THE IMPLICATIONS OF THE CITY OF DAVIS' URBAN GROWTH BOUNDARY

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Department of Public Policy and Administration

Abstract

of

THE IMPLICATIONS OF THE CITY OF DAVIS' URBAN GROWTH BOUNDARY

by

Ryan Joseph Pistochini

The City of Davis, California has a very high median housing value when compared to its surrounding area and the statewide average. High housing values can make the area increasingly unaffordable. A key policy question is whether Davis' urban growth boundary adopted in 2000 has been a contributing factor to high housing prices. This thesis uses quantitative analysis from a range of California cities to assess the effect of Davis' urban growth boundary on median housing values.

More specifically, this thesis draws on a panel data regression analysis using United States Census data from the 1990 Decennial Census, the 2000 Decennial Census, the 2010 Decennial Census and the 2010 American Communities Survey. A total of 56 California cities are studied. Supply side variables such as city land area, number of rooms, number of bedrooms and the age of the housing stock are considered in this analysis. Demand side variables include median household income, number of professional workers, number of people in poverty, number of high earning households, age, and percent of population married.

The analysis determined that urban growth boundaries do contribute to increased median housing values over time. For each year the boundary is in effect, the median housing value is expected to increase by $5,811. Other factors also influence the median housing value. The City

of Davis needs to consider the long-term impact of the urban growth boundary on its housing affordability during the debate on whether to allow new development.

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Chapter 1

Introduction

The City of Davis, California has very high single family home prices compared to its neighboring cities. Many mention the reasons for this are because of its amenities, strong public school system and its proximity to the University of California, Davis campus. Others believe that Davis' strong urban growth boundary law contributes to high housing prices. Land use research of other cities with an urban growth boundary (UGB) indicates that the boundary can lead to a rise in the cost of homes, making it more unaffordable to buy as well as rent.

This thesis seeks to determine if the UGB is a contributing factor to increases in Davis' home prices. If the UGB is a contributing factor, what is the significance of that impact? Finally, this thesis will identify the implications of the UGB in the context of current and future city land policy decisions.

In this chapter, the case will be made why Davis is an ideal area to study and provide an overview of the history leading to the UGB adoption. The chapter will also discuss the specifics of the UGB ordinance. It will also summarize several projects proposed since the UGB's adoption. The chapter will conclude with a review of the University of California, Davis' perspective of the UGB and the need to study the effects of the UGB on the city.

Why Study Davis?

The city of Davis, California is located in northern California, approximately 15 miles to the west of the City of Sacramento and 74 miles to the northeast of the City of San Francisco. Davis is generally surrounded by agricultural land. The City's population is approximately 67,000 and covers 10.5 square miles (Davis, 2014b). Davis has a number of attractive amenities

and features, particularly in parks and recreation such as three golf courses (one public, two private), over 50 miles of bicycle paths, the highest bicycle ownership per capita rate in the nation, 32 parks with almost 500 acres of improved landscaping, and over 500 acres of open space land (Davis, 2014b, p. 2-11). In addition, the City's economy has almost 100 start-up businesses primarily in agricultural technology, medical technology and "sustainable manufacturing" (Davis, 2014b, p. 2-11). The local school district has about 8,500 student enrolled, and approximately 90% of graduating seniors move on to post-secondary education. The State's Academic Performance Index (API) score for the local Davis-area school district compared to the statewide average and other local school districts are in Table 1 below (CDE, 2014). These are very high scores as the maximum score is 1,000.

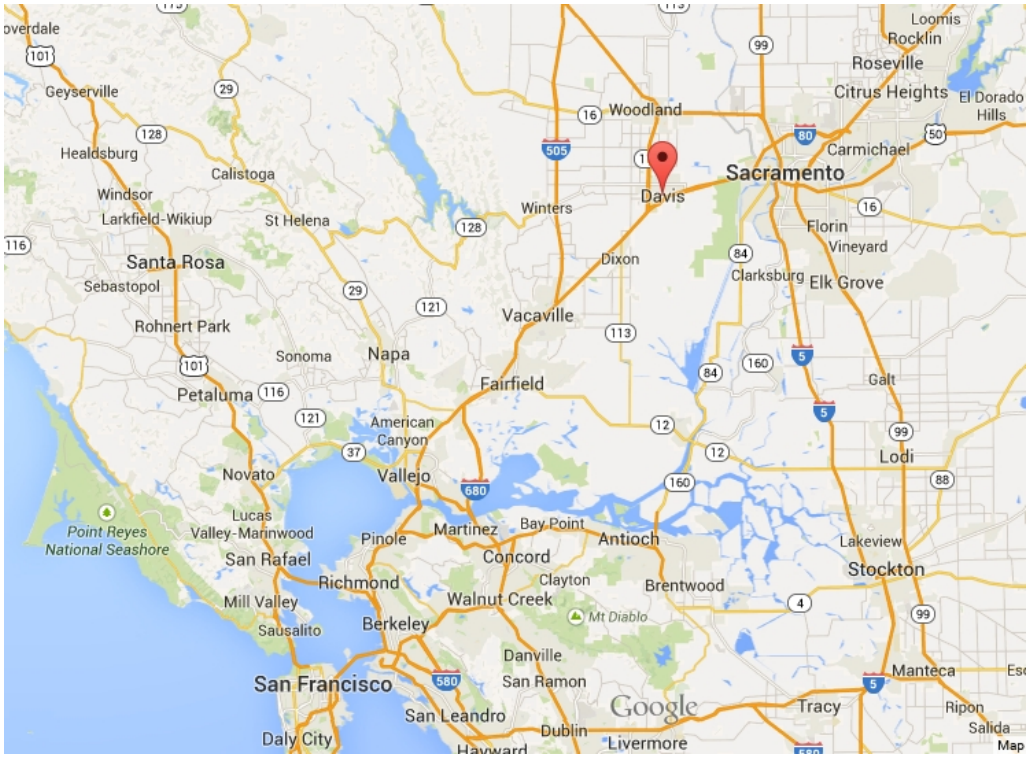
Table 1 - Academic Performance Index scores for Davis and nearby school districts

School District Name	Area(s) Served	2013 API Growth	2012 API Base	2013 Graduation Rate
Davis Joint Unified	Davis	882	880	94.85%
Folsom-Cordova	Folsom, Rancho Cordova	839	840	91.32%
Elk Grove Unified	Elk Grove	805	810	86.21%
Statewide	N/A	790	791	78.87%
Woodland Joint	Woodland	767	767	87.85%
Washington Unified	West Sacramento	766	767	84.96%
Sacramento City Unified	Sacramento	760	770	79.91%

The nearest cites to Davis are Dixon to the southwest (9 miles), Woodland to the north (11 miles), West Sacramento to the east (13 miles), Winters to the west (14 miles). California Department of Finance's January 2014 population estimates for Davis is 66,656, Dixon is 19,005, Woodland is 57,233, West Sacramento is 50,836 and Winters is 6,979 (DOF, 2014). Dixon, Woodland, and Winters are all surrounded by agriculture and open space. West Sacramento is

prevented from growing westward to Davis due to the Yolo Bypass State Wildlife Area buffering it. All this presents the opportunity to minimize the effects of other cities' growth actions on Davis. The map below shows the location of Davis marked by a red point in California in relation to Sacramento and San Francisco (Google, 2015).

Figure 1 - Location of the City of Davis, California



Davis' adopted its UGB law in 2000. In 1980, the amount of homes owned by people under 35 was 30%, but in 2013 declined to 4% (Reese, 2015). The implication of Reese's article supports the idea that Davis has become unaffordable for a number of people. Table 1-2 below lists the median value of a detached single family residence in the Sacramento area, with selected

metropolitan areas and the statewide and nationwide averages (Zillow, 2015). The prices for Davis are higher than the region and the statewide average.

Table 2 - Median value of a detached single family residence as of December 2014

City Name	County	Median Value
San Francisco Metro	*N/A*	*$ 741,200*
Davis	**Yolo**	**$ 580,900**
Los Angeles Metro	*N/A*	*$ 557,700*
Loomis	Placer	$ 500,100
California Average	*N/A*	*$ 442,700*
Folsom	Sacramento	$ 440,500
Boulder, CO Metro	*N/A*	*$ 420,400*
Rocklin	Placer	$ 410,700
Lincoln	Placer	$ 389,900
Auburn	Placer	$ 380,800
Roseville	Placer	$ 373,700
Dixon	Solano	$ 344,900
Sacramento Metro	*N/A*	*$ 338,700*
Elk Grove	Sacramento	$ 336,700
Winters	Yolo	$ 322,200
Citrus Heights	Sacramento	$ 313,000
Portland, OR Metro	*N/A*	*$ 288,000*
Placerville	El Dorado	$ 283,900
Woodland	Yolo	$ 280,400
West Sacramento	Yolo	$ 280,000
Rancho Cordova	Sacramento	$ 276,000
Sacramento	Sacramento	$ 265,600
Galt	Sacramento	$ 262,800
US Average	*N/A*	*$ 177,700*

What is unique about Davis is that it is directly adjacent to the University of California, Davis campus. UC Davis is a state entity that is exempt from local land use laws and also legally resides outside Davis city limits. UC Davis functions as its own self-contained city and has its own municipal services such as police, fire and public works services.

The place of UC Davis in the University of California system is that it is the largest campus in land size (52,000 acres), second largest in expenditures, and third largest in enrollment. Enrollment in 2014 is approximately 31,000 students. In comparison with other universities nationwide, UC Davis is ranked 12th in research funding and was invited to be one of 62 universities in the "prestigious" American Association of Universities. (Davis, 2014b, p. 2-13).

The build up to the adoption of Davis' Urban Growth Boundary

The build up to the adoption of Davis' UGB started in the 1960s. During this time, Davis issued two general plans, documents that outline how the City plans to add housing and manage land use. Jennifer Fulton (2000), a reporter for the local *Davis Enterprise* newspaper summarized some of the early history leading to the UGB. The 1964 General Plan supported a vision of Davis having a population of 75,000 by 1985. Five years later, the 1969 General Plan envisioned Davis with a population of 90,000 by 1990. Fulton notes that the 1969 plan "set off alarm bells throughout the town," which led to a 1974 amendment that modified the vision to 50,000 by 1990.

An election forum was held prior to the March 2000 election adopting the UGB. The newspaper account of the forum captures the pro-UGB thinking. Then-Councilmember Ken Wagstaff stated that "[t]he growth in Davis has strained our small city" and was paraphrased as saying the growth has eroded public trust (Turner, 2000). Wagstaff is further attributed as saying the population of Davis has grown by 40% since 1986 and this contributed to “greater traffic problems, overcrowded schools and other associated problems" (Turner, 2000). Wagstaff's views prevailed during the election and the UGB was enacted through Measure J.

Technical Background of Davis' Urban Growth Boundary

On March 7, 2000, Davis adopted Measure J by a 54% to 46% margin (County of Yolo, n.d.). Over 69% of registered voters turned out of this election (County of Yolo, n.d.). This measure established an UGB by requiring a public vote by the city's residents for any conversion of agricultural designated land into developed land.

In the measure, the declared findings for the need of the UGB are to 1) preserve existing agricultural/open space lands around Davis to preserve the agricultural economy and supply; 2) prevent traffic congestion, air pollution, other environmental reasons, and avoid stress on existing public facilities; 3) preserve the quality of life and unique benefits that accompany the "broad vistas at the urban edge"; 4) support the development of a compact urban form; 5) preserve the existing city policies that supports agricultural preservation; and 6) preserve the existing City General Plan (City of Davis, n.d.).

The measure required itself to be renewed in ten years by another general election. Measure R was placed on the ballot to renew Measure J. On June 8, 2010, Measure R passed by a 77% to 23% (County of Yolo, n.d.). Almost 38% of registered voters turned out for this election (County of Yolo, n.d.). Measure R codified Measure J into present-day City Ordinance Article 41.01 - Citizens' Right to Vote on Future Use of Open Space and Agricultural Lands. Henceforth, this thesis will consider the UGB enacted by Measure J & Measure R as the Ordinance or Ordinance 41.01 for clarity.

