population growth rate slowed during the 1990s relative to its benchmark cities. It is instructive to note that this reduction in Lexington's growth rate corresponds to the period when the urban service area boundary started to limit development within Lexington. Our second approach examined the impact of changes in the urban service area on house prices in Lexington. The results from this approach suggested that there was upward price pressure in housing prior to the expansion and that house prices did decline in the quarter when the supply of developable land was expanded. This suggests that maintaining flexibility with respect to the growth boundary can reduce the negative consequences associated with limiting developable land. Our final approach consisted of a micro level analysis of vacant land sales in Lexington. Although the results from this analysis are relatively weak, they do suggest that land prices were sensitive to expansion of the urban service area.

Considering the three empirical approaches together, our analysis suggests that the implementation of the urban growth boundary has produced the intended effect of limiting Lexington's growth – particularly in the second half of the 1990s as the supply of developable land declined. Given that the restriction on the supply of developable land has only recently begun to be felt, it is not surprising that our empirical analysis shows that the growth controls have had a weak impact on Lexington's housing market. However, the theoretical studies predict that as the supply of developable land within the urban service district continues to decline, we can expect significant impacts to be capitalized into Lexington land values.

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Web Resources

American Planning Association
http://www.planning.org/

Brooking Institution: Center on Urban and Metropolitan Policy
http://www.brook.edu/es/urban/urban.htm

Cornell's Department of City and Regional Planning
http://www.crp.cornell.edu/home/

EPA Smart Growth Website
http://www.epa.gov/smartgrowth/

Federal Home Loan Mortgage Association
http://www.freddiemac.com/

Lexington/Fayette County Division of Planning
http://www.lfucg.com/PlanDiv/

Lincoln Institute of Land Policy
http://www.lincolninst.edu/main.html
http://www.lincolninst.edu/landline/ll.html#ARCHIVES

Maryland Department of Planning
http://www.mdp.state.md.us/

National Association of Home Builders
http://www.nahb.com/housing_issues/regulation.htm

National Neighborhood Coalition
http://www.neighborhoodcoalition.org/SG%20Publications.htm

Office of Federal Housing Enterprise Oversight (OFHEO)
http://www.ofheo.gov/

Oregon Department of Land Conservation and Development
http://www.lcd.state.or.us/

Smart Growth Online
http://www.smartgrowth.org/Default.asp?res=800

University of Wisconsin-Madison Department of Real Estate and Urban Land Economics
http://www.bus.wisc.edu/realestate/

Urban Land Institute
http://www.uli.org/dk/index.cfm

U.S. Census Bureau
http://www.census.gov/

UK Center for Real Estate Studies

The Center for Real Estate Studies is located in the Gatton College of Business and Economics at the University of Kentucky. The Center supports real estate education to undergraduate, graduate, and professional level students as well as to real estate practitioners throughout the Commonwealth. The Center also supports ongoing real estate research projects. The Center's publications include applied as well as academic research on a variety of real estate topics.

The Mission of the Center is:

- *To provide support for real estate courses that serve as electives for students interested in studying real estate and to serve as the focal point for students interested in real estate.*

- *To sponsor rigorous research focused upon financial and economic aspects of real estate markets and institutions at the National, State, and local level.*

- *To disseminate research results to professionals and practitioners in the real estate industry, as well as the general public.*

Author Biographies

Brent W. Ambrose is the Director of the Center for Real Estate Studies and Professor of Finance at the University of Kentucky where he holds the Kentucky Real Estate Professorship. Prior to joining the University of Kentucky, Dr. Ambrose was an Associate Professor at the University of Wisconsin-Milwaukee where he directed the UWM real estate program. From 1997 to 1998, Dr. Ambrose was a Visiting Associate Professor and Research Fellow at the University of Pennsylvania Wharton School of Business. In addition, Dr. Ambrose serves as Executive Vice President of the American Real Estate and Urban Economics Association and serves on the editorial boards of the *Journal of Real Estate Finance and Economics,* the *Journal of Real Estate Research*, and *Real Estate Economics,* and is on the advisory board of the Real Estate Research Institute.

Dr. Ambrose specializes in real estate finance, corporate finance, and fixed income security analysis. His research interests include issues related to Real Estate Investment Trusts (REITs), loss mitigation programs associated with mortgage default and foreclosure, Government Sponsored Enterprises (GSEs), and fixed-income securities. Dr. Ambrose has consulted with the U.S. Department of Housing and Urban Development and the Congressional Budget Office on several occasions regarding issues concerning FHA mortgage default and foreclosure, economically targeted assets and privatization of Fannie Mae and Freddie Mac. Dr. Ambrose has published extensively in the fields of real estate and finance. His work appears in *The Journal of Money Credit and Banking, The Journal of Real Estate Finance and Economics, Journal of Financial and Quantitative Analysis, Financial Management, Financial Analysts Journal, Real Estate Economics, Regional Science and Urban Economics, Journal of Real Estate Research, Journal of Urban Economics, Journal of Housing Research,* and *Cityscape: A Journal of Policy Development and Research.* Dr. Ambrose holds a Ph.D. and M.B.A. from the University of Georgia and a B.S. in Business from Wake Forest University.

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