Ordinance 41.01 requires a public vote when the City's land use map is amended or modified to change land designated from agricultural or open space into an urban land use or urban reserve use category. Converting land designated as "urban reserve use" into urban land use also requires a vote. Any proposal to convert agricultural, open space or urban reserve land

that previously was converted from urban use requires a vote on a return to urban use. Urban reserve is land held for urban use after all other urban use land is developed. Urban reserve also includes the greenbelts that Davis maintains. Finally, the Ordinance specifically requires a public vote prior to developing two large areas identified in Davis' 1999 land use map for future urban use. These two areas are Covell Center and Nishi Properties (Covell Center is subsequently named as Covell Village in a 2005 development effort).

The Ordinance exempted from public vote any conversion for the purposes of creating public parks, public schools, and large-scale municipal works such as water-treatment plants, corporation yards and the like. The Ordinance allows for a limited expansion directly adjacent to the local hospital provided that the land use is for medical purposes (City of Davis, n.d.).

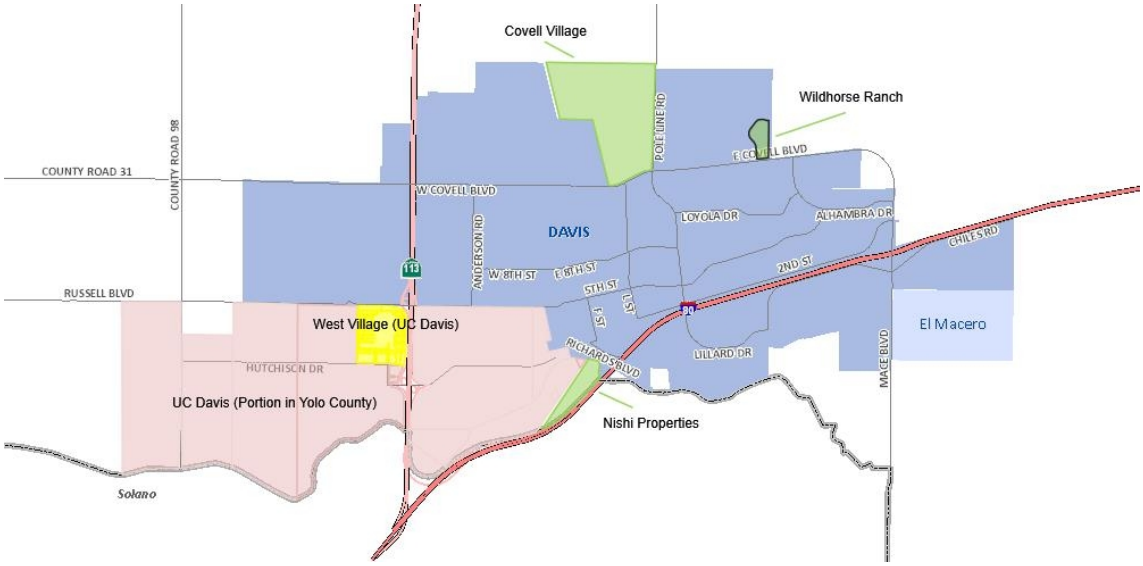
Prior to having a public vote, the land use change must first accompany with a project plan that outlines all the land use components and proposed public and recreation facilities. Once the project plan is established, it cannot be changed unless by subsequent public vote. After the plan is established, it must demonstrate the project complies with California environmental, planning and zoning laws. The project's next step is approval by the City Council. After approval by the City Council, the project is submitted to the voters for approval by majority vote. If the project receives a majority vote, development of the land may commence.

At the election forum debating the merits of Measure J, opponents feared this process will result in "ballot box planning" that dilutes representative democracy. Opponents also doubted it would result in "rational growth management" while further contending development proposals will be "subject to politics rather than sound planning principles" (Turner, 2000). Proponents felt this process will force developers to propose plans that the community wants, lead to "greater developer responsibility," and allow for "various alternatives presented to us as an

intelligent populace" (Turner, 2000). While Davis debated over Measure J, nearby Woodland was exploring new residential and commercial growth. Woodland's expansion was thought to be beneficial as it could provide jobs to UC Davis graduates, provide sales tax growth fueled in part new shopping amenities for Davis residents and lower housing prices than a college town (Fulton, 2000).

Figure 2, compiled and modified from the publically accessible Yolo County GIS system, shows the current boundaries of Davis (blue) that is largely coterminous with the UGB (County of Yolo, 2015). In green are the three development parcels mentioned earlier. In pink and yellow are lands within Yolo County that is UC Davis property. UC Davis also owns land in Solano County immediately south of Interstate 80 and east of the north/south alignment of State Highway 113, but this is not displayed on the map. El Macero is an unincorporated developed master planned community with a golf course predating the UGB.

Figure 2 - Map of the Davis area and development projects proposed since 2000



Development projects taken after 2000

The adoption of the UGB did not dissuade developers from proposing projects requiring a public vote. The first project to go through the process was Covell Village (identified as Covell Center in the Ordinance). Covell Village proposed to develop land adjacent to City limits on three sides in the northern part of Davis. Covell Village went to the voters on November 8, 2005 in the form of Measure X. It lost, with 41% in support to 59% opposed with a turnout of 61% of registered voters (County of Yolo, n.d.).

The next project to go through the voter process was Wildhorse Ranch. The land use for the Wildhorse Ranch project was located within city limits and had an agricultural designation. The Ordinance required a vote on any agricultural to urban land use change. The voters' opportunity to vote on Wildhorse Ranch was November 3, 2009. Measure P contained the Wildhorse Ranch project. Measure P failed with 25% in support and 75% in opposed with a turnout of 33% of registered voters (County of Yolo, n.d.).

In early 2015, the City is exploring several projects that will ultimately require voter approval. The first is the Nishi Properties in south Davis. Nishi Properties is an agricultural designated land outside city limits bordered in the north by UC Davis, in the south by Interstate 80 and in the east by the City. The western border is a tip where UC Davis and Interstate 80 meet.

The second project is a collection of proposals to create "innovation parks". Concerned about Davis' ability to have sufficient space to support existing and potential high-technology industries, the City is proposing new annexations to allow the development of large commercial and research buildings. Two immediate events are spurring this idea.

First, UC Davis greatly upset the local environment when it was disclosed that it was looking at developing a UC Davis World Food Center campus in West Sacramento or Sacramento. These two cities are just to the east of the main campus. A local Davis columnist noted that despite the reasons for UC Davis to look outside of Davis, it is because "Davis is a cute little college town, but it's certainly not up to hosting smart people from around the world" (Dunning, 2014).

In addition, one long time Davis firm, Schilling Robotics, is looking to expand but has space needs that can only be fulfilled by a new innovation park (Ryan, 2014a). Planners of the innovation parks also seek to include residential housing but are running into resistance from the City Council. The vision is for innovation parks to be "live-work-play environments that attract high-skilled, technology professionals" (Ryan, 2014a). This integrated community intends to reduce vehicle trips and promote walkability. However, one city council member expressed his concern that an example planning document lists an innovation park creating 5,000 jobs but requiring 3,000 housing units (Ryan, 2014b). Statements like this show that Davis still has an anti-growth element when it comes to housing.

Davis' Open Space Preservation Efforts

In addition to the Ordinance, the City's population fretted about Dixon and Woodland expanding to the city limits. In an effort to contain Dixon and Woodland, the City initiated a two-pronged approach to limit growth. The first approach secured preservation easements on farmland between Davis and the other cities through Measure O on the November 7, 2000 ballot. Measure O was a tax measure that successfully passed the 2/3 vote requirement with 70% in favor and 30% opposed with a turnout of 77% of registered voters (County of Yolo). Each parcel is assessed a $24 annual tax to purchase development rights for up to 2,200 acres of agricultural

and farm land (Yamamura, 2000). In junction with non-profit organizations, the city of Davis has purchased easements to 3,998 acres as of January 2014 (City of Davis, 2014a).

The second approach is through lawsuits stopping development located outside its city limits but within a reasonable distance to have an impact on city quality of life. This action focused on an area called Kidwell. Kidwell is an area in adjacent Solano County, southwest of Davis on Interstate 80. It is separated from the city by UC Davis and is about 4 miles away from the city's core. The area is entirely agricultural and is served by a large freeway interchange. It was intended to be developed into an industrial area by Solano County, with the possibility of annexation by the city of Dixon. Davis successfully sued to stop the project. Since then, it is the focus of intense easement purchasing activity, with 932 of the 3,998 acres being in this area.

Davis' open space activities create additional pressure to restrict new housing located outside its city limits. This creates additional demand for housing in the city by people who do not want to commute to Davis.

The University Perspective

The University of California, Davis is a very large land-holding university located outside of the City limits but is directly adjacent to the City's southwestern borders. UC Davis originally started out as research farm of UC Berkeley and subsequently received its own University status with full-fledged higher education offerings found at other major universities. As a major employer next to the City, the University and the City are very intertwined with each other. UC Davis decisions to grow its enrollment impacts the City through student and staff growth looking for housing and shopping opportunities in the City. City decisions on land use policy affect the University's ability to attract students and staff in light of housing constraints.

In the build up to Measure J's Election Day, University officials actively spoke out against Measure J as being bad for the University. A *Sacramento Bee* article best captures the University's concern in its interview with UC Davis' then-Chancellor Larry Vanderhoef stating:

> "UC Davis Chancellor Larry Vanderhoef said Measure J "does not meet the mutual needs" of the city and the university, which must ensure adequate housing for students and faculty. "The cost of housing will go up, and that hurts us, because we have to recruit people from all over the country into this community," Vanderhoef said. "Stanford (University) lost their college town. Nobody at Stanford can afford to live in Palo Alto anymore." (Vellinga, 2000a, p. A1)

In response to Measure J passing, Vanderhoef announced less than three months later that the University will consider planning a "mini-city" on University land (Vellinga, 2000b, p. A1). This development is intended to provide affordable housing for staff and faculty. No public vote is needed because as a State entity, it is exempt from local planning laws.

In 2003, UC Davis received approval from the oversight body, the Regents of the University of California, to build a 4,300 person neighborhood on University grounds directly south and adjacent to the City's West Davis neighborhoods. This UC Davis "West Village" provides additional student housing that no longer can be met with existing space in the campus core. A UC Davis dean is quoted that the development "is a big tool in our recruitment" of faculty (Martineau, 2003, p. B1).

Why study the impact of a Local Urban Growth Boundary?

As a public policy question, theorists hold that local urban growth boundaries impact the development of the enacting boundary city and nearby cities. Local, or municipal-based, UGBs

are distinguished from regional or metropolitan UGBs. Davis is a municipal-based UGB, where the boundary is set by the City and is imposed on the City. Frequently studied Portland, Oregon's UGB is a metropolitan UGB, where the boundary is state-imposed, regionally-maintained and impacts multiple municipalities and unincorporated areas. Local UBGs may contribute to extraordinary housing costs and sprawl. Conversely, in Portland, the metropolitan UGB is found to reduce sprawl. These impacts are explored further in Chapter 2. In California, the state is actively trying to reduce carbon emissions through the promotion of regional planning efforts. If it is true that local UGBs push housing growth to other cities, this will work against efforts to reduce pollution and regional housing efforts. Some research also believes that local UGBs hinders overall region growth for reasons explained in Chapter 2 in a review of Wassmer and Boarnet's (2002) research.

Summary

This thesis will review the literature about the impacts of UGBs on the housing and rental markets in the next chapter. Chapter 2 is a literature review of UGB research and will help support the approach of the regression analysis. The thesis will review the data used to test the impact of the UGB on the Davis housing markets over time in chapter 3. Chapter 3 will also discuss the methodology used to test the impact of the UGB. Chapter 4 are the results and interpretation of the data analysis. Finally, Chapter 5 will conclude the thesis and identify the implications of the UGB in the context of current and future city land policy decisions.

This thesis will bring together existing research with my own research to inform the City of Davis the implications, if any, exist due to the UGB. It is important to understand the potential effect the UGB had on the community. If that effect runs contrary to the UGB's goal, that is also important to understand when considering new development. The proposed innovation parks

provide a nice window for a discussion about the UGB and whether it is time to consider limited new growth.

Chapter 2

Literature Review

A lot of academic literature exists concerning urban growth boundaries. Some research focuses on the effect of UGBs within the boundary and others focus on the effect outside the boundaries. Research varies from the effect on housing prices, rental prices, undeveloped land, and nearby cities. Some research also looks at UGBs in the context of an overall urban containment strategy. Urban containment is an umbrella term encompassing UGBs, as well as other policies that seek to limit expansion of a city.

This review will begin with a brief look at the political dimension associated with UGBs, move into the literature of UGBs in places outside of California, and then end with consideration of the UGB literature focused on California. At the conclusion of the review, this chapter will analyze the areas of knowledge gaps that exist. The conclusion will also discuss the variables used for analysis. This will allow the ability to determine if there is something unique about Davis when compared to other cities with UGBs. In addition, the review will draw to light methodologies used in other research that can be replicated for analyzing Davis' housing prices.

What is a UGB and what makes it a distinct urban containment strategy?

UGBs are a policy that limits growth by establishing a line where a city or metropolitan area will not expand into for development purposes. UGBs are sized between two philosophical planning approaches. First, communities that do not want grow will size the UGBs to the current municipality's boundary. This generally prevents any future expansion of the city. Alternatively, some UGBs provide an amount of undeveloped land for development and meet the city future growth estimates. This allows for controlled and orderly growth. Sometimes UGBs are set in

between these two sizes. For example, Portland's UGB includes growth assumptions for the next twenty years. Boulder's greenbelt strategy allows some growth over time.

Davis is not sized for growth assumptions. Every several years, a county-based Local Agency Formation Commission (LAFCO) studies a local government's service level and sphere of influence. No local government can annex land outside its city boundaries without LAFCO approval. LAFCO also advises local agencies where to best focus its growth activity with 10 and 20 year sphere of influence designations. Yolo LAFCO most recently studied Davis in 2008. In its municipal services report, Yolo LAFCO (2008) found that the current opportunities for redevelopment and infill use in Davis was "insufficient" for future growth in the next 20 years (p. 3.0-1).

Pendall et al. (2002) state simply that with UGBs, "[p]roperty inside the boundary which is designated for urbanization will be zoned for urban use; property outside the boundary will be zoned for rural use" (p. 26). This statement makes clear that UGBs are a zoning tool used by municipalities. This differs from greenbelts that involve the purchasing of land and/or development easements. Pendall's definition presumes that a single government entity, or a cooperation between two or more government entities, are able to zone land on both sides of the boundary. Other researchers generally define UGBs similarly. Weitz' (2012) review of growth management literature by defined UGBs as an effort to "redistribute development from fringe areas to more central locations" (p. 398). Dempsey and Plantinga's (2013) study of Oregon's UGB law defined UGBs as "an orderly and efficient transition from rural to urban use" (p. 998).

Weitz's definition recognizes the ability of a municipality to limit its own growth and its ability to redirect it internally. However, this relies on the ability of the adjacent municipality, or in the case of unincorporated land, the county, being respectful of the UGB originating city's

plan. Dempsey's definition is limited to a specific case study of UGB in Oregon. In Oregon, state law charges regional bodies to draw metropolitan-scale UGBs. This reflects the fact that multiple jurisdictions have the ability to influence other jurisdictions when it comes to sprawl. A metropolitan-scale UGB that is imposed upon a region prevents any one city from ignoring the effect of its sprawl on another city, provides a more cohesive regional approach to manage overall growth, and considers the regional urban footprint.

UGBs are not as permanent as other urban containment strategies. The most permanent containment strategy is the greenbelt strategy wherein a government entity purchases easements and land to preserve open space. Because UGBs are at its foundation a line on a map, it is easy for elected bodies or the electorate to shift boundaries. Gerber and Phillips' (2005) research focused on 65 UGBs in California and noted that about 27% of the studied municipality-adopted UGBs have since been modified (p. 319). Their study found that all of the 15 UGBs adopted by initiative remained unchanged (p. 319). Other more malleable strategies include limits on the number of residential permits issued or urban service limit boundaries. Gerber's findings are instrumental for Davis' planning purposes. Mentioned earlier in Chapter 1 are some pending projects intended to bring in new jobs and businesses. As Davis city staff and council consider the benefits and costs of these proposals, they must also realize that the process to change an initiative-adopted UGB is extraordinarily high.

Wassmer and Boarnet's paper (2002) summarizes the importance of understanding the impact of UGBs in a broader scale on regional economies. As a region grows, certain communities can reap the benefits, but only if the majority of communities in the region are willing to grow. As mentioned earlier in Chapter 1, Woodland thought its sales tax revenue could grow by offering more shopping opportunities for Davis residents. Wassmer and Boarnet noted

that growth allows for greater consumer choices to exist in the region because the fixed cost to produce per good declines when there are more people to purchase it. Growth can also lead to greater diversity and revitalize distressed areas. Wassmer and Boarnet also mentioned that growth can allow the clustering of like businesses such as intensive technology companies clustered in Silicon Valley. Mentioned earlier is an interest of more high-technology and agricultural technology firms wanting space to grow in Davis. The proposed innovation parks could facilitate the clustering of agricultural technology firms. Wassmer and Boarnet's paper is important to keep in mind as Davis wants to ensure its downtown remains vibrant and attract desired businesses to innovation parks while preserving public trust and ensuring local infrastructure can meet demand.

Political Dimension of UGBs

It is important to understand the context of why places adopt UGBs and the problem the UGB addresses. An UGB adopted through initiative is different from UGBs adopted by state or local governmental bodies. The differences in the reason and manner the UGB was adopted affect the rigidness of the UGBs and scope of their impact. For example, the UGB adopted in Seoul, South Korea by the national government sought to limit sprawl, land speculation and for national defense purposes (Bengston & Youn, 2006). The often-studied Portland, Oregon UGB is a metropolitan UGB imposed by the state. This UGB is a single boundary affecting multiple cities within the Portland metropolitan area.

O'Connell (2009) studied the actors in support and against urban containment policies when the policy is considered. He notes that political actors in support of containment tend to be environmental groups, local politicians, neighborhood groups, smart growth groups, and local newspapers. He notes that those opposed to containment tend to be real estate developers.

O'Connell concludes that urban containment policies are more likely to be adopted when there are a large number of types of supporters, a state requirement for comprehensive planning, and large numbers of college graduates (2009, p. 287).

Anthony's (2008) research came to some different conclusions from O'Connell's findings. Anthony believed that some studies, including one of O'Connell's earlier works, suffered from "methodologically flawed research" (p. 1376). Anthony focused on the long-term socioeconomic variables because he believed that studying only recent years does not explain the political environment leading to and during the adoption of the UGB. He points to Portland establishing its UGB in the 1970s. At the time, Portland was not a place attractive to college graduates, had lower home ownership rates, lower incomes and lower housing prices (p. 1375). This counters O'Connell's earlier point that containment policy adoption is more likely with higher number of college graduate residents. Anthony's finding leads to the question of what brought college graduates to the city in the first place. Anthony also says counting environmental groups, without giving weight to the number of members in the groups, can distort findings as to what causes adoption of containment policies.

According to Gerber and Phillips (2005), UGBs adopted through the direct democracy process are generally more restrictive than those adopted by a city council or other government body. Their findings identified that none of the direct democracy urban growth boundaries contained any provision for 25 years or more of supply of available land for future development. In addition, these measures also greatly restrict the ability of the elected boards to modify the measure. Gerber and Phillips (2005) found that about a quarter of the boundaries adopted by the elected board contained a 25-year or more supply of available land for future development. They also found that communities that adopted an UGB by direct democracy are more likely to adopt

new boundaries when the city council is more pro-growth and when city councils hold frequent meetings. For Davis, this implies that the current discussion on innovation parks and Nishi Properties may trigger a revision to Ordinance 41.01.

UGB effects researched outside of California

Woo and Guldmann (2011) studied the effect of state-mandated and local UGBs on central city housing from 1990 to 2000. They found that contained central cities with statewide UGBs, when compared to uncontained central cities have a lower median housing age, twice as much population growth, a higher employment rate and more growth in the nearby suburban cities (p. 3523). These findings indicate that a state-mandated UGB is beneficial for the continued renewal and development of a central city, thus reducing sprawl. Woo and Guldmann found that locally-adopted UGBs can promote growth in the core area, but not to the extent as state-level UGBs. They also saw that local UGBs resulted in more growth in the suburban area than the local UGB city, even when compared to state-mandated UGBs.

Oregon's UGB laws are state-mandated, and require regionally planned UGBs. These laws date from 1974 and provide land use researchers long time period to study the impact of the UGB laws. Oregon requires regions to plan for 20 years of land supply for growth. The UGB serves to direct growth in areas close to urban services but not to halt growth. Portland, Oregon's regional UGB encompasses over 360 square miles, 24 cities and portions of three counties (Pendall et al., 2002). All other cities have their own UGB. Oregon law allows for some development under certain conditions outside of a UGB. Dempsey and Planting (2013) studied 19 Oregon cities other than Portland to test if UGBs had any effect on containing growth, using data from 1973 to 2000. The general conclusion was that most development was contained within the UGB, but that some development occurred outside the UGB.

Specifically focusing on Portland, Grout et al. (2011) found that there could be significant zonal differences of land prices along a UGB line. Rather than compare the land prices in and out of a UGB, Grout et al. looked at if different areas along a UGB experience different impacts on the value of land. Looking at land values within a narrow band of long segments of Portland's UGB, Grout et al. found that the Portland UGB's effect is not uniform throughout the region. That is, it found big land price differentials between land in and out of the UGB on the region's southern and western side, but little on the eastern side. In addition, the eastern side has a number of undeveloped parcels within the UGB. Grout et al. contemplates that the intra-regional differences could be due to the region having multiple city centers, instead of one core city center where the land value gradually changes from the core.

Specifically focusing on housing prices, Jun (2006) found that Portland's UGB had an insignificant effect on Portland's housing prices. In this research, Jun performed a regression analysis of Portland against 32 US metropolitan markets using 1990 and 2000 US Census data.

Carlson and Dierwechter (2007) studied a metropolitan growth boundary in Pierce County, Washington. This county includes the City of Tacoma and is located just south of Seattle. Carlson and Dierwechter used residential permit data to evaluate a question about whether this UGB was effective in reducing residential sprawl. They believed that it is problematic to use US Census to determine an area's density and whether the UGB impacted population density. These researchers instead use residential building permit data gathered from 1991 to 2002 from the metropolitan planning body and form Pierce County. The researchers found that after the UGB's adoption in 1995, the number of new permits issued to locations outside the UGB fell and rose inside the UGB. The methodology used for this finding consisted of GIS mapping and statistical tabulation.

Boulder, Colorado is another city with strong urban growth controls. In 1967, Boulder voters adopted a tax to purchase and maintain open space around the city. Boulder relied primarily on land and easement acquisitions to build a greenbelt around their city and at time to build a buffer to limit other cities' growth (Lorentz & Shaw, 2000). This local/municipal growth control strategy is very relevant to Davis. Lorentz and Shaw note that Boulder's approach has created an imbalance of jobs to residences. They mention that the county expects traffic volumes to increase by 86% within 20 years due to increased commutes. Boulder updated its zoning plans to allow some new housing growth through the conversion of some commercial land to residential use. Pollack (1998) expands on the benefits and costs of Boulder's policies. He notes that while Boulder has managed to focus development within the city to maximize existing city infrastructure, the nearby town of Spencer grew from 255 people to 3,377 people in six years but is a place with few jobs and a small tax base (Pollack, 1998, p. 2). A replication of Boulder's side effects in Davis will see a similar expansion of nearby cities such as Dixon or Woodland and more crowded roadways into Davis. This is the opposite result of some of the stated reasons for passing Davis' Ordinance.

Early research of Boulder's greenbelts discovered that housing prices increased in the area near the greenbelts. Correll, Lillydalh and Singell (1978) observed 1975 assessor data of housing within 3,200 feet of a greenbelt. They found that a house approximately 30 feet from a greenbelt had a roughly $13,000 greater value in 1975 dollars than a house approximately 3,200 feet from a greenbelt (p. 211). Davis' UGB functions very similar to a greenbelt in that Davis, like Boulder, is significantly surrounded by open space. While this paper will not conduct a spatial analysis of housing prices affected by distance to the UGB line, Correll, Lillydahl and Singell's general findings have bearing in Davis. Davis does have a greenbelt procurement effort and the UGB also functions to preserve open space.

UGB effects researched inside of California

California centric research on UGB effects is limited. Levine (1999) did focus on California, but studied the impact of urban containment strategies and an even broader set of policies of growth management strategies. While his work considered growth management strategies, not just limited to urban containment strategies, it still offers a good historical narrative of the topic. Levine studied net changes in housing from 1980 to 1990 for 490 jurisdictions in California. Levine's model took into account a lag in adopting growth controls to manifest itself in a reduction in the growth rate of housing stock. The lag is about "a year or two to affect the production of new housing" (p. 2054). Four growth management policies had a significant effect on new housing stock. The first two strongest effects are urban containment strategies. The removal of land available for residential development had the strongest effect, followed by the removal for land for commercial/industrial use. Levine suggests that removal of commercial/industrial use land may affect mixed-use projects and the loss of potential proximity with an employment site creates less of a demand for residential units (p. 2056). Levine's study found that growth management policies "are associated with fewer rental housing units being produced, with fewer families being added, but with increased rent levels, increased ownership value and increased household incomes" (p. 2062). This supports an idea that UGBs restrict supply of residential housing without modifying demand.

Landis, Deng and Reilly (2002), surveyed recent research and conducted their own research of the impacts of UGBs in California. There approach is able to look at the local/municipal UGBs. They focused on all types of growth, noting "[g]rowth is like toothpaste. Squeezed out of one location, it must go somewhere else" (p. 414). Specific to UGBs, these researchers looked at the effect of UGBs in four cities and twelve peer cities without UGBs.

They find that UGB cities growth 20% more than their peer cities (p. 19), confirming supporters' believe that UGBs can redirect growth within a city. These researchers noted that other research indicated that cities with growth controls might have increased housing prices due to the growth control city being a well-developed city with a lot of amenities and a highly desired quality of life when compared to other cities. Landis, Deng and Reilly's research of the four UGB cities found that the average housing demand-supply balance between 1990 and 2000 indicated that there was more than enough new supply of houses to meet demand; whereas the twelve peer cities had five times more demand than supply (pp. 25-26). They also conducted a regression analysis using 1990 and 2000 US Census median household income data. They concluded that median income of a community was the leading cause for housing prices, not the existence of a UGB (pp. 28-29). This finding is illuminating because Anthony's (2008) premise is that sociological factors can be the driver for UGBs. With Landis, Deng and Reilly's research, maybe it is communities with high incomes drive up housing prices and secondary to that, adopt an UGB to preserve city character. For this paper, the analysis will need to consider if median income is a driver of housing prices in spite of, or in addition to, an UGB.

Methodology Approaches Learned from this Review

Landis, Deng and Reilly's (2002), Gerber and Phillips (2004) and Jun's (2006) research are similar in that they rely on US Census data to determine the effect of UGBs on housing prices. By using a similar methodology and the same data source, my research and analysis should have a comparable approach. This paper proposes to use the 1990, 2000 and 2010 US Census data whereas the other research only had 1990 and 2000 available at the time. Specifically, from Landis, Deng and Reilly's research, this paper will use the same UGB control

and peer city sets shown in the table below. I added a new UGB control and city set focusing on Davis to the Landis, Deng and Reilly table as a starting point for my methodology approach.

Table 3 - Modified Landis, Deng & Reilly UGB and peer city table

UGB City	Santa Cruz	Visalia	Vacaville	Davis (core)	Davis (core + region)
Peer Cities	Morgan Hill	Hanford	Woodland	Woodland	Dixon
	Saratoga	Tulare	Fairfield	Rocklin	Winters
	Watsonville	Porterville	Pittsburg	Folsom	West Sacramento
	Marina			Rancho Cordova	Elk Grove
					Roseville

In addition, this paper will make use of a number of US Census data categories used as variables in several researchers' regression analysis. These data categories, with the associated researchers, are in the table below.

Table 4 - US Census data used in other research

US Census Data Category	Used in Landis, Deng & Reilly (2002)?	Used in Gerber & Phillips (2004)?	Used in Jun (2006)?
Median Household Income	Yes	Yes	Yes
Population	No	Yes	Yes
Land area	No	Yes	No
Density	No	Yes	No
% of units built in previous ten years	No	No	Yes
Vacancy Rate	No	No	Yes
Average housing prices	No	No	Yes

Conclusion

The research demonstrates that the effect of UGB varies based on whether it is a local/municipal or a metropolitan UGB; this distinction means that is important to develop additional research of municipal UGBs. California does not have any formal regional or state governmental entity that can adopt, impose, or otherwise control a metropolitan UGB. The state recently required regional bodies to develop regional sustainable community strategies to encourage more ordered and centralized growth through financial incentives. The incentives are in the form of transportation funding, which the regional bodies can control.

Despite the abundance of metropolitan UGBs, there is not a lot of research on local UGBs, including those in California. The state is large with diverse population centers. Looking at California UGBs using different cities is important to figure out the effect of other factors. In Landis, Deng and Reilly's study (2002), one of the UGB cities studied is Santa Cruz, a city that is against State Parks on the West, the Pacific Ocean to the South, incorporated and unincorporated develop land to the East and mountains to the North. While Gerber and Phillips (2004), Jun (2006) and Landis, Deng and Reilly (2002) all used a variety of US Census data, they focused on 1990 and 2000 data. During this period, California and the nation experienced a period of strong economic growth. The period between 2000 and 2010 did not have strong economic growth and a number of years were during a recessionary period. Therefore, a new look at a local UGB in California using 1990, 2000 and 2010 US Census data is needed to see if the assumptions about the UGB's effect on a municipality still hold true during the most recent ten-year period that had two recessions.

Chapter 3

Methodology

This paper seeks to determine the effect that the City of Davis' UGB had on housing prices. To determine if there was an effect, and if so, the magnitude to the effect, I intend to conduct a regression analysis using 1990, 2000 and 2010 US Census data. The units of analysis are select California cities, identified later in this chapter. A portion of data previously collected by the US Census was collected in the American Communities Survey (ACS) in 2010. ACS is an annual survey conducted by the US Census.) This approach will inform Davis, citizens and policymakers regarding the current discussion about city expansion to include Nishi Properties and/or innovation parks and the impact they could have on the local housing and rental markets.

This chapter will discuss in detail each of the variables selected for analysis and why. Each US Census variable is generally consistent in its tabulation approach across all years. Therefore, each discussion of a US Census variable will apply to all three US Census datasets, unless otherwise mentioned in each variable section.

Variables for analyzing the impact of Davis' UGB on the housing market

To determine the impact of Davis' UGB on the housing market, this paper relies on the US Census' median price of a single family residence as the dependent variable. The dependent variable is the element that changes based on independent variables. Independent variables are those that move freely and unaffected by movement in the dependent variable. In addition to these variables, the research includes one dummy variable to capture and include in the analysis the effect of the existence of the UGB. I assign a value of one if the UGB is in effect and a value of zero if the UGB is not in effect during that Census year.

Table 5 - List of variables

Dependent Variable	Source
Median Housing Value, single family residence by each city	US Census (1990 & 2000) & ACS 2010
Independent Variables - Supply Side	**Source**
Land Area	US Census, 1990, 2000 & 2010
Urban Growth Boundary in effect? (Yes=1, No=0)	Based on subject city's LAFCO municipal service review report or general plan, detailed in Appendix E
# of years urban growth boundary in effect, (No UGB or less than 6 months is 0)	Based on subject city's LAFCO municipal service review report or general plan, detailed in Appendix E
# of housing units	US Census, 1990, 2000 & 2010
% of housing units with 1 bedroom	US Census, 1990, 2000 & ACS 2010
% of housing units with 2 bedrooms	US Census, 1990, 2000 & ACS 2010
% of housing units with 3 bedrooms	US Census, 1990, 2000 & ACS 2010
% of housing units with 4 bedrooms	US Census, 1990, 2000 & ACS 2010
% of housing units with 5 or more bedrooms	US Census, 1990, 2000 & ACS 2010
% of residencies 10 years in age or less	US Census, 1990, 2000 & ACS 2010
% of residencies 10 to 20 years in age	US Census, 1990, 2000 & ACS 2010
% of residencies 20 to 30 years in age	US Census, 1990, 2000 & ACS 2010
Independent Variables - Demand Side	**Source**
Median Household Income	US Census, 1990, 2000 & ACS 2010
% of households in poverty	US Census, 1990, 2000 & ACS 2010
% of households with $150,000 in income or more	US Census, 1990, 2000 & ACS 2010
Population	US Census, 1990, 2000 & 2010
% of population with professional occupations	US Census, 1990, 2000 & ACS 2010
% of population with 4 year college degrees	US Census, 1990, 2000 & ACS 2010
% of population under 18	US Census, 1990, 2000 & ACS 2010
% of population 65 and over	US Census, 1990, 2000 & ACS 2010
% of population married	US Census, 1990, 2000 & ACS 2010
Dummy Variables - For Panel Data	**Source**
City Identification Number	Assigned a number from 1-62 in alphabetical order of city name for the arrangement of panel data
Observation Year	Assigned 1 for 1990, 2 for 2000 or 3 for 2010 based on year of data

Background on the US Census datasets

The US Census is a decennial effort where the federal government attempts to survey every household within a defined Census geographical place. This population survey is through a short form for the 1990 and 2000 census. Those years also used a long form, which surveyed a subset of population with detailed questions. The 2000 census long form sampled about 17% of the population (US Census, 2007, p. C-6). The 1990 census long form generally sampled at about 17% (1 in 6) of the population, with 1 in 2 sampled in incorporated places, counties and other similar government units smaller than 2,500 in population (US Census, 1992, p. C-1). This thesis makes use of both data from both the short form and long form.

Shortly after conducting the 2000 census, the US Census introduced the American Community Survey (ACS). The ACS surveys a sample of the households monthly and aggregated into 1, 3 and 5 year estimates. In 2010, the ACS replaced the long form census used in the 1990 and 2000 censuses. The ACS sampled about 3 million addresses in 2010 (US Census, n.d. A). This thesis makes use of the 5 year estimate because it is identified as the estimate set that is "best used when precision is more important than currency" and because 1 year and 3 year estimates do not present data for places smaller than 65,000 or 20,000 people respectively (US Census, n.d. B).

The US Census definition of a "place" includes an incorporated city. At the time of the 1990 and 2000 US Census, the cities of Elk Grove and Rancho Cordova did not exist. The city of Citrus Heights did not exist in the 1990 Census. During these Census years, the US Census has defined Census Designated Place (CDP) for each location bearing the same name. These will be used as proxies, although Elk Grove city was formed from three CDPs (Elk Grove, Laguna and Laguna West-Lakeside CDPs) and Rancho Cordova was formed from one CDP (Rancho Cordova

CDP) (US Census, 2013). The city of Citrus Heights is entirely within, but not co-terminus with the boundaries of the original Citrus Heights CDP (Kowta & Meigs, 2011). A CDP is a place that "usually physically resemble incorporated places in that they contain a residential nucleus, have a closely spaced street pattern and frequently have commercial or other urban types of land use." (US Census, 1994, pp. 9-1 - 9-2).

Cities Studied

This thesis studies 62 California cities. Appendix A lists all these cities, their county and the reason for inclusion in this study. The starting point is to include all the cities located in the same county as Davis, the neighboring city of Dixon in the adjacent county of Solano, and all the cities studied by Landis, Deng and Reilly (2002). Any city identified by Landis, Deng and Reilly (2002) as a UGB city, I included all other cities in the same county as that UGB city. Also included are all cities in the counties of Sacramento and Placer. These counties are in the same region as Davis and experienced strong growth in the early 2000s. All cities in Sonoma County are included because this county has a strong pro-UGB movement. All cities in Santa Clara County are included due to its strong growth in the early 2000s and because Landis, Deng and Reilly (2002) studied two non-UGB cities located in this county. Landis, Deng and Reilly (2002) also included Chico as a UGB city, however, on review; I excluded this city as it only has a greenline on the western side of the city and is uncontained in all other directions.

Description of the dataset and discussion of the variables

The variables are categorized in two groups, those reflecting the supply side of housing and demand side of housing. Supply side variables look to see if the UGB's effect on the ability to develop and supply more housing impacts the median housing prices. Demand side variables seek to explain if a change in demand for housing affected median housing prices. In

O'Sullivan's (2009) book on urban land policy, he succinctly discusses the economic impacts of an UGB (pp. 235-241). He notes that landowners within the UGB gain from the UGB as there is more competition for a stable number of housing units. He also notes that an UGB will lead to higher densities because as land prices rises, new development will shrink the housing's footprint to minimize land costs.

Median housing value, single family residence

This variable looks at the median housing value of a single family residence. The definition the US Census uses for a single family residence is limited to housing unit that could be detached or attached units (houses, mobile homes and condominiums). The Census asked the surveyed population what they believe the housing unit will sell for at the time of the survey. In 2010, the US Census measured median housing prices through its American Communities Survey (ACS). Also in 2010, this variable measurement methodology changed from the 2000 methodology. Beginning with the 2008 ACS, all housing values were collected via a write-in by the survey respondent while the 2000 Census recorded housing values through categories (US Census,2011, p. 41.). In 1990 the question was asked on a 100% basis, whereas the 2000 Census and 2010 ACS are on a sample basis.

Median housing value is important measure that indicates how affordable a city or place is to purchase a house. One can look at the median housing value and quickly determine if the area is within their price range.

Troubling is that the US Census records median housing value up to $1,000,000 for the 2010 ACS and 2000 Census. Any median housing value above $1 million dollars is recorded as "$1,000,000+". In the 1990 Census, the highest housing value captured by the US Census was $500,000 and recorded as "$500,001". Six out of the 62 cities studied has a median housing

value greater than $1,000,000 in the 2010 ACS. In the 2000 Census, three of the 62 fell outside the upper bound and in the 1990 Census, four of the 62 fell outside the upper bound for housing value. The cities in the 2000 and 1990 Census that fell outside the upper bound are also part of the same six cities in the 2010 ACS that fell outside the upper bound of reported housing values. These cities are all located in Santa Clara County and are Los Altos, Los Altos Hills, Los Gatos, Monte Sereno, Palo Alto and Saratoga. The six cities are removed from the regression analysis and are listed in Appendix B.

All dollar values are converted into 2010 dollars by applying a consumer price index (CPI) specific to California. The California Department of Finance (2015) maintains a statewide CPI, tracking the change in prices, and thus the value of the dollar, by calendar year as summarized in Table 6 below.

Table 6 - California Consumer Price Index

Calendar Year Average, (1992-84=100)		
Year	Index Value	% change from 2010
1990	135	68.09%
2000	174.8	29.82%
2010	226.919	

Supply side variables

Land Area

Land area is a measurement of the area of a US Census place in terms of square miles. This measurement is a subset of total area for a US Census place. Total area includes the water area for the place. Water area includes permanent inland water features, but areas that are intermittingly under water are included in land area (US Census, 2012, p. A-9).

Depending how a UGB is structured, it can be tightly confined to existing developed areas or allow a certain amount of planned growth over a time period. As mentioned in Chapter 2, Portland's UGB is designed to provide a 20 year land supply for growth.

Number of housing units

The number of housing units is a count of the number of houses (detached, duplexes and the like), apartments and mobile homes in a defined place. It does not include group quarters, which includes college dormitories or detention facilities. The count of housing units is comparable for all three survey years.

A non-UGB city should have a positive correlation with the number of housing units, as this should reflect the lack of restriction on residential growth. However, it could be skewed if a non-UGB instituted another form of growth control in the form of limiting issuing new residential construction permits.

Percent of residences 10 years of age or less

This is my calculation using Census data of the data set "Year Structure Built". Survey respondents are asked the year the structure is built. I calculated the groups falling within 10 years of the Census/ACS date as a percentage of the total structures reported. The 2010 and 2000 surveys are comparable. The 1990 survey had a category of "Don't know" for when a respondent doesn't know when the structure was built. This was eliminated in 2000 because the US Census found a high number of people marked this category in 1990 (US Census, 2003). For all survey years, the US Census warns that the question relies on the respondent's memory and could be subject to errors.

New residences are a sign of a city undergoing growth. This variable will be able to see how an UGB city differs from a non-UGB city through the increase in new residencies. This

variable helps capture Davis' efforts infill development that occurs without boundary changes. A small amount of new housing will manifest itself increased housing prices as there is more competition for scarce resources.

Percent of residences 10 to 20 years of age

The method in how this variable is populated is described above in the discussion about the variable of percent of residences under 10 years of age.

This category of the age of housing stock can indicate that the overall housing stock in the place is aging, creating an upward pressure on housing prices due to limited supply.

Percent of residences 20 to 30 years of age

This variable is calculated the same way as the other age of housing stock variables. Including this variable helps determine if a city's recent growth has slowed, particularly when considered in junction with the length of time an UGB has been in effect.

If a larger share of residences are in this age category, then it is likely to contribute to an upward pressure on housing prices due to a limited supply of new housing.

Percent of housing units with 1, 2, 3, 4 or 5 and more bedroom(s)

This variable is a calculated value using 2010 ACS and 1990 and 2000 Census data. The US Census collects the number bedrooms in each housing unit in each place and bins them into categories. The categories are housing units with zero, one, two, three, four and five or more bedrooms. This measurement will account for those places where large housing is more prevalent than other communities. No census data exists on lot or building size, so this variable is used as sort of a proxy to account for large houses. The US Census changed how it asks the number of bedroom question for 2010 compared to prior surveys. In 2010, respondents are asked

to write in a zero (0) if the housing unit is a studio apartment (US Census, 2011, p. 12). Also in 2010, the survey was redesigned to have a two-part question that first ask the number of rooms followed by the number of bedrooms (US Census, 2011, p. 12).

Through this measurement, this study can see if a UGB city compensates with slow growth through increased number of housing units with a large number of bedrooms.

Urban Growth Boundary in effect?

This variable is an independent variable and is a dummy variable. Using the cities studied by Landis, Deng and Reilly (2002) and my own comparison cities for Davis, I researched the each city's website and general plan, the city's LAFCO municipal service review, and a search of California papers accessible through Newsbank to determine if a UGB is in effect for those cities to determine if a UGB is in effect during or prior to 2010. In limited cases, some cities have no record of adopting an UGB when reviewing these sources. Any UGB implemented after 2010 is not reflected in this thesis. A value of one (1) is assigned to cities with an UGB and a value of zero (0) is assigned to cities without an UGB. This is summarized in Appendix D.

Number of years the city's UGB is in effect?

For all the cities included in this analysis, I will review their municipal services review reports and general plans to determine when a city's UGB became effective. Cities without an UGB are coded as zero (0). For cities with an UGB starting in the middle of a calendar year, a value of one (1) is assigned to those with an UGB effective in the first six months of a calendar year and a value of zero (0) is assigned to those effective in the last six months of a calendar year. All years are counted from January 1. This is summarized in Appendix D.

Demand Side Variables

Median Household Income

Median household income is obtained from the total income data in the US Census. Total income includes income received by person 15 years and older and is the sum on wages, self-employment, government assistance, investment income and/or pension income (US Census, 2011, pp. 77-78). The 2000 Census income question is based on income received in the prior calendar year, while the 2010 ACS is based on income received in the prior twelve months. Additionally, the US Census warns that respondents tend to underreport income and that Census staff used "extensive computer editing procedures" to improve the quality of this data (US Census, 2011, p. 83).

Percent of households with income of $150,000 or more

The surveys all will categorize a household's income into bins. The 1990 Census uppermost bin is income of $150,000 or greater. The 2000 Census and 2010 ACS uppermost bin is $200,000 and also have a $150,000 to $200,000 bin. This data is used to determine the percent of households with incomes of $150,000 or larger of the total number of households in that place. The number of households in each income bin is based on the income in that survey year's dollars. Thus, there is no adjustment to 2010 dollars.

A larger percent of households with higher levels of income indicates there is more disposable income to spend on housing.

Population

As mentioned earlier, population is based on the defined "place" used by the US Census. Population is a count of everyone who resided in the subject place during the time the Census was recorded (US Census, 2012, p. B-1).

An increase in population indicates that Davis is a desirable place to live, and this is presumed to have an upward pressure on median housing prices. However, the opposite can be true if the city expands, which will be reflected in land area and density.

Percent of population 18 years of age or over with a Bachelor's degree or greater

The US Census measured a population's educational attainment in the 1990 and 2000 Census and in the 2010 ACS. The survey question asked respondents what level of education they attained. If the respondent indicated multiple levels, the US Census recoded the response to the highest level of attainment. The order of superiority from highest to lowest is doctoral, professional, master's, then bachelor's. The 1990 Census, 2000 Census and 2010 ACS all record this information and present the educational attainment. The US Census made some changes in how this information is categorized over the years and those changes are limited to the portion of the population having less than a bachelor's degree.

The presumption with this variable is that if housing becomes increasing unaffordable after adopting a UGB, then only those with higher incomes will afford housing in Davis. Higher incomes are associated with attaining a college degree. Additionally, this variable will look at Anthony's (2008) research about whether college educated population is drawn to a UGB city because it is a desirable place to live.

Percent of population under 18

The US Census surveyed each residence's population about their age in the 1990 and 2000 Census and in the 2010 ACS. Age is recorded by the US Census in whole years, with respondents asked to round up their age if they are close to their birthday.

If housing is constrained and increasingly expensive in an UGB city, then younger populations, including those of child bearing age, should shrink. The effect on median housing prices from age is that only increasingly older populations can afford Davis.

Percent of population 65 years in age or older

As explained above in the "younger than 18" variable, the US Census inquires about the age of the population. Age is recorded by the US Census in whole years, with respondents asked to round up their age if they are close to their birthday.

An aging population can be indicative that there isn't pressure to leave the city, and by extension, a constrained supply of housing available for purchase.

Percent of population married

The 1990 Census, 2000 Census and 2010 ACS asks the population what is there marital status at the time of the survey. This information is tabulated only for the portion of the population age 15 and over (US Census, 2011, p. 96). There are enough similarities between all three surveys that they can be compared for this study.

Married couples can have more disposable income than a single person. This can impact demand for housing as couples can maximize their income to purchase a home.

Percent of population with a professional occupation

This variable captures the percent of the population 16 and over whose occupation is in the management, business, science or arts category. The categories not included are "service", "sales and office", "natural resources, construction and maintenance", and "production, transportation and materials moving" occupations. The survey asks the question employed people what was their job in the previous week to completing the survey, or if worked more than

one job, records the response of the job where the respondent worked the most hours. Job occupations are classified in to broad categories using the "Standard Occupation Classification Manual" (SOC) issued by the US President's Office of Management and Budget. The SOC underwent major changes between the 1990 Census to the 2000 Census and should not be compared with each other (US Census, 2003, p. B-25). These changes reflect the creation of new occupations, deletion of other occupations, the breaking up or consolidation of occupations, and/or the re-categorization of occupations. Additional notable changes in occupational categories occurred between 2000 and 2010 in the "information technology, healthcare, printing, and human resources occupations" (US Census, 2011, p. 100). Due to the complexity to sort these changes out, this author makes no adjustment for these changes.

As mentioned earlier, if a city with an UGB becomes increasingly unaffordable, then those who can live in this city need more income. Presuming that management, business and science occupations pay higher wages, there should be a growth of people in these occupations in an UGB city compared to a non-UGB city. Thus, an increase in these occupations may have a positive correlation with median housing prices.

Percent of families in poverty

This variable from the US Census measures the number of households in poverty. Poverty is a designation where the threshold shifts based on the size of the family, number of children and age of the householder. A household is in poverty when the last twelve months of income for the family is below a threshold. The US Census changed some survey methodology between the 2000 Census and the 2010 ACS that may cause a shift in the amount of families in poverty (US Census, 2011, pp. 102-105.) However, no such changes occurred between the 2000 and 1990 Censuses.

If it holds true that housing is increasing unaffordable after a city adopts an UGB, then one expects to see the poverty rate decline as these families are pushed out of the UGB city. The expected effect of the existence of the UGB is to have a negative correlation with poverty, and thus a negative correlation with median housing prices.

Conclusion

A large amount of data from varying sources was compiled to build this dataset. Appendix G provides a detailed documentation of the various US Census data sources and tables used to compile this author's dataset.

The formula inputted into the regression model is:

Median Housing Price = f(population, land area, structures built in the last 10 years, structures built 10 to 20 years ago, structures built 20 to 30 years ago, percent of population in a professional occupation, percent of population with bachelor's degrees or higher, percent of population in poverty, percent of population wealthy, percent of population under 18, percent of population 65 and over, percent of population married, mean number of rooms, percent of housing units with 1 bedroom, percent of housing units with 2 bedrooms, percent of housing units with 3 bedrooms, percent of housing units with 4 bedrooms, percent of housing units with 5 or more bedroom, urban growth boundary dummy variable, years of urban growth boundary in effect)

This dataset is analyzed through a regression analysis detailed in Chapter 4. Chapter 4 will present the results of analysis in narrative and numerical form.

Chapter 4

Analysis and Results

In this chapter, I will present the results of my regression analysis. Specifically, this chapter will begin with descriptive statistics, proceed to a description of the tests used to ensure the regression approach is correct, and conclude with a description of findings.

Summary Statistics

The data analyzed includes 168 observations, or three per city. There are 56 cities, technically called groups of observations, in this analysis. A summary statistics table is below in Table 7 and a panel data descriptive statistics table is in Appendix C.

Table 7 - Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Median Housing Value	168	336,079.90	172,952.20	82,532.00	993,500.00
Population	168	62,884.14	126,200.60	804.00	945,942.00
Land Area	168	16.47	26.06	0.40	176.53
Percent of structures built in the last 10 years	168	21.97	13.39	2.81	74.42
Percent of structures built 10 to 20 years ago	168	20.56	8.70	4.45	44.69
Percent of structures built 20 to 30 years ago	168	18.81	7.13	0.78	41.17
Percent in professional occupations	168	32.03	12.75	5.11	74.80
Percent with Bachelor's or higher	168	20.37	12.83	1.63	71.02
Percent married	168	55.83	6.71	33.13	70.53
Percent in poverty	168	11.68	7.54	2.50	39.90
Percent under 18 years of age	168	26.85	5.29	13.67	39.28
Percent 65 or higher of age	168	11.53	4.05	6.03	32.30
Percent of households with income greater than $150,000	168	6.17	6.98	0.00	37.80
Median household income	168	63,119.21	18,755.45	28,624.05	130,353.60

Mean number of rooms	168	5.13	0.49	4.02	6.36
Percent of housing with 1 bedroom	168	13.23	5.96	2.10	32.23
Percent of housing with 2 bedrooms	168	29.02	7.69	9.95	55.00
Percent of housing with 3 bedrooms	168	37.37	7.43	19.22	55.25
Percent of housing with 4 bedrooms	168	15.09	7.47	3.08	36.98
Percent of housing with 5 or more bedrooms	168	2.48	2.12	0.00	12.30
UGB in effect (dummy variable)	168	0.16	0.37	0.00	1.00
Years UGB in effect	168	1.33	3.64	0.00	19.00

Analyzing Panel Data

The type of regression used for analyzing data changing over time, or panel data, depends on whether the person uses a fixed effect model or a random effects model. A fixed effects model looks is "designed to study the causes of changes within a person [or entity] (Kohler & Kreuter, 2009 as cited in Torres-Reyna, n.d.). When the dependent variable is affected by the difference in the entity (city), researchers use a random effects model. To determine which method to use, I ran both a fixed effects and random effects model, then executed a Hausman's specification test. The results of this test indicate that a fixed effects model is appropriate for this study. The results are in Appendix F.

The next step is to check for presence of heteroskedasticity. Heteroskedasticity is a term to describe when there is a violation of the fifth assumption of the classical model of econometrics. Researchers must make corrections to their analytical approach if there is a violation of any of the classical model assumptions. Assumption five assumes that the error term

as a constant variance, or another words the distribution of errors from the model regression line is constant over a number of observations. The modified Wald's test for groupwise heteroskedasticity indicates that heteroskedasticity is present as shown in the figure below.

Figure 3 - Results of Modified Wald Test

```
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (56)  =    5614.88
Prob>chi2 =      0.0000
```

Another test I performed identifies auto-correlation. Auto-correlation, also called serial correlation, is a violation of the fourth classical assumption in the econometrics model. The fourth assumption is that error terms do not correlate with another error term for an observation unit (city) over time. When I performed a fixed effects model regression on my data, the rho value was near one, indicating the possible presence of auto-correlation. To confirm this suspicion, I ran Wooldridge's test for auto correlation in panel data. The test indicates that there is a greater than 99% probability that auto correlation is present. The result of the test is in the figure below:

Figure 4 - Results of Wooldridge Test

```
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,       55) =      8.392
           Prob > F =      0.0054
```

After correcting for heteroskedasticity and auto correlation, my regression results indicate the rho is close to zero (0.07) and my R-squared score is 0.86. An R-squared score closer to one means the equation I developed reasonably fits, or explains the dependent variable. The results are presented in Table 8.

Table 8 - Regression results with the real median housing value as the dependent variable

Variables	Coefficient (Robust Std. Err.)
Population	0.6942672 *** (0.1889544)
Land Area	-3,569.694 *** (874.0723)
Percent of structures built in the last 10 years	-1,277.11 (715.9242)
Percent of structures built 10 to 20 years ago	148.63 (749.6981)
Percent of structures built 20 to 30 years ago	-3,330.307 *** (888.944)
Percent in professional occupations	-2,832.88 (1,888.329)
Percent with Bachelor's or higher	1,027.89 (2,192.599)
Percent married	-1,957.56 (1,770.949)
Percent in poverty	362.261 (1,776.955)
Percent under 18 years of age	-10,238.75 *** (2,525.309)
Percent 65 or higher of age	-2,735.43 (2,488.234)
Percent of households with income greater than $150,000	8,223.494 ** (2,587.039)
Median household income	4.932104 *** (1.235465)
Mean number of rooms	-26,004.92 (32,046.43)
Percent of housing with 1 bedroom	-8,602.978 * (4,218.888)
Percent of housing with 2 bedrooms	-2,395.301 (3,759.063)
Percent of housing with 3 bedrooms	-6,455.416 (3,736.225)
Percent of housing with 4 bedrooms	-4,939.576 (4,068.866)

Percent of housing with 5 or more bedrooms	-356.9626 (6,033.131)
UGB in effect (dummy variable)	-39,924.24 (27,370.4)
Years UGB in effect	5,810.588 * (2,866.987)
Constant	1,190,946 ** (409,053)
Observations	168
r-squared	0.8578999
Groups (Cities)	56

*** p<0.01, ** p<0.05, * p<0.10

Findings

The regression results indicate that there are several factors that have a statistically significant impact on the median housing price in a city. The significance level is at 90% level of confidence. For each unit change in the significant variable, the median housing price will change by the amount of the coefficient. The real median housing value in this data set averaged $336,080. For example, the model predicts that the real median housing price will increase by $0.69 for each person increase in population. A summary of the statistically significant variables at the 90% level of confidence interval is below in Table 9.

Table 9 - Statistically significant variables

Variable	Coefficient	90% Confidence Interval	
Population	0.6942672 ***	0.383	1.005
Land Area	-3,569.694 ***	-5,007.415	-2,131.973
Percent of structures built 20 to 30 years ago	-3,330.307 ***	-4,792.489	-1,868.124
Percent under 18 years of age	-10,238.75 ***	-14,392.510	-6,084.988

Percent of households with income greater than $150,000	8,223.494 **	3,968.193	12,478.790
Median household income	4.932104 ***	2.900	6.964
Percent of housing with 1 bedroom	-8,602.978 *	-15,542.430	-1,663.524
Years UGB in effect	5,810.588 *	1,094.813	10,526.360
Additional variable of note	**Coefficient**	**90% Confidence Interval**	
UGB in effect (dummy variable)	-39,924.24	-84,944.540	5,096.062

The model offers mixed results as to the influence of the key UGB policy variables. The model did not find it statistically significant that the existence of an UGB affects median housing values. The probability of significance for the UGB dummy variable is at 85%, below the 90% threshold. Critically, the model finds that the existence of an UGB over a length of time does have a statistically significant positive effect on median housing values. The model predicts the length of time the UGB is in effects has an upward pressure on the median housing price by $5,811 per year. The length the UGB is in effect will, over time, reduce the available land for development. This places greater upward pressure on land costs.

Other variables also have significant positive effects, including population, households earning $150,000 or more, median household income, all have a positive effect on median housing prices. An increasing number of households having incomes over $150,000 will place great upward pressure on the median housing price of a community. This pressure is valued at $8,234 for every percent of the community that is a high-earning household. It also predicts that the median housing price will increase by almost five dollars for each one dollar increase in median household income. This is probably due to the fact that households with more income can spend more on housing. The model predicts that the median housing price will increase by $0.69 for each person increase in population.

Land area, age of older structures, youth and one-bedroom housing units all has a negative effect on median housing prices. Interestingly, an increase in the number of youth by one percent decreases housing prices by $10,239. More children skews demand as more of the city's population is within a household, reducing demand on housing. The model predicts that for every percent of housing structures that only has one bedroom, the median housing price declines by $8, 603. This negative effect could either be due to their size allowing more housing units to exist in the city, thus reducing competition, or that a prevalence of one bedroom housing units are make the city an undesirable place to live. An increase in a city's land area allows the construction of more housing units, thus reducing competition for housing and lower prices. For every square mile a city grows, the median housing price will decline by $3,570. Finally, each percent that the city's housing stock falls within the age of 20 to 30 years old will reduce the median housing price by $3,330. Something about this age housing stock is not valued the same as even older housing stock. It could be that this group of housing stock is prone for renewal maintenance, such as a new roof, or cultural, this group is not valued as much as even older housing stock because the 30 plus group has more land or more architectural appeal ("character"). This is very likely due to older housing stock needing repairs and maintenance that newer housing stock do not.

Conclusion

The results of this regression analysis lead me to believe that I correctly identified a reasonable model to describe effects on median housing prices. Based on the results, I can infer the impact of Davis' urban growth boundary and land use policy responses that can achieve the city's goals stated in the UGB ordinance and other government documents. This will be discussed in Chapter 5.

Chapter 5

Conclusion

This research concludes that municipal urban growth boundaries do have an effect on median housing values after several years pass since their adoption. Specifically, when an UGB is adopted, median housing values first drop by $39,924 and then increase by $5,811 each year thereafter. Within seven years, the median housing value in a city with an UGB is higher than a city without an UGB. This chapter reviews how this result relates to existing research, considers opportunities for additional research, and discusses implications for Davis in the context of its existing growth consideration.

As noted in Chapter 1, the city of Davis has a municipal UGB in effect since 2000. The city recently was the subject of a *Sacramento Bee* article about how home ownership by younger generations has declined. Davis is currently considering growth proposals in the form of innovation parks that will be built just outside of the UGB, bringing the UGB policy back into the public discourse. As a resident of Davis, and a recent homebuyer, I was very interested in knowing if the UGB impacted the city's housing market. I wanted to know if the UGB increased the median housing value or if there are other factors that impacted the city's housing values. These events piqued my interest to research the effect of the UGB more. During the course of the research, I came across several articles quoting UC Davis staff expressing concern about the UGB having an adverse affect on median housing values. My research says yes, that over time, the UGB does have a positive effect on housing prices that continues to increase as time passes since implementation.

My regression analysis drawing on US Census data from 56 cities and 168 observations for the 1990, 2000 and 2010 survey years led me to the above conclusion. I found that for each

year the UGB is in effect, median housing value is expected to increase by $5,811 but the mere adoption of an UGB is predicted to reduce the value by $39,924. These are the mid points of the range that the coefficient values for the variable. The 90% confidence level for the effect each year an UGB is in force ranges from $1,095 to $10,526.

Other factors affect median housing prices as well, including population, city land area, age of the housing stock, the percentage of youth of the city population, the percentage of high income households, the median household income and the number of housing units with one bedroom. Population has the least magnitude of effect of all the previously listed variables having a statistically significant level of confidence. Each person increase in population is predicted to raise the median housing value by $0.69. Alternatively, for each percentage increase in the number of high earning households will increase the median housing value by $8,233. A growth in the number of youth has the second biggest reducing effect on housing values, estimated at $10,239 for each percentage increase of youth out of the overall population. The key point to emphasize is that UGB's have an impact even controlling for all of these important variables.

Relation to other research

Research of metropolitan and municipal UGBs generally focused on communities outside of California. However, my research does build upon some of the research mentioned in my literature review in Chapter 2.

My analysis of the data gathered showed that UGBs do have an effect on median housing values as time passes. Levine's (1999) research concluded that it takes one to two years before urban containment policies affect new housing production. My research indicates that UGBs also

have a time-delay affect, wherein over time, an existing UGB contributes to an upward pressure on median housing values.

The analysis reconfirms Landis, Deng and Reilly's (2002) conclusion that median household income is a factor on median housing prices despite some differences in approach. My analysis had a different approach to achieve its sample size than Landis, Deng and Reilly. Another difference is that my research used different variables, and also through the benefit of time lapsed, includes an additional Census year that did not exist at the time of the prior research.

However, this research seems to challenge Jun's (2006) findings that an UGB has an insignificant effect on housing prices. The difference in results may be due to the fact that Jun looked at metropolitan regions and metropolitan UGBs, whereas the focus of my research was on municipal UGBs. As such, the divergent results should be viewed with caution.

One area my research did not delve into are the areas that O'Connell's (2009) and Anthony's (2008) research focused on. Both researchers focused on demographic influences on UGB adoption, with a discussion of college graduates. My research looked at whether an increasing number of college graduates as a percent of a city's population affected median housing prices. My conclusion is that the proportion of the overall population being college graduates does not impact median housing values. While my research did not look at UGB adoption factors, the fact that college graduates did not impact housing values means that there is opportunity for further research to determine if a connection exists between demographics characteristics that impact both UGB adoption rates and median housing prices.

Limitations of my research approach

My regression model and research approach have limitations. First, the data set contains only three observations per city. A data set that has more observations per city can be useful to conduct a more granular view of the influence each variable has on median housing values. Further, a data set that adds even more cities beyond the original 62 cities I started with will mitigate any concerns one may have that my dataset suffers from sample bias.

Second, the US Census does not track median housing values by type of housing units. For example, it would be useful to see how the median housing value of a two bedroom housing unit changes over time when compared to a five or more bedroom housing unit. The use of multiple listing service (MLS) data can provide additional granularity that the US Census data does not. Alternatively, Zillow produces its own granular data, but does not have data from 1990.

Third, more dummy variables could be used to determine if direct adjacency to another city is a factor. For example, Rohnert Park and Cotati in Sonoma County are two UGBs that are adjacent on one side of their border, while some of the non-UGB cities in Santa Clara County are adjacent with each other.

Fourth, this data set does not that factor in how much land is available for building within an UGB at the time of the UGB's adoption. A city may have an UGB that closely aligns the city's existing developed area or could have an UGB that provides 20 or 30 year growth supply of land.

The model I used also does not consider commute times of its residents and the ratio of residents to jobs within the city. These factors could influence housing prices as one can test if a bedroom community (where there is significantly more adults than jobs) has a neutral, positive or negative effect on housing prices. Presumably, people want to live close to their job to maximize

their available free time for more enjoyable activities. Thus, a variable that can test for this will add additional refinement to the model.

Opportunities for additional research

This thesis is only one piece of the effort to study UGBs. Critically, this thesis does not review the effect of the UGB on the rental market. Future research can test the effect of the variables I used on the amount of income people spend on rental costs. This is important for a community like Davis where a local university relies on a strong rental market to support its student population.

This research also does not test the effect of municipal UGBs on agricultural or undeveloped land values located just outside the UGB as Grout et al. (2011) did for metropolitan UGBs. A number of cities I selected for my research are in counties that have a strong agricultural community such Sonoma, Tulare and Yolo counties.

Finally, another area of research is to see how long-term demographic variables such as proportion of college graduates, high earners, and number of youth impact UGB policy adoption. For example, what demographic factors led to all the cities in Sonoma County adopting an UGB, and in particular, why did the city of Cloverdale adopt an UGB so long after other cities in Sonoma County adopted their UGB? Having a better understanding of the factors leading to UGB adoption can help determine how important other variables besides the UGB term consistently have a factor over time. In the case of Davis, Chapter 1 noted that the 1969 Davis General Plan was too expansionist for residents and the city subsequently revised the plan to adopt slower population growth goals. This will address some of Anthony's (2009) concerns about demographic research on UGB adoption. In addition, such research also takes a broader

approach to see if the demographic variables leading to UGB adoption have an impact on median housing prices prior to and after UGB adoption.

Public policy implications for Davis

At the time of this writing, Davis' UGB has been in force for 15 years. The model suggests that the length of UGB has an upward pressure of over $87,000 on median housing prices in Davis. The net effect with the decline of housing values due to the existence of the UGB is $47,241 in 2015. For comparison of 2010 median housing values with nearby cities, Davis was $571,600, Dixon was $394,400, West Sacramento was $293,900, Winters was $349,300 and Woodland was $352,100. Three of the six findings in the Davis' UGB ordinance are generally about agricultural preservation. However, a city that becomes increasing unaffordable to live due to the UGB will have unintended consequences. As nearby cities become more affordable than the UGB city, the population will seek housing in these nearby cities, contributing to sprawl. This will also contribute to more miles driven, counteracting the second goal of Davis' ordinance to prevent traffic congestion and air pollution.

As Davis considers the innovation park proposal and the associated modification of the UGB, the citizens of Davis, must decide the best way to achieve the second goal of the Ordinance. Does the fourth goal to preserve agricultural lands need be absolute, or is there a way to direct new growth to be compact, maintain the unique qualities of Davis and mitigate increased vehicle miles traveled through new housing?

Is a median housing value that becomes increasingly higher than the surrounding area as well as unaffordable something that Davis wants to occur? Is one of the desired unique qualities of Davis is its high housing prices? Davis states that "[a]ffordable housing is a major priority for

City Council." (Davis, 2014b, p. 2-5). Thus, the City Council needs to consider a modification of the UGB because the passage of time since its adoption is working against affordable housing.

Appendix A

Cities studied in this thesis and reason for inclusion

City Name	County Name	Reason for Inclusion
Pittsburg	Contra Costa	Non UGB city studied by Landis, Deng and Reilly (2002)
Hanford	Kings	Non UGB city studied by Landis, Deng and Reilly (2002)
Marina	Monterey	Non UGB city studied by Landis, Deng and Reilly (2002)
Auburn	Placer	In same county as Roseville
Colfax	Placer	In same county as Roseville
Lincoln	Placer	In same county as Roseville
Loomis	Placer	In same county as Roseville
Rocklin	Placer	In same county as Roseville
Roseville	Placer	Fast growing city in same region as Davis
Citrus Heights	Sacramento	In adjacent county to Yolo County
Elk Grove	Sacramento	In adjacent county to Yolo County
Folsom	Sacramento	In adjacent county to Yolo County
Galt City	Sacramento	In adjacent county to Yolo County
Isleton	Sacramento	In adjacent county to Yolo County
Rancho Cordova	Sacramento	In adjacent county to Yolo County
Sacramento	Sacramento	In adjacent county to Yolo County
Campbell	Santa Clara	In same county as Morgan Hill and Saratoga
Cupertino	Santa Clara	In same county as Morgan Hill and Saratoga
Gilroy	Santa Clara	In same county as Morgan Hill and Saratoga
Los Altos	Santa Clara	In same county as Morgan Hill and Saratoga
Los Altos Hills	Santa Clara	In same county as Morgan Hill and Saratoga
Los Gatos	Santa Clara	In same county as Morgan Hill and Saratoga
Milpitas	Santa Clara	In same county as Morgan Hill and Saratoga
Monte Sereno	Santa Clara	In same county as Morgan Hill and Saratoga
Morgan Hill	Santa Clara	Non UGB city studied by Landis, Deng and Reilly (2002)
Mountain View	Santa Clara	In same county as Morgan Hill and Saratoga
Palo Alto	Santa Clara	In same county as Morgan Hill and Saratoga
San Jose	Santa Clara	In same county as Morgan Hill and Saratoga
Santa Clara	Santa Clara	In same county as Morgan Hill and Saratoga
Saratoga	Santa Clara	Non UGB city studied by Landis, Deng and Reilly (2002)
Sunnyvale	Santa Clara	In same county as Morgan Hill and Saratoga
Capitola	Santa Cruz	In same county as Santa Cruz
Santa Cruz	Santa Cruz	UGB city studied by Landis, Deng and Reilly (2002)

Scotts Valley	Santa Cruz	In same county as Santa Cruz
Watsonville	Santa Cruz	In same county as Santa Cruz
Benicia	Solano	In same county as Dixon and Vacaville
Dixon	Solano	Neighboring city to Davis
Fairfield	Solano	In same county as Dixon and Vacaville
Rio Vista	Solano	In same county as Dixon and Vacaville
Vacaville	Solano	Non UGB city studied by Landis, Deng and Reilly (2002)
Vallejo	Solano	In same county as Dixon and Vacaville
Cloverdale	Sonoma	In county with strong UGB activity
Cotati	Sonoma	In county with strong UGB activity
Healdsburg	Sonoma	In county with strong UGB activity
Petaluma	Sonoma	In county with strong UGB activity
Rohnert Park	Sonoma	In county with strong UGB activity
Santa Rosa	Sonoma	In county with strong UGB activity
Sebastopol	Sonoma	In county with strong UGB activity
Sonoma	Sonoma	In county with strong UGB activity
Windsor	Sonoma	In county with strong UGB activity
Dinuba	Tulare	In same county as Visalia
Exeter	Tulare	In same county as Visalia
Farmersville	Tulare	In same county as Visalia
Lindsay	Tulare	In same county as Visalia
Porterville	Tulare	In same county as Visalia
Tulare	Tulare	In same county as Visalia
Visalia	Tulare	UGB city studied by Landis, Deng and Reilly (2002)
Woodlake	Tulare	In same county as Visalia
Davis	Yolo	Subject city
West Sacramento	Yolo	In same county as Davis
Winters	Yolo	In same county as Davis
Woodland	Yolo	In same county as Davis

Appendix B

List of Cities originally studied and subsequently excluded

City	Exclusion Reason
Los Altos	Exceeds upper reporting limit for median house value in 2010 ACS & 1990 Census
Los Altos Hills	Exceeds upper reporting limit for median house value in 2010 ACS, 2000 Census & 1990 Census
Los Gatos	Exceeds upper reporting limit for median house value in 2010 ACS
Monte Sereno	Exceeds upper reporting limit for median house value in 2010 ACS, 2000 Census & 1990 Census
Palo Alto	Exceeds upper reporting limit for median house value in 2010 ACS
Saratoga	Exceeds upper reporting limit for median house value in 2010 ACS, 2000 Census & 1990 Census

Appendix C

Descriptive Statistics

Variable		Mean	Std. Dev.	Min	Max	Observations	
Median housing value	overall	336079.9	172952.2	82532	993500	N =	168
	between		156351.5	111524	833390.7	n =	56
	within		75891.12	185134.2	517489.2	T =	3
Population	overall	62884.14	126200.6	804	945942	N =	168
	between		125980.8	821.6667	874377.7	n =	56
	within		15668.7	-29245.5	139071.8	T =	3
Land Area	overall	16.46829	26.06233	0.39923	176.5264	N =	168
	between		26.04097	0.412858	174.2174	n =	56
	within		3.038747	-0.04191	38.21973	T =	3
Age of Structure, less than 10 years	overall	0.219662	0.133925	0.028133	0.744195	N =	168
	between		0.102688	0.073701	0.514651	n =	56
	within		0.086702	0.006908	0.450906	T =	3
Age of Structure, 10 to 20 years	overall	0.205607	0.087006	0.044516	0.446856	N =	168
	between		0.051208	0.101177	0.348364	n =	56
	within		0.070564	0.022913	0.384093	T =	3
Age of Structure, 20 to 30 years	overall	0.188147	0.071304	0.007795	0.411672	N =	168
	between		0.043696	0.107805	0.275669	n =	56
	within		0.056548	0.014743	0.327249	T =	3
Percent in professional occupations	overall	0.320334	0.12754	0.051131	0.748	N =	168
	between		0.117433	0.075044	0.661324	n =	56
	within		0.051393	0.183856	0.446773	T =	3
Percent with Bachelor's or higher	overall	0.203695	0.128319	0.016251	0.710221	N =	168
	between		0.109054	0.020883	0.538289	n =	56
	within		0.06867	-0.05229	0.375627	T =	3

Variable		Mean	Std. Dev.	Min	Max	Observations	
Percent married	overall	0.558259	0.067056	0.331294	0.705333	N =	168
	between		0.057503	0.379198	0.65932	n =	56
	within		0.035064	0.451054	0.688491	T =	3
Percent in poverty	overall	0.116819	0.075408	0.025	0.399	N =	168
	between		0.07375	0.034544	0.328195	n =	56
	within		0.017678	0.027209	0.187623	T =	3
Percent under 18 years of age	overall	0.268516	0.052934	0.136723	0.392783	N =	168
	between		0.050483	0.163359	0.381512	n =	56
	within		0.016852	0.204082	0.310226	T =	3
Percent 65 or higher of age	overall	0.115261	0.040463	0.060259	0.322962	N =	168
	between		0.037193	0.072788	0.258175	n =	56
	within		0.016447	0.070038	0.198901	T =	3
Percent of households with income greater than $150,000	overall	0.061709	0.06977	0	0.378	N =	168
	between		0.045608	0.005231	0.2326	n =	56
	within		0.053034	-0.11491	0.207923	T =	3
Median household income	overall	63119.21	18755.45	28624.05	130353.6	N =	168
	between		18223.14	30036.3	119706.3	n =	56
	within		4864.259	49649.95	75787.79	T =	3
Mean number of rooms	overall	5.130079	0.492372	4.015475	6.356187	N =	168
	between		0.461738	4.150381	6.088538	n =	56
	within		0.178273	4.628156	5.757692	T =	3
Percent of housing with 1 bedroom	overall	0.132275	0.059581	0.020969	0.322251	N =	168
	between		0.052914	0.032241	0.282695	n =	56
	within		0.027992	0.020097	0.217215	T =	3
Percent of housing with 2 bedrooms	overall	0.290173	0.076926	0.099549	0.550036	N =	168
	between		0.070303	0.141069	0.522183	n =	56
	within		0.032161	0.202127	0.407938	T =	3

Variable		Mean	Std. Dev.	Min	Max	Observations	
Percent of housing with 3 bedrooms	overall	0.373661	0.074262	0.192162	0.552524	N =	168
	between		0.068073	0.212478	0.521445	n =	56
	within		0.0306	0.263233	0.488338	T =	3
Percent of housing with 4 bedrooms	overall	0.150911	0.074662	0.030805	0.369809	N =	168
	between		0.069402	0.041011	0.319137	n =	56
	within		0.028558	0.084032	0.239846	T =	3
Percent of housing with 5 or more bedrooms	overall	0.024836	0.02116	0	0.122952	N =	168
	between		0.017223	0	0.084275	n =	56
	within		0.012437	-0.01061	0.073242	T =	3
UGB in effect (dummy variable)	overall	0.160714	0.368365	0	1	N =	168
	between		0.262013	0	0.666667	n =	56
	within		0.260508	-0.50595	0.827381	T =	3
Years UGB in effect	overall	1.333333	3.642179	0	19	N =	168
	between		2.324225	0	9.333333	n =	56
	within		2.815696	-8	11	T =	3

Appendix D

List of cities studied and effective month and year of an UGB

City Name	County Name	UGB in effect?	Effective Year	Effective Month
Pittsburg	Contra Costa	No		
Hanford	Kings	No		
Marina	Monterey	Yes	2000	December
Auburn	Placer	No		
Colfax	Placer	No		
Lincoln	Placer	No		
Loomis	Placer	No		
Rocklin	Placer	No		
Roseville	Placer	No		
Citrus Heights	Sacramento	No		
Elk Grove	Sacramento	No		
Folsom	Sacramento	No		
Galt	Sacramento	No		
Isleton	Sacramento	No		
Rancho Cordova	Sacramento	No		
Sacramento	Sacramento	No		
Campbell	Santa Clara	No		
Cupertino	Santa Clara	No		
Gilroy	Santa Clara	No		
Los Altos	Santa Clara	No		
Los Altos Hills	Santa Clara	No		
Los Gatos	Santa Clara	No		
Milpitas	Santa Clara	Yes	1998	November
Monte Sereno	Santa Clara	No		
Morgan Hill	Santa Clara	Yes	1996	September
Mountain View	Santa Clara	No		
Palo Alto	Santa Clara	No		
San Jose	Santa Clara	Yes	1996	November
Santa Clara	Santa Clara	No		
Saratoga	Santa Clara	No		
Sunnyvale	Santa Clara	No		
Capitola	Santa Cruz	No		

City Name	County Name	UGB in effect?	Effective Year	Effective Month
Santa Cruz	Santa Cruz	No		
Scotts Valley	Santa Cruz	No		
Watsonville	Santa Cruz	Yes	2002	November
Benicia	Solano	Yes	1999	June
Dixon	Solano	No		
Fairfield	Solano	Yes	2003	November
Rio Vista	Solano	Yes	2002	July
Vacaville	Solano	No		
Vallejo	Solano	No		
Cloverdale	Sonoma	Yes	2010	November
Cotati	Sonoma	Yes	1990	November
Healdsburg	Sonoma	Yes	1996	November
Petaluma	Sonoma	Yes	1998	November
Rohnert Park	Sonoma	Yes	2000	November
Santa Rosa	Sonoma	Yes	1990	November
Sebastopol	Sonoma	Yes	1996	November
Sonoma	Sonoma	Yes	2000	November
Windsor	Sonoma	Yes	1998	January
Dinuba	Tulare	No		
Exeter	Tulare	No		
Farmersville	Tulare	No		
Lindsay	Tulare	No		
Porterville	Tulare	No		
Tulare	Tulare	No		
Visalia	Tulare	Yes	1991	September
Woodlake	Tulare	No		
Davis	Yolo	Yes	2000	November
West Sacramento	Yolo	No		
Winters	Yolo	No		
Woodland	Yolo	No		

Appendix E

Source for determining a city has an urban growth boundary in effect

City Name	County Name	UGB in effect?	Source
Marina	Monterey	Yes	City's General Plan (City of Marina, 2006)
Milpitas	Santa Clara	Yes	Santa Clara LAFCO (Santa Clara LAFCO, 2006)
Morgan Hill	Santa Clara	Yes	Santa Clara LAFCO (Santa Clara LAFCO, 2006)
San Jose	Santa Clara	Yes	Santa Clara LAFCO (Santa Clara LAFCO, 2006)
Watsonville	Santa Cruz	Yes	City's General Plan (City of Watsonville, 2013)
Benicia	Solano	Yes	City's General Plan (City of Benicia, 1999)
Fairfield	Solano	Yes	Solano LAFCO (Solano LAFCO, 2012)
Rio Vista	Solano	Yes	City's General Plan (City of Rio Vista, 2002)
Cloverdale	Sonoma	Yes	City's Website (City of Cloverdale, n.d.)
Cotati	Sonoma	Yes	San Francisco Chronicle (Complete results, 1990)
Healdsburg	Sonoma	Yes	Sonoma LAFCO (Sonoma LAFCO, 2006)
Petaluma	Sonoma	Yes	Sonoma LAFCO (Sonoma LAFCO, 2008)
Rohnert Park	Sonoma	Yes	League of Women Voters (League of Women Voters, 2001)
Santa Rosa	Sonoma	Yes	City's General Plan (City of Santa Rosa, 2009)
Sebastopol	Sonoma	Yes	City's General Plan (City of Sebastopol, 2014)
Sonoma	Sonoma	Yes	City's General Plan (City of Sonoma, 2006)
Windsor	Sonoma	Yes	Town's General Plan (Town of Windsor, 2015)
Visalia	Tulare	Yes	City's General Plan (City of Visalia, 1990)
Davis	Yolo	Yes	City Ordinance (City of Davis, n.d.)

Appendix F

Hausman's Specification Test Result

Variable	---- Coefficients ---- (b) fixed	(B) random	(b-B) Difference	sqrt(diag (V_b-V_B)) S.E.
Population	-0.08728	0.556237	-0.6435176	0.285239
Land Area	-1240.04	-2871.98	1631.938	1513.368
Percent of structures built in the last 10 years	33295.57	-97908.4	131204	56800.44
Percent of structures built10 to 20 years ago	7261.688	-28707.3	35969.03	52306.22
Percent of structures built 20 to 30 years ago	-284014	-369230	85216.04	55660.58
Percent in professional occupations	-211444	-237733	26288.91	163620.9
Percent with Bachelor's or higher	108200.4	-22649.4	130849.8	101043.8
Percent married	-199977	-194190	-5787.522	102591.7
Percent in poverty	-201095	-35000.8	-166094.2	210919.1
Percent under 18 years of age	-1129670	-1355830	226160	282697.5
Percent 65 or higher of age	-182529	-449192	266662.8	332277.2
Percent of households with income greater than $150,000	1007944	838616.4	169327.2	102674.2
Median household income	-2.40641	3.959532	-6.365938	1.345451
Mean number of rooms	11190.1	-3970.89	15160.99	23526.69
Percent of housing with 1 bedroom	-449184	-625724	176539.9	321414.7
Percent of housing with 2 bedrooms	-323208	-110712	-212496.4	207461.5
Percent of housing with 3 bedrooms	-239912	-460542	220629.4	273825.3
Percent of housing with 4 bedrooms	98243.72	-356427	454670.4	336948.8
Percent of housing with 5 or more bedrooms	-134516	175870.7	-310386.7	477935.3
UGB in effect (dummy variable)	2008.025	-30423.2	32431.22	10057.24
Years UGB in effect	2573.263	5482.365	-2909.102	998.7693

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(19) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 52.32

Prob>chi2 = 0.0001

Appendix G

United States Census Data Source

Data Set	2010 Source	2010 ID	2000 Source	2000 ID	1990 Source	1990 ID
Median Housing Price	2010 ACS 5-year estimates	B25077	2000 Census Summary File 3	H085	1990 Census Summary Tape File 3	H061A001
Population	2010 Census Summary File 1	G001	2000 Census Summary File 1	G001	1990 Census Summary Tape File 1	P0010001
Land Area	2010 Census Summary File 1	G001	2000 Census Summary File 1	G001	1990 Census Summary Tape File 1	AREALAND
Year Structure Built	2010 ACS 5-year estimates	B25034	2000 Census Summary File 3	H034	1990 Census Summary Tape File 3	H025
Industry by Occupation for the Civilian Employed Population 16 Years and Over	2010 ACS 5-year estimates	S2405	2000 Census Summary File 3	DP-3	1990 Census Summary Tape File 3	P078
Age	2010 Census Summary File 1	P12	2000 Census Summary File 1	DP-1	1990 Census Summary Tape File 1	P013
Percent of persons for whom poverty status is determined, all ages	2010 ACS 5-year estimates	S1701	2000 Census Summary File 3	QT-P34	1990 Census Summary Tape File 3	P117
Total Housing Units	2010 Census Summary File 1	G001	2000 Census Summary File 1	G001	1990 Census Summary Tape File 1	H0010001

Marital Status	2010 ACS 5-year estimates	B12002	2000 Census Summary File 3	PCT007	1990 Census Summary Tape File 3	P027
Median Household Income	2011 ACS 5-year estimates	S1901	2000 Census Summary File 3	DP-3	1990 Census Summary Tape File 3	P080A001
Educational Attainment for the Population 25 and over	2010 ACS 5-year estimates	S1501	2000 Census Summary File 3	DP-2	1990 Census Summary Tape File 3	P0570006
Educational Attainment by Employment Status for the Population 18 and over	2010 ACS 5-year estimates	B23006	2000 Census Summary File 3	QT-P20	1990 Census Summary Tape File 3	P0600006
Aggregate number of rooms	2010 ACS 5-year estimates	B25019	2000 Census Summary File 3	H025	1990 Census Summary Tape File 3	H0170001
Bedrooms	2010 ACS 5-year estimates	B25041	2000 Census Summary File 3	H041	1990 Census Summary Tape File 3	H031

Note 1: All 2010 and 2000 IDs correspond to the US Census American Fact Finder data set available at http://factfinder.census.gov/ (Reference US Census n.d. C)

Note 2: All 1990 IDs correspond to the US Census 1990 Census CD-Rom database files available at https://www.census.gov/mp/www/cat/decennial_census_1990/ (Reference US Census 2012, October 2)

